



Preliminary Drainage Strategy

Project:

Proposed Residential Development, Hereward Way, Crowland

Client:

Sharman Architecture
Oak Barn,
Willow Drove,
Borough Fen,
Peterborough,
PE6 7QB

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Introduction

Jackson consulting engineers have been appointed by Sharman Architecture, to undertake a drainage strategy, forming part of the supporting evidence of the planning submission for 4 proposed dwellings, Hereward Road, Crowland. The following document is to assist the planners and Internal Drainage Board (IDB) in demonstrating that the development is acceptable in terms of drainage strategy and that it does not cause offsite flood risk as a result of the development.

Existing Site

The site lies to the east of Hereward Way, Crowland, PE6 0BL. An aerial location plan is shown in figure 1, please note that the red line is indicative and does not indicate the planning boundary.



Figure 1 - Site Location

Site Topography

A topographical survey is currently not available for the site, but from visual inspection and local knowledge the site would be considered flat. The site is bounded by residential property on all sides, other than onto Hereward Way.

The existing site is a mixture of brownfield with some areas being some landscaping. There are a number of storage buildings on site and the access areas are a mixture of gravel and hardstanding.

Existing services on the site have not currently been recorded.



Ground Conditions

A phase 1 or 2 ground investigation report is not available for this site currently, and the findings of this section are based on publicly available information. A relevant ground investigation will be undertaken prior to detailed design and assessed by the appointed engineer.

The bedrock geology of the site is described as 'Oxford Clay Formation'. This generally indicates that deeper infiltration into the bedrock will not be possible, and at this stage deeper infiltration devices are to be discounted.

The superficial deposits are described as 'Abbey Sand and Gravel', consisting of sand and gravel. This type of strata should offer a good response zone for shallow infiltration devices to be utilised, and subject to infiltration testing, this is the preferred method of surface water drainage disposal.

Both British Geological Survey definitions for the bedrock and superficial deposits can be found respectively in figures 2 and 3 below.

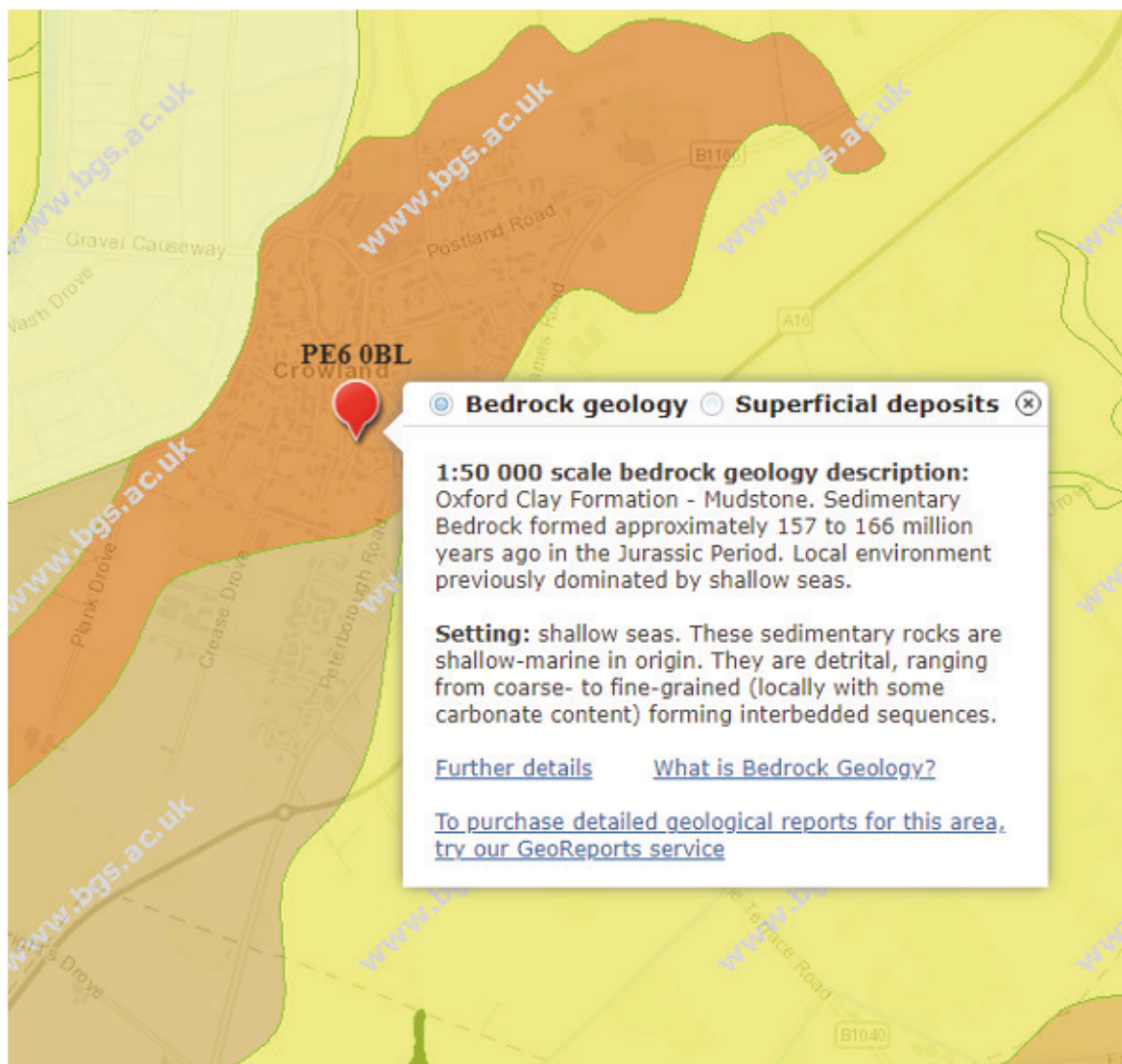


Figure 2 - BGS Bedrock Geology

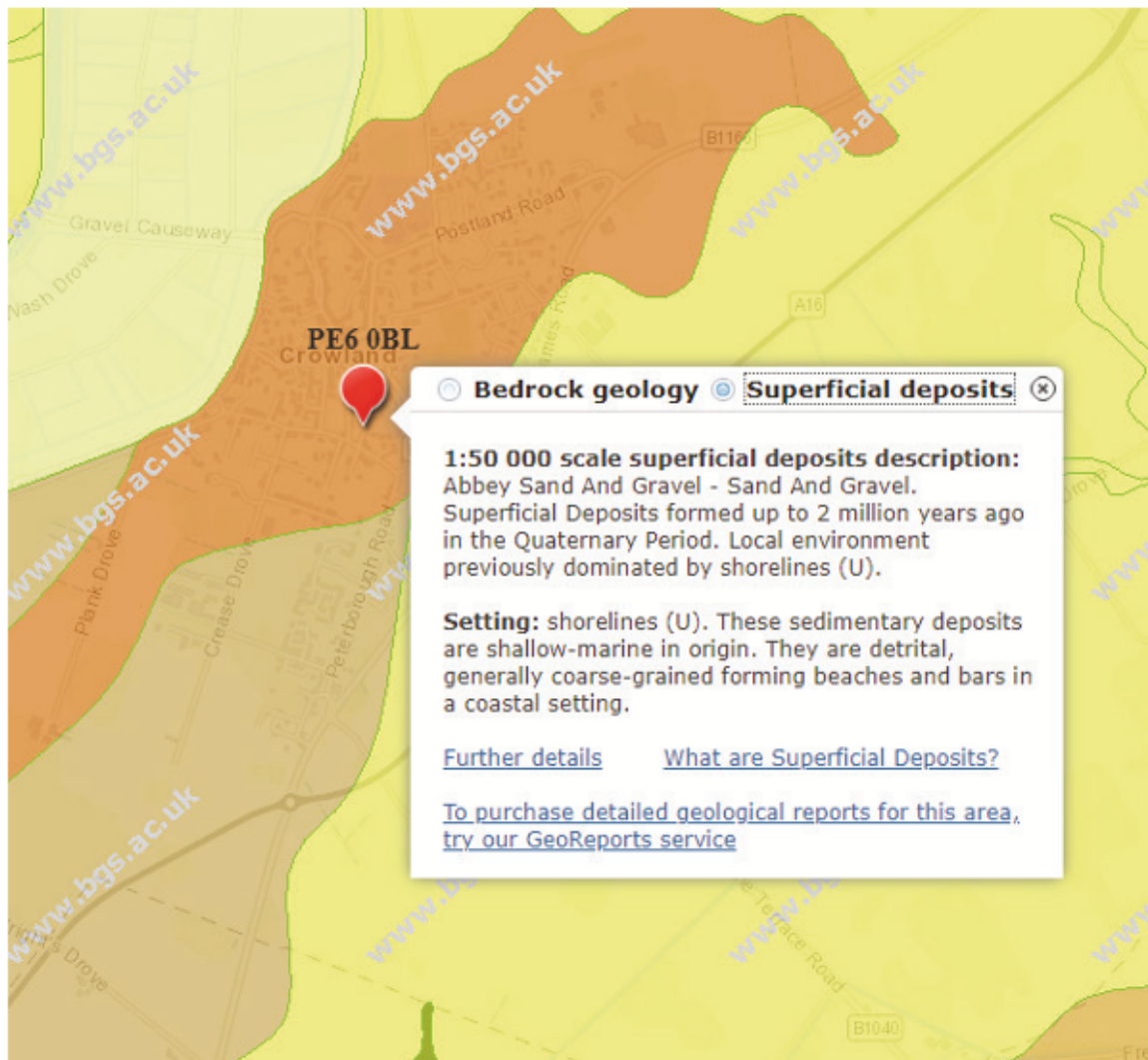


Figure 3 - BGS Superficial Deposits

Surrounding Drainage

The site falls within the catchment of North Level Internal Drainage Board. The closest watercourse is approximately 250m metres away to the north east – this is not accessible for the site.

Hereward Way itself does not appear to be served by highway drainage, with the carriageway generally falling to 'over the edge' drainage, and therefore highway drainage does not appear to be present.

Given the anticipated ground conditions and the relatively large plots the existing dwellings rest upon, it is likely that the majority of the surrounding drainage drains to soakaways.

An extract of the local AW sewers is shown below. There is a substantial foul water sewer running to Hereward Way which will be utilised for the foul water. There is an existing adopted surface water manhole roughly 30m to the south of the site, although access to this is limited by existing properties.



Figure 4 - AW Asset Map Extract

Flood Risk

The site is located in Flood Zone 1, and given the sites size a flood risk assessment is not required.

Development Proposals

The development consists of the erection of 4 dwellings with associated hardstanding and garages. The dwellings have large sized gardens. The initial site layout is shown in the figure below.



Figure 5 - Initial Site Layout



Drainage Strategy

The following section provides narrative on the principles behind the drainage strategy and has been carried out in general accordance with building regulations, DEFRA's national standards and "CIRIA's C753 – the SUDS Manual", where appropriate.

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 Defra's "Non-statutory Technical Standards for Sustainable Drainage Systems" (NTS), 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

At present infiltration testing has not been undertaken, but it is expected that the designation of the soil will mean that infiltration is possible, and the sites drainage can be fully reliant on infiltration drainage, although both the infiltration rate and water table will need to be verified prior to construction.

Guidance set out in CIRIA 753 – The SUDS Manual, shows that infiltration rates of various soil types are expected to be, as described in the figure below.

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media • gravel • sand • loamy sand • sandy loam	Sandy GRAVEL Slightly silty slightly clayey SAND Silty slightly clayey SAND Silty clayey SAND	$3 \times 10^{-4} - 3 \times 10^{-2}$ $1 \times 10^{-5} - 5 \times 10^{-5}$ $1 \times 10^{-4} - 3 \times 10^{-5}$ $1 \times 10^{-7} - 1 \times 10^{-5}$
Poor infiltration media • loam • silt loam • chalk (structureless) • sandy clay loam	Very silty clayey SAND Very sandy clayey SILT N/A Very clayey silty SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$ $1 \times 10^{-7} - 1 \times 10^{-5}$ $3 \times 10^{-8} - 3 \times 10^{-6}$ $3 \times 10^{-10} - 3 \times 10^{-7}$
Very poor infiltration media • silty clay loam • clay • till	– – Can be any texture of soil described above	$1 \times 10^{-8} - 1 \times 10^{-6}$ $< 3 \times 10^{-8}$ $3 \times 10^{-9} - 3 \times 10^{-6}$
Other • rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$

Figure 6 - Typical Soil Infiltration Coefficients



Sands and gravels have a range of infiltration between 3×10^{-4} and 3×10^{-2} m/s, which would represent good infiltration potential. The ground water levels are not known, but it is expected that it would be relatively high, and therefore any infiltration device will be kept as high as possible. It is expected that the roof water will discharge into soakaway crates, and the roads will be constructed out of permeable materials.

Watercourse

As previously described, the closest watercourse to the site is not accessible by the development and is not being considered.

Surface Water Sewer

There is an AW surface water sewer located approximately 30m to the southern boundary of the site, although access to this would be difficult. If infiltration is not deemed possible, then it is proposed that the connection will be made into the AW sewer. If the landowners do not consent to this, then it is proposed that a 'sewer requisition' will be made. A discharge rate will need to be agreed with Anglian Water through the section 106 process and an attenuated scheme developed. The levels of the drainage are not known, and a pump may be required.

It is proposed that the site will discharge through soakaways, although this is to be determined at detailed design. In the event that this is not possible, then the back up option of a connection into the AW sewer is available and therefore there is a definitive drainage solution.

Soakaway Design

Presently, the infiltration rates are unknown, but given the BGS map descriptions, it is likely that the infiltration rate of the strata will be good, conservatively estimated at 3×10^{-4} . The largest house on site has an area of approximately 170m^2 . Using the infiltration rate at the start above, this would require a soakaway size of $3 \times 4 \times 0.4\text{m}$, and given the ample garden sizes this will adequately fit within the plot's boundaries, and remain compliant with building regulations regarding offsets.

The porous paving will be constructed using permeable blocks (or other permeable surfacing) and porous sub-base. The minimum overall depth of construction is typically expected to be 450mm, which would leave a minimum of 300mm for the porous sub-base. A minimum sub-base depth of 300mm, gives a maximum water level of 26mm, and therefore it would be more than suitable. Given the nature of the porous paving, it will only receive a like for like area, and as a result it does not need to be offset 5m from the building. Furthermore, as the infiltration is like for like, the plan area size does not matter as the infiltrating area will always match. Unlike traditional soakaways, the base area cannot be discounted as it is the only place to infiltrate. In these circumstance, CIRIA 753 have provided factors of safety relevant to the application, in this case a FoS of 3 (Private drives will be less than 100m^2 , although the shared drive will be greater than 100, but less than 1000m^2) needs to be used. An extract of the table is found in the table below, the FoS is specified in the calcs.



Size of area to be drained	Consequences of failure		
	No damage or inconvenience	Minor damage to external areas or inconvenience (eg surface water on car parking)	Damage to buildings or structures, or major inconvenience (eg flooding of roads)
< 100 m ²	1.5	2	10
100–1000 m ²	1.5	3	10
> 1000 m ²	1.5	5	10

Figure 7 - Factors of Safety for Infiltration Systems

The preliminary calcs for the soakaways and porous paving can be found in appendix A and B respectively, with the indicative drainage sketch being provided in appendix C. All soakaways have been designed for storms up to and including 1 in 100 year + 40% climate change events.

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
- Non-residential parking/ low traffic roads - 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. This simple approach is considered suitable for this type of development.

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 8 - Pollution hazard indices for different land use classifications



Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates ¹	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.6 ⁴	0.5	0.6
A soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.4 ⁴	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential ² of at least 300 mm in depth ³	0.8 ⁴	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 inflow concentrations relevant to the contributing drainage area.		

Figure 9 - Indicative SuDS mitigation indices for discharging to groundwater

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):

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

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 mitigation achieved in the right-hand side column. The right-hand side's total must be higher than the left-hand side.



Roof areas

The roof water enters the below ground pipework directly, before passing into a catchpit, before entering the soakaway. Although the catchpit is not recognised as providing mitigation, it will prevent sediment from entering the soakaway. The soakaway will have a minimum of 300mm soil below the device and therefore the mitigation will be:

0.2 0.2 0.05 = 300mm Soil 0.4 0.3 0.3

Sufficient mitigation has been provided by the soil below the soakaway.

Low traffic roads

The low traffic parking will drain through a porous paving build up, and even if this is just loose stone, it will contain a geotextile to provide the water quality performance. This will then discharge directly into the sub-grade, the mitigation for the is:

0.5 0.4 0.4 = Porous Paving 0.7 0.6 0.7

The mitigation provided by the porous paving is more than adequate.

In summary all the methods above provide enough water quality in accordance with CIRIA's C753 requirements.

Flood Risk off-site

As the flow from site will be being discharged back into the ground, and as storms of up to the 1 in 100 year + 40% climate change events are being stored within the site, the flood risk from the site is not being increased, in accordance with DEFRA's non-statutory guidance.

Management/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. It is currently assumed that the site owners management team will maintain the SUDS devices. This can form a condition if the planning application is acceptable.

The devices outlined below are preliminary only and subject to detailed design.



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

Soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually



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

Unlike surface water drainage, the preference for foul water disposal is to connect into a sewer, and only where this is not a viable option should other means of drainage be considered.

Connection to a Sewer

Extracts of the Anglian Water asset maps, local to the site are shown in the figure 4 (extract repeated below).



There is a sewer located in Hereward Way, with the existing AW foul wastewater manhole of 0001/0903 being the closest possible connection to the site. It is proposed that the site will connect into these points either directly into the manholes mentioned, or if this is not available a new manhole will be placed on the existing sewer. The depth of the manholes are recorded as 1.4 to 1.6m deep which should provide plenty of fall to allow the site to drain, the pipe size of 225mm dia. should have good capacity.

The final connection will be determined through a section 106 application, but it is unlikely there will be an objection to this proposal. AW will need to agree the discharge rate at this later stage.



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.
- Provided infiltration is sufficient, there will be no flow offsite for all storms up to and including the 1 in 100 year + 40% climate change event.
- If infiltration is not viable, then a proposed connection into the existing AW sewer to the south will be utilised, via. a sewer requisition if necessary.
- The proposed scheme does not increase the risk of flooding either on or off site as a result of the development.
- The proposed foul connection is into an existing AW sewer, subject to a section 106 application.



Appendices

Appendix A – Soakaway Calculation

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
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)
Catchpit	0.017	5.00	10.000	500	0.700
Soakaway			10.000	1	0.728

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	Catchpit	Soakaway	2.844	0.600	9.300	9.272	0.028	100.0	100	5.06	50.0

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	0.769	6.0	2.3	0.600	0.628	0.017	0.0	43	0.715

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	2.844	100.0	100	Circular	10.000	9.300	0.600	10.000	9.272	0.628

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	10.000	0.700	500					
				0	1.000	9.300	100	
Soakaway	10.000	0.728	1		1	1.000	9.272	100

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 (m ³ /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 Soakaway Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	1.0	Invert Level (m)	9.000
Side Inf Coefficient (m/hr)	1.08000	Porosity	0.95	Time to half empty (mins)	35

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	12.0	0.0	0.400	12.0	4.8	0.401	0.0	4.8

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Catchpit	10	9.348	0.048	2.4	0.0094	0.0000	OK
120 minute winter	Soakaway	86	9.128	-0.144	0.8	1.4562	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	2.4	0.678	0.393	0.0100
120 minute winter	Soakaway	Infiltration		0.3			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Catchpit	10	9.393	0.093	5.9	0.0183	0.0000	OK
60 minute winter	Soakaway	47	9.266	-0.006	3.0	3.0332	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	5.7	0.805	0.950	0.0201
60 minute winter	Soakaway	Infiltration		0.9			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Catchpit	10	9.430	0.130	7.6	0.0254	0.0000	SURCHARGED
60 minute winter	Soakaway	46	9.343	0.071	3.9	3.9063	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	7.4	0.954	1.232	0.0214
60 minute winter	Soakaway	Infiltration		1.2			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	Catchpit	48	9.844	0.544	5.5	0.1066	0.0000	FLOOD RISK
60 minute winter	Soakaway	48	9.842	0.570	5.5	4.5657	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute winter	Catchpit	1.000	Soakaway	10.4	1.331	1.725	0.0220
30 minute winter	Soakaway	Infiltration		1.4			



Appendix B – Porous Paving Calculation

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
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)
Catchpit		5.00	10.000	500	0.300
Soakaway	0.100		10.000	1	0.328

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	Catchpit	Soakaway	2.844	0.600	9.700	9.672	0.028	100.0	100	5.06	50.0

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	0.769	6.0	0.0	0.200	0.228	0.000	0.0	0	0.000

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	2.844	100.0	100	Circular	10.000	9.700	0.200	10.000	9.672	0.228

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Catchpit	500	Manhole	1 Adoptable	Soakaway	1	Manhole	1 Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
Catchpit	10.000	0.300	500					
				0	1.000	9.700	100	
Soakaway	10.000	0.328	1		1	1.000	9.672	100

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 (m ³ /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 Soakaway Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	1.08000	Safety Factor	3.0	Invert Level (m)	9.550
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Time to half empty (mins)	4

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1000.0	1000.0	0.300	1000.0	1000.0	0.301	0.0	1000.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
15 minute winter	Soakaway	12	9.556	-0.116	14.1	1.7209	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute winter	Soakaway	Infiltration		11.5			

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
15 minute winter	Soakaway	12	9.564	-0.108	34.6	4.2204	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute winter	Soakaway	Infiltration		28.1			

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
15 minute winter	Soakaway	12	9.568	-0.104	44.9	5.4791	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute winter	Soakaway	Infiltration		36.5			

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute summer	Catchpit	1	9.700	0.000	0.0	0.0000	0.0000	OK
15 minute winter	Soakaway	12	9.576	-0.096	62.8	7.6693	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)
15 minute summer	Catchpit	1.000	Soakaway	0.0	0.000	0.000	0.0000
15 minute winter	Soakaway	Infiltration		51.1			



Appendix C – Preliminary Drainage Sketch

Drainage Key

Proposed road drainage
Red frames and hatching to be
agreed with the local authority
for the drainage design

Subsidence level with red line
preliminary also shown on



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 12. All dimensions shall be in metres unless otherwise stated.

Preliminary
For planning approval

Rev	Description	Date	Drawn	Checked

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Project Title:
Proposed Residential Development,
Hereward Way,
Crowland

Drawing Title:
Drainage General Arrangement

Drawing Status:
Preliminary

Scale: 1:200	Page: 1 of 1	Date: 25/04/2022
Drawn: JCE	Checked: JCE	Approved: JCE

Drawing Number:
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