NORTH CRAY ROAD ESS

Sidcup, DA14 5HE

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

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Transport Planning | Flood Risk & Hydrology | Infrastructure & Drainage

Control Sheet

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Prepared by	Signature	Date
Cory Foster BSc Graduate Flood Risk Consultant		26/03/2025

Reviewed by	Signature	Date
Patrick Goodey BSc MSc Head of Flood Risk and Hydrology		26/03/2025

Approved for issue by	Signature	Date
Patrick Goodey BSc MSc Head of Flood Risk and Hydrology		26/03/2025

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1 EXECUTIVE SUMMARY

1.1.1 Planning permission is being sought for a proposed Energy Storage System (ESS) on land adjacent to the east of North Cray Road, Sidcup.

1.1.2 This document considers the flood risk to the site and presents a drainage strategy to mitigate against the potential downstream impacts of the development.

1.1.3 The Flood Map for Planning shows that the site is located in Flood Zone 1, at Low risk of flooding from rivers and the sea. The proposals constitute 'Essential Infrastructure' and are appropriate in Flood Zone 1.

1.1.4 Parts of the site are considered to be at a mapped risk of surface water flooding, however, with the exception of access tracks, no development is proposed in areas at risk of surface water flooding.

1.1.5 The site is not considered to be at significant risk of flooding from, groundwater, sewers, or artificial sources.

1.1.6 As a result of the above, in accordance with paragraph 175 of the National Planning Policy Framework, neither the Sequential Test nor Exception Test are required for the proposals.

1.1.7 A sealed gravel base system is proposed to underlay each of the ESS areas in order to detain contaminated water in the unlikely event of a fire. Flows will be shut off by penstock chambers during a fire event, thus forming a sealed system. There would be sufficient storage available for at least nine hours (eastern ESS area) and 36 hours (western ESS area) of fog water suppression spraying, in the extremely unlikely event this is required.

1.1.8 During regular and design rainfall events, flows from the gravel base system would be discharged at slow rates into a proposed infiltration basin (eastern ESS area) and underground infiltration crates (western ESS) via a hydrobrake penstock chamber and pipes. Therefore, the gravel bases would be providing the storage of design rainfall with the infiltration basin providing the discharge destination.

1.1.9 Rain falling on more isolated infrastructure would be directed to the ground, mimicking the existing site.

1.1.10 The drainage infrastructure has been designed to accommodate a design event, which includes 25% uplift for climate change in accordance with national guidance. To ensure compliance with local policy, a sensitivity event with 40% uplift has ben utilised, with sufficient storage provided.

1.1.11 The proposals meet the aims of the National Planning Policy Framework, being safe from all sources of flooding and replicating existing runoff arrangements as closely as is reasonably practicable.

2 INTRODUCTION

2.1 Background

2.1.1 Calibro has been appointed to undertake a Flood Risk Assessment (FRA) for a proposed Energy Storage System (ESS) on land adjacent to the east of the North Cray Road (A223), Sidcup.

2.1.2 The National Planning Policy Framework (NPPF) requires that the planning system takes full account of flood risk. This requires that:

- Within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- The development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
- It incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- Any residual risk can be safely managed; and
- Safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

2.1.3 Footnote 63 of the NPPF states that a site-specific FRA will be required for proposals:

a) that are greater than 1 hectare in area within Flood Zone 1;

b) that are located in Flood Zones 2 and 3;

c) in an area within Flood Zone 1 which has critical drainage problems;

d) in an area within Flood Zone 1 identified in a Strategic Flood Risk Assessment (SFRA) as being at flood risk now or in the future; and

e) in an area in Flood Zone 1 that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

2.1.4 This assessment considers the risks of all types of flooding to the site and provides a drainage strategy to manage surface water runoff from the development.

3 EXISTING SITE AND HYDROLOGY CHARACTERISTICS

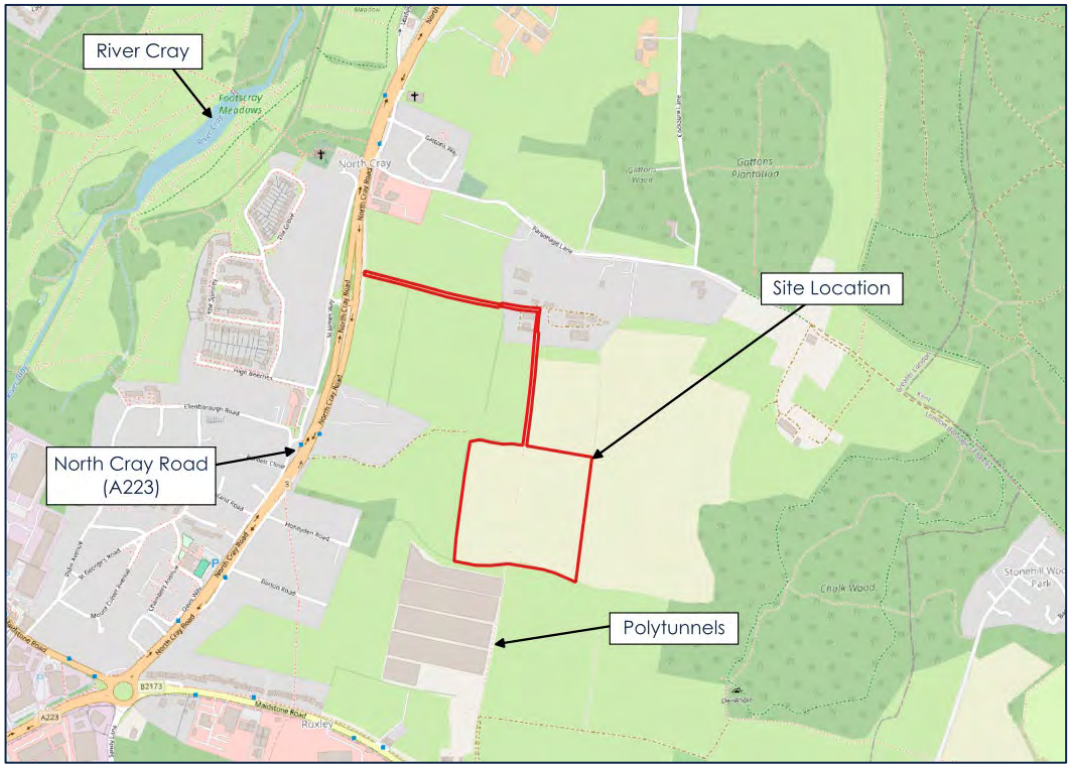
3.1 Site Description

3.1.1 The site is located on land adjacent to North Cray Road (A223), Sidcup. The approximate coordinates at the centre of the site are 548850, 170970. The nearest postcode is DA14 5HE.

3.1.2 The site is approximately 7.5ha in area and comprises greenfield land.

3.1.1 The site is bordered with greenfield agricultural land. To the immediate south of the site sits a series of polytunnels and associated warehouses. Access to the site is via North Cray Road. Figure 3-1 shows the site location.

Figure 3-1 Site Location

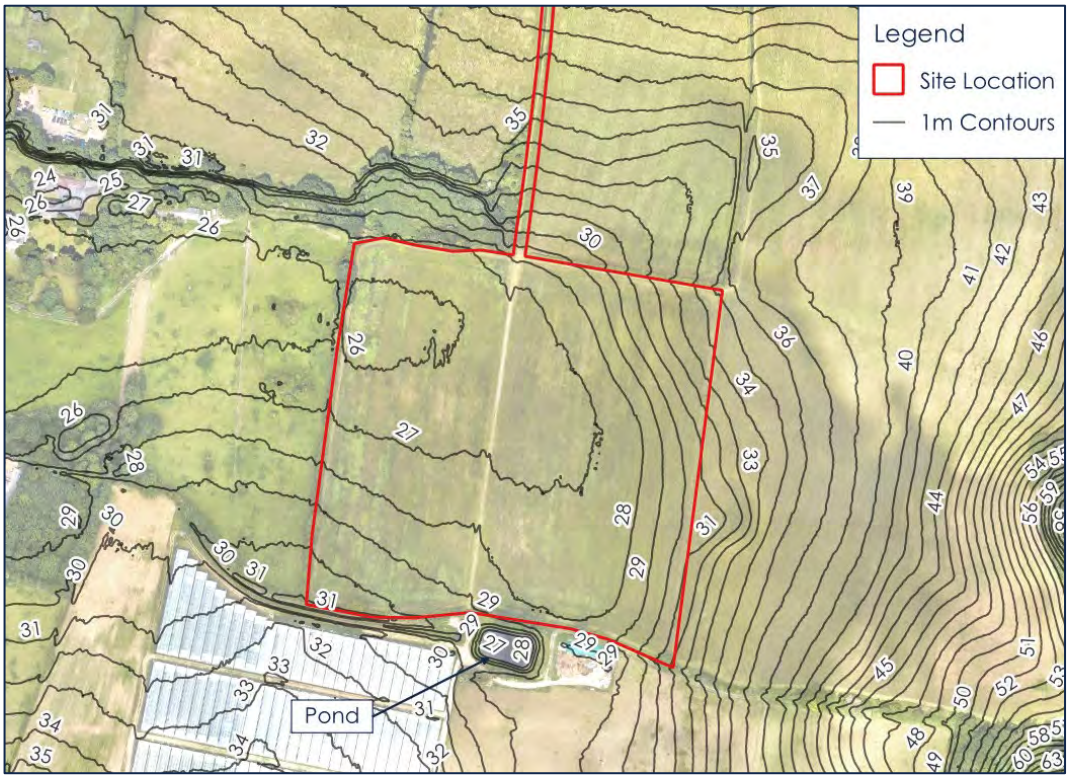


3.2 Topography and Hydrology

3.2.1 Topography is a defining feature of the site, with the presence of a slight valley formation which enters the site at the south before turning west out of the site. The site therefore slopes to the north and west with a fall of approximately 9m across it (from approximately 35mAOD to approximately 26mAOD), at approximately 1 in 30, as demonstrated in Figure 3-2.

3.2.2 The closest designated Main River to the site is the River Cray which is located approximately 1km to the west. There is a pond located to the immediate south of the site and is associated with the polytunnels located in the same area. A review of LiDAR data shows that the pond is bunded and has an inflow from a suspected drainage ditch located to the west of the pond. There are no evident outfalls associated with the pond, nor any other waterbodies within the vicinity of the site.

Figure 3-2 Site Topography and Hydrology

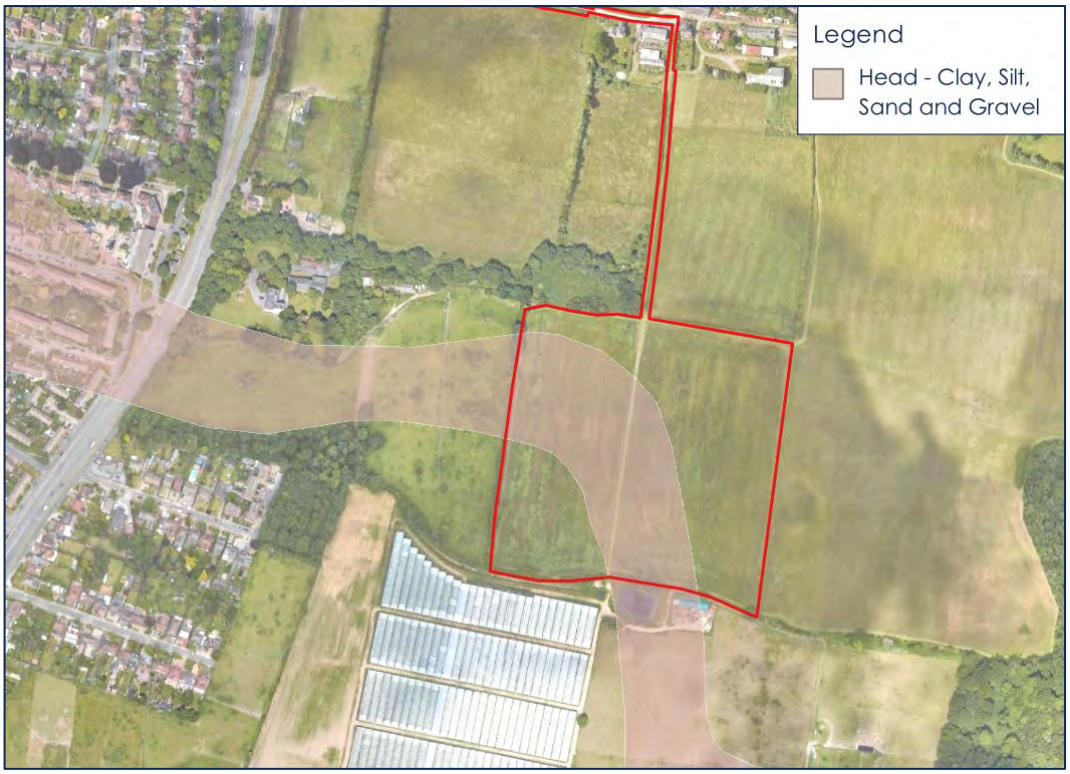


3.3 Geology and Soils

3.3.1 Geological data held by the British Geological Survey (BGS) show that the majority of the site is underlain by *'Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated) – Chalk'*, with a small part of the northeastern corner of the site being underlain by *'Thanet Formation – Sand'*.

3.3.2 BGS records also indicate that there is a band of *'Head – Clay, Silt, Sand and Gravel'* superficial deposits following the base of the valley running through the site. Figure 3-3 shows the superficial deposits for the site.

Figure 3-3 BGS Superficial Deposits



3.3.3 The BGS Hydrogeology aquifer classification (625k) records the geology under the entire site as a '*Highly Productive Aquifer'*.

3.3.4 SoilScapes mapping records that the entire site is underlain by '*Freely draining slightly acid but base-rich soils'*.

4 PROPOSED DEVELOPMENT

4.1 Site Proposals

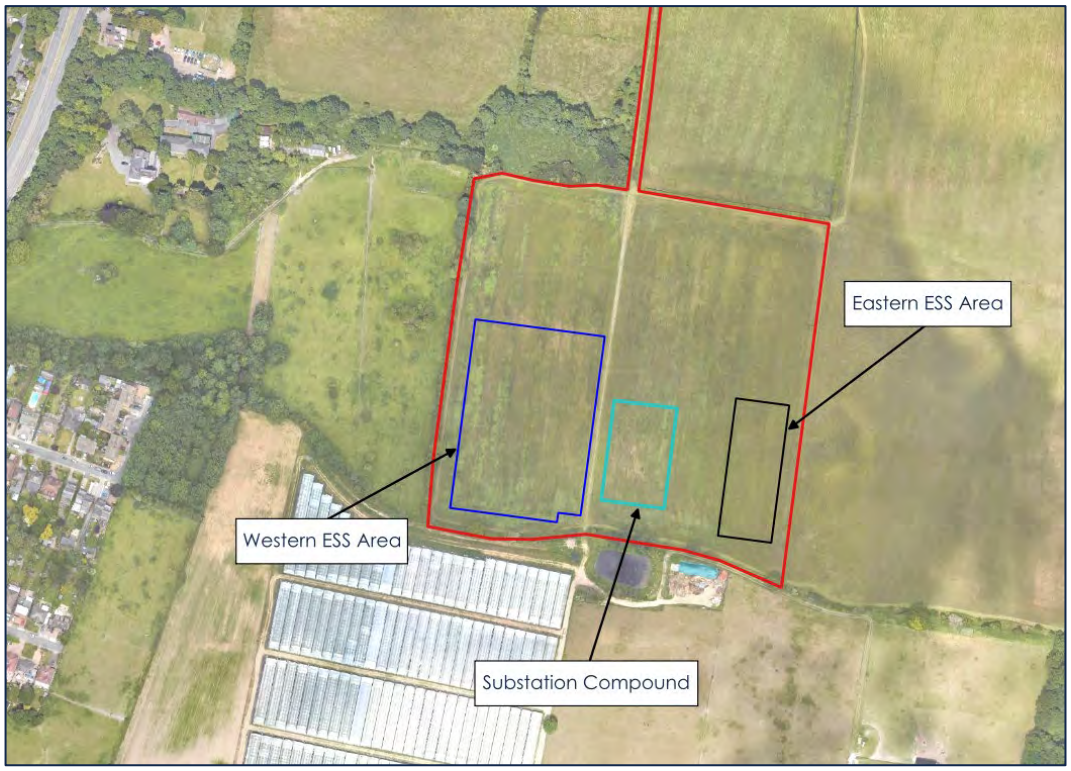
4.1.1 The proposals are for an ESS. The site will comprise energy storage racks, a transformer and containerised infrastructure. Fencing, lighting, and CCTV will also be installed on site.

4.1.2 The development will be split into three sections comprising a western ESS area, a substation compound and an eastern ESS area. These development areas within the site are shown in Figure 4-1. The proposed site layout is shown in Appendix A.

4.1.3 The reason for the location and alignment of the development areas within the site is to manage surface water flood risk, as described in Section 5.4 of this report.

4.1.4 Including their proposed perimeter access roads, the eastern ESS area measures approximately 0.41ha with the western area measuring approximately 1.4ha.

Figure 4-1 ESS Development Areas



4.1.5 The infrastructure, with the exception of fencing or lighting and CCTV columns, will be laid on gravel bases and the access track will be formed from permeable compacted gravel material.

4.1.6 The more vulnerable infrastructure (energy storage racks, transformers, cabins) will be constructed on concrete bases or plinths, which will lie atop the gravel. This will ensure the units are raised slightly above the surrounding ground.

4.1.7 This assessment recommends the minimum depth of the gravel bases for both the substation and ESS areas required for the surface water drainage strategy, described in Section 6.1.

4.1.8 The proposals would have an anticipated lifetime of approximately 40 years and consequently it is envisaged that decommissioning would commence before the year 2070.

5 FLOOD RISK

5.1 National Planning Policy Framework (NPPF)

5.1.1 In accordance with the NPPF, this FRA considers the following sources of flooding:

a) Tidal Flooding – from the sea;
b) Fluvial Flooding – from rivers and streams;
c) Surface Water Flooding – from intense rainfall events;
d) Groundwater flooding – from elevated groundwater levels or springs;
e) Flooding from sewers – from existing sewer systems; and
f) Artificial sources – from reservoirs, canals etc.

5.2 Historical Flooding

5.2.1 The EA Recorded Flood Outlines dataset indicates that the site is not recorded to have experienced historical flooding.

5.3 Flood Zones

5.3.1 The Flood Zones are based on the assessed probability of the site flooding from rivers and the sea, ignoring the presence of flood defences. The Flood Zone classifications from PPG are presented in Table 5-1 below.

Table 5-1 Flood Zone Classification

Flood Zone	Risk	Fluvial Flooding Annual Probability	Tidal Flooding Annual Probability
1	Low	> 1 in 1,000 year	
2	Medium	1 in 1,000 – 1 in 100 year	1 in 1,000 – 1 in 200 year
3	High	1 in 100 year	1 in 200 year
3b	Functional Floodplain	Land where water has to flow or be stored in times of flood. This is defined in the relevant SFRA.	

5.3.2 The Flood Map for Planning defines the entire site as Flood Zone 1 (Figure 5-2). These areas are not predicted to be at risk of fluvial flooding during a 1 in 1,000 year event and are at **Low** risk. The site is well beyond the limit of any tidal influences.

5.4 Surface Water Flooding

5.4.1 The Risk of Flooding from Surface Water (RoFSW) dataset indicates areas where surface water is likely to flow and accumulate. The mapping is derived by simulation of rainfall events over a digital terrain model (DTM).

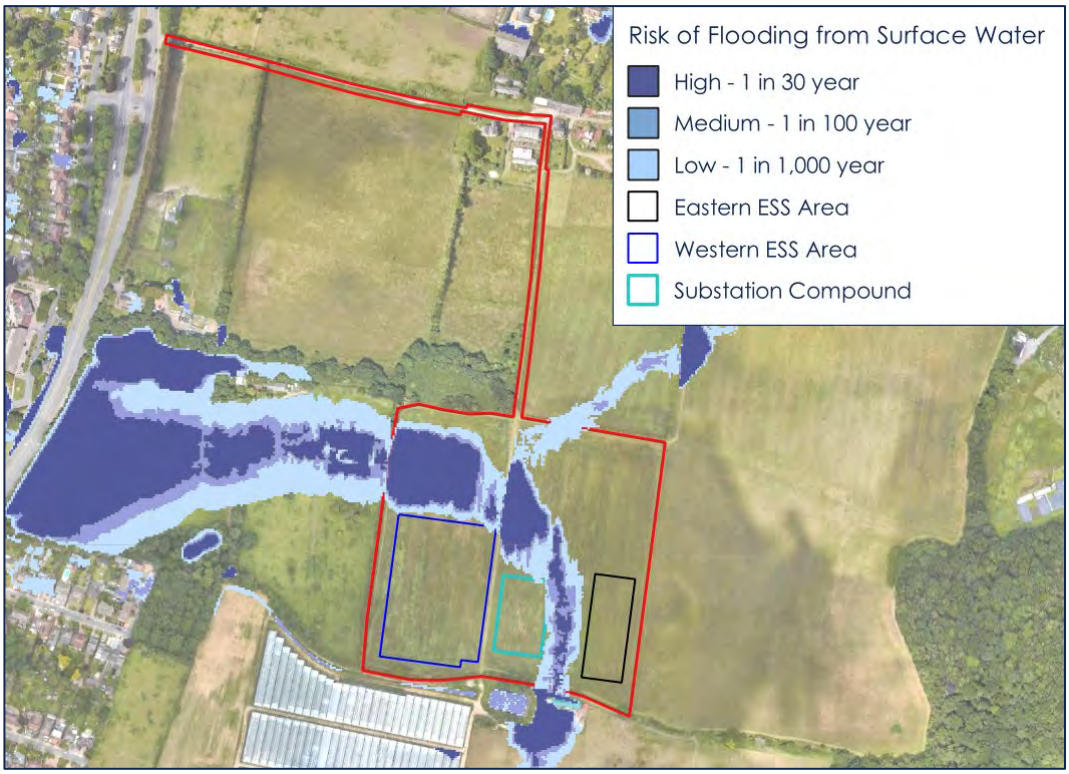
5.4.2 The RoFSW dataset (inclusive of 20% climate change), shown in Figure 5-2, demonstrates that surface water flooding follows the shape of the valley in the site as mentioned in Section 3.2. surface water flooding is predicted to enter the site from the south before turning west to flow out of the site.

5.4.3 Furthermore, analysis of the data shows that surface water flooding is predicted to be shallow, less than 200mm for much of its extent and not predicted to exceed 0.3m in depth.

5.4.4 Due to its bunded nature, the pond located to the south of the site is shown to not have an impact on surface water flooding at the site.

5.4.5 With the exception of permeable access tracks that would not cause a negative impact to the movement of surface water across the site, no infrastructure is proposed in predicted surface water flooding extents. As a result, the site is assessed to be at **Low** risk of surface water flooding.

Figure 5-1 RoFSW +20% Climate Change Extents



5.5 Groundwater Flooding

5.5.1 The BGS Hydrogeology aquifer classification (625k) records the geology under the majority of the site as a 'Low Productivity Aquifer'. OS mapping indicates that there are no springs within the vicinity of the site.

5.5.2 The London Borough of Bexley Level 1 SFRA shows groundwater levels to range between 2-5m below the ground surface. Furthermore, in the very unlikely event groundwater were to emerge above the ground, it's unlikely to exceed the extents of surface water flooding at the Site.

5.5.3 The risk of flooding from groundwater is therefore assessed as being **Very Low.**

5.6 Flooding from Sewers

5.6.1 There are no known private or public sewers within the site. Given the land use surrounding the site, there are no areas served by a sewer network sufficient enough to generate significant flooding. Furthermore, the topography is not conducive for sewer flooding to affect the site.

5.6.2 Therefore, the site is at **Negligible** risk of sewer flooding.

5.7 Flooding from Artificial Sources

5.7.1 Mapping data from the Environment Agency shows that the site is not at risk from a catastrophic reservoir breach. No other artificial sources, such as canals, have been identified which may pose a risk to the site.

5.7.2 The development is therefore considered to be at **Negligible** risk of flooding from artificial sources.

5.8 Safe Access and Egress

5.8.1 Given the overall low risk of flooding posed to the site, site access and egress would likely be unhindered even during extreme weather. Furthermore, the site will be operated remotely with only intermittent access required, which could avoid times of flooding or severe weather.

5.1 Development Vulnerability

5.1.1 Table 2 of the Planning Practice Guidance (PPG) defines which types of development are acceptable in each Flood Zone and is reproduced in Table 4-1. The proposed development is classified as 'Essential Infrastructure' and falls within Flood Zone 1. The proposed development is also located outside of the extents of surface water flooding within the site and has been assessed as being at an overall low risk of flooding from other sources.

5.1.2 Furthermore, the location of the ESS areas and substations means the more vulnerable elements of the site are located in the areas of lowest risk of flooding. Consequently, the proposed development adheres to one of the core requirements of the NPPF, as per paragraph 2.1.2 of this report.

5.1.3 The proposals are therefore considered to be appropriate without the need for the Sequential or Exception tests.

Table 4-2 PPG Development Vulnerability Classification

Flood Zone	Flood Risk Vulnerability				
	Essential Infrastructure	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**	**Water Compatible**
1	✓	✓	✓	✓	✓
2	✓	Exception Test Required	✓	✓	✓
3a	Exception Test Required	×	Exception Test Required	✓	✓
3b	Exception Test Required	×	×	×	✓

6 PROPOSED DRAINAGE STRATEGY

6.1 Surface Water Management

6.1.1 All ESS infrastructure will be situated on top of gravel bases and access tracks will be constructed using permeable material.

6.1.2 The SuDS hierarchy requires that surface water runoff should be managed as high up the following list as practically possible:

- Into the ground (infiltration), or then;
- To a surface water body, or then;
- To a surface water sewer, highway drain or another drainage system, or then;
- To a combined sewer.

6.1.3 In order to determine the most suitable method of surface water management, the options have been assessed below, with the highest option in the SuDS hierarchy used.

Into the Ground

6.1.4 As evidenced in Section 3.3, the soils under the site are freely draining and are likely to yield sufficient infiltration rates to discharge surface water runoff to the ground. The data suggests the soils are of a loamy composition. In the absence of specific soakage testing, the typical infiltration rate assumed at the site was $5x10^{-6}$m/sec (0.018m/hr), which is the lowest rate for a loamy sand, based on Table 25.1 of the CIRIA SuDS Manual.

6.1.5 The proposed drainage strategy's surface water runoff management approach is to discharge surface water runoff generated by the proposed development to the ground via infiltration, thus satisfying the SuDS hierarchy.

6.1.6 The drainage of the site will be self-sufficient with no offsite discharges and therefore exceeds the minimum requirements of Policy 5.13 of the London Plan (2014).

6.2 Climate Change

6.2.1 In accordance with NPPF, an allowance for climate change must be applied to the rainfall calculations. The proposed site is estimated to have an anticipated lifetime of 40 years. The site lies within the Darent and Cray Management Catchment. For a development with a 40-year lifetime, the central allowance for the 2070s epoch is applied. This equates to a 25% uplift in rainfall rates. The design event for the proposals is therefore 1 in 100 year +25%.

6.2.2 Policy DP33 of the Bexley Local Plan requires sites to achieve greenfield runoff rates for flood events up to and including the 1 in 100 year +40% climate change event. For the proposed development, this is beyond the anticipated lifetime of the scheme in accordance with national guidance.

The proposed drainage strategy is based on infiltration with no offsite discharges so complies with the local policy. To test if the proposed drainage network is also able to accommodate the 1 in 100 + 40% climate change event, a sensitivity test using this event has been conducted, with results shown in Appendix B.

6.3 Greenfield Runoff Rates

6.3.1 In order to limit proposed flows from the ESS areas to their infiltration facilities as close to greenfield rates as possible, greenfield runoff rates for the contribution areas have been calculated using the FEH Statistical Method, the results of which are shown in Table 6-1, with calculations provided in Appendix B.

6.3.2 It is noted that as no off-site discharges are proposed, there is no need to control flows from the ESS areas to greenfield rates. However, to limit the size of the infiltration facilities, the aim is to match greenfield rates wherever possible.

6.3.3 The area contributing rainfall to the below ground drainage system will be the gravel bases beneath the ESS units and the internal access track. As the perimeter access tracks will be permeable (see Section 6.4 below), they have been discounted from the contribution areas. Consequently, the contribution areas for the purposes of calculating drainage for the eastern ESS area measure approximately 2,400m^3 (0.24ha) with the western area being approximately 9,700m^2 (0.9ha).

Table 6-1 Greenfield Runoff

Rainfall Event	Eastern ESS Runoff (l/s)	Western ESS Runoff (l/s)
QBar	0.2	0.8
1 in 30 year	0.5	1.9
1 in 100 year	0.6	2.6

6.3.4 The proposed drainage strategy has been designed to achieve the above rates during the sensitivity event mentioned in Section 6.2.

6.4 Access Tracks

6.4.1 Access tracks will be constructed using permeable material and consequently would allow rainfall to percolate to the ground locally, mimicking the existing site. Therefore, no further mitigation is proposed.

6.5 Isolated Infrastructure

6.5.1 Isolated infrastructure will be situated on gravel bases.

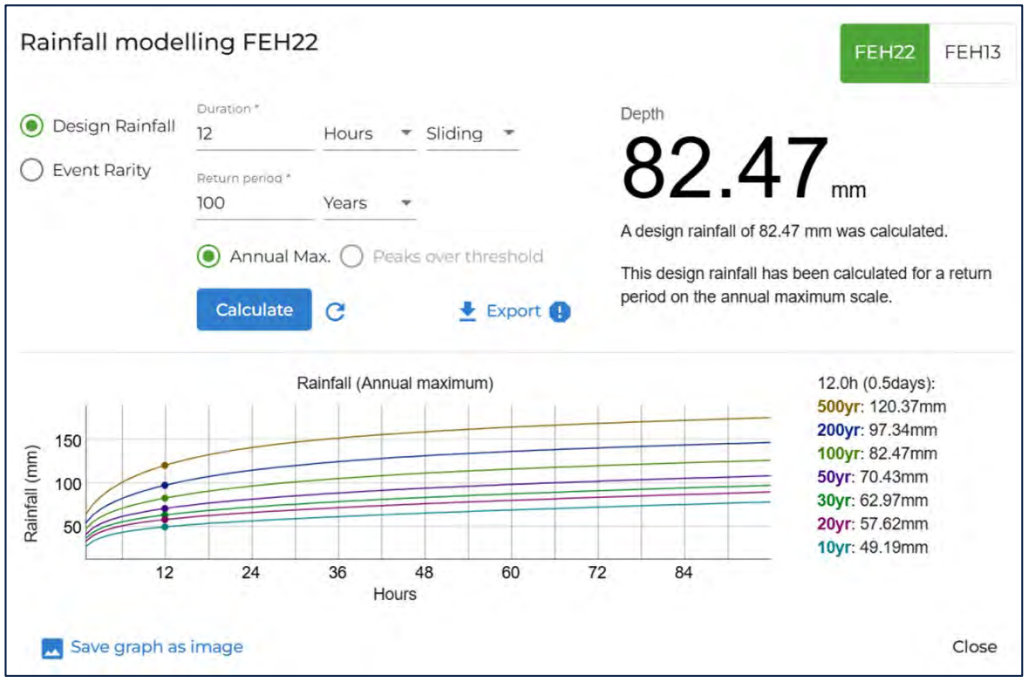
6.5.2 The gravel bases would discharge water via natural soakage rather than a fitted outfall. However, as discussed below. The gravel bases have been sized to store runoff generated during a 1 in 100 year, 12 hour storm, inclusive of climate change and with no infiltration or outflow allowance in the calculations.

6.5.3 Given the geological conditions at the site (detailed in Section 3.3) infiltration is expected to be good and therefore this is likely to be a conservative assessment.

Storage Requirements

6.5.4 To calculate the likely volume of runoff generated from the infrastructure impermeable areas during the 1 in 100 year, 12 hour storm, the Depth-Duration-Frequency model in the Flood Estimation Handbook (FEH) was used. The FEH predicted rainfall depth for the present day is 82.5mm provided in Figure 6-1.

Figure 6-1 Depth-Duration Curve Model Results



6.5.5 In accordance with the NPPF, an allowance for climate change must be applied to the design rainfall. Therefore, the 1 in 100 year, 12 hour + 25% design rainfall depth is 103.1mm.

6.5.6 As explained in Section 6.2, a sensitivity event assuming a 40% uplift on rainfall depths has been completed. The rainfall depth during the sensitivity event is 115.5mm.

6.5.7 The footprint areas of the various containerised infrastructure are provided in Table 6-1. It should be noted these include the gravel bases as well as the container roofs to ensure rain falling on the gravel bases themselves is accounted for, not just the containers. The table also summarises the calculated runoff generated from the container areas during the design event, and the storage provided by the gravel bases.

6.5.8 The isolated gravel bases would be lined by a permeable geotextile and extend at least 300mm on all sides of the infrastructure, with the resultant areas shown in Table 6-1. The bases would have depths of 400mm and porosity of 0.3, with the resultant storage capacity also provided in Table 6-1.

Table 6-2 Isolated Infrastructure Runoff and Storage (Sensitivity Event)

Isolated Infrastructure	Footprint Area (m^2)	Runoff Generated (m^3)	Gravel Base Area (m^2)	Gravel Base Storage (m^3)
Switchroom	38.8	5.5	47.7	5.7
Containers	31.5	4.7	40.7	4.9
Harmonic Filters	21.1	3.2	27.6	3.3
Transformer	71.2	9.5	81.9	9.8
DNO Container	29.9	4.4	37.8	4.5

6.5.9 As shown in Table 6-1, the proposed gravel beds provide sufficient capacity to store the 1 in 100 year + 40% sensitivity event and therefore the design rainfall event, with additional capacity for an exceedance event. It would encourage percolation to the ground as per the existing site. However, infiltration rates have not been included in the calculations to ensure a conservative estimate.

6.6 ESS Units

6.6.1 The ESS comprises the largest land take of the proposals and is therefore the largest area of relatively concentrated hardstanding.

6.6.2 For reasons of fire management (explained below), it is not recommended to simply allow the ESS units area to drain to ground locally. Therefore, it is proposed to discharge runoff generated from the ESS units to infiltration features. Due to the proximity of the predicted surface water flooding area, the western ESS area would drain to underground Geocellular crates. The eastern ESS units would be able to discharge to an infiltration basin. Runoff will be routed to the storage crates and infiltration basin via hydrobrake penstock chambers with discharge rates as close to greenfield QBar rates as possible.

6.6.3 The capacities of the proposed infiltration features have been calculated using hydrographs extracted from the Microdraiange Source Control calculations for each of the ESS area gravel bases during the critical duration event. The extracted hydrographs were then used as inflows into the proposed infiltration features.

6.6.4 The infiltration basin, storage crates and gravel bases have been designed to have sufficient capacity to store a design rainfall event (1 in 100 year +25%) and provide sufficient capacity during the sensitivity event. As with the isolated infrastructure, the

contribution area for the calculations includes the gravel base areas as well as the ESS containers, to ensure rain falling on the gravel base is accounted for.

6.6.5 The above arrangements would ensure no offsite discharge is proposed and rainfall would be managed on site.

6.6.6 Due to the lack of sensitive downstream receptors, a Factor of Safety of 5 has been applied to the infiltration calculations.

Eastern ESS Area

6.6.7 The proposed gravel base would have an area of approximately 0.24ha and therefore a QBar runoff equivalent of approximately 0.2l/s. However, in order to manage blockage risk and comply with relevant Sewerage Sector Guidance, an orifice of at least 50mm is required, resulting in a discharge rate of 0.9l/s.

6.6.8 Microdrainage source control calculations (Appendix C) indicate that approximately 181m^3 of volume is required in the infiltration basin and approximately 103m^3 of volume is required in the gravel bases for the eastern ESS area during the design, critical duration, event.

6.6.9 The proposed gravel base for the eastern ESS area would measure approximately 0.24ha and have a depth of at least 0.4m at its downstream end, base slope of 1:300 and porosity of 0.3. Microdrainage calculations show that such bases would only fill to a maximum of 0.3m during the design event and 0.34m during the sensitivity event, providing 100mm of additional capacity for an exceedance event.

6.6.10 The infiltration basin for the eastern ESS area measures 1m deep, has a base area of approximately 55m^2, a crest area of approximately 162m^2, has 1 in 3 side slopes and an approximate volume capacity of 104m^3.

Western ESS Area

6.6.11 As with the eastern area, a 0.9l/s discharge rate is required to comply with Sewerage Sector Guidance, which is therefore as close to greenfield QBar rates as reasonably practicable.

6.6.12 Microdrainage source control calculations indicate that approximately 177m^3 of volume is required in the infiltrating geocellular crates and approximately 830m^3 of volume is required in the gravel bases for the western ESS area during the design, critical duration, event.

6.6.13 The proposed gravel base for the western ESS area would measure approximately 0.97ha and have a depth of at least 0.5m at its downstream end, base slope of 1:300 and porosity of 0.3. Microdrainage calculations show that such bases would only fill to a maximum of 0.43m during the design event and 0.48 during the sensitivity event, providing some additional capacity for an exceedance event.

6.6.14 The storage crates are proposed to be 1m deep, have a length of 50m, a width of 4m and a total area of approximately 200m^2. An assumed infiltration rate of 0.018m/hr has been used to inform the design of the storage crates. The storage crates have a capacity of approximately 190m^3, approximately 13m^3 greater than the volume required.

6.7 Fire Management

Background

6.7.1 ESS units have, without mitigation, the potential to ignite. Ignition is most commonly caused by thermal runaway, which occurs when ESS units overheat. This can be exacerbated in a few ways, including proximity to ESS units already alight.

6.7.2 Significant mitigation is included within the ESS units and the ESS safety management plan, reported elsewhere in the planning documents, and ESS safety technology is rapidly improving. This significantly reduces the chances for ignition to occur and includes methods to limit the chance for overheating due to proximity. For example, many ESS units can be manufactured to contain a fire within the container or cabinet.

6.7.3 In the unlikely event a unit does ignite, the typical response to supress the fire (if required) is to utilise inert, non-Per- and polyfluoroalkyl substances (PFAS) products. However, the fire service may choose to use water spraying as part of the method of suppression, particularly to keep adjacent units cool and reduce the chance for them to ignite.

6.7.4 Alternatively, many modern energy storage units are able to remain sealed, containing fires within the unit, thus negating the spread of contaminants.

6.7.5 The latest, draft, National Fire Chiefs Council (NFCC) guidance recommends that fog spraying or similar should be sufficient to manage the thermal runaway of adjacent units. Fog nozzles have various flow rates but for the purposes of this assessment, they are presumed to have a rate of 650l/min.

Mitigation

6.7.6 The ESS units themselves would be underlain by limestone-based gravel base wrapped in an impermeable liner and served by a network of perforated pipes to ensure the system could discharge to the infiltration features.

6.7.7 The perforated pipes would flow to a single point of discharge in each network, which would be facilitated by a penstock chamber. The chambers would have outlet perforated pipes that would discharge to the infiltration basin.

6.7.8 The penstock chambers would remain open during normal conditions, to allow the passage of rainfall into the infiltration basin. However, during a fire event, the penstocks would be shut, creating a sealed system beneath the ESS units. Once the system is sealed, water in the penstock can be tested for contaminants. If they are

identified, water can be pumped out and disposed of appropriately. When contamination is at safe levels, the penstock can be released to resume the normal flow regime.

6.7.9 As shown in the drainage strategy, the western ESS area would have an area of approximately 9,700m^2. Presuming the sealed gravel base would be at least 0.5m deep with a porosity of 0.3 would result in a capacity of at least 1,400m^3, sufficient for more than 36 hours of fog spraying with a pump rate of zero.

6.7.10 The eastern ESS areas would measure approximately 2,400m^2 in area. Presuming the sealed gravel base would be at least 0.4m deep with a porosity of 0.3 would result in a capacity of approximately 360m^3, sufficient for more than nine hours of fog spraying with a pump rate of zero.

6.7.11 The gravel bases would be specified to be limestone-based. This is because the calcium carbonate content in limestone is known to be effective at neutralising HF, particularly when diluted[1].

6.7.12 The proposed drainage strategy, including the fire management procedures, is included in Appendix D.

6.8 Water Quality

6.8.1 The SuDS Manual (CIRIA C753) states that the design of surface water drainage should consider minimising contaminants in surface water runoff discharged from the Site. The level of treatment required depends on the proposed land use, according to the pollution hazard indices. To provide adequate treatment, the SuDS mitigation indices for the development must be equal to, or exceed, the pollution hazard indices.

6.8.2 Using a precautionary approach to runoff water quality, the closest land use in the SuDS Manual to the containers is 'other roofs'. Surface water runoff from 'other roofs' are considered by Table 26.2 of the SuDS Manual to present a Low hazard to water quality, respectively (see Table 6-2)

6.8.3 Table 26.4 of the SuDS Manual provides SuDS mitigation indices for various SuDS methods discharging to the ground, as summarised in Table 6-2. This shows that the nearest equivalent to gravel bases would be infiltration trenches and the nearest equivalent for infiltration basins is bioretention, these would provide sufficient mitigation of the likely pollutants expected.

Table 6-3 Water Quality Indices (as per C753 The SuDS Manual)

	Pollution Hazard Level	Total suspended solids	Metals	Hydro-carbons

[1] https://prod-edam.honeywell.com/content/dam/honeywell-edam/pmt/oneam/en-us/hydrofluoric-acid/honeywell-bases-for-neutralization-of-HF-v2.pdf?download=false

Land Use	Other roofs	Low	0.3	0.2	0.05
SuDS Mitigation Indices	Infiltration trenches	-	0.4	0.4	0.4
	Bioretention underlain by soil with good containment potential	-	0.8	0.8	0.8

6.9 Design for Exceedance

6.9.1 It is recommended the proposed infrastructure would be raised on plinths or pads which would prevent flood damage in an exceedance event.

6.9.2 As shown in Table 6-1 and Section 6.3, the storage capacity of the isolated gravel bases and ESS area gravel bases would exceed the volume of runoff in a design event, providing some additional capacity for an exceedance event.

6.9.3 In the unlikely event the capacity of the beds was exceeded, water would slowly dissipate overland onto surrounding grassed areas, where it would absorb into the ground as per the existing site and general antecedent conditions.

6.10 Maintenance Regime

6.10.1 Maintenance of SuDS features is essential for the operation of the surface water drainage system.

6.10.2 The proposed maintenance schedule is included as Table 6-2.

Table 6-4 Proposed Drainage System Maintenance Plan

Drainage Component	Required Action	Typical Frequency
Subbase storage	Remove litter and debris from gravel beds surface	As required
	Inspect gravel surface for blockages, clogging, standing water and structural damage	Monthly
	Inspect for evidence of poor operation and/or weed growth – if required take remedial action	Every three months, 48 hours after large storms in the first six months
	Replacement of gravel	As required
	Stabilise adjacent areas	As required

Pipework, manholes, flow control chambers, catch pits and silt traps	Remove litter and debris	As required
	Clear any poor performing structures.	As required
	Inspect all structures for poor operation	Three monthly, 48 hours after large storms in first six months
	Monitor inspection chambers. Inspect silt accumulation rates and determine silt clearance frequencies	Annually
Basins	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter and cut back adjacent vegetation where possible.	As required
	Re-seed areas of poor growth.	As required
	Repair erosion or other damage by re- turfing	As required
	Re-level uneven surfaces to reinstate design levels	As required
	Scarify and spike topsoil to improve performance, break up silt deposits and prevent compaction	As required
	Remove sediment build-up	As required
	Inspect surfaces for ponding, compaction and silt accumulation. Record areas where water is ponding for more than 48 hours	As required

7 SUMMARY

7.1.1 It is proposed to construct an Energy Storage System (ESS) on land off North Cray Road, Sidcup.

7.1.2 The entirety of the site is located in Flood Zone 1 and is considered to be at a low risk of flooding from rivers and the sea.

7.1.3 Parts of the site are considered to be at a mapped risk of flooding from surface water, however there is no development proposed in those areas, therefore the development is considered to be at a very low risk of surface water flooding.

7.1.4 The site is considered to be at a Very Low risk of groundwater flooding, flooding from sewers and flooding from artificial sources.

7.1.5 On account of the low flood risk posed to the site, neither the Sequential Test nor Exception Test are required for the proposals.

7.1.6 It is proposed that runoff from proposed isolated infrastructure will be stored in their associated gravel bases before percolating into the ground. The bases have been sized to accommodate at least the 1 in 100 year +25%, 12 hour duration, rainfall event.

7.1.7 The proposed drainage strategy has been designed to provide sufficient capacity for the 1 in 100 year + 40% climate change event, as per policy DP33 of the Bexley Local Plan.

7.1.8 For reasons of fire management, the ESS units are proposed to be sited on top of two seperate sealed gravel base networks.

7.1.9 The western ESS area gravel base would have a depth of 0.5m and will discharge via a hydrobrake penstock chamber into nearby underground infiltration crates with a discharge rate of 0.9/s (closest equivalent to QBar greenfield rates).

7.1.10 The eastern ESS gravel base measures 0.4m in depth and will discharge via a hydrobrake penstock chamber into a nearby infiltration basin measuring 1m deep with a discharge rate of 0.9l/s.

7.1.11 The gravel base network has been sized to accommodate at least the 1 in 100 year +25%, 12 hour duration, rainfall event and applies assumed infiltration rates of 0.018m/hr.

7.1.12 The proposed eastern ESS infiltration basin measures 1m deep, has a base area of approximately 55m^2, a crest area of approximately 167m^2 and has a volume capacity of 104m^3. The infiltration basin has been designed to accommodate flows from the proposed gravel base network during the 1 in 100 year +25%, 12 hour duration, rainfall event.

7.1.13 The proposed western ESS infiltration crates would have a depth of 1m, area of 200m^2 and capacity of 190m^3.

7.1.14 There is an extremely low risk of ignition in the ESS units. Ignition is typically caused by thermal runaway in units. Therefore, the control of temperature can be an effective way of preventing fires spreading to additional units. The management of fires in ESS units is a rapidly improving industry, often either being self-contained in the container or using non-water based suppression. However, in accordance with relevant guidance, at this stage it is presumed that some fog water spraying suppression would be required.

7.1.15 A sealed drainage system is proposed through use of an impermeable membrane around the gravel underlying the ESS units and a penstock to allow the drainage system to be sealed during a fire. If contaminants are identified during monitoring and testing, water from the penstock chamber can be pumped out and subsequently removed from the site as necessary.

7.1.16 The eastern ESS sealed drainage system would have sufficient capacity for more than nine hours of fog spraying with zero discharge, with the western ESS being able to contain over 36 hours of fog spraying.

7.1.17 With the recommended measures in place the proposed development would be safe from all forms of flooding and manage runoff as close to the existing situation as reasonably practicable and therefore meets the requirements of NPPF.

APPENDICES

APPENDIX A

Site Proposals

A0

Revisions:

Revision	Date	Revision Notes	Drawn	Inspected
01	16.01.25	First Issue	CS	JH
02	20.01.25	Revised Substation	CS	JH
03	27.02.25	Layout Updated	CS	JH
04	04.03.25	Layout Updated	HL	JH
05	26.03.25	RLB & Access Amended	CS	JH
06	31.03.25	RLB & Access Amended	CS	JH

LEGEND:

PLANNING APPLICATION BOUNDARY

WATERCOURSE

MAINTENANCE ACCESS

SITE ACCESS

EMERGENCY ACCESS

DNO ACCESS

SECURITY FENCELINE

ELE — HV 132kV OVERHEAD ELEC CABLE 132kV ELE — HV 132kV

ELE — HV 33kV OVERHEAD ELEC CABLE 33kV ELE — HV 33kV

ELE — HV — ELE OVERHEAD ELEC CABLE 11kV ELE — HV — ELE

GAS — GAS — GAS MEDIUM PRESSURE GAS GAS — GAS — GAS

TEL — TEL — TEL BT TELECOMS TEL — TEL — TEL

ELE — HV — ELE UNDERGROUND ELEC CABLE ELE — HV — ELE

ELE — HV 33kV UNDERGROUND ELEC CABLE 33kV ELE — HV 33kV

SITE INFRASTRUCTURE:

- SECURITY GATE
- 132kV SUBSTATION
- CCTV CAMERA
- DNO CONTROL ROOM
- TWIN SKID (TX)
- 240,000l WATER TANK & PUMP
- ESS UNIT
- SCS INVERTER
- ESS INTERFACE CABINET
- 40FT STORAGE CONTAINER
- CUSTOMER SWITCHROOM
- 40FT WELFARE OFFICE
- WATER HYDRANT

VEGETATION:

- CATEGORY A TREE GROUP
- CATEGORY B TREE GROUP
- CATEGORY C TREE GROUP
- BRANCH SPREAD
- ROOT PROTECTION AREA (RPA)
- FIRST SIGNIFICANT BRANCH DIRECTION

PL-02

N

Project:

North Cray Road

North Cray Road ESS
Sidcup, DA14 5HE

Applicant:

Net Zero Thirtytwo Limited

Net Zero Thirtytwo Ltd
Foresters Hall,
25-27 Westow Street,
London, SE19 3RY

Tel: +44 (0) 2071172077
Mob: +44 (0) 7737651384

Drawn by:

CADmando
2D , 3D CAD & BIM SERVICES

CADmando Design & Draughting Solutions Ltd
Unit B2, The Courtyard, Severn Drive, Tewkesbury Business Park, GL20 8GD

Tel: +44 (0) 1684 850019
Mob: +44 (0) 7814436910

Status:

PLANNING

Drawing Title:

North Cray Road Sidcup ESS
Proposed Site Layout Plan (Overall)

Drawn:	Checked:	First Issued:
CS	JH	16.01.2025

Project Code: **FST029-** Drawing Number: **PL-01**

Sheet Size:	Scale:	Revision:
A0	**1:2500**	**06**

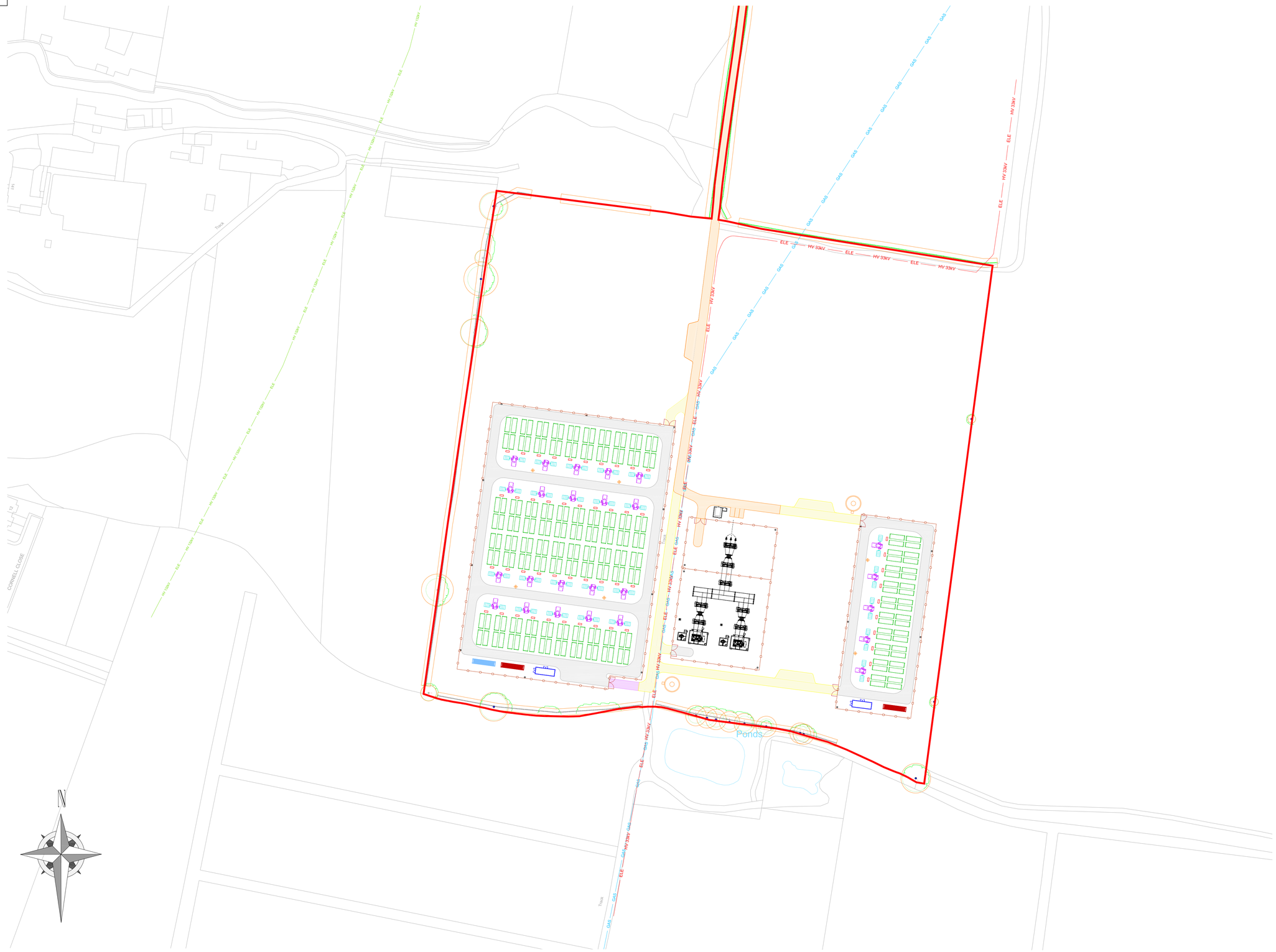
1 NORTH CRAY ROAD - PROPOSED SITE LAYOUT PLAN (OVERALL)

Scale: 1:2500@A0

0 50 100 150 200 250m

SCALE 1:2500

A1



Revisions:

Revision	Date	Revision Notes	Drawn	Inspected
01	16.01.25	First Issue	CS	JH
02	20.01.25	Revised Substation	CS	JH
03	27.02.25	Layout Updated	CS	JH
04	04.03.25	Layout Updated	HL	JH

LEGEND:

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- MAINTENANCE ACCESS
- SITE ACCESS
- DNO ACCESS
- EMERGENCY ACCESS
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- ELE — HV 33kV — OVERHEAD ELEC CABLE 33kV — ELE — HV 33kV —
- ELE — HV — ELE — OVERHEAD ELEC CABLE 11kV — ELE — HV — ELE
- GAS — GAS — MEDIUM PRESSURE GAS — GAS — GAS —
- TEL — TEL — BT TELECOMS — TEL — TEL —
- ELE — HV — ELE — UNDERGROUND ELEC CABLE — ELE — HV — ELE
- ELE — HV 33kV — UNDERGROUND ELEC CABLE — ELE — HV 33kV — 33kV

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- ROOT PROTECTION AREA (RPA)
- FIRST SIGNIFICANT BRANCH DIRECTION

Project:

North Cray Road
North Cray Road ESS
Sidcup, DA14 5HE

Applicant:

Net Zero Thirtytwo Limited

Net Zero Thirtytwo Ltd
Foresters Hall,
25-27 Westow Street,
London, SE19 3RY

Tel: +44 (0) 2071172077
Mob: +44 (0) 7737651384

Drawn by:

CADmando
2D , 3D CAD & BIM SERVICES

CADmando Design & Draughting Solutions Ltd
Unit B2, The Courtyard, Severn Drive, Tewkesbury
Business Park, GL20 8GD

Tel: +44 (0) 1684 850019
Mob: +44 (0) 7814436910

Status:

PLANNING

Drawing Title:

North Cray Road Sidcup ESS
Proposed Site Layout Plan

Drawn:	Checked:	First Issued:
CS	JH	16.01.2025

Project Code: **FST029-** Drawing Number: **PL-02**

Sheet Size:	Scale:	Revision:
A1	1:1000	04

1 NORTH CRAY ROAD - PROPOSED SITE LAYOUT PLAN (ESS)

Scale: 1:1000@A1

0 10 20 30 40 50 60 70 80 90 100m

SCALE 1:1000

APPENDIX B

Drainage Calculations

Flood Estimation Handbook Runoff Calculation Sheet

Job Number	24-431	Project Name	Manor Farm, Bexley - Western ESS		
Author	CF	Checker	PG	Date	26/02/2025

This spreadsheet applies the FEH statistical method equation in accordance with the method as set out in the SUDS Manual section 24.3.2, using a minimum area of 50ha and scaling down

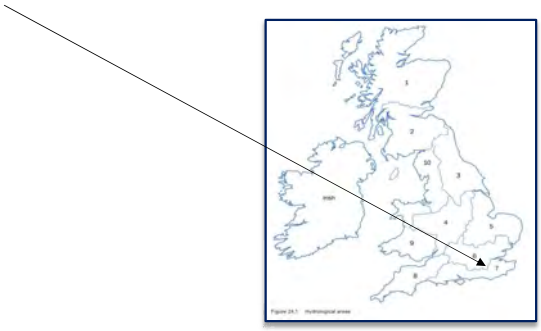
FEH stats equation

$$Q_{med\ sds} = 8.3062\ AREA^{0.8510} \times 0.1536^{(1000/SAAR)} \times FARL^{3.4451} \times 0.0460^{BFIHOST^2}$$

FEH descriptors have been extracted from the FEH Webservice for the location noted below

FEH Point data	Eastings	Northings	
	548857	171009	
AREA (ha)	0.97		Area for runoff calculation
BFIHOST	0.767		Baseflow Index extracted from FEH webservice
FAARL	1		Flood Attenuation due to Reservoirs and Lakes
SAAR	620		Standardised Average Annual Rainfall
QMED (50ha) m^3/s	0.04		
QMED (50ha) l/s	36.67		
QMED l/s/ha	0.73		
QMED (site) l/s	**0.71**		Calculated for 50 hectares and scaled down in accordance with SuDS Manual Recommendation
Hydrological Region	6/7		

Site Location



Greenfied Runoff Rates

Event	Growth Curve Factor	Runoff (l/s)	Runoff (l/s/ha)
1 year	0.85	**0.7**	**0.7**
2 year (QMED)	0.88	**0.7**	**0.7**
QBAR	n/a	**0.8**	**0.8**
10 year	1.62	**1.3**	**1.3**
30 year	2.4	**1.9**	**2.0**
100 year	3.19	**2.6**	**2.7**

Flood Estimation Handbook Runoff Calculation Sheet

Job Number	24-431	Project Name	Manor Farm, Bexley - Eastern ESS		
Author	CF	Checker	PG	Date	26/02/2025

This spreadsheet applies the FEH statistical method equation in accordance with the method as set out in the SUDS Manual section 24.3.2, using a minimum area of 50ha and scaling down

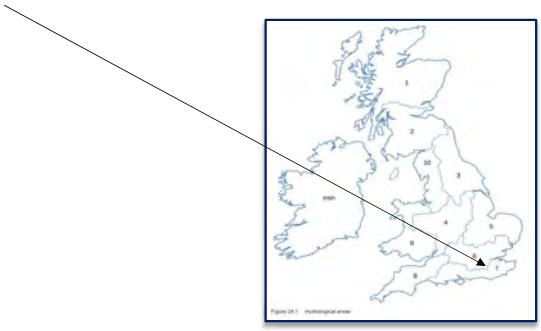
FEH stats equation

$$Q_{med\ sds} = 8.3062\ AREA^{0.8510} \times 0.1536^{(1000/SAAR)} \times FARL^{3.4451} \times 0.0460^{BFIHOST^2}$$

FEH descriptors have been extracted from the FEH Webservice for the location noted below

FEH Point data	Eastings	Northings	
	548857	171009	
AREA (ha)	0.24		Area for runoff calculation
BFIHOST	0.767		Baseflow Index extracted from FEH webservice
FAARL	1		Flood Attenuation due to Reservoirs and Lakes
SAAR	620		Standardised Average Annual Rainfall
QMED (50ha) m^3/s	0.04		
QMED (50ha) l/s	36.67		
QMED l/s/ha	0.73		
QMED (site) l/s	**0.18**		Calculated for 50 hectares and scaled down in accordance with SuDS Manual Recommendation
Hydrological Region	6/7		

Site Location



Greenfied Runoff Rates

Event	Growth Curve Factor	Runoff (l/s)	Runoff (l/s/ha)
1 year	0.85	**0.2**	**0.7**
2 year (QMED)	0.88	**0.2**	**0.7**
QBAR	n/a	**0.2**	**0.8**
10 year	1.62	**0.3**	**1.3**
30 year	2.4	**0.5**	**2.0**
100 year	3.19	**0.6**	**2.7**

Summary of Results for 100 year Return Period (+25%)

Half Drain Time : 1729 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.126	0.126	0.0	0.9	0.9	54.6	Flood Risk
30 min Summer	0.153	0.153	0.0	0.9	0.9	74.4	Flood Risk
60 min Summer	0.181	0.181	0.0	0.9	0.9	94.3	Flood Risk
120 min Summer	0.208	0.208	0.0	0.9	0.9	114.1	Flood Risk
180 min Summer	0.227	0.227	0.0	0.9	0.9	127.7	Flood Risk
240 min Summer	0.240	0.240	0.0	0.9	0.9	137.1	Flood Risk
360 min Summer	0.255	0.255	0.0	0.9	0.9	147.7	Flood Risk
480 min Summer	0.263	0.263	0.0	0.9	0.9	153.1	Flood Risk
600 min Summer	0.267	0.267	0.0	0.9	0.9	155.9	Flood Risk
720 min Summer	0.268	0.268	0.0	0.9	0.9	157.2	Flood Risk
960 min Summer	0.268	0.268	0.0	0.9	0.9	157.1	Flood Risk
1440 min Summer	0.259	0.259	0.0	0.9	0.9	150.1	Flood Risk
2160 min Summer	0.244	0.244	0.0	0.9	0.9	139.6	Flood Risk
2880 min Summer	0.232	0.232	0.0	0.9	0.9	131.0	Flood Risk
4320 min Summer	0.211	0.211	0.0	0.9	0.9	116.0	Flood Risk
5760 min Summer	0.193	0.193	0.0	0.9	0.9	103.1	Flood Risk
7200 min Summer	0.177	0.177	0.0	0.9	0.9	91.4	Flood Risk
8640 min Summer	0.163	0.163	0.0	0.9	0.9	81.2	Flood Risk
10080 min Summer	0.150	0.150	0.0	0.9	0.9	72.4	Flood Risk
15 min Winter	0.137	0.137	0.0	0.9	0.9	62.7	Flood Risk
30 min Winter	0.168	0.168	0.0	0.9	0.9	84.9	Flood Risk
60 min Winter	0.199	0.199	0.0	0.9	0.9	107.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.545	0.0	54.7	19
30 min Summer	97.406	0.0	70.9	34
60 min Summer	60.421	0.0	96.5	64
120 min Summer	36.418	0.0	118.4	124
180 min Summer	27.275	0.0	133.4	184
240 min Summer	22.123	0.0	141.8	244
360 min Summer	16.204	0.0	144.5	362
480 min Summer	12.883	0.0	142.2	482
600 min Summer	10.747	0.0	139.9	602
720 min Summer	9.252	0.0	137.8	722
960 min Summer	7.290	0.0	134.0	962
1440 min Summer	5.175	0.0	127.7	1398
2160 min Summer	3.683	0.0	215.9	1668
2880 min Summer	2.902	0.0	224.3	2044
4320 min Summer	2.086	0.0	232.5	2852
5760 min Summer	1.659	0.0	245.8	3632
7200 min Summer	1.391	0.0	252.6	4400
8640 min Summer	1.210	0.0	258.5	5192
10080 min Summer	1.080	0.0	264.1	5952
15 min Winter	149.545	0.0	62.1	19
30 min Winter	97.406	0.0	74.9	34
60 min Winter	60.421	0.0	109.5	64

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	0.230	0.230	0.0	0.9	0.9	129.7	Flood Risk
180 min Winter	0.252	0.252	0.0	0.9	0.9	145.3	Flood Risk
240 min Winter	0.267	0.267	0.0	0.9	0.9	156.2	Flood Risk
360 min Winter	0.284	0.284	0.0	0.9	0.9	168.7	Flood Risk
480 min Winter	0.293	0.293	0.0	0.9	0.9	175.2	Flood Risk
600 min Winter	0.299	0.299	0.0	0.9	0.9	178.9	Flood Risk
720 min Winter	0.301	0.301	0.0	0.9	0.9	180.9	Flood Risk
960 min Winter	0.303	0.303	0.0	0.9	0.9	181.9	Flood Risk
1440 min Winter	0.296	0.296	0.0	0.9	0.9	176.9	Flood Risk
2160 min Winter	0.279	0.279	0.0	0.9	0.9	164.9	Flood Risk
2880 min Winter	0.262	0.262	0.0	0.9	0.9	152.8	Flood Risk
4320 min Winter	0.232	0.232	0.0	0.9	0.9	130.9	Flood Risk
5760 min Winter	0.204	0.204	0.0	0.9	0.9	111.1	Flood Risk
7200 min Winter	0.179	0.179	0.0	0.9	0.9	92.9	Flood Risk
8640 min Winter	0.157	0.157	0.0	0.9	0.9	77.0	Flood Risk
10080 min Winter	0.138	0.138	0.0	0.9	0.9	63.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	36.418	0.0	133.3	122
180 min Winter	27.275	0.0	144.9	180
240 min Winter	22.123	0.0	145.6	240
360 min Winter	16.204	0.0	141.9	358
480 min Winter	12.883	0.0	139.2	476
600 min Winter	10.747	0.0	137.0	592
720 min Winter	9.252	0.0	135.1	708
960 min Winter	7.290	0.0	131.7	936
1440 min Winter	5.175	0.0	125.8	1384
2160 min Winter	3.683	0.0	244.3	2008
2880 min Winter	2.902	0.0	252.3	2244
4320 min Winter	2.086	0.0	245.3	3112
5760 min Winter	1.659	0.0	280.6	3976
7200 min Winter	1.391	0.0	289.1	4760
8640 min Winter	1.210	0.0	296.8	5536
10080 min Winter	1.080	0.0	304.1	6256

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 548707 170729 TQ 48707 70729	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+25

Time Area Diagram

Total Area (ha) 0.240

Time (mins) From:	To:	Area (ha)
0	4	0.240

Model Details

Storage is Online Cover Level (m) 0.400

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	80.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	666.7	Slope (1:X)	300.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0052-9000-0400-9000
Design Head (m)	0.400
Design Flow (l/s)	0.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	0.9	Kick-Flo®	0.270	0.8
Flush-Flo™	0.116	0.9	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.2	2.000	1.9	4.000	2.5	7.000	3.4
0.200	0.9	1.000	1.4	2.200	1.9	4.500	2.7	7.500	3.5
0.300	0.8	1.200	1.5	2.400	2.0	5.000	2.8	8.000	3.6
0.400	0.9	1.400	1.6	2.600	2.1	5.500	3.0	8.500	3.7
0.500	1.0	1.600	1.7	3.000	2.2	6.000	3.1	9.000	3.8
0.600	1.1	1.800	1.8	3.500	2.4	6.500	3.2	9.500	3.9

Summary of Results for Input Hydrograph

Half Drain Time : 3744 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
Input Hydrograph	0.992	0.992	0.3	102.6	Flood Risk

Storm Event	Flooded Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	2882

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2	0.0	110	0.0	218	0.5	326	0.9	434	0.9	542	0.8	650	0.8	758	0.8
4	0.0	112	0.0	220	0.5	328	0.9	436	0.9	544	0.8	652	0.8	760	0.8
6	0.0	114	0.0	222	0.5	330	0.9	438	0.9	546	0.8	654	0.8	762	0.8
8	0.0	116	0.0	224	0.5	332	0.9	440	0.9	548	0.8	656	0.8	764	0.8
10	0.0	118	0.0	226	0.5	334	0.9	442	0.9	550	0.8	658	0.8	766	0.8
12	0.0	120	0.0	228	0.5	336	0.9	444	0.9	552	0.8	660	0.8	768	0.8
14	0.0	122	0.0	230	0.6	338	0.9	446	0.9	554	0.8	662	0.8	770	0.8
16	0.0	124	0.0	232	0.6	340	0.9	448	0.9	556	0.8	664	0.8	772	0.8
18	0.0	126	0.0	234	0.6	342	0.9	450	0.9	558	0.8	666	0.8	774	0.8
20	0.0	128	0.0	236	0.6	344	0.9	452	0.9	560	0.8	668	0.8	776	0.8
22	0.0	130	0.0	238	0.6	346	0.9	454	0.9	562	0.8	670	0.8	778	0.8
24	0.0	132	0.0	240	0.6	348	0.9	456	0.9	564	0.8	672	0.8	780	0.8
26	0.0	134	0.0	242	0.6	350	0.9	458	0.9	566	0.8	674	0.8	782	0.8
28	0.0	136	0.0	244	0.6	352	0.9	460	0.9	568	0.8	676	0.8	784	0.8
30	0.0	138	0.0	246	0.6	354	0.9	462	0.9	570	0.8	678	0.8	786	0.8
32	0.0	140	0.0	248	0.6	356	0.9	464	0.9	572	0.8	680	0.8	788	0.8
34	0.0	142	0.0	250	0.6	358	0.9	466	0.9	574	0.8	682	0.8	790	0.8
36	0.0	144	0.0	252	0.7	360	0.9	468	0.9	576	0.8	684	0.8	792	0.8
38	0.0	146	0.0	254	0.7	362	0.9	470	0.9	578	0.8	686	0.8	794	0.8
40	0.0	148	0.0	256	0.7	364	0.9	472	0.9	580	0.8	688	0.8	796	0.8
42	0.0	150	0.0	258	0.7	366	0.9	474	0.9	582	0.8	690	0.8	798	0.8
44	0.0	152	0.0	260	0.7	368	0.9	476	0.9	584	0.8	692	0.8	800	0.8
46	0.0	154	0.0	262	0.7	370	0.9	478	0.9	586	0.8	694	0.8	802	0.8
48	0.0	156	0.1	264	0.7	372	0.9	480	0.9	588	0.8	696	0.8	804	0.8
50	0.0	158	0.1	266	0.7	374	0.9	482	0.9	590	0.8	698	0.8	806	0.8
52	0.0	160	0.1	268	0.7	376	0.9	484	0.9	592	0.8	700	0.8	808	0.8
54	0.0	162	0.1	270	0.7	378	0.9	486	0.9	594	0.8	702	0.8	810	0.8
56	0.0	164	0.1	272	0.7	380	0.9	488	0.9	596	0.8	704	0.8	812	0.8
58	0.0	166	0.2	274	0.7	382	0.9	490	0.9	598	0.8	706	0.8	814	0.8
60	0.0	168	0.2	276	0.7	384	0.9	492	0.9	600	0.8	708	0.8	816	0.8
62	0.0	170	0.2	278	0.7	386	0.9	494	0.9	602	0.8	710	0.8	818	0.8
64	0.0	172	0.2	280	0.8	388	0.9	496	0.9	604	0.8	712	0.8	820	0.8
66	0.0	174	0.2	282	0.8	390	0.9	498	0.9	606	0.8	714	0.8	822	0.8
68	0.0	176	0.2	284	0.8	392	0.9	500	0.9	608	0.8	716	0.8	824	0.8
70	0.0	178	0.3	286	0.8	394	0.9	502	0.9	610	0.8	718	0.8	826	0.8
72	0.0	180	0.3	288	0.8	396	0.9	504	0.9	612	0.8	720	0.8	828	0.8
74	0.0	182	0.3	290	0.8	398	0.9	506	0.9	614	0.8	722	0.8	830	0.8
76	0.0	184	0.3	292	0.8	400	0.9	508	0.9	616	0.8	724	0.8	832	0.8
78	0.0	186	0.3	294	0.8	402	0.9	510	0.9	618	0.8	726	0.8	834	0.8
80	0.0	188	0.3	296	0.8	404	0.9	512	0.9	620	0.8	728	0.8	836	0.8
82	0.0	190	0.3	298	0.8	406	0.9	514	0.9	622	0.8	730	0.8	838	0.8
84	0.0	192	0.4	300	0.8	408	0.9	516	0.9	624	0.8	732	0.8	840	0.8
86	0.0	194	0.4	302	0.8	410	0.9	518	0.9	626	0.8	734	0.8	842	0.8
88	0.0	196	0.4	304	0.8	412	0.9	520	0.9	628	0.8	736	0.8	844	0.8
90	0.0	198	0.4	306	0.9	414	0.9	522	0.9	630	0.8	738	0.8	846	0.8
92	0.0	200	0.4	308	0.9	416	0.9	524	0.9	632	0.8	740	0.8	848	0.8
94	0.0	202	0.4	310	0.9	418	0.9	526	0.9	634	0.8	742	0.8	850	0.8
96	0.0	204	0.4	312	0.9	420	0.9	528	0.9	636	0.8	744	0.8	852	0.8
98	0.0	206	0.4	314	0.9	422	0.9	530	0.9	638	0.8	746	0.8	854	0.8
100	0.0	208	0.4	316	0.9	424	0.9	532	0.9	640	0.8	748	0.8	856	0.8
102	0.0	210	0.5	318	0.9	426	0.9	534	0.9	642	0.8	750	0.8	858	0.8
104	0.0	212	0.5	320	0.9	428	0.9	536	0.9	644	0.8	752	0.8	860	0.8
106	0.0	214	0.5	322	0.9	430	0.9	538	0.9	646	0.8	754	0.8	862	0.8
108	0.0	216	0.5	324	0.9	432	0.9	540	0.9	648	0.8	756	0.8	864	0.8

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
866	0.8	974	0.8	1082	0.8	1190	0.8	1298	0.8	1406	0.8	1514	0.8	1622	0.8
868	0.8	976	0.8	1084	0.8	1192	0.8	1300	0.8	1408	0.8	1516	0.8	1624	0.8
870	0.8	978	0.8	1086	0.8	1194	0.8	1302	0.8	1410	0.8	1518	0.8	1626	0.8
872	0.8	980	0.8	1088	0.8	1196	0.8	1304	0.8	1412	0.8	1520	0.8	1628	0.8
874	0.8	982	0.8	1090	0.8	1198	0.8	1306	0.8	1414	0.8	1522	0.8	1630	0.8
876	0.8	984	0.8	1092	0.8	1200	0.8	1308	0.8	1416	0.8	1524	0.8	1632	0.8
878	0.8	986	0.8	1094	0.8	1202	0.8	1310	0.8	1418	0.8	1526	0.8	1634	0.8
880	0.8	988	0.8	1096	0.8	1204	0.8	1312	0.8	1420	0.8	1528	0.8	1636	0.8
882	0.8	990	0.8	1098	0.8	1206	0.8	1314	0.8	1422	0.8	1530	0.8	1638	0.8
884	0.8	992	0.8	1100	0.8	1208	0.8	1316	0.8	1424	0.8	1532	0.8	1640	0.8
886	0.8	994	0.8	1102	0.8	1210	0.8	1318	0.8	1426	0.8	1534	0.8	1642	0.8
888	0.8	996	0.8	1104	0.8	1212	0.8	1320	0.8	1428	0.8	1536	0.8	1644	0.8
890	0.8	998	0.8	1106	0.8	1214	0.8	1322	0.8	1430	0.8	1538	0.8	1646	0.8
892	0.8	1000	0.8	1108	0.8	1216	0.8	1324	0.8	1432	0.8	1540	0.8	1648	0.8
894	0.8	1002	0.8	1110	0.8	1218	0.8	1326	0.8	1434	0.8	1542	0.8	1650	0.8
896	0.8	1004	0.8	1112	0.8	1220	0.8	1328	0.8	1436	0.8	1544	0.8	1652	0.8
898	0.8	1006	0.8	1114	0.8	1222	0.8	1330	0.8	1438	0.8	1546	0.8	1654	0.8
900	0.8	1008	0.8	1116	0.8	1224	0.8	1332	0.8	1440	0.8	1548	0.8	1656	0.8
902	0.8	1010	0.8	1118	0.8	1226	0.8	1334	0.8	1442	0.8	1550	0.8	1658	0.8
904	0.8	1012	0.8	1120	0.8	1228	0.8	1336	0.8	1444	0.8	1552	0.8	1660	0.8
906	0.8	1014	0.8	1122	0.8	1230	0.8	1338	0.8	1446	0.8	1554	0.8	1662	0.8
908	0.8	1016	0.8	1124	0.8	1232	0.8	1340	0.8	1448	0.8	1556	0.8	1664	0.8
910	0.8	1018	0.8	1126	0.8	1234	0.8	1342	0.8	1450	0.8	1558	0.8	1666	0.8
912	0.8	1020	0.8	1128	0.8	1236	0.8	1344	0.8	1452	0.8	1560	0.8	1668	0.8
914	0.8	1022	0.8	1130	0.8	1238	0.8	1346	0.8	1454	0.8	1562	0.8	1670	0.8
916	0.8	1024	0.8	1132	0.8	1240	0.8	1348	0.8	1456	0.8	1564	0.8	1672	0.8
918	0.8	1026	0.8	1134	0.8	1242	0.8	1350	0.8	1458	0.8	1566	0.8	1674	0.8
920	0.8	1028	0.8	1136	0.8	1244	0.8	1352	0.8	1460	0.8	1568	0.8	1676	0.8
922	0.8	1030	0.8	1138	0.8	1246	0.8	1354	0.8	1462	0.8	1570	0.8	1678	0.8
924	0.8	1032	0.8	1140	0.8	1248	0.8	1356	0.8	1464	0.8	1572	0.8	1680	0.8
926	0.8	1034	0.8	1142	0.8	1250	0.8	1358	0.8	1466	0.8	1574	0.8	1682	0.8
928	0.8	1036	0.8	1144	0.8	1252	0.8	1360	0.8	1468	0.8	1576	0.8	1684	0.8
930	0.8	1038	0.8	1146	0.8	1254	0.8	1362	0.8	1470	0.8	1578	0.8	1686	0.8
932	0.8	1040	0.8	1148	0.8	1256	0.8	1364	0.8	1472	0.8	1580	0.8	1688	0.8
934	0.8	1042	0.8	1150	0.8	1258	0.8	1366	0.8	1474	0.8	1582	0.8	1690	0.8
936	0.8	1044	0.8	1152	0.8	1260	0.8	1368	0.8	1476	0.8	1584	0.8	1692	0.8
938	0.8	1046	0.8	1154	0.8	1262	0.8	1370	0.8	1478	0.8	1586	0.8	1694	0.8
940	0.8	1048	0.8	1156	0.8	1264	0.8	1372	0.8	1480	0.8	1588	0.8	1696	0.8
942	0.8	1050	0.8	1158	0.8	1266	0.8	1374	0.8	1482	0.8	1590	0.8	1698	0.8
944	0.8	1052	0.8	1160	0.8	1268	0.8	1376	0.8	1484	0.8	1592	0.8	1700	0.8
946	0.8	1054	0.8	1162	0.8	1270	0.8	1378	0.8	1486	0.8	1594	0.8	1702	0.8
948	0.8	1056	0.8	1164	0.8	1272	0.8	1380	0.8	1488	0.8	1596	0.8	1704	0.8
950	0.8	1058	0.8	1166	0.8	1274	0.8	1382	0.8	1490	0.8	1598	0.8	1706	0.8
952	0.8	1060	0.8	1168	0.8	1276	0.8	1384	0.8	1492	0.8	1600	0.8	1708	0.8
954	0.8	1062	0.8	1170	0.8	1278	0.8	1386	0.8	1494	0.8	1602	0.8	1710	0.8
956	0.8	1064	0.8	1172	0.8	1280	0.8	1388	0.8	1496	0.8	1604	0.8	1712	0.8
958	0.8	1066	0.8	1174	0.8	1282	0.8	1390	0.8	1498	0.8	1606	0.8	1714	0.8
960	0.8	1068	0.8	1176	0.8	1284	0.8	1392	0.8	1500	0.8	1608	0.8	1716	0.8
962	0.8	1070	0.8	1178	0.8	1286	0.8	1394	0.8	1502	0.8	1610	0.8	1718	0.8
964	0.8	1072	0.8	1180	0.8	1288	0.8	1396	0.8	1504	0.8	1612	0.8	1720	0.8
966	0.8	1074	0.8	1182	0.8	1290	0.8	1398	0.8	1506	0.8	1614	0.8	1722	0.8
968	0.8	1076	0.8	1184	0.8	1292	0.8	1400	0.8	1508	0.8	1616	0.8	1724	0.8
970	0.8	1078	0.8	1186	0.8	1294	0.8	1402	0.8	1510	0.8	1618	0.8	1726	0.8
972	0.8	1080	0.8	1188	0.8	1296	0.8	1404	0.8	1512	0.8	1620	0.8	1728	0.8

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
1730	0.8	1838	0.8	1946	0.8	2054	0.8	2162	0.8	2270	0.9	2378	0.9	2486	0.9
1732	0.8	1840	0.8	1948	0.8	2056	0.8	2164	0.8	2272	0.9	2380	0.9	2488	0.9
1734	0.8	1842	0.8	1950	0.8	2058	0.8	2166	0.8	2274	0.9	2382	0.9	2490	0.9
1736	0.8	1844	0.8	1952	0.8	2060	0.8	2168	0.8	2276	0.9	2384	0.9	2492	0.9
1738	0.8	1846	0.8	1954	0.8	2062	0.8	2170	0.8	2278	0.9	2386	0.9	2494	0.9
1740	0.8	1848	0.8	1956	0.8	2064	0.8	2172	0.8	2280	0.9	2388	0.9	2496	0.9
1742	0.8	1850	0.8	1958	0.8	2066	0.8	2174	0.8	2282	0.9	2390	0.9	2498	0.9
1744	0.8	1852	0.8	1960	0.8	2068	0.8	2176	0.8	2284	0.9	2392	0.9	2500	0.9
1746	0.8	1854	0.8	1962	0.8	2070	0.8	2178	0.8	2286	0.9	2394	0.9	2502	0.9
1748	0.8	1856	0.8	1964	0.8	2072	0.8	2180	0.8	2288	0.9	2396	0.9	2504	0.9
1750	0.8	1858	0.8	1966	0.8	2074	0.8	2182	0.8	2290	0.9	2398	0.9	2506	0.9
1752	0.8	1860	0.8	1968	0.8	2076	0.8	2184	0.8	2292	0.9	2400	0.9	2508	0.9
1754	0.8	1862	0.8	1970	0.8	2078	0.8	2186	0.8	2294	0.9	2402	0.9	2510	0.9
1756	0.8	1864	0.8	1972	0.8	2080	0.8	2188	0.8	2296	0.9	2404	0.9	2512	0.9
1758	0.8	1866	0.8	1974	0.8	2082	0.8	2190	0.8	2298	0.9	2406	0.9	2514	0.9
1760	0.8	1868	0.8	1976	0.8	2084	0.8	2192	0.8	2300	0.9	2408	0.9	2516	0.9
1762	0.8	1870	0.8	1978	0.8	2086	0.8	2194	0.8	2302	0.9	2410	0.9	2518	0.9
1764	0.8	1872	0.8	1980	0.8	2088	0.8	2196	0.8	2304	0.9	2412	0.9	2520	0.9
1766	0.8	1874	0.8	1982	0.8	2090	0.8	2198	0.8	2306	0.9	2414	0.9	2522	0.9
1768	0.8	1876	0.8	1984	0.8	2092	0.8	2200	0.8	2308	0.9	2416	0.9	2524	0.9
1770	0.8	1878	0.8	1986	0.8	2094	0.8	2202	0.8	2310	0.9	2418	0.9	2526	0.9
1772	0.8	1880	0.8	1988	0.8	2096	0.8	2204	0.8	2312	0.9	2420	0.9	2528	0.9
1774	0.8	1882	0.8	1990	0.8	2098	0.8	2206	0.8	2314	0.9	2422	0.9	2530	0.9
1776	0.8	1884	0.8	1992	0.8	2100	0.8	2208	0.8	2316	0.9	2424	0.9	2532	0.9
1778	0.8	1886	0.8	1994	0.8	2102	0.8	2210	0.8	2318	0.9	2426	0.9	2534	0.9
1780	0.8	1888	0.8	1996	0.8	2104	0.8	2212	0.8	2320	0.9	2428	0.9	2536	0.9
1782	0.8	1890	0.8	1998	0.8	2106	0.8	2214	0.8	2322	0.9	2430	0.9	2538	0.9
1784	0.8	1892	0.8	2000	0.8	2108	0.8	2216	0.8	2324	0.9	2432	0.9	2540	0.9
1786	0.8	1894	0.8	2002	0.8	2110	0.8	2218	0.8	2326	0.9	2434	0.9	2542	0.9
1788	0.8	1896	0.8	2004	0.8	2112	0.8	2220	0.8	2328	0.9	2436	0.9	2544	0.9
1790	0.8	1898	0.8	2006	0.8	2114	0.8	2222	0.8	2330	0.9	2438	0.9	2546	0.9
1792	0.8	1900	0.8	2008	0.8	2116	0.8	2224	0.8	2332	0.9	2440	0.9	2548	0.9
1794	0.8	1902	0.8	2010	0.8	2118	0.8	2226	0.8	2334	0.9	2442	0.9	2550	0.9
1796	0.8	1904	0.8	2012	0.8	2120	0.8	2228	0.8	2336	0.9	2444	0.9	2552	0.9
1798	0.8	1906	0.8	2014	0.8	2122	0.8	2230	0.8	2338	0.9	2446	0.9	2554	0.9
1800	0.8	1908	0.8	2016	0.8	2124	0.8	2232	0.8	2340	0.9	2448	0.9	2556	0.9
1802	0.8	1910	0.8	2018	0.8	2126	0.8	2234	0.9	2342	0.9	2450	0.9	2558	0.9
1804	0.8	1912	0.8	2020	0.8	2128	0.8	2236	0.9	2344	0.9	2452	0.9	2560	0.9
1806	0.8	1914	0.8	2022	0.8	2130	0.8	2238	0.9	2346	0.9	2454	0.9	2562	0.9
1808	0.8	1916	0.8	2024	0.8	2132	0.8	2240	0.9	2348	0.9	2456	0.9	2564	0.9
1810	0.8	1918	0.8	2026	0.8	2134	0.8	2242	0.9	2350	0.9	2458	0.9	2566	0.9
1812	0.8	1920	0.8	2028	0.8	2136	0.8	2244	0.9	2352	0.9	2460	0.9	2568	0.9
1814	0.8	1922	0.8	2030	0.8	2138	0.8	2246	0.9	2354	0.9	2462	0.9	2570	0.9
1816	0.8	1924	0.8	2032	0.8	2140	0.8	2248	0.9	2356	0.9	2464	0.9	2572	0.9
1818	0.8	1926	0.8	2034	0.8	2142	0.8	2250	0.9	2358	0.9	2466	0.9	2574	0.9
1820	0.8	1928	0.8	2036	0.8	2144	0.8	2252	0.9	2360	0.9	2468	0.9	2576	0.9
1822	0.8	1930	0.8	2038	0.8	2146	0.8	2254	0.9	2362	0.9	2470	0.9	2578	0.9
1824	0.8	1932	0.8	2040	0.8	2148	0.8	2256	0.9	2364	0.9	2472	0.9	2580	0.9
1826	0.8	1934	0.8	2042	0.8	2150	0.8	2258	0.9	2366	0.9	2474	0.9	2582	0.9
1828	0.8	1936	0.8	2044	0.8	2152	0.8	2260	0.9	2368	0.9	2476	0.9	2584	0.9
1830	0.8	1938	0.8	2046	0.8	2154	0.8	2262	0.9	2370	0.9	2478	0.9	2586	0.9
1832	0.8	1940	0.8	2048	0.8	2156	0.8	2264	0.9	2372	0.9	2480	0.9	2588	0.9
1834	0.8	1942	0.8	2050	0.8	2158	0.8	2266	0.9	2374	0.9	2482	0.9	2590	0.9
1836	0.8	1944	0.8	2052	0.8	2160	0.8	2268	0.9	2376	0.9	2484	0.9	2592	0.9

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
2594	0.9	2630	0.9	2666	0.9	2702	0.9	2738	0.9	2774	0.9	2810	0.9	2846	0.9
2596	0.9	2632	0.9	2668	0.9	2704	0.9	2740	0.9	2776	0.9	2812	0.9	2848	0.9
2598	0.9	2634	0.9	2670	0.9	2706	0.9	2742	0.9	2778	0.9	2814	0.9	2850	0.9
2600	0.9	2636	0.9	2672	0.9	2708	0.9	2744	0.9	2780	0.9	2816	0.9	2852	0.9
2602	0.9	2638	0.9	2674	0.9	2710	0.9	2746	0.9	2782	0.9	2818	0.9	2854	0.9
2604	0.9	2640	0.9	2676	0.9	2712	0.9	2748	0.9	2784	0.9	2820	0.9	2856	0.9
2606	0.9	2642	0.9	2678	0.9	2714	0.9	2750	0.9	2786	0.9	2822	0.9	2858	0.9
2608	0.9	2644	0.9	2680	0.9	2716	0.9	2752	0.9	2788	0.9	2824	0.9	2860	0.9
2610	0.9	2646	0.9	2682	0.9	2718	0.9	2754	0.9	2790	0.9	2826	0.9	2862	0.9
2612	0.9	2648	0.9	2684	0.9	2720	0.9	2756	0.9	2792	0.9	2828	0.9	2864	0.9
2614	0.9	2650	0.9	2686	0.9	2722	0.9	2758	0.9	2794	0.9	2830	0.9	2866	0.9
2616	0.9	2652	0.9	2688	0.9	2724	0.9	2760	0.9	2796	0.9	2832	0.9	2868	0.9
2618	0.9	2654	0.9	2690	0.9	2726	0.9	2762	0.9	2798	0.9	2834	0.9	2870	0.9
2620	0.9	2656	0.9	2692	0.9	2728	0.9	2764	0.9	2800	0.9	2836	0.9	2872	0.9
2622	0.9	2658	0.9	2694	0.9	2730	0.9	2766	0.9	2802	0.9	2838	0.9	2874	0.9
2624	0.9	2660	0.9	2696	0.9	2732	0.9	2768	0.9	2804	0.9	2840	0.9	2876	0.9
2626	0.9	2662	0.9	2698	0.9	2734	0.9	2770	0.9	2806	0.9	2842	0.9	2878	0.9
2628	0.9	2664	0.9	2700	0.9	2736	0.9	2772	0.9	2808	0.9	2844	0.9	2880	0.9

Model Details

Storage is Online Cover Level (m) 1.000

Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.01800 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.01800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	55.0	1.000	162.1

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1992 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.137	0.137	0.0	0.9	0.9	62.7	Flood Risk
30 min Summer	0.168	0.168	0.0	0.9	0.9	84.9	Flood Risk
60 min Summer	0.199	0.199	0.0	0.9	0.9	107.3	Flood Risk
120 min Summer	0.230	0.230	0.0	0.9	0.9	129.7	Flood Risk
180 min Summer	0.252	0.252	0.0	0.9	0.9	145.3	Flood Risk
240 min Summer	0.267	0.267	0.0	0.9	0.9	156.2	Flood Risk
360 min Summer	0.284	0.284	0.0	0.9	0.9	168.7	Flood Risk
480 min Summer	0.293	0.293	0.0	0.9	0.9	175.2	Flood Risk
600 min Summer	0.298	0.298	0.0	0.9	0.9	178.9	Flood Risk
720 min Summer	0.301	0.301	0.0	0.9	0.9	180.8	Flood Risk
960 min Summer	0.302	0.302	0.0	0.9	0.9	181.6	Flood Risk
1440 min Summer	0.295	0.295	0.0	0.9	0.9	176.3	Flood Risk
2160 min Summer	0.280	0.280	0.0	0.9	0.9	165.5	Flood Risk
2880 min Summer	0.266	0.266	0.0	0.9	0.9	155.9	Flood Risk
4320 min Summer	0.244	0.244	0.0	0.9	0.9	139.4	Flood Risk
5760 min Summer	0.225	0.225	0.0	0.9	0.9	125.8	Flood Risk
7200 min Summer	0.208	0.208	0.0	0.9	0.9	113.5	Flood Risk
8640 min Summer	0.193	0.193	0.0	0.9	0.9	102.8	Flood Risk
10080 min Summer	0.180	0.180	0.0	0.9	0.9	93.3	Flood Risk
15 min Winter	0.150	0.150	0.0	0.9	0.9	71.7	Flood Risk
30 min Winter	0.184	0.184	0.0	0.9	0.9	96.6	Flood Risk
60 min Winter	0.219	0.219	0.0	0.9	0.9	121.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	167.490	0.0	62.1	19
30 min Summer	109.094	0.0	74.9	34
60 min Summer	67.671	0.0	109.5	64
120 min Summer	40.788	0.0	133.3	124
180 min Summer	30.548	0.0	144.9	184
240 min Summer	24.778	0.0	145.4	244
360 min Summer	18.148	0.0	141.7	362
480 min Summer	14.429	0.0	138.9	482
600 min Summer	12.037	0.0	136.7	602
720 min Summer	10.362	0.0	134.7	722
960 min Summer	8.165	0.0	131.3	962
1440 min Summer	5.796	0.0	125.0	1440
2160 min Summer	4.125	0.0	244.1	1816
2880 min Summer	3.251	0.0	251.2	2164
4320 min Summer	2.336	0.0	239.4	2936
5760 min Summer	1.858	0.0	280.2	3696
7200 min Summer	1.558	0.0	288.7	4536
8640 min Summer	1.355	0.0	296.2	5280
10080 min Summer	1.209	0.0	303.3	6056
15 min Winter	167.490	0.0	69.1	19
30 min Winter	109.094	0.0	75.9	34
60 min Winter	67.671	0.0	123.9	64

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	0.255	0.255	0.0	0.9	0.9	147.3	Flood Risk
180 min Winter	0.279	0.279	0.0	0.9	0.9	165.1	Flood Risk
240 min Winter	0.297	0.297	0.0	0.9	0.9	177.5	Flood Risk
360 min Winter	0.316	0.316	0.0	0.9	0.9	191.8	Flood Risk
480 min Winter	0.327	0.327	0.0	0.9	0.9	199.6	Flood Risk
600 min Winter	0.333	0.333	0.0	0.9	0.9	204.1	Flood Risk
720 min Winter	0.337	0.337	0.0	0.9	0.9	206.7	Flood Risk
960 min Winter	0.340	0.340	0.0	0.9	0.9	208.7	Flood Risk
1440 min Winter	0.334	0.334	0.0	0.9	0.9	204.8	Flood Risk
2160 min Winter	0.319	0.319	0.0	0.9	0.9	193.6	Flood Risk
2880 min Winter	0.303	0.303	0.0	0.9	0.9	181.9	Flood Risk
4320 min Winter	0.274	0.274	0.0	0.9	0.9	161.3	Flood Risk
5760 min Winter	0.244	0.244	0.0	0.9	0.9	139.8	Flood Risk
7200 min Winter	0.217	0.217	0.0	0.9	0.9	120.4	Flood Risk
8640 min Winter	0.193	0.193	0.0	0.9	0.9	103.2	Flood Risk
10080 min Winter	0.172	0.172	0.0	0.9	0.9	88.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	40.788	0.0	145.3	122
180 min Winter	30.548	0.0	145.1	182
240 min Winter	24.778	0.0	142.5	240
360 min Winter	18.148	0.0	139.3	358
480 min Winter	14.429	0.0	137.2	476
600 min Winter	12.037	0.0	135.6	592
720 min Winter	10.362	0.0	134.1	708
960 min Winter	8.165	0.0	131.5	940
1440 min Winter	5.796	0.0	126.5	1386
2160 min Winter	4.125	0.0	267.3	2028
2880 min Winter	3.251	0.0	259.6	2304
4320 min Winter	2.336	0.0	240.1	3240
5760 min Winter	1.858	0.0	319.1	4088
7200 min Winter	1.558	0.0	329.5	4904
8640 min Winter	1.355	0.0	338.9	5704
10080 min Winter	1.209	0.0	347.9	6456

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 548707 170729 TQ 48707 70729	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.240

Time (mins) From:	To:	Area (ha)
0	4	0.240

Model Details

Storage is Online Cover Level (m) 0.400

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	80.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	666.7	Slope (1:X)	300.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0052-9000-0400-9000
Design Head (m)	0.400
Design Flow (l/s)	0.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	52
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	0.9	Kick-Flo®	0.270	0.8
Flush-Flo™	0.116	0.9	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.2	2.000	1.9	4.000	2.5	7.000	3.4
0.200	0.9	1.000	1.4	2.200	1.9	4.500	2.7	7.500	3.5
0.300	0.8	1.200	1.5	2.400	2.0	5.000	2.8	8.000	3.6
0.400	0.9	1.400	1.6	2.600	2.1	5.500	3.0	8.500	3.7
0.500	1.0	1.600	1.7	3.000	2.2	6.000	3.1	9.000	3.8
0.600	1.1	1.800	1.8	3.500	2.4	6.500	3.2	9.500	3.9

Summary of Results for 100 year Return Period (+25%)

Half Drain Time : 6978 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.192	0.192	0.0	1.1	1.1	222.8	O K
30 min Summer	0.224	0.224	0.0	1.1	1.1	304.4	Flood Risk
60 min Summer	0.253	0.253	0.0	1.1	1.1	387.9	Flood Risk
120 min Summer	0.283	0.283	0.0	1.1	1.1	474.3	Flood Risk
180 min Summer	0.304	0.304	0.0	1.1	1.1	535.8	Flood Risk
240 min Summer	0.319	0.319	0.0	1.1	1.1	580.3	Flood Risk
360 min Summer	0.338	0.338	0.0	1.1	1.1	636.0	Flood Risk
480 min Summer	0.350	0.350	0.0	1.1	1.1	670.4	Flood Risk
600 min Summer	0.358	0.358	0.0	1.1	1.1	694.3	Flood Risk
720 min Summer	0.364	0.364	0.0	1.1	1.1	711.9	Flood Risk
960 min Summer	0.373	0.373	0.0	1.1	1.1	736.3	Flood Risk
1440 min Summer	0.380	0.380	0.0	1.1	1.1	758.3	Flood Risk
2160 min Summer	0.384	0.384	0.0	1.1	1.1	769.6	Flood Risk
2880 min Summer	0.384	0.384	0.0	1.1	1.1	769.3	Flood Risk
4320 min Summer	0.378	0.378	0.0	1.1	1.1	751.3	Flood Risk
5760 min Summer	0.370	0.370	0.0	1.1	1.1	727.9	Flood Risk
7200 min Summer	0.363	0.363	0.0	1.1	1.1	707.6	Flood Risk
8640 min Summer	0.357	0.357	0.0	1.1	1.1	691.3	Flood Risk
10080 min Summer	0.353	0.353	0.0	1.1	1.1	678.9	Flood Risk
15 min Winter	0.205	0.205	0.0	1.1	1.1	255.5	Flood Risk
30 min Winter	0.239	0.239	0.0	1.1	1.1	346.9	Flood Risk
60 min Winter	0.271	0.271	0.0	1.1	1.1	440.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.545	0.0	94.1	19
30 min Summer	97.406	0.0	92.6	34
60 min Summer	60.421	0.0	184.2	64
120 min Summer	36.418	0.0	179.8	124
180 min Summer	27.275	0.0	175.3	184
240 min Summer	22.123	0.0	170.8	244
360 min Summer	16.204	0.0	162.9	364
480 min Summer	12.883	0.0	158.7	484
600 min Summer	10.747	0.0	156.5	604
720 min Summer	9.252	0.0	155.4	724
960 min Summer	7.290	0.0	154.6	964
1440 min Summer	5.175	0.0	152.1	1442
2160 min Summer	3.683	0.0	309.2	2164
2880 min Summer	2.902	0.0	303.0	2880
4320 min Summer	2.086	0.0	290.0	4320
5760 min Summer	1.659	0.0	612.4	5008
7200 min Summer	1.391	0.0	587.5	5760
8640 min Summer	1.210	0.0	561.4	6488
10080 min Summer	1.080	0.0	534.6	7264
15 min Winter	149.545	0.0	93.7	19
30 min Winter	97.406	0.0	92.0	34
60 min Winter	60.421	0.0	182.4	64

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	0.304	0.304	0.0	1.1	1.1	537.9	Flood Risk
180 min Winter	0.328	0.328	0.0	1.1	1.1	607.3	Flood Risk
240 min Winter	0.346	0.346	0.0	1.1	1.1	657.7	Flood Risk
360 min Winter	0.367	0.367	0.0	1.1	1.1	720.7	Flood Risk
480 min Winter	0.381	0.381	0.0	1.1	1.1	760.0	Flood Risk
600 min Winter	0.390	0.390	0.0	1.1	1.1	787.6	Flood Risk
720 min Winter	0.397	0.397	0.0	1.1	1.1	808.2	Flood Risk
960 min Winter	0.407	0.407	0.0	1.1	1.1	837.2	Flood Risk
1440 min Winter	0.417	0.417	0.0	1.1	1.1	865.1	Flood Risk
2160 min Winter	0.423	0.423	0.0	1.1	1.1	883.2	Flood Risk
2880 min Winter	0.425	0.425	0.0	1.1	1.1	888.3	Flood Risk
4320 min Winter	0.421	0.421	0.0	1.1	1.1	879.1	Flood Risk
5760 min Winter	0.414	0.414	0.0	1.1	1.1	858.3	Flood Risk
7200 min Winter	0.405	0.405	0.0	1.1	1.1	830.8	Flood Risk
8640 min Winter	0.398	0.398	0.0	1.1	1.1	809.2	Flood Risk
10080 min Winter	0.392	0.392	0.0	1.1	1.1	792.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	36.418	0.0	176.3	124
180 min Winter	27.275	0.0	169.0	182
240 min Winter	22.123	0.0	162.8	242
360 min Winter	16.204	0.0	159.1	360
480 min Winter	12.883	0.0	159.7	480
600 min Winter	10.747	0.0	160.6	598
720 min Winter	9.252	0.0	160.9	716
960 min Winter	7.290	0.0	160.8	952
1440 min Winter	5.175	0.0	158.3	1426
2160 min Winter	3.683	0.0	320.6	2120
2880 min Winter	2.902	0.0	316.5	2820
4320 min Winter	2.086	0.0	304.2	4152
5760 min Winter	1.659	0.0	621.3	5472
7200 min Winter	1.391	0.0	603.8	6624
8640 min Winter	1.210	0.0	586.7	6912
10080 min Winter	1.080	0.0	569.3	7768

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 548707 170729 TQ 48707 70729	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+25

Time Area Diagram

Total Area (ha) 0.972

Time (mins) From:	To:	Area (ha)
0	4	0.972

Model Details

Storage is Online Cover Level (m) 0.500

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	81.0
Membrane Percolation (mm/hr)	1000	Length (m)	120.0
Max Percolation (l/s)	2700.0	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0056-1100-0500-1100
Design Head (m)	0.500
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	56
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	1.1	Kick-Flo®	0.331	0.9
Flush-Flo™	0.148	1.1	Mean Flow over Head Range	-	1.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.1	0.800	1.4	2.000	2.1	4.000	2.8	7.000	3.7
0.200	1.1	1.000	1.5	2.200	2.1	4.500	3.0	7.500	3.8
0.300	1.0	1.200	1.6	2.400	2.2	5.000	3.1	8.000	4.0
0.400	1.0	1.400	1.7	2.600	2.3	5.500	3.3	8.500	4.1
0.500	1.1	1.600	1.9	3.000	2.5	6.000	3.4	9.000	4.2
0.600	1.2	1.800	2.0	3.500	2.7	6.500	3.6	9.500	4.3

Summary of Results for Input Hydrograph

Half Drain Time : 5221 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
Input Hydrograph	0.893	0.893	0.4	217.1	Flood Risk

Storm Event	Flooded Volume (m³)	Time-Peak (mins)
Input Hydrograph	0.0	5764

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
4	0.0	220	0.0	436	0.2	652	0.9	868	1.1	1084	1.1	1300	1.1	1516	1.0
8	0.0	224	0.0	440	0.2	656	1.0	872	1.1	1088	1.1	1304	1.1	1520	1.0
12	0.0	228	0.0	444	0.2	660	1.0	876	1.1	1092	1.1	1308	1.1	1524	1.0
16	0.0	232	0.0	448	0.3	664	1.0	880	1.1	1096	1.1	1312	1.1	1528	1.0
20	0.0	236	0.0	452	0.3	668	1.0	884	1.1	1100	1.1	1316	1.1	1532	1.0
24	0.0	240	0.0	456	0.3	672	1.0	888	1.1	1104	1.1	1320	1.1	1536	1.0
28	0.0	244	0.0	460	0.3	676	1.0	892	1.1	1108	1.1	1324	1.1	1540	1.0
32	0.0	248	0.0	464	0.4	680	1.0	896	1.1	1112	1.1	1328	1.1	1544	1.0
36	0.0	252	0.0	468	0.4	684	1.0	900	1.1	1116	1.1	1332	1.1	1548	1.0
40	0.0	256	0.0	472	0.4	688	1.0	904	1.1	1120	1.1	1336	1.1	1552	1.0
44	0.0	260	0.0	476	0.4	692	1.0	908	1.1	1124	1.1	1340	1.1	1556	1.0
48	0.0	264	0.0	480	0.5	696	1.0	912	1.1	1128	1.1	1344	1.1	1560	1.0
52	0.0	268	0.0	484	0.5	700	1.0	916	1.1	1132	1.1	1348	1.1	1564	1.0
56	0.0	272	0.0	488	0.5	704	1.0	920	1.1	1136	1.1	1352	1.1	1568	1.0
60	0.0	276	0.0	492	0.5	708	1.0	924	1.1	1140	1.1	1356	1.1	1572	1.0
64	0.0	280	0.0	496	0.5	712	1.0	928	1.1	1144	1.1	1360	1.1	1576	1.0
68	0.0	284	0.0	500	0.6	716	1.0	932	1.1	1148	1.1	1364	1.1	1580	1.0
72	0.0	288	0.0	504	0.6	720	1.0	936	1.1	1152	1.1	1368	1.1	1584	1.0
76	0.0	292	0.0	508	0.6	724	1.0	940	1.1	1156	1.1	1372	1.1	1588	1.0
80	0.0	296	0.0	512	0.6	728	1.0	944	1.1	1160	1.1	1376	1.1	1592	1.0
84	0.0	300	0.0	516	0.6	732	1.0	948	1.1	1164	1.1	1380	1.1	1596	1.0
88	0.0	304	0.0	520	0.6	736	1.0	952	1.1	1168	1.1	1384	1.1	1600	1.0
92	0.0	308	0.0	524	0.7	740	1.0	956	1.1	1172	1.1	1388	1.1	1604	1.0
96	0.0	312	0.0	528	0.7	744	1.0	960	1.1	1176	1.1	1392	1.1	1608	1.0
100	0.0	316	0.0	532	0.7	748	1.0	964	1.1	1180	1.1	1396	1.1	1612	1.0
104	0.0	320	0.0	536	0.7	752	1.0	968	1.1	1184	1.1	1400	1.1	1616	1.0
108	0.0	324	0.0	540	0.7	756	1.0	972	1.1	1188	1.1	1404	1.1	1620	1.0
112	0.0	328	0.0	544	0.7	760	1.1	976	1.1	1192	1.1	1408	1.1	1624	0.9
116	0.0	332	0.0	548	0.7	764	1.1	980	1.1	1196	1.1	1412	1.1	1628	0.9
120	0.0	336	0.0	552	0.7	768	1.1	984	1.1	1200	1.1	1416	1.0	1632	0.9
124	0.0	340	0.0	556	0.7	772	1.1	988	1.1	1204	1.1	1420	1.0	1636	0.9
128	0.0	344	0.0	560	0.8	776	1.1	992	1.1	1208	1.1	1424	1.0	1640	0.9
132	0.0	348	0.0	564	0.8	780	1.1	996	1.1	1212	1.1	1428	1.0	1644	0.9
136	0.0	352	0.0	568	0.8	784	1.1	1000	1.1	1216	1.1	1432	1.0	1648	0.9
140	0.0	356	0.0	572	0.8	788	1.1	1004	1.1	1220	1.1	1436	1.0	1652	0.9
144	0.0	360	0.0	576	0.8	792	1.1	1008	1.1	1224	1.1	1440	1.0	1656	0.9
148	0.0	364	0.0	580	0.8	796	1.1	1012	1.1	1228	1.1	1444	1.0	1660	0.9
152	0.0	368	0.0	584	0.8	800	1.1	1016	1.1	1232	1.1	1448	1.0	1664	0.9
156	0.0	372	0.0	588	0.8	804	1.1	1020	1.1	1236	1.1	1452	1.0	1668	0.9
160	0.0	376	0.0	592	0.8	808	1.1	1024	1.1	1240	1.1	1456	1.0	1672	0.9
164	0.0	380	0.0	596	0.8	812	1.1	1028	1.1	1244	1.1	1460	1.0	1676	0.9
168	0.0	384	0.0	600	0.8	816	1.1	1032	1.1	1248	1.1	1464	1.0	1680	0.9
172	0.0	388	0.0	604	0.9	820	1.1	1036	1.1	1252	1.1	1468	1.0	1684	0.9
176	0.0	392	0.0	608	0.9	824	1.1	1040	1.1	1256	1.1	1472	1.0	1688	0.9
180	0.0	396	0.0	612	0.9	828	1.1	1044	1.1	1260	1.1	1476	1.0	1692	0.9
184	0.0	400	0.0	616	0.9	832	1.1	1048	1.1	1264	1.1	1480	1.0	1696	0.9
188	0.0	404	0.0	620	0.9	836	1.1	1052	1.1	1268	1.1	1484	1.0	1700	0.9
192	0.0	408	0.0	624	0.9	840	1.1	1056	1.1	1272	1.1	1488	1.0	1704	0.9
196	0.0	412	0.0	628	0.9	844	1.1	1060	1.1	1276	1.1	1492	1.0	1708	0.9
200	0.0	416	0.0	632	0.9	848	1.1	1064	1.1	1280	1.1	1496	1.0	1712	0.9
204	0.0	420	0.0	636	0.9	852	1.1	1068	1.1	1284	1.1	1500	1.0	1716	0.9
208	0.0	424	0.1	640	0.9	856	1.1	1072	1.1	1288	1.1	1504	1.0	1720	0.9
212	0.0	428	0.1	644	0.9	860	1.1	1076	1.1	1292	1.1	1508	1.0	1724	0.9
216	0.0	432	0.1	648	0.9	864	1.1	1080	1.1	1296	1.1	1512	1.0	1728	0.9

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
1732	0.9	1948	1.0	2164	1.0	2380	1.0	2596	1.0	2812	1.0	3028	1.0	3244	1.0
1736	0.9	1952	1.0	2168	1.0	2384	1.0	2600	1.0	2816	1.0	3032	1.0	3248	1.0
1740	0.9	1956	1.0	2172	1.0	2388	1.0	2604	1.0	2820	1.0	3036	1.0	3252	1.0
1744	0.9	1960	1.0	2176	1.0	2392	1.0	2608	1.0	2824	1.0	3040	1.0	3256	1.0
1748	0.9	1964	1.0	2180	1.0	2396	1.0	2612	1.0	2828	1.0	3044	1.0	3260	1.0
1752	0.9	1968	1.0	2184	1.0	2400	1.0	2616	1.0	2832	1.0	3048	1.0	3264	1.0
1756	0.9	1972	1.0	2188	1.0	2404	1.0	2620	1.0	2836	1.0	3052	1.0	3268	1.0
1760	0.9	1976	1.0	2192	1.0	2408	1.0	2624	1.0	2840	1.0	3056	1.0	3272	1.0
1764	0.9	1980	1.0	2196	1.0	2412	1.0	2628	1.0	2844	1.0	3060	1.0	3276	1.0
1768	0.9	1984	1.0	2200	1.0	2416	1.0	2632	1.0	2848	1.0	3064	1.0	3280	1.0
1772	0.9	1988	1.0	2204	1.0	2420	1.0	2636	1.0	2852	1.0	3068	1.0	3284	1.0
1776	0.9	1992	1.0	2208	1.0	2424	1.0	2640	1.0	2856	1.0	3072	1.0	3288	1.0
1780	1.0	1996	1.0	2212	1.0	2428	1.0	2644	1.0	2860	1.0	3076	1.0	3292	1.0
1784	1.0	2000	1.0	2216	1.0	2432	1.0	2648	1.0	2864	1.0	3080	1.0	3296	1.0
1788	1.0	2004	1.0	2220	1.0	2436	1.0	2652	1.0	2868	1.0	3084	1.0	3300	1.0
1792	1.0	2008	1.0	2224	1.0	2440	1.0	2656	1.0	2872	1.0	3088	1.0	3304	1.0
1796	1.0	2012	1.0	2228	1.0	2444	1.0	2660	1.0	2876	1.0	3092	1.0	3308	1.0
1800	1.0	2016	1.0	2232	1.0	2448	1.0	2664	1.0	2880	1.0	3096	1.0	3312	1.0
1804	1.0	2020	1.0	2236	1.0	2452	1.0	2668	1.0	2884	1.0	3100	1.0	3316	1.0
1808	1.0	2024	1.0	2240	1.0	2456	1.0	2672	1.0	2888	1.0	3104	1.0	3320	1.0
1812	1.0	2028	1.0	2244	1.0	2460	1.0	2676	1.0	2892	1.0	3108	1.0	3324	1.0
1816	1.0	2032	1.0	2248	1.0	2464	1.0	2680	1.0	2896	1.0	3112	1.0	3328	1.0
1820	1.0	2036	1.0	2252	1.0	2468	1.0	2684	1.0	2900	1.0	3116	1.0	3332	1.0
1824	1.0	2040	1.0	2256	1.0	2472	1.0	2688	1.0	2904	1.0	3120	1.0	3336	1.0
1828	1.0	2044	1.0	2260	1.0	2476	1.0	2692	1.0	2908	1.0	3124	1.0	3340	1.0
1832	1.0	2048	1.0	2264	1.0	2480	1.0	2696	1.0	2912	1.0	3128	1.0	3344	1.0
1836	1.0	2052	1.0	2268	1.0	2484	1.0	2700	1.0	2916	1.0	3132	1.0	3348	1.0
1840	1.0	2056	1.0	2272	1.0	2488	1.0	2704	1.0	2920	1.0	3136	1.0	3352	1.0
1844	1.0	2060	1.0	2276	1.0	2492	1.0	2708	1.0	2924	1.0	3140	1.0	3356	1.0
1848	1.0	2064	1.0	2280	1.0	2496	1.0	2712	1.0	2928	1.0	3144	1.0	3360	1.0
1852	1.0	2068	1.0	2284	1.0	2500	1.0	2716	1.0	2932	1.0	3148	1.0	3364	1.0
1856	1.0	2072	1.0	2288	1.0	2504	1.0	2720	1.0	2936	1.0	3152	1.0	3368	1.0
1860	1.0	2076	1.0	2292	1.0	2508	1.0	2724	1.0	2940	1.0	3156	1.0	3372	1.0
1864	1.0	2080	1.0	2296	1.0	2512	1.0	2728	1.0	2944	1.0	3160	1.0	3376	1.0
1868	1.0	2084	1.0	2300	1.0	2516	1.0	2732	1.0	2948	1.0	3164	1.0	3380	1.0
1872	1.0	2088	1.0	2304	1.0	2520	1.0	2736	1.0	2952	1.0	3168	1.0	3384	1.0
1876	1.0	2092	1.0	2308	1.0	2524	1.0	2740	1.0	2956	1.0	3172	1.0	3388	1.0
1880	1.0	2096	1.0	2312	1.0	2528	1.0	2744	1.0	2960	1.0	3176	1.0	3392	1.0
1884	1.0	2100	1.0	2316	1.0	2532	1.0	2748	1.0	2964	1.0	3180	1.0	3396	1.0
1888	1.0	2104	1.0	2320	1.0	2536	1.0	2752	1.0	2968	1.0	3184	1.0	3400	1.0
1892	1.0	2108	1.0	2324	1.0	2540	1.0	2756	1.0	2972	1.0	3188	1.0	3404	1.0
1896	1.0	2112	1.0	2328	1.0	2544	1.0	2760	1.0	2976	1.0	3192	1.0	3408	1.0
1900	1.0	2116	1.0	2332	1.0	2548	1.0	2764	1.0	2980	1.0	3196	1.0	3412	1.0
1904	1.0	2120	1.0	2336	1.0	2552	1.0	2768	1.0	2984	1.0	3200	1.0	3416	1.0
1908	1.0	2124	1.0	2340	1.0	2556	1.0	2772	1.0	2988	1.0	3204	1.0	3420	1.0
1912	1.0	2128	1.0	2344	1.0	2560	1.0	2776	1.0	2992	1.0	3208	1.0	3424	1.0
1916	1.0	2132	1.0	2348	1.0	2564	1.0	2780	1.0	2996	1.0	3212	1.0	3428	1.0
1920	1.0	2136	1.0	2352	1.0	2568	1.0	2784	1.0	3000	1.0	3216	1.0	3432	1.0
1924	1.0	2140	1.0	2356	1.0	2572	1.0	2788	1.0	3004	1.0	3220	1.0	3436	1.0
1928	1.0	2144	1.0	2360	1.0	2576	1.0	2792	1.0	3008	1.0	3224	1.0	3440	1.0
1932	1.0	2148	1.0	2364	1.0	2580	1.0	2796	1.0	3012	1.0	3228	1.0	3444	1.0
1936	1.0	2152	1.0	2368	1.0	2584	1.0	2800	1.0	3016	1.0	3232	1.0	3448	1.0
1940	1.0	2156	1.0	2372	1.0	2588	1.0	2804	1.0	3020	1.0	3236	1.0	3452	1.0
1944	1.0	2160	1.0	2376	1.0	2592	1.0	2808	1.0	3024	1.0	3240	1.0	3456	1.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
3460	1.0	3676	1.0	3892	1.0	4108	1.0	4324	1.0	4540	1.0	4756	1.0	4972	1.0
3464	1.0	3680	1.0	3896	1.0	4112	1.0	4328	1.0	4544	1.0	4760	1.0	4976	1.0
3468	1.0	3684	1.0	3900	1.0	4116	1.0	4332	1.0	4548	1.0	4764	1.0	4980	1.0
3472	1.0	3688	1.0	3904	1.0	4120	1.0	4336	1.0	4552	1.0	4768	1.0	4984	1.0
3476	1.0	3692	1.0	3908	1.0	4124	1.0	4340	1.0	4556	1.0	4772	1.0	4988	1.0
3480	1.0	3696	1.0	3912	1.0	4128	1.0	4344	1.0	4560	1.0	4776	1.0	4992	1.0
3484	1.0	3700	1.0	3916	1.0	4132	1.0	4348	1.0	4564	1.0	4780	1.0	4996	1.0
3488	1.0	3704	1.0	3920	1.0	4136	1.0	4352	1.0	4568	1.0	4784	1.0	5000	1.0
3492	1.0	3708	1.0	3924	1.0	4140	1.0	4356	1.0	4572	1.0	4788	1.0	5004	1.0
3496	1.0	3712	1.0	3928	1.0	4144	1.0	4360	1.0	4576	1.0	4792	1.0	5008	1.0
3500	1.0	3716	1.0	3932	1.0	4148	1.0	4364	1.0	4580	1.0	4796	1.0	5012	1.0
3504	1.0	3720	1.0	3936	1.0	4152	1.0	4368	1.0	4584	1.0	4800	1.0	5016	1.0
3508	1.0	3724	1.0	3940	1.0	4156	1.0	4372	1.0	4588	1.0	4804	1.0	5020	1.0
3512	1.0	3728	1.0	3944	1.0	4160	1.0	4376	1.0	4592	1.0	4808	1.0	5024	1.0
3516	1.0	3732	1.0	3948	1.0	4164	1.0	4380	1.0	4596	1.0	4812	1.0	5028	1.0
3520	1.0	3736	1.0	3952	1.0	4168	1.0	4384	1.0	4600	1.0	4816	1.0	5032	1.0
3524	1.0	3740	1.0	3956	1.0	4172	1.0	4388	1.0	4604	1.0	4820	1.0	5036	1.0
3528	1.0	3744	1.0	3960	1.0	4176	1.0	4392	1.0	4608	1.0	4824	1.0	5040	1.0
3532	1.0	3748	1.0	3964	1.0	4180	1.0	4396	1.0	4612	1.0	4828	1.0	5044	1.0
3536	1.0	3752	1.0	3968	1.0	4184	1.0	4400	1.0	4616	1.0	4832	1.0	5048	1.0
3540	1.0	3756	1.0	3972	1.0	4188	1.0	4404	1.0	4620	1.0	4836	1.0	5052	1.0
3544	1.0	3760	1.0	3976	1.0	4192	1.0	4408	1.0	4624	1.0	4840	1.0	5056	1.0
3548	1.0	3764	1.0	3980	1.0	4196	1.0	4412	1.0	4628	1.0	4844	1.0	5060	1.0
3552	1.0	3768	1.0	3984	1.0	4200	1.0	4416	1.0	4632	1.0	4848	1.0	5064	1.0
3556	1.0	3772	1.0	3988	1.0	4204	1.0	4420	1.0	4636	1.0	4852	1.0	5068	1.0
3560	1.0	3776	1.0	3992	1.0	4208	1.0	4424	1.0	4640	1.0	4856	1.0	5072	1.0
3564	1.0	3780	1.0	3996	1.0	4212	1.0	4428	1.0	4644	1.0	4860	1.0	5076	1.0
3568	1.0	3784	1.0	4000	1.0	4216	1.0	4432	1.0	4648	1.0	4864	1.0	5080	1.0
3572	1.0	3788	1.0	4004	1.0	4220	1.0	4436	1.0	4652	1.0	4868	1.0	5084	1.0
3576	1.0	3792	1.0	4008	1.0	4224	1.0	4440	1.0	4656	1.0	4872	1.0	5088	1.0
3580	1.0	3796	1.0	4012	1.0	4228	1.0	4444	1.0	4660	1.0	4876	1.0	5092	1.0
3584	1.0	3800	1.0	4016	1.0	4232	1.0	4448	1.0	4664	1.0	4880	1.0	5096	1.0
3588	1.0	3804	1.0	4020	1.0	4236	1.0	4452	1.0	4668	1.0	4884	1.0	5100	1.0
3592	1.0	3808	1.0	4024	1.0	4240	1.0	4456	1.0	4672	1.0	4888	1.0	5104	1.0
3596	1.0	3812	1.0	4028	1.0	4244	1.0	4460	1.0	4676	1.0	4892	1.0	5108	1.0
3600	1.0	3816	1.0	4032	1.0	4248	1.0	4464	1.0	4680	1.0	4896	1.0	5112	1.0
3604	1.0	3820	1.0	4036	1.0	4252	1.0	4468	1.0	4684	1.0	4900	1.0	5116	1.0
3608	1.0	3824	1.0	4040	1.0	4256	1.0	4472	1.0	4688	1.0	4904	1.0	5120	1.0
3612	1.0	3828	1.0	4044	1.0	4260	1.0	4476	1.0	4692	1.0	4908	1.0	5124	1.0
3616	1.0	3832	1.0	4048	1.0	4264	1.0	4480	1.0	4696	1.0	4912	1.0	5128	1.0
3620	1.0	3836	1.0	4052	1.0	4268	1.0	4484	1.0	4700	1.0	4916	1.0	5132	1.0
3624	1.0	3840	1.0	4056	1.0	4272	1.0	4488	1.0	4704	1.0	4920	1.0	5136	1.0
3628	1.0	3844	1.0	4060	1.0	4276	1.0	4492	1.0	4708	1.0	4924	1.0	5140	1.0
3632	1.0	3848	1.0	4064	1.0	4280	1.0	4496	1.0	4712	1.0	4928	1.0	5144	1.0
3636	1.0	3852	1.0	4068	1.0	4284	1.0	4500	1.0	4716	1.0	4932	1.0	5148	1.0
3640	1.0	3856	1.0	4072	1.0	4288	1.0	4504	1.0	4720	1.0	4936	1.0	5152	1.0
3644	1.0	3860	1.0	4076	1.0	4292	1.0	4508	1.0	4724	1.0	4940	1.0	5156	1.0
3648	1.0	3864	1.0	4080	1.0	4296	1.0	4512	1.0	4728	1.0	4944	1.0	5160	1.0
3652	1.0	3868	1.0	4084	1.0	4300	1.0	4516	1.0	4732	1.0	4948	1.0	5164	1.0
3656	1.0	3872	1.0	4088	1.0	4304	1.0	4520	1.0	4736	1.0	4952	1.0	5168	1.0
3660	1.0	3876	1.0	4092	1.0	4308	1.0	4524	1.0	4740	1.0	4956	1.0	5172	1.0
3664	1.0	3880	1.0	4096	1.0	4312	1.0	4528	1.0	4744	1.0	4960	1.0	5176	1.0
3668	1.0	3884	1.0	4100	1.0	4316	1.0	4532	1.0	4748	1.0	4964	1.0	5180	1.0
3672	1.0	3888	1.0	4104	1.0	4320	1.0	4536	1.0	4752	1.0	4968	1.0	5184	1.0

Input Hydrograph

Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)	Time (mins)	Flow (l/s)
5188	1.0	5260	1.0	5332	1.0	5404	1.0	5476	1.0	5548	1.0	5620	1.0	5692	1.0
5192	1.0	5264	1.0	5336	1.0	5408	1.0	5480	1.0	5552	1.0	5624	1.0	5696	1.0
5196	1.0	5268	1.0	5340	1.0	5412	1.0	5484	1.0	5556	1.0	5628	1.0	5700	1.0
5200	1.0	5272	1.0	5344	1.0	5416	1.0	5488	1.0	5560	1.0	5632	1.0	5704	1.0
5204	1.0	5276	1.0	5348	1.0	5420	1.0	5492	1.0	5564	1.0	5636	1.0	5708	1.0
5208	1.0	5280	1.0	5352	1.0	5424	1.0	5496	1.0	5568	1.0	5640	1.0	5712	1.0
5212	1.0	5284	1.0	5356	1.0	5428	1.0	5500	1.0	5572	1.0	5644	1.0	5716	1.0
5216	1.0	5288	1.0	5360	1.0	5432	1.0	5504	1.0	5576	1.0	5648	1.0	5720	1.0
5220	1.0	5292	1.0	5364	1.0	5436	1.0	5508	1.0	5580	1.0	5652	1.0	5724	1.0
5224	1.0	5296	1.0	5368	1.0	5440	1.0	5512	1.0	5584	1.0	5656	1.0	5728	1.0
5228	1.0	5300	1.0	5372	1.0	5444	1.0	5516	1.0	5588	1.0	5660	1.0	5732	1.0
5232	1.0	5304	1.0	5376	1.0	5448	1.0	5520	1.0	5592	1.0	5664	1.0	5736	1.0
5236	1.0	5308	1.0	5380	1.0	5452	1.0	5524	1.0	5596	1.0	5668	1.0	5740	1.0
5240	1.0	5312	1.0	5384	1.0	5456	1.0	5528	1.0	5600	1.0	5672	1.0	5744	1.0
5244	1.0	5316	1.0	5388	1.0	5460	1.0	5532	1.0	5604	1.0	5676	1.0	5748	1.0
5248	1.0	5320	1.0	5392	1.0	5464	1.0	5536	1.0	5608	1.0	5680	1.0	5752	1.0
5252	1.0	5324	1.0	5396	1.0	5468	1.0	5540	1.0	5612	1.0	5684	1.0	5756	1.0
5256	1.0	5328	1.0	5400	1.0	5472	1.0	5544	1.0	5616	1.0	5688	1.0	5760	1.0

Model Details

Storage is Online Cover Level (m) 1.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.01800 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.01800

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	256.0	256.0	1.000	256.0	392.0

Summary of Results for 100 year Return Period (+40%)

Half Drain Time exceeds 7 days.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.205	0.205	0.0	0.9	0.9	255.7	Flood Risk
30 min Summer	0.239	0.239	0.0	0.9	0.9	347.2	Flood Risk
60 min Summer	0.271	0.271	0.0	0.9	0.9	441.2	Flood Risk
120 min Summer	0.305	0.305	0.0	0.9	0.9	539.0	Flood Risk
180 min Summer	0.329	0.329	0.0	0.9	0.9	608.9	Flood Risk
240 min Summer	0.346	0.346	0.0	0.9	0.9	659.8	Flood Risk
360 min Summer	0.368	0.368	0.0	0.9	0.9	723.8	Flood Risk
480 min Summer	0.382	0.382	0.0	0.9	0.9	764.1	Flood Risk
600 min Summer	0.392	0.392	0.0	0.9	0.9	792.6	Flood Risk
720 min Summer	0.399	0.399	0.0	0.9	0.9	814.2	Flood Risk
960 min Summer	0.410	0.410	0.0	0.9	0.9	845.1	Flood Risk
1440 min Summer	0.421	0.421	0.0	0.9	0.9	876.9	Flood Risk
2160 min Summer	0.429	0.429	0.0	0.9	0.9	900.3	Flood Risk
2880 min Summer	0.432	0.432	0.0	0.9	0.9	910.4	Flood Risk
4320 min Summer	0.432	0.432	0.0	0.9	0.9	910.0	Flood Risk
5760 min Summer	0.427	0.427	0.0	0.9	0.9	896.2	Flood Risk
7200 min Summer	0.421	0.421	0.0	0.9	0.9	877.2	Flood Risk
8640 min Summer	0.416	0.416	0.0	0.9	0.9	863.7	Flood Risk
10080 min Summer	0.413	0.413	0.0	0.9	0.9	854.3	Flood Risk
15 min Winter	0.219	0.219	0.0	0.9	0.9	292.3	Flood Risk
30 min Winter	0.255	0.255	0.0	0.9	0.9	394.9	Flood Risk
60 min Winter	0.292	0.292	0.0	0.9	0.9	500.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	167.490	0.0	76.6	19
30 min Summer	109.094	0.0	75.2	34
60 min Summer	67.671	0.0	148.6	64
120 min Summer	40.788	0.0	142.9	124
180 min Summer	30.548	0.0	135.8	184
240 min Summer	24.778	0.0	131.1	244
360 min Summer	18.148	0.0	130.2	364
480 min Summer	14.429	0.0	131.6	484
600 min Summer	12.037	0.0	132.3	604
720 min Summer	10.362	0.0	132.6	724
960 min Summer	8.165	0.0	132.5	964
1440 min Summer	5.796	0.0	130.5	1442
2160 min Summer	4.125	0.0	265.7	2164
2880 min Summer	3.251	0.0	262.3	2884
4320 min Summer	2.336	0.0	252.1	4320
5760 min Summer	1.858	0.0	514.2	5760
7200 min Summer	1.558	0.0	503.1	6416
8640 min Summer	1.355	0.0	489.3	7176
10080 min Summer	1.209	0.0	473.2	7960
15 min Winter	167.490	0.0	76.2	19
30 min Winter	109.094	0.0	74.5	34
60 min Winter	67.671	0.0	146.1	64

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
120 min Winter	0.329	0.329	0.0	0.9	0.9	610.3	Flood Risk
180 min Winter	0.356	0.356	0.0	0.9	0.9	689.0	Flood Risk
240 min Winter	0.376	0.376	0.0	0.9	0.9	746.2	Flood Risk
360 min Winter	0.401	0.401	0.0	0.9	0.9	818.6	Flood Risk
480 min Winter	0.416	0.416	0.0	0.9	0.9	864.5	Flood Risk
600 min Winter	0.428	0.428	0.0	0.9	0.9	897.3	Flood Risk
720 min Winter	0.436	0.436	0.0	0.9	0.9	922.2	Flood Risk
960 min Winter	0.449	0.449	0.0	0.9	0.9	958.4	Flood Risk
1440 min Winter	0.462	0.462	0.0	0.9	0.9	997.3	Flood Risk
2160 min Winter	0.473	0.473	0.0	0.9	0.9	1028.4	Flood Risk
2880 min Winter	0.478	0.478	0.0	0.9	0.9	1044.8	Flood Risk
4320 min Winter	0.482	0.482	0.0	0.9	0.9	1054.6	Flood Risk
5760 min Winter	0.480	0.480	0.0	0.9	0.9	1049.6	Flood Risk
7200 min Winter	0.475	0.475	0.0	0.9	0.9	1034.8	Flood Risk
8640 min Winter	0.469	0.469	0.0	0.9	0.9	1018.0	Flood Risk
10080 min Winter	0.464	0.464	0.0	0.9	0.9	1002.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	40.788	0.0	136.4	124
180 min Winter	30.548	0.0	130.8	182
240 min Winter	24.778	0.0	132.1	242
360 min Winter	18.148	0.0	135.2	362
480 min Winter	14.429	0.0	136.7	480
600 min Winter	12.037	0.0	137.5	598
720 min Winter	10.362	0.0	137.8	716
960 min Winter	8.165	0.0	137.7	954
1440 min Winter	5.796	0.0	135.6	1428
2160 min Winter	4.125	0.0	276.8	2124
2880 min Winter	3.251	0.0	273.3	2824
4320 min Winter	2.336	0.0	262.9	4192
5760 min Winter	1.858	0.0	539.7	5536
7200 min Winter	1.558	0.0	529.4	6840
8640 min Winter	1.355	0.0	516.8	8048
10080 min Winter	1.209	0.0	502.3	9080

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 548707 170729 TQ 48707 70729	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.972

Time (mins) From:	To:	Area (ha)
0	4	0.972

Model Details

Storage is Online Cover Level (m) 0.500

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	81.0
Membrane Percolation (mm/hr)	1000	Length (m)	120.0
Max Percolation (l/s)	2700.0	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0051-9000-0500-9000
Design Head (m)	0.500
Design Flow (l/s)	0.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	51
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	0.9	Kick-Flo®	0.328	0.7
Flush-Flo™	0.150	0.9	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.9	0.800	1.1	2.000	1.7	4.000	2.3	7.000	3.0
0.200	0.9	1.000	1.2	2.200	1.7	4.500	2.4	7.500	3.1
0.300	0.8	1.200	1.3	2.400	1.8	5.000	2.6	8.000	3.2
0.400	0.8	1.400	1.4	2.600	1.9	5.500	2.7	8.500	3.3
0.500	0.9	1.600	1.5	3.000	2.0	6.000	2.8	9.000	3.4
0.600	1.0	1.800	1.6	3.500	2.2	6.500	2.9	9.500	3.5

APPENDIX C

Drainage Strategy

north

STORAGE CRATES DIMENSIONS:
DEPTH = 1m
LENGTH = 50m
WIDTH = 4m
AREA = 200m²
VOLUME = 190m³
POROSITY = 0.95
ASSUMED INFILTRATION RATE = 0.018m/hr

HYDROBRAKE PENSTOCK DIMENSIONS:
DIAMETER = 56mmØ
DISCHARGE RATE = 1.1l/s
CHAMBER SIZE = 2100mm

WESTERN ESS AREA GRAVEL BASE DIMENSIONS:
AREA = 0.97ha
DEPTH = 0.5m
POROSITY = 0.3

INFILTRATION BASIN DIMENSIONS:
DEPTH = 1m
CREST AREA = 167m²
BASE AREA = 55m²
VOLUME = 103.9m³
SIDE SLOPES = 1 IN 3
ASSUMED INFILTRATION RATE = 0.018m/hr

DNO CONTAINER GRAVEL BASE DIMENSIONS:
AREA = 37.8m²
DEPTH = 0.4m

HYDROBRAKE PENSTOCK DIMENSIONS:
DIAMETER = 52mmØ
DISCHARGE RATE = 0.9l/s
CHAMBER SIZE = 2100mm

EASTERN ESS AREA GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
AREA = 0.24ha
POROSITY =0.3

HARMONIC FILTER GRAVEL BASE DIMENSIONS:
AREA = 27.6m²
DEPTH = 0.4m

TRANSFORMER GRAVEL BASE DIMENSIONS:
AREA = 81.9m²
DEPTH = 0.4m

SWITCHROOM GRAVEL BASE DIMENSIONS:
AREA = 47.6m²
DEPTH = 0.4m

CONTAINER GRAVEL BASE DIMENSIONS:
AREA = 36.3m²
DEPTH = 0.4m

Ponds

LEGEND

- BASIN CONTRIBUTION AREA
- PROPOSED GRAVEL BASES
- BASIN BASE
- PROPOSED SUBBASE STORAGE
- BASIN CREST
- PROPOSED PERFORATED PIPES
- INSPECTION CHAMBER
- HYDROBRAKE PENSTOCK CHAMBER

NOTES

1. ALL LEVELS AND PRECISE LOCATIONS SUBJECT TO SITE SETTING OUT
2. DO NOT SCALE FROM THIS DRAWING
3. FOR INFORMATION ONLY
4. NOT SUITABLE FOR CONSTRUCTION

REV:	DESCRIPTION:	BY:	CHK:	DATE:
00	FIRST ISSUE	CF	PG	21/03/25

STATUS: FOR INFORMATION

CLIENT: NET ZERO THIRTYTWO LTD

SITE: NORTH CRAY ROAD ESS

TITLE: DRAWING TITLE

calibro

SCALE:	DATE:	DRAWN:	CHECKED:
1:1000 @ A3	21/03/2025	CF	PG

PROJECT:	COMPANY:	TYPE:	DRAWING NO:	SHEET NO:	REVISION:
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Spectrum | Bristol | BS1 3LG T 0117 2441 970
E hello@calibro-consultants.com www.calibro-consultants.com

calibro

Spectrum, Bond St. | Bristol | BS1 3LG
0117 2441 970
hello@calibro-consultants.com
www.calibro-consultants.com
Registered office as above
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