BRAMFORD BATTERY SUBSTATION

Flood Risk Assessment and Surface Water Drainage Strategy

Prepared for: EDF-R

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BASIS OF REPORT

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

Executive Summary

SLR Consulting Limited has prepared this Flood Risk Assessment and Surface Water Drainage Strategy on behalf of EDF-R to support the development of a battery storage facility on land at Bramford Substation, Ipswich, IP8 4JL. A summary of key findings from this report is provided below.

Subject	Element	Findings
Site Flood Risk	Tidal	The site is remote from the coast, elevated to at least 54.9m aOD and therefore at low risk of tidal flooding.
	Fluvial	The site is located within Flood Zone 1 which is described as a low risk of flooding. There is no flood outline associated with the ditch to the south however this is largely sourced from on site overland flows.
	Ground Water	Local borehole records indicate the diamicton deposits locally are around 18-21m thick and generally has a high boulder clay composition. Groundwater was identified some 46m bgl. On this basis we consider groundwater flood risk to be low.
	Surface Water	Surface water flooding at the site is very low. There is one surface water pathway locally confined to the ditch on the southern site boundary (i.e., overland flows from the site) and therefore does not impact the proposed development.
	Sewers and Artificial Sources	There are no sewers or artificial features in the vicinity of the site.
Planning Requirements	Sequential Test and Exception Test	The Sequential Test and Exception Test are deemed to be passed as the site is within Flood Zone 1. The Proposed Development has been classified as *'Essential Infrastructure'*.
Mitigation measures	Design Flood Event	The design flood event (DFE) is the defended 1 % AEP event. A climate change allowance has been considered for peak rainfall intensity (20%) at the development site with no anticipated adverse impact.
	Finished Floor Levels	The site is at low risk of tidal, fluvial, and surface water flooding. All track roads will comprise permeable materials and there is no necessity to raise finished floor levels from the original substation design.
	Safe access and egress	Not Required.
	Floodplain compensation	Not Required.
	Surface water drainage strategy	A Surface Water Drainage Strategy has been developed which uses permeable materials across the majority of the site (railway ballast / aggregate) combined with a proposed detention basin to the south of the site. Rainfall falling onto the site and shedding off the concrete plinths will percolate into the void space and discharge into the detention basin. Runoff from the proposed detention basin will discharge into the Southern Boundary Ditch at restricted rates of 3.5l/s.
	Residual Risk	Exceedance flood events in excess of the design standard indicates runoff will revert to the pre-existing regime with flows shedding from the level development platform and proposed detention basin towards the ditch to the south, discharging away from the site.
Conclusion		This Flood Risk Assessment and Surface Water Drainage Strategy concludes that the requirements of national, regional, and local planning policy can be achieved at the site given the nature of development proposed.

1.0 Introduction

1.1 Background

SLR Consulting Limited (SLR) has been appointed by EDF-R ("the client") to provide consultancy services to support the development of a 57 MW battery storage facility on land at Bramford Substation, Ipswich, IP8 4JL ("the site"). Planning permission for the battery planning application was originally granted on 23 September 2019 (ref: DC/19/03008), which was amended by two subsequent Non-Material Amendment consents DC/21/06919 and DC/22/05586. An application for an amended bellmouth access (DC/22/05587) was approved on 19th January 2023.

A site layout plan of the development proposals is included in **Appendix 01**.

This Flood Risk assessment (FRA) and Surface Water Drainage Strategy (SWDS) has been prepared under the direction of a Technical Director of Hydrology at SLR who specialises in flood risk and associated planning matters. Reporting has been completed in accordance with guidance presented within the National Planning Policy Framework[1] (NPPF) and its associated Planning Practice Guidance[2] (PPG), taking due account of current best practice documents relating to the assessment of flood risk published by the British Standards Institution BS8533[3] and local planning policies.

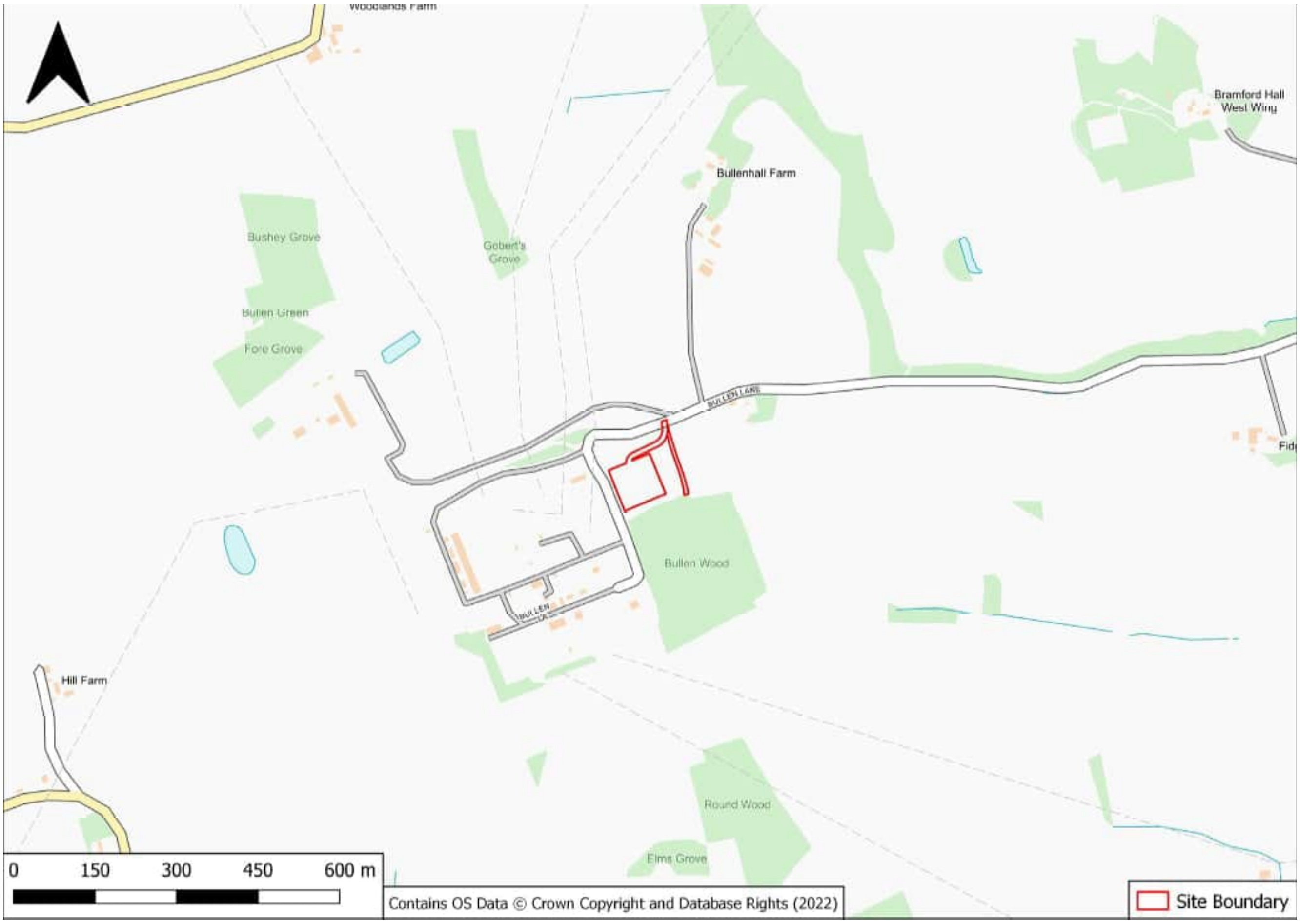
1.2 Site Location

The application site is located on the western periphery of Ipswich, centred around National Grid Reference (NGR): TM 10161 46046. The main body of the site is square but branches out to the north then east to allow for new access tracks and eastern strip line / public walkway. It is envisaged that the proposed battery facility will connect into the existing National Grid Bramford Transmission Substation adjacent to the site. At present the site comprises largely of arable farmland and a small woodland strip (which is to be retained and enhanced). Land use to the south of the site is dense woodland vegetation but the wider area is mainly used for arable farming. Access and egress to and from the site is provided off Bullen Lane to the north.

A site location plan is included below as Figure 1-1.

1 Revised National Planning Policy Framework: Communities and Local Government, February 2012 (Updated July 2021)
2 Planning Practice Guidance, Flood Risk and Coastal Change: Communities and Local Government, March 2014 (Updated August 2022)
3 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (2nd Edition, December 2017)

Figure 1-1
Site Location Plan



1.3 Administrative Context

The site falls under the planning jurisdiction of Mid Suffolk District Council and Suffolk County Council. The former is the local planning authority who determined the application, and the latter is the Lead Local Flood Authority of the area managing flood risk and drain age issues.

2.0 Baseline Site Appraisal

The site is approximately 1.8km west of the small village of Bramford and land use within the wider area is generally rural smallholdings, other renewable energy developments, the National Grid Bramford substation, and arable farming with more urbanised development prevalent in Ipswich c.3km east.

Satellite imagery of the site, which covers a total area of 0.72ha, is provided below in Figure 2-1.

The site is bound to the west by a narrow strip of dense wooded vegetation which separates the development area from the existing National Grid Bramford Substation. Dense woodland vegetation additionally bounds the site to the south. The small strip of land in the east of the main development area is a public right of way and no development is proposed here.

Access onto the site will be provided via a new access tack linking to Bullen Lane which is present 35m to the north. This will provide a direct connection towards the B1113 to the east of the site and the A14.

A site walkover was undertaken on 17/01/2022 to supplement the findings of this report. Conditions observed during the walkover noted clayey ground conditions with areas of standing surface water. Photographs taken during the site walkover are provided in **Appendix 02.**

Figure 2-1
Satellite Imagery of the site

2.1 Topography

Topographic data from on and around the site, gathered using Light Detection and Ranging (LiDAR) aerial photogrammetric techniques, has been downloaded from the Environment Agency open data website[4]. This data is a Digital Terrain Model (DTM) which is bare earth model and therefore excludes features such as built development and vegetation. LiDAR plots of the wider area and the site are presented in Figure 2-2and Figure 2-3.

A topographic survey of the site is included as **Appendix 03**. This data correlates well with the LiDAR plots.

Figure 2-2
1m DTM LiDAR plot of the site and wider context

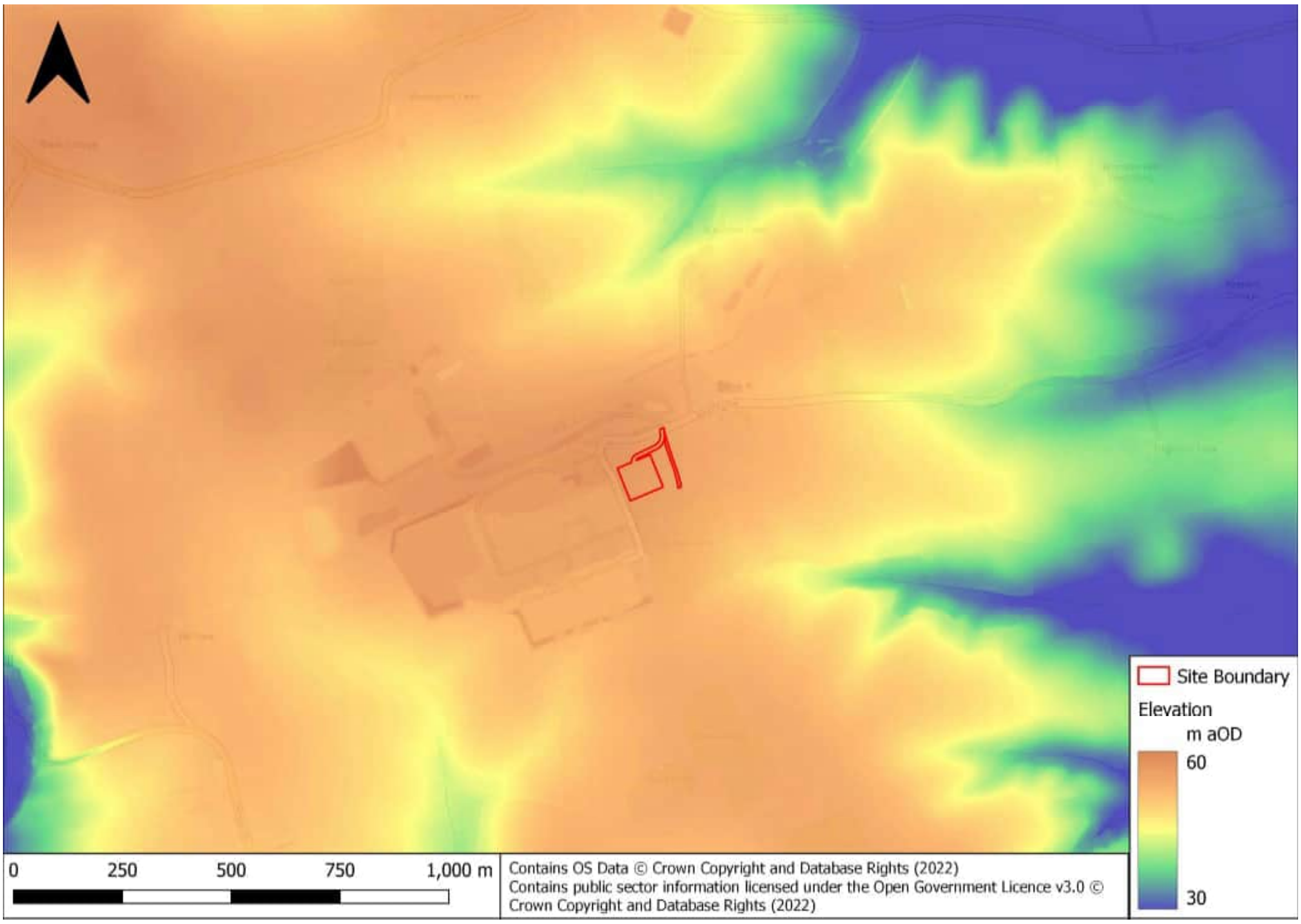


Figure 2-2 indicates that the site sits near the top of a topographic crest which splits the upper catchment areas for the River Gipping (east) and Belstead Brook (south / south west).

4 Environment Agency open data website http://environment.data.gov.uk

Figure 2-3
1m DTM LiDAR Plot of the site

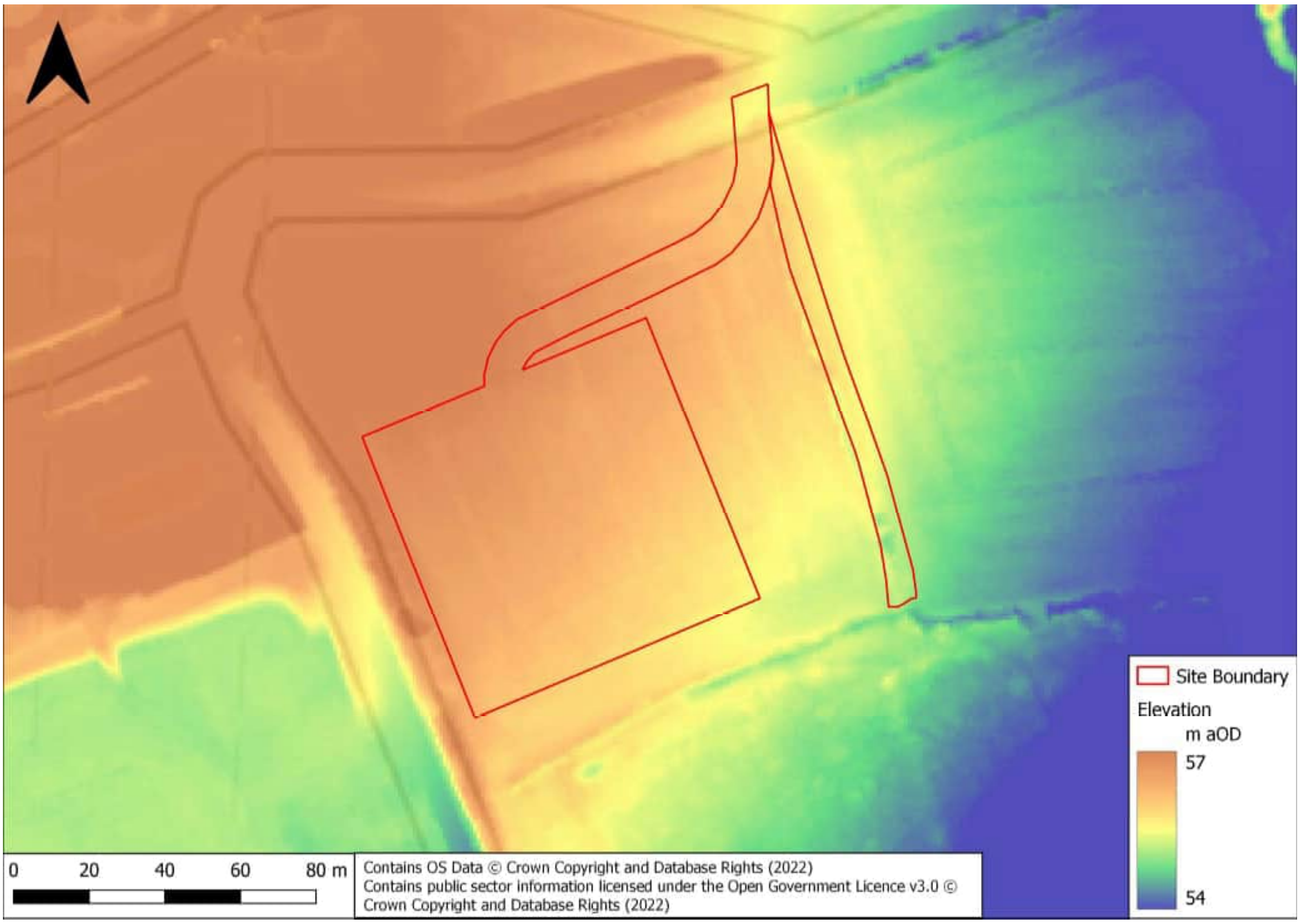


Figure 2-3 and **Appendix 03** indicate that the site falls in a south easterly direction towards a small ditch feature located to the south of the site boundary.

Ground levels across the main square body of the site slope gently from 57m aOD in the north west to 55.4m aOD in the south east. Ground levels along the access track fall in an eastward direction and towards Bullen Lane to a low of 55.4m aOD. Additionally, the small strip of land retained to the east of the site is generally downgradient of the proposed development area, at 54.9-55.9m aOD. The ditch to the south of the site, which is referred to as the Southern Boundary Ditch in this report, is approximately 0.4m deep and declines in an easterly direction past the site. Top of bank elevation ranges from 55.7m aOD in the west, to 54.93m aOD at the eastern extent.

2.2 Hydrology

The River Gipping flows south / southeast past the site some 2.5km to the east. At this point, the river drains a total catchment area estimated[5] at 296km^2 which is largely a rural land use for arable / horticultural development with some urban development in the valley. The channel flows over predominantly clay and chalk bedrock which has resulted in a gaining channel influenced to a degree by groundwater flows from the chalk to derive a baseflow index[6] of 0.5. Groundwater abstractions locally have a significant impact on natural runoff from the catchment and ultimately flow levels.

5 Flood Estimation Handbook Web Service, UK Centre for Ecology and Hydrology, https://fehweb.ceh.ac.uk/GB/map

6 35010- Gipping at Bramford, National River Flow Archive, https://nrfa.ceh.ac.uk/data/station/info/35010

Belstead Brook, at its closest point, is located 1.5km south west of the site and drains a total upstream catchment area estimated[5] at 20.2km^2 which is largely agricultural land. The brook is sourced from permeable sandstone and chalk geology which progresses south east to join the River Gipping at a confluence 7.3km south east of the site.

The elevation data presented in Figure 2-3 and **Appendix 03** indicates a small ditch feature (Southern Boundary Ditch) which progresses in an easterly direction and discharges towards the River Gipping. This ditch is around 0.4-0.5m deep and approximately 3-4 metres wide becoming more prominent in the topography away from the site. Based on topography this ditch would currently intercept and conveys any overland flows derived from the site.

A small crossing (which has collapsed) or wooded pathway was observed over the Southern Boundary Ditch within the adjacent woodland. No evidence of surface water was observed in the ditch at the time of the walkover which demonstrates flows are not significantly hindered by the blockage.

Along the retained strip of land to the east, a heavily vegetated ditch progresses parallel to the existing footpath. This ditch was observed to have some standing water. The ditch is not connected into the Southern Boundary Ditch and therefore flows within this feature either infiltrate to ground very slowly and / or are evaporated. During major storms this ditch will overtop and flows will drain down into the Southern Boundary Ditch.

There is also another series of ditches which run along Bullen Lane in a westerly direction towards the B1113 discharging towards the River Gipping.

2.3 Geology

The National Soils Resources Institute, Soilscapes website[7], indicates that soils across the site comprise of *"Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils"* which have impeded drainage.

British Geology Survey (BGS) mapping[8] indicates that the development area is underlain by the Thames Group - Clay, Silt and Sand. The Thanet Formation and Lambeth Group (Undifferentiated) - Clay, Silt and Sand, extends marginally into the north-eastern site boundary along the access road.

The bedrock geology at the site is fully overlain by Lowestoft Formation – Diamicton superficial deposits. Local BGS boreholes TM04NE48 (1.2km west) and TM14NW158 (90m east) identified the diamicton deposits to 18 – 21m depth respectively. The lithology of these deposits was generally described as yellow and blue boulder clays. Chalk geology was also identified at 33m depth.

2.4 Hydrogeology

The Thames Group, Thanet formation and Lambeth Group bedrocks are all classified as *"unproductive"* [9] aquifer systems, which are defined as *"areas comprised of rocks that have negligible significance for water supply or baseflow to rivers, lakes and wetlands"*.

Borehole records locally (TM14NW158) indicate a groundwater strike 46m below ground level (bgl) within the chalk aquifer. This infers that groundwater flows in the chalk are confined beneath the Thames Group, Thanet Formation and Lambeth Group aquitards which equally inhibit recharge.

The diamicton superficial geology is designated as a *"Secondary (undifferentiated)"*[9] aquifer, whereby is has not been possible to determine A or B status, and permeability and water storage is dependent on lithological characteristics locally. Given the described characteristics of this material from local borehole records groundwater flows in this unit are likely negligible.

7 Soilscapes online soil map, Cranfield Soil and Agrifood Institute, http://www.landis.org.uk/soilscapes/

8 BGS Geology of Britain Viewer, available at http://mapapps.bgs.ac.uk/geologyofbritain/home.html.

9 Magic Map Application, managed by Natural England, delivered by Landmark, https://magic.defra.gov.uk/MagicMap.aspx

Infiltration testing in the Lowestoft Diamicton has been undertaken by Geosphere Environmental for a neighbouring planning application (planning reference: DC/21/05468) to determine the feasibility of infiltration of surface water to ground. A copy of the infiltration test results is included as **Appendix 04** which demonstrate that infiltration was not viable in the three trial pits excavated on site due to the cohesive clayey nature of the soils. These tests were undertaken 60m to the east of the site boundary (development area) and are likely a reliable indicator of the conditions on the site.

The site is located within a Zone III- total catchment Source Protection Zone. This is defined as the total area needed to support the abstraction or discharge from the protected groundwater source, which is likely a result of local groundwater abstractions in the Chalk.

Groundwater vulnerability at the site is however classified as low which is a result of impermeable shallow geology.

2.5 Existing Drainage Regime

The existing site currently comprises of undeveloped agricultural land whereby all runoff from the site follows local topographic gradients to the southeast / east and into the Southern Boundary Ditch. Small field drain features have been excavated to intercept and convey flows towards the Southern Boundary Ditch. While there may be some localised infiltration to ground, geology and soil type locally comprises of cohesive clay sediments and therefore soil situation capacity i.e., ability for water storage in the soils, is severely limited.

3.0 Policy Status for Proposed Development

3.1 Development Proposals

This report supports the development of a 57MW battery storage facility on land to the east of the existing Bramford National Grid Transmission substation. The development will connect into the existing transmission grid substation owned by National Grid.

The proposed scheme is classified as an "*essential infrastructure*" development type associated with infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations.

3.2 Flood Zone Classification

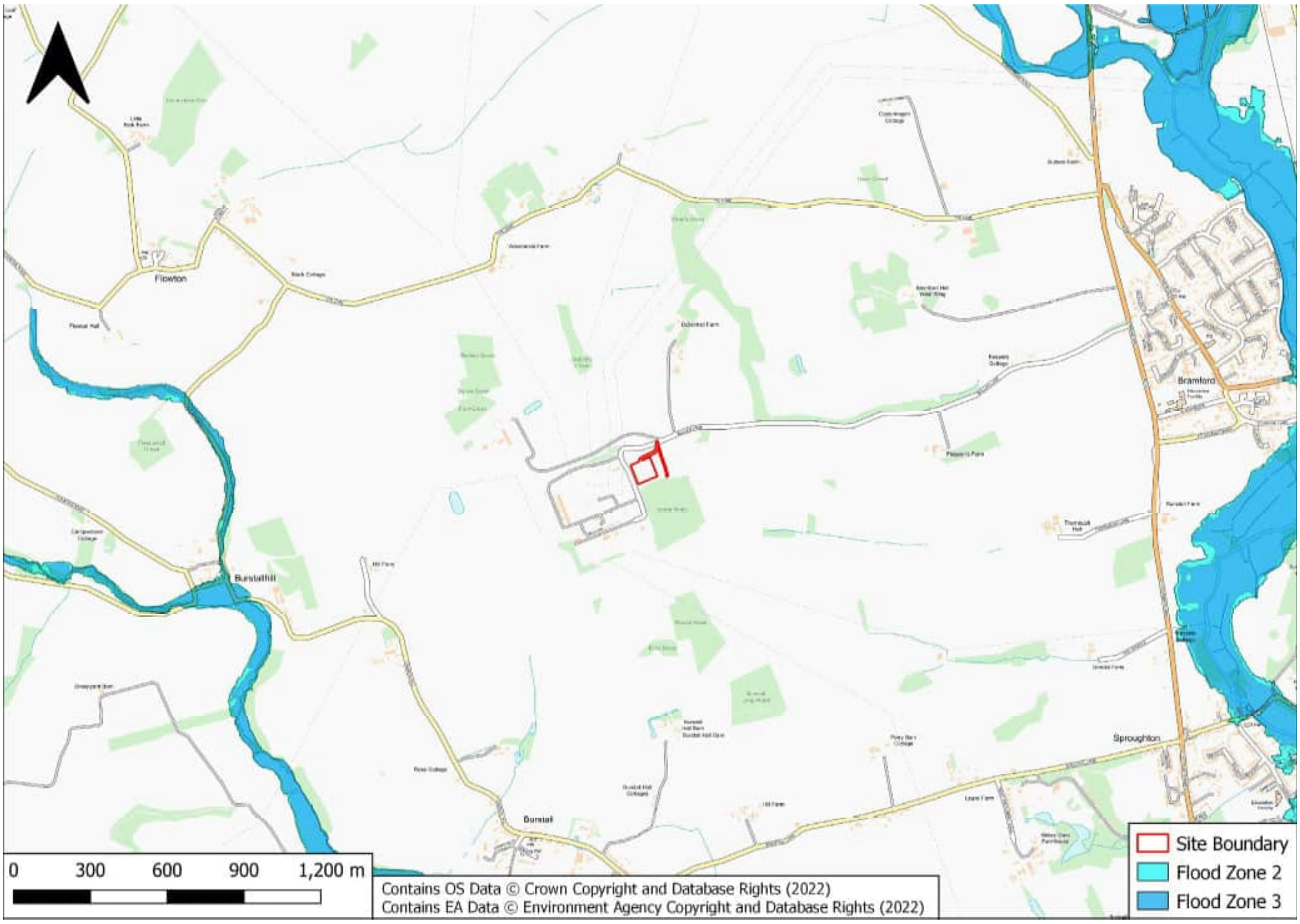
The definition of Environment Agency flood zones is provided in PPG *Table 1: Flood Zones*:

- *Zone 1 - Low Probability* (Flood Zone 1) is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% annual probability of occurrence (1:1,000 year) i.e., considered to be at 'low probability' of flooding.
- *Zone 2 - Medium Probability* (Flood Zone 2) is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% (1:100 year) and 0.1% (1:1,000 year) from fluvial sources and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources i.e., considered to be at 'medium probability' of flooding.
- *Zone 3a - High Probability* (Flood Zone 3a) is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200 year) from tidal sources i.e., considered to be at 'high probability' of flooding.
- *Zone 3b - the Functional Floodplain* (Flood Zone 3b) is defined as land where water has to flow or be stored in times of flood. Local Planning Authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain in agreement with the Environment Agency. In the absence of definitive information, it is often defined as land that would flood with an annual probability of occurrence of 5% (1:20 year) or greater.

In assessing the boundary between Flood Zones 1, 2 and 3, the protection afforded by any flood defence structures, and other local circumstances, is not considered by the Environment Agency.

An extract of the Environment Agency Flood Map for Planning is included as Figure 3-1. Based on this, the site lies wholly within Flood Zone 1 and remote from areas of Flood Zone 2 and 3.

Figure 3-1
Extract of the Environment Agency Flood Map for Planning



3.3 National Planning Policy

This FRA report has been completed in accordance with the guidance presented in the NPPF[1] and with reference to PPG[2].

3.3.1 Flood Risk Compatibility

The proposed scheme is classified as an "*essential infrastructure*" development type associated with infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations.

As outlined in Table 3 of the PPG guidance[2] (reproduced as Table 3-1 Flood Risk Vulnerability and Flood Zone 'Compatibility') '*essential infrastructure'* development types are considered appropriate within Flood Zone 1 and therefore the Exception Test does not need to be applied.

Table 3-1
Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted

3.3.2 Sequential Test

With reference to the NPPF[1], the Sequential Test gives preference to locating new development in areas that are at lowest risk of flooding (i.e., Flood Zone 1). The Environment Agency Flood Map for Planning (Figure 3-1) and SFRA are geared to providing the basis for applying this test.

The Sequential Test requires developers to demonstrate that there are no:

"…..reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding."

and this should

"take into account all sources of flood risk and the current and future impacts of climate change"

The site is located wholly within Flood Zone 1 (i.e., the lowest probability of flooding) and this assessment, as detailed in Section 4.0, confirms that there is no significant flood risk from more localised sources and the risk will not appreciably change as a result of climate change. As a result the sequential test is therefore passed.

3.4 Local Planning Policy

The Mid Suffolk Core Strategy Development Plan Document[10] was adopted in September 2008. This is a key planning document guided by sustainable development principals and sets the context for other Development Plan Documents. Policy CS4 of the Core Strategy is included below and focuses of adapting to climate change for flood risk and pollution purposes.

Policy CS 4

Adapting to Climate Change

All development proposals will contribute to the delivery of sustainable development and reflect the need to plan for climate change, through addressing its causes and potential impacts:

10 Core Strategy Development Plan Document, Mid Suffolk Local Development Framework, Mid Suffolk District Council, Adopted September 2008, https://www.midsuffolk.gov.uk/assets/Strategic-Planning/Mid-Suffolk-Core-Strategy/Core-Strategy-with-CSFR-label-and-insert-sheet-07-01-13.pdf

Flood Risk: The council will support development proposals that avoid areas of current and future flood risk, and which do not increase flooding elsewhere, adopting the precautionary principle to development proposals.

This will involve a risk based sequential approach to determining the suitability of land for development. All new development, wherever possible must be located in Flood Zone 1. Developments proposed on 'dry islands' which are situated in the middle of flood risk zones 2 and 3 will be treated in the same way as developments in flood zone 2 or 3 for the purposes of the sequential test.

New development in Flood Zone 3a will be restricted to the following categories:

- *water compatible uses as defined in PPS25;*
- *minor development as defined in PPS25; and*
- *changes of Use to an equal or lower risk category in the flood risk vulnerability classification, where there is no operational development.*

Allocations will not be made in Flood Zones 2 and 3 with the exception of allocations for water compatible use and Stowmarket where if no reasonable site within flood zone 1 is available, allocations in flood zones 2 and 3 will be considered in accordance with PPS25 and the Strategic Flood Risk Assessment.

The Council will seek the implementation of Sustainable Urban Drainage Systems into all new developments where technically feasible.

Where protected species are threatened by flooding, replacement habitats which are on a like for like basis in terms of size and quality will need to be provided to ensure there is no net loss of important habitats. There may be opportunities for creation of new habitats in areas at risk of flooding, and for river restoration programmes that allow rivers to reconnect to their floodplains through natural processes, to the benefit of wildlife.

Pollution: To protect people and the environment from unsafe or unhealthy pollutants. Development that harms the quality of soil or air and/or causes noise, dust, odour or light pollution will be avoided wherever possible. Development proposals will have no adverse effect on water quality.

Development must also seek to adapt for the anticipated negative impacts from climate change upon Biodiversity by protecting the districts natural capital and applying an ecological network approach - re-enforcing and creating links between core areas of biodiversity.

The Babergh and Mid Suffolk Joint Local Plan[11] is currently in its consultation phase and will seek to provide a framework for future development to 2037. The pre-submission regulation 19 document of the joint Local Plan was submitted in November 2020 for review and includes the proposed policies which will guide future sustainable development in the area. Relevant policy includes:

Policy LP29 – Flood risk and vulnerability

Proposals for new development can be approved where:

1. *The Strategic Flood Risk Assessment, as a starting point, has been used to assess whether the proposal is at risk of flooding and any impact of the proposal on flood risk. Other available flooding evidence should also be considered where it is relevant and/or is more up to date;*
2. *In areas at medium or high risk from flooding, it has been soundly demonstrated that the new development or intensification of development, can be made safe for its lifetime without increasing flooding elsewhere. This includes the 'sequential test'; where needed the 'exception test' and also a site specific flood risk assessment.*
3. *Mitigation is provided against existing and potential flood risks throughout the life of the development (including fluvial, surface, coastal and sewer flooding) through application of a sequential approach to flood risk, the implementation of Sustainable Drainage Systems (SuDS), and risks to ground or surface water quality.*

11 Babergh and Mid Suffolk Joint Local Plan, Pre-Submission (Reg19) Document, November 2020, Mid Suffolk District Council, Babergh District Council, https://www.babergh.gov.uk/assets/Strategic-Planning/JLPExamination/CoreDocLibrary/A-SubmissionDocs/A01-Part-1-Objective-and-Strategic-Policies-Part-2-Local-Policies.pdf

4. *Above ground, appropriate SuDS are incorporated within new developments wherever possible, and take opportunities to provide multifunctional benefits, including biodiversity, landscape, amenity and water quality enhancement.*
5. *Proposals are submitted appropriate to the scale of development detailing how on-site surface water drainage will be managed so as to not cause, or increase flooding elsewhere. This includes the cumulative impact of minor developments.*
6. *Opportunities to provide betterment of greenfield runoff rates to reduce the overall risk of flooding, have been provided wherever possible.*
7. *In circumstances requiring surface water management measures (including rain water harvesting and greywater recycling), adequate mitigation which avoids any risks and/or detrimental impacts are provided to the Lead Local Flood Authority.*
8. *Further details of maintenance and adoption by an appropriate body are provided at application stage.*
9. *There is no site conflict with areas identified as vulnerable to coastal erosion.*

3.5 Climate Change

In February 2016, the Environment Agency issued guidance on the impacts of climate change on flood risk in the UK to support NPPF[12]. This was most recently updated in May 2022 and advice sets out that peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change. Consideration of the changes to these parameters should use the allowances outlined below based on the anticipated lifetime of the development. Changes to peak rainfall are only appropriate in this assessment.

The guidance acknowledges that there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, the document provides estimates of possible changes that reflect a range of different emission scenarios. Updates issued through to May 2022 have brought the advice in line with the finding of UK Climate Projections 2018 (UKCP18).

3.5.1 Anticipated Lifetime of Development

This planning permission consents a 30-year operational lifetime of development. Based on an indicative completion date for construction of 2024 this would mean that the end of the development lifetime would be reach in 2054.

3.5.2 Peak Rainfall Intensity

For peak rainfall intensity the PPG guidance states that flood risk assessments with a development life time up to 2060 (in this instance, 2052), the central allowance for the 2050s epoch should be used to asset the impacts of climate change on surface water flood risk and similarly drainage design. As detailed in Table 3-2, this equates to an uplift of 20%.
Suffolk County Council, as detailed in Section 5.1.3, requires a 45% uplift to accommodate for climate change over the development lifetime. This is however specific to residential development and therefore will not be applied at the site. We will however undertake a sensitivity analysis using the 45% uplift.

12 Environment Agency, Flood Risk Assessments: Climate change allowances. February 2016, Updated May 2022

Table 3-2
Peak Rainfall Intensity Allowance

Management Catchment	Annual Exceedance Probability (%)	Allowance Category	Total potential change anticipated for the 2050s	Total potential change for the 2070s
East Suffolk	3.3%	Upper End	40%	40%
		Central	20%	20%
	1%	Upper End	45%	40%
		Central	20%	20%

4.0 Potential Sources of Flooding

4.1 Methodology and Best Practice

This FRA report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA) [13], and British Standard BS8533[3].

A screening study has been completed to identify whether there are any potential sources of flooding at the site which may warrant further consideration. If required, any potential significant flooding issues identified in the screening study are then considered in subsequent sections of this assessment.

4.2 Screening Study

Potential sources of flooding include:

- Flooding from the sea or tidal flooding;
- Flooding from rivers or fluvial flooding;
- Flooding from surface water and overland flow;
- Flooding from groundwater;
- Flooding from sewers and mains;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

The flood risk from each of these potential sources is discussed below and summarised in Section 4.3.

4.2.1 Flooding from the Sea or Tidal Flooding

The site is located remote from the coast / tidal watercourses and is elevated to over 55m aOD.

Flooding from the Sea or Tidal Flooding is therefore negligible and not considered further.

4.2.2 Flooding from Rivers or Fluvial Flooding

With reference to the Environment Agency Flood Map for Planning, the site lies wholly within Flood Zone 1 and is remote from significant watercourses.

As discussed in Section 2.2, the Southern Boundary Ditch flows south of the site in an eastward direction. The catchment area for the ditch upstream of the site is small and almost limited to the site itself. Any flooding from this feature (for example arising from a blockage) would flow to the southeast and away from the site following the natural topography.

Flooding from Rivers of Fluvial Flooding is therefore negligible and is not considered further.

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13 Report C753, The SuDS Manual; CIRIA (2015). Report C753, November 2015.

4.2.3 Flooding from Surface Water and Overland Flow

Topographic data provided in Figure 2-2 and Figure 2-3 indicates the site is situated close to a topographic crest between two river valleys and has a gentle slope towards the southeast / east. There is therefore a very limited upgradient catchment area for surface water and overland flows to progress onto the site. Additionally, there are no localised depressions on the site where overland flows would generally pool.

Long Term Flood Risk Information (LTFRI)[14] provided by the Environment Agency includes mapping of surface water flood risk. Surface water modelling has been undertaken by the Environment Agency in order to establish areas at risk of surface water flooding based upon latest hydrological techniques and surface terrain data. This is not representative of any surface water drainage (such as highways drainage) and therefore likely overestimates the flood risk.

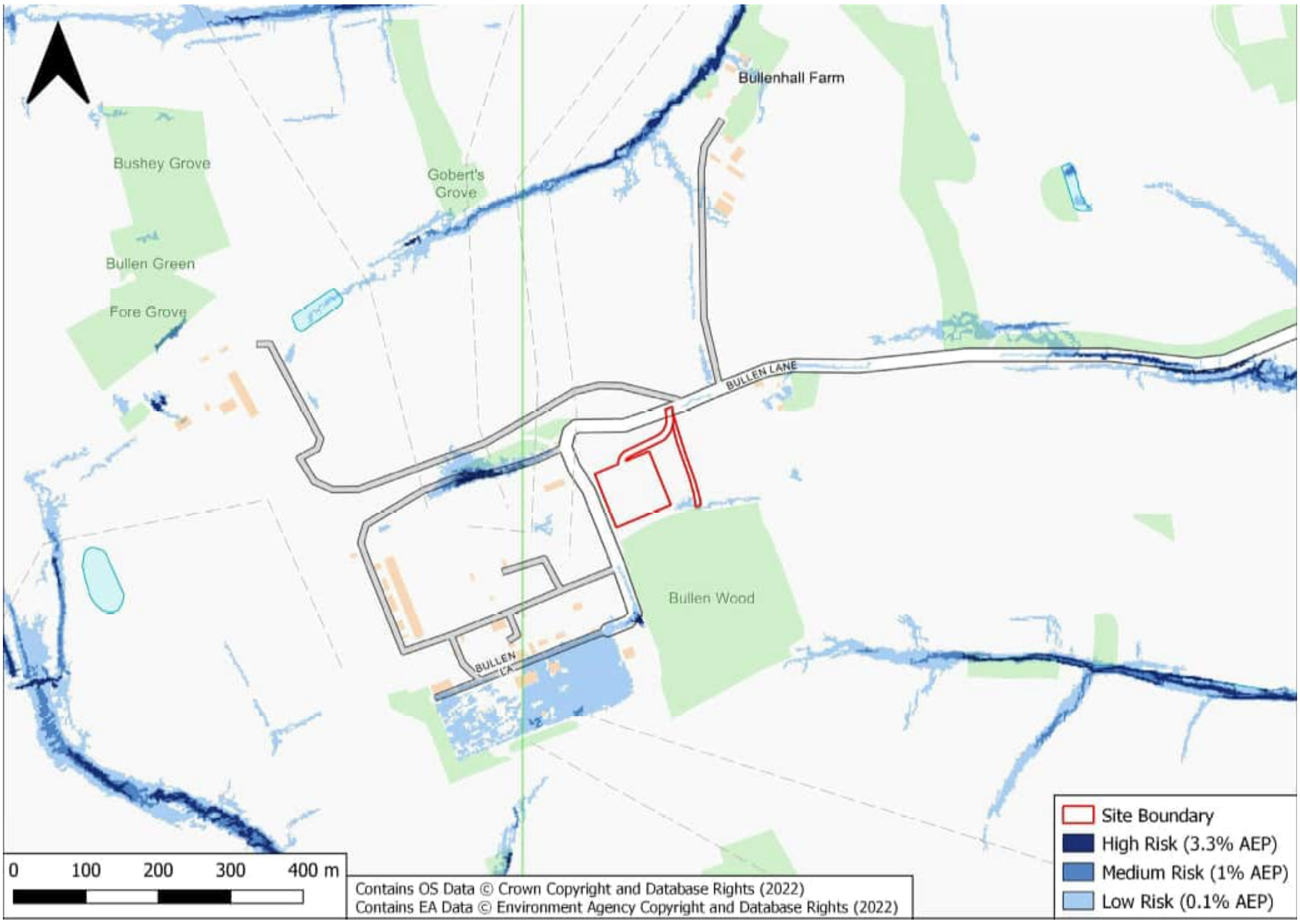
An extract of the map for the site and surrounding area is presented in Figure 4-1, where the Environment Agency define the surface water flood risk categories as:

- **Very Low:** less than 1 in 1,000 annual probability of flooding in any given year;
- **Low:** less than 1 in 100 annual probability but greater than or equal to 1 in 1,000 annual probability of flooding in any given year;
- **Medium**: between 1 in 100 annual probability and 1 in 30 annual probability of flooding in any given year; and
- **High:** greater than 1 in 30 annual probability of flooding in any given year.

An extract of the Environment Agency Surface Water Flood Map is included below as Figure 4-1.

14 Environment Agency, Long Term Flood Risk Information Service: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

Figure 4-1
Extract of the Environment Agency Surface Water Flood Map



The Environment Agency Surface Water Flood Map indicates that the site is at a very low risk of surface water flooding and ultimately confirms the conceptual understanding that there is insufficient upgradient catchment area for significant surface water flows to progress onto the site. There is also a small low probability flow pathway in the south eastern site which progresses in a west to east direction. This corresdetention basins to the Southern Boundary Ditch to the south of the site boundary which does not appear to result in flooding of the proposed developed areas.

Runoff from the site will be appropriately managed through the Surface Water Drainage Strategy (see Section 5.0) which will also reduce downstream flood risk to the receiving southern ditch.

Flooding from Surface Water and Overland Flow is therefore very and is not considered further.

4.2.4 Flooding from Groundwater

The diamicton superficial deposits at the site are around 20m thick and are comprised of cohesive clay glacial sediments. This would not give rise to groundwater flooding due to poor permeability and limited capacity for water storage. Local borehole records have not identified groundwater within the diamicton deposits but instead confined below the Thames Group aquitard in chalk geology some 46m deep.

Groundwater flood risk at the site is very low and will not be considered further.

4.2.5 Flooding from Sewers and Mains

With reference to Anglian Water Asset Plans contained in **Appendix 05**, there is no adopted wastewater or water mains infrastructure in the vicinity of the site.

The risk of flooding from sewers and mains is therefore negligible and will not be considered further.

4.2.6 Flooding from Reservoirs, Canals, and Other Artificial Sources

Environment Agency Reservoir Breach mapping[15] indicates the site is not located in an area at risk of flooding from reservoirs. There are additionally no canals or other artificial sources which could potentially cause flooding at the site.

The risk of flooding from these sources is therefore negligible and is not considered further.

4.2.7 Flooding from Infrastructure Failure

The site is not afforded protection from flood defences and, with reference to Ordnance Survey mapping, the site is also not located within the vicinity of a pumping station.

The risk of flooding from infrastructure failure is therefore negligible and is not considered further.

4.3 Summary of Flood Screening

Table 4-1 below summarises the flood screening assessment.

Table 4-1
Potential Risk Posed by Flood Sources

Potential Source	Potential Significant Flood Risk at Site?
Sea or Tidal Flooding	No
Rivers or Fluvial Flooding	No
Surface Water and Overland Flow	No
Groundwater	No
Sewers and Water Mains	No
Reservoirs, Canals and other Artificial Sources	No
Infrastructure Failure	No

15 Environment Agency Risk of Flooding from Reservoirs - Maximum Extent Flood Map

5.0 Surface Water Drainage Strategy

This surface water drainage strategy sets out high level principles for managing storm water on the site in line with best practice and the requirements of Suffolk County Council, the LLFA for the area. The strategy has been produced in support for the client and, if required, to support a planning application to amend the battery site layout and separately a planning application for drainage works recommended in this report.

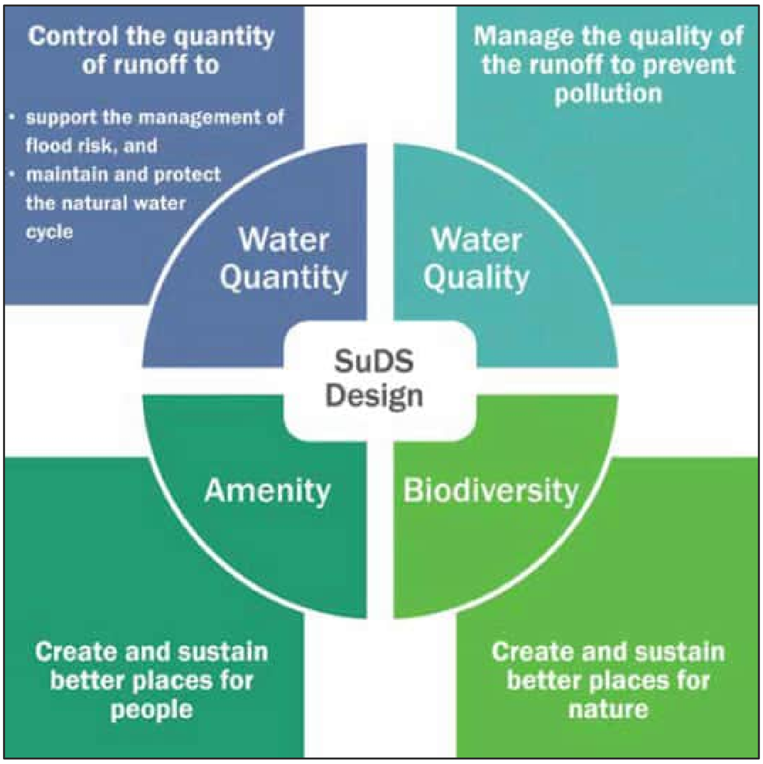
This strategy is intended to demonstrate that, given the nature and quantum of development proposed, it will be feasible to drain the site in line with planning requirements.

5.1 Key Principals of Surface Water Management

5.1.1 Overview

Current best practice guidance document; The Sustainable Drainage System (SuDS) Manual (CIRIA Report C753)[13], promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the 'four pillars of SuDS design' as depicted in Figure 5-1.

Figure 5-1
Four Pillars of SuDS (extract from CIRIA Report C753)

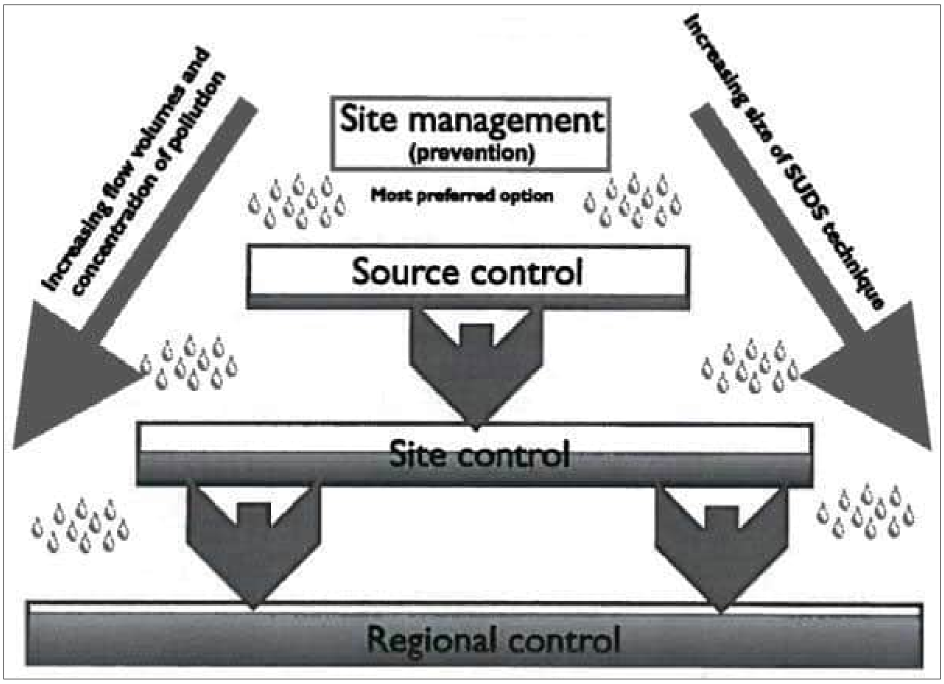


The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train'. The hierarchy of techniques is identified as:

- **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
- **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).

- **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
- **Regional Control** – management of runoff from several sites, typically in a retention detention basin or wetland.

Figure 5-2
SuDS Management Train



It is generally accepted that the implementation of SuDS, as opposed to conventional drainage systems, provides a number of benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- Reducing potable water demand through rainwater harvesting;
- Improving amenity through the provision of public open spaces and wildlife habitat; and replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

5.1.2 National Policy Context

Current national planning policy guidance and best practice, namely NPPF and PPG, require development proposals in all Flood Zones to seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of SuDS.

5.1.3 Local Guidance

Local policies provided in Section 3.4 focuses primarily on flood risk matters and adaptation to climate change. Whilst the policies mention the requirement for SuDS principles and implementation into development schemes, these policies do not provide in-depth requirements which are often sought by the LLFA.

Suffolk County Council (SCC) published their own Surface Water Drainage (SuDS) guidance – Suffolk Flood Risk Management Strategy Appendix A Sustainable Drainage Systems (SuDS): A Local Design Guide[16] in 2023. The guide is intended to provide direction on the Council's requirements for SuDS on all major developments.

The SuDS general design principals are:

- Not increase flood risk off-site for all events up to and including the 1% annual event probability (AEP) plus an allowance for climate change (cc), volumes of above ground flooding in excess of $5m^3$ must be assessed by the applicant to establish risks to occupants/site users etc.
- Ensure no internal flooding on-site during all events up to and including the 1% AEP plus an allowance for cc and no above ground flooding on-site, other than designated storage areas, during all events up to and including the 3.33% AEP, plus an allowance for cc.
- Runoff must be managed at source with residual flows conveyed downstream using above ground conveyance to further above ground storage or treatment components where required.
- Take account of the construction, operation and maintenance requirements of SuDS allowing for any maintenance access required to undertake this work.
- Accommodate climate change, the allowance for which is 45%, (with some parts of Suffolk being less than this in accordance with the Environment Agency's catchment-based approach) for residential development (with a lifetime of 100 years) at the time of writing. This value is regularly updated, at such time it will take precedence over this
- As a general rule of thumb, for areas shown as having a high risk of pluvial flooding:
    - Avoid constructing residential & commercial properties with water compatible land uses SuDS and/or public open space being preferable. Flood volumes should not be displaced.
- For areas shown as having a medium/low risk of pluvial flooding:
    - Avoid constructing residential properties in these areas. Flood resilient commercial properties could be located in these areas. Water compatible uses are again encouraged e.g. SuDS.
    - Flood volumes should not be displaced.
- For areas shown as having a very low risk of pluvial flooding:
    - Manage the residual risk through raising finished floor levels and exceedance routes.
    - The development should not increase off-site flood risk through the channelling of flows.
- Managing Runoff Quality: Surface water runoff should be managed via a method as high up the following SuDS hierarchy as reasonably possible, with more sustainable options ruled out only where sufficient evidence can be provided to support the decision:
    - Rainwater Harvesting/Re-Use Onsite.

16 Suffolk Flood Risk, Management Strategy Appendix A Sustainable Drainage Systems (SuDS): A Local Design Guide, Suffolk County Council, https://www.suffolk.gov.uk/asset-library/2023-sf3967-scc-suffolk-flood-risk-appendix-a2.pdf

  - Shallow infiltration (circa 2.0m, see section on infiltration systems).
  - Gravity discharge to a watercourse.
  - Gravity discharge to a surface water sewer/highway drain.
  - Gravity discharge to a combined sewer.

  The following options are listed as a last resort, rather than a hierarchical order and are based on site specific constraints

  - Deep infiltration
  - Pumped discharge to a watercourse or infiltration feature.
  - Pumped discharge to a surface water sewer/highway drain.
  - Pumped discharge to a combined sewer.
  - Gravity or pumped discharge to a foul sewer.

- To simplify the design, discharge should be restricted to QBAR (SCC LLFA preference). Please note that discharging at QBAR is SCC LLFA's preferred approach and if this approach is not feasible then full justification must be provided as to why an alternative strategy is proposed.
- For discharges to tidal watercourses, the rate of runoff often need not be restricted, however the impact of a tide locking scenario must be considered with capacity for onsite storage up to and including the 1 in 200 plus cc tidal scenario and the 1 in 30 plus cc pluvial scenario occurring in conjunction.
- Where discharging to an Anglian Water sewer, Anglian Water must be consulted as to whether any additional criteria or limiting discharge rates are required.
- On smaller sites a 100mm minimum orifice size should be used to reduce the risk of blockage, where this results in a higher discharge rates than would otherwise be acceptable, any resultant flood risk implications must be assessed by the applicant. A smaller sized orifice may be used for discharge from pervious surfacing where the risk of blockage is lower.
- On brownfield sites, runoff should be restricted to greenfield rates where possible, with a minimum 30% betterment offered for the 1 hour storm in each modelled rainfall event otherwise (calculated by modelling the existing system or in the same way as greenfield runoff but using Soil Type 5)
- On major sites, where the proposed discharge rate is greater than QBAR, or if complex flow controls are proposed, the runoff volume must be managed. This can be achieved through rainwater harvesting or a separate area of long term storage must be provided on-site with this volume discharged via infiltration or at 2 l/s/ha. Refer to the CIRIA SuDS Manual and sudsguide.uk for further details.
- Commercial and industrial developments must undertake a demand/yield assessment for rainwater harvesting to determine feasibility. Where demand is 3 x greater than yield, options for rainwater harvesting should be explored in detail in accordance with CIRIA SuDS Manual (C753 p.220 and NPPG paragraph 56).
- Where private sewage treatment works are proposed, comprising a discharge of treated effluent to the watercourse, this should be included within the total discharge rate such that the discharge of effluent combined with surface water should not exceed QBAR.
- The local surface water management plan (SWMP), if available, should be consulted as it may require discharge rates to be reduced below QBAR due to local flood risk concerns.
- Greenfield rates should be calculated in accordance with the CIRIA SuDS Manual (C753 p.509-518), based only on the area of the site to be positively drained, with no climate change allowance.

- For assessing water quantity, SCC LLFA's preferred method for calculating greenfield runoff rates is the FEH methodology (C753 p.510). In areas where surface water runoff is a critical issue, sensitivity checks should be undertaken to establish which runoff estimation method is the most conservative, with this method being used.
- For sites on steep slopes or where overland flows of surface water are known to present issues locally, even if this hasn't been identified on national pluvial flood mapping, an allowance should be made for this within the location and design of SuDS features (e.g. including interception features to safely divert flows).
- Calculations of residential impermeable areas should include an allowance of 10% for urban creep.
- Exceedance flows should be identified on a plan demonstrating where water would travel should a rainfall event occur that was in excess of the design capacity of the network or in the event of a blockage or failure of the system. Exceedance flows should be mitigated where necessary (i.e. where they cannot be directed away from existing/proposed buildings).
- Interception storage should be provided to capture the first 5mm of rainfall, in the form of initial losses into the ground, this can be achieved by using above ground conveyance, vegetated surfaces, permeable surfaces or long-term storage (for further information see Table 24.6 of C753 p.529-530)
- Maximum depth of the basin should not exceed 1.5m (C753 p.763) while the maximum water depth within the basin should not exceed 1.0m (C753 p.847).
- A minimum of 300-500mm freeboard should be provided between the maximum 1% AEP + cc water level and the top of structure.
- Sides slopes should not exceed 1 in 4 unless specific site/safety/maintenance arrangements allow for steeper slopes (C753 p.490 & 651).
- A 3.5m wide, level maintenance strip should be provided to allow maintenance access (C753 p.501).
- The feature should have a maximum half drain time of 24 hours for the 3.33% + cc AEP storm with space for an additional 10% + cc AEP storm if it exceeds 24 hours (C753 p.262).

5.2 Existing Surface Water Drainage Regime

The existing site is comprised of undeveloped arable farmland. Rainfall falling onto the site will typically infiltrate into the soil and then evaporate (i.e. infiltration negligible). In the event of heavy and prolonged rainfall the soils will become saturated and excess water will flow overland in line with local topographic gradients to the southeast / east and be intercepted by the Southern Boundary Ditch to the south of the southern site boundary. The potential for infiltration of rainfall to ground is limited by the impermeable topsoil and superficial geology of boulder clays.

5.2.1 Pre-Development Runoff Rates (Greenfield)

Greenfield runoff rates for the proposed drained area (Table 5-3) have been estimated through application of the Revitalised Flood Hydrograph Model (ReFH2). ReFH2 is recommended by the Environment Agency as the methodology for estimating flood peaks and hydrographs for small catchments[17].

The ReFH2 method is applied using software 'The Revitalised Flood Hydrograph' modelling tool.

17 Environment Agency, Estimating flood peaks and hydrographs for small catchments: Phase 1, Project: SC090031, May 2012

In addition to the FEH parameters (obtained from FEH webservice for 1km grid; 610152, 246056) the following parameters were incorporated:

- Drained Area: 0.69 ha

The parameters used in this model have been reviewed and are considered to provide a robust representation of site conditions (i.e., clay catchment with low BFIHOST).

Table 5-1
Greenfield Runoff Rates

Annual Probability	1 in X Years Probability	Greenfield Runoff Rate (l/s/ha)	Drained Area (l/s)
100%	1	4.3	3.0
50%	2	5.1	3.5
3.3%	30	12.2	8.4
1%	100	15.8	10.9

5.3 Constraints on the Use of SuDS

5.3.1 Geology

Superficial geology at the site comprises of diamicton deposits and clayey soils with poor permeability. Infiltration testing undertaken on a neighbouring site with the same geology (see Section 2.4 and **Appendix 04**) failed due to the limited infiltration capacity of the soils. In addition to this, areas of standing water were observed on site during the walkover demonstrating poor drainage. Infiltration of runoff to ground is therefore not considered achievable at the site.

5.3.2 Watercourses

There are no active watercourses in the vicinity of the site however there is an existing ditch feature (Southern Boundary Ditch) to the south of the site which intercepts and conveys overland flows during periods of heavy rainfall when the ground is saturated. This ditch forms a tributary to the River Gipping in the east and could receive surface water flows from the developed site.

5.3.3 Topography

The topography across the site slopes in a south / south eastly direction towards the Southern Boundary Ditch along the southern field boundary. To achieve gravity drainage SuDS features should be ideally located in the lowest areas on site however it is envisaged as part of the redevelopment proposals the site will be relevelled using cut and fill but will retain a south easterly fall.

Existing ground levels to the south of the site are at around 55.5m aOD however based on the topographic survey in **Appendix 03**, the invert level of the ditch falls to around 54.9-55m aOD and therefore deep SuDS features would not be possible. Shallow SuDS features must therefore be created to ensure that there is sufficient slope for a gravity drainage connection (at least 1 in 100) into the Southern Boundary Ditch.

SCC SuDS guidance requires a freeboard on basins between 300-500mm. As deep SuDS features are not possible at the site, a freeboard of 300-500mm from the ground surface is not achievable. In order for this freeboard to be applicable, the banks of the open SuDS feature will have to be engineered above ground levels.

5.3.4 Spatial Constraints

There is limited available space within the site boundary for large open SuDS features. Narrow strips of land area available to the north, south and east of the site boundary outside of the security fencing. The Woodland Trust require a 15m buffer between any SuDS features and the area of ancient woodland to the south of the site. Land to the south of the site is within this 15m buffer and therefore SuDS features can only be present to the east given that land to the north is raised above site levels.

5.3.5 Biodiversity and Amenity

In line with SuDS principals, the amenity and biodiversity of SuDS has been considered within the drainage design. Flows which are shed from the compound will discharge into a large SuDS detention basin. The detention basin has been designed with a shallow side gradient (1 in 4) and these margins would be planted up with appropriate aquatic vegetation.

5.4 Proposed Discharge Arrangement

With reference to the SuDS Manual, the hierarchy of preferred disposal options for surface water runoff from development sites in decreasing order of sustainability is as follows:

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Table 5-2 summarises the suitability of disposal methods suitability in the context of the site and the proposed development. Based on this, it is proposed that runoff from the site will be discharged to surface waters.

Table 5-2
Suitability of Surface Water Disposal Methods

Surface Water Disposal Method (in Order of Preference)	Suitability Description	Method Suitable? (Y / N)
Infiltration to Ground	Based on the results of the infiltration testing undertaken in the neighbouring site in the same geology, infiltration of surface water runoff is not an appropriate method of discharge at the site.	N
Surface Water Discharge	A small field ditch (Southern Boundary Ditch) is present to the south of the site conveying flows in an easterly direction towards the River Gipping. Flows from the site could	Y

Surface Water Disposal Method (in Order of Preference)	Suitability Description	Method Suitable? (Y / N)
	outfall into this ditch, which is the existing rainfall runoff mechanism, and route discharge away from the site.	
Sewer Discharge	With reference to Anglian Water Asset plans contained in **Appendix 05**, there is no sewerage infrastructure within the vicinity of the site.	N

5.5 Conceptual Surface Water Drainage Strategy

The proposed drainage strategy will manage surface water runoff as close to the source as possible within the confines of the site for the 1% AEP event plus a 20% accommodation for climate change throughout the 30-year anticipated lifetime of development, as discussed in Section 3.5.

It is envisaged that development of the site will involve scraping back the topsoil and overlaying the site with a permeable aggregate / stone (generally single sized). This would form a gravelled compound area (30% void space) fully within the confines of the security fencing. The battery units and ancillary equipment will be located within the gravelled area on concrete plinths. A shallow gravel strip would be provided adjacent to the access track in the north to intercept and convey flows shed off the access track towards the compound.

Surface water falling on the aggregate / stone areas and water that is shed from the power units / concrete plinth areas will rapidly infiltrate into the void space. Due to the slope across the site, the gravelled compound would be tiered to prevent surface water flows rapidly discharging in a south easterly direction through the void space. We would propose there to be four separate tiers across the site with a trickle point in the centre to allow flows from the upgradient tier to discharge down towards the outfall. A sunken perforated pipe would span the southern boundary of the compound conveying flows from the aggregate compound (bottom tier) towards a detention basin feature to the east of the development area for attenuation.

Runoff from the detention basin will discharge into the Southern Boundary Ditch using a Hydrobrake device restricting rates to 3.5l/s (2-year greenfield rates) in line with the requirements of SCC. The restricted rates will provide significant betterment of runoff rates for larger / rarer storm events. A weir overflow will be provided on the detention basin to provide a controlled overflow in the event of exceedance of the design storm.

Flows from the hydrobrake will discharge into a small gravel strip which progressively decreases in depth (no pipework required) to reach surface level, allowing for a diffuse discharge into the southern boundary ditch whilst providing additional filtration of flows. The landowner of the southern boundary ditch has granted permission for EDF-R to discharge into the watercourse. This agreement in principal is contained in **Appendix 06**.

A small earth bund (speed bump formation 150mm in height) and upgradient gravel strip will be provided along the northern boundary of the gravel compound to prevent offsite flows discharging into the drainage system. This will encourage the infiltration of these flows to ground but also route them east and west so that they can progress downstream bypassing the development area and draining towards the southern boundary ditch at the existing greenfield rates. As a result, runoff upgradient areas will not enter the development site and are therefore not accounted for in the calculations.

A conceptual surface water drainage strategy is provided in **Appendix 07**.

5.6 Proposed Catchment Area Schedule

For the purposes of the drainage calculations, the proposed areas 'contributing' runoff to the drainage network were assessed from the development proposals plan (refer to **Appendix 01**). A breakdown of the proposed surface types (and associated contributing catchment areas) is presented in Table 5-3.

It is assumed that all proposed development areas, including the gravels overlain to form the compound and the detention basin, will be effectively impermeable. This is a conservative approach as in reality some infiltration to ground (albeit limited) will occur through the shallow sub soils.

Table 5-3
Proposed Contributing Catchment Areas

Proposed Land Use	Area (ha)
Concrete Plinths (underlying all infrastructure)	0.130
Access Track Road	0.161
Proposed Gravel Compound Area[1]	0.319
Proposed Detention basin Surface Area	0.08
Total Drained Area	**0.69**

5.7 Allowable Discharge Rates

All areas of the site inside of the security fencing which are not overlain by a track road or concrete plinths will be overlain by a gravel layer to provide attenuation of stormwater flows. A detention basin is also provided to the east of the compound, generating a total drainage area of 0.69ha.

As discussed in Section 5.1.3, SCC recommends that discharge is restricted to QBAR for all events up to the critical 1% AEP + climate change. Based on greenfield runoff calculations, runoff rates from the site for a 2-year rainfall event (i.e., QBAR) are estimated at 3.5l/s. Following the requirements of SCC (the higher discharge option), runoff from the site will be restricted to 3.5l/s for all events up to and including the 1% AEP + 20% climate change.

5.8 SuDS Assessment of Drainage

5.8.1 Attenuation Storage

Temporary storage volumes required within the aggregate compound and detention basin have been estimated using the Source Control function in the WinDes software, an appropriate methodology for planning and master planning purposes.

The Flood Estimation Handbook (FEH) rainfall model was used with a design standard return period of 1% AEP (1 in 100-year return period) plus an allowance for climate change as recommended within climate change guidance detailed in Section 3.5 (applied as a 20% uplift in peak rainfall intensity). The modelling has been undertaken using the Cascade function in WinDes, whereby the outflow from the compound aggregate (modelled as permeable paving) discharges into the detention basin.

As the proposed site slopes towards the south east, the compound aggregate would be tiered so that water could not rapidly flow in a south easterly direction and would be instead levelled in a series of steps with a trickle point allowing flows to slowly discharge into the downgradient tier. This has been modelled as a singular flat feature to demonstrate capacity within the system. It is also assumed that the gravelled area is effectively hardstanding however infiltration into the underlying soils will be possible.

A sunken perforated pipe would be provided along the southern site boundary beneath the gravels to collect and convey flows into the detention basin.

The following parameters have been incorporated into the modelling:

Aggregate Compound (Permeable Paving)

- Impermeable / Contributing Area: 0.610ha
- Cover Level: 56.1m aOD (n.b. the minimum ground level on the site has been used as the cover level to ensure that an appropriate fall is achievable into the detention basin. In reality the cover level will be variable across the slope with engineered tiers to prevent rapid through flow)
- Invert Level: 55.65m aOD
- Width: 56.5m
- Length 56.5m
- Porosity: 0.3
- HydroBrake Outflow Control:
    - Invert Level: 55.65m aOD
    - Design Head: 0.45m
    - Design Flow: 6.0l/s

Detention basin

Note that this has been modelled as an infiltration basin (with 0mm/hr of infiltration) in order to derive half drain times for the detention basin. Half Drain times are not provided when modelling detention basins in Source Control.

- Impermeable / Contributing Area: 0.08ha
- Cover Level: 56.0 m aOD

  (n.b. the external ground levels in the detention basin location are approximately 55.7m aOD and therefore, to achieve the desired cover level and freeboard, the banks of the detention basin will be engineered and raised above the ground level).
- Invert Level: 55.25m aOD
- Base Area: 550m^2
- Depth: 0.75m
- Side Slope: 1:4
- Top of Bank Area: 827.7m^2
- HydroBrake Outflow Control
    - Invert Level: 55.25m aOD

- Design Head: 0.45m
- Design Flow: 3.5l/s

- Weir Overflow Control
  - Crest Level: 55.7m aOD
  - Coefficient of Discharge: 0.544
  - Width: 0.021m

Full calculation results of the cascade modelling are provided in **Appendix 08.**

5.8.2 Performance

The SuDS features will provide attenuation of stormwater runoff whilst reducing flows to 1 in 2-year greenfield rates. The design event for the attenuation requirements has been analysed as the 100-year event with 20% climate change uplift.

Results from the modelling are summarised below in Table 5-4 which demonstrates sufficient capacity in the drainage system for the design 1% AEP plus 20% climate change event.

Table 5-4
SuDS Performance: Attenuation Volumes

SuDS Feature	Annual Probability (%)	Critical Event	Peak Water Depth (m)	Freeboard (mm)	Maximum Discharge (l/s)	Maximum Volume (m^3)	Half Drain Time (mins)
Aggregate Compound	1 + 20% CC	360 min Summer	0.380	70	6.0	363.8	519
Detention basin	1 + 20% CC	2160 min Winter	0.449	301	3.5	282.0	684

Comparison between the pre and post development runoff rates are summarised per rainfall event in Table 5-5.

Table 5-5
SuDS Performance: Rates

Annual Exceedance Probability Event (%)	Drained Area Runoff Rate (l/s)[1]	Post Development Runoff Rate (l/s)	Reduction in Runoff Rate	
			(l/s)	(%)
50%	3.5	3.4	0.1	3
3.3%	8.4	3.5	4.9	58
1%	10.9	3.5	7.4	68

Annual Exceedance Probability Event (%)	Drained Area Runoff Rate (l/s)[1]	Post Development Runoff Rate (l/s)	Reduction in Runoff Rate	
			(l/s)	(%)
1% + 20% CC	10.9	3.5	7.4	68

1. The reduction in flows for the 1% + 20% climate change event is made in comparison to the present day 1% AEP storm.

The development successfully provides drainage of stormwater up to the 1 in 100-year event plus a 20% uplift for climate change whilst restricting flows to the 1 in 2-year greenfield rates. This provides a reduction of up to 68% from greenfield rates.

We have also undertaken a sensitivity check on the 1% AEP using a 45% climate change allowance in line with SCC recommendations for a residential development. The results of the modelling are summarised below in Table 5-6 and provided as **Appendix 09.**

Table 5-6
SuDS Sensitivity Check using 45% Climate Change Allowance

SuDS Feature	Annual Probability (%)	Critical Event	Peak Water Depth (m)	Flood Depth (mm)	Maximum Discharge (l/s)	Maximum Volume (m^3)	Half Drain Time (mins)
Aggregate Compound	1 + 45% CC	480 min Winter	0.472	220	6.1	453.3	639
Detention basin	1 + 45% CC	2160 min Winter	0.519	0	4.4	332.4	788

The modelling of the 1% AEP storm using a 45% climate change allowance event predicts 220mm of shallow flooding from the permeable paving. These flows would discharge offsite overland to the south east and into the southern boundary ditch, mimicking the existing regime.

No flooding is predicted from the detention basin however due to presence of the weir overflow (i.e, allowing a controlled discharge for water levels above 55.7m aOD) flow rates increase by 0.9l/s. A rate of 4.4l/s is still significantly below the existing 1% AEP greenfield rate of 10.9l/s and ensures any overflows are controlled.

In addition to this, SCC require that features have a half drain time for the 3.33% AEP storm plus 20% climate change. This scenario has been modelled and demonstrates half drain times well within 24 hours (i.e., 1,440 mins). The outputs of this modelling are provided in **Appendix 10** and summarised below in Table 5-7.

Table 5-7
SuDS Half Drain Time Check

SuDS Feature	Annual Probability (%)	Critical Event	Peak Water Depth (m)	Maximum Discharge (l/s)	Maximum Volume (m^3)	Half Drain Time (mins)
Aggregate Compound	3.33 + 20% CC	360 min Winter	0.275	6.0	263.9	379
Detention basin	3.33 + 20% CC	1440 min Winter	0.338	3.5	205.3	491

5.9 SuDS Assessment of Water Quality

SuDS provide a number of water quality benefits, and the proposed surface water management uses an aggregate compound and detention basin for attenuation of flows prior to discharge. It is assumed that the stone ballast / aggregate compound will provide the pollution hazard indices equivalent to a french drain.

They can help reduce pollutant levels in runoff by filtering out fine sediments, metals, hydrocarbons, and other pollutants. Similarly, attenuation detention basins can facilitate sedimentation and, in this instance, will provide secondary treatment prior to discharge.

The simple index method, as outlined within the SuDS Manual, provides a way of quantifying the benefit to water quality of the SuDS Management Train. The pollution hazard from the land use and the mitigation from the SUDS component are each assigned an index. The total mitigation index must be greater than the pollution hazard index for adequate treatment to be delivered.

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each containment type)

The total SUDS mitigation is the summation of the first components mitigation index and half the mitigation index of any subsequent component.

With reference to the SuDS Manual, post-development surface water runoff generated from is considered to have a *'Low' Pollution Hazard Level* respectively as presented in Table 5-8.

Table 5-8
Pollution Hazard Potential of the Proposed Development

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Battery Storage Facility (site with infrequent traffic movements)	Low	0.5	0.4	0.4

The proposed drainage system is required to demonstrate sufficient treatment capability to manage the specified Pollution Hazard Indices. The SuDS mitigation indices for the Proposed Development is provided in Table 5-9.

Table 5-9
SuDS Mitigation Indices for the Proposed Development

SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydro-Carbons
French drain	0.4	0.4	0.4
Detention basin	0.5	0.5	0.6

It is assumed that the permeable aggregate would have the equivalent mitigation indices as a French Drain.

Table 5-10 compares the SuDS Mitigation Indices, provided by the proposed 'Source Control', 'Conveyance' and 'Site Control' measures against the Pollution Hazard Indices.

Table 5-10
SuDS Performance: Water Quality Indices

Land Use	Pollution Hazard Level	Pollution Hazard and SuDS Mitigation Indices Comparison					
		Total Suspended Solids (TSS)		Metals		Hydro-Carbons	
		Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index
Other Roofs	Low	0.5	0.65	0.4	0.65	0.4	0.6

1. Mitigation indices = (1 x french drain index) + (0.5 x detention basin index) to account for primary and secondary components in the drainage scheme. A factor of 0.5 is used to account for the reduced performance of the secondary component (detention basin).

As the SuDS Mitigation Index provided by the proposed SuDS measures are ≥ Pollution Hazard Index the water quality assessment criteria are satisfied for the site.

5.10 SuDS Operation and Maintenance

A full SuDS maintenance plan would be produced as part of the detailed drainage design post-development and the precise requirement would depend on manufacture specification of the final design. At this time, it is considered that the maintenance of the drainage network would be the responsibility of the site owner and / or operator.

In line with the requirements of SCC, a copy of the CDM designer risk log is included as **Appendix 11**.

An outline of the typical maintenance requirements of each proposed SuDS feature is provided below.

5.10.1 Gravel Compound and Orifice

The proposed drainage scheme will utilise a permeable aggregate / stone compound as a mechanism for attenuation, treatment, and conveyance of surface water runoff towards the detention basin. Flows will discharge from the compound via an orifice.

The anticipated maintenance and management for the gravel compound and orifice associated with the surface water drainage system is outlined in Table 5-11.

Table 5-11
Typical Gravel Compound Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from surface, access chambers and pre-treatment devices	Monthly, or as required
	Inspect gravel surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
	Remove sedimentation that has become entrained into the outflow	Every 6 months
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g., NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required
	Periodic measuring of the orifice bore size	Every 3 years
	Checking of the orifice for leakage issues	Annually

5.10.2 Detention Basin and Hydrobrake

The proposed drainage scheme will use a detention basin along the eastern site boundary as the final attenuation and filtration destination before discharge via a hydrobrake control device to the receiving ditch.

The anticipated maintenance and management for the detention basin and hydrobrake associated with the surface water drainage system is outlined in Table 5-12.

Table 5-12
Typical Detention basin and Hydrobrake Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter and debris removal.	Monthly.
	Cut grass in and around lagoon.	Half yearly (spring – before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (or as required).
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect banksides, liner, structures, pipework etc. for evidence of physical damage.	Monthly.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
	Check any penstocks and other mechanical devices.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from inlet, outlets and forebay.	Annually (or as required).
	Manage wetland plants in outlet pool – where provided.	Annually.
	Removing sedimentation that has become entrained into the outflow	Six monthly, or as required
	Ensure there are no leakage issues associated with the hydro-brake	Six monthly, or as required
	Check HydroBrake for sedimentation, or other blockages and flow bypassing	Six monthly
Occasional Maintenance	Re-seed areas of poor vegetation growth.	As required.
	Prune and trim any trees and remove cuttings.	Every 2 years, or as required.
	Remove sediment from inlets, outlets, forebay and main basin when required.	Every 5 years, or as required.
	Periodic measuring of the bore size	Every 3 years, or as required.
Remedial actions	Repair erosion or other damage by reseeding or re-turfing.	As required.
	Realignment of rip-rap.	As required.
	Repair/rehabilitation of inlets, outlets and overflows.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.

5.11 Exceedance

In the event of exceedance from the surface water drainage network, flood water would surcharge from the detention basin and gravel compound and overtop towards the south in line with the prevailing topography. These exceedance flows, which are illustrated in **Appendix 07**, would be intercepted by the southern boundary ditch and conveying in an eastern direction towards the River Gipping.

This exceedance flow would simply mimic the existing regime however the volume of runoff and thus severity of flooding is reduced due to attenuation provision provided in the compound and detention basin.

An overflow weir has been provided on the detention basin along the southern boundary to allow exceedance flows to discharge off site at controlled rates.

SCC SuDS Guidance requests that a climate change factor of 45% should be applied to assess the wider flood risk. This model run is summarised in Table 5-6 indicating shallow flooding from the aggregate compound. Such flooding will not cause damage to the site and will simply discharge offsite to the south mimicking the existing regime.

No significant flooding of the site or external areas is anticipated as a result of exceedance of the drainage strategy.

6.0 Conclusions

SLR Consulting Limited (SLR) has been appointed by EDF-R ("the client") to provide consultancy services to support the development of a 57MW battery storage facility on land at Bramford Substation, Ipswich, IP8 4JL ("the site") and a future planning application for site drainage infrastructure to drain the battery compound.

6.1 Flood Risk

Flood risk has been assessed in line with BS8533[3] taking account of national and local planning policy and guidance, and all potential sources of flooding to the site have been considered.

A screening assessment, detailed in Section 4.0, has reviewed the flood risk posed by sources including fluvial, tidal, surface water, groundwater, sewer and water mains, reservoirs, canals, and infrastructure failure. The screening assessment concluded that there are no significant risks of flooding at the site and therefore, in terms of both the Exception and Sequential Tests, the site is suitable for development.

As there are no considerable flood risks on site, allowances for changes to peak river flows, sea levels, wind speed and wave height are not required. In line with national policy, the development must make allowance for a 20% uplift in peak rainfall to accommodate for climate change over the anticipated 30-year lifetime of development, and as such, has been included within the Surface Water Drainage Strategy for the site.

6.2 Surface Water Drainage Strategy

The Surface Water Drainage Strategy has been developed to demonstrate that the requirements of national, regional, and local planning policy can be achieved at the site given the nature and the quantum of development proposed. Storm water discharge from the proposed development area of the site currently follows local topographic gradients south and is intercepted by an existing ditch (Southern Boundary Ditch) and conveyed towards the River Gipping.

The site will be tiered to facilitate development and then overlain by a gravel substrate for attenuation and filtration of runoff. A perforated pipe will be located along the southern boundary of the compound / bottom tier intercepting and conveying flows into a detention basin prior to discharge into the Southern Boundary Ditch. A shallow gravel strip will also be provided parallel to the access track in the north to convey any overland flows from the access track towards the compound.

The gravel compound and detention basin will provide sufficient filtration of flows in line with the simple index method whilst also maximising infiltration where possible (i.e., all features will remain unlined). The drainage design has been developed to provide attenuation and appropriate discharge of stormwater for all events up to the 1% AEP plus a 20% climate change allowance.

Discharge rates from the site will be restricted to the 1 in 2-year greenfield runoff rate of 3.5l/s in line with the requirements of Suffolk County Council. The proposed drainage strategy therefore provides considerable betterment from the existing regime.

In common with most drainage strategies put forward in support of planning applications, the strategy presented here will need to be subject to detailed design and any relevant approvals before construction commences.

APPENDICES

Appendix 01: Development Masterplan

NOTES

1. Drawing details are for planning purposes only.

LEGEND

- PLANNING APPLICATION BOUNDARY
- FILTER DRAIN
- PERIMETER FENCE

EQUIPMENT INDEX	
SHEET	DRAWING TITLE
G001	Power Conversion System (PCS) & Transformer Arrangement
G002	Spare Parts Container Arrangement
G003	Not used
G004	Battery Arrangement
G005	DNO Substation Arrangement
G006	Gate, Fencing & CCTV Arrangement
G007	BESS Switchroom Arrangement
G008	Auxiliary & Earthing Transformer Arrangement
G009	Comms & DNO Feeder Pillar Arrangement
G010	LV Board, Control Room & Intermediate Substation Arrangement

Rev	Description	Date	Checked
AD	Annotations updated	28.02.23	SS MC
AC	Swale maintenance gate added	20.02.23	SS MC
AB	Updated PSUK design	08.02.23	SS MC
AA	PSUK design	31.01.23	SS MC
Z	Labeling updates	27.10.22	SS AF
Y	Revised layout, SMA equipment	18.10.22	SS CH
X	Solar, POC & private wire cables added	15.08.22	SS EF
W	BoP equipment rearranged, DNO sub	03.08.22	SS CH
V	Drg title change, drainage extended	31.05.22	SS MC
U	Eqpt/access changes, Rev J RLB back	28.04.22	SS NM
T	57MW PE skid design implemented	25.04.21	SS
S	Repositioned LV Aux Switchroom	25.04.21	SS
R	Revised NG incomer	25.04.21	SS
Q	Updated PCS/Tx fencing	25.04.21	SS
P	Updated equipment	25.04.21	SS
O	Incomer/fence/BESS eqpt repositioned	25.04.21	SS
N	Incomer repositioned	25.04.21	SS
M	Red line reverted to Rev J	25.04.21	SS
L	Various equipment/positioning changes	14.10.21	SS
K	Red line extended west	13.05.20	SS
J	Drawing title amendment	05.06.19	SS
I	Revised red line/aerial mapping hidden	31.05.19	SS
H	Revised red line	29.05.19	SS
G	Revised mapping	17.05.19	SS
F	Revised config/location	14.05.19	SS
E	Revised config	26.03.19	SS
D	Revised location/annotations	24.07.18	SS
C	System relocated, annotation changes	20.06.18	SS
B	Switched to containers	26.04.18	SS
A	Lease area added	25.04.18	SS
-	First Issue	13.03.18	SS

Drawing No.
BRAM-PP-TCL-DRG-P001

Project
Bramford Substation Battery (amended scheme)

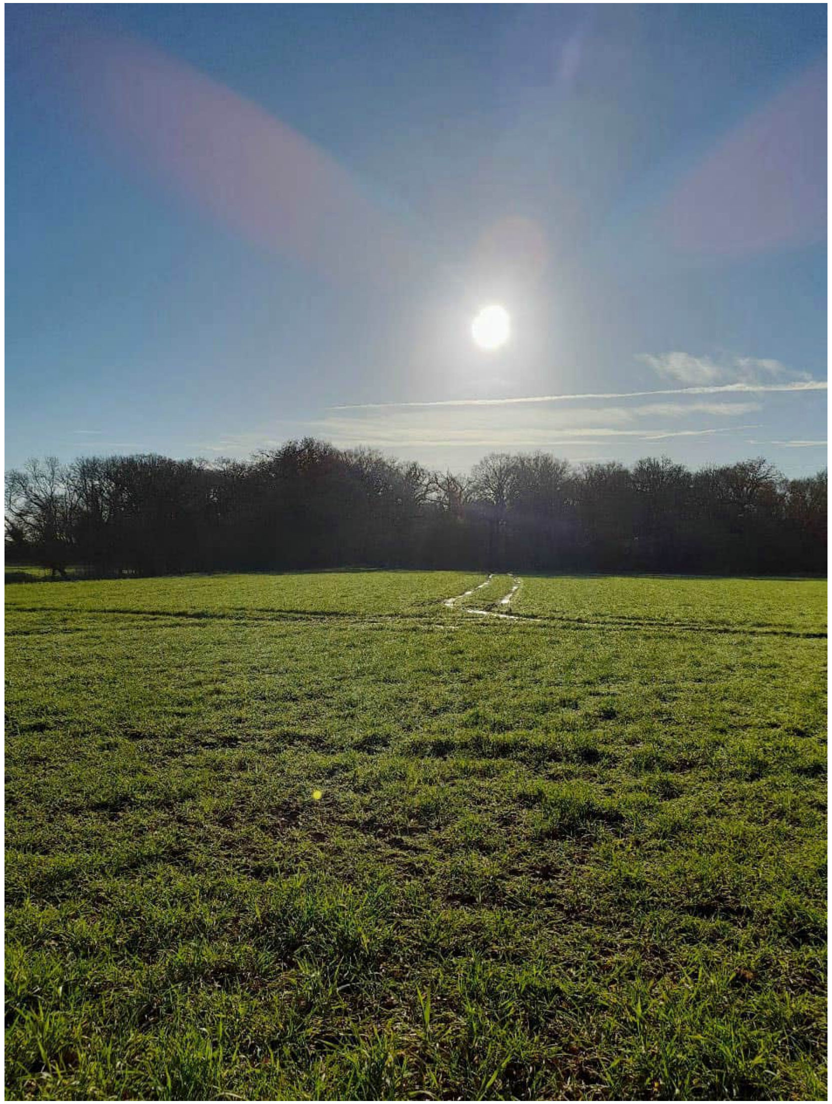
Title
Site Layout

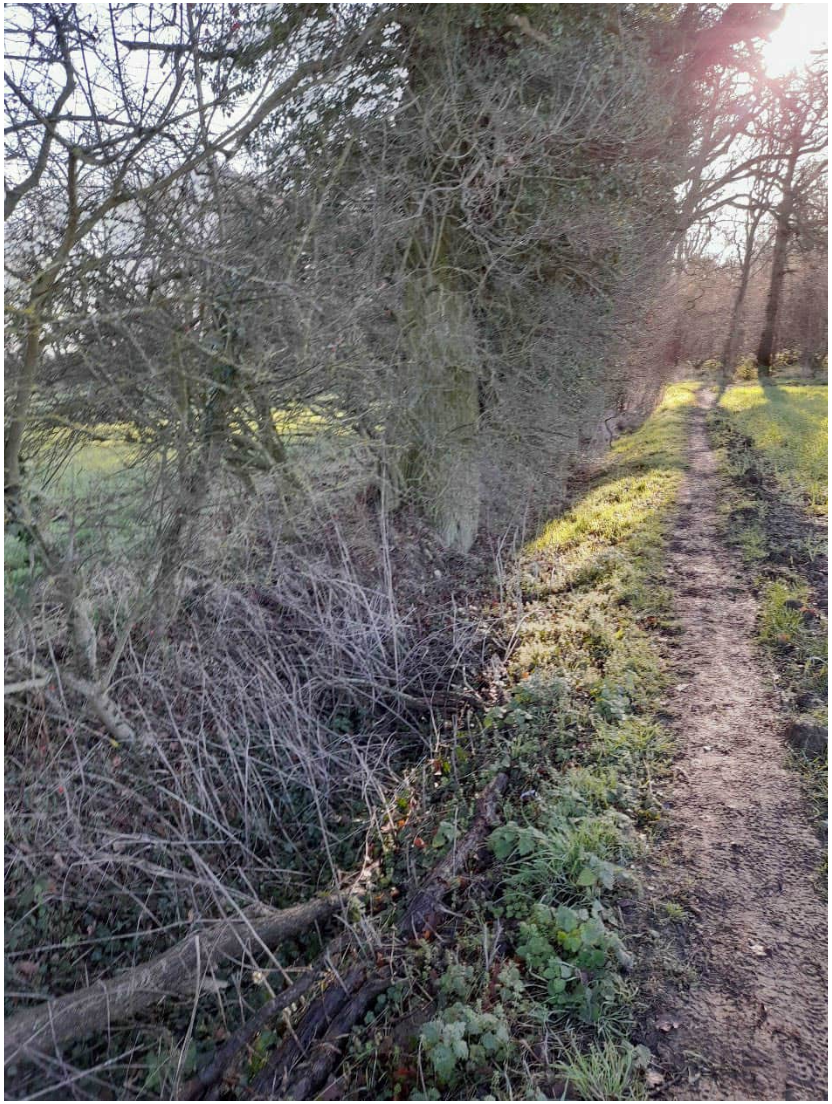
Scale	Drawn by	Checked	Date
1:1250 @A3	SS	MC	28.02.23

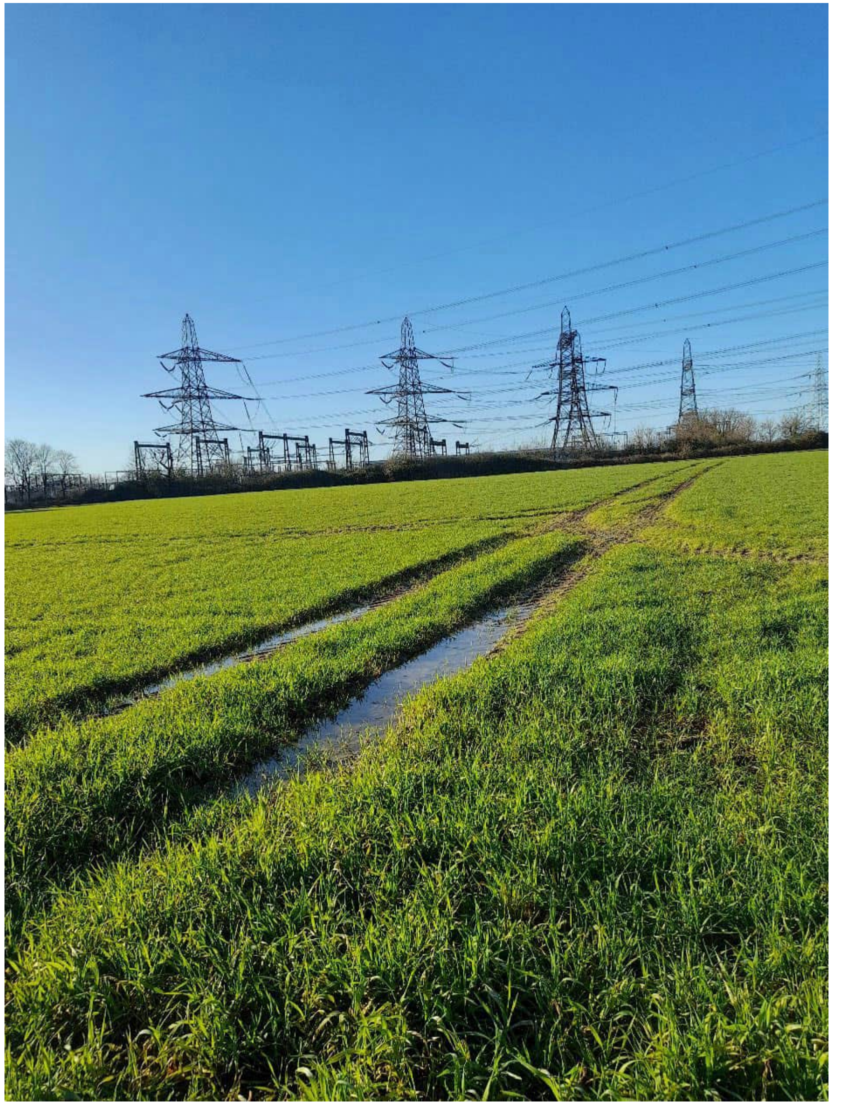
pivot power
EDF renewables

A: Pivot Power Limited, Cardinal Place, 80 Victoria Street, London SW1E 5JL
E: info@pivot-power.co.uk
W: www.pivot-power.co.uk

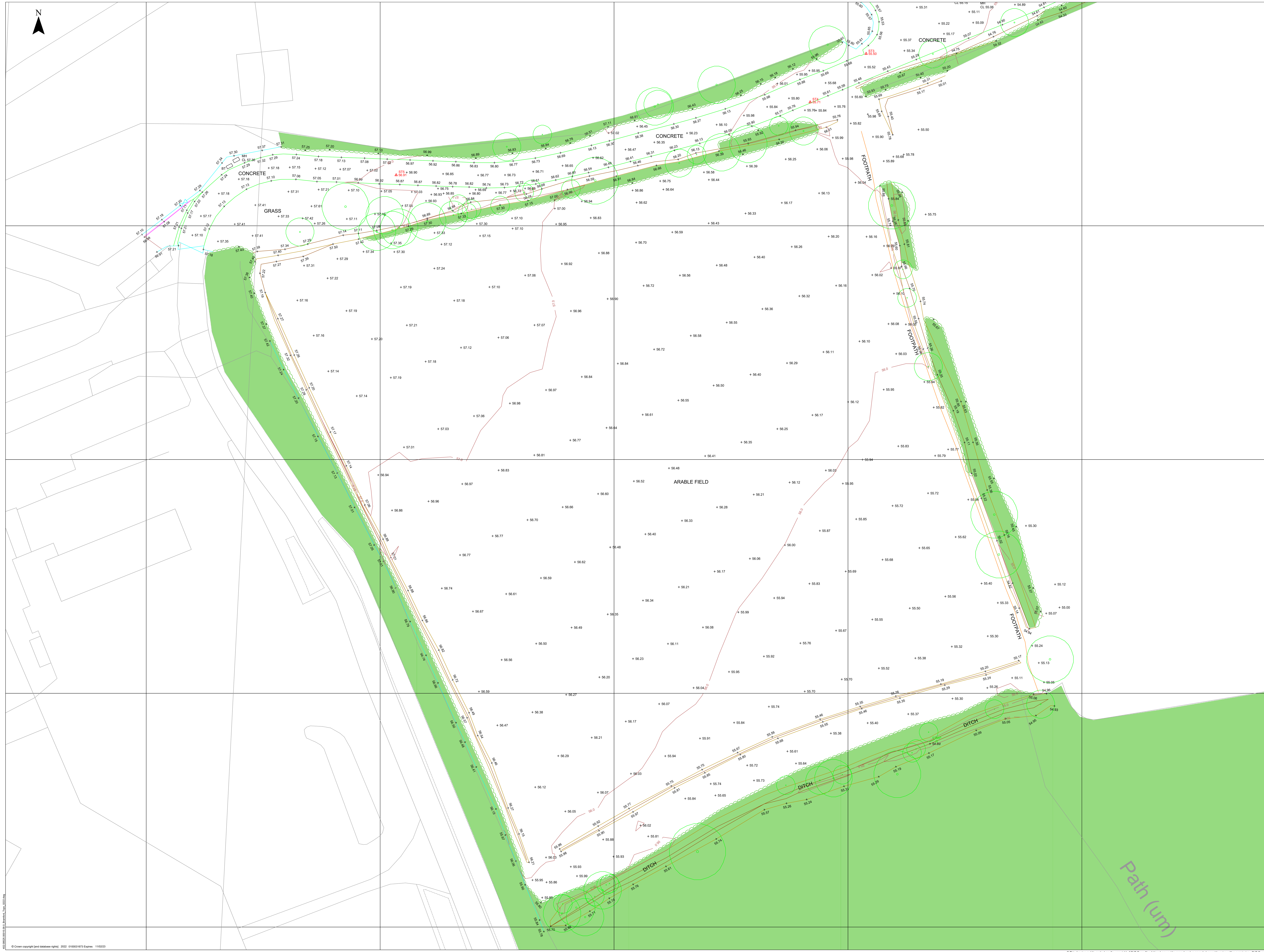
Appendix 02: Site Walkover Photographs







Appendix 03: Topographic Survey



NOTES

1. SURVEY CARRIED OUT BY SLR CONSULTING LTD ON THE 7TH FEBRUARY 2022.

2. THIS PLAN IS ORIENTATED TO ORDNANCE SURVEY NATIONAL GRID AND NEWLYN DATUM DERIVED FROM ORDNANCE SURVEY ACTIVE NETWORK (OSTN15,OSGB36).

3. THE TOPOGRAPHICAL SURVEY HAS NO ORDNANCE SURVEY LOCAL SCALE FACTOR APPLIED. THE ORIGIN OF THE SITE SURVEY GRID IS ST1

4. UNLESS STATED ALL MEASUREMENTS ARE IN METERS.

5. ALL FEATURES SHOWN WERE CURRENT AT THE TIME OF THE SURVEY. THERE MAY BE FEATURES MISSING DURING THE SURVEY DUE TO OBSTRUCTIONS OR LACK OF ACCESS.

6. BOUNDARIES SHOWN ARE PHYSICAL FEATURES ON SITE AND DO NOT NECESSARILY REPRESENT THE LEGAL EXTENTS OF OWNERSHIP.

7. THE ACCURACY OF THIS SURVEY IS COMMENSURATE WITH THE DRAWING SCALE SPECIFIED WITHIN THE TITLE BLOCK. ALL CRUCIAL DIMENSIONS SHOULD BE CHECKED ON SITE.

8. OS DATA IS SHOWN IN GREY.

9. THIS SURVEY SHOULD ONLY BE USED FOR THE PURPOSE ORIGINALLY CARRIED OUT FOR.

LEGEND

Abbreviations
(where applicable)

BB	Belisha Beacon	LR	Life Ring
BC	Building Canopy	MH	Manhole
BH	Borehole	MKR	Marker
BM	Bench Mark	PO	Post
BDY	Boundary	PM	Parking Meter
BOL	Bollard	PInv	Pipe Invert
BT	British Telecom Manhole	RL	Ridge Level
CCTV	Closed Circuit Television	RNP	Road Name Plate
CTV	Cable Television Manhole	RS	Sign Post
CUL	Culvert	SO	Soffit Level
DK	Drop Kerb	ST	Stop Tap
DP	Drain Pipe	Stmp	Stump (Tree)
DPC	Damp Proof Course	SV	Stop Valve
DWB	Dog Waste Bin	SVP	Soil Vent Pipe
EB	Electricity Box	SW	Storm Water
EL	Eaves Level	SY	Stay (e.g. Pylon, TP)
EP	Electricity Pole	TAP	Stand Pipe
ER	Earthing Rod	TCB	Telephone Call Box
IFL	Internal Floor Level	TCL	Tactile
INV	Invert	THL	Threshold Level
FE	Fire Point	TL	Traffic Light
FA	Fire Alarm	TW	Top of Wall
GB	Grit Box	TP	Telegraph Pole
GV	Gas Valve	TPT	Trial Pit
GP	Gate Post	U/B	Under Beam
G	Gully	UTL	Unable To Lift
FH	Hydrant	VP	Vent Pipe
IC	Inspection Chamber	WSL	Window Sill Level
IT	Intercom	WHL	Window Head Level
KO	Kerb Outlet	WL	Water Level
LB	Life Buoy	WM	Water Meter
LP	Lamp Post		

BANK BOTTOM
BANK TOP
FENCE
EDGE OF VEGETATION
KERB BOTTOM
KERB TOP
VERGE
TREE
SPOT LEVEL
SURVEY CONTROL
VEGETATION

0	NS	GJH	02/22	TOPOGRAPHIC SURVEY
Revision	By	Chk'd By	Date	Comments

SLR
7 WORNAL PARK
MENMARSH ROAD
WORMINGHALL, AYLESBURY
BUCKS. HP18 9PH
T: 01844 337380
F: 01844 337381
www.slrconsulting.com

Site
BRAMFORD SUBSTATION BATTERY

Project
TOPOGRAPHICAL SURVEY

Drawing Title
TOPOGRAPHIC SURVEY
7th FEBRUARY 2022

Scale: 1:250 @ A0
Date: FEBRUARY 2022

Drawing Number: **001**
Revision: **0**

OVERVIEW

Appendix 04: Infiltration Testing Results for Planning Application DC/21/05468

APPENDIX 2 – EXPLORATORY HOLE LOGS

Trial Pit Logs
(TP01 to TP03)

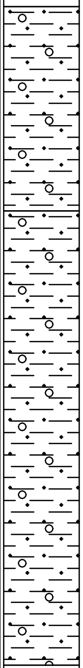
Geosphere Environmental Ltd
Unit 11 Brightwell Barns
Brightwell, Ipswich, IP10 0BJ
Telephone: 01603 298 076

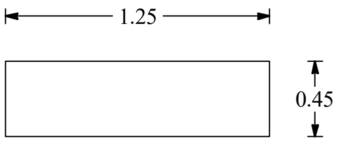
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Bullen Lane, Bramford	Pigeon Investment Management Ltd	TP01

Job No	Date	Ground Level (m)	Grid Reference ()
5191,SK	10-11-20 11-11-20		

Fieldwork By	Logged By	Sheet
GEL	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.25	Brown gravelly clayey fine and coarse SAND. Gravel is fine to coarse angular to subrounded flint (TOPSOIL)				
0.25-0.70	Orangish brown sandy gravelly CLAY. Gravel is fine to coarse angular to subrounded flint				
0.70-1.70	Light greyish brown gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded chalk and flint				Trial pit terminated at 1.7m bgl. No further progress possible - soils too dense



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:16.6666666666667	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Unit 11 Brightwell Barns
Brightwell, Ipswich, IP10 0BJ
Telephone: 01603 298 076

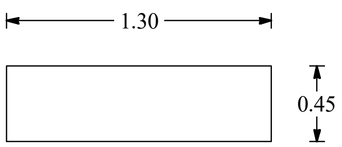
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Bullen Lane, Bramford	Pigeon Investment Management Ltd	TP02

Job No	Date	Ground Level (m)	Grid Reference ()
5191,SK	10-11-20 11-11-20		

Fieldwork By	Logged By	Sheet
GEL	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.20	Brown gravelly clayey fine and coarse SAND. Gravel is fine to coarse angular to subrounded flint (TOPSOIL)				
0.20-0.65	Orangish brown sandy gravelly CLAY. Gravel is fine to coarse angular to subrounded flint				
0.65-1.70	Light greyish brown gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded chalk and flint				Trial pit terminated at 1.7m bgl. No further progress possible - soils too dense



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:16.6666666666667	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Unit 11 Brightwell Barns
Brightwell, Ipswich, IP10 0BJ
Telephone: 01603 298 076

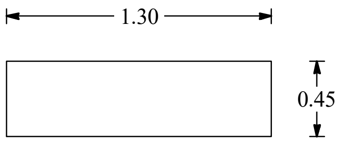
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Bullen Lane, Bramford	Pigeon Investment Management Ltd	TP03

Job No	Date	Ground Level (m)	Grid Reference ()
5191,SK	10-11-20 11-11-20		

Fieldwork By	Logged By	Sheet
GEL	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.25	Brown gravelly clayey fine and coarse SAND. Gravel is fine to coarse angular to subrounded flint (TOPSOIL)				
0.25-0.65	Orangish brown sandy gravelly CLAY. Gravel is fine to coarse angular to subrounded flint				
0.65-1.70	Light greyish brown gravelly sandy CLAY. Gravel is fine to coarse subangular to subrounded chalk and flint				Trial pit terminated at 1.7m bgl. No further progress possible - soils too dense



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:16.6666666666667	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

APPENDIX 3 – INFILTRATION TEST RESULTS

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 5191,SK

Date: 23/11/2020

Project Name: Land at Bullen Lane, Bramford

Time [min]	Depth to Water [mbgl]
0	1.180
1	1.180
2	1.185
3	1.185
4	1.185
5	1.185
35	1.195
65	1.200
120	1.210
1045	1.305
1440	1.335

Pit Size [m]		
Length	Width	Depth
1.25	0.45	1.70

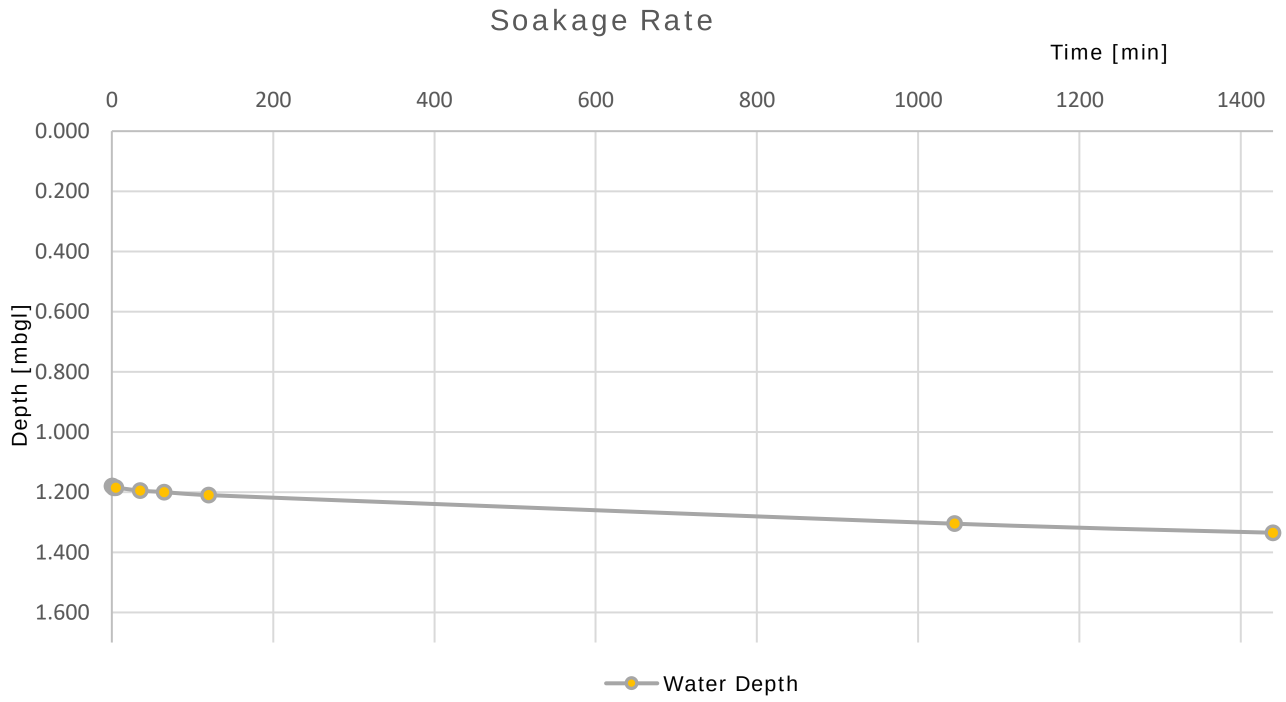
It was not possible to undertake full-depth soakaway test.

Trial Pit: TP01

Run: 1 of 1

Test Date: 10/11/20 - 11/11/20

Groundwater Encountered: n/a



mbgl - (metres below ground level)

Calculated by: PC

Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 5191,SK

Date: 23/11/2020

Project Name: Land at Bullen Lane, Bramford

Time [min]	Depth to Water [mbgl]
0	1.195
1	1.195
2	1.195
3	1.195
4	1.195
5	1.200
60	1.196
120	1.207
1080	1.251
1440	1.286

Pit Size [m]		
Length	Width	Depth
1.25	0.45	1.70

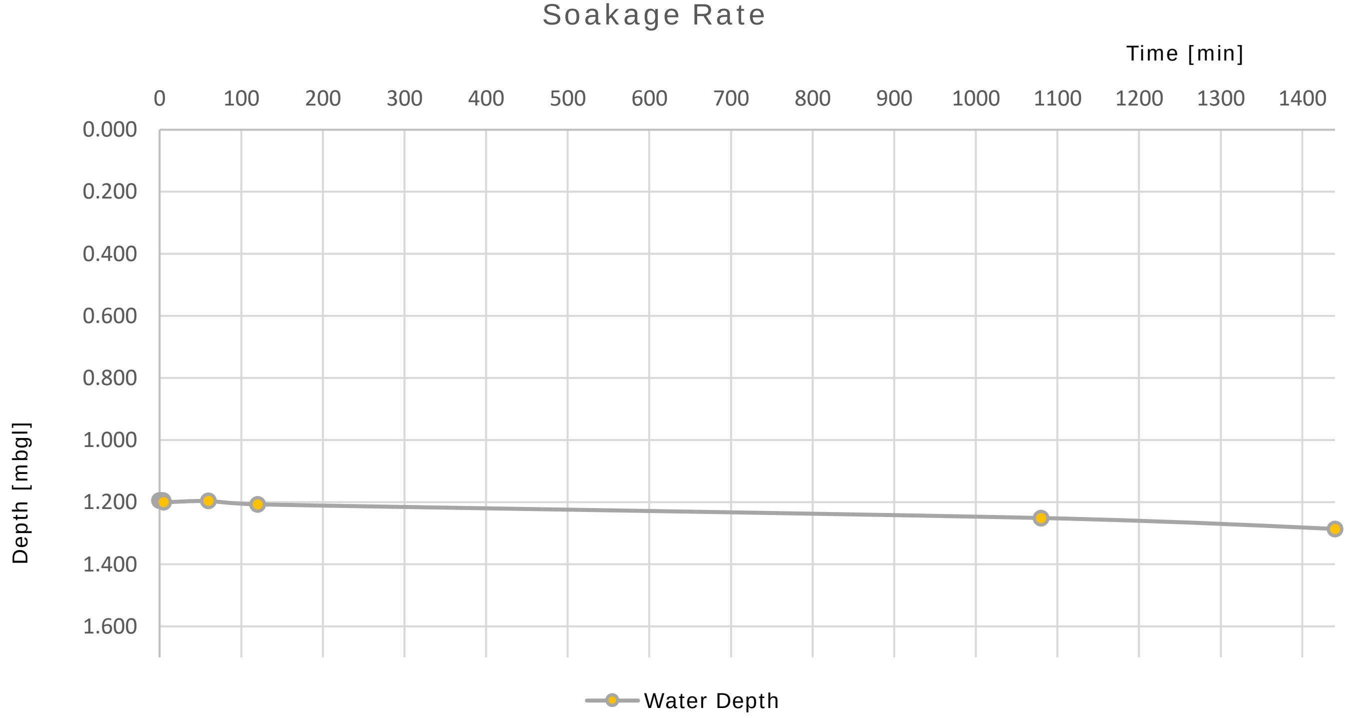
It was not possible to undertake full-depth soakaway test.

Trial Pit: TP02

Run: 1 of 1

Test Date: 10/11/20 - 11/11/20

Groundwater Encountered: n/a



mbgl - (metres below ground level)

Calculated by: PC Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 5191,SK

Date: 23/11/2020

Project Name: Land at Bullen Lane, Bramford

Time [min]	Depth to Water [mbgl]
0	1.190
1	1.195
2	1.200
3	1.205
4	1.205
5	1.215
40	1.220
60	1.225
120	1.246
180	1.261
1080	1.383
1440	1.418

Pit Size [m]		
Length	Width	Depth
1.3	0.45	1.70

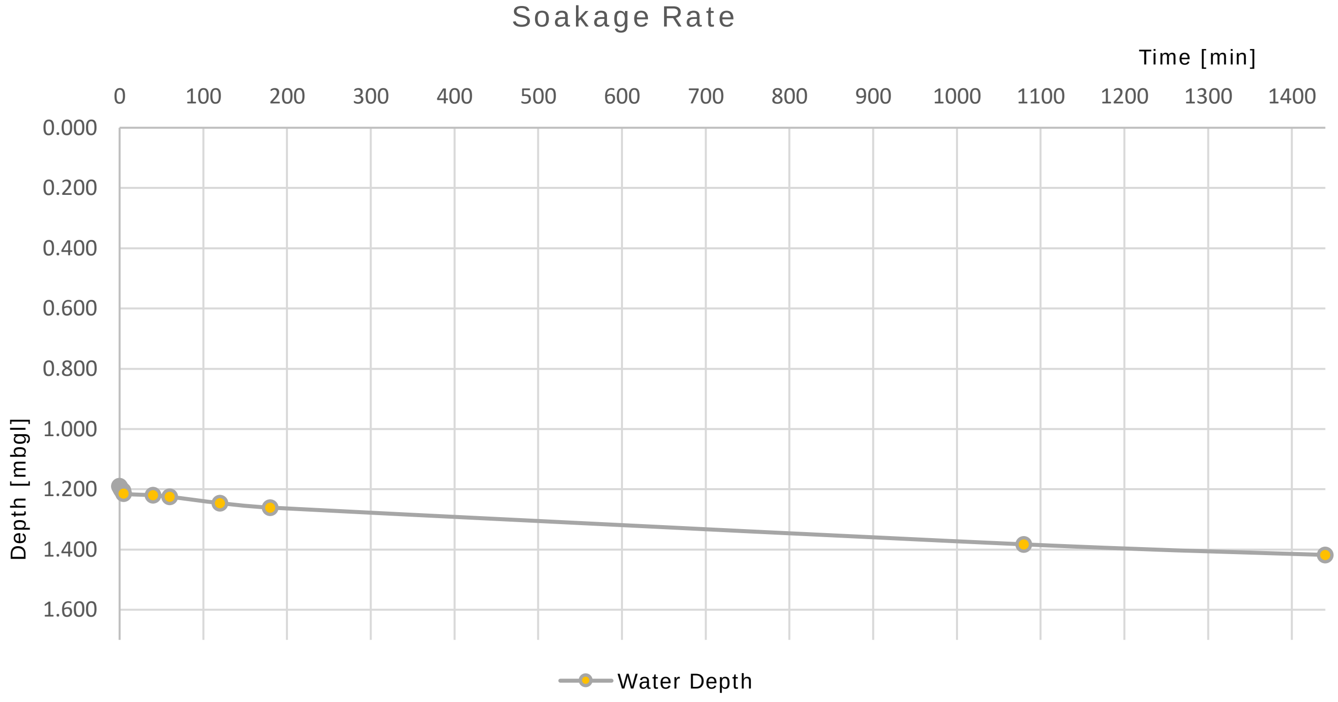
It was not possible to undertake full-depth soakaway test.

Trial Pit: TP01

Run: 1 of 1

Test Date: 10/11/20 - 11/11/20

Groundwater Encountered: n/a



mbgl - (metres below ground level)

Calculated by: PC

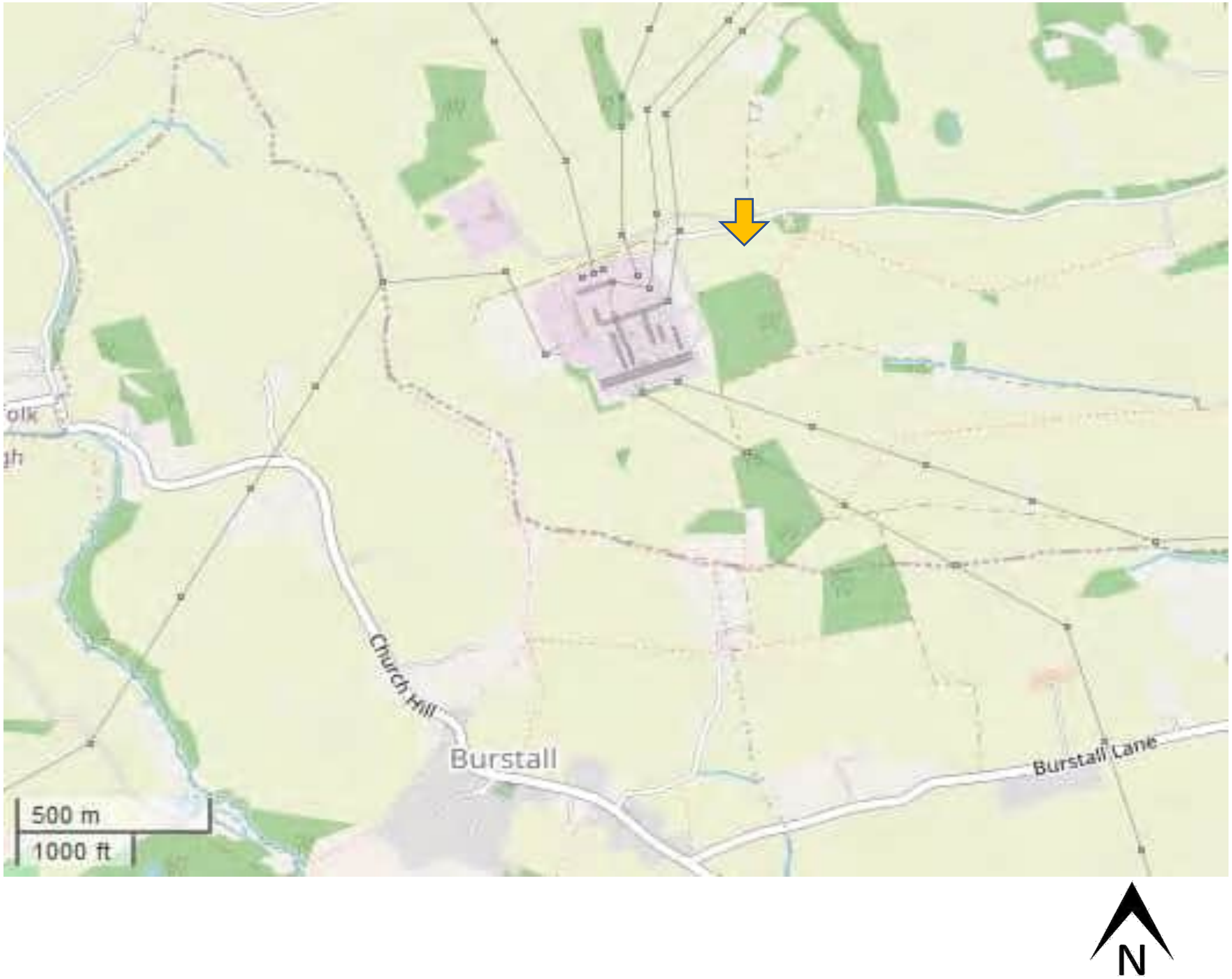
Checked by: SG

TPSK02 / 03-10-18 / V2

APPENDIX 4 – DRAWINGS

Site Location Plan - Drawing ref. 5191,SK/001/Rev0

Exploratory Hole Location Plan – Drawing ref. 5191,SK/002/Rev0



GEOSPHERE ENVIRONMENTAL

LEGEND

Site Location

SOURCE

© OpenStreetMap contributors

PROJECT

Land off Bullen Lane, Bramford

TITLE

Site Location Plan

DRAWING NUMBER

5191,SK/001/Rev0

SCALE	DATE
As Marked	20/11/2020
DRAWN BY	CHECKED BY
PC	SG

GEOSPHERE ENVIRONMENTAL

LEGEND

Site boundary

Trial pit

SOURCE

Envirocheck

PROJECT

Land off Bullen Lane, Bramford

TITLE

Exploratory Hole Location Plan

DRAWING NUMBER

5191,SK/002/Rev0

SCALE	DATE
NTS	20/11/2020
DRAWN BY	CHECKED BY
PC	SG

GEO

GEOSPHERE ENVIRONMENTAL

Ec Ecology.

Fr Flood Risk.

Ge Geotechnical.

En Environmental.

Kw Knotweed.

GEOSPHERE ENVIRONMENTAL LTD
Brightwell Barns, Ipswich Road, Brightwell, Suffolk, IP10 0BJ
T: 01603 298076 | 01473 353519 | **E**: info@geosphere-environmental.co.uk | **W**: geosphere-environmental.co.uk

Appendix 05: Anglian Water Asset Plans

Date: 12/01/22 | Scale: 1:1250 | Map Centre: 610184,246072 | Data updated: 31/12/21 | Our Ref: 753991 - 1 | Wastewater Plan A0

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station

*(Colour denotes effluent type)

chloenelson@slrconsulting.com

bramford

love every drop
anglianwater

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix 06: Southern Boundary Ditch Discharge Agreement

BROOKS LENEY
YOUR LAND OUR KNOWLEDGE

Flood and Water Management
Suffolk County Council
Endeavour House
8 Russell Road
Ipswich
Suffolk
IP1 2BX

Our ref: CJL/DA/60196
9th June 2023

For the attention of: Jason Skilton, Flood and Water Engineer

Dear Mr Skilton,

Planning Application DC/23/02280
Land to the South of Bullen Lane, Bramford, Ipswich, Suffolk, IP8 4JD

As agents to the landowners of the watercourse identified as Southern Boundary Ditch on the northern edge of Bullen Bramford, we can confirm that we have granted Pivoted Power LLP (part of EDF Renewables) the rights to discharge surface water run-off into that watercourse in perpetuity.

Should you have any questions, please contact me on one of the numbers below.

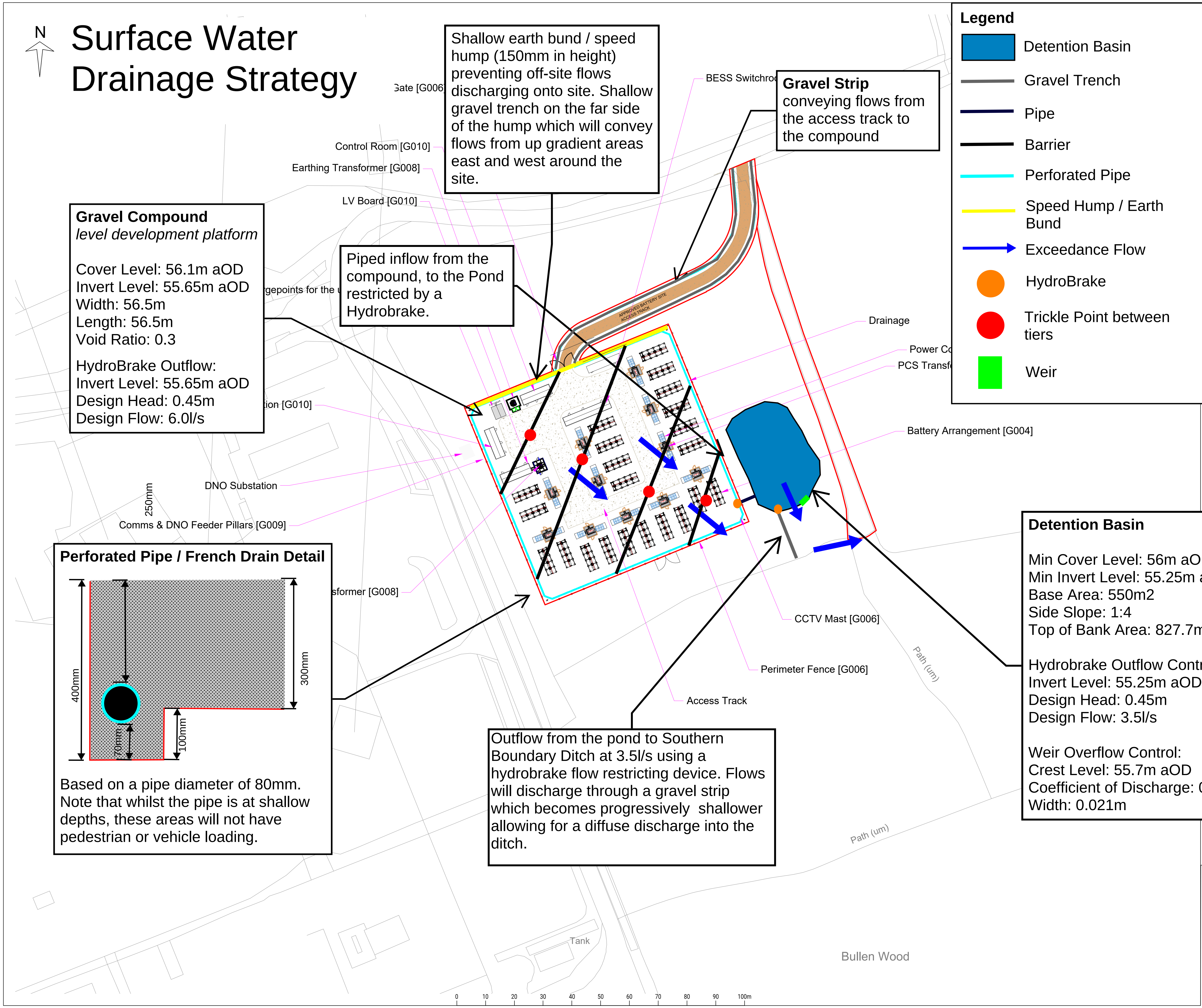
Yours sincerely

C J Leney MRICS FAAV REV | Partner
For & on behalf of Brooks Leney

Direct: 01473 835253 | Mobile: 07717 274413 | Email: cjl@brooksleney.co.uk | PA: Debbie Allum 01473 835251

Appendix 07: Conceptual Surface Water Drainage Drawing

Surface Water Drainage Strategy



Shallow earth bund / speed hump (150mm in height) preventing off-site flows discharging onto site. Shallow gravel trench on the far side of the hump which will convey flows from up gradient areas east and west around the site.

Gravel Strip conveying flows from the access track to the compound

Gravel Compound
level development platform

Cover Level: 56.1m aOD
Invert Level: 55.65m aOD
Width: 56.5m
Length: 56.5m
Void Ratio: 0.3

HydroBrake Outflow:
Invert Level: 55.65m aOD
Design Head: 0.45m
Design Flow: 6.0l/s

Piped inflow from the compound, to the Pond restricted by a Hydrobrake.

Legend

- Detention Basin
- Gravel Trench
- Pipe
- Barrier
- Perforated Pipe
- Speed Hump / Earth Bund
- Exceedance Flow
- HydroBrake
- Trickle Point between tiers
- Weir

Perforated Pipe / French Drain Detail

Based on a pipe diameter of 80mm. Note that whilst the pipe is at shallow depths, these areas will not have pedestrian or vehicle loading.

Outflow from the pond to Southern Boundary Ditch at 3.5l/s using a hydrobrake flow restricting device. Flows will discharge through a gravel strip which becomes progressively shallower allowing for a diffuse discharge into the ditch.

Detention Basin

Min Cover Level: 56m aOD
Min Invert Level: 55.25m aOD
Base Area: 550m2
Side Slope: 1:4
Top of Bank Area: 827.7m2

Hydrobrake Outflow Control:
Invert Level: 55.25m aOD
Design Head: 0.45m
Design Flow: 3.5l/s

Weir Overflow Control:
Crest Level: 55.7m aOD
Coefficient of Discharge: 0.544
Width: 0.021m

NOTES

1. Drawing details are for planning purposes only.

LEGEND

- PLANNING APPLICATION BOUNDARY
- FILTER DRAIN
- PERIMETER FENCE

EQUIPMENT INDEX

SHEET	DRAWING TITLE
G001	Power Conversion System (PCS) & Transformer Arrangement
G002	Spare Parts Container Arrangement
G003	Not used
G004	Battery Arrangement
G005	DNO Substation Arrangement
G006	Gate, Fencing & CCTV Arrangement
G007	BESS Switchroom Arrangement
G008	Auxiliary & Earthing Transformer Arrangement
G009	Comms & DNO Feeder Pillar Arrangement
G010	LV Board, Control Room & Intermediate Substation Arrangement

AD	Annotations updated	28.02.23	SS MC
AC	Swale maintenance gate added	20.02.23	SS MC
AB	Updated PSUK design	08.02.23	SS MC
AA	PSUK design	31.01.23	SS MC
Z	Labeling updates	27.10.22	SS AF
Y	Revised layout, SMA equipment	18.10.22	SS CH
X	Solar, POC & private wire cables added	15.08.22	SS EF
W	BoP equipment rearranged, DNO sub	03.08.22	SS CH
V	Drg title change, drainage extended	31.05.22	SS MC
U	Eqpt/access changes, Rev J RLB back	28.04.22	SS NM
T	57MW PE skid design implemented	25.04.21	SS
S	Repositioned LV Aux Switchroom	25.04.21	SS
R	Revised NG incomer	25.04.21	SS
Q	Updated PCS/Tx fencing	25.04.21	SS
P	Updated equipment	25.04.21	SS
O	Incomer/fence/BESS eqpt repositioned	25.04.21	SS
	mer repositioned	25.04.21	SS
	line reverted to Rev J	25.04.21	SS
	ous equipment/positioning changes	14.10.21	SS
	line extended west	13.05.20	SS
	ing title amendment	05.06.19	SS
	sed red line/aerial mapping hidden	31.05.19	SS
	sed red line	29.05.19	SS
	sed mapping	17.05.19	SS
	sed config/location	14.05.19	SS
	sed config	26.03.19	SS
	sed location/annotations	24.07.18	SS
	em relocated, annotation changes	20.06.18	SS
	ched to containers	26.04.18	SS
	e area added	25.04.18	SS
	Issue	13.03.18	SS
	cription	Date	Checked

BRAM-PP-TCL-DRG-P001

rd Substation Battery (amended scheme)

Site Layout

Scale	Drawn by	Checked	Date
1:1250 @A3	SS	MC	28.02.23

pivot power
EDF renewables

A: Pivot Power Limited,
Cardinal Place,
80 Victoria Street,
London SW1E 5JL

E: info@pivot-power.co.uk
W: www.pivot-power.co.uk

Appendix 08: Post Development Runoff Calculations

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 275 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	55.685	0.035	0.0	0.7	0.7	33.6	O K
30 min Summer	55.699	0.049	0.0	1.4	1.4	47.2	O K
60 min Summer	55.713	0.063	0.0	2.1	2.1	59.9	O K
120 min Summer	55.739	0.089	0.0	3.7	3.7	85.0	O K
180 min Summer	55.749	0.099	0.0	4.3	4.3	94.9	O K
240 min Summer	55.755	0.105	0.0	4.6	4.6	100.2	O K
360 min Summer	55.760	0.110	0.0	4.9	4.9	105.1	O K
480 min Summer	55.761	0.111	0.0	5.0	5.0	106.3	O K
600 min Summer	55.761	0.111	0.0	4.9	4.9	106.1	O K
720 min Summer	55.760	0.110	0.0	4.9	4.9	105.1	O K
960 min Summer	55.757	0.107	0.0	4.7	4.7	102.3	O K
1440 min Summer	55.750	0.100	0.0	4.4	4.4	96.0	O K
2160 min Summer	55.742	0.092	0.0	3.9	3.9	88.1	O K
2880 min Summer	55.736	0.086	0.0	3.5	3.5	82.1	O K
4320 min Summer	55.727	0.077	0.0	3.0	3.0	74.1	O K
5760 min Summer	55.722	0.072	0.0	2.6	2.6	68.7	O K
7200 min Summer	55.718	0.068	0.0	2.4	2.4	64.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	32.762	0.0	22.4	19
30 min Summer	21.111	0.0	35.3	34
60 min Summer	13.010	0.0	55.3	62
120 min Summer	9.294	0.0	88.4	122
180 min Summer	7.295	0.0	107.8	168
240 min Summer	6.031	0.0	120.9	192
360 min Summer	4.498	0.0	137.2	254
480 min Summer	3.601	0.0	147.2	322
600 min Summer	3.016	0.0	154.3	390
720 min Summer	2.604	0.0	159.7	456
960 min Summer	2.060	0.0	167.8	590
1440 min Summer	1.476	0.0	177.7	852
2160 min Summer	1.064	0.0	197.8	1232
2880 min Summer	0.851	0.0	207.4	1588
4320 min Summer	0.632	0.0	223.3	2336
5760 min Summer	0.520	0.0	247.0	3056
7200 min Summer	0.452	0.0	262.8	3816

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.715	0.065	0.0	2.2	2.2	62.0	O K
10080 min Summer	55.712	0.062	0.0	2.1	2.1	59.8	O K
15 min Winter	55.685	0.035	0.0	0.7	0.7	33.6	O K
30 min Winter	55.699	0.049	0.0	1.4	1.4	47.2	O K
60 min Winter	55.713	0.063	0.0	2.1	2.1	60.1	O K
120 min Winter	55.739	0.089	0.0	3.7	3.7	85.7	O K
180 min Winter	55.750	0.100	0.0	4.4	4.4	96.1	O K
240 min Winter	55.755	0.105	0.0	4.6	4.6	100.7	O K
360 min Winter	55.759	0.109	0.0	4.9	4.9	104.8	O K
480 min Winter	55.759	0.109	0.0	4.9	4.9	104.9	O K
600 min Winter	55.758	0.108	0.0	4.8	4.8	103.4	O K
720 min Winter	55.756	0.106	0.0	4.7	4.7	101.4	O K
960 min Winter	55.751	0.101	0.0	4.4	4.4	96.7	O K
1440 min Winter	55.742	0.092	0.0	3.9	3.9	88.2	O K
2160 min Winter	55.732	0.082	0.0	3.3	3.3	78.6	O K
2880 min Winter	55.725	0.075	0.0	2.8	2.8	71.9	O K
4320 min Winter	55.716	0.066	0.0	2.3	2.3	63.1	O K
5760 min Winter	55.710	0.060	0.0	1.9	1.9	57.4	O K
7200 min Winter	55.706	0.056	0.0	1.7	1.7	53.5	O K
8640 min Winter	55.703	0.053	0.0	1.5	1.5	50.6	O K
10080 min Winter	55.701	0.051	0.0	1.4	1.4	48.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.406	0.0	277.9	4496
10080 min Summer	0.373	0.0	291.8	5248
15 min Winter	32.762	0.0	22.4	19
30 min Winter	21.111	0.0	35.3	33
60 min Winter	13.010	0.0	55.3	62
120 min Winter	9.294	0.0	88.4	118
180 min Winter	7.295	0.0	107.8	172
240 min Winter	6.031	0.0	120.9	196
360 min Winter	4.498	0.0	137.2	270
480 min Winter	3.601	0.0	147.2	346
600 min Winter	3.016	0.0	154.3	418
720 min Winter	2.604	0.0	159.7	492
960 min Winter	2.060	0.0	167.8	628
1440 min Winter	1.476	0.0	177.8	896
2160 min Winter	1.064	0.0	197.9	1296
2880 min Winter	0.851	0.0	207.6	1672
4320 min Winter	0.632	0.0	223.8	2420
5760 min Winter	0.520	0.0	247.5	3168
7200 min Winter	0.452	0.0	263.7	3888
8640 min Winter	0.406	0.0	279.1	4592
10080 min Winter	0.373	0.0	293.5	5256

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.610

Time From:	(mins) To:	Area (ha)
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 216 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.274	0.024	0.0	0.3	0.0	0.3	13.1	O K
30 min Summer	55.283	0.033	0.0	0.6	0.0	0.6	18.4	O K
60 min Summer	55.293	0.043	0.0	0.9	0.0	0.9	23.9	O K
120 min Summer	55.315	0.065	0.0	1.8	0.0	1.8	36.5	O K
180 min Summer	55.328	0.078	0.0	2.4	0.0	2.4	44.1	O K
240 min Summer	55.337	0.087	0.0	2.7	0.0	2.7	49.3	O K
360 min Summer	55.348	0.098	0.0	3.1	0.0	3.1	55.8	O K
480 min Summer	55.354	0.104	0.0	3.3	0.0	3.3	59.3	O K
600 min Summer	55.358	0.108	0.0	3.4	0.0	3.4	61.2	O K
720 min Summer	55.359	0.109	0.0	3.4	0.0	3.4	61.7	O K
960 min Summer	55.359	0.109	0.0	3.4	0.0	3.4	61.7	O K
1440 min Summer	55.357	0.107	0.0	3.4	0.0	3.4	60.9	O K
2160 min Summer	55.354	0.104	0.0	3.3	0.0	3.3	58.8	O K
2880 min Summer	55.349	0.099	0.0	3.1	0.0	3.1	56.3	O K
4320 min Summer	55.342	0.092	0.0	2.9	0.0	2.9	51.8	O K
5760 min Summer	55.335	0.085	0.0	2.6	0.0	2.6	48.2	O K
7200 min Summer	55.331	0.081	0.0	2.5	0.0	2.5	45.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	32.762	0.0	19.6	0.0	467
30 min Summer	21.111	0.0	32.9	0.0	376
60 min Summer	13.010	0.0	59.3	0.0	338
120 min Summer	9.294	0.0	96.3	0.0	310
180 min Summer	7.295	0.0	118.1	0.0	336
240 min Summer	6.031	0.0	132.8	0.0	372
360 min Summer	4.498	0.0	151.0	0.0	450
480 min Summer	3.601	0.0	162.2	0.0	530
600 min Summer	3.016	0.0	170.1	0.0	610
720 min Summer	2.604	0.0	176.1	0.0	698
960 min Summer	2.060	0.0	184.8	0.0	814
1440 min Summer	1.476	0.0	195.0	0.0	1056
2160 min Summer	1.064	0.0	223.6	0.0	1428
2880 min Summer	0.851	0.0	234.5	0.0	1804
4320 min Summer	0.632	0.0	251.5	0.0	2540
5760 min Summer	0.520	0.0	284.1	0.0	3272
7200 min Summer	0.452	0.0	302.8	0.0	3976

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.327	0.077	0.0	2.3	0.0	2.3	43.4	O K
10080 min Summer	55.324	0.074	0.0	2.2	0.0	2.2	41.8	O K
15 min Winter	55.274	0.024	0.0	0.3	0.0	0.3	13.1	O K
30 min Winter	55.283	0.033	0.0	0.6	0.0	0.6	18.4	O K
60 min Winter	55.293	0.043	0.0	0.9	0.0	0.9	23.9	O K
120 min Winter	55.315	0.065	0.0	1.8	0.0	1.8	36.5	O K
180 min Winter	55.328	0.078	0.0	2.4	0.0	2.4	44.1	O K
240 min Winter	55.337	0.087	0.0	2.7	0.0	2.7	49.3	O K
360 min Winter	55.348	0.098	0.0	3.1	0.0	3.1	55.8	O K
480 min Winter	55.355	0.105	0.0	3.3	0.0	3.3	59.3	O K
600 min Winter	55.358	0.108	0.0	3.4	0.0	3.4	61.3	O K
720 min Winter	55.359	0.109	0.0	3.4	0.0	3.4	62.0	O K
960 min Winter	55.358	0.108	0.0	3.4	0.0	3.4	61.4	O K
1440 min Winter	55.354	0.104	0.0	3.3	0.0	3.3	59.2	O K
2160 min Winter	55.347	0.097	0.0	3.0	0.0	3.0	54.9	O K
2880 min Winter	55.340	0.090	0.0	2.8	0.0	2.8	50.6	O K
4320 min Winter	55.329	0.079	0.0	2.4	0.0	2.4	44.4	O K
5760 min Winter	55.322	0.072	0.0	2.1	0.0	2.1	40.2	O K
7200 min Winter	55.317	0.067	0.0	1.9	0.0	1.9	37.4	O K
8640 min Winter	55.313	0.063	0.0	1.7	0.0	1.7	35.3	O K
10080 min Winter	55.310	0.060	0.0	1.6	0.0	1.6	33.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	0.406	0.0	320.2	0.0	4704
10080 min Summer	0.373	0.0	335.8	0.0	5440
15 min Winter	32.762	0.0	19.6	0.0	467
30 min Winter	21.111	0.0	32.9	0.0	376
60 min Winter	13.010	0.0	59.3	0.0	338
120 min Winter	9.294	0.0	96.3	0.0	312
180 min Winter	7.295	0.0	118.1	0.0	336
240 min Winter	6.031	0.0	132.8	0.0	374
360 min Winter	4.498	0.0	151.0	0.0	452
480 min Winter	3.601	0.0	162.2	0.0	530
600 min Winter	3.016	0.0	170.1	0.0	612
720 min Winter	2.604	0.0	176.1	0.0	700
960 min Winter	2.060	0.0	184.8	0.0	832
1440 min Winter	1.476	0.0	195.0	0.0	1090
2160 min Winter	1.064	0.0	223.7	0.0	1484
2880 min Winter	0.851	0.0	234.7	0.0	1864
4320 min Winter	0.632	0.0	252.0	0.0	2612
5760 min Winter	0.520	0.0	284.6	0.0	3336
7200 min Winter	0.452	0.0	303.7	0.0	4072
8640 min Winter	0.406	0.0	321.5	0.0	4840
10080 min Winter	0.373	0.0	337.6	0.0	5536

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.080

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m) 55.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 341 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	55.745	0.095	0.0	4.1	4.1	91.1	O K
30 min Summer	55.776	0.126	0.0	5.6	5.6	120.6	O K
60 min Summer	55.805	0.155	0.0	6.0	6.0	148.7	O K
120 min Summer	55.843	0.193	0.0	6.0	6.0	184.9	O K
180 min Summer	55.859	0.209	0.0	6.0	6.0	200.6	O K
240 min Summer	55.866	0.216	0.0	6.0	6.0	207.1	O K
360 min Summer	55.869	0.219	0.0	6.0	6.0	209.7	O K
480 min Summer	55.867	0.217	0.0	6.0	6.0	207.9	O K
600 min Summer	55.863	0.213	0.0	6.0	6.0	204.5	O K
720 min Summer	55.859	0.209	0.0	6.0	6.0	199.9	O K
960 min Summer	55.848	0.198	0.0	6.0	6.0	189.5	O K
1440 min Summer	55.826	0.176	0.0	6.0	6.0	168.6	O K
2160 min Summer	55.799	0.149	0.0	5.9	5.9	142.5	O K
2880 min Summer	55.780	0.130	0.0	5.8	5.8	124.6	O K
4320 min Summer	55.760	0.110	0.0	4.9	4.9	105.4	O K
5760 min Summer	55.748	0.098	0.0	4.3	4.3	94.0	O K
7200 min Summer	55.740	0.090	0.0	3.8	3.8	86.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	71.516	0.0	77.7	19
30 min Summer	46.471	0.0	109.1	33
60 min Summer	28.885	0.0	151.2	62
120 min Summer	18.452	0.0	199.2	122
180 min Summer	13.860	0.0	226.9	180
240 min Summer	11.188	0.0	245.6	240
360 min Summer	8.139	0.0	269.2	296
480 min Summer	6.429	0.0	283.8	356
600 min Summer	5.331	0.0	294.1	420
720 min Summer	4.566	0.0	301.9	486
960 min Summer	3.563	0.0	313.0	618
1440 min Summer	2.509	0.0	327.4	880
2160 min Summer	1.772	0.0	352.9	1252
2880 min Summer	1.392	0.0	365.5	1588
4320 min Summer	1.005	0.0	385.8	2332
5760 min Summer	0.806	0.0	414.5	3056
7200 min Summer	0.687	0.0	434.3	3752

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.735	0.085	0.0	3.4	3.4	81.1	O K
10080 min Summer	55.730	0.080	0.0	3.2	3.2	76.9	O K
15 min Winter	55.745	0.095	0.0	4.1	4.1	91.1	O K
30 min Winter	55.776	0.126	0.0	5.7	5.7	120.8	O K
60 min Winter	55.806	0.156	0.0	6.0	6.0	149.1	O K
120 min Winter	55.843	0.193	0.0	6.0	6.0	185.2	O K
180 min Winter	55.860	0.210	0.0	6.0	6.0	201.0	O K
240 min Winter	55.867	0.217	0.0	6.0	6.0	207.6	O K
360 min Winter	55.867	0.217	0.0	6.0	6.0	207.9	O K
480 min Winter	55.864	0.214	0.0	6.0	6.0	204.5	O K
600 min Winter	55.858	0.208	0.0	6.0	6.0	198.8	O K
720 min Winter	55.850	0.200	0.0	6.0	6.0	191.8	O K
960 min Winter	55.834	0.184	0.0	6.0	6.0	176.5	O K
1440 min Winter	55.805	0.155	0.0	6.0	6.0	148.3	O K
2160 min Winter	55.775	0.125	0.0	5.6	5.6	120.0	O K
2880 min Winter	55.759	0.109	0.0	4.9	4.9	104.4	O K
4320 min Winter	55.740	0.090	0.0	3.8	3.8	86.6	O K
5760 min Winter	55.730	0.080	0.0	3.1	3.1	76.4	O K
7200 min Winter	55.723	0.073	0.0	2.7	2.7	69.7	O K
8640 min Winter	55.718	0.068	0.0	2.4	2.4	64.9	O K
10080 min Winter	55.714	0.064	0.0	2.2	2.2	61.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.606	0.0	453.0	4496
10080 min Summer	0.548	0.0	469.8	5240
15 min Winter	71.516	0.0	77.7	18
30 min Winter	46.471	0.0	109.1	33
60 min Winter	28.885	0.0	151.2	62
120 min Winter	18.452	0.0	199.2	120
180 min Winter	13.860	0.0	226.9	176
240 min Winter	11.188	0.0	245.6	232
360 min Winter	8.139	0.0	269.2	326
480 min Winter	6.429	0.0	283.8	370
600 min Winter	5.331	0.0	294.2	446
720 min Winter	4.566	0.0	302.0	520
960 min Winter	3.563	0.0	313.1	664
1440 min Winter	2.509	0.0	327.5	924
2160 min Winter	1.772	0.0	352.9	1280
2880 min Winter	1.392	0.0	365.7	1644
4320 min Winter	1.005	0.0	386.2	2380
5760 min Winter	0.806	0.0	414.9	3112
7200 min Winter	0.687	0.0	435.0	3824
8640 min Winter	0.606	0.0	453.9	4576
10080 min Winter	0.548	0.0	471.3	5248

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.610

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)**
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 367 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.313	0.063	0.0	1.7	0.0	1.7	35.1	O K
30 min Summer	55.335	0.085	0.0	2.6	0.0	2.6	47.8	O K
60 min Summer	55.358	0.108	0.0	3.4	0.0	3.4	61.6	O K
120 min Summer	55.397	0.147	0.0	3.5	0.0	3.5	84.6	O K
180 min Summer	55.421	0.171	0.0	3.5	0.0	3.5	99.1	O K
240 min Summer	55.438	0.188	0.0	3.5	0.0	3.5	109.4	O K
360 min Summer	55.460	0.210	0.0	3.5	0.0	3.5	123.3	O K
480 min Summer	55.475	0.225	0.0	3.5	0.0	3.5	132.3	O K
600 min Summer	55.486	0.236	0.0	3.5	0.0	3.5	139.0	O K
720 min Summer	55.494	0.244	0.0	3.5	0.0	3.5	144.2	O K
960 min Summer	55.505	0.255	0.0	3.5	0.0	3.5	151.4	O K
1440 min Summer	55.508	0.258	0.0	3.5	0.0	3.5	153.3	O K
2160 min Summer	55.492	0.242	0.0	3.5	0.0	3.5	143.3	O K
2880 min Summer	55.474	0.224	0.0	3.5	0.0	3.5	131.9	O K
4320 min Summer	55.435	0.185	0.0	3.5	0.0	3.5	107.6	O K
5760 min Summer	55.402	0.152	0.0	3.5	0.0	3.5	87.7	O K
7200 min Summer	55.379	0.129	0.0	3.5	0.0	3.5	73.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	71.516	0.0	78.8	0.0	250
30 min Summer	46.471	0.0	113.2	0.0	247
60 min Summer	28.885	0.0	166.9	0.0	292
120 min Summer	18.452	0.0	220.8	0.0	444
180 min Summer	13.860	0.0	252.0	0.0	548
240 min Summer	11.188	0.0	272.8	0.0	626
360 min Summer	8.139	0.0	299.1	0.0	746
480 min Summer	6.429	0.0	315.3	0.0	836
600 min Summer	5.331	0.0	326.6	0.0	918
720 min Summer	4.566	0.0	335.1	0.0	990
960 min Summer	3.563	0.0	346.8	0.0	1126
1440 min Summer	2.509	0.0	360.5	0.0	1410
2160 min Summer	1.772	0.0	398.9	0.0	1700
2880 min Summer	1.392	0.0	413.1	0.0	2032
4320 min Summer	1.005	0.0	434.4	0.0	2736
5760 min Summer	0.806	0.0	473.4	0.0	3440
7200 min Summer	0.687	0.0	496.5	0.0	4104

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.363	0.113	0.0	3.4	0.0	3.4	64.2	O K
10080 min Summer	55.355	0.105	0.0	3.3	0.0	3.3	59.6	O K
15 min Winter	55.313	0.063	0.0	1.7	0.0	1.7	35.1	O K
30 min Winter	55.335	0.085	0.0	2.6	0.0	2.6	47.8	O K
60 min Winter	55.358	0.108	0.0	3.4	0.0	3.4	61.6	O K
120 min Winter	55.397	0.147	0.0	3.5	0.0	3.5	84.7	O K
180 min Winter	55.422	0.172	0.0	3.5	0.0	3.5	99.3	O K
240 min Winter	55.439	0.189	0.0	3.5	0.0	3.5	109.8	O K
360 min Winter	55.461	0.211	0.0	3.5	0.0	3.5	123.9	O K
480 min Winter	55.476	0.226	0.0	3.5	0.0	3.5	133.1	O K
600 min Winter	55.487	0.237	0.0	3.5	0.0	3.5	139.8	O K
720 min Winter	55.495	0.245	0.0	3.5	0.0	3.5	144.9	O K
960 min Winter	55.506	0.256	0.0	3.5	0.0	3.5	151.8	O K
1440 min Winter	55.506	0.256	0.0	3.5	0.0	3.5	152.2	O K
2160 min Winter	55.477	0.227	0.0	3.5	0.0	3.5	133.9	O K
2880 min Winter	55.444	0.194	0.0	3.5	0.0	3.5	113.0	O K
4320 min Winter	55.387	0.137	0.0	3.5	0.0	3.5	78.2	O K
5760 min Winter	55.356	0.106	0.0	3.3	0.0	3.3	60.4	O K
7200 min Winter	55.344	0.094	0.0	2.9	0.0	2.9	53.0	O K
8640 min Winter	55.335	0.085	0.0	2.6	0.0	2.6	48.1	O K
10080 min Winter	55.329	0.079	0.0	2.4	0.0	2.4	44.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	0.606	0.0	517.8	0.0	4760
10080 min Summer	0.548	0.0	536.2	0.0	5448
15 min Winter	71.516	0.0	78.8	0.0	250
30 min Winter	46.471	0.0	113.2	0.0	247
60 min Winter	28.885	0.0	166.9	0.0	292
120 min Winter	18.452	0.0	220.9	0.0	442
180 min Winter	13.860	0.0	252.0	0.0	546
240 min Winter	11.188	0.0	272.8	0.0	624
360 min Winter	8.139	0.0	299.2	0.0	740
480 min Winter	6.429	0.0	315.4	0.0	830
600 min Winter	5.331	0.0	326.7	0.0	908
720 min Winter	4.566	0.0	335.2	0.0	978
960 min Winter	3.563	0.0	347.0	0.0	1110
1440 min Winter	2.509	0.0	361.0	0.0	1396
2160 min Winter	1.772	0.0	399.0	0.0	1712
2880 min Winter	1.392	0.0	413.3	0.0	2072
4320 min Winter	1.005	0.0	435.0	0.0	2744
5760 min Winter	0.806	0.0	473.9	0.0	3352
7200 min Winter	0.687	0.0	497.3	0.0	4048
8640 min Winter	0.606	0.0	518.9	0.0	4760
10080 min Winter	0.548	0.0	538.0	0.0	5480

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.080

Time From:	(mins) To:	Area (ha)
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m) 55.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)**
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 419 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.775	0.125	0.0	5.6	5.6	119.6	O K
30 min Summer	55.817	0.167	0.0	6.0	6.0	159.7	O K
60 min Summer	55.857	0.207	0.0	6.0	6.0	198.4	O K
120 min Summer	55.906	0.256	0.0	6.0	6.0	245.3	O K
180 min Summer	55.931	0.281	0.0	6.0	6.0	268.8	O K
240 min Summer	55.944	0.294	0.0	6.0	6.0	281.2	O K
360 min Summer	55.951	0.301	0.0	6.0	6.0	288.3	O K
480 min Summer	55.949	0.299	0.0	6.0	6.0	286.5	O K
600 min Summer	55.945	0.295	0.0	6.0	6.0	282.3	O K
720 min Summer	55.939	0.289	0.0	6.0	6.0	276.9	O K
960 min Summer	55.926	0.276	0.0	6.0	6.0	263.9	O K
1440 min Summer	55.896	0.246	0.0	6.0	6.0	235.4	O K
2160 min Summer	55.855	0.205	0.0	6.0	6.0	196.3	O K
2880 min Summer	55.822	0.172	0.0	6.0	6.0	165.2	O K
4320 min Summer	55.782	0.132	0.0	5.9	5.9	126.3	O K
5760 min Summer	55.764	0.114	0.0	5.1	5.1	108.9	O K
7200 min Summer	55.752	0.102	0.0	4.5	4.5	98.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	90.794	0.0	106.1	19
30 min Summer	59.620	0.0	147.9	33
60 min Summer	37.210	0.0	201.5	62
120 min Summer	23.516	0.0	260.3	122
180 min Summer	17.682	0.0	296.1	182
240 min Summer	14.312	0.0	320.9	242
360 min Summer	10.464	0.0	353.1	356
480 min Summer	8.294	0.0	373.5	406
600 min Summer	6.893	0.0	387.9	464
720 min Summer	5.910	0.0	398.7	522
960 min Summer	4.614	0.0	413.8	654
1440 min Summer	3.232	0.0	431.1	920
2160 min Summer	2.255	0.0	458.8	1300
2880 min Summer	1.751	0.0	470.4	1668
4320 min Summer	1.235	0.0	486.2	2336
5760 min Summer	0.971	0.0	510.9	3056
7200 min Summer	0.814	0.0	527.6	3752

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.745	0.095	0.0	4.1	4.1	90.6	O K
10080 min Summer	55.739	0.089	0.0	3.7	3.7	85.0	O K
15 min Winter	55.775	0.125	0.0	5.6	5.6	119.7	O K
30 min Winter	55.817	0.167	0.0	6.0	6.0	159.8	O K
60 min Winter	55.857	0.207	0.0	6.0	6.0	198.5	O K
120 min Winter	55.906	0.256	0.0	6.0	6.0	245.2	O K
180 min Winter	55.930	0.280	0.0	6.0	6.0	268.6	O K
240 min Winter	55.943	0.293	0.0	6.0	6.0	280.8	O K
360 min Winter	55.951	0.301	0.0	6.0	6.0	288.1	O K
480 min Winter	55.947	0.297	0.0	6.0	6.0	284.0	O K
600 min Winter	55.940	0.290	0.0	6.0	6.0	277.3	O K
720 min Winter	55.932	0.282	0.0	6.0	6.0	269.8	O K
960 min Winter	55.913	0.263	0.0	6.0	6.0	251.6	O K
1440 min Winter	55.872	0.222	0.0	6.0	6.0	212.5	O K
2160 min Winter	55.820	0.170	0.0	6.0	6.0	162.3	O K
2880 min Winter	55.785	0.135	0.0	5.9	5.9	128.8	O K
4320 min Winter	55.756	0.106	0.0	4.7	4.7	101.0	O K
5760 min Winter	55.741	0.091	0.0	3.8	3.8	86.7	O K
7200 min Winter	55.731	0.081	0.0	3.2	3.2	77.9	O K
8640 min Winter	55.725	0.075	0.0	2.8	2.8	71.8	O K
10080 min Winter	55.720	0.070	0.0	2.5	2.5	67.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.709	0.0	543.5	4496
10080 min Summer	0.635	0.0	558.2	5240
15 min Winter	90.794	0.0	106.1	18
30 min Winter	59.620	0.0	147.9	33
60 min Winter	37.210	0.0	201.5	62
120 min Winter	23.516	0.0	260.3	120
180 min Winter	17.682	0.0	296.1	178
240 min Winter	14.312	0.0	320.9	234
360 min Winter	10.464	0.0	353.2	346
480 min Winter	8.294	0.0	373.6	446
600 min Winter	6.893	0.0	388.0	476
720 min Winter	5.910	0.0	398.8	548
960 min Winter	4.614	0.0	414.0	694
1440 min Winter	3.232	0.0	431.5	978
2160 min Winter	2.255	0.0	458.9	1344
2880 min Winter	1.751	0.0	470.5	1672
4320 min Winter	1.235	0.0	486.7	2376
5760 min Winter	0.971	0.0	511.3	3112
7200 min Winter	0.814	0.0	528.2	3824
8640 min Winter	0.709	0.0	544.5	4576
10080 min Winter	0.635	0.0	559.6	5248

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.610

Time From:	(mins) To:	Area (ha)
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)**
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 539 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.332	0.082	0.0	2.5	0.0	2.5	46.5	O K
30 min Summer	55.362	0.112	0.0	3.4	0.0	3.4	63.8	O K
60 min Summer	55.398	0.148	0.0	3.5	0.0	3.5	85.3	O K
120 min Summer	55.448	0.198	0.0	3.5	0.0	3.5	115.5	O K
180 min Summer	55.479	0.229	0.0	3.5	0.0	3.5	135.1	O K
240 min Summer	55.502	0.252	0.0	3.5	0.0	3.5	149.3	O K
360 min Summer	55.532	0.282	0.0	3.5	0.0	3.5	168.9	O K
480 min Summer	55.553	0.303	0.0	3.5	0.0	3.5	182.5	O K
600 min Summer	55.569	0.319	0.0	3.5	0.0	3.5	192.9	O K
720 min Summer	55.582	0.332	0.0	3.5	0.0	3.5	201.4	O K
960 min Summer	55.599	0.349	0.0	3.5	0.0	3.5	212.9	O K
1440 min Summer	55.616	0.366	0.0	3.5	0.0	3.5	224.6	O K
2160 min Summer	55.607	0.357	0.0	3.5	0.0	3.5	218.2	O K
2880 min Summer	55.583	0.333	0.0	3.5	0.0	3.5	202.3	O K
4320 min Summer	55.529	0.279	0.0	3.5	0.0	3.5	167.0	O K
5760 min Summer	55.477	0.227	0.0	3.5	0.0	3.5	133.4	O K
7200 min Summer	55.435	0.185	0.0	3.5	0.0	3.5	107.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	90.794	0.0	110.0	0.0	241
30 min Summer	59.620	0.0	155.8	0.0	289
60 min Summer	37.210	0.0	223.5	0.0	422
120 min Summer	23.516	0.0	289.4	0.0	616
180 min Summer	17.682	0.0	329.3	0.0	744
240 min Summer	14.312	0.0	356.8	0.0	844
360 min Summer	10.464	0.0	392.2	0.0	990
480 min Summer	8.294	0.0	414.0	0.0	1100
600 min Summer	6.893	0.0	428.8	0.0	1194
720 min Summer	5.910	0.0	439.1	0.0	1276
960 min Summer	4.614	0.0	451.4	0.0	1404
1440 min Summer	3.232	0.0	450.8	0.0	1636
2160 min Summer	2.255	0.0	518.4	0.0	1992
2880 min Summer	1.751	0.0	531.4	0.0	2284
4320 min Summer	1.235	0.0	547.7	0.0	2896
5760 min Summer	0.971	0.0	582.5	0.0	3592
7200 min Summer	0.814	0.0	601.9	0.0	4272

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.404	0.154	0.0	3.5	0.0	3.5	88.5	O K
10080 min Summer	55.381	0.131	0.0	3.5	0.0	3.5	75.1	O K
15 min Winter	55.332	0.082	0.0	2.5	0.0	2.5	46.5	O K
30 min Winter	55.362	0.112	0.0	3.4	0.0	3.4	63.8	O K
60 min Winter	55.398	0.148	0.0	3.5	0.0	3.5	85.4	O K
120 min Winter	55.448	0.198	0.0	3.5	0.0	3.5	115.7	O K
180 min Winter	55.480	0.230	0.0	3.5	0.0	3.5	135.5	O K
240 min Winter	55.503	0.253	0.0	3.5	0.0	3.5	150.0	O K
360 min Winter	55.534	0.284	0.0	3.5	0.0	3.5	170.0	O K
480 min Winter	55.555	0.305	0.0	3.5	0.0	3.5	183.8	O K
600 min Winter	55.571	0.321	0.0	3.5	0.0	3.5	194.4	O K
720 min Winter	55.584	0.334	0.0	3.5	0.0	3.5	202.9	O K
960 min Winter	55.601	0.351	0.0	3.5	0.0	3.5	214.1	O K
1440 min Winter	55.617	0.367	0.0	3.5	0.0	3.5	225.3	O K
2160 min Winter	55.602	0.352	0.0	3.5	0.0	3.5	215.0	O K
2880 min Winter	55.562	0.312	0.0	3.5	0.0	3.5	188.6	O K
4320 min Winter	55.471	0.221	0.0	3.5	0.0	3.5	129.9	O K
5760 min Winter	55.401	0.151	0.0	3.5	0.0	3.5	87.0	O K
7200 min Winter	55.362	0.112	0.0	3.4	0.0	3.4	63.8	O K
8640 min Winter	55.349	0.099	0.0	3.1	0.0	3.1	56.0	O K
10080 min Winter	55.340	0.090	0.0	2.8	0.0	2.8	50.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	0.709	0.0	620.2	0.0	4936
10080 min Summer	0.635	0.0	635.8	0.0	5600
15 min Winter	90.794	0.0	110.0	0.0	241
30 min Winter	59.620	0.0	155.8	0.0	289
60 min Winter	37.210	0.0	223.5	0.0	422
120 min Winter	23.516	0.0	289.4	0.0	614
180 min Winter	17.682	0.0	329.3	0.0	744
240 min Winter	14.312	0.0	356.8	0.0	840
360 min Winter	10.464	0.0	392.2	0.0	982
480 min Winter	8.294	0.0	414.1	0.0	1090
600 min Winter	6.893	0.0	429.0	0.0	1182
720 min Winter	5.910	0.0	439.4	0.0	1260
960 min Winter	4.614	0.0	452.1	0.0	1382
1440 min Winter	3.232	0.0	454.3	0.0	1606
2160 min Winter	2.255	0.0	518.6	0.0	1980
2880 min Winter	1.751	0.0	531.6	0.0	2252
4320 min Winter	1.235	0.0	548.3	0.0	2944
5760 min Winter	0.971	0.0	582.9	0.0	3576
7200 min Winter	0.814	0.0	602.7	0.0	4112
8640 min Winter	0.709	0.0	621.3	0.0	4808
10080 min Winter	0.635	0.0	637.7	0.0	5480

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.080

Time From:	(mins) To:	Area (ha)
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m) 55.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)**
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 519 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	55.803	0.153	0.0	6.0	6.0	146.8	O K
30 min Summer	55.854	0.204	0.0	6.0	6.0	195.6	O K
60 min Summer	55.904	0.254	0.0	6.0	6.0	243.2	O K
120 min Summer	55.965	0.315	0.0	6.0	6.0	302.1	O K
180 min Summer	55.998	0.348	0.0	6.0	6.0	333.2	O K
240 min Summer	56.016	0.366	0.0	6.0	6.0	350.8	O K
360 min Summer	56.030	0.380	0.0	6.0	6.0	363.8	O K
480 min Summer	56.029	0.379	0.0	6.0	6.0	362.7	O K
600 min Summer	56.023	0.373	0.0	6.0	6.0	357.5	O K
720 min Summer	56.017	0.367	0.0	6.0	6.0	351.1	O K
960 min Summer	56.001	0.351	0.0	6.0	6.0	336.2	O K
1440 min Summer	55.965	0.315	0.0	6.0	6.0	302.0	O K
2160 min Summer	55.916	0.266	0.0	6.0	6.0	254.9	O K
2880 min Summer	55.875	0.225	0.0	6.0	6.0	215.6	O K
4320 min Summer	55.817	0.167	0.0	6.0	6.0	160.1	O K
5760 min Summer	55.784	0.134	0.0	5.9	5.9	128.4	O K
7200 min Summer	55.769	0.119	0.0	5.3	5.3	113.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	108.953	0.0	132.9	19
30 min Summer	71.544	0.0	182.9	33
60 min Summer	44.652	0.0	246.5	64
120 min Summer	28.219	0.0	317.0	122
180 min Summer	21.219	0.0	359.9	182
240 min Summer	17.175	0.0	389.6	242
360 min Summer	12.556	0.0	428.3	360
480 min Summer	9.953	0.0	452.8	468
600 min Summer	8.272	0.0	470.1	514
720 min Summer	7.091	0.0	483.1	572
960 min Summer	5.537	0.0	501.3	696
1440 min Summer	3.878	0.0	522.5	952
2160 min Summer	2.707	0.0	557.6	1340
2880 min Summer	2.101	0.0	572.7	1704
4320 min Summer	1.481	0.0	594.3	2420
5760 min Summer	1.165	0.0	624.6	3064
7200 min Summer	0.977	0.0	646.7	3752

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.759	0.109	0.0	4.8	4.8	104.1	O K
10080 min Summer	55.751	0.101	0.0	4.4	4.4	97.0	O K
15 min Winter	55.803	0.153	0.0	6.0	6.0	146.8	O K
30 min Winter	55.854	0.204	0.0	6.0	6.0	195.7	O K
60 min Winter	55.904	0.254	0.0	6.0	6.0	243.3	O K
120 min Winter	55.965	0.315	0.0	6.0	6.0	301.7	O K
180 min Winter	55.997	0.347	0.0	6.0	6.0	332.6	O K
240 min Winter	56.015	0.365	0.0	6.0	6.0	349.9	O K
360 min Winter	56.029	0.379	0.0	6.0	6.0	363.0	O K
480 min Winter	56.028	0.378	0.0	6.0	6.0	362.2	O K
600 min Winter	56.021	0.371	0.0	6.0	6.0	354.9	O K
720 min Winter	56.011	0.361	0.0	6.0	6.0	345.3	O K
960 min Winter	55.990	0.340	0.0	6.0	6.0	325.5	O K
1440 min Winter	55.942	0.292	0.0	6.0	6.0	280.1	O K
2160 min Winter	55.877	0.227	0.0	6.0	6.0	217.5	O K
2880 min Winter	55.826	0.176	0.0	6.0	6.0	168.9	O K
4320 min Winter	55.773	0.123	0.0	5.5	5.5	118.2	O K
5760 min Winter	55.754	0.104	0.0	4.6	4.6	99.2	O K
7200 min Winter	55.742	0.092	0.0	3.9	3.9	88.3	O K
8640 min Winter	55.735	0.085	0.0	3.4	3.4	80.9	O K
10080 min Winter	55.729	0.079	0.0	3.1	3.1	75.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.851	0.0	668.0	4496
10080 min Summer	0.761	0.0	687.7	5240
15 min Winter	108.953	0.0	132.9	18
30 min Winter	71.544	0.0	182.9	33
60 min Winter	44.652	0.0	246.5	62
120 min Winter	28.219	0.0	317.0	120
180 min Winter	21.219	0.0	359.9	178
240 min Winter	17.175	0.0	389.6	236
360 min Winter	12.556	0.0	428.4	350
480 min Winter	9.953	0.0	452.9	458
600 min Winter	8.272	0.0	470.2	560
720 min Winter	7.091	0.0	483.2	588
960 min Winter	5.537	0.0	501.6	732
1440 min Winter	3.878	0.0	523.1	1012
2160 min Winter	2.707	0.0	557.7	1408
2880 min Winter	2.101	0.0	572.8	1760
4320 min Winter	1.481	0.0	594.7	2380
5760 min Winter	1.165	0.0	625.0	3112
7200 min Winter	0.977	0.0	647.2	3816
8640 min Winter	0.851	0.0	668.8	4576
10080 min Winter	0.761	0.0	689.2	5248

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.610

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)**
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 684 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.352	0.102	0.0	3.2	0.0	3.2	57.6	O K
30 min Summer	55.391	0.141	0.0	3.5	0.0	3.5	81.0	O K
60 min Summer	55.435	0.185	0.0	3.5	0.0	3.5	107.7	O K
120 min Summer	55.494	0.244	0.0	3.5	0.0	3.5	144.7	O K
180 min Summer	55.531	0.281	0.0	3.5	0.0	3.5	168.0	O K
240 min Summer	55.557	0.307	0.0	3.5	0.0	3.5	185.3	O K
360 min Summer	55.596	0.346	0.0	3.5	0.0	3.5	211.1	O K
480 min Summer	55.620	0.370	0.0	3.5	0.0	3.5	226.8	O K
600 min Summer	55.635	0.385	0.0	3.5	0.0	3.5	237.7	O K
720 min Summer	55.647	0.397	0.0	3.5	0.0	3.5	245.5	O K
960 min Summer	55.663	0.413	0.0	3.5	0.0	3.5	256.7	O K
1440 min Summer	55.687	0.437	0.0	3.5	0.0	3.5	273.2	O K
2160 min Summer	55.698	0.448	0.0	3.5	0.0	3.5	281.2	O K
2880 min Summer	55.677	0.427	0.0	3.5	0.0	3.5	266.3	O K
4320 min Summer	55.635	0.385	0.0	3.5	0.0	3.5	237.1	O K
5760 min Summer	55.587	0.337	0.0	3.5	0.0	3.5	205.1	O K
7200 min Summer	55.532	0.282	0.0	3.5	0.0	3.5	168.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	108.953	0.0	139.5	0.0	257
30 min Summer	71.544	0.0	193.7	0.0	384
60 min Summer	44.652	0.0	273.9	0.0	548
120 min Summer	28.219	0.0	352.6	0.0	784
180 min Summer	21.219	0.0	400.0	0.0	946
240 min Summer	17.175	0.0	432.2	0.0	1068
360 min Summer	12.556	0.0	472.0	0.0	1236
480 min Summer	9.953	0.0	494.4	0.0	1342
600 min Summer	8.272	0.0	506.2	0.0	1434
720 min Summer	7.091	0.0	509.5	0.0	1514
960 min Summer	5.537	0.0	496.7	0.0	1650
1440 min Summer	3.878	0.0	463.0	0.0	1862
2160 min Summer	2.707	0.0	629.7	0.0	2192
2880 min Summer	2.101	0.0	646.5	0.0	2476
4320 min Summer	1.481	0.0	668.5	0.0	3076
5760 min Summer	1.165	0.0	711.0	0.0	3792
7200 min Summer	0.977	0.0	736.6	0.0	4480

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.489	0.239	0.0	3.5	0.0	3.5	141.2	O K
10080 min Summer	55.454	0.204	0.0	3.5	0.0	3.5	119.0	O K
15 min Winter	55.352	0.102	0.0	3.2	0.0	3.2	57.6	O K
30 min Winter	55.391	0.141	0.0	3.5	0.0	3.5	81.0	O K
60 min Winter	55.435	0.185	0.0	3.5	0.0	3.5	107.8	O K
120 min Winter	55.495	0.245	0.0	3.5	0.0	3.5	145.0	O K
180 min Winter	55.532	0.282	0.0	3.5	0.0	3.5	168.7	O K
240 min Winter	55.559	0.309	0.0	3.5	0.0	3.5	186.4	O K
360 min Winter	55.598	0.348	0.0	3.5	0.0	3.5	212.2	O K
480 min Winter	55.621	0.371	0.0	3.5	0.0	3.5	227.9	O K
600 min Winter	55.637	0.387	0.0	3.5	0.0	3.5	238.7	O K
720 min Winter	55.649	0.399	0.0	3.5	0.0	3.5	246.7	O K
960 min Winter	55.667	0.417	0.0	3.5	0.0	3.5	259.5	O K
1440 min Winter	55.690	0.440	0.0	3.5	0.0	3.5	275.4	O K
2160 min Winter	55.699	0.449	0.0	3.5	0.0	3.5	282.0	O K
2880 min Winter	55.670	0.420	0.0	3.5	0.0	3.5	261.5	O K
4320 min Winter	55.594	0.344	0.0	3.5	0.0	3.5	209.3	O K
5760 min Winter	55.496	0.246	0.0	3.5	0.0	3.5	145.9	O K
7200 min Winter	55.426	0.176	0.0	3.5	0.0	3.5	101.9	O K
8640 min Winter	55.380	0.130	0.0	3.5	0.0	3.5	74.3	O K
10080 min Winter	55.358	0.108	0.0	3.4	0.0	3.4	61.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	0.851	0.0	760.7	0.0	5176
10080 min Summer	0.761	0.0	781.9	0.0	5848
15 min Winter	108.953	0.0	139.5	0.0	257
30 min Winter	71.544	0.0	193.7	0.0	384
60 min Winter	44.652	0.0	273.9	0.0	548
120 min Winter	28.219	0.0	352.7	0.0	782
180 min Winter	21.219	0.0	400.0	0.0	942
240 min Winter	17.175	0.0	432.3	0.0	1062
360 min Winter	12.556	0.0	472.2	0.0	1226
480 min Winter	9.953	0.0	494.7	0.0	1330
600 min Winter	8.272	0.0	506.9	0.0	1418
720 min Winter	7.091	0.0	511.1	0.0	1494
960 min Winter	5.537	0.0	500.5	0.0	1618
1440 min Winter	3.878	0.0	469.2	0.0	1822
2160 min Winter	2.707	0.0	629.9	0.0	2144
2880 min Winter	2.101	0.0	646.7	0.0	2424
4320 min Winter	1.481	0.0	669.4	0.0	3156
5760 min Winter	1.165	0.0	711.4	0.0	3824
7200 min Winter	0.977	0.0	737.2	0.0	4456
8640 min Winter	0.851	0.0	761.8	0.0	5024
10080 min Winter	0.761	0.0	783.9	0.0	5544

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.080

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m)	55.250	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Appendix 09: 45% Climate Change Sensitivity Check

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 639 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	55.839	0.189	0.0	6.0	6.0	181.1	O K
30 min Summer	55.901	0.251	0.0	6.0	6.0	240.7	O K
60 min Summer	55.963	0.313	0.0	6.0	6.0	299.6	O K
120 min Summer	56.040	0.390	0.0	6.0	6.0	373.2	O K
180 min Summer	56.080	0.430	0.0	6.0	6.0	411.7	O K
240 min Summer	56.103	0.453	0.0	6.0	6.0	433.5	FLOOD
360 min Summer	56.121	0.471	0.0	6.1	6.1	451.6	FLOOD
480 min Summer	56.122	0.472	0.0	6.1	6.1	452.6	FLOOD
600 min Summer	56.116	0.466	0.0	6.1	6.1	446.5	FLOOD
720 min Summer	56.108	0.458	0.0	6.1	6.1	439.4	FLOOD
960 min Summer	56.092	0.442	0.0	6.0	6.0	423.4	O K
1440 min Summer	56.057	0.407	0.0	6.0	6.0	389.3	O K
2160 min Summer	56.004	0.354	0.0	6.0	6.0	338.9	O K
2880 min Summer	55.953	0.303	0.0	6.0	6.0	289.9	O K
4320 min Summer	55.876	0.226	0.0	6.0	6.0	216.8	O K
5760 min Summer	55.826	0.176	0.0	6.0	6.0	168.5	O K
7200 min Summer	55.795	0.145	0.0	5.9	5.9	138.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.652	0.0	166.3	19
30 min Summer	86.449	0.0	226.3	34
60 min Summer	53.954	0.0	302.5	64
120 min Summer	34.098	0.0	387.6	122
180 min Summer	25.639	0.0	439.4	182
240 min Summer	20.753	2.6	475.3	242
360 min Summer	15.172	20.6	522.1	360
480 min Summer	12.027	21.7	551.7	480
600 min Summer	9.995	15.6	572.6	548
720 min Summer	8.569	8.5	588.2	600
960 min Summer	6.690	0.0	610.0	722
1440 min Summer	4.686	0.0	634.1	982
2160 min Summer	3.270	0.0	680.9	1404
2880 min Summer	2.539	0.0	700.5	1784
4320 min Summer	1.790	0.0	729.3	2508
5760 min Summer	1.408	0.0	766.7	3176
7200 min Summer	1.180	0.0	795.5	3824

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.778	0.128	0.0	5.7	5.7	122.6	O K
10080 min Summer	55.768	0.118	0.0	5.3	5.3	113.3	O K
15 min Winter	55.839	0.189	0.0	6.0	6.0	181.1	O K
30 min Winter	55.901	0.251	0.0	6.0	6.0	240.8	O K
60 min Winter	55.963	0.313	0.0	6.0	6.0	299.5	O K
120 min Winter	56.039	0.389	0.0	6.0	6.0	372.8	O K
180 min Winter	56.079	0.429	0.0	6.0	6.0	411.1	O K
240 min Winter	56.102	0.452	0.0	6.0	6.0	433.0	FLOOD
360 min Winter	56.121	0.471	0.0	6.1	6.1	451.5	FLOOD
480 min Winter	56.122	0.472	0.0	6.1	6.1	453.3	FLOOD
600 min Winter	56.116	0.466	0.0	6.1	6.1	447.2	FLOOD
720 min Winter	56.106	0.456	0.0	6.0	6.0	437.1	FLOOD
960 min Winter	56.086	0.436	0.0	6.0	6.0	417.1	O K
1440 min Winter	56.040	0.390	0.0	6.0	6.0	373.3	O K
2160 min Winter	55.964	0.314	0.0	6.0	6.0	300.8	O K
2880 min Winter	55.898	0.248	0.0	6.0	6.0	237.3	O K
4320 min Winter	55.809	0.159	0.0	6.0	6.0	151.8	O K
5760 min Winter	55.772	0.122	0.0	5.5	5.5	116.7	O K
7200 min Winter	55.756	0.106	0.0	4.7	4.7	101.8	O K
8640 min Winter	55.746	0.096	0.0	4.1	4.1	92.3	O K
10080 min Winter	55.740	0.090	0.0	3.7	3.7	85.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.028	0.0	823.5	4504
10080 min Summer	0.920	0.0	849.8	5240
15 min Winter	131.652	0.0	166.3	19
30 min Winter	86.449	0.0	226.3	33
60 min Winter	53.954	0.0	302.5	62
120 min Winter	34.098	0.0	387.6	120
180 min Winter	25.639	0.0	439.4	180
240 min Winter	20.753	2.1	475.4	236
360 min Winter	15.172	20.6	522.1	352
480 min Winter	12.027	22.4	551.8	462
600 min Winter	9.995	16.3	572.7	568
720 min Winter	8.569	6.2	588.3	664
960 min Winter	6.690	0.0	610.2	750
1440 min Winter	4.686	0.0	634.8	1054
2160 min Winter	3.270	0.0	681.0	1476
2880 min Winter	2.539	0.0	700.6	1848
4320 min Winter	1.790	0.0	729.7	2508
5760 min Winter	1.408	0.0	767.0	3120
7200 min Winter	1.180	0.0	796.0	3824
8640 min Winter	1.028	0.0	824.3	4576
10080 min Winter	0.920	0.0	851.2	5248

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.610

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)**
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 788 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.377	0.127	0.0	3.5	0.0	3.5	72.6	O K
30 min Summer	55.428	0.178	0.0	3.5	0.0	3.5	103.2	O K
60 min Summer	55.481	0.231	0.0	3.5	0.0	3.5	136.0	O K
120 min Summer	55.552	0.302	0.0	3.5	0.0	3.5	181.4	O K
180 min Summer	55.603	0.353	0.0	3.5	0.0	3.5	215.3	O K
240 min Summer	55.637	0.387	0.0	3.5	0.0	3.5	238.4	O K
360 min Summer	55.679	0.429	0.0	3.5	0.0	3.5	268.2	O K
480 min Summer	55.705	0.455	0.0	3.5	0.0	3.5	286.4	O K
600 min Summer	55.721	0.471	0.0	3.6	0.1	3.7	297.9	O K
720 min Summer	55.732	0.482	0.0	3.6	0.2	3.8	305.5	O K
960 min Summer	55.744	0.494	0.0	3.7	0.3	4.0	314.5	O K
1440 min Summer	55.754	0.504	0.0	3.7	0.5	4.1	321.7	O K
2160 min Summer	55.763	0.513	0.0	3.7	0.6	4.3	328.0	O K
2880 min Summer	55.765	0.515	0.0	3.7	0.6	4.3	329.6	O K
4320 min Summer	55.736	0.486	0.0	3.6	0.2	3.9	308.8	O K
5760 min Summer	55.704	0.454	0.0	3.5	0.0	3.5	285.3	O K
7200 min Summer	55.666	0.416	0.0	3.5	0.0	3.5	258.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	131.652	0.0	176.0	0.0	331
30 min Summer	86.449	0.0	238.6	0.0	512
60 min Summer	53.954	0.0	336.6	0.0	718
120 min Summer	34.098	0.0	430.5	0.0	1014
180 min Summer	25.639	0.0	484.8	0.0	1194
240 min Summer	20.753	0.0	518.6	0.0	1304
360 min Summer	15.172	0.0	543.7	0.0	1460
480 min Summer	12.027	0.0	537.4	0.1	1576
600 min Summer	9.995	0.0	531.7	1.5	1664
720 min Summer	8.569	0.0	527.1	3.5	1742
960 min Summer	6.690	0.0	517.9	6.9	1882
1440 min Summer	4.686	0.0	497.6	10.6	2140
2160 min Summer	3.270	0.0	768.0	14.6	2464
2880 min Summer	2.539	0.0	789.6	17.2	2748
4320 min Summer	1.790	0.0	815.3	5.9	3280
5760 min Summer	1.408	0.0	871.8	0.1	3928
7200 min Summer	1.180	0.0	904.9	0.0	4632

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.628	0.378	0.0	3.5	0.0	3.5	232.2	O K
10080 min Summer	55.589	0.339	0.0	3.5	0.0	3.5	206.0	O K
15 min Winter	55.377	0.127	0.0	3.5	0.0	3.5	72.6	O K
30 min Winter	55.428	0.178	0.0	3.5	0.0	3.5	103.2	O K
60 min Winter	55.481	0.231	0.0	3.5	0.0	3.5	136.2	O K
120 min Winter	55.552	0.302	0.0	3.5	0.0	3.5	182.0	O K
180 min Winter	55.604	0.354	0.0	3.5	0.0	3.5	216.0	O K
240 min Winter	55.637	0.387	0.0	3.5	0.0	3.5	239.0	O K
360 min Winter	55.680	0.430	0.0	3.5	0.0	3.5	268.4	O K
480 min Winter	55.705	0.455	0.0	3.5	0.0	3.5	286.3	O K
600 min Winter	55.721	0.471	0.0	3.6	0.1	3.7	297.7	O K
720 min Winter	55.732	0.482	0.0	3.6	0.2	3.8	305.3	O K
960 min Winter	55.744	0.494	0.0	3.7	0.3	4.0	314.3	O K
1440 min Winter	55.754	0.504	0.0	3.7	0.5	4.1	321.9	O K
2160 min Winter	55.769	0.519	0.0	3.7	0.6	4.4	332.4	O K
2880 min Winter	55.767	0.517	0.0	3.7	0.6	4.3	330.9	O K
4320 min Winter	55.722	0.472	0.0	3.6	0.1	3.7	298.2	O K
5760 min Winter	55.648	0.398	0.0	3.5	0.0	3.5	246.0	O K
7200 min Winter	55.563	0.313	0.0	3.5	0.0	3.5	189.0	O K
8640 min Winter	55.485	0.235	0.0	3.5	0.0	3.5	138.4	O K
10080 min Winter	55.427	0.177	0.0	3.5	0.0	3.5	102.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	1.028	0.0	936.6	0.0	5400
10080 min Summer	0.920	0.0	964.8	0.0	6184
15 min Winter	131.652	0.0	176.0	0.0	331
30 min Winter	86.449	0.0	238.7	0.0	512
60 min Winter	53.954	0.0	336.6	0.0	716
120 min Winter	34.098	0.0	430.5	0.0	1010
180 min Winter	25.639	0.0	484.8	0.0	1190
240 min Winter	20.753	0.0	518.7	0.0	1298
360 min Winter	15.172	0.0	544.5	0.0	1454
480 min Winter	12.027	0.0	539.0	0.1	1568
600 min Winter	9.995	0.0	533.7	1.5	1656
720 min Winter	8.569	0.0	529.5	3.4	1732
960 min Winter	6.690	0.0	521.0	6.8	1868
1440 min Winter	4.686	0.0	502.6	10.7	2112
2160 min Winter	3.270	0.0	768.4	17.7	2380
2880 min Winter	2.539	0.0	790.1	18.7	2664
4320 min Winter	1.790	0.0	817.1	2.3	3232
5760 min Winter	1.408	0.0	872.1	0.0	4032
7200 min Winter	1.180	0.0	905.5	0.0	4824
8640 min Winter	1.028	0.0	937.5	0.0	5448
10080 min Winter	0.920	0.0	966.8	0.0	6040

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.080

Time (mins) From:	To:	Area (ha)
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m) 55.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Appendix 10: Half Drain Time Sensitivity Check

Cascade Summary of Results for Permeable Paving.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond.SRCX	(None)

Half Drain Time : 379 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	55.767	0.117	0.0	5.3	5.3	112.2	O K
30 min Summer	55.805	0.155	0.0	6.0	6.0	148.1	O K
60 min Summer	55.841	0.191	0.0	6.0	6.0	183.1	O K
120 min Summer	55.889	0.239	0.0	6.0	6.0	228.9	O K
180 min Summer	55.911	0.261	0.0	6.0	6.0	250.0	O K
240 min Summer	55.921	0.271	0.0	6.0	6.0	260.0	O K
360 min Summer	55.925	0.275	0.0	6.0	6.0	263.8	O K
480 min Summer	55.923	0.273	0.0	6.0	6.0	261.2	O K
600 min Summer	55.918	0.268	0.0	6.0	6.0	256.8	O K
720 min Summer	55.913	0.263	0.0	6.0	6.0	251.4	O K
960 min Summer	55.900	0.250	0.0	6.0	6.0	239.1	O K
1440 min Summer	55.874	0.224	0.0	6.0	6.0	214.1	O K
2160 min Summer	55.839	0.189	0.0	6.0	6.0	180.9	O K
2880 min Summer	55.812	0.162	0.0	6.0	6.0	154.9	O K
4320 min Summer	55.779	0.129	0.0	5.8	5.8	123.6	O K
5760 min Summer	55.763	0.113	0.0	5.1	5.1	108.6	O K
7200 min Summer	55.753	0.103	0.0	4.5	4.5	98.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	85.819	0.0	98.8	19
30 min Summer	55.765	0.0	136.5	33
60 min Summer	34.662	0.0	186.1	62
120 min Summer	22.143	0.0	243.8	122
180 min Summer	16.632	0.0	277.1	182
240 min Summer	13.426	0.0	299.5	240
360 min Summer	9.767	0.0	328.0	336
480 min Summer	7.714	0.0	345.7	386
600 min Summer	6.398	0.0	358.2	446
720 min Summer	5.479	0.0	367.7	508
960 min Summer	4.275	0.0	381.4	644
1440 min Summer	3.010	0.0	399.5	908
2160 min Summer	2.127	0.0	430.6	1296
2880 min Summer	1.670	0.0	446.9	1644
4320 min Summer	1.206	0.0	473.6	2336
5760 min Summer	0.968	0.0	508.9	3056
7200 min Summer	0.824	0.0	534.7	3752

Cascade Summary of Results for Permeable Paving.SRCX

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
8640 min Summer	55.746	0.096	0.0	4.1	4.1	92.2	O K
10080 min Summer	55.741	0.091	0.0	3.8	3.8	87.2	O K
15 min Winter	55.767	0.117	0.0	5.3	5.3	112.3	O K
30 min Winter	55.805	0.155	0.0	6.0	6.0	148.3	O K
60 min Winter	55.841	0.191	0.0	6.0	6.0	183.3	O K
120 min Winter	55.889	0.239	0.0	6.0	6.0	228.9	O K
180 min Winter	55.911	0.261	0.0	6.0	6.0	249.8	O K
240 min Winter	55.921	0.271	0.0	6.0	6.0	259.8	O K
360 min Winter	55.925	0.275	0.0	6.0	6.0	263.6	O K
480 min Winter	55.919	0.269	0.0	6.0	6.0	257.8	O K
600 min Winter	55.913	0.263	0.0	6.0	6.0	251.6	O K
720 min Winter	55.905	0.255	0.0	6.0	6.0	243.9	O K
960 min Winter	55.886	0.236	0.0	6.0	6.0	226.4	O K
1440 min Winter	55.850	0.200	0.0	6.0	6.0	191.4	O K
2160 min Winter	55.805	0.155	0.0	6.0	6.0	148.9	O K
2880 min Winter	55.778	0.128	0.0	5.7	5.7	122.7	O K
4320 min Winter	55.754	0.104	0.0	4.6	4.6	99.1	O K
5760 min Winter	55.740	0.090	0.0	3.8	3.8	86.6	O K
7200 min Winter	55.732	0.082	0.0	3.3	3.3	78.6	O K
8640 min Winter	55.726	0.076	0.0	2.9	2.9	72.9	O K
10080 min Winter	55.722	0.072	0.0	2.6	2.6	68.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.727	0.0	559.2	4496
10080 min Summer	0.658	0.0	581.6	5240
15 min Winter	85.819	0.0	98.8	18
30 min Winter	55.765	0.0	136.5	33
60 min Winter	34.662	0.0	186.1	62
120 min Winter	22.143	0.0	243.8	120
180 min Winter	16.632	0.0	277.1	178
240 min Winter	13.426	0.0	299.6	234
360 min Winter	9.767	0.0	328.0	342
480 min Winter	7.714	0.0	345.7	396
600 min Winter	6.398	0.0	358.3	464
720 min Winter	5.479	0.0	367.8	540
960 min Winter	4.275	0.0	381.6	684
1440 min Winter	3.010	0.0	399.8	964
2160 min Winter	2.127	0.0	430.6	1324
2880 min Winter	1.670	0.0	447.0	1648
4320 min Winter	1.206	0.0	474.0	2376
5760 min Winter	0.968	0.0	509.3	3112
7200 min Winter	0.824	0.0	535.4	3816
8640 min Winter	0.727	0.0	560.1	4504
10080 min Winter	0.658	0.0	583.0	5248

Cascade Rainfall Details for Permeable Paving.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.610

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.610

Cascade Model Details for Permeable Paving.SRCX

Storage is Online Cover Level (m) 56.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	56.5
Membrane Percolation (mm/hr)	1000	Length (m)	56.5
Max Percolation (l/s)	886.7	Slope (1:X)	0.0
Safety Factor	1.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.650	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0122-6000-0450-6000
Design Head (m)	0.450
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	122
Invert Level (m)	55.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.450	6.0
Flush-Flo™	0.185	6.0
Kick-Flo®	0.348	5.3
Mean Flow over Head Range	-	4.8

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)**
0.100	4.4	1.200	9.5	3.000	14.7	7.000	22.1
0.200	6.0	1.400	10.2	3.500	15.8	7.500	22.9
0.300	5.7	1.600	10.9	4.000	16.8	8.000	23.7
0.400	5.7	1.800	11.5	4.500	17.8	8.500	24.4
0.500	6.3	2.000	12.1	5.000	18.7	9.000	25.1
0.600	6.9	2.200	12.7	5.500	19.6	9.500	25.8
0.800	7.8	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Cascade Summary of Results for Pond.SRCX

Upstream Structures	Outflow To	Overflow To
Permeable Paving.SRCX	(None)	(None)

Half Drain Time : 491 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	55.327	0.077	0.0	2.3	0.0	2.3	43.5	O K
30 min Summer	55.354	0.104	0.0	3.3	0.0	3.3	59.2	O K
60 min Summer	55.386	0.136	0.0	3.5	0.0	3.5	77.8	O K
120 min Summer	55.434	0.184	0.0	3.5	0.0	3.5	107.0	O K
180 min Summer	55.463	0.213	0.0	3.5	0.0	3.5	125.1	O K
240 min Summer	55.484	0.234	0.0	3.5	0.0	3.5	138.0	O K
360 min Summer	55.511	0.261	0.0	3.5	0.0	3.5	155.2	O K
480 min Summer	55.529	0.279	0.0	3.5	0.0	3.5	166.7	O K
600 min Summer	55.542	0.292	0.0	3.5	0.0	3.5	175.4	O K
720 min Summer	55.553	0.303	0.0	3.5	0.0	3.5	182.3	O K
960 min Summer	55.569	0.319	0.0	3.5	0.0	3.5	192.7	O K
1440 min Summer	55.588	0.338	0.0	3.5	0.0	3.5	205.3	O K
2160 min Summer	55.576	0.326	0.0	3.5	0.0	3.5	197.7	O K
2880 min Summer	55.557	0.307	0.0	3.5	0.0	3.5	184.9	O K
4320 min Summer	55.517	0.267	0.0	3.5	0.0	3.5	158.8	O K
5760 min Summer	55.475	0.225	0.0	3.5	0.0	3.5	132.3	O K
7200 min Summer	55.440	0.190	0.0	3.5	0.0	3.5	110.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	85.819	0.0	101.9	0.0	239
30 min Summer	55.765	0.0	143.4	0.0	269
60 min Summer	34.662	0.0	206.2	0.0	380
120 min Summer	22.143	0.0	270.8	0.0	568
180 min Summer	16.632	0.0	308.1	0.0	690
240 min Summer	13.426	0.0	333.1	0.0	782
360 min Summer	9.767	0.0	364.5	0.0	912
480 min Summer	7.714	0.0	383.7	0.0	1014
600 min Summer	6.398	0.0	397.1	0.0	1100
720 min Summer	5.479	0.0	406.9	0.0	1176
960 min Summer	4.275	0.0	419.9	0.0	1316
1440 min Summer	3.010	0.0	430.5	0.0	1570
2160 min Summer	2.127	0.0	486.6	0.0	1928
2880 min Summer	1.670	0.0	504.9	0.0	2208
4320 min Summer	1.206	0.0	533.4	0.0	2872
5760 min Summer	0.968	0.0	580.2	0.0	3592
7200 min Summer	0.824	0.0	610.0	0.0	4296

Cascade Summary of Results for Pond.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	55.413	0.163	0.0	3.5	0.0	3.5	93.9	O K
10080 min Summer	55.392	0.142	0.0	3.5	0.0	3.5	81.4	O K
15 min Winter	55.327	0.077	0.0	2.3	0.0	2.3	43.5	O K
30 min Winter	55.354	0.104	0.0	3.3	0.0	3.3	59.2	O K
60 min Winter	55.386	0.136	0.0	3.5	0.0	3.5	77.8	O K
120 min Winter	55.434	0.184	0.0	3.5	0.0	3.5	107.2	O K
180 min Winter	55.464	0.214	0.0	3.5	0.0	3.5	125.5	O K
240 min Winter	55.485	0.235	0.0	3.5	0.0	3.5	138.6	O K
360 min Winter	55.512	0.262	0.0	3.5	0.0	3.5	156.1	O K
480 min Winter	55.531	0.281	0.0	3.5	0.0	3.5	167.9	O K
600 min Winter	55.544	0.294	0.0	3.5	0.0	3.5	176.6	O K
720 min Winter	55.555	0.305	0.0	3.5	0.0	3.5	183.5	O K
960 min Winter	55.570	0.320	0.0	3.5	0.0	3.5	193.8	O K
1440 min Winter	55.588	0.338	0.0	3.5	0.0	3.5	205.4	O K
2160 min Winter	55.568	0.318	0.0	3.5	0.0	3.5	192.3	O K
2880 min Winter	55.534	0.284	0.0	3.5	0.0	3.5	169.8	O K
4320 min Winter	55.459	0.209	0.0	3.5	0.0	3.5	122.2	O K
5760 min Winter	55.400	0.150	0.0	3.5	0.0	3.5	86.1	O K
7200 min Winter	55.364	0.114	0.0	3.4	0.0	3.4	65.1	O K
8640 min Winter	55.351	0.101	0.0	3.2	0.0	3.2	57.4	O K
10080 min Winter	55.343	0.093	0.0	2.9	0.0	2.9	52.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
8640 min Summer	0.727	0.0	637.8	0.0	4976
10080 min Summer	0.658	0.0	662.2	0.0	5648
15 min Winter	85.819	0.0	101.9	0.0	239
30 min Winter	55.765	0.0	143.4	0.0	270
60 min Winter	34.662	0.0	206.2	0.0	380
120 min Winter	22.143	0.0	270.9	0.0	566
180 min Winter	16.632	0.0	308.1	0.0	688
240 min Winter	13.426	0.0	333.1	0.0	776
360 min Winter	9.767	0.0	364.6	0.0	906
480 min Winter	7.714	0.0	383.8	0.0	1004
600 min Winter	6.398	0.0	397.2	0.0	1086
720 min Winter	5.479	0.0	407.1	0.0	1162
960 min Winter	4.275	0.0	420.3	0.0	1298
1440 min Winter	3.010	0.0	432.2	0.0	1544
2160 min Winter	2.127	0.0	486.7	0.0	1900
2880 min Winter	1.670	0.0	505.1	0.0	2208
4320 min Winter	1.206	0.0	534.1	0.0	2924
5760 min Winter	0.968	0.0	580.6	0.0	3576
7200 min Winter	0.824	0.0	610.7	0.0	4136
8640 min Winter	0.727	0.0	638.9	0.0	4776
10080 min Winter	0.658	0.0	664.1	0.0	5488

Cascade Rainfall Details for Pond.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 610152 246056 TM 10152 46056
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.080

Time From:	(mins) To:	Area (ha)
0	4	0.080

Cascade Model Details for Pond.SRCX

Storage is Online Cover Level (m) 56.000

Infiltration Basin Structure

Invert Level (m) 55.250 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	0.750	827.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-3500-0450-3500
Design Head (m)	0.450
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	55.250
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.450	3.5
Flush-Flo™	0.154	3.5
Kick-Flo®	0.332	3.0
Mean Flow over Head Range	-	2.9

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)
0.100	3.1	1.200	5.5	3.000	8.5	7.000	12.8
0.200	3.5	1.400	5.9	3.500	9.1	7.500	13.2
0.300	3.2	1.600	6.3	4.000	9.7	8.000	13.7
0.400	3.3	1.800	6.7	4.500	10.3	8.500	14.1
0.500	3.7	2.000	7.0	5.000	10.8	9.000	14.5
0.600	4.0	2.200	7.3	5.500	11.3	9.500	14.9
0.800	4.6	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.3		

Weir Overflow Control

Discharge Coef 0.544 Width (m) 0.021 Invert Level (m) 55.700

Appendix 11: CDM Designers Risk Assessment

Project Name: Bramford Substation **Project Stage: Full Planning** **Designers: SLR Consulting**	**Likelihood Rating** Rare - The impact/risk may occur only in exceptional circumstances. 1 Unlikely - The risk could occur at some time but there is confidence that it will not. 2 Possible - There is uncertainty that the risk could occur 3 Likely - The risk is likely to occur in most circumstances 4 Almost Certain - It is almost certain that the risk will occur in most circumstances. 5	**Severity rating** Insignificant - No injuries Minor - First aid treatment Moderate - Medical Treatment Major - Hospital Catastrophic - death

Reference	**Activity / Hazard**	**Persons or Property at Risk**			**Project Lifecycle Phase**				**Likelihood**	**x**	**Severity**	**Intial Risk Rating**
		Work	**Site**	**Others**	**Construction**	**Use**	**Maintenance**	**Demolition**				
1	Gravel Compound - slip / trip hazard	YES	YES	NO	YES	YES	YES	NO	2	x	2	LOW
2	Gravel Compound - gravel levelling and relevelling disturbing below ground cables	YES	YES	NO	YES	NO	YES	NO	1	x	5	MEDIUM
3	Detention Basin - slip / trip hazard	YES	NO	YES	YES	YES	YES	NO	2	x	2	LOW
4	Detention Basin- shallow standing water	YES	NO	YES	YES	YES	YES	NO	2	x	2	LOW

1. this is a private secure site and the gravel compound will be fenced off from public access

2a. below ground electricity cables would be signficantly deeper than the depth of gravel on the compound

2b. Levelling of gravels should only be undertaken by competent personnel with knowledge of known cable routes on site

3. the basin is to the west of a public footpath and therefore may be entered by members of the public; side slopes of 1:4 have been applied.

4. To reduce risk maintenance should only be undertaken by competent personnel

EUROPEAN OFFICES

United Kingdom

AYLESBURY
T: +44 (0)1844 337380

BELFAST
belfast@slrconsulting.com

BRADFORD-ON-AVON
T: +44 (0)1225 309400

BRISTOL
T: +44 (0)117 906 4280

CARDIFF
T: +44 (0)29 2049 1010

CHELMSFORD
T: +44 (0)1245 392170

EDINBURGH
T: +44 (0)131 335 6830

EXETER
T: + 44 (0)1392 490152

GLASGOW
glasgow@slrconsulting.com

GUILDFORD
guildford@slrconsulting.com

LONDON
T: +44 (0)203 805 6418

MAIDSTONE
T: +44 (0)1622 609242

MANCHESTER (Denton)
T: +44 (0)161 549 8410

MANCHESTER (Media City)
T: +44 (0)161 872 7564

NEWCASTLE UPON TYNE
T: +44 (0)191 261 1966

NOTTINGHAM
T: +44 (0)115 964 7280

SHEFFIELD
T: +44 (0)114 245 5153

SHREWSBURY
T: +44 (0)1743 23 9250

STIRLING
T: +44 (0)1786 239900

WORCESTER
T: +44 (0)1905 751310

Ireland

DUBLIN
T: + 353 (0)1 296 4667

France

GRENOBLE
T: +33 (0)6 23 37 14 14