CASTLE ROAD BATTERY ENERGY STORAGE SYSTEM (BESS)

Land north of Castle Road, Burton, Rhoose, CF62 3DE

FLOOD CONSEQUENCE ASSESSMENT

Project No	24-278-60
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Issue date	21/02/25

Transport Planning | Flood Risk & Hydrology | Infrastructure & Drainage

Control Sheet

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1 EXECUTIVE SUMMARY

1.1.1 Calibro Consultants has been appointed by *REWE 7 Ltd* to undertake a Flood Consequence Assessment (FCA) to accompany a planning application for a proposed Battery Energy Storage System (BESS) and associated infrastructure on land north of Castle Road, Burton, Rhoose.

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

1.1.3 According to the Technical Advice Note 15, the Site is located in Development Advice Map Zone A, meaning it is at low risk of flooding from rivers and the sea and need not apply the Justification Test.

1.1.4 A small part of the Site is predicted to be at risk of surface water flooding but this area has been avoided as part of the proposed Site layout.

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

1.1.6 Infiltration testing undertaken on the 3rd September 2024 confirms that infiltration is viable within the Site, therefore runoff from the BESS and associated infrastructure is proposed to be directed to the ground via an infiltration basin.

1.1.7 A sealed gravel base system is proposed to underlay the BESS units in order to detain contaminated water in the unlikely event of a fire . Flows from the sealed system will be shut off by penstock chambers during a fire event, with sufficient storage available for at least six hours of fog water suppression spraying, if this is required.

1.1.8 During regular rainfall events, flows from the gravel base system would be discharged into the proposed infiltration basin via pipes and a conveyance swale.

1.1.9 The Proposed Development complies with the aims of the TAN15, being safe from all sources of flooding and replicating existing runoff arrangements as closely as is reasonably practicable.

2 INTRODUCTION

2.1 Background

2.1.1 Calibro Consultants has been appointed by *REWE 7 Ltd* to undertake a Flood Consequence Assessment (FCA) to accompany a planning application for a proposed Battery Energy Storage System (BESS) and associated infrastructure on land north of Castle Road, Burton, Rhoose.

2.2 Policy Requirements

2.2.1 The general approach of Planning Policy Wales (PPW) is to advise caution in respect of new development by setting out a precautionary framework to guide planning decisions and directing development away from areas at high risk of flooding.

2.2.2 'Technical Advice Note 15 – Development and Flood Risk' (TAN15), provides a framework for assessing flooding associated with proposed development. This includes the definition of Flood Zones A, B, C1 and C2 which form the starting point for any assessment.

2.2.3 In accordance with TAN15, an FCA must be produced for any proposed development shown to be at risk from a 1 in 1,000 year (0.1% annual exceedance probability event) as defined by Zone C of the Development Advice Maps (DAMs) hosted on Welsh Government Portal for Open GIS data. The proposed development Site is shown as falling within the DAM Zone A extent. However, given the Site measures over 10ha and the proposals are for electrical infrastructure, an FCA has been conducted to assess the risk of flooding to the Site from all sources.

2.2.4 In accordance with TAN15, an FCA must consider:

- The consequences of flooding on a development.
- The consequences (i.e., overall impacts) of the development of flood risk elsewhere within the catchment for a range of potential flooding scenarios up to that flood having a probability of 0.1%.
- Whether appropriate mitigation measures are required and can be incorporated within the design of the development to ensure that development minimises risk to life, damage to property and disruption to people living and working on the Site or elsewhere in the floodplain.

2.2.5 This FCA considers the risks of all types of flooding to the Site and sets out measures to minimise flood risk elsewhere over the lifetime of the development.

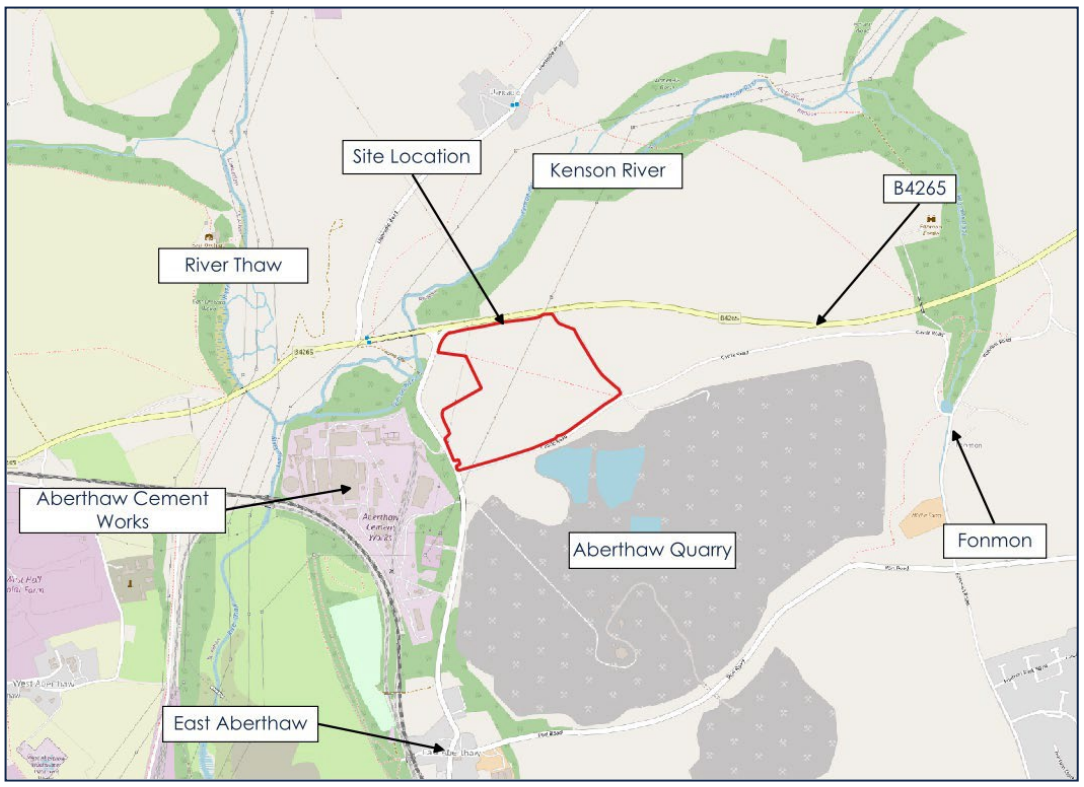
3 EXISTING SITE AND HYDROLOGY CHARACTERISTICS

3.1 Site Description

3.1.1 The location of the proposed development is shown in Figure 3-1.

3.1.2 The Site redline boundary measures approximately 10.5ha and is located approximately 900m west of Fonmon, 700m north of East Aberthaw and immediately south of the B4265. To the south of the Site is Aberthaw Quarry and to the west is Aberthaw Cement Works. The nearest postcode of the Site is CF62 3DE and NGR is 303350, 167500.

Figure 3-1 Site Overview



3.2 Topography and Hydrology

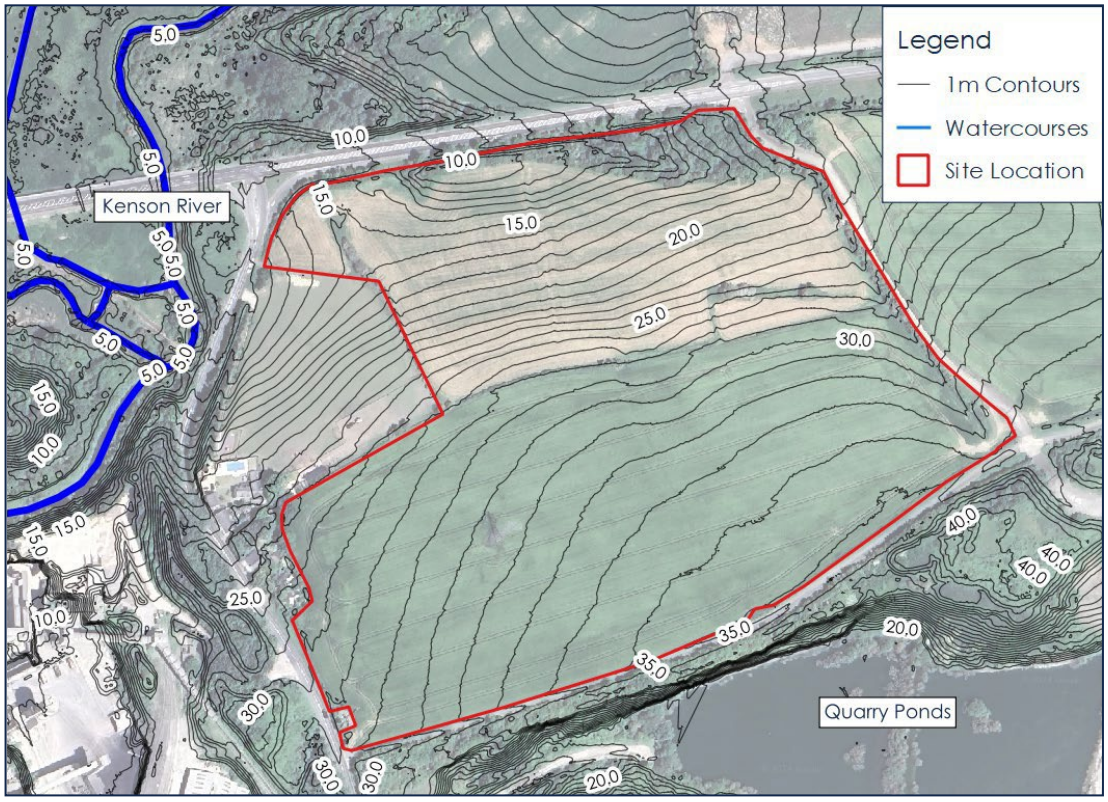
3.2.1 The land slopes from south to north, falling to a specific low point in the centre of the northern boundary adjacent to the B4265. The high point of the Site is at approximately 36mAOD along the southern boundary the low point is approximately 10mAOD.

3.2.2 The B4265 road is elevated above the northern edge of the Site by as much as approximately 5m adjacent to the low point of the site.

3.2.3 The principal hydrological features of the Site are the Kenson River, which is a designated Main River and flows in a southerly direction past the Site before joining the River Thaw. At its nearest point, the Kenson River is approximately 65m west of the Site, but at least 10m below the level of Site. In addition, two ponds associated with the Aberthaw Quarry are located to the south of the Site but with the Kenson River, the Site is elevated significantly above these features. There are no other known watercourses within the vicinity of the Site.

3.2.4 Key hydrological features are shown in Figure 3-2.

Figure 3-2 Topography and Hydrology



3.2.5 The existing Site is greenfield, comprising arable farmland. It is therefore understood that the Site drains naturally with no positive drainage.

3.3 Geology and Soils

3.3.1 Geological data held by the British Geological Survey (BGS) shows that the entire Site is underlain by Porthkerry Member bedrock, which comprises interbedded limestone and mudstone. There are no mapped superficial deposits on the Site with

the nearest being Alluvium (clay, silt, sand and gravel) associated with the Kenson River to the west.

3.3.2 The BGS Hydrogeology dataset defines the bedrock as being '*Rocks with essentially no groundwater*'.

3.3.3 SoilScapes mapping shows the Site to be underlain by '*Freely draining slightly acid but base-rich soils*'.

3.3.4 Infiltration testing was undertaken at the Site on the 3rd September 2024. The full report and results are included in Appendix A.

3.3.5 In summary, the testing concluded that infiltration is viable in the southern, higher topographical, parts of the site. The lowest recorded rate in this area was 3.75×10^{-5} m/s (0.135m/hr).

3.3.6 In the northern, lower-lying, parts of the site, the tests failed and therefore infiltration deemed unviable.

4 FLOOD RISK

4.1 Introduction

4.1.1 In accordance with TAN15, this FCA considers all sources of flooding including:

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

4.2 Flood History

4.2.1 The Natural Resources Wales (NRW) historic flood outlines and the Vale of Glamorgan Strategic Flood Consequences Assessment (SFCA) datasets only record flooding to the west of the Site associated with an event in 1981 on the Kenson River. The mapped extent of this event did not reach the Site but was confined to the valley.

4.2.2 The Chronology of British Hydrological Events was searched for the key words 'Fonmon', 'East Aberthaw' and 'Kenson River'. No instances of flooding in the vicinity of the Site were recorded in the database.

4.3 Development Advice Map Zone

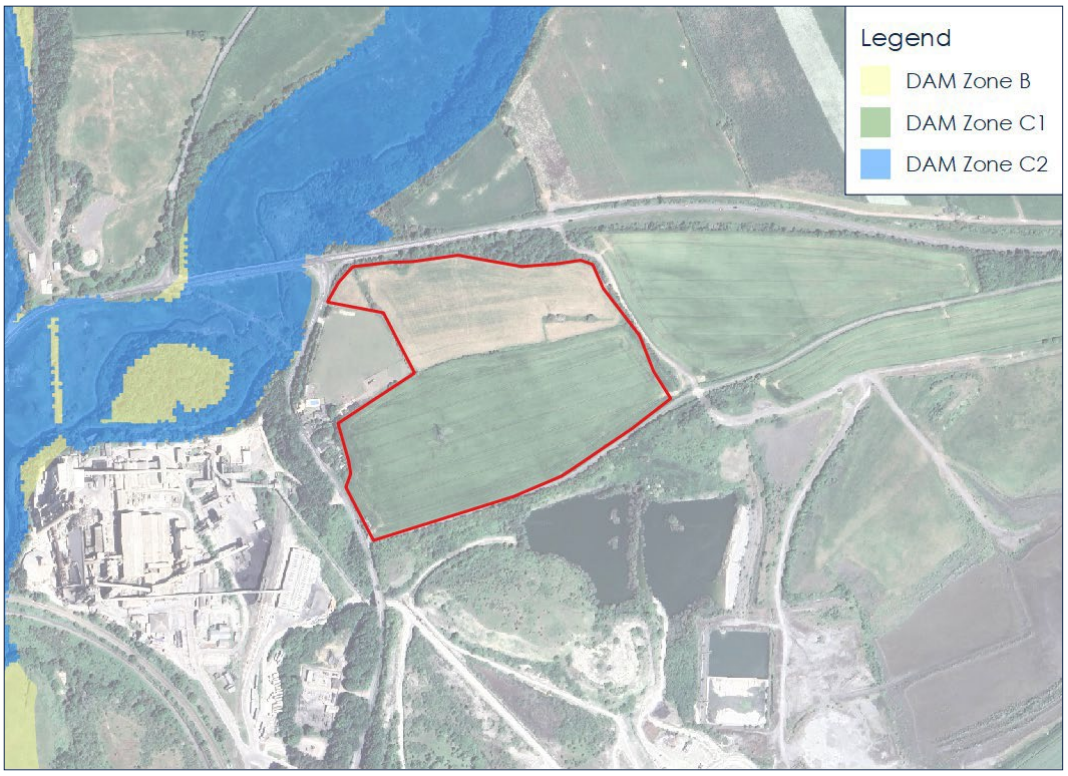
4.3.1 The NRW Development Advice Map (DAM) Zones underpin the approach to managing flood risk through spatial planning. The definition of the zones is reproduced from TAN15 in Table 4-1.

4.3.2 As shown in Figure 4-1, the entire Site is located within DAM Zone A meaning it is at low risk of fluvial and tidal flooding and there is no need to apply the Justification Test.

Table 4-1 DAM Zones Classification

Description of Zone	Code	Use within the Precautionary Framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where Site levels should be checked against the extreme (0.1%) flood level. If Site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

Figure 4-1 DAM Zones



4.1 Tidal and Fluvial Flood Risk – Flood Map for Planning

4.1.1 Given the Site's location in DAM Zone A and its elevation above the Kenson River, it is considered to be at **Very Low** flood risk from rivers or the sea.

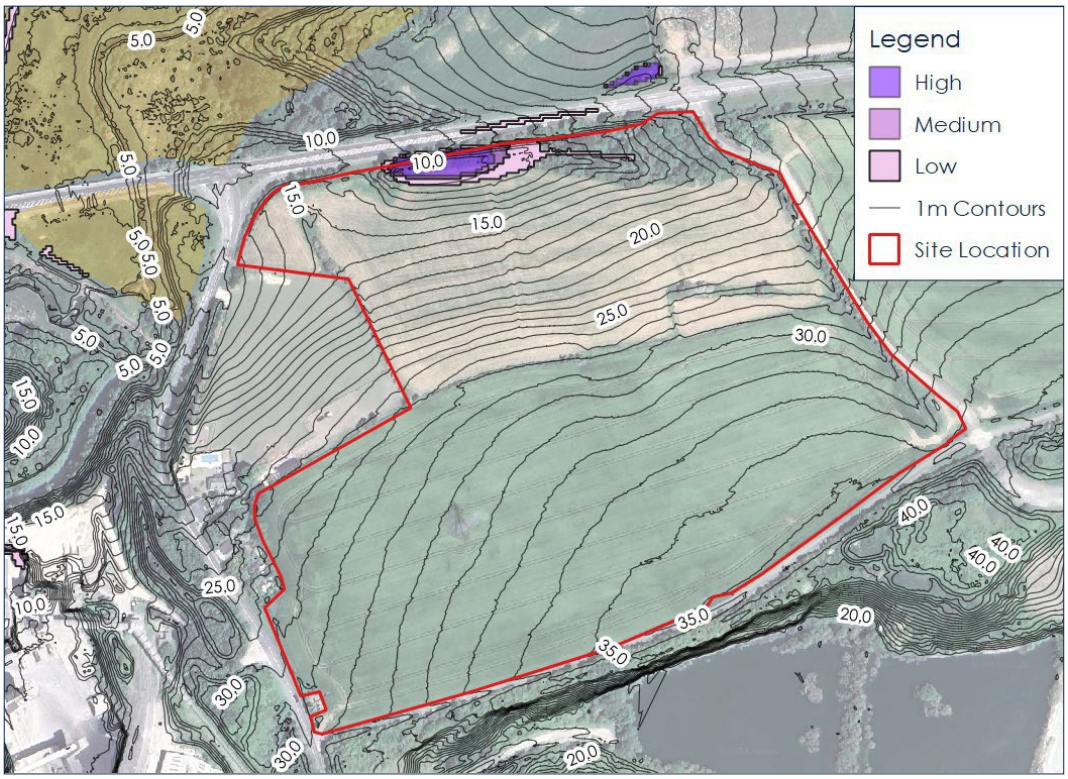
4.2 Flooding from Small Watercourses and Surface Water

4.2.1 The NRW Flood Risk Assessment Wales Map maps risk of flooding from both rivers and small watercourses. The risk categories are:

i. high – *chance of flooding greater than 1 in 30* (in any given year)
ii. medium – *chance of flooding between 1 in 30 and 1 in 100* (in any given year)
iii. low – *chance of flooding between 1 in 100 and 1 in 1,000* (in any given year)

4.2.2 The Flooding from Small Watercourses and Surface Water outlines are presented in Figure 4-2.

Figure 4-2 Flooding from Small Watercourses and Surface Water



4.2.3 The model predicts that the only area of potential flooding would be at the low point along the northern boundary of the Site. This is presumed to be caused by water ponding in the low point of the Site, due to the elevated nature of the B4265 preventing water from escaping.

4.2.4 Identifying this as a physical constraint of the Site, the design has taken into account this identified area and no built development will be placed within this area of flood risk. Consequently, the proposals will be at **Very Low** risk from surface water or small watercourses.

4.3 Groundwater Flooding

4.3.1 The Site ground conditions and topography are not considered to be conducive to groundwater emergence or flooding. The risk of flooding from groundwater is therefore assessed as being **Negligible**.

4.4 Flooding from Sewers

4.4.1 Given the rural setting of the Site, it is considered unlikely that there are any significant sewers located within the vicinity of the Site to generate sewer flooding. Therefore, the risk of sewer flooding to the Site is considered to be **Negligible**.

4.5 Flooding from Artificial Sources

4.5.1 According to NRW's Large Raised Reservoirs dataset, there are no known impounded reservoirs in the River Thaw or Kenson River catchments.

4.5.2 The Site is elevated well above the adjacent ponds located within the Aberthaw Quarry site to the south, and there are no other known artificial waterbodies in the vicinity of the Site.

4.5.3 The development is therefore considered to be at **Negligible** risk of flooding from reservoirs, canals and artificial sources.

4.6 Safe Access and Egress

4.6.1 The Site is at overall low risk of flooding and would be remotely operated, with the exception of intermittent maintenance visits. Therefore, there are not anticipated to be any access or egress issues posed to the Site.

5 DEVELOPMENT PROPOSALS AND POLICY IMPLICATIONS

5.1 Proposed Development

5.1.1 The Proposed Development is a Battery Energy Storage System (BESS) and associated infrastructure. This will comprise battery storage including battery containers, inverter and transformer units, auxiliary transformers, and a substation housing a 33kV to 400kV transformer, switchgear containers and a control room. An internal access track is also proposed as well as fencing, lighting, landscaping and CCTV would be installed.

5.1.2 The BESS units and their associated infrastructure will be situated in the south of the Site.

5.1.3 The proposed Layout Plan is shown in Appendix B.

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

5.1.5 Some infrastructure is more sensitive to flooding and water damage, such as the BESS units, the transformers and the inverter and transformer units. As a result, these will be constructed on concrete pads or plinths, which will lie atop the gravel. This will ensure the key infrastructure is raised slightly above the surrounding ground.

5.2 Development Vulnerability

5.2.1 Figure 2 of TAN15 sets out the definition of three development categories and is reproduced below in Figure 5-1. These categories are used to determine the justification test.

Figure 5-1 Development categories (reproduced form TAN15 Figure 2)

Development category	Types
Emergency services	hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood
Highly vulnerable development	all residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites

5.2.2 Not all development types fall within the defined categories, and there is no reference to any form of renewable energy.

5.2.3 Nonetheless, the location of the Site within DAM Zone A means that the justification test is not applicable, and the Proposed Development is appropriate on the Site.

6 SURFACE WATER DRAINAGE

6.1.1 The Statutory National Standards for Sustainable Drainage System (SuDS) hierarchy should be followed when managing surface water runoff:

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

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

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

6.2 Climate Change

6.2.1 The development is proposed for a temporary period of 40 years therefore will be operating up to the mid-2060s. In accordance with Table 2 of NRW's Flood Consequences Assessments: Climate Change guidance, this would put the development in the 2050s epoch.

6.2.2 In accordance with the above guidance, the Site falls in a large (over 5km^2), rural catchment in the West Wales River Basin District.

6.2.3 NRW's Flood Consequences Assessments: Climate Change Guidance states that rainfall allowances should be applied when considering surface water flooding and drainage assessments.

6.2.4 As a result of the above, the relevant rainfall uplift for the proposals is 20%. Therefore, the design rainfall event is the 1 in 100 year +20%.

Water Collection

6.2.5 Given the Site would be remotely operated and only visited occasionally for routine maintenance. In addition, washing water or irrigation water will be limited, meaning it would be unviable to include water reuse facilities.

To the Ground

6.2.6 As demonstrated in Section 3.3, the south of the Site has good infiltration rates, therefore, provided the drainage infrastructure is located in this area, the preferred method of infiltration will be to ground. As described in Section 3.3, the reference infiltration rate is 3.75x10^{-5} m/s (0.135m/hr), which was the lowest rate recorded and is therefore conservative.

6.3 BESS Units

6.3.1 For reasons of fire management (explained below), it is not possible to simply allow the BESS units area to drain to ground locally. Therefore, it is proposed to discharge runoff generated from the BESS units area to an infiltration basin located in the southwestern part of the Site. Runoff will be routed to the infiltration basin via perforated pipes and a conveyance swale.

6.3.2 The infiltration basin has been designed to have sufficient capacity to store a design rainfall event (1 in 100 year +20%). Microdrainage source control calculations indicate that approximately 1,135m^3 of volume is required in the basin during the design, critical duration, event.

6.3.3 Microdrainage source control calculations are included in Appendix C

6.3.4 The infiltration basin is proposed to be 1.8m deep with an additional 0.3m freeboard, measuring a total depth of 2.1m, with 1 in 3 side slopes. The crest area (at the freeboard level) of the basin is approximately 1,290m^2, with a base area of approximately 370m^2. At the maximum water level of 1.8m depth, the basin will have a total volume of approximately 1,330m^3; 195m^3 more than the volume required. In addition, at the freeboard level, the basin volume would be 1,665m^3, providing over 500m^3 of additional storage in an exceedance event.

6.3.5 The basin has also been fitted to have a 3m maintenance strip around the crest to allow access for maintenance works.

6.3.6 As shown in Section 3.3, the lowest recorded infiltration rate at the site was 0.135m/hr, therefore this value has been used to inform the Microdrainage source control calculations for the infiltration basin.

6.3.7 Due to the presence of residential dwellings downslope of the proposed basin, a safety factor of 10 has been used to ensure a conservative approach.

6.4 Substation and Isolated Containers

6.4.1 The auxiliary transformers, inverter and transformer units and infrastructure within the substation compound would also be underlain by gravel beds. It is proposed to allow rain falling on these units to discharge to the ground locally, via their gravel bases.

6.4.2 Using the reference infiltration rate and applying a factor of safety of 10 to ensure a conservative estimate, the depth of the gravel bases has ben calculated for the substation hardstanding and each container type. The resulting dimensions and depths are shown in the drainage strategy drawings provided in Appendix D and Microdrainage calculations provided in Appendix C.

6.4.3 Generally, presuming the gravel bases extend 0.3m from each container edge, a 0.4m depth of gravel is sufficient to contain the design event.

6.4.4 It should be noted that the calculated drainage contribution areas includes rain falling on the gravel bases and not just the containers themselves, to ensure a conservative estimate.

6.5 Fire Management

Background

6.5.1 In the extremely unlikely event of a fire significant mitigation is included within the battery units as set out in the Outline Battery Safety Management Plan for this application. The mitigation in place significantly reduces the chances for ignition to occur and includes methods to limit the chance for overheating due to proximity.

6.5.2 If units do ignite, the typical response to supress the fire is to utilise inert, non-Per- and polyfluoroalkyl substances (PFAS) products. However, the fire service may choose to use water spraying as part of the method of suppression, particularly to keep adjacent units cool and reduce the chance for them to ignite.

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

6.5.4 If ignition does occur, it could result in the release of hydrogen fluoride gas. When this makes contact with water (for example water suppression spray) it becomes hydrofluoric acid (HF), albeit naturally diluted by the spray water.

Mitigation

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

6.5.6 Due to the size of the BESS area, the topography of the Site and that the substation would be self-drained (as explained above), two separate networks (known as the Northern Network and Southern Network) of perforated pipes are proposed.

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

6.5.8 The penstock chambers would remain open during normal conditions, to allow the passage of rainfall into the infiltration basin. However, during the unlikely event of a fire , the penstocks would be shut, creating a sealed system beneath the BESS units.

6.5.9 Once the system is sealed, water in the penstock can be tested for contaminants. If they are identified, water can be pumped out and disposed of appropriately. When contamination is at safe levels, the penstock can be released to resume the normal flow regime.

6.5.10 As shown in the drainage strategy (in Appendix D), the northern BESS area would have an area of approximately 5,860m^2. Presuming the sealed gravel base would be at least 0.2m deep with a porosity of 0.3 would result in a capacity of approximately 350m^3, sufficient for more than six hours of fog spraying with a pump rate of zero and should therefore meet the requirements of the NFCC guidance.

6.5.11 The southern BESS area would have an area of approximately 1.22ha. presuming the sealed gravel base would be 0.2m deep with a porosity of 0.3 would result in a capacity of approximately 732m^3, sufficient for more than six hours of spraying with a pump rate of zero.

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

6.6 Design for Exceedance

6.6.1 The proposed infrastructure would be raised on plinths or pads which would prevent flood damage in an exceedance event.

6.6.2 The storage capacity of the infiltration basin would exceed the volume of runoff in a design event, providing some additional capacity for an exceedance event. Furthermore, the storage capacity in the BESS gravel bases, perforated pipes and conveyance swale has been discounted. In reality, these would provide additional capacity in an exceedance event.

6.6.3 In the unlikely event the capacity of the gravel bases were to be exceeded, exceedance water would flow over landscaped areas, allowing it to absorb to ground. Alternatively, it would be captured by the swale or basin, which has significant additional capacity to accommodate exceedance flows.

6.7 Water Quality

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

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

indices for the development must be equal to, or exceed, the pollution hazard indices.

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

6.7.3 Table 26.4 of the SuDS Manual provides SuDS mitigation indices for various SuDS methods discharging to the ground, as summarised in Table 6-1. This shows that the nearest equivalent to gravel bases would be infiltration trenches and the nearest equivalent for infiltration basins is bioretention, these would provide sufficient mitigation of the likely pollutants expected.

Table 6-1 Water Quality Indices (as per C753 The SuDS Manual)

		Pollution Hazard Level	Total suspended solids	Metals	Hydro-carbons
Land Use	Other roofs	Low	0.3	0.2	0.05
SuDS Mitigation Indices	Gravel bases	-	0.4	0.4	0.4
	Bioretention underlain by soil with good containment potential	-	0.8	0.8	0.8

6.8 Maintenance Regime

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

6.8.2 An indicative maintenance schedule is included as Table 6-2. A full maintenance regime should be produced as part of the detailed design to ensure that the drainage system remains operational. This can be secured by condition.

Table 6-2 Gravel Bases, Perforated Pipes, Swales and Basin Maintenance

Maintenance Schedule	Action	Frequency
Subbase storage	Remove litter and debris from subbase storage	As required
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly

	Inspect inlets and perforated pipework for silt accumulation and establish appropriate silt removal frequencies	Six monthly, or as required
	Inspect for evidence of poor operation and/or weed growth – if required take remedial action	Every three months, 48 hours after large storms in the first six months
	Replacement of gravel	As required
	Jetting perforated pipe	As required
	Replacement of geotextile wrap	As Required
	Required Action	Typical Frequency
Pipework, manholes, flow control chambers, catch pits and silt traps	Stabilise adjacent areas	As required
	Remove litter and debris	As required
	Clear any poor performing structures.	As required
	Inspect all structures for poor operation	Three monthly, 48 hours after large storms in first six months
	Monitor inspection chambers. Inspect silt accumulation rates and determine silt clearance frequencies	Annually
Storage Basins and Conveyance Swales	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	
	Re-seed areas of poor growth.	
	Repair erosion or other damage by re-turfing	
	Re-level uneven surfaces to reinstate design levels	
	Scarify and spike topsoil to improve performance, break up silt deposits and prevent compaction	
	Remove sediment build-up	

	Inspect surfaces for ponding, compaction and silt accumulation. Record areas where water is ponding for more than 48 hours

7 CONCLUSIONS

7.1.1 The Site falls within DAM Zone A and therefore all forms of development are appropriate without the need to apply the TAN15 justification test.

7.1.2 A small part of the Site is predicted to be at risk from surface water flooding. This has been taken into account when designing the layout of the development and there would be no built development in this area.

7.1.3 The Site is considered to be at overall low risk of all other forms of flooding.

7.1.4 Infiltration testing undertaken at the site on the 3rd September 2024 yielded a lowest infiltration rate of 0.135m/hr, therefore infiltration has been deemed appropriate.

7.1.5 The site would manage rainfall to mimic existing site conditions as closely as possible by directing rainfall to ground. This will be achieved by an infiltration basin located to the west of the BESS area within the Site, the capacity of the infiltration basin would be sufficient to contain a 1 in 100 year + 20% climate change event.

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

7.1.7 The sealed drainage system would have sufficient capacity for more than six hours of fog spraying with zero discharge.

7.1.8 The sealed system would be upstream of the proposed infiltration basin and therefore would provide additional capacity for design rainfall or repeat storms.

APPENDICES

APPENDIX A

Infiltration Testing Results

Sent by e-mail to: Codry.foster@calibro-consultants.com

Calibro Consultants Ltd
Spectrum (2nd Floor)
Bond Street
Bristol
BS1 3LG

For the attention of Mr Cory Foster,

13th September 2024

E-45121– SUDs Tests (BRE 365)– Land at East Aberthaw, Rhoose, CF62 3JB

Dear Cory,

1. Introduction

Environmental Management Solutions Limited (EMS) have been commissioned by the client Mr Cory Foster to undertake infiltration tests for a proposed development at the above site.

This letter report has been produced to summarise the findings of recent BRE 365 Infiltration tests at the site to aid with drainage design and accompany ongoing planning requirements.

2. Site Location and Description

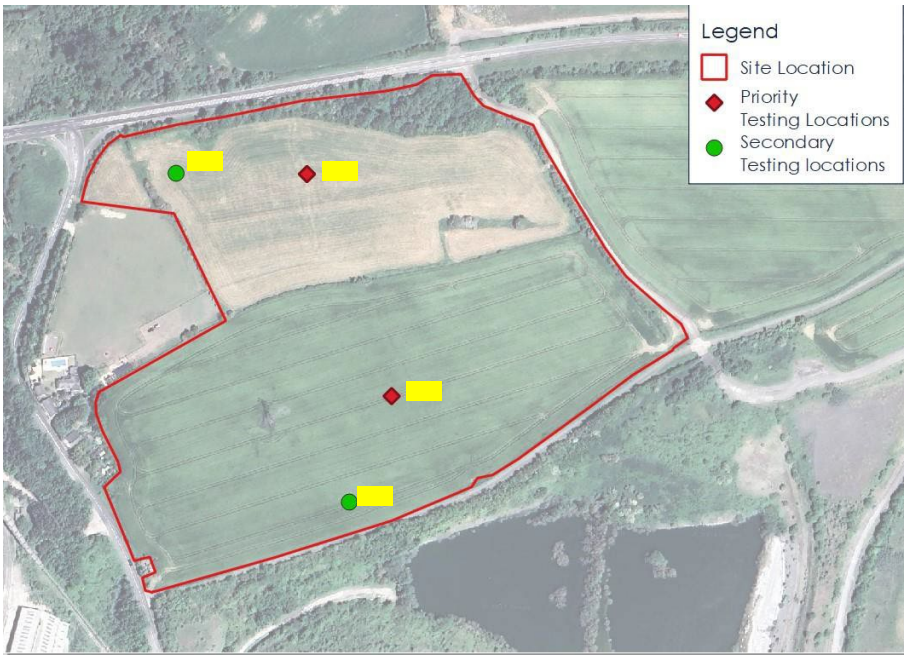


Figure 1 – Site Layout (Not to Scale)

The site is located directly east of Burton Hill in East Aberthaw, Rhoose, CF62 3JB. The approximate National Grid Reference for the site is E: 303659, N: 167687.

The site is irregular in shape and covers approximately 10.5 hectares. See Figure 1.

The site sits at an approximate elevation of between 12-34m Above Ordnance Datum (m AOD), falling to the north/north-east, the topography steepens towards the north-west.

The south field within the site boundary was generally a mixture of soil, stone and remnants of the last crop (Hay), this can be seen in the photographic record in attachment A. The field to the north/north-east was laid to grass, about a foot in length. There were no structures on either field apart from an electricity pylon within the central west of the southern field.

Exploratory hole locations were proposed by the Client. BRE 365 infiltration tests were performed at 1.5mbgl in all exploratory trial holes. The location of these test locations can be seen on the appended drawing or in figure 1 above.

3. Proposed Development

Details of the proposed development have not been shared; EMS are unaware of the proposed plans for the site.

4. Geology

The BGS map (Sheet 261&262 'Bridgend', 1:50,000 scale), indicates the site to be underlain by the Porthkerry Member which consists of limestones and mudstones, interbedded. There is no recorded superficial geology on site.

There are no recorded BGS boreholes within proximity to site. The closest borehole is some 400m west to north-west of site and describes similar ground conditions to those encountered on site; however, the silty and sandy clay above the fractured limestone is much thicker than seen on site.

5. Hydrogeology

The Porthkerry Member is designated as a Secondary A aquifer. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.

The site is not located within a Groundwater Source Protection Zone.

Groundwater vulnerability is given as high for this area.

6. Hydrology and Flood Risk

There are two surface water features near the site boundary. Firstly, a large manmade surface water body associated with the quarrying works to the south/south-east. Secondly, there is a surface water feature north of site, flowing to the southwest. It is assumed groundwater will flow towards the second of these features and to the north.

The Natural Resource Wales Flood Map for Planning website (https://naturalresources.wales/flooding/flood-map-for-planning-development-advice-

map/?lang=en) shows the site to be located within a Flood Zone A area. Flood Zone A areas are considered to be at little or no risk of fluvial or coastal/tidal flooding.

7. Previous Investigation Works

EMS are not aware of any previous investigations conducted at the site.

8. Site Works

Site works were undertaken on the 3rd September 2024 and included excavating 4 trial holes in areas of the site indicated to us by the client (shown in figure 1) to perform soakaway testing.

- TP01 was located in the southern field, it measured 1.5m in length, 0.4m in width and 1.5m in depth.
- TP02 was located in the northern field, it measured 1.2m in length, 0.35m in width and 1.5m in depth.
- TP03 was located in the northern field, it measured 1.2m in length, 0.4m in width and 1.5m in depth.
- TP04 was located in the southern field, it measured 1.2m in length, 0.4m in width and 1.5m in depth.

9. Encountered Ground Conditions

The encountered ground conditions mainly contained clayey sands or sandy clays followed by weak and weathered limestone within a clay matrix. TP03, located in the northern field, had a higher quantity of clay and less limestone was found to the full test depth of 1.5 m. The published ground conditions are similar to those described above except as these were cultivated (or previously cultivated) fields, much of the upper soils had been mixed together.

The limestone itself was fractured and tabular, as well as heavily weathered.

No groundwater was encountered within any of the trial pits.
A photographic record of the trial pits and testing are presented in Attachment A. Detailed Trial Pit logs are presented in Attachment B.

10. Soil Infiltration Rates

A summary of soakaway testing is presented in Table 1 overleaf.

Table 1: Summary of Soakaway Test Results				
Test Pit	**Strata Tested**	**Elapsed Time**	**Measured Outflow**	**Infiltration Rate (m/s)**
TP01 Test 1	0.97 mbgl – 1.5 mbgl	27 minutes.	100%	$1.18x10^{-4}$ m/s
TP01 Test 2	1.00 mbgl – 1.5 mbgl	1 hour and 14 minutes	100%	$4.42x10^{-5}$ m/s
TP01 Test 3	1.00 mbgl – 1.5 mbgl	1 hour and 25 minutes	100%	**$3.75x10^{-5}$ m/s** *(Infiltration rate to BRE 365 after 3 fills)*
TP02 Test 1	0.82 mbgl To 1.5 mbgl	3 hours and 51 minutes	~34%	Insufficient infiltration observed to calculate reliable infiltration rate.
TP03 Test 1	0.85 mbgl To 1.5 mbgl	4 hours and 23 minutes	~3%	Insufficient infiltration observed to calculate reliable infiltration rate.
TP04 Test 1	0.83 mbgl To 1.5 mbgl	41 minutes	100%	$8.63x10^{-5}$ m/s
TP04 Test 2	0.97 mbgl To 1.5 mbgl	55 minutes	100%	$5.91x10^{-5}$ m/s
TP04 Test 3	0.95 mbgl To 1.5 mbgl	1 hour and 25 minutes	100%	**$3.85x10^{-5}$ m/s** *(Infiltration rate to BRE 365 after 3 fills)*

Soakaway tests TP01 and TP04 both managed 3 full fills in each within a single day. Tests performed at TP01 between ~1.0-1.5 mbgl had an infiltration rate on the third fill of **$3.75x10^{-5}$ m/s**. Tests performed at TP04 between ~0.95-1.5 mbgl proved an infiltration rate on the third fill of **$3.85x10^{-5}$ m/s**.

Tests performed at TP02 and TP03 were abandoned due to slow infiltration on the initial day. There was a higher clay fraction within these two trial pits which may have caused the slower infiltration observed. Infiltration in TP02 may be viable with more days of testing.

11. Soakaway Advice

Two infiltration tests undertaken within the sandy and clayey GRAVELS (of weak and weathered Limestone) managed to infiltrate 3 full fills and an infiltration rate could be established for both TP01 & TP04. Two locations testing were not able to provide a usable infiltration rate.

TP01 achieved an infiltration rate of $3.75x10^{-5}$ m/s between 1.00 and 1.50mbgl after three fills.

TP04 achieved an infiltration rate of $3.85x10^{-5}$ m/s between 0.95 and 1.50mbgl after three fills.

As stated in the National Planning Practice Guidance, the aim should be to discharge surface water run-off as high up the drainage hierarchy, as reasonably practicable:

- into the ground (infiltration).
- to a surface water body.

- to a surface water sewer, highway drain, or another drainage system.
- to a combined sewer.

We recommend considering a combination of drainage system (SuDS) components. Options include:

- Source control
- Swales & conveyance channels
- Filtration
- Infiltration
- Retention & detention
- Wetlands
- Inlets, outlets & control structures

A successful SuDS scheme may use a combination of these processes and components. We recommend providing our information to a drainage designer experienced with SuDS to consider the best approach.

Yours sincerely,

For and on behalf of Environmental Management Solutions Limited

Joshua Greenland-Pigott (Geo-Environmental Engineer)

Attachments

Attachment A: Photographic record
Attachment B: Trial Pit Logs
Attachment C: Soakaway data

Attachment A – Photographic Record

The Old Surgery, 22a King Street, Hereford HR4 9DA
T: 01432 263333 E: info@emsgroupuk.com

Photo 01	Photo 02
	
03/09/24 East Aberthaw SUDs	**03/09/24 East Aberthaw SUDs**
General view of southern field showing ploughed surface and large quantity of cobbles and stone at the surface.	General view of northern field laid to grass.

Photo 03

03/09/24 East Aberthaw SUDs

Excavation at TP01 showing finer soils being followed by weathered, weak rock fragments.

Photo 04

03/09/24 East Aberthaw SUDs

Excavation at TP01 showing finer soils being followed by weathered, weak rock fragments.

Photo 05

03/09/24 East Aberthaw SUDs

Excavation at TP01 showing finer soils being followed by weathered, weak rock fragments.

Photo 06

03/09/24 East Aberthaw SUDs

Excavation at TP01 showing finer soils being followed by weathered, weak rock fragments.

Photo 07

03/09/24 East Aberthaw SUDs

General view of parking area off Blackfriar's Street in the southern area of the now demolished Blackfriars Stand.

Photo 08

03/09/24 East Aberthaw SUDs

General view of the pitch looking north

Attachment B – Trial Pit Logs

The Old Surgery, 22a King Street, Hereford HR4 9DA
T: 01432 263333 E: info@emsgroupuk.com

Trial Pit Log

Project Name: East Aberthaw
Client: Cody Foster
Date: 03/09/2024

Location: Rhoose, CF62 3JB
Contractor: Natha Davies

Project No. : E-45121
Crew Name:
Equipment: 3 tonne excavator with attachments

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP01	TP		JGP	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Loose dull brown clayey gravelly SAND.
					0.30			Loose orangish brown clayey SAND.
					0.50			Medium dense grey to orange slightly sandy clayey GRAVEL. Gravels are generally cobble sized and thought to be weak and well fractured limestone bedrock.
					0.80			Suspected weak LIMESTONE bedrock within a clay matrix.
					1.50			End of Trial Pit at 1.50m

Dimensions

collapse from weak and fractured bedrock falling into the base during excavation.

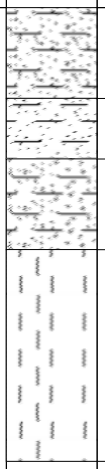
Remarks

Depth to groundwater not proven.

EMSgeotech

Trench	5	
Support and Comment	Pumping Data	

Pit Length	Pit Width	Pit Stability	Shoring Used			Remarks	Date	Rate	Remarks
1.50	0.40	Some sidewall							



		collapse from weak and fractured bedrock falling into the base during excavation.						

Remarks

Depth to groundwater not proven.

ENVIRONMENTAL MANAGEMENT SOLUTIONS

Trial Pit Log

Project Name: East Aberthaw
Client: Cody Foster
Date: 03/09/2024

Location: Rhoose, CF62 3JB
Contractor: Natha Davies

Project No. : E-45121
Crew Name:
Equipment: 3 tonne excavator with attachments

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP02	TP		JGP	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.10			Loose dull brown clayey gravelly SAND. Roots and rootlets.
								Loose orangish brown clayey SAND.
					0.50			Medium dense grey to orange slightly sandy clayey GRAVEL. Gravels are coarse to cobble sized and tabular. Suspected Limestone.
					0.80			Well fractured suspected LIMESTONE Bedrock within a slightly sandy clayey matrix.
					1.50			End of Trial Pit at 1.50m

Dimensions

collapse from weak and fractured bedrock falling into the base during excavation.

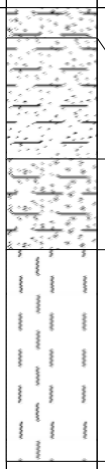
Remarks

Depth to groundwater not proven.

EMSgeotech

Trench	5	
Support and Comment	Pumping Data	

Pit Length	Pit Width	Pit Stability	Shoring Used			Remarks	Date	Rate	Remarks
1.20	0.35	Some sidewall							



		collapse from weak and fractured bedrock falling into the base during excavation.					

Remarks

Depth to groundwater not proven.

ENVIRONMENTAL MANAGEMENT SOLUTIONS

Trial Pit Log

Project Name: East Aberthaw
Client: Cody Foster
Date: 03/09/2024

Location: Rhoose, CF62 3JB
Contractor: Natha Davies

Project No. : E-45121
Crew Name:
Equipment: 3 tonne excavator with attachments

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP03	TP		JGP	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Loose greyish dark brown silty clayey gravelly SAND. Roots and rootlets.
					0.20			Soft brown sandy gravelly CLAY.
					0.40			Firm brown slightly sandy gravelly CLAY. Gravels are cobble to boulder size fragments of suspected weak Limestone bedrock.
					1.50			End of Trial Pit at 1.50m

Dimensions

collapse from weak and fractured bedrock falling into the base during excavation.

Remarks

Depth to groundwater not proven.

EMSgeotech

Trench	5	
Support and Comment	Pumping Data	

Pit Length	Pit Width	Pit Stability	Shoring Used			Remarks	Date	Rate	Remarks
1.20	0.40	Some sidewall							

		collapse from weak and fractured bedrock falling into the base during excavation.					

Remarks

Depth to groundwater not proven.

ENVIRONMENTAL MANAGEMENT SOLUTIONS

Trial Pit Log

Project Name: East Aberthaw
Client: Cody Foster
Date: 03/09/2024

Location: Rhoose, CF62 3JB
Contractor: Natha Davies

Project No. : E-45121
Crew Name:
Equipment: 3 tonne excavator with attachments

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP04	TP		JGP	1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
								Loose dull brown clayey gravelly SAND.
					0.30			Loose orangish brown clayey SAND.
					0.45			Medium dense grey to orange slightly sandy clayey GRAVEL. Gravels are coarse to cobble sized and tabular, of suspected weak/weathered/fractured Limestone.
					0.75			Well fractured/weathered suspected LIMESTONE bedrock in a slightly clayey, sandy matrix.
					1.50			End of Trial Pit at 1.50m

Dimensions

collapse from weak and fractured bedrock falling into the base during excavation.

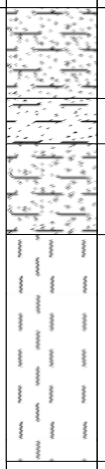
Remarks

Depth to groundwater not proven.

EMSgeotech

Trench	5	
Support and Comment	Pumping Data	

Pit Length	Pit Width	Pit Stability	Shoring Used			Remarks	Date	Rate	Remarks
1.20	0.40	Some sidewall							



		collapse from weak and fractured bedrock falling into the base during excavation.					

Remarks

Depth to groundwater not proven.

ENVIRONMENTAL MANAGEMENT SOLUTIONS

Attachment C – Soakaway Data

The Old Surgery, 22a King Street, Hereford HR4 9DA
T: 01432 263333 E: info@emsgroupuk.com

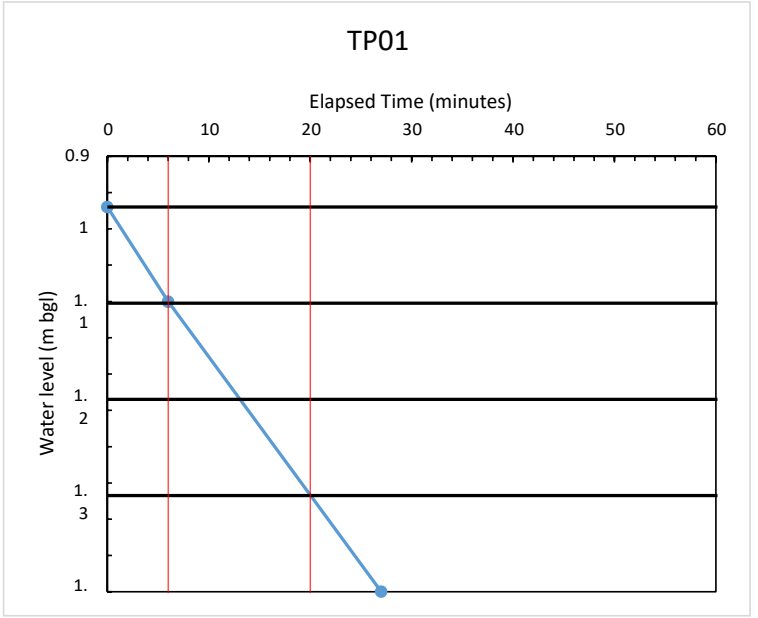
Environmental Management Solutions Ltd. Registered in England. Company No. 4855462
Registered Office: The Old surgery, 22a King Street, Hereford HR4 9DA

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP01 Test 1
The test pit was backf lled by client	

Depth of pit (m):	50
Effective depth (m):	53
Width of pit (m):	40
Length of pit (m):	50

Time elapsed (mins)	Water level (m below ground level)
0	0.97
6	1.10
27	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 16 m^3, Storage volume from 75% to 25% depth

a_{s50} = 61 m^2 wetted area of pit 50% full;

t_{p75-25} = 14 minutes, time to fall from 75% depth to 25% depth

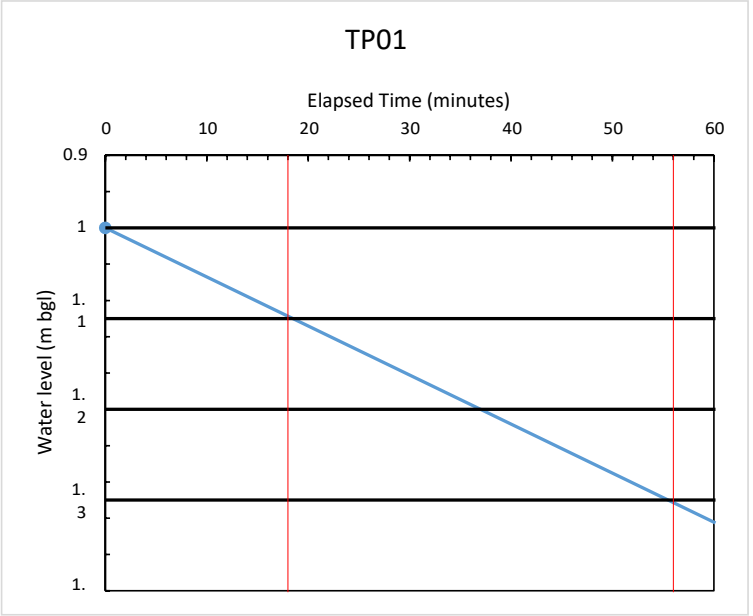
***f* (soil infiltration rate) =** **1.18 -04** m/s

$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP01 Test 2
The test pit was backf lled by client	
Depth of pit (m):	50
Effective depth (m):	50
Width of pit (m):	40
Length of pit (m):	50

Time elapsed (mins)	Water level (m below ground level)
0	1.00
74	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 15 m^3, Storage volume from 75% to 25% depth

a_{s50} = 55 m^2 wetted area of pit 50% full;

t_{p75-25} = 38 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** **4.24 -05** m/s

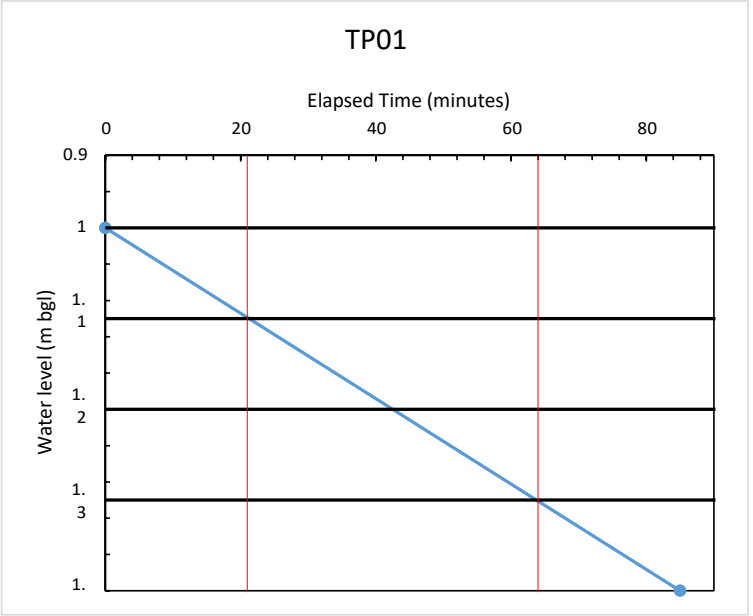
$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP01 Test 3
The test pit was backf lled by client	

Depth of pit (m):	50
Effective depth (m):	50
Width of pit (m):	40
Length of pit (m):	50

Time elapsed (mins)	Water level (m below ground level)
0	1.00
85	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 15 m^3, Storage volume from 75% to 25% depth

a_{s50} = 55 m^2 wetted area of pit 50% full;

t_{p75-25} = 43 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** **3.75 -05** m/s

$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

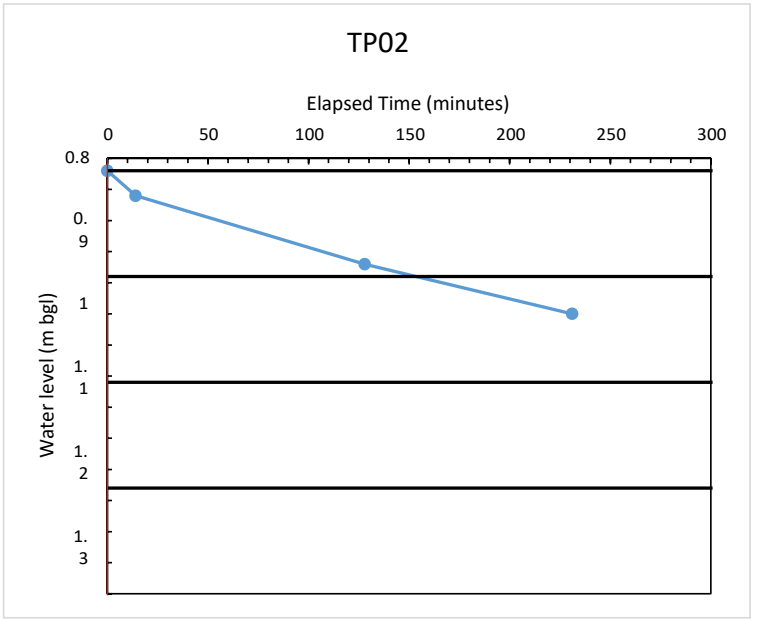
Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP02 Test 1

The test pit was backfilled by client

Depth of pit (m):	1.50
Effective depth (m):	0.68
Width of pit (m):	0.35
Length of pit (m):	1.20

Time elapsed (mins)	Water level (m below ground level)
0	0.82
14	0.86
128	0.97
231	1.05
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 0.14 m^3, Storage volume from 75% to 25% depth

a_{s50} = 1.47 m^2 wetted area of pit 50% full;

t_{p75-25} = 0 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** [redacted] m/s

$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

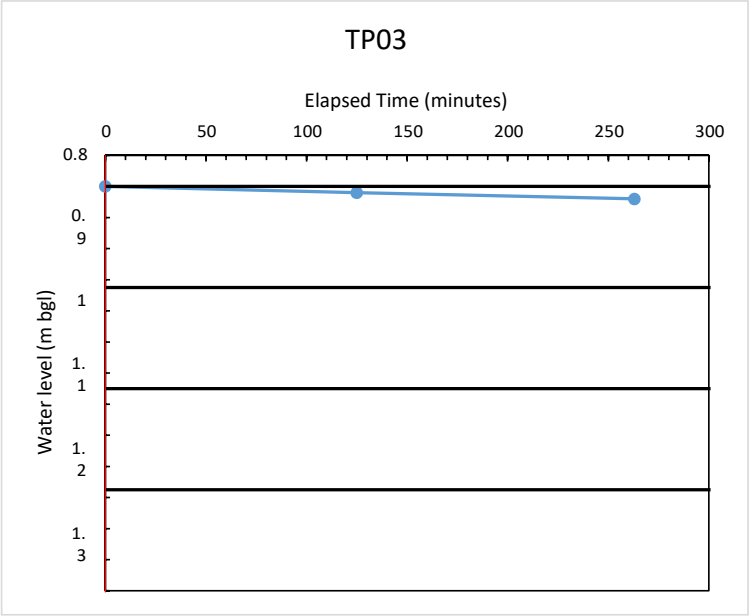
Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP03 Test 1

The test pit was backfilled by client

Depth of pit (m):	1.50
Effective depth (m):	0.65
Width of pit (m):	0.40
Length of pit (m):	1.20

Time elapsed (mins)	Water level (m below ground level)
0	0.85
125	0.86
263	0.87
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 0.16 m^3, Storage volume from 75% to 25% depth

a_{s50} = 1.52 m^2 wetted area of pit 50% full;

t_{p75-25} = 0 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** [redacted] m/s

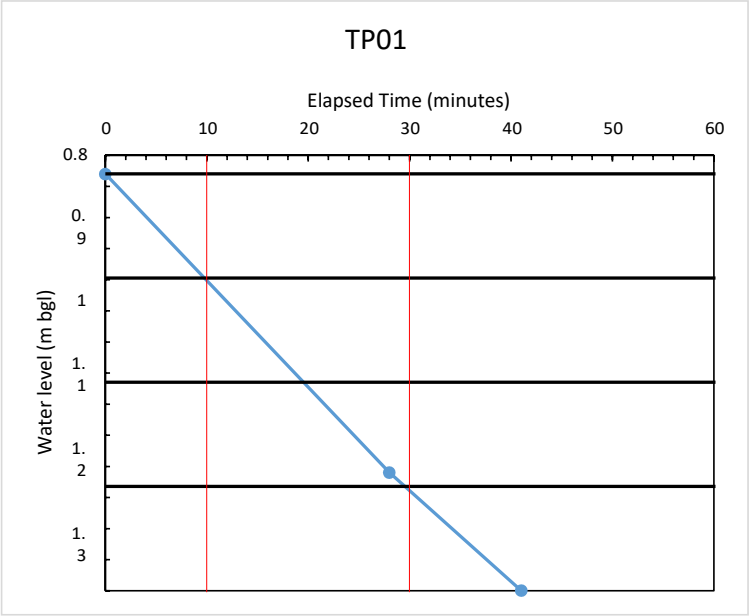
$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP04 Test 1
The test pit was backf lled by client	

Depth of pit (m):	50
Effective depth (m):	67
Width of pit (m):	40
Length of pit (m):	20

Time elapsed (mins)	Water level (m below ground level)
0	0.83
28	1.31
41	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 16 m^3, Storage volume from 75% to 25% depth

a_{s50} = 55 m^2 wetted area of pit 50% full;

t_{p75-25} = 20 minutes, time to fall from 75% depth to 25% depth

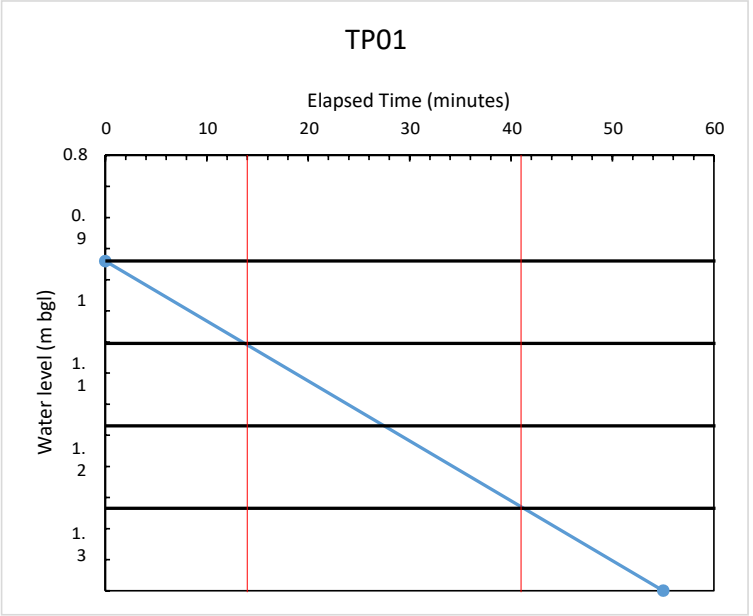
***f* (soil infiltration rate) =** **8.63 -05** m/s

$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP04 Test 2
The test pit was backf lled by client	
Depth of pit (m):	50
Effective depth (m):	53
Width of pit (m):	40
Length of pit (m):	20

Time elapsed (mins)	Water level (m below ground level)
0	0.97
55	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00



V_{p75-25} = 13 m^3, Storage volume from 75% to 25% depth

a_{s50} = 33 m^2 wetted area of pit 50% full;

t_{p75-25} = 27 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** **5.91 -05** m/s

$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

Soakaway Test Result Sheet

Project Name:	East Aberthaw
Project Number:	E-45121
Date of Test:	03/09/2024
Test Location:	TP04 Test 3

The test pit was backf lled by client

Depth of pit (m):	50
Effective depth (m):	55
Width of pit (m):	40
Length of pit (m):	20

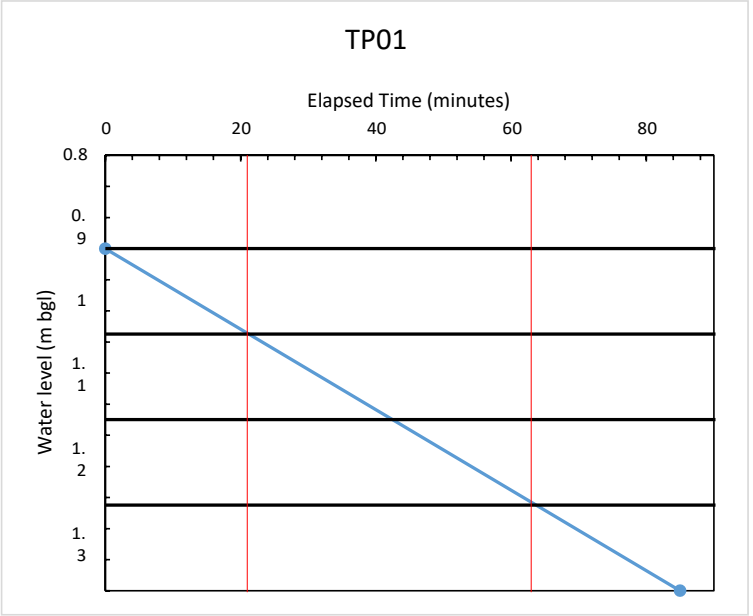
Time elapsed (mins)	Water level (m below ground level)
0	0.95
85	1.50
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00
0	0.00

V_{p75-25} = 13 m^3, Storage volume from 75% to 25% depth

a_{s50} = 36 m^2 wetted area of pit 50% full;

t_{p75-25} = 42 minutes, time to fall from 75% depth to 25% depth

***f* (soil infiltration rate) =** **3.85 -05** m/s

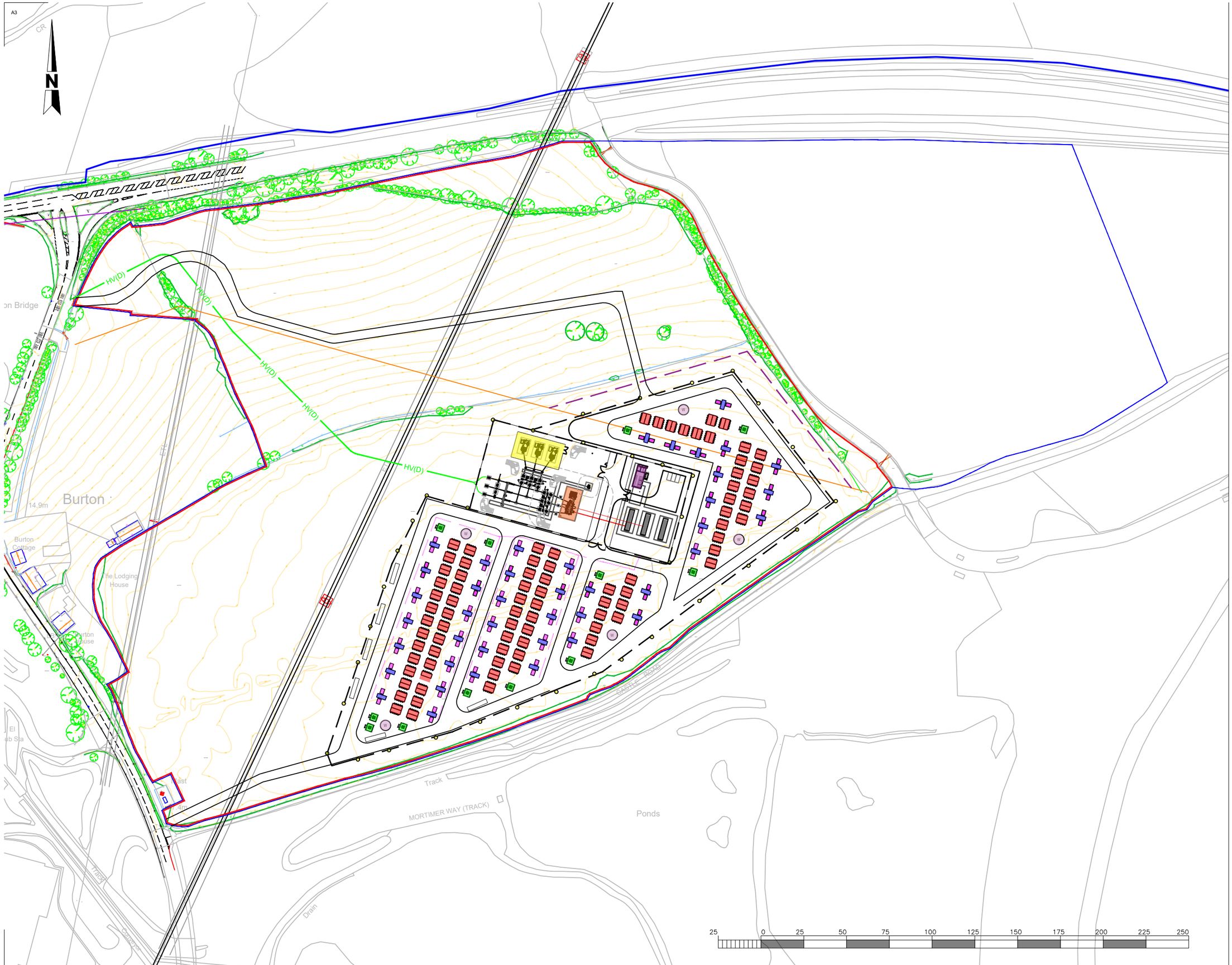


$$f = \frac{Vp75\text{-}25}{as50 \times tp75\text{-}25 \times 60}$$

APPENDIX B

Site Proposals

A3



NOTES:

1. ALL DIMENSIONS TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION
2. ALL DIMENSIONS ARE INDICATIVE AND IN METERS (M) UNLESS STATED OTHERWISE

LEGEND:

- BESS CONTAINER
- TWIN SKID INVERTER
- TWIN SKID TRANSFORMER
- AUXILIARY TRANSFORMER
- SWITCHGEAR
- HARMONIC FILTERS
- HV 33/400kV TRANSFORMER
- CONTROL ROOM
- RED LINE BOUNDARY
- FENCELINE
- MV CABLING INDICATIVE
- 275kV CABLE INDICATIVE
- CCTV POLE
- EXISTING PRoW
- PROPOSED PRoW DIVERGENCE
- WATER TANK

REV	DATE	BY	CHECKED	APPROVED
06	17-02-25	WS	MS	LS
ACCESS TRACK AMENDED				
05	11-02-25	WS	MS	LS
INDICATIVE HV CABLE ROUTE ADDED				
04	31-01-25	WS	MS	LS
MAIN ACCESS ADDED				
03	24-01-25	WS	LS	JK
320-350MW				
02	05-12-24	WS	LS	JK
AMENDED SOLBANK 3				
01	24-09-24	WS	LS	JK
FIRST ISSUE				

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CLIENT

REWE 7 LTD

PROJECT TITLE

FONMON

DRAWING TITLE

FONMON BESS DESIGN - 320-350MW SOLBANK 3.0

SCALE @ A3

1:7500

JOB No.	REV.
08	06

DRAWING No.

WIN-BES-08-DR-03-03-01

APPENDIX C

Microdrainage Source Control Calculations

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 84 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.085	0.085	0.3	1.5	O K
30 min Summer	0.104	0.104	0.3	1.9	Flood Risk
60 min Summer	0.118	0.118	0.3	2.2	Flood Risk
120 min Summer	0.116	0.116	0.3	2.2	Flood Risk
180 min Summer	0.111	0.111	0.3	2.1	Flood Risk
240 min Summer	0.106	0.106	0.3	1.9	Flood Risk
360 min Summer	0.094	0.094	0.3	1.7	O K
480 min Summer	0.082	0.082	0.3	1.5	O K
600 min Summer	0.072	0.072	0.3	1.3	O K
720 min Summer	0.064	0.064	0.3	1.1	O K
960 min Summer	0.051	0.051	0.3	0.8	O K
1440 min Summer	0.040	0.040	0.2	0.6	O K
2160 min Summer	0.031	0.031	0.2	0.4	O K
2880 min Summer	0.026	0.026	0.1	0.3	O K
4320 min Summer	0.022	0.022	0.1	0.2	O K
5760 min Summer	0.020	0.020	0.1	0.2	O K
7200 min Summer	0.019	0.019	0.1	0.1	O K
8640 min Summer	0.018	0.018	0.1	0.1	O K
10080 min Summer	0.017	0.017	0.1	0.1	O K
15 min Winter	0.094	0.094	0.3	1.7	O K
30 min Winter	0.117	0.117	0.3	2.2	Flood Risk
60 min Winter	0.134	0.134	0.3	2.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	17
30 min Summer	87.193	0.0	31
60 min Summer	55.800	0.0	60
120 min Summer	32.952	0.0	90
180 min Summer	24.164	0.0	124
240 min Summer	19.348	0.0	158
360 min Summer	14.072	0.0	224
480 min Summer	11.184	0.0	288
600 min Summer	9.335	0.0	350
720 min Summer	8.042	0.0	408
960 min Summer	6.335	0.0	520
1440 min Summer	4.509	0.0	762
2160 min Summer	3.207	0.0	1120
2880 min Summer	2.529	0.0	1472
4320 min Summer	1.835	0.0	2204
5760 min Summer	1.480	0.0	2904
7200 min Summer	1.274	0.0	3640
8640 min Summer	1.135	0.0	4328
10080 min Summer	1.035	0.0	5136
15 min Winter	129.474	0.0	17
30 min Winter	87.193	0.0	31
60 min Winter	55.800	0.0	60

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	0.131	0.131	0.3	2.5	Flood Risk
180 min Winter	0.124	0.124	0.3	2.3	Flood Risk
240 min Winter	0.115	0.115	0.3	2.2	Flood Risk
360 min Winter	0.097	0.097	0.3	1.8	O K
480 min Winter	0.080	0.080	0.3	1.4	O K
600 min Winter	0.066	0.066	0.3	1.1	O K
720 min Winter	0.055	0.055	0.3	0.9	O K
960 min Winter	0.044	0.044	0.2	0.7	O K
1440 min Winter	0.033	0.033	0.2	0.4	O K
2160 min Winter	0.025	0.025	0.1	0.3	O K
2880 min Winter	0.022	0.022	0.1	0.2	O K
4320 min Winter	0.019	0.019	0.1	0.1	O K
5760 min Winter	0.017	0.017	0.1	0.1	O K
7200 min Winter	0.016	0.016	0.1	0.1	O K
8640 min Winter	0.015	0.015	0.0	0.1	O K
10080 min Winter	0.014	0.014	0.0	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.952	0.0	96
180 min Winter	24.164	0.0	134
240 min Winter	19.348	0.0	172
360 min Winter	14.072	0.0	242
480 min Winter	11.184	0.0	306
600 min Winter	9.335	0.0	366
720 min Winter	8.042	0.0	418
960 min Winter	6.335	0.0	530
1440 min Winter	4.509	0.0	766
2160 min Winter	3.207	0.0	1092
2880 min Winter	2.529	0.0	1472
4320 min Winter	1.835	0.0	2204
5760 min Winter	1.480	0.0	2856
7200 min Winter	1.274	0.0	3680
8640 min Winter	1.135	0.0	4504
10080 min Winter	1.035	0.0	5144

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.007

Time (mins) From:	To:	Area (ha)
0	4	0.007

Model Details

Storage is Online Cover Level (m) 0.400

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.13500	Trench Width (m)	5.5
Infiltration Coefficient Side (m/hr)	0.13500	Trench Length (m)	12.7
Safety Factor	10.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 81 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.080	0.080	0.2	1.3	O K
30 min Summer	0.099	0.099	0.2	1.6	O K
60 min Summer	0.112	0.112	0.2	1.9	Flood Risk
120 min Summer	0.110	0.110	0.2	1.9	Flood Risk
180 min Summer	0.106	0.106	0.2	1.8	Flood Risk
240 min Summer	0.100	0.100	0.2	1.7	Flood Risk
360 min Summer	0.088	0.088	0.2	1.5	O K
480 min Summer	0.078	0.078	0.2	1.3	O K
600 min Summer	0.068	0.068	0.2	1.1	O K
720 min Summer	0.060	0.060	0.2	0.9	O K
960 min Summer	0.049	0.049	0.2	0.7	O K
1440 min Summer	0.039	0.039	0.2	0.5	O K
2160 min Summer	0.030	0.030	0.1	0.4	O K
2880 min Summer	0.024	0.024	0.1	0.3	O K
4320 min Summer	0.019	0.019	0.1	0.2	O K
5760 min Summer	0.017	0.017	0.1	0.1	O K
7200 min Summer	0.016	0.016	0.1	0.1	O K
8640 min Summer	0.015	0.015	0.1	0.1	O K
10080 min Summer	0.015	0.015	0.1	0.1	O K
15 min Winter	0.089	0.089	0.2	1.5	O K
30 min Winter	0.111	0.111	0.2	1.9	Flood Risk
60 min Winter	0.127	0.127	0.2	2.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	17
30 min Summer	87.193	0.0	31
60 min Summer	55.800	0.0	58
120 min Summer	32.952	0.0	88
180 min Summer	24.164	0.0	122
240 min Summer	19.348	0.0	156
360 min Summer	14.072	0.0	224
480 min Summer	11.184	0.0	288
600 min Summer	9.335	0.0	348
720 min Summer	8.042	0.0	406
960 min Summer	6.335	0.0	520
1440 min Summer	4.509	0.0	764
2160 min Summer	3.207	0.0	1124
2880 min Summer	2.529	0.0	1476
4320 min Summer	1.835	0.0	2204
5760 min Summer	1.480	0.0	2936
7200 min Summer	1.274	0.0	3616
8640 min Summer	1.135	0.0	4280
10080 min Summer	1.035	0.0	5104
15 min Winter	129.474	0.0	17
30 min Winter	87.193	0.0	31
60 min Winter	55.800	0.0	58

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	0.124	0.124	0.2	2.1	Flood Risk
180 min Winter	0.117	0.117	0.2	2.0	Flood Risk
240 min Winter	0.109	0.109	0.2	1.8	Flood Risk
360 min Winter	0.091	0.091	0.2	1.5	O K
480 min Winter	0.075	0.075	0.2	1.2	O K
600 min Winter	0.062	0.062	0.2	1.0	O K
720 min Winter	0.052	0.052	0.2	0.8	O K
960 min Winter	0.043	0.043	0.2	0.6	O K
1440 min Winter	0.032	0.032	0.1	0.4	O K
2160 min Winter	0.023	0.023	0.1	0.3	O K
2880 min Winter	0.019	0.019	0.1	0.2	O K
4320 min Winter	0.017	0.017	0.1	0.1	O K
5760 min Winter	0.015	0.015	0.1	0.1	O K
7200 min Winter	0.014	0.014	0.0	0.1	O K
8640 min Winter	0.013	0.013	0.0	0.1	O K
10080 min Winter	0.013	0.013	0.0	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.952	0.0	96
180 min Winter	24.164	0.0	134
240 min Winter	19.348	0.0	170
360 min Winter	14.072	0.0	240
480 min Winter	11.184	0.0	304
600 min Winter	9.335	0.0	362
720 min Winter	8.042	0.0	412
960 min Winter	6.335	0.0	530
1440 min Winter	4.509	0.0	778
2160 min Winter	3.207	0.0	1144
2880 min Winter	2.529	0.0	1472
4320 min Winter	1.835	0.0	2224
5760 min Winter	1.480	0.0	2936
7200 min Winter	1.274	0.0	3592
8640 min Winter	1.135	0.0	4456
10080 min Winter	1.035	0.0	5128

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.006

Time (mins) From:	To:	Area (ha)
0	4	0.006

Model Details

Storage is Online Cover Level (m) 0.400

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.13500	Trench Width (m)	6.3
Infiltration Coefficient Side (m/hr)	0.13500	Trench Length (m)	9.8
Safety Factor	10.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 1688 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.807	0.807	3.8	412.9	O K
30 min Summer	1.002	1.002	4.5	551.1	O K
60 min Summer	1.192	1.192	5.1	701.1	O K
120 min Summer	1.301	1.301	5.5	795.2	O K
180 min Summer	1.362	1.362	5.7	850.2	O K
240 min Summer	1.403	1.403	5.8	888.3	O K
360 min Summer	1.456	1.456	6.0	938.7	O K
480 min Summer	1.486	1.486	6.1	967.2	O K
600 min Summer	1.502	1.502	6.2	983.6	O K
720 min Summer	1.511	1.511	6.2	992.4	O K
960 min Summer	1.515	1.515	6.2	995.7	O K
1440 min Summer	1.501	1.501	6.2	982.6	O K
2160 min Summer	1.482	1.482	6.1	964.0	O K
2880 min Summer	1.464	1.464	6.0	946.2	O K
4320 min Summer	1.428	1.428	5.9	911.3	O K
5760 min Summer	1.395	1.395	5.8	880.6	O K
7200 min Summer	1.368	1.368	5.7	855.6	O K
8640 min Summer	1.347	1.347	5.6	836.7	O K
10080 min Summer	1.332	1.332	5.6	823.2	O K
15 min Winter	0.880	0.880	4.1	462.6	O K
30 min Winter	1.089	1.089	4.7	617.6	O K
60 min Winter	1.291	1.291	5.4	786.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	123.160	0.0	19
30 min Summer	82.511	0.0	34
60 min Summer	52.859	0.0	64
120 min Summer	30.419	0.0	124
180 min Summer	21.987	0.0	184
240 min Summer	17.462	0.0	242
360 min Summer	12.628	0.0	362
480 min Summer	10.012	0.0	482
600 min Summer	8.355	0.0	602
720 min Summer	7.203	0.0	722
960 min Summer	5.696	0.0	960
1440 min Summer	4.098	0.0	1228
2160 min Summer	2.959	0.0	1600
2880 min Summer	2.360	0.0	1992
4320 min Summer	1.732	0.0	2848
5760 min Summer	1.405	0.0	3680
7200 min Summer	1.204	0.0	4472
8640 min Summer	1.069	0.0	5280
10080 min Summer	0.973	0.0	6056
15 min Winter	123.160	0.0	19
30 min Winter	82.511	0.0	34
60 min Winter	52.859	0.0	64

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	1.408	1.408	5.8	892.8	O K
180 min Winter	1.474	1.474	6.1	955.5	O K
240 min Winter	1.518	1.518	6.2	999.3	O K
360 min Winter	1.576	1.576	6.4	1057.9	O K
480 min Winter	1.609	1.609	6.5	1092.2	O K
600 min Winter	1.629	1.629	6.6	1113.1	O K
720 min Winter	1.641	1.641	6.7	1125.7	O K
960 min Winter	1.650	1.650	6.7	1135.1	O K
1440 min Winter	1.640	1.640	6.7	1124.8	O K
2160 min Winter	1.614	1.614	6.6	1097.0	O K
2880 min Winter	1.590	1.590	6.5	1071.8	O K
4320 min Winter	1.537	1.537	6.3	1017.7	O K
5760 min Winter	1.486	1.486	6.1	967.2	O K
7200 min Winter	1.441	1.441	5.9	923.8	O K
8640 min Winter	1.402	1.402	5.8	887.5	O K
10080 min Winter	1.371	1.371	5.7	858.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	30.419	0.0	122
180 min Winter	21.987	0.0	180
240 min Winter	17.462	0.0	240
360 min Winter	12.628	0.0	356
480 min Winter	10.012	0.0	474
600 min Winter	8.355	0.0	588
720 min Winter	7.203	0.0	702
960 min Winter	5.696	0.0	926
1440 min Winter	4.098	0.0	1354
2160 min Winter	2.959	0.0	1684
2880 min Winter	2.360	0.0	2136
4320 min Winter	1.732	0.0	3068
5760 min Winter	1.405	0.0	3928
7200 min Winter	1.204	0.0	4824
8640 min Winter	1.069	0.0	5624
10080 min Winter	0.973	0.0	6464

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 463512 149652 SU 63512 49652	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.800

Time (mins) From:	To:	Area (ha)
0	4	1.800

Model Details

Storage is Online Cover Level (m) 2.100

Infiltration Basin Structure

Invert Level (m) 0.000 Safety Factor 10.0
Infiltration Coefficient Base (m/hr) 0.13500 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.13500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	372.0	1.800	1143.0	2.100	1289.0

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 6406 minutes.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.026	0.026	0.0	0.3	0.3	296.0	Flood Risk
30 min Summer	0.034	0.034	0.0	0.5	0.5	398.5	Flood Risk
60 min Summer	0.044	0.044	0.0	0.8	0.8	509.3	Flood Risk
120 min Summer	0.052	0.052	0.0	1.0	1.0	599.8	Flood Risk
180 min Summer	0.057	0.057	0.0	1.2	1.2	657.8	Flood Risk
240 min Summer	0.060	0.060	0.0	1.3	1.3	700.1	Flood Risk
360 min Summer	0.065	0.065	0.0	1.4	1.4	759.0	Flood Risk
480 min Summer	0.069	0.069	0.0	1.5	1.5	799.2	Flood Risk
600 min Summer	0.071	0.071	0.0	1.6	1.6	828.7	Flood Risk
720 min Summer	0.073	0.073	0.0	1.6	1.6	851.2	Flood Risk
960 min Summer	0.076	0.076	0.0	1.7	1.7	882.9	Flood Risk
1440 min Summer	0.079	0.079	0.0	1.7	1.7	919.2	Flood Risk
2160 min Summer	0.081	0.081	0.0	1.8	1.8	944.3	Flood Risk
2880 min Summer	0.083	0.083	0.0	1.8	1.8	956.3	Flood Risk
4320 min Summer	0.084	0.084	0.0	1.8	1.8	971.8	Flood Risk
5760 min Summer	0.086	0.086	0.0	1.9	1.9	994.6	Flood Risk
7200 min Summer	0.089	0.089	0.0	1.9	1.9	1027.0	Flood Risk
8640 min Summer	0.091	0.091	0.0	2.0	2.0	1059.9	Flood Risk
10080 min Summer	0.094	0.094	0.0	2.0	2.0	1091.2	Flood Risk
15 min Winter	0.029	0.029	0.0	0.4	0.4	331.5	Flood Risk
30 min Winter	0.039	0.039	0.0	0.6	0.6	446.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	23.5	19
30 min Summer	87.193	0.0	39.5	34
60 min Summer	55.800	0.0	108.7	64
120 min Summer	32.952	0.0	139.5	124
180 min Summer	24.164	0.0	159.3	184
240 min Summer	19.348	0.0	173.4	244
360 min Summer	14.072	0.0	191.8	364
480 min Summer	11.184	0.0	202.8	484
600 min Summer	9.335	0.0	209.6	604
720 min Summer	8.042	0.0	213.5	724
960 min Summer	6.335	0.0	215.9	962
1440 min Summer	4.509	0.0	209.3	1442
2160 min Summer	3.207	0.0	423.3	2160
2880 min Summer	2.529	0.0	419.1	2880
4320 min Summer	1.835	0.0	389.4	3720
5760 min Summer	1.480	0.0	780.0	4440
7200 min Summer	1.274	0.0	800.9	5184
8640 min Summer	1.135	0.0	804.7	5968
10080 min Summer	1.035	0.0	789.1	6848
15 min Winter	129.474	0.0	28.8	19
30 min Winter	87.193	0.0	48.0	34

Summary of Results for 100 year Return Period (+20%)

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
60 min Winter	0.049	0.049	0.0	0.9	0.9	570.3	Flood Risk
120 min Winter	0.058	0.058	0.0	1.2	1.2	671.6	Flood Risk
180 min Winter	0.064	0.064	0.0	1.4	1.4	736.5	Flood Risk
240 min Winter	0.068	0.068	0.0	1.5	1.5	783.9	Flood Risk
360 min Winter	0.073	0.073	0.0	1.6	1.6	849.8	Flood Risk
480 min Winter	0.077	0.077	0.0	1.7	1.7	894.9	Flood Risk
600 min Winter	0.080	0.080	0.0	1.8	1.8	928.0	Flood Risk
720 min Winter	0.082	0.082	0.0	1.8	1.8	953.4	Flood Risk
960 min Winter	0.085	0.085	0.0	1.9	1.9	989.1	Flood Risk
1440 min Winter	0.089	0.089	0.0	1.9	1.9	1030.5	Flood Risk
2160 min Winter	0.092	0.092	0.0	2.0	2.0	1060.5	Flood Risk
2880 min Winter	0.093	0.093	0.0	2.0	2.0	1076.5	Flood Risk
4320 min Winter	0.094	0.094	0.0	2.0	2.0	1094.7	Flood Risk
5760 min Winter	0.096	0.096	0.0	2.1	2.1	1112.4	Flood Risk
7200 min Winter	0.099	0.099	0.0	2.1	2.1	1144.1	Flood Risk
8640 min Winter	0.101	0.101	0.0	2.1	2.1	1175.5	Flood Risk
10080 min Winter	0.104	0.104	0.0	2.1	2.1	1204.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	55.800	0.0	129.9	64
120 min Winter	32.952	0.0	165.2	124
180 min Winter	24.164	0.0	187.3	182
240 min Winter	19.348	0.0	202.7	242
360 min Winter	14.072	0.0	222.0	360
480 min Winter	11.184	0.0	233.0	478
600 min Winter	9.335	0.0	239.3	596
720 min Winter	8.042	0.0	242.7	714
960 min Winter	6.335	0.0	243.9	952
1440 min Winter	4.509	0.0	235.1	1414
2160 min Winter	3.207	0.0	478.8	2100
2880 min Winter	2.529	0.0	471.6	2768
4320 min Winter	1.835	0.0	435.6	4060
5760 min Winter	1.480	0.0	883.4	4560
7200 min Winter	1.274	0.0	902.1	5480
8640 min Winter	1.135	0.0	899.3	6400
10080 min Winter	1.035	0.0	874.8	7360

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.220

Time (mins) From:	To:	Area (ha)
0	4	1.220

Model Details

Storage is Online Cover Level (m) 0.200

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	12200.0	0.0	0.200	12200.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0076-2300-0700-2300
Design Head (m)	0.700
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.3	Kick-Flo®	0.454	1.9
Flush-Flo™	0.207	2.3	Mean Flow over Head Range	-	2.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.4	2.000	3.7	4.000	5.1	7.000	6.7
0.200	2.3	1.000	2.7	2.200	3.9	4.500	5.4	7.500	6.9
0.300	2.2	1.200	2.9	2.400	4.1	5.000	5.7	8.000	7.1
0.400	2.1	1.400	3.2	2.600	4.2	5.500	6.0	8.500	7.4
0.500	2.0	1.600	3.4	3.000	4.5	6.000	6.2	9.000	7.6
0.600	2.1	1.800	3.5	3.500	4.8	6.500	6.5	9.500	7.8

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 6406 minutes.

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.026	0.026	0.0	0.3	0.3	296.0	Flood Risk
30 min Summer	0.034	0.034	0.0	0.5	0.5	398.5	Flood Risk
60 min Summer	0.044	0.044	0.0	0.8	0.8	509.3	Flood Risk
120 min Summer	0.052	0.052	0.0	1.0	1.0	599.8	Flood Risk
180 min Summer	0.057	0.057	0.0	1.2	1.2	657.8	Flood Risk
240 min Summer	0.060	0.060	0.0	1.3	1.3	700.1	Flood Risk
360 min Summer	0.065	0.065	0.0	1.4	1.4	759.0	Flood Risk
480 min Summer	0.069	0.069	0.0	1.5	1.5	799.2	Flood Risk
600 min Summer	0.071	0.071	0.0	1.6	1.6	828.7	Flood Risk
720 min Summer	0.073	0.073	0.0	1.6	1.6	851.2	Flood Risk
960 min Summer	0.076	0.076	0.0	1.7	1.7	882.9	Flood Risk
1440 min Summer	0.079	0.079	0.0	1.7	1.7	919.2	Flood Risk
2160 min Summer	0.081	0.081	0.0	1.8	1.8	944.3	Flood Risk
2880 min Summer	0.083	0.083	0.0	1.8	1.8	956.3	Flood Risk
4320 min Summer	0.084	0.084	0.0	1.8	1.8	971.8	Flood Risk
5760 min Summer	0.086	0.086	0.0	1.9	1.9	994.6	Flood Risk
7200 min Summer	0.089	0.089	0.0	1.9	1.9	1027.0	Flood Risk
8640 min Summer	0.091	0.091	0.0	2.0	2.0	1059.9	Flood Risk
10080 min Summer	0.094	0.094	0.0	2.0	2.0	1091.2	Flood Risk
15 min Winter	0.029	0.029	0.0	0.4	0.4	331.5	Flood Risk
30 min Winter	0.039	0.039	0.0	0.6	0.6	446.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	23.5	19
30 min Summer	87.193	0.0	39.5	34
60 min Summer	55.800	0.0	108.7	64
120 min Summer	32.952	0.0	139.5	124
180 min Summer	24.164	0.0	159.3	184
240 min Summer	19.348	0.0	173.4	244
360 min Summer	14.072	0.0	191.8	364
480 min Summer	11.184	0.0	202.8	484
600 min Summer	9.335	0.0	209.6	604
720 min Summer	8.042	0.0	213.5	724
960 min Summer	6.335	0.0	215.9	962
1440 min Summer	4.509	0.0	209.3	1442
2160 min Summer	3.207	0.0	423.3	2160
2880 min Summer	2.529	0.0	419.1	2880
4320 min Summer	1.835	0.0	389.4	3720
5760 min Summer	1.480	0.0	780.0	4440
7200 min Summer	1.274	0.0	800.9	5184
8640 min Summer	1.135	0.0	804.7	5968
10080 min Summer	1.035	0.0	789.1	6848
15 min Winter	129.474	0.0	28.8	19
30 min Winter	87.193	0.0	48.0	34

Summary of Results for 100 year Return Period (+20%)

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
60 min Winter	0.049	0.049	0.0	0.9	0.9	570.3	Flood Risk
120 min Winter	0.058	0.058	0.0	1.2	1.2	671.6	Flood Risk
180 min Winter	0.064	0.064	0.0	1.4	1.4	736.5	Flood Risk
240 min Winter	0.068	0.068	0.0	1.5	1.5	783.9	Flood Risk
360 min Winter	0.073	0.073	0.0	1.6	1.6	849.8	Flood Risk
480 min Winter	0.077	0.077	0.0	1.7	1.7	894.9	Flood Risk
600 min Winter	0.080	0.080	0.0	1.8	1.8	928.0	Flood Risk
720 min Winter	0.082	0.082	0.0	1.8	1.8	953.4	Flood Risk
960 min Winter	0.085	0.085	0.0	1.9	1.9	989.1	Flood Risk
1440 min Winter	0.089	0.089	0.0	1.9	1.9	1030.5	Flood Risk
2160 min Winter	0.092	0.092	0.0	2.0	2.0	1060.5	Flood Risk
2880 min Winter	0.093	0.093	0.0	2.0	2.0	1076.5	Flood Risk
4320 min Winter	0.094	0.094	0.0	2.0	2.0	1094.7	Flood Risk
5760 min Winter	0.096	0.096	0.0	2.1	2.1	1112.4	Flood Risk
7200 min Winter	0.099	0.099	0.0	2.1	2.1	1144.1	Flood Risk
8640 min Winter	0.101	0.101	0.0	2.1	2.1	1175.5	Flood Risk
10080 min Winter	0.104	0.104	0.0	2.1	2.1	1204.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	55.800	0.0	129.9	64
120 min Winter	32.952	0.0	165.2	124
180 min Winter	24.164	0.0	187.3	182
240 min Winter	19.348	0.0	202.7	242
360 min Winter	14.072	0.0	222.0	360
480 min Winter	11.184	0.0	233.0	478
600 min Winter	9.335	0.0	239.3	596
720 min Winter	8.042	0.0	242.7	714
960 min Winter	6.335	0.0	243.9	952
1440 min Winter	4.509	0.0	235.1	1414
2160 min Winter	3.207	0.0	478.8	2100
2880 min Winter	2.529	0.0	471.6	2768
4320 min Winter	1.835	0.0	435.6	4060
5760 min Winter	1.480	0.0	883.4	4560
7200 min Winter	1.274	0.0	902.1	5480
8640 min Winter	1.135	0.0	899.3	6400
10080 min Winter	1.035	0.0	874.8	7360

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.220

Time (mins) From:	To:	Area (ha)
0	4	1.220

Model Details

Storage is Online Cover Level (m) 0.200

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	12200.0	0.0	0.200	12200.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0076-2300-0700-2300
Design Head (m)	0.700
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.3	Kick-Flo®	0.454	1.9
Flush-Flo™	0.207	2.3	Mean Flow over Head Range	-	2.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.1	0.800	2.4	2.000	3.7	4.000	5.1	7.000	6.7
0.200	2.3	1.000	2.7	2.200	3.9	4.500	5.4	7.500	6.9
0.300	2.2	1.200	2.9	2.400	4.1	5.000	5.7	8.000	7.1
0.400	2.1	1.400	3.2	2.600	4.2	5.500	6.0	8.500	7.4
0.500	2.0	1.600	3.4	3.000	4.5	6.000	6.2	9.000	7.6
0.600	2.1	1.800	3.5	3.500	4.8	6.500	6.5	9.500	7.8

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 86 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.088	0.088	0.2	0.9	O K
30 min Summer	0.109	0.109	0.2	1.1	Flood Risk
60 min Summer	0.123	0.123	0.2	1.3	Flood Risk
120 min Summer	0.121	0.121	0.2	1.2	Flood Risk
180 min Summer	0.117	0.117	0.2	1.2	Flood Risk
240 min Summer	0.111	0.111	0.2	1.1	Flood Risk
360 min Summer	0.099	0.099	0.2	1.0	O K
480 min Summer	0.087	0.087	0.2	0.9	O K
600 min Summer	0.077	0.077	0.2	0.7	O K
720 min Summer	0.068	0.068	0.1	0.6	O K
960 min Summer	0.054	0.054	0.1	0.5	O K
1440 min Summer	0.042	0.042	0.1	0.3	O K
2160 min Summer	0.032	0.032	0.1	0.2	O K
2880 min Summer	0.027	0.027	0.1	0.2	O K
4320 min Summer	0.023	0.023	0.1	0.1	O K
5760 min Summer	0.021	0.021	0.0	0.1	O K
7200 min Summer	0.019	0.019	0.0	0.1	O K
8640 min Summer	0.018	0.018	0.0	0.1	O K
10080 min Summer	0.017	0.017	0.0	0.1	O K
15 min Winter	0.098	0.098	0.2	1.0	O K
30 min Winter	0.123	0.123	0.2	1.3	Flood Risk
60 min Winter	0.140	0.140	0.2	1.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	17
30 min Summer	87.193	0.0	32
60 min Summer	55.800	0.0	60
120 min Summer	32.952	0.0	90
180 min Summer	24.164	0.0	124
240 min Summer	19.348	0.0	158
360 min Summer	14.072	0.0	224
480 min Summer	11.184	0.0	290
600 min Summer	9.335	0.0	350
720 min Summer	8.042	0.0	412
960 min Summer	6.335	0.0	522
1440 min Summer	4.509	0.0	762
2160 min Summer	3.207	0.0	1124
2880 min Summer	2.529	0.0	1472
4320 min Summer	1.835	0.0	2200
5760 min Summer	1.480	0.0	2936
7200 min Summer	1.274	0.0	3672
8640 min Summer	1.135	0.0	4368
10080 min Summer	1.035	0.0	5064
15 min Winter	129.474	0.0	17
30 min Winter	87.193	0.0	31
60 min Winter	55.800	0.0	60

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	0.137	0.137	0.2	1.4	Flood Risk
180 min Winter	0.130	0.130	0.2	1.3	Flood Risk
240 min Winter	0.122	0.122	0.2	1.2	Flood Risk
360 min Winter	0.103	0.103	0.2	1.0	Flood Risk
480 min Winter	0.085	0.085	0.2	0.8	O K
600 min Winter	0.070	0.070	0.1	0.7	O K
720 min Winter	0.058	0.058	0.1	0.5	O K
960 min Winter	0.046	0.046	0.1	0.4	O K
1440 min Winter	0.034	0.034	0.1	0.2	O K
2160 min Winter	0.026	0.026	0.1	0.1	O K
2880 min Winter	0.023	0.023	0.1	0.1	O K
4320 min Winter	0.019	0.019	0.0	0.1	O K
5760 min Winter	0.018	0.018	0.0	0.1	O K
7200 min Winter	0.016	0.016	0.0	0.1	O K
8640 min Winter	0.015	0.015	0.0	0.1	O K
10080 min Winter	0.015	0.015	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.952	0.0	96
180 min Winter	24.164	0.0	134
240 min Winter	19.348	0.0	172
360 min Winter	14.072	0.0	242
480 min Winter	11.184	0.0	308
600 min Winter	9.335	0.0	368
720 min Winter	8.042	0.0	424
960 min Winter	6.335	0.0	530
1440 min Winter	4.509	0.0	776
2160 min Winter	3.207	0.0	1104
2880 min Winter	2.529	0.0	1468
4320 min Winter	1.835	0.0	2244
5760 min Winter	1.480	0.0	2968
7200 min Winter	1.274	0.0	3560
8640 min Winter	1.135	0.0	4400
10080 min Winter	1.035	0.0	4960

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.004

Time (mins) From:	To:	Area (ha)
0	4	0.004

Model Details

Storage is Online Cover Level (m) 0.400

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.13500	Trench Width (m)	3.0
Infiltration Coefficient Side (m/hr)	0.13500	Trench Length (m)	12.7
Safety Factor	10.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 70 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.076	0.076	0.2	0.9	O K
30 min Summer	0.093	0.093	0.2	1.1	O K
60 min Summer	0.103	0.103	0.2	1.2	Flood Risk
120 min Summer	0.101	0.101	0.2	1.2	Flood Risk
180 min Summer	0.096	0.096	0.2	1.1	O K
240 min Summer	0.091	0.091	0.2	1.0	O K
360 min Summer	0.079	0.079	0.2	0.9	O K
480 min Summer	0.069	0.069	0.2	0.8	O K
600 min Summer	0.061	0.061	0.2	0.6	O K
720 min Summer	0.054	0.054	0.2	0.5	O K
960 min Summer	0.045	0.045	0.2	0.4	O K
1440 min Summer	0.036	0.036	0.1	0.3	O K
2160 min Summer	0.028	0.028	0.1	0.2	O K
2880 min Summer	0.025	0.025	0.1	0.2	O K
4320 min Summer	0.022	0.022	0.1	0.1	O K
5760 min Summer	0.020	0.020	0.0	0.1	O K
7200 min Summer	0.018	0.018	0.0	0.1	O K
8640 min Summer	0.017	0.017	0.0	0.1	O K
10080 min Summer	0.017	0.017	0.0	0.1	O K
15 min Winter	0.085	0.085	0.2	1.0	O K
30 min Winter	0.104	0.104	0.2	1.2	Flood Risk
60 min Winter	0.117	0.117	0.2	1.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	17
30 min Summer	87.193	0.0	31
60 min Summer	55.800	0.0	54
120 min Summer	32.952	0.0	86
180 min Summer	24.164	0.0	120
240 min Summer	19.348	0.0	154
360 min Summer	14.072	0.0	220
480 min Summer	11.184	0.0	282
600 min Summer	9.335	0.0	342
720 min Summer	8.042	0.0	398
960 min Summer	6.335	0.0	518
1440 min Summer	4.509	0.0	754
2160 min Summer	3.207	0.0	1104
2880 min Summer	2.529	0.0	1468
4320 min Summer	1.835	0.0	2200
5760 min Summer	1.480	0.0	2904
7200 min Summer	1.274	0.0	3592
8640 min Summer	1.135	0.0	4392
10080 min Summer	1.035	0.0	5104
15 min Winter	129.474	0.0	17
30 min Winter	87.193	0.0	31
60 min Winter	55.800	0.0	58

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	0.113	0.113	0.2	1.3	Flood Risk
180 min Winter	0.106	0.106	0.2	1.2	Flood Risk
240 min Winter	0.097	0.097	0.2	1.1	O K
360 min Winter	0.080	0.080	0.2	0.9	O K
480 min Winter	0.065	0.065	0.2	0.7	O K
600 min Winter	0.054	0.054	0.2	0.5	O K
720 min Winter	0.047	0.047	0.2	0.5	O K
960 min Winter	0.039	0.039	0.1	0.3	O K
1440 min Winter	0.030	0.030	0.1	0.2	O K
2160 min Winter	0.024	0.024	0.1	0.1	O K
2880 min Winter	0.022	0.022	0.1	0.1	O K
4320 min Winter	0.019	0.019	0.0	0.1	O K
5760 min Winter	0.017	0.017	0.0	0.1	O K
7200 min Winter	0.016	0.016	0.0	0.1	O K
8640 min Winter	0.015	0.015	0.0	0.1	O K
10080 min Winter	0.014	0.014	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.952	0.0	94
180 min Winter	24.164	0.0	132
240 min Winter	19.348	0.0	168
360 min Winter	14.072	0.0	236
480 min Winter	11.184	0.0	296
600 min Winter	9.335	0.0	350
720 min Winter	8.042	0.0	406
960 min Winter	6.335	0.0	528
1440 min Winter	4.509	0.0	762
2160 min Winter	3.207	0.0	1124
2880 min Winter	2.529	0.0	1424
4320 min Winter	1.835	0.0	2196
5760 min Winter	1.480	0.0	2936
7200 min Winter	1.274	0.0	3704
8640 min Winter	1.135	0.0	4384
10080 min Winter	1.035	0.0	5104

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.004

Time (mins) From:	To:	Area (ha)
0	4	0.004

Model Details

Storage is Online Cover Level (m) 0.400

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.13500	Trench Width (m)	3.3
Infiltration Coefficient Side (m/hr)	0.13500	Trench Length (m)	13.7
Safety Factor	10.0	Slope (1:X)	500.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	0.000	Cap Infiltration Depth (m)	0.000

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 73 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	0.075	0.075	0.8	3.4	O K
30 min Summer	0.096	0.096	0.8	4.7	O K
60 min Summer	0.112	0.112	0.8	5.6	Flood Risk
120 min Summer	0.114	0.114	0.8	5.8	Flood Risk
180 min Summer	0.112	0.112	0.8	5.6	Flood Risk
240 min Summer	0.107	0.107	0.8	5.4	Flood Risk
360 min Summer	0.097	0.097	0.8	4.7	O K
480 min Summer	0.085	0.085	0.8	4.0	O K
600 min Summer	0.075	0.075	0.8	3.4	O K
720 min Summer	0.066	0.066	0.8	2.9	O K
960 min Summer	0.053	0.053	0.8	2.1	O K
1440 min Summer	0.042	0.042	0.6	1.4	O K
2160 min Summer	0.035	0.035	0.5	1.0	O K
2880 min Summer	0.032	0.032	0.4	0.8	O K
4320 min Summer	0.027	0.027	0.3	0.6	O K
5760 min Summer	0.024	0.024	0.2	0.5	O K
7200 min Summer	0.023	0.023	0.2	0.4	O K
8640 min Summer	0.021	0.021	0.2	0.4	O K
10080 min Summer	0.020	0.020	0.2	0.3	O K
15 min Winter	0.084	0.084	0.8	4.0	O K
30 min Winter	0.109	0.109	0.8	5.4	Flood Risk
60 min Winter	0.128	0.128	0.8	6.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	129.474	0.0	17
30 min Summer	87.193	0.0	32
60 min Summer	55.800	0.0	60
120 min Summer	32.952	0.0	90
180 min Summer	24.164	0.0	124
240 min Summer	19.348	0.0	158
360 min Summer	14.072	0.0	224
480 min Summer	11.184	0.0	290
600 min Summer	9.335	0.0	350
720 min Summer	8.042	0.0	408
960 min Summer	6.335	0.0	520
1440 min Summer	4.509	0.0	750
2160 min Summer	3.207	0.0	1104
2880 min Summer	2.529	0.0	1468
4320 min Summer	1.835	0.0	2200
5760 min Summer	1.480	0.0	2936
7200 min Summer	1.274	0.0	3640
8640 min Summer	1.135	0.0	4400
10080 min Summer	1.035	0.0	5136
15 min Winter	129.474	0.0	17
30 min Winter	87.193	0.0	31
60 min Winter	55.800	0.0	60

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
120 min Winter	0.128	0.128	0.8	6.6	Flood Risk
180 min Winter	0.124	0.124	0.8	6.3	Flood Risk
240 min Winter	0.116	0.116	0.8	5.9	Flood Risk
360 min Winter	0.099	0.099	0.8	4.9	O K
480 min Winter	0.082	0.082	0.8	3.8	O K
600 min Winter	0.068	0.068	0.8	2.9	O K
720 min Winter	0.056	0.056	0.8	2.2	O K
960 min Winter	0.045	0.045	0.7	1.5	O K
1440 min Winter	0.036	0.036	0.5	1.0	O K
2160 min Winter	0.031	0.031	0.4	0.7	O K
2880 min Winter	0.027	0.027	0.3	0.6	O K
4320 min Winter	0.023	0.023	0.2	0.4	O K
5760 min Winter	0.021	0.021	0.2	0.3	O K
7200 min Winter	0.019	0.019	0.1	0.3	O K
8640 min Winter	0.018	0.018	0.1	0.3	O K
10080 min Winter	0.017	0.017	0.1	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
120 min Winter	32.952	0.0	98
180 min Winter	24.164	0.0	134
240 min Winter	19.348	0.0	172
360 min Winter	14.072	0.0	242
480 min Winter	11.184	0.0	308
600 min Winter	9.335	0.0	366
720 min Winter	8.042	0.0	418
960 min Winter	6.335	0.0	522
1440 min Winter	4.509	0.0	748
2160 min Winter	3.207	0.0	1096
2880 min Winter	2.529	0.0	1456
4320 min Winter	1.835	0.0	2188
5760 min Winter	1.480	0.0	2856
7200 min Winter	1.274	0.0	3600
8640 min Winter	1.135	0.0	4472
10080 min Winter	1.035	0.0	5096

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 303597 167628 ST 03597 67628	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.020

Time (mins) From:	To:	Area (ha)
0	4	0.020

Model Details

Storage is Online Cover Level (m) 0.400

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.13500	Width (m)	10.5
Membrane Percolation (mm/hr)	1000	Length (m)	19.3
Max Percolation (l/s)	56.3	Slope (1:X)	500.0
Safety Factor	10.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	0.000	Membrane Depth (m)	0

APPENDIX D

Proposed Drainage Strategy

north

LEGEND

- BASIN CONTRIBUTION AREA
- PROPOSED GRAVEL BASES
- BASIN BASE
- BASIN TOP WATER LEVEL
- BASIN 3m MAINTENANCE STRIP
- BASIN/SWALE GRADING (1 IN 3)
- CONVEYANCE SWALE
- PROPOSED PERFORATED PIPES
- INSPECTION CHAMBER
- PENSTOCK CHAMBER

INFILTRATION BASIN
BASE AREA = 370m²
MAX WATER LEVEL AREA = 1,140m²
FREEBOARD AREA = 1,290m²
BASE LEVEL = 25.9mAOD
CREST LEVEL (INCL. FB) = 28mAOD
VOLUME CAPACITY AT MAX. WATER LEVEL= 1,300m³
VOLUME CAPACITY AT FB LEVEL = 1,665m³
STORAGE REQUIRED IN DESIGN EVENT = 1,135m³
SIDE SLOPES = 1 IN 3
INFILTRATION RATE = 0.135mm/hr
FACTOR OF SAFETY= 10

SWALE DIMENSIONS:
DEPTH = 300mm
BASE WIDTH = 500mm

SWALE TO BE LINED BY IMPERMEABLE MEMBRANE WHERE IT CROSSES THE CABLE ROUTE TO MINIMISE WATER INGRESS

ACO SUDS SWALE INLET OR SIMILAR APPROVED

ACO SUDS SWALE INLET OR SIMILAR APPROVED

BASIN LOCATED UPSLOPE OF EXISTING PROPERTIES. THEREFORE FoS 10 APPLIED AND SIGNIFICANT OVER CAPACITY PROVIDED FOR EXCEEDANCE EVENTS

SUBSTATION COMPOUND TO BE PERMEABLE SURFACED EXCEPT FOR CONTAINERS OR CONCRETE PADS, AS SHOWN

CONTROL ROOM GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
WIDTH = 5.5m
LENGTH = 12.7m

SWITCHGEAR GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
WIDTH = 3.3m
LENGTH = 13.7m

HARMONIC FILTERS GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
WIDTH = 6.3m
LENGTH = 9.8m

SPARE PARTS CONTAINER GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
WIDTH = 2.7m
LENGTH = 12.7m

TRANSFORMER GRAVEL BASE DIMENSIONS:
DEPTH = 0.4m
WIDTH = 10.5m
LENGTH = 19.3m

PENSTOCK CHAMBER TO BE SHUT IN THE EVENT THAT FIRE SUPRESSION WATER IS USED

PENSTOCK CHAMBER TO BE SHUT IN THE EVENT THAT FIRE SUPRESSION WATER IS USED

ACCESS TRACKS AND PARKING AREAS TO BE FORMED BY PERMEABLE MATERIAL

0.3m high retaining wall

0.3m high retaining wall

0.6m high retaining wall

0.3m high retaining wall

NORTHERN PERFORATED PIPE NETWORK TO AVOID PROPOSED UNITS WHERE POSSIBLE

PERFORATED PIPES TO BE SET IN A TRENCH TO ENSURE MINIMUM 900mm COVER

NORTHERN NETWORK GRAVEL BASE DEPTH = 0.2
GRAVEL BASE SLOPE = 1 IN 300
SLOPE ANGLED TOWARDS COLLECTOR PERFORATED PIPES

SOUTHERN PERFORATED PIPE NETWORK

SOUTHERN NETWORK GRAVEL BASE DEPTH = 0.2m
GRAVEL BASE SLOPE = 1 IN 300
SLOPE ANGLED TOWARDS COLLECTOR PERFORATED PIPES

BESS GRAVEL BASE TO BE WRAPPED IN IMPERMEABLE MEMBRANE

BESS GRAVEL BASE TO BE FORMED FROM LIMESTONE

Burton Bridge
Burton
14.9m
Burton Cottage
LB
Burton House
El Sub Sta
ETL
CASTLE ROAD
MORTIMER WAY (TRACK)
Ponds

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

REV:	DESCRIPTION:	BY:	CHK:	DATE:
02	LABELS ADDED TO REFLECT FINAL LAYOUT	CF	PG	17/02/25
01	AMENDED TO REFLECT LAYOUT CHANGES	CF	PG	11/02/25
00	FIRST ISSUE	CF	PG	22/01/25

STATUS: FOR INFORMATION

CLIENT: CSWE 7 LTD.

SITE: CASTLE ROAD BESS

TITLE: PROPOSED SURFACE WATER DRAINAGE STRATEGY

calibro

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
1 : 750	22/01/2025	CF	PG

PROJECT NO:	COMPANY:	TYPE:	DRAWING NO:	SHEET NO:	REVISION:
24-278	CAL	DR	60-100	01	01

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