



Proposed Drainage Strategy

Project:

Proposed Residential Development, Land off Lucks Bridge, Spalding,
Lincolnshire

Client:

Remway Design Ltd

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Introduction

Jackson consulting engineers have been appointed by Remway Design Ltd, to undertake a drainage strategy forming part of the supporting evidence for the planning submission of the proposed residential development to land off Lucks Bridge, Spalding approximate postcode – PE11 3BA. The following document is to assist the planners in demonstrating that the development is acceptable in terms of sustainable drainage strategy and post development flood risk as a result of the development.

Existing Site

The site lies to the south of South Drove, Spalding. An aerial location plan, with approximate site boundary is shown in figure 1.

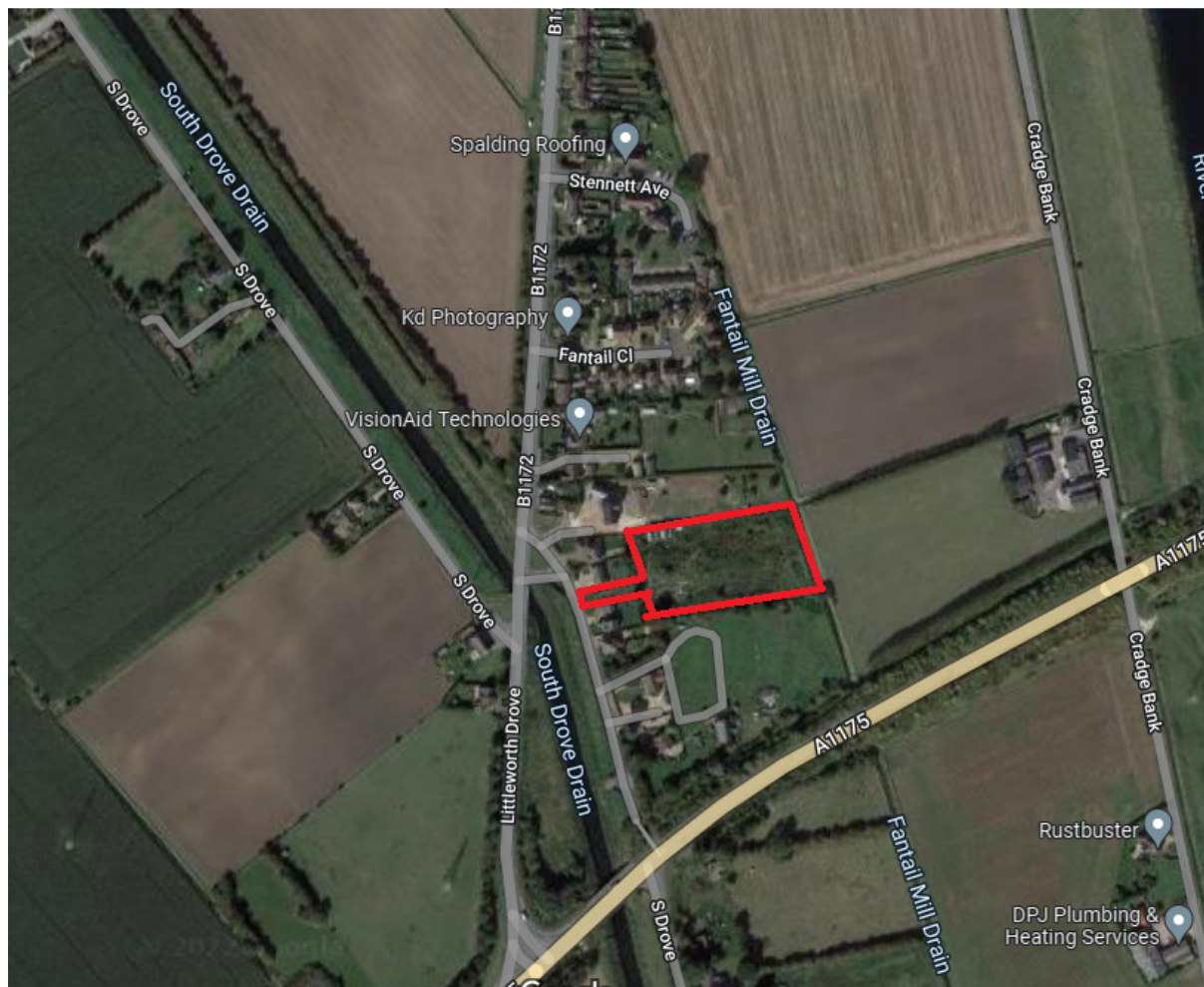


Figure 1 - Site Location

The site is currently greenfield, laid to grass/vegetation. The proposed site has an approximate total site area of approximately 0.81 hectares. There is no impermeable or existing permanent brownfield areas located on the site.

A topographical survey has been undertaken by Lincolnshire Surveys, and will be available as part of the planning application, referenced 'Topographical Survey (20094-01)'. The site has the following characteristics:



The site, once cleared is relatively featureless, and typical for the Fens, would be considered as flat, with a range across the site of 0.8m (approximate land levels of between 1.3-2.1m AOD), although the upper ranges are local spots.

The entrance to the site is between two residential dwellings, and connects directly onto South Drove, at which the level is approximately 2.15m AOD. Either side of the access way is bound by the side of the dwellings, or fences. Once through the access the site develops into the larger development.

The western edge of the large site adjoins existing rear gardens. North of the access the boundary is a fence, and south of the access it is a hedge.

Both north and south boundaries are bound by hedges, with the northern hedge being more established.

The eastern boundary is directly onto an existing ditch. The ditch appeared to be relatively well maintained, was fairly deep, and contained running water, at the time of site walkover (May 2022).

Flood Risk Mitigation

The proposed dwellings have been positioned at 3.1m AOD, which is equivalent to 1m above the highest ground level on site. This assessment has been made by another consultant, and this is just reported as an observation.

Flood Risk Offsite

The scheme will be designed so that the risk of flooding to offsite properties will not be increased as a result of the development.



Development Proposals

The re-development involves clearing the existing greenfield site, with the creation of up to 9 proposed dwellings, associated car parking and associated infrastructure. An indicative site layout is shown in the figure below.

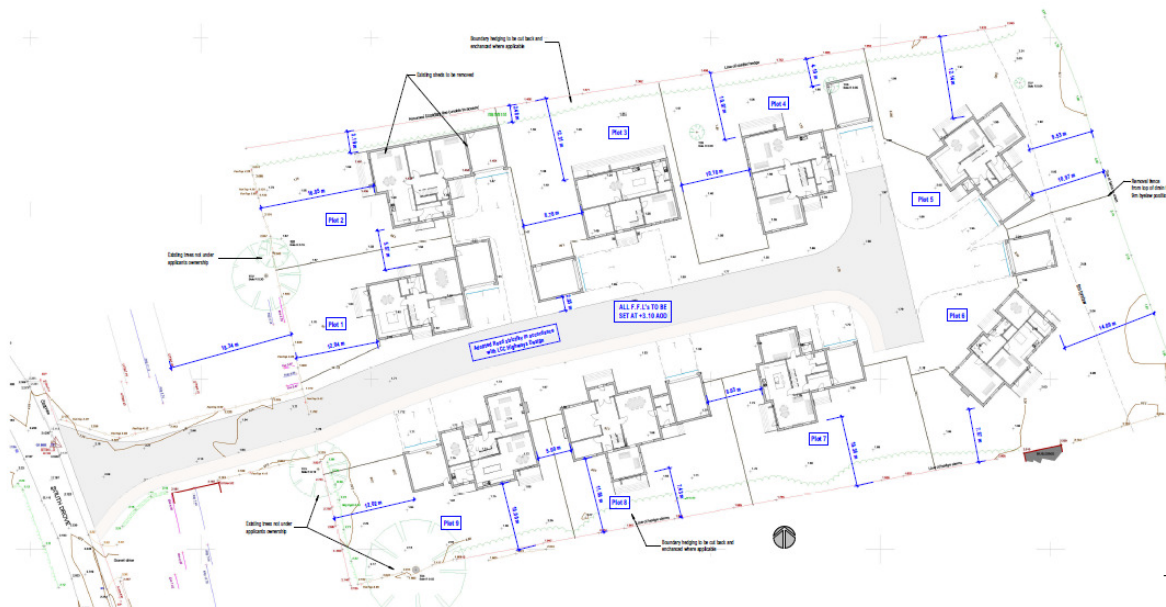


Figure 2 - Indicative Site Layout

Proposed Drainage Strategy

The following section provides narrative on the principles behind the drainage strategy and has been carried out in general accordance with Lincolnshire County Councils SUDS Guidance, "CIRIA's C753 – the SUDS Manual", and national technical standards where appropriate. Please note that as this development is for less than 10 dwellings, it is considered as a minor development, and will not be fully design in accordance with LCC's guidelines.

Surface Water Drainage

For new developments there is a requirement to apply sustainable drainage principles (SuDS) to the disposal of surface water from the site where practicable. As required by Building Regulations and PPG, surface water must discharge to the following, listed in priority.

1. To ground – in an adequate soakaway or some other adequate infiltration system.
2. To a watercourse.
3. To a surface water sewer, highway drain or other drainage system.
4. To a combined sewer.

Infiltration

Infiltration testing was planned to be undertaken by JCE in May 2022. During the investigation, 2 shallow excavations were made to test the infiltration. These were only around 600mm deep and would be described as pliable clay – this is not suitable for infiltration. A third, deeper trial pit was excavated to around 1.2m to ensure that 1m of distance between the top of water table and base of device was achievable. During this excavation, water seepage was encountered at 0.9m deep, with



standing water sitting at 0.9m BGL after 10 minutes. Due to the proximity of the water table the infiltration testing was abandoned.

Combined with the clayey strata, and depth to the water table, infiltration is not viable for this site. Various site photographs are shown in the figures below.



Figure 3 – First Recorded Trial Pit – Primarily Clay, 600mm Deep



Figure 4 - 2nd Recorded Trial Pit - 600mm Deep



Figure 5 – Standing Water after 10 minutes – 900mm below ground level

Watercourse

The site falls within the catchment of Welland and Deepings Internal Drainage Board, specifically Deeping Fen Catchment, as shown in the figure below. The exact drain reference known as Fantail Drain. This watercourse appears to flow to the south and appeared to be in a good condition during the site inspection, as seen in the second figure below.

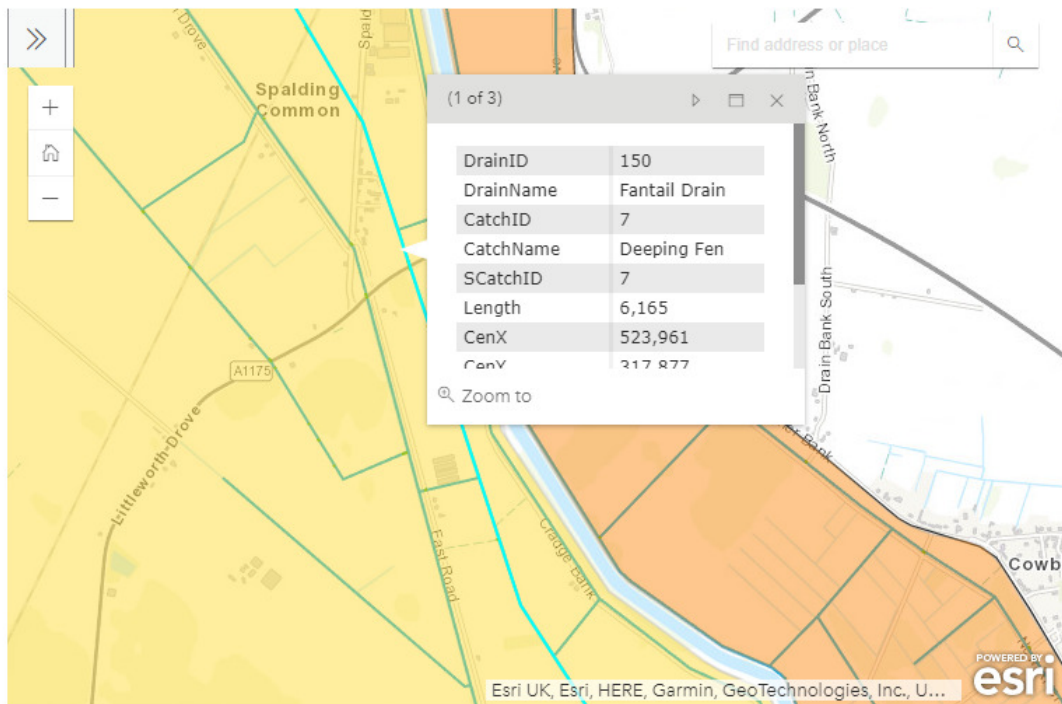


Figure 6 - WDIDB: Fantail Drain – Deeping Fen Catchment



Figure 7 - View on Fantail Drain



The Internal Drainage Board have a number of bylaws specific to this site, namely;

- Byelaw 3: Control of Introduction of Water and Increase in Flow or Volume of Water
- Byelaw 10: "No Obstruction within 9 metres of the Edge of the Watercourse

Full details of these bylaws can be found on Welland and Deepings IDB's website.

The site will need to apply for byelaw 3 consent. The IDB generally has an allowable 'pumped catchment' rate of 1.4l/s which does not necessary relate to the greenfield run-off or flood risk. As the total area will be relatively small in comparison to the pumped catchment rate, the 'free' discharge will also be low.. Therefore, subject to board approval, it will be proposed that the discharge rate from the site is increased above the pumped catchment rate. Tentative, informal discussions with the IDB have been undertaken on this, and it was agreed in principle, subject to the final proposals being submitted, and subject to the IDB confirming that they have capacity to receive a discharge rate of 5l/s

The proposed dyke at the connection point appears to be in good condition, and of significant size. It is generally open watercourses. The downstream dykes appear to get larger, and it is assumed that these interconnecting drains do not have capacity problems.

Surface Water Sewer

No surface water sewers have been identified in the proximity of the site, and as a connection into a watercourse is viable, no further consideration for a connection into a surface water sewer is needed.

Combined Water Sewer

No combined water sewers have been identified in the proximity of the site, and as a connection into a watercourse is viable, no further consideration for a connection into a surface water sewer is needed.

Proposed Surface Water Drainage Design

The proposed drainage layout is shown on JCE drawing 0213-JCE-00-SI-DR-C-3000.

All drainage models has been simulated for the 1 in 1, 30, 100 and 100 + 40% climate change events using FSR data.

A full copy of the preliminary drainage calculations can be found in appendix B of this document, and a graphical representation of the model is shown in the figure below.

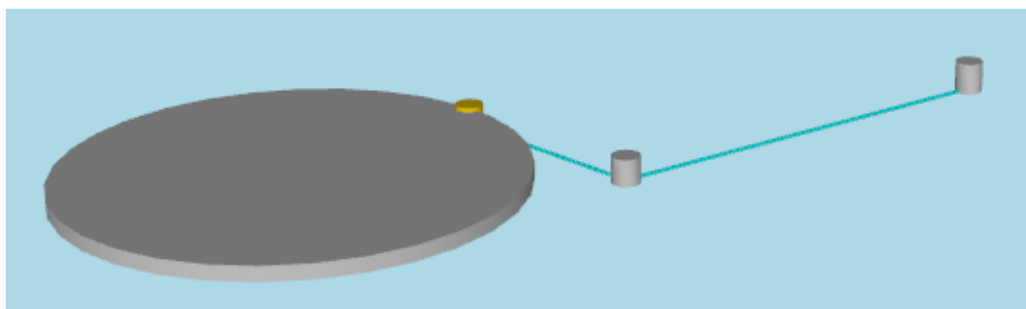


Figure 8 – Drainage Model



Surface Water – Main Road

In order to achieve attenuation for the site, it is proposed that the main road will be a tanked porous paving system, designed to a set thickness to provide the necessary attenuation for the site.

Surface Water - Roofs

The surface water from the roofs will be collected traditionally through pipework, before entering a catchpit and then discharging into the base of the main road.

Surface Water - Private Drives

Infiltration is ruled out for the site and therefore infiltrating permeable paving systems have been discounted for this scheme. Given the elevated FFL's it is proposed that the drives will be constructed out of impermeable finishes, which will flow into the main permeable paved road – provided that maximum contributing areas are not exceeded. Where the maximum ratios area exceeded it is proposed that the driveways will drain to gullies or channel drains before connecting into the main road.

Surface Water Drainage Summary

- In summary, the surface water drainage will be to the following.
- Domestic roofwater will discharge into a piped system before discharging into the tanked road's sub-base.
- Domestic drives will discharge onto the main road's porous paving, or into the sub-base through either a gully or aco.
- The main road will be tanked permeable paving, acting as attenuation.
- The tanked permeable paving will discharge into the IDB watercourse at an agreed rate.

Flood Routing

The scheme has been designed so that no above ground flooding is created in the 1 in 100 year + 40% climate change critical storm, and therefore a plan is not required to represent the volumes, depths, velocities or extents of flooding.

The finished floor levels are positioned well above existing ground levels and the flood risk assessment shows that this is not at risk of flooding. Exceedance flooding will safely discharge around the proposed properties, towards the rear IDB drain, along the route of the proposed access road.

Water Quality

The methods of surface water disposal mentioned above have included provisions for water quality. In accordance with CIRIA C753, the pollution hazard features for the drainage areas are:

- | | |
|---------------------------------|------------|
| • Residential roofs | - Very low |
| • Individual property driveways | - Low |
| • Private access | - Low |
| • Private Road | - Low |

To remove the pollution risks, CIRA have developed 'Pollution hazard indices' and the 'mitigation indices' that the SuDS components provide, further details of these are found in the figures below.



Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/Industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Figure 9 - Pollution hazard indices for different land use classifications

Type of SuDS component	Mitigation indices ¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 10 - Indicative SuDS mitigation indices for discharging to a surface water

To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

$$\text{Total SuDS mitigation index} \geq \text{pollution hazard index} \\ (\text{for each contaminant type}) (\text{for each contaminant type})$$

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required where:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5 (\text{mitigation index}_2)$$



Where:

$$\text{Mitigation index}_n = \text{mitigation index for component } n$$

Provided the total SuDS mitigation index exceeds the pollution hazard indices, then sufficient water quality will be provided.

For the calculations below the hazards are represented by;

Total suspended solids = Red

Metals = Blue

Hydrocarbons = Green

The figures are presented to show the actual achieved in the right-hand side column. The right-hand side's total must be higher than the left-hand side.

Roofs

0.2 0.2 0.05 = Permeable Paving 0.7 0.6 0.7

The mitigation provided by the permeable paving exceeds all the pollution indices, therefore sufficient treatment has been provided. Additionally the roof water will pass through a catchpit, offering further water quality improvements.

Individual property driveways

0.5 0.4 0.4 = Permeable Paving 0.7 0.6 0.7

The mitigation provided by the porous paving exceeds all the pollution indices, therefore sufficient treatment has been provided.

Private Road

0.5 0.4 0.4 = Permeable Paving 0.7 0.6 0.7

The mitigation provided by the permeable paving exceeds all the pollution indices, therefore sufficient treatment has been provided.

All the methods above provide enough water quality in accordance with CIRIA's C753 document.

Maintenance

It is crucial that the elements mentioned in the drainage elements and water quality are maintained to a sufficient standard to ensure that the devices can still function as designed. Generally, the maintenance requirements are either from CIRIA 753, or manufacturer guidance.



Hydrobrake Maintenance

Maintenance

Normally, little maintenance is required as there are no moving parts within the Flow Control. Experience has shown that if blockages occur they do so at the intake, and the cause on such occasions has been due to a lack of attention to engineering detail such as approach velocities being too low, inadequate benching, or the use of units below the minimum recommended size. The Flow Control (where applicable) is fitted with a pivoting bypass door, which allows the manhole chamber to be drained down should blockage occur. The smaller conical units, below the minimum recommended size, are also supplied with rodding facilities or vortex suppressor pipes as standard.

Following installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced, please do not hesitate to contact the company so that an investigation may be made.

All Flow Control units are typically manufactured from grade 304 Stainless Steel, and if required they can also be manufactured in grade 316 Stainless Steel. Both materials have an estimated life span in excess of the design life of drainage systems.

Porous Paving Maintenance

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

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Catchpits

Catchpits are utilised to help prevent the ingress of heavy sediment and other debris from entering the system. Maintenance requirements are low, and it is recommended that catchpits are inspected every six months and any build-up of sediment removed.

Pipework

If sediment in the catchpits are above the incoming pipes, or if performance of the site is hampered, then the pipes are to be inspect and jetted as necessary. The condition of the pipes shall generally be checked at the catchpit inspections.



Foul Proposals

There is a sewer located around 100m from the site, but access to this from the development is restricted, with it either failing within private gardens or within roads. The only way to access the sewer is via digging up residential gardens and roads, causing huge disruption and not necessarily consented by the land owners.

Given the lack of access and cost implications, it is not considered that a connection into the existing sewer is feasible and therefore it has been ruled out. The developer will confirm this with the EA.

Due to the lack of sewerage infrastructure, it is proposed that the wastewater from the site will discharge into the ditch at the rear of the site. To meet the EA's criteria, the foul discharge will be treated through wastewater treatment plants, before discharging into the ditch – subject to IDB consent.

Given the water quality from the treatment plants, the small volume of water from the development and the fact that the ditch has a permanent and flowing water, this proposal will comply with the EA's general binding rules and no further discussion with the EA is required.

Conclusion

- The above drainage strategy demonstrates that the site can be drained through the use of a Sustainable Drainage System at an appropriate level for the development.
- The flow offsite will be restricted to rate agreed with by the IDB.
- No above ground flooding is present for the 1 in 100 year + 40% climate change event.
- A preliminary drainage layout can be found on JCE's Preliminary Drainage Strategy drawing: 0213-JCE-00-SI-DR-C-3000.
- Finished floor levels will be set at a minimum of 3.1m AOD – in accordance with the architects layout.



Appendices

Appendix A – Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	1.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Hydrobrake	0.332	5.00	2.000	1200	1.000
PS1			2.000	1200	1.120
Headwall			2.000	1200	1.373

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Hydrobrake	PS1	17.941	0.600	1.000	0.880	0.120	150.0	150	5.37	1.0
1.001	PS1	Headwall	37.946	0.600	0.880	0.627	0.253	150.0	150	6.14	1.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.818	14.5	0.9	0.850	0.970	0.332	0.0	25	0.455
1.001	0.818	14.5	0.9	0.970	1.223	0.332	0.0	25	0.455

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	17.941	150.0	150	Circular	2.000	1.000	0.850	2.000	0.880	0.970
1.001	37.946	150.0	150	Circular	2.000	0.880	0.970	2.000	0.627	1.223

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Hydrobrake	1200	Manhole	1 Adoptable	PS1	1200	Manhole	1 Adoptable
1.001	PS1	1200	Manhole	1 Adoptable	Headwall	1200	Manhole	1 Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Hydrobrake	2.000	1.000	1200		0	1.000	150
PS1	2.000	1.120	1200		1	0.880	150
					0	0.880	150

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Headwall	2.000	1.373	1200	1	1.001	0.627	150



Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node Hydrobrake Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.000	Product Number	CTL-SHE-0109-5000-0800-5000
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node Hydrobrake Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	1.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	878.0	0.0	0.625	878.0	0.0	0.626	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 97.17%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Hydrobrake	50	1.273	0.273	24.3	19.7127	0.0000	SURCHARGED
240 minute summer	PS1	164	0.942	0.062	5.0	0.0697	0.0000	OK
240 minute summer	Headwall	164	0.688	0.061	5.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	Hydrobrake	Hydro-Brake®	PS1	5.0				
240 minute summer	PS1	1.001	Headwall	5.0	0.742	0.346	0.2558	48.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.17%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Hydrobrake	118	1.465	0.465	35.9	70.5494	0.0000	SURCHARGED
240 minute winter	PS1	404	0.942	0.062	5.0	0.0697	0.0000	OK
240 minute winter	Headwall	404	0.688	0.061	5.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	Hydrobrake	Hydro-Brake®	PS1	5.0				
240 minute winter	PS1	1.001	Headwall	5.0	0.742	0.346	0.2558	123.1

Results for 100 year Critical Storm Duration. Lowest mass balance: 97.17%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Hydrobrake	120	1.591	0.591	47.2	103.7784	0.0000	SURCHARGED
1440 minute winter	PS1	990	0.942	0.062	5.0	0.0697	0.0000	OK
1440 minute winter	Headwall	990	0.688	0.061	5.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Hydrobrake	Hydro-Brake®	PS1	5.0				
1440 minute winter	PS1	1.001	Headwall	5.0	0.742	0.346	0.2558	232.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.17%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	Hydrobrake	176	1.801	0.801	48.5	159.2869	0.0000	FLOOD RISK
180 minute winter	PS1	176	0.942	0.062	5.0	0.0698	0.0000	OK
180 minute winter	Headwall	180	0.688	0.061	5.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	Hydrobrake	Hydro-Brake®	PS1	5.0				
180 minute winter	PS1	1.001	Headwall	5.0	0.742	0.346	0.2559	116.7