BATTERY STORAGE FACILITY, CULHAM

Flood Risk Assessment and Conceptual Drainage Strategy

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Contents

Appendices

1 SCOPE OF WORK

Background

1.1 At the request of Statera Energy, RPS Consulting Services Limited (RPS) has prepared a site-specific Flood Risk Assessment (FRA) to support the application for the development of a Battery storage facility and associated infrastructure. The site is located north of Thame Lane, Culham, OX14 3GY. The assessment has been undertaken in accordance with the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG).

1.2 The key objectives of the FRA are to:

- assess the flood risk to the proposed development and to demonstrate the feasibility of appropriately designing the development such that any residual flood risk to the development and users would be acceptable;
- assess the potential impact of the proposed development on flood risk elsewhere and to demonstrate the feasibility of appropriately designing the development such that the development would not increase flood risk elsewhere; and
- satisfy the requirements of the NPPF and Planning Practice Guidance which require FRAs to be submitted in support of planning applications for development over 1 ha in area.

1.3 Developments that are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. Current guidance on development and flood risk identifies several key aims for a development to ensure that it is sustainable in flood risk terms. These aims are as follows:

- the development should not be at a significant risk of flooding and should not be susceptible to damage due to flooding;
- the development should not be exposed to flood risk such that the health, safety or welfare of the users of the development, or the population elsewhere, is threatened;
- normal operation of the development should not be susceptible to disruption as a result of flooding;
- safe access to and from the development should be possible during flood events;
- the development should not increase flood risk elsewhere;
- the development should not prevent safe maintenance of watercourses or maintenance and operation of flood defences;
- the development should not be associated with an onerous or difficult operation and maintenance regime to manage flood risk. The responsibility for any operation and maintenance required should be clearly defined;
- future users of the development should be made aware of any flood risk issues relating to the development;
- the development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues;
- the development should not lead to degradation of the environment; and
- the development should meet all of the above criteria for its entire lifetime, including consideration of the potential effects of climate change.

1.4 The FRA is undertaken with due consideration of these sustainability aims.

Project Scope

1.5 This FRA has the following structure:

- Sections 2 and 3 identify the sources of information that have been consulted in preparation of the report;
- Sections 4 and 5 describe the site location and the existing and proposed site development layout;
- Section 6 provides a hydrological review of the site and undertakes an FRA of the proposed development scheme;
- Section 7 describes the sites vulnerability status in line with the NPPF and PPG;
- Section 8 describes the runoff characteristics and drainage of the site;
- Section 9 provides a summary and conclusion to the report.

2 SOURCES OF INFORMAITON

Introduction

2.1 Table 1 below lists the information sources consulted during preparation of this report.

Table 1: Information sources consulted during preparation of the report.

Source	Data	Notes
Ordnance Survey	OS Mapping 1: 50 000	Area information, rivers and other watercourses, general site environs, built environment, catchment Information
British Geological Survey	BGS (online) Geology of Britain Viewer	Site and area geology
Environment Agency (EA)	EA data holdings, customer service and engagement team	Current flood risk, local flood defences, flood levels, supplementary geology and groundwater information
Local Planning Authority (LPA) South Oxfordshire District Council	South Oxfordshire Local Plan	Flood Zoning Local Development Framework
UK Government: Department for Communities and Local Government	NPPF Planning Practice Guidance	Flood zoning for the site as used by the EA in England

2.2 The Reports consulted during the preparation of the document are listed below:

Table 2: Reports consulted during preparation of the document

Source	Data	Information consulted/ provided
Oxfordshire County Council	Oxfordshire County Council Local Flood Risk Management Strategy	Current Flood Zone / risk to the site including historical flooding locations Any relevant flood modelling complete for the site
EA	Thames: Catchment Flood Management Plan December 2009	Flood risk management policies

Legislation and Guidance

National Planning Policy Framework

2.3 The National Planning Policy Framework (NPPF) was released in March 2012 and was last updated in December 2023. The document sets out Government planning policies for England and how these are expected to be applied. The framework acts as guidance for local planning authorities and decision-takers, both in drawing up plans and making decisions about planning applications.

2.4 Section 14 sets out the need for an appropriate assessment of flood risk. Guidance on the minimum requirements for such an assessment is contained in PPG ID7.

2.5 The NPPF requires the application of a sequential risk-based approach to determining the suitability of land for development in flood risk areas, and that flood risk assessment should be carried out to the appropriate degree, at all levels of the planning process.

2.6 Footnote 55 identifies that '*A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use*'.

Planning Practice Guidance

2.7 PPG ID7 Flood Risk and Coastal Change provides guidance to ensure the effective implementation of the NPPF planning policy for development in areas at risk of flooding.

Legislative background

2.8 Following the implementation of the Flood and Water Management Act 2010 local flood risk has become the responsibility of the Local Planning Authority. The Act places new duties on upper tier Councils, by designating them as Lead Local Flood Authorities (LLFAs) for the coordination of local flood risk management in their respective administrative areas.

2.9 From April 6, 2015, the responsibility for drainage and surface water management design approval resides with the local planning authority and should be submitted as part of the planning process.

2.10 The local planning authority has responsibility for the approval of proposed drainage systems in new developments and redevelopments. Approval must be given before any developer can commence construction. In order to be approved, the proposed drainage system would have to meet national standards for sustainable drainage.

2.11 The local planning authority is also responsible for adopting and maintaining SuDS which serve more than one property, which they have approved. The Highways Authorities will be responsible for maintaining SuDS in public roads to National Standards.

2.12 The SuDS Manual C753 sets out the criteria by which the form of drainage appropriate to any particular site or development can be determined, as well as requirements for the design, construction, operation and maintenance of SuDS.

2.13 Additional guidance for the use of SuDS is provided via CIRIA and BRE in the following:

- C609 Sustainable drainage systems. Hydraulic, structural and water quality advice (Superseded by C697 but remains current)
- C156 Infiltration Drainage – Manual of Good practice
- BRE Digest 365 Soakaway design

Climate Change

2.14 The NPPF and supporting planning practice guidance on Flood Risk and Coastal Change explain when and how flood risk assessments should be used. This includes demonstrating how flood risk will be managed now and over the development's lifetime, taking climate change into account.

Peak River Flow Allowances

2.15 In May 2022, the EA last updated advice on climate change allowances to support the NPPF. Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts. Peak River Flow Allowances should be considered for locations that are currently in Flood Zone 1 but might be in Flood Zone 2 or 3 in the future.

2.16 EA guidance on the application of climate changes allowance is dependent on the proposed developments vulnerability. As the development is a Battery Storage facility this application is deemed as Essential Infrastructure. The EA require that for Essential Infrastructure developments located in Flood Zones 2, 3a or 3b, the higher central allowance should be used to assess climate change. Battery Storage developments have a lifetime of 40 years therefore will fall into the 2060s epoch.

2.17 The proposed Culham site is located within the Gloucestershire and the Vale Management Catchment for which the following peak river flow allowances are applicable.

Table 3: Gloucestershire and the Vale Management Catchment Peak River Flow Allowances

Epoch	Central	Higher Central	Upper End
2020s	11%	17%	33%
2050s	11%	19%	43%
2080s	26%	41%	84%

2.18 Based on the lifetime of the development and the vulnerability classification, an allowance of 19 – 41% is appropriate. As the Peak River Flow Allowances are considered to ensure the safety of people using the development when planning safe access, escape routes and places of refuge, it is unlikely that this will be a pertinent focus for this development. However, for completeness, comment will be made on this in Section 6.

Peak Rainfall Allowances

2.19 Peak Rainfall Allowances are used to consider how increased rainfall affects surface water flood risk and the design of drainage systems to manage the increased rainfall.

2.20 New guidance requires that for developments with a lifetime of between 2061 and 2100, Flood Risk Assessments and Strategic Flood Risk Assessments should assess the central allowances for the 2070s epoch for both the 1% and 3.3% annual exceedance probability events. The proposed Culham site is located within the Gloucestershire and the Vale Management Catchment for which the following Peak Rainfall Allowances are applicable.

Table 4: Gloucestershire and the Vale Management Catchment Peak Rainfall Allowances

3.3% Annual Exceedance Rainfall Event		
Epoch	**Central**	**Upper**
2050s	20%	35%
2070s	25%	35%
1% Annual Exceedance Rainfall Event		
Epoch	Central	Upper
2050s	20%	40%
2070s	25%	40%

2.21 Based on the above information, an allowance of 20 - 25% is appropriate. RPS have taken a conservative approach to the design of the conceptual drainage system and added 40% to all attenuation / runoff calculations for the development to account for climate change.

Local Planning Policy

2.22 The South Oxfordshire District Council Local Plan 2035 was adopted on 10th December 2020. The Local Plan contains the following policy relating to flood risk and drainage:

Policy EP4: Flood Risk

1. *The Risk and impact of flooding will be minimised through:*
    - *i.) Directing new development areas with the lowest possibility of flooding;*

   ii.) *Ensuring that all new development addresses the effective management of all sources of flood risk;*

   iii.) *Ensuring that development does not increase the risk of flooding elsewhere; and*

   iv.) *Ensuring wider environmental benefits of development in relation to flood risk.*

2. *The suitability of development proposed in Flood Zones will be strictly assessed using the 'Sequential Test' and where necessary the 'Exceptions Test'. A sequential approach should be used at site level.*
3. *A site-specific Flood Risk Assessment (FRA) should be provided for all developments in Flood Zones 2 and 3. In Flood Zone 1 an FRA should accompany all proposals involving:*
   - *sites of 1 hectare or more;*
   - *land which has been identified by the Environment Agency as having critical drainage problems;*
   - *land identified in the Strategic Flood Risk Assessment as being at increased flood risk in future; or*
   - *land that may be subject to other sources of flooding, where development would introduce a more vulnerable use.*
4. *All development proposals must be assessed against the current South Oxfordshire Strategic Flood Risk Assessment or any updates and the Oxfordshire Local Flood Risk Management Strategy to address locally significant flooding. Appropriate mitigation and management measures must be implemented and maintained.*
5. *All development will be required to provide a Drainage Strategy. Development will be expected to incorporate Sustainable Drainage Systems and ensure that run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Development should strive to reduce run-off rates for existing developed sites.*
6. *Sustainable Drainage Systems should seek to enhance water quality and biodiversity in line with the Water Framework Directive.*

2.23 The South Oxfordshire District Council SFRA identifies and maps flood risk from all sources at a borough-wide scale as well as providing guidance on producing site specific FRAs. Relevant information from the SFRA has been referenced throughout this FRA report.

3 CONSULTATION

Environment Agency

3.1 The FRA has been prepared in consultation with the Partnership and Strategic Overview Team at the EA. The EA has been contacted with request for information for the flood history in the area and any other flood related issues at the site. A response was received on 10th January 2023. The EA confirmed that they do not have any detailed flood risk modelling for the site. The full response is provided in Appendix A for reference.

Lead Local Flood Authority

3.2 The site is within the administrative boundary of Oxfordshire County Council, who act as the LLFA for the site. Consultation has been undertaken with the Flood Team regarding any information relating to flood risk and drainage.

3.3 The LLFA confirmed that they do not hold data for any historical flood events that have occurred in the vicinity of the site. The full response is provided in Appendix B for reference.

Local Planning Authority

3.4 Comments were received on the development from the South Oxfordshire District Council (SODC) Planning Officer in August 2024. The reason for refusal related to drainage, and where/how this has been addressed is detailed below:

Table 5. SODC Refusal Reason - Drainage and Addressed Comment

Reason Number	Reason Details	How/where this has been addressed
6	Insufficient information has been submitted to demonstrate that the proposed development would be served by an appropriate drainage strategy. As such, the proposal is contrary to Policies INF4, EP4 and STRAT4 of the South Oxfordshire Local Plan 2035.	The drainage strategy had previously been designed utilising a surface water outfall to an ordinary watercourse, which was deemed unfeasible. The Drainage Strategy for the site has now been designed utilising infiltration methods of surface water disposal as per the preference of the Drainage Hierarchy. Concerns have previously been raised over the use of infiltration at battery storage sites, due to fire risk and the associated contamination of waterbodies during firefighting activities. It is proposed that the battery compound gravel bases are lined to prevent uncontrolled infiltration. The bases will form an attenuation blanket, which during normal operating conditions will form part of the wider drainage strategy. The penstocks will be present at the outlet of the attenuation blanket. The penstocks at site, as default, will be open. This will allow surface water from these areas to be collected and conveyed into the wider surface water management strategy at the site. The installation of an automated penstock system will

allow the remote closure of penstocks, at the outset of a fire event, without the need for personnel on-site.

The attenuation blanket will provide storage for water released onto the site during a fire event, and will hold the water until testing is undertaken, and deemed if the water should be tanked off-site for specialised treatment or can be released into the wider drainage system.

Details on the proposed surface water drainage system are provided within Section 8, and Appendices G and H.

Internal Drainage Board

3.5 The site is not located within an IDB District

4 SITE SETTING

Site Location

4.1 The site is located at National Grid Reference SU 52952 96447, is irregular in shape and occupies an area of approximately 25.13 hectares (ha). The site location is presented in Figure 1.

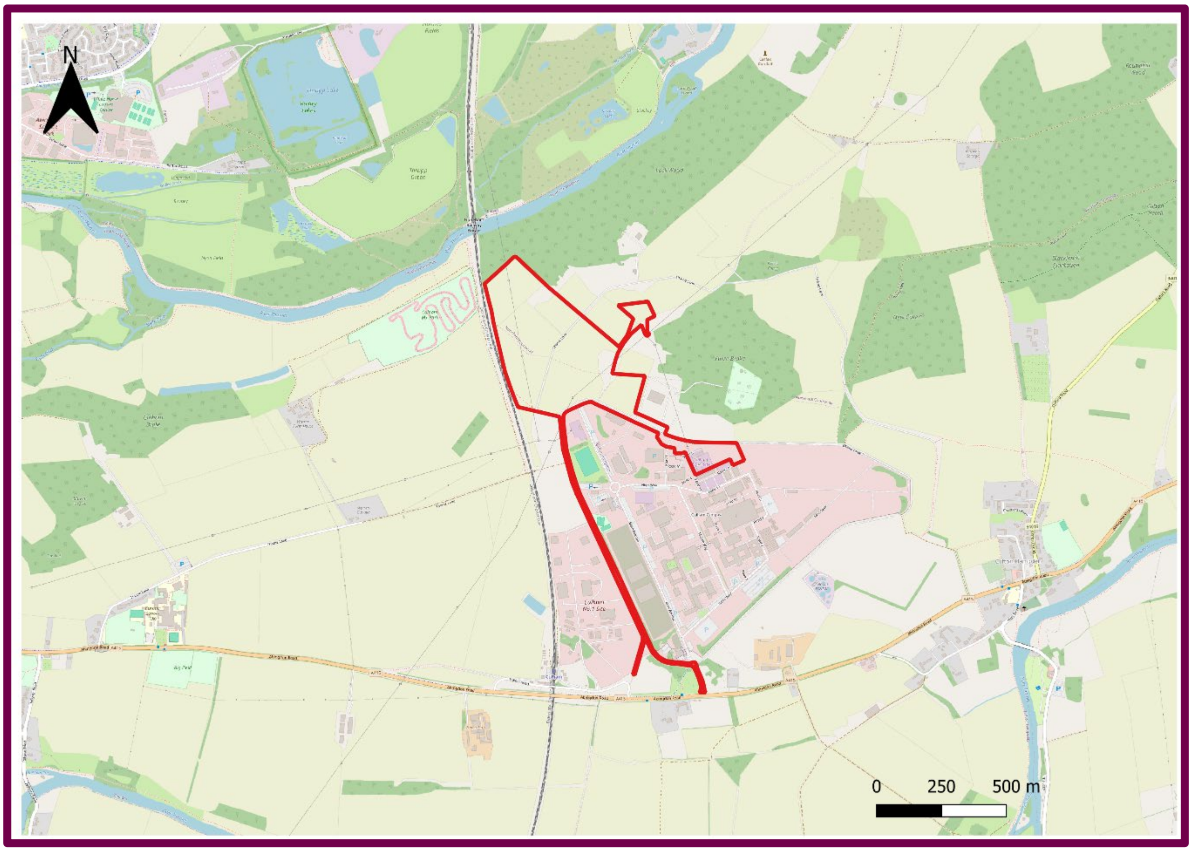

Figure 1: Site Location

4.2 The site is currently occupied by greenfield, which is used for agricultural purposes. Vehicular and pedestrian access to site is via Thame Lane which currently passes through the site. The site comprises approximately 95% soft landscaping cover and 5% hardstanding.

Surrounding Land Uses

4.3 The site is bounded to the north and east by undeveloped greenfield land. Wooded areas lie beyond the greenfield land which are named as Lock Wood and Furze Brake to the north and east respectively.

4.4 The Didcot and Chester Railway Line runs along the western edge of the site.

4.5 Culham Science Centre to located to the south of the site.

4.6 There are no designated sensitive areas, e.g. Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI)) within close proximity to the site. The Culham Brake SSSI is located approximately 1.8km west of the site.

Topography

4.7 A topographic survey was completed by Beacon Land Surveys in August 2022, reference 22-059-01. The survey indicates that the site generally falls in a south easterly direction with levels of approximately 74.69m AOD along the north-eastern boundary of the site, falling to approximately 63.77m AOD along the south-western boundary. The topographic survey is located in Appendix C.

5 PROPOSED DEVELOPMENT

5.1 It is understood that a planning application is sought for the construction of a Battery Storage Facility with associated infrastructure consisting of;

- Substations;
- Inverters and transformers;
- Battery Containers with a loose gravel surface;
- Access roads and hardstanding for parking;
- Associated car parking and control kiosk;
- 1.5 m high Fencing; and
- Landscaping including hedgerows and woodland planting.

5.2 Development plans are shown in Appendix D.

5.3 Site access will be via a track leading to the south of the site, onto Thame Lane.

5.4 The proposed use of the site is classified as 'Essential Infrastructure' within the PPG.

5.5 The potential to provide surface water attenuation, including the use of Sustainable Drainage Systems (SuDS), has been considered as part of the preliminary design process (see Section 10 – Surface Water Management).

6 FLOOD RISK ASSESSMENT

Hydrological Overview

6.1 OS Mapping indicates that the nearest main watercourse feature is located approximately 500m north of the site and is considered to be stretch of the River Thames, which is alternatively known as the River Isis within the region, from its source in the Cotswolds until the confluence with the Thame in Oxfordshire. A further branch of the River Thames is also located approximately 2 km south of the site.

6.2 Located approximately 1.3km to the west of the site is Swift Ditch which is an artificial channel which is linked/feeds into the River Thames.

6.3 The site is not tidally influenced and there appears to be no culverted watercourses within the vicinity of the site.

6.4 No other significant artificial features such as canals and reservoirs have been identified within 1km of the site.

Fluvial and Tidal Flooding

6.5 The EA Flood Map for Planning, which is available online, indicates that the site is located within Flood Zone 1, which is land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding. The EA Flood Map for Planning is provided in Figure 2.

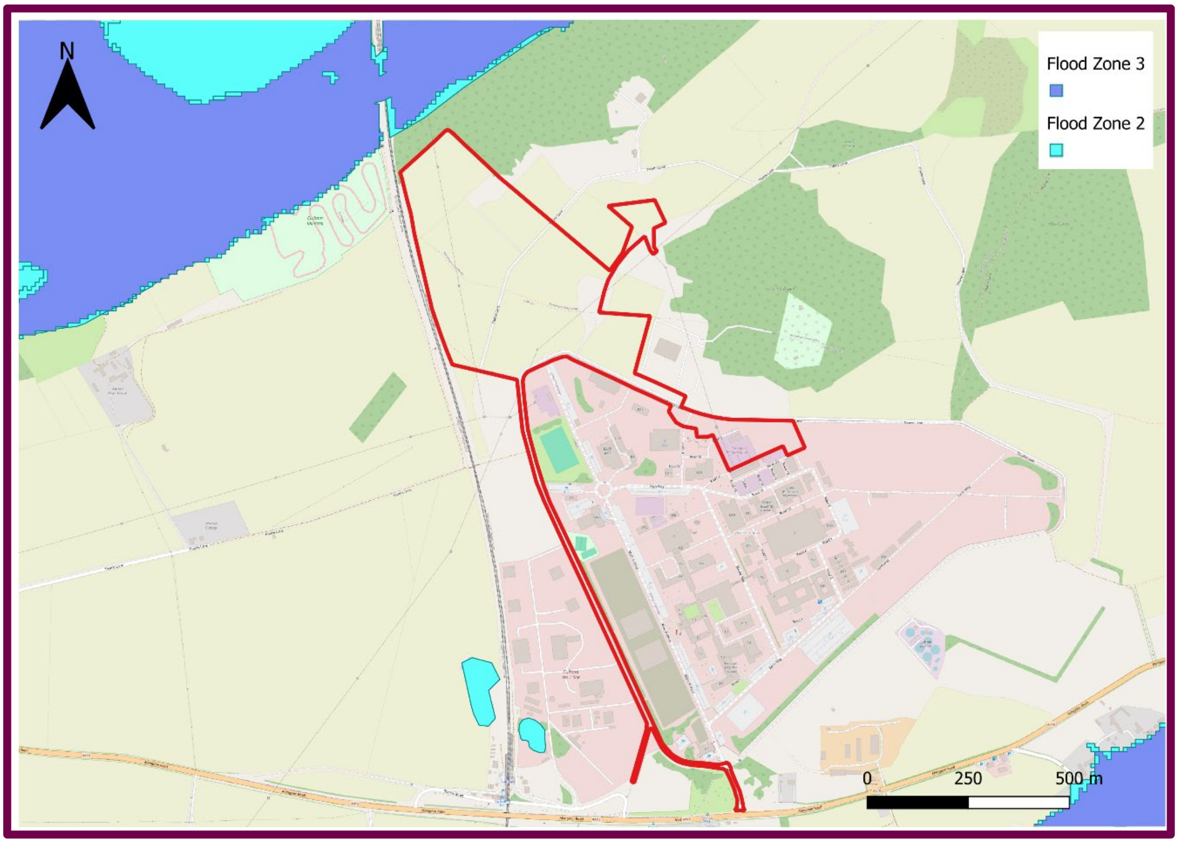

Figure 2: EA Flood Map for Planning (River and Sea)

6.6 As the site is located a significant distance in land, the site is not considered to be at risk from tidal sources.

EA Flood Warning Area

6.7 The EA defines a Flood Warning Area as “geographical areas where we expect flooding to occur and where we provide a Flood Warning Service. They generally contain properties that are expected to flood from rivers or the sea and in some areas, from groundwater." The site is not located in a Flood Warning Area.

Surface Water Flood Risk Classification

6.8 The EA's updated Flood Map for Surface Water, which is available online, identifies areas at risk of surface water flooding. The classification of the risk is based on the following annual probability of flooding:

- High risk; area has a chance of flooding greater than 1 in 30.
- Medium risk; area has a chance of flooding between 1 in 30 and 1 in 100.
- Low risk; area has a chance of flooding between 1 in 100 and 1 in 1000.
- Very low risk; has a chance of flooding less than 1 in 1000.

6.9 The EA surface water map indicates that the vast majority of the site is at a 'Very Low' risk of surface water flooding.

6.10 Small discrete areas of 'Low' risk are identified within the eastern portion of the site and along Thame Lane adjacent to the southern boundary. During a low-risk scenario, depths within these areas do not exceed 0.3m, with velocities between 0.25 – 1.00 m/s.

6.11 The updated Flood Map for Surface Water is presented in Figure 3.

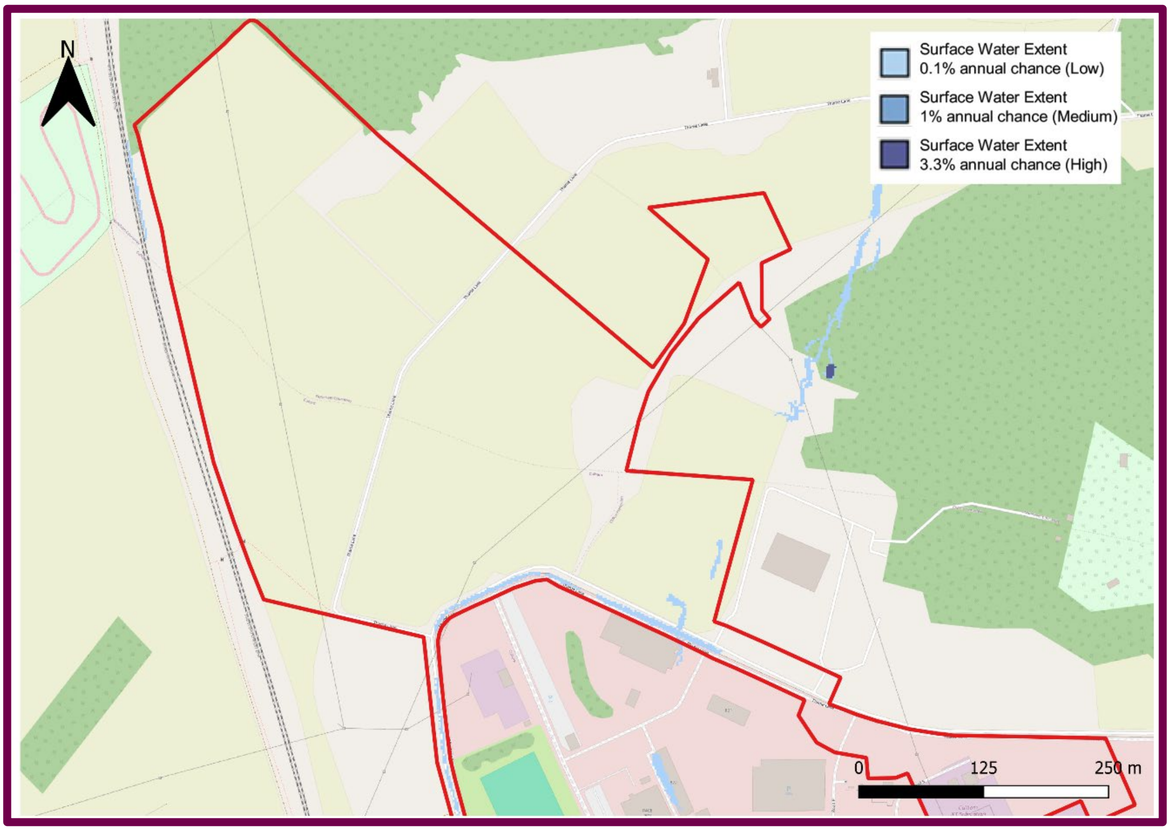

Figure 3: Flood Map for Surface Water

Reservoir Flooding Flood Risk Classification

6.12 The Flood Risk from Reservoirs Map indicates that the site is not at risk of reservoir flooding. Reservoir regulation ensures that reservoirs are stringently inspected and supervised by qualified civil engineers and that any required maintenance or upgrade works are carried out quickly. This helps ensure that the likelihood of one of them failing remains extremely low.

Groundwater Flooding

6.13 British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is situated on Lower Greensand Group, comprising sandstone. There are no records of superficial deposits at the site.

6.14 No available BGS borehole logs are located within the surrounding area.

6.15 The soils are described as ‘freely draining slightly acid sandy soils’ by the National Soils Research Institute.

6.16 According to the MAGIC’s Aquifer Designation Mapping, the Lower Greensand Group is classified as a Secondary A aquifer. These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers.

6.17 MAGIC’s online groundwater Source Protection Zone (SPZ) mapping indicates that the site is not located within a groundwater SPZ.

6.18 An intrusive ground investigation was carried out by Geo-Environmental Services Ltd (ref: GE21162/SA01/221006) to inform the emerging drainage strategy for the proposed development. The ground investigation consisted of three dynamic windowless boreholes to the depths of up to 5.0m below ground level (bgl).

6.19 The data collected from the ground investigation at the site is summarised in Table 5 below. For the full results of the intrusive ground investigation please see Appendix E.

Table 6: Borehole Ground Investigation Results

Borehole Name	Borehole Location	Borehole depth (m)	Deposits	Groundwater Strikes
WS1	North-east of the site	3.70 m	Summertown Radley sand and Gravel Member Superficial deposits of light brown silty gravelly fine, medium sand and some rootlets.	No groundwater strikes were recorded at this borehole
WS2	South of the site	4.70m	Summertown Radley sand and Gravel Member Stratum was described as brown silty medium with some rootlet topsoil.	Groundwater strikes were recorded at 3.18 bgl.
WS3	North of the site	5.0 m	Summertown-Radley Sand and Gravel Member The stratum was described as brown slightly silty gravelly medium Sand with some rootlets and topsoil.	Groundwater strikes were recorded at 4.95m bgl

6.20 Overall, Borehole WS2 and Borehole WS3 both recorded ground water strikes. WS2 had groundwater from depths of 2.6m below ground level (bgl). In WS3, groundwater strikes were recorded at 4.95m bgl immediately after drilling but had dropped to a depth below 5.00m bgl in the monitoring standpipe after 2.5 hours.

Soakaway Testing

6.21 Percolation Tests help to determine whether the ground conditions are suitable for soakaway installation, by analysing the water absorption rate of the soil, which indicates how quickly the soil seeps down.

6.22 BRE365 testing provides the information on carrying information for calculating soil infiltration (percolation) rates as well. Soakaways should discharge from full to half-volume within 24 hours.

6.23 Soakaway testing was carried out in accordance with BRE365 and was undertaken in trial pits TP1 to TP4. In trial pits TP1 and TP3, Test 1 was abandoned, and Test 2 commenced at the end of the first day of testing when it became apparent that Test 1 would conclude during the night and accurate measurements would not be possible.

6.24 The test results have been summarised in Table 6 below. For the full results of the investigation please see Appendix E.

Table 7. Soakage Test Results

Location	Pit Depth (m bgl)	Permeability (m/s)		
		Test 1	Test 2	Test 3
TP1	1.70	2.6×10^{-6}*	2.6×10^{-6}	1.9×10^{-6}*
TP2	1.90	1.4×10^{-5}	1.1×10^{-5}	8.7×10^{-6}
TP3	1.60	3.3×10^{-6}*	2.9×10^{-6}	2.8×10^{-6}*
TP4	2.00	2.7×10^{-6}	Insufficient time to complete further tests	

Note: * based on data extrapolation

Sewer/Water Main Failure Assessment

6.25 No drainage records have been provided for the site. The land is currently agricultural land and therefore it is assumed that no artificial drainage systems will be present within the site area.

6.26 It is assumed that sewer and surface water drainage will have been designed to industry standards (e.g. Sewers for Adoption). However, the most common causes of flooding from sewers are; inadequate flow capacity, blockages, pumping station failures, burst water mains, water inflow from rivers or the sea, tide locking, siltation, fats/greases, and sewer collapse. Should any of these events occur there is a risk of flooding by surcharge where the flows are in excess of the sewer capacity (usually 1 in 30 year events or greater).

6.27 Taking into account the above and absence of any historical sewer flooding the overall risk of flooding via artificial drainage system to the site has been assessed as low.

7 FLOOD RISK VULNERABILITY CLASSIFICATION

Vulnerability Classification

7.1 In accordance with the Flood Risk Vulnerability Classification in Table 2 of the Planning and Practice Guidance Flood Risk and Coastal Change, the Battery storage facility is classified as an ‘Essential Infrastructure’ development in flood risk terms.

7.2 The built development associated with the application site is located within an area identified as Flood Zone 1. Table 3 of Planning Practice Guidance (Table 4 of this report) indicates that all uses are acceptable for locations in Flood Zone 1.

Table 8: Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability classification (see Table 3 of Planning Practice Guidance)	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	Yes	Yes	Yes	Yes	Yes
Zone 2	Yes	Yes	Exception test required	Yes	Yes
Zone 3a	Exception test required	Yes	No	Exception test required	Yes
Zone 3b Functional Floodplain	Exception test required	Yes	No	No	No

Key: Yes: Development is appropriate, No: Development should not be permitted.

8 DRAINAGE

Surface Water and Drainage Strategy

8.1 The sustainable management of surface water is an essential element of reducing future flood risk to the site and its surroundings.

8.2 Undeveloped sites generally rely on natural drainage to convey or absorb rainfall, the water soaking into the ground or flowing across the surface into watercourses.

8.3 The effect of development is generally to reduce the permeability of at least part of the site, which markedly changes the site's response to rainfall. Without specific measures to manage surface water the volume of water and peak flow rate are likely to increase. Inadequate surface water drainage arrangements can threaten the development itself and increase the risk of flooding to others.

8.4 Surface water arising from a developed site should as far as is practicable be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development while reducing the risk of flooding at the site and elsewhere, taking climate change into account.

Sustainable Drainage Options

8.5 The NPPF and associated Planning Practice Guidance ID7 and CIRIA C753 SUDS Manual (2015) promotes sustainable water management through the use of SuDS. A hierarchy of techniques is identified:

1. Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting).
3. Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
4. Regional Control – management of runoff from several sites, typically in a detention pond or wetland.

8.6 The implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

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

Runoff Calculations

8.7 The greenfield nature of the site means that surface water will slowly soak into the ground (infiltrate), be intercepted by vegetation or run off by way of overland flow, according to the soil characteristics and following the topography of the site.

8.8 Impermeable areas for the site have been calculated allowing for the following:

- Crushed Stone Tracks
- Batteries
- Inverter Houses
- Transformers
- Control Rooms
- Spare Parts Containers
- Water Tanks

8.9 To ensure that the development manages surface water sustainably, an allowance has also been provided for the additional substation compounds associated with the development. As these areas will contain very limited hardstanding, the following impermeable allowances have been given for each substation area:

- Statera owned Compound – located to the east of the site – comprises transformers located within a bunded area on gravel base – 30% impermeable area
- Extension to existing NGET substation – located to the south east of the site – comprises circuit breakers sat on permeable gravel surface – 20% impermeable area

8.10 Details of the substation areas and cross sections are provided with Appendix D.

8.11 Due to the nature of these areas, it is determined that there is no contamination potential, and additional lining of these areas does not need to be considered.

8.12 Greenfield runoff rates for the site have been calculated by way of Interim Code of Practice for Sustainable Drainage Systems (ICP SUDS). This implements a pro rata IOH124 methodology, for sites below 50ha in size. The runoff rates were calculated using the MicroDrainage software.

8.13 The following parameters were incorporated into the greenfield runoff calculations:

- Impermeable Area: 4.175ha
- Average Annual Rainfall (SAAR): 600 mm/year
- Soil: 0.300
- Region No: 6

8.14 The calculation has been included for reference within Appendix F and outputs are summarised within Table 8.

Table 9: Greenfield Runoff (Based on a 1 ha area)

Return Period	Greenfield Runoff Rate (l/s)
Q1	1.3
QBar	1.5
Q30	3.4
Q100	4.9

Infiltration Rates

8.15 Infiltration rates help to determine, the rates at which ground conditions are suitable for soakaway/infiltration installation. The best case and worst-case scenarios are calculated, and the worst-case scenario value helps to inform the actual drainage concept.

8.16 The infiltration rates have been calculated from the soakaway testing results. The following is a summary of results for the 100-year +40% climate change for worst and best case infiltration scenarios.

Table 10. Storage Calculations for the Worst-Case Infiltration

Storm Event	600 min Winter
Max Level (m)	63.855
Max Depth (m)	1.095
Max Infiltration (l/s)	17.3
Max Volume (m^3)	3260.5

Table 11. Storage Calculations for the Best-Case Infiltration

Storm Event	480 min Winter
Max Level (m)	63.857
Max Depth (m)	1.097
Max Infiltration (l/s)	26.2
Max Volume (m^3)	3035.6

8.17 As the worst-case scenario is used to inform the drainage strategy, the maximum storage volume required for a 1 in 100 year + 40% climate change event is approximately 3,260m^3.

Proposed Surface Water Drainage

8.18 The proposed surface water drainage system was designed using current MicroDrainage analysis software, taking into account planning, LLFA and EA guidance to prevent uncontrolled flooding of the site and surrounding area.

8.19 The Indicative Drainage Layout is provided in Appendix G. Surface water runoff will be captured by a series of on-site filter drains, designed in accordance with the CIRIA C753 SuDS Manual. Each filter drain will contain a perforated pipe. Prior to surface water entering the infiltration basin it will pass through a proprietary Vortex Grit Separator, to provide additional treatment of the surface water flows. The infiltration basin will provide adequate storage for all storm events up to and including the 1 in 100-year return period with an additional 40% for future climate change, based on the MicroDrainage calculations provided in Appendix H.

8.20 Infiltration methods are deemed to be appropriate given the underlying geology and the soakaway testing results. This will ensure that runoff is managed as close to the source as possible.

8.21 Gravel compound bases will be lined to prevent uncontrolled infiltration. This will form an attenuation blanket and will provide additional attenuation, to be utilised in the unlikely event of a battery fire.

8.22 The Infiltration Basin will provide adequate storage for all storm events up to and including the 1 in 100-year return period with an additional 40% for future climate change, based on the MicroDrainage calculations provided in Appendix H.

8.23

8.24 The development site will be operated remotely, and so will not generate any foul drainage water. There is no requirement for any foul drainage provision on this site.

Management of Fire Water

8.25 In order to manage the risk associated with a highly unlikely fire event, the development will include both a provision for the supply of fire water via water tanks and/or hydrants, in addition containment of fire water used to supress any fire.

8.26 As set out by the National Fire Chiefs Council (NFCC), a water supply able to provide 1,900 litres per minute for at least two hours (228,000 litres/ 228 m^3) is required at BESS sites.

8.27 Fire water will be stored on site within the main compound in either meet the requirements of the NFCC.

8.28 An onsite fire containment strategy will be incorporated into the overall site drainage design. In the unlikely event of a fire the unit on fire will be left to burn out, in accordance with general guidance for Battery units, whilst water will be focussed on the adjacent battery units to ensure the fire is contained. As a consequence, the runoff generated is less likely to pose a contamination risk. Runoff used to cool the units will be initially intercepted and contained within the lined gravel bases. This will allow a compartmentalised approach to the containment of water in the event of a fire. Automatically controlled penstocks will be installed at the outlet of the lined gravel bases allow containment of potentially contaminated water for testing prior to either tanking offsite if contaminated, or alternatively discharged in accordance with the approved drainage strategy. The drainage strategy provides sufficient storage for the additional firewater which may be released onto the site. Details on the attenuation blanket storage are provided in Appendix H.

Construction Stage Drainage

8.29 During construction of the development, the building contractor will be responsible for management and disposal of rainwater runoff generated from the site in its temporary condition.

8.30 The contractor shall develop a formal site management plan, which will address pollution management and control in relation to site plant and vehicles, raw materials storage and waste generation, to ensure that all surface water runoff generated in the temporary condition will be free of contamination.

8.31 The site will be subject to topsoil strip and bulk earthworks to prepare the site to the correct level for development. The contractor shall provide temporary drainage measures to contain runoff within the development site boundary ensuring that this is sized appropriately, and that means to remove excess surface water are available for use at all times.

Water Quality / Pollution Control

8.32 Surface water run-off should be managed by SuDS that are designed to attenuate flows and to avoid water quality impacts downstream. To demonstrate that surface water arising from the development will be appropriately treated prior to discharge, the Simple Index Approach, as outlined within the SuDS Manual (CIRIA C753) has been followed.

8.33 As stated in the SuDS Manual 2015 (C753), the risk posed by surface water runoff to the receiving environment is a function of:

- the pollution hazard at a particular site (i.e. the pollutant source)
- the effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels, groundwater (i.e. the pollutant pathway)
- the sensitivity of the receiving environment (i.e. the environmental receptor).

8.34 Table 26.2 of C753 (Table 11 of this report) provides details of various land uses and the associated pollution hazard levels. While there is no one category which exactly suits this development, the proposals are industrial in nature, so it is considered that applying a High Hazard Level would be the most appropriate, if not conservative. An extract of Table 26.2 is provided below.

Table 12: Pollution hazard indices for different land use classifications

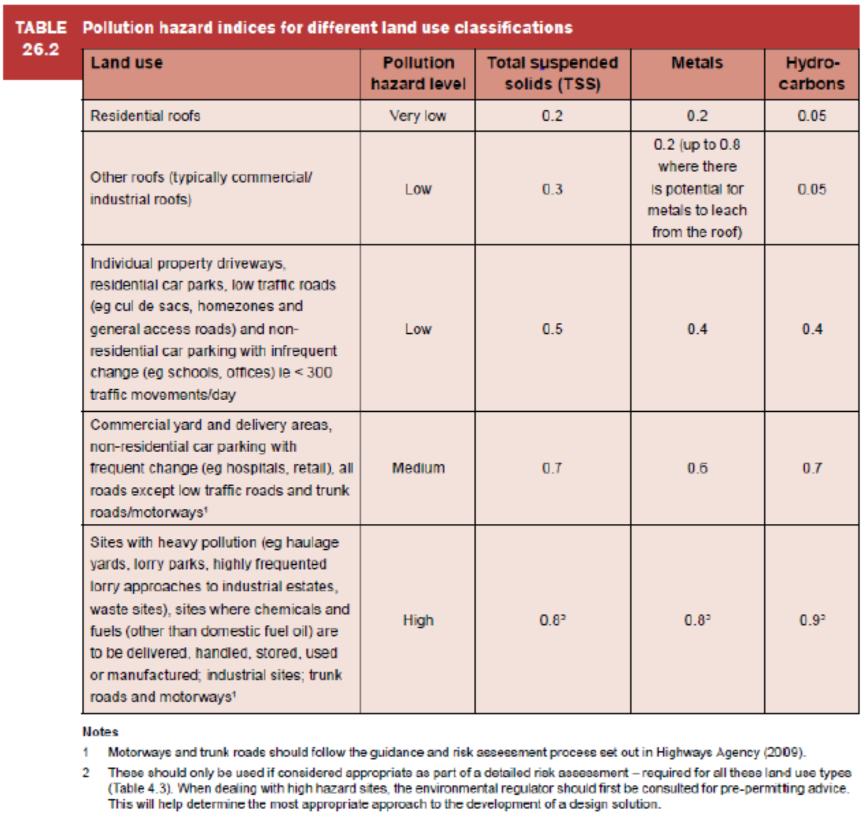

TABLE 26.2 **Pollution hazard indices for different land use classifications**

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

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

8.35 Table 26.3 of C753 (Table 12 of this report) indicates indicative pollution hazard level mitigation indices for different SuDS measures.

Table 13: Indicative SuDS mitigation indices for discharges to surface waters

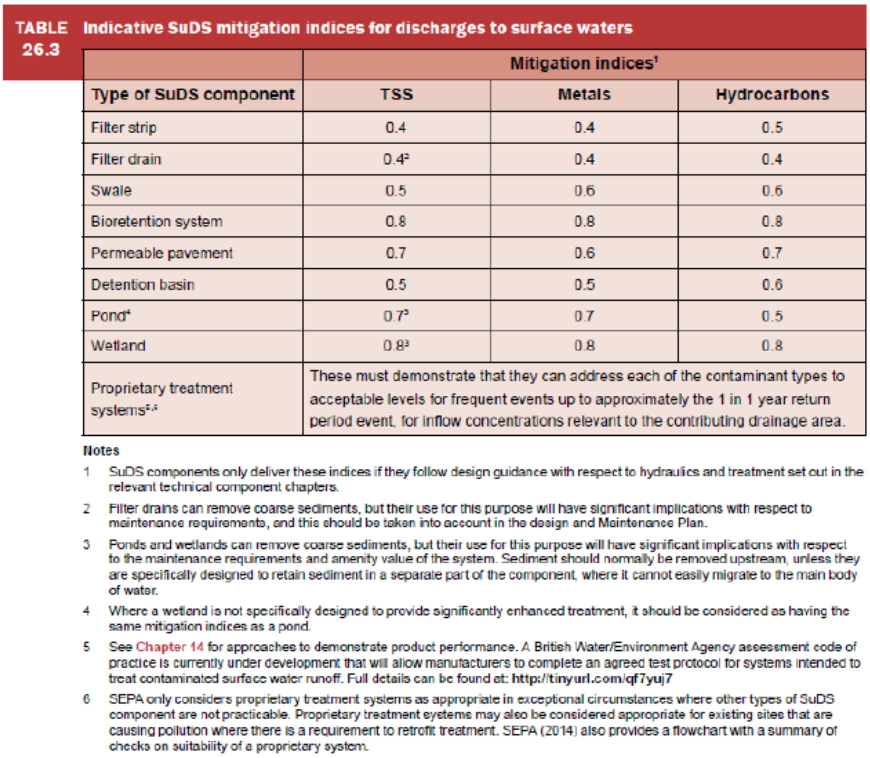

TABLE 26.3 **Indicative SuDS mitigation indices for discharges to surface waters**

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

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

8.36 The information summarised in Table 13 below indicates that suitable pollution mitigation provision would be afforded through the use of filter drains, a grit separator and the attenuation blanket.

Table 14: Summary of Pollution Hazard and Mitigation Indices for Site and Proposed SuDS components

Pollution	Pollution Hazard	SuDS Component	TSS	Metal	Hydro-carbons
Hazard Indices	High	-	0.8	0.8	0.9
SuDS Mitigation	-	Filter Drain	0.4	0.4	0.4
	-	Attenuation Blanket	0.7^T	0.6^T	0.7^T
	-	Grit Separator*	0.5^T	0.4^T	0.8^T
Total SuDS Mitigation	-	-	1	0.9	1.15

* Mitigation indices have been calculated using the Advanced Hydrodynamic Vortex Separator manufactured by Hydro International.

^{T} When designing in accordance with the SuDS Manual (Ciria C753), when two or more methods are used in sequence to target the same pollutant, only half of the mitigation index of the subsequent components should be allowed in the calculation.

Maintenance

8.37 The following information indicates the typical maintenance regimes, and not exhaustive, that will be considered within the detailed drainage design to ensure continued satisfactory operation of the site drainage systems. The maintenance activities would be split into three categories, namely Regular, Occasional & Remedial, as detailed in Table 32.1 of C753 (Table 14 of this report).

Table 15: SuDS components operation and maintenance activities

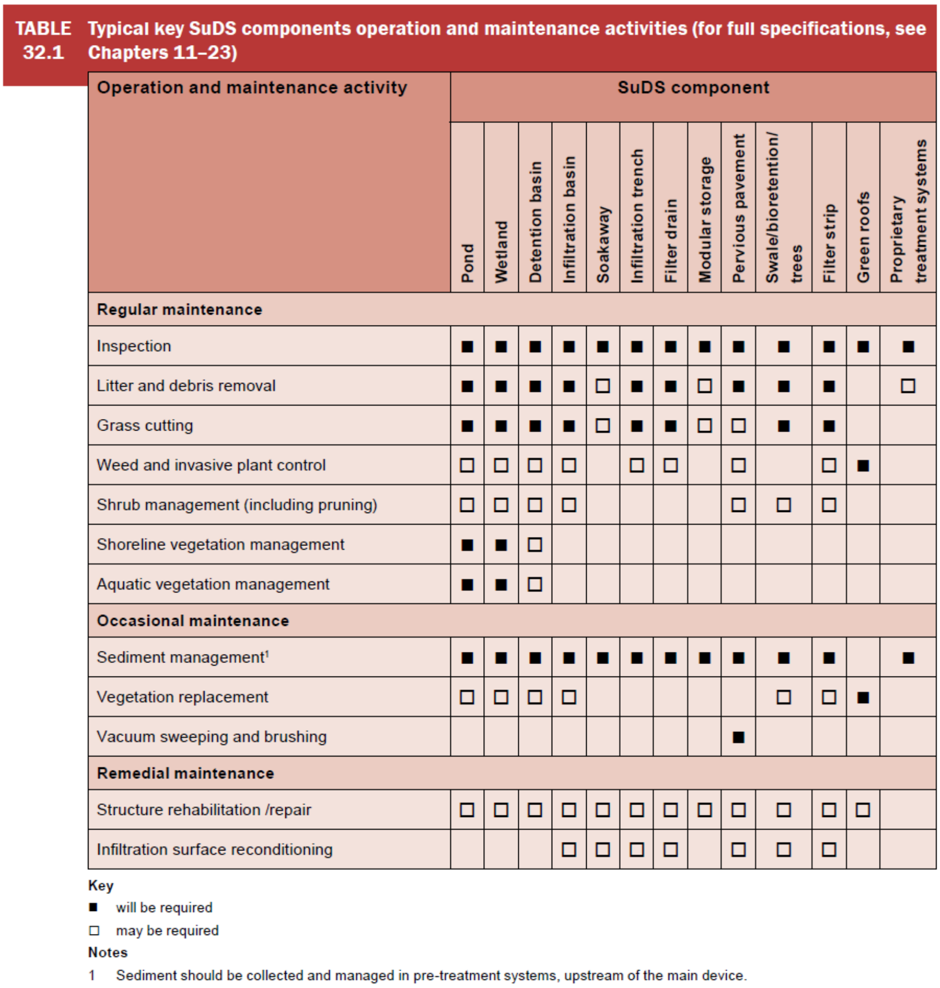

TABLE 32.1 **Typical key SuDS components operation and maintenance activities (for full specifications, see Chapters 11–23)**

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/ trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management[1]	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

■ will be required

□ may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

8.38 There may also be one-off requirements sometimes referred to as "establishment maintenance", particularly for planting (e.g. weeding and watering). Regular maintenance consists of basic tasks carried out on a frequent and predictable schedule, including inspections/monitoring, silt or oil removal (if required more frequently than once per year), vegetation management, sweeping of surfaces and litter/debris removal.

8.39 Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis that the regular tasks. Guidance on the components pertinent to this drainage proposal are detailed below.

8.40 Remedial maintenance comprises the intermittent tasks that may be required to rectify faults associated with system, although the likelihood of faults can be minimised by good design, construction and regular maintenance activities. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, so timings are difficult to predict.

8.41 In addition to general cleaning of roof gutters and downstream sediment traps, Tables 15 to 18 indicate the minimum required maintenance regime that needs to be implemented post construction for the SuDS elements that will comprise the bulk of the proposed drainage system, including filter drains, grit separator, attenuation blanket and associated infrastructure.

Table 16: Proprietary Treatment Systems (Grit Separator) Maintenance Requirements

Maintenance schedule	Require Action	Typical Frequency
Routine Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Table 17: Filter Drains Maintenance Requirements

Maintenance schedule	Require Action	Typical Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Table 18: Attenuation Blanket Maintenance Requirements

Maintenance schedule	Require Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural	As required

	performance or a hazard to users, and replace lost jointing material	
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action	Quarterly, 48 hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 19: Inlet and Outlet Headwalls Maintenance Requirements

Maintenance schedule	Require Action	Typical Frequency
Regular Maintenance	Litter removal	As required
	Inspect vegetation above and around headwall and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from aprons	Annually
	Flap valves and grilles: Check for and clear obstructions	Quarterly
Remedial Actions	Repair of erosion or other damage around headwalls	As required
Monitoring	Inspect structures for evidence of poor operation	Monthly/after large storms
	Inspect structures, pipework etc. for evidence of physical damage	Monthly/after large storms
	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly
	Check flap valves	Half yearly

9 SUMMARY AND CONCLUSIONS

Summary

9.1 A site-specific Flood Risk Assessment (FRA) in accordance with the NPPF and PPG ID7 has been prepared to support the application for the development of a Battery facility and associated infrastructure.

Flood Risk

9.2 EA mapping shows that the site is located within Flood Zone 1, which is land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding.

9.3 The majority of the site is at a 'Very Low' risk of surface water flooding. Small discreet areas of 'Low' risk are identified within the eastern portion of the site and along Thames Lane adjacent to the southern boundary. During a low-risk scenario, depths within these areas do not exceed 0.3m, with velocities between 0.25 – 1.00 m/s.

9.4 The site susceptibility to groundwater flooding has been assessed as low.

9.5 The site is not at risk of flooding from reservoir infrastructure failure.

9.6 The proposed development type is defined as 'Essential Infrastructure' in the NPPF and PPG.

9.7 There will be an increase in impermeable area at site, therefore surface water will be attenuated and discharged from the site via an attenuation blanket and infiltration basin. MicroDrainage calculations indicate that the overall attenuation requirement for the development is approximately 3260m^3 for the 1 in 100 year storm event plus a 40% allowance for climate change.

9.8 The drainage strategy incorporates a number of surface water cleaning techniques in order that any discharges are as 'clean' as reasonably practicable.

9.9 The impacts of the increase in surface water runoff will be reduced by the incorporation of appropriate and practicable SuDS mitigations measures in the built design.

Conclusion

9.10 This FRA and supporting documentation illustrate that the development area is at low risk of flooding from all sources and meets the requirements of the NPPF and Planning Practice Guidance.

Appendix A – EA Consultation Response

From:	Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Sent:	10 January 2023 10:46
To:	RPS Hydrology Services
Subject:	THM293876 Flooding Information Request (Product 4): Land North of Thame Lane, OX14 3GY

Dear Jessica,

THM293876

Location of site: Land North of Thame Lane, OX14 3GY

Thank you for your email requesting Product 4 data.

We unfortunately do not have any detailed flood risk modelling in this location. We are sorry that we are therefore unable to provide modelled flood levels and extents for your site.

The Flood Map for Planning in this location is likely to be based on JFLOW data which is not suitable for use in site specific Flood Risk Assessments. Please advise if you would like to request JFLOW data for this location.

You can access our flood map for planning on our website:

https://flood-map-for-planning.service.gov.uk/

You can find more information on the long term risk of flooding for this location on our website:

https://flood-warning-information.service.gov.uk/long-term-flood-risk

You can find recorded flood outlines for this location via the link below:

https://data.gov.uk/dataset/recorded-flood-outlines1

You can find out the risk of flooding from surface water for this location via the link below:

https://data.gov.uk/dataset/d5ca01ec-e535-4d3f-adc0-089b4f03687d/risk-of-flooding-from-surface-water-suitability

You may be interested in the following guidance / information publically available:

- ‘Planning Practice Guidance’ - provides information about planning considerations in areas at risk of flooding. https://www.gov.uk/government/collections/planning-practice-guidance
- **‘**Planning applications: assessing flood risk’ - information about completing Flood Risk Assessments. https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications
- ‘Site specific flood risk assessment: Checklist’ – a checklist to help ensure you have considered all the relevant factors in your flood risk assessment. https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section

Please be aware that from 20th July 2021 the climate change allowances required in flood risk assessments have been updated. Please see https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#contents for more information.

I hope that we have correctly interpreted your request. Please refer to our Open Government Licence for the permitted use of the supplied data: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

Please be aware that many of our datasets are now available online. Simply visit environment.data.gov.uk

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Kind regards,

Customers & Engagement Team **– Thames**

8 enquiries_THM@environment-agency.gov.uk

+ **Environment Agency** | Red Kite House, Howbery Park, Wallingford, OX10 8BD

From: RPS Hydrology Services <RPSHydrologyServices@rpsgroup.com>
Sent: 23 December 2022 11:47
To: Enquiries_THM <enquiries_THM@environment-agency.gov.uk>
Subject: Flooding Information Request (Product 4): Land North of Thame Lane, OX14 3GY

Dear Sir / Madam,

We would like to request flood risk assessment data (also known as a Product 4) for the Land North of Thame Lane, OX14 3GY (GRID REF: SU 52950 96434). We also would like to have any history of flooding at the site and any other flood related information. A map with the site boundary is attached below:

Kind regards,
Jessica

RPS Hydrology Services (They/Them)

RPS | Consulting UK & Ireland
4th Floor
1 Newhall St
Birmingham B3 3NH, United Kingdom
T +44 121 622 8520
E RPSHydrologyServices@rpsgroup.com

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Appendix B – LLFA Consultation

Jessica Grady

From:	Littler, Adam - Oxfordshire County Council <Adam.Littler@Oxfordshire.gov.uk>
Sent:	09 December 2022 15:33
To:	Louisa Anscomb
Subject:	Flood Risk Query: OX14 3GY

CAUTION: This email originated from outside of RPS.

Dear Louisa,

I note your following request for information.

RPS have been commissioned to prepare a Flood Risk Assessment for a development, for *Land north of Culham Science Park with the nearest post code being OX14 3GY.*

As part of our enquiries, could we please request the following:

- Details of any historic flooding from any source in the vicinity of the site
- Details of any culverted watercourses in the vicinity of the site
- Any flood modelling or mapping that the council has regarding the vicinity of the site
- Details of any known surface water drainage issues in the vicinity of the site

Do you have any site-specific comments and drainage constraints or requirements for this site?

The LLFA have checked our historic flood data base and we do not have any recorded flood events in the area provided below. It should be stressed that this is not to say it has not flooded but it means we do not have a record of it.

Please could I direct you to the link in the below signature for OCC LLFA Pre-Application service, should you choose this option the LLFA will be able to provide site specific steer to your proposals.

Kind regards,

Adam.

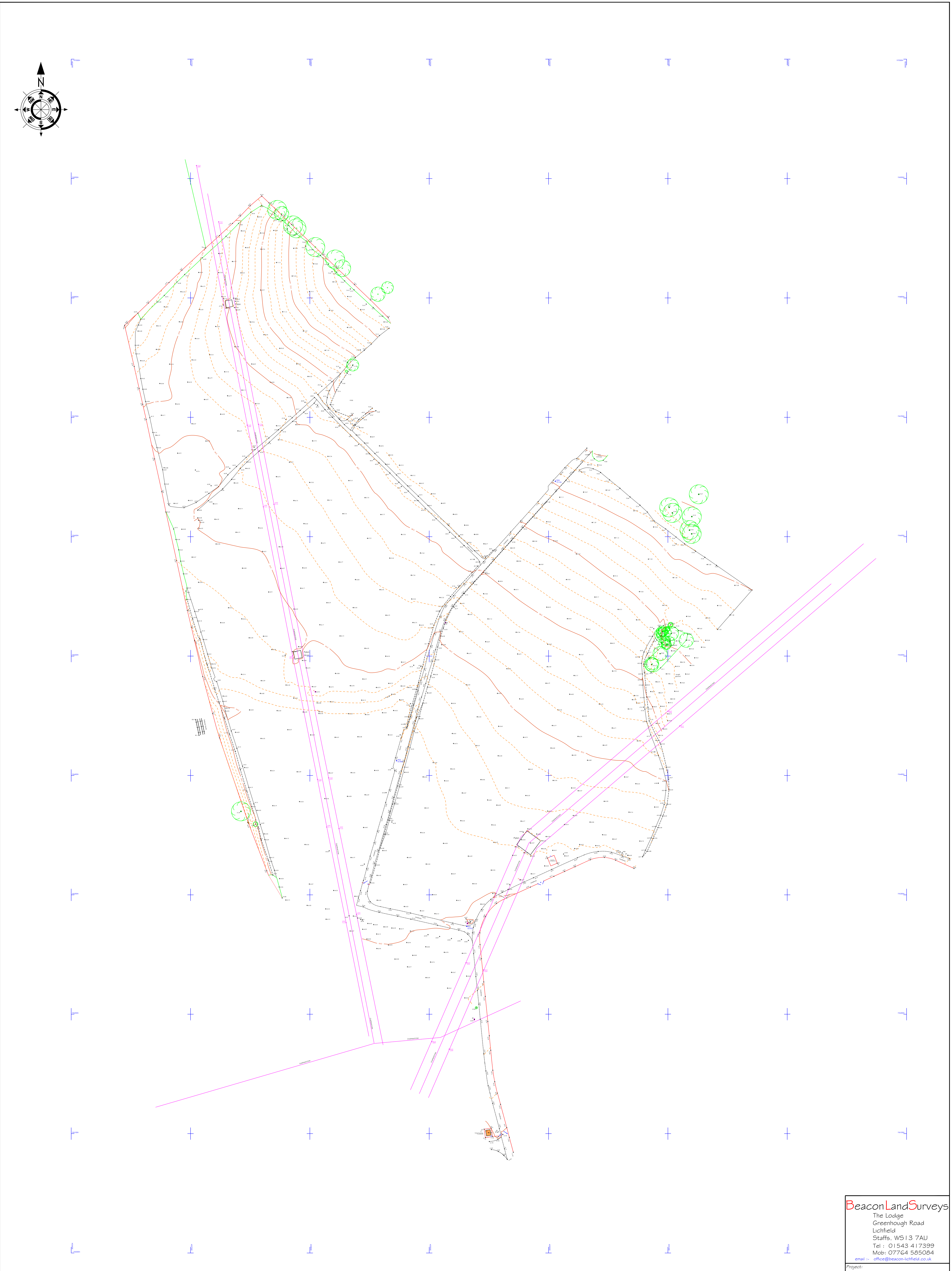
Flood Risk Engineer (South and Vale)
Environment and Place | Growth and Place
Oxfordshire County Council
County Hall
New Road
Oxford
OX1 1ND

Did you know that we have a new pre-application service available for Lead Local Flood Authority advice? Find out more here .

www.oxfordshire.gov.uk

For information about how Oxfordshire County Council manages your personal information please see our Privacy Notice.

Appendix C - Topographic Survey



Survey Key:-

BO	Bollard
BB	Belisha Beacon
BT	BT Cover
CB	Telephone Control Box
CH	Coal Hole
CO	Unidentified Cover
Conc	Concrete
EP	Electricity Pole
FH	Fire Hydrant
FT	Face Profile Target
FW	Foul Water Drain Cover
GU	Drainage Gully Cover
GV	Gas Valve
Gas	Gas Cover
IC	Inspection Chamber Cover

LB	Letter Box
LP	Lamp Post
MC	Metal Drainage Channel
MH	Manhole Cover (round)
MP	Marker Post
Rwp	Rain Water Pipe
SV	Water Stop Valve
SW	Storm Water Drain Cover
TCB	Telephone Call Box
TL	Traffic Light
TP	Telegraph Pole
TV	Cable TV Cover
WM	Water Meter Cover

STN 157.08	Survey Control Station
TP 154.87	Trial Pit
BH 154.87	Borehole
WL 154.87 21/01/10	Water Level (with date measured)
+ 154.87	Spot Level
154.87	Tree (spread to scale)

Some of these symbols may not appear on this drawing

Linetypes

—ı——ı—	Fenceline
‹ — × — ›	Electricity Transmission Line
▨	Hedge
┬┬┬┬┬	Rock Face
▶	Embankment Slope
— 10.00 —	Contour Lines
—	Gas Pipeline
—	Water Pipeline

USW + 154.87	Underside of lowest wire level

Notes :-

Survey is tied to Ordnance Survey grid and level by GPS Smartnet

Grid crosses are shown at 100 metre spacings

Contours where shown are at 0.5m intervals and highlighted at 2m intervals

BeaconLandSurveys
The Lodge
Greenhough Road
Lichfield
Staffs. WS13 7AU
Tel : 01543 417399
Mob: 07764 585084
email :- office@beacon-lichfield.co.uk

Project:
Statera Energy Limited
Culham Battery Storage
Culham, Oxfordshire

Drawing:
Topographic Site Survey

Scales:	Drawn/Sheet Size:
1:1000	mjs/AO
Date:	Drawing No:
Aug 2022	22-059-01

Appendix D – Development Plans

Legend

- Site boundary
- Land ownership boundary
- Existing hedgerows and trees
- New woodland planting
- New hedgerow
- New scrubland
- Wildflower grass
- Existing tree
- Existing tree
- Stone access track
- Existing macadam track
- Attenuation pond
- Loose permeable gravel
- New macadam track
- 4m high infrared CCTV pole
- Emergency services information point
- Existing contours
- Proposed contours
- Tower maintenance clearance zone
- Public Right of Way (PRoW)
- Viewpoint
- Nuneham and Courtenay Conservation Area
- Historic parkland boundary
- Thames water main
- Railway easement
- Underground electric cable connection
- Overhead electricity line
- Permissive path for the duration of the planning consent
- Inverter building (total 31)
- Transformer
- Battery container (total 248)
- Control room (total 5)
- WT Fire water tank
- Welfare and storage containers
- 4m high wooden acoustic fence
- 1.5m high stock proof fence
- 2.5m high steel weld mesh fence
- 1.8m high deer fence
- Impermeable drainage channel with penstocks to allow drainage from the compound to be controlled in the case of an emergency

Revision	Date	Comment
A	11.09.24	Proposed connection tower relocated out of the Registered Park and Garden into the proposed BESS compound. Batteries reduced from 296 to 248 and inverters from 37 down to 31. Earth mounding to landscape areas removed.

ON BEHALF
STATERA

PROJECT
CULHAM BATTERY ENERGY
STORAGE SYSTEM

DATE 22 July 2022
SCALE 1 : 2,000 @ A1
DWG No SL254__L__X__GA__1__Rev A
APPROVED CMcD

TITLE
BLOCK PLAN

Appendix E – Ground Investigation Report

6th October 2022

Our ref: GE21162/SA01/221006

Oliver Troup
Statera Energy
145 Kensington Church Street
London
W8 7LP

By email

Dear Oliver,

RE: Land to the rear of Culham Science Centre, Culham, Abingdon, OX14 3DB – Letter Report

1. Introduction

Further to your instruction, we write to present the findings of the intrusive investigation undertaken at land to the rear of Culham Science Centre, Culham, Abingdon, OX14 3DB (Figure 1).

2. Proposed Development

The proposed development is understood to comprise a battery energy storage facility with associated infrastructure including a number of stormwater basins.

3. Objectives

The investigation was undertaken to inform the emerging drainage strategy for the proposed development.

4. Site Description

The site was located at NGR 452888, 196448 and was formed by an irregularly shaped parcel of land comprising sections of two grazing fields. The fields were separated by a concrete track initially running east to west in the very south of the site, before turning to run in a north-north-east direction through the centre of the site. Topographically, the site sloped gently downhill to the south.

Two strings of overhead electricity cables supported by pylons ran across the site. One string ran north to south through the western part of the site with one supporting pylon located in the northwest of the site. The second string of cables ran along the south-eastern boundary before crossing the eastern extend of the site. Two inspection chamber covers were observed in the northwest of the site to the south of the pylon in this area. When lifted, these appeared to be former soakaways. A trunk water main was mapped running southwest to northeast through the east of the site. Although no visible evidence of this utility was recorded, it was possible to trace its location using radio-detection techniques during the investigation.

The majority of the site boundaries did not coincide with any physical feature with the exception of the western boundary which was formed by post and wire fencing and a deciduous hedgerow. Access to the site was afforded by an external perimeter track around the Science Park accessed via the industrial estate to the southwest of the site.

A railway line within a cutting was located to the west of the site. A continuation of grazing fields, some woodland and cover crop (maize) were located to the north and northeast. A raised area covered by long grass with a number of deciduous trees was located to the east with a large warehouse type building approximately 200m beyond. An electricity pylon and small mobile telecommunications compound, surrounded by timber close-boarded fencing was located immediately adjacent to the southeast of the site with Culham Science Park beyond. The Science Park was secured by tall metal mesh fencing. Two further electricity pylons were located to the south of the site in an area of long grass. One of these was noted to connect to a large substation located within the Science Park.

5. Fieldwork

The scope of works agreed with the Client comprised:

- Attendance of a Geo-Environmental Engineer to set out and supervise the intrusive investigation, undertake logging of recovered soils from exploratory holes and in-situ testing.
- Construction of 3No. dynamic windowless sampler boreholes (WS1 to WS3) to depths of up to 5.00m bgl.
- Installation of the boreholes with 3No. monitoring standpipes with upstanding covers to allow for future groundwater monitoring.
- Construction of 4No. machine excavated trial pits (TP1 to TP4) to depths between 1.60m and 2.00m bgl.
- Soakage testing in accordance with BRE365 undertaken in trial pits TP1 to TP4.
- 3No. return groundwater monitoring visits.
- Provision of a Letter Report.

The intrusive investigation was carried out on 27th, 28th and 29th September 2022. The positions were agreed with the Client but adjusted on site to avoid overhead and underground utilities. The locations of the exploratory holes are shown on Figure 2.

6. Ground Conditions

The ground conditions encountered by the investigation comprised a mantle of Topsoil overlying Summertown-Radley Sand and Gravel Member. A generalised summary of the encountered conditions is presented in Table 1.

Top (m bgl)	Base (m bgl)	Geology	Locations
0.00	0.20 – 0.35	**TOPSOIL:** Brown or light brown fine and medium SAND with low or moderate proportions of silt and gravel with occasional or some rootlets.	All
0.20 – 0.35	>1.60 – >5.00	**SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER:** Typically orange brown, but occasionally brown or light orange brown, medium or medium and coarse SAND with low to moderate silt and gravel content. Moderate clay content occasionally recorded. Silt and gravel also absent on occasion. Greenish grey and grey colouration, some decayed 5-10mm roots and natural organic odour recorded from 1.00m to 1.70m bgl in TP4.	All

Table 1 Summary of Ground Conditions

For further details of the ground conditions encountered, reference should be made to the exploratory hole logs in Appendix A.

8. Groundwater

Groundwater was encountered within WS2 at 3.18m bgl immediately after drilling, rising to 3.30m bgl with the installed monitoring standpipe after 3.5 hours. Groundwater was recorded at 4.95m bgl in WS3 immediately after drilling but had dropped to a depth of greater than 5.00m bgl in the monitoring standpipe after 2.5 hours. No other groundwater was encountered during the intrusive investigation.

Groundwater monitoring standpipes were installed within WS1 to WS3 in order to facilitate return spot monitoring of groundwater levels . 3No. groundwater monitoring visits are planned, upon completion this report will be updated to include the data collected.

The groundwater level in the 3No. monitoring standpipes was measured on 29th September 2022 (the final day of the investigation and two days following installation). No groundwater was recorded within the depth of the installed standpipes with the exception of WS2 where the water depth was recorded at 3.01m bgl.

It should be noted that changes in groundwater and perched water levels do occur for a number of reasons including seasonal effects and variations in drainage. Such fluctuations may only be recorded by the measurement of the groundwater level within a series of standpipes or piezometers installed within appropriate response zones.

9. Obstructions

Boreholes WS1 and WS2 refused on dense strata at depths of 3.70m and 4.70m bgl respectively. No other natural or manmade obstructions were encountered. Obstructions elsewhere on the site cannot be completely ruled out.

10. Soakaways

Soakage testing in broad accordance with BRE365 was undertaken in trial pits TP1 to TP4. Testing was undertaken on 28th and 29th September 2022 for the two day test period agreed with the Client.

The results of the testing are summarised in Table 2 below. The soakage test results are included within Appendix B. In trial pits TP1 and TP3 Test 1 was abandoned, and Test 2 commenced at the end of the first day of testing when it became apparent that Test 1 would conclude during the night when accurate measurement would not be possible.

Location	Pit depth (m bgl)	Permeability (m/s)		
		Test 1	Test 2	Test 3
TP1	1.70	2.6×10^{-6}*	2.6×10^{-6}	1.9×10^{-6}*
TP2	1.90	1.4×10^{-5}	1.1×10^{-5}	$8.7 \times 10\text{-}^{-6}$
TP3	1.60	3.3×10^{-6}*	2.9×10^{-6}	2.8×10^{-6}*
TP4	2.00	2.7×10^{-6}	Insufficient time to complete further tests	

NOTE: * - based on data extrapolation

Table 2 Soakage Test Results

In line with building control requirements soakaways should be located at least 5m from any structure.

11. Conditions

The data collected from the investigations have been used to provide an interpretation of the geotechnical and/or environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained. Geo-Environmental takes no responsibility for conditions that either have not been revealed in the available records, or that occur between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

A Discovery Strategy (Appendix C) should remain in force throughout groundworks and construction of the proposed development.

Information contained in this report is intended for the use of the Client and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

This report remains the property of Geo-Environmental and the Client has no rights to, or reliance upon this document or supporting documents until such time as payment has been received in full for all invoices for works undertaken in connection with this report.

12. Closure

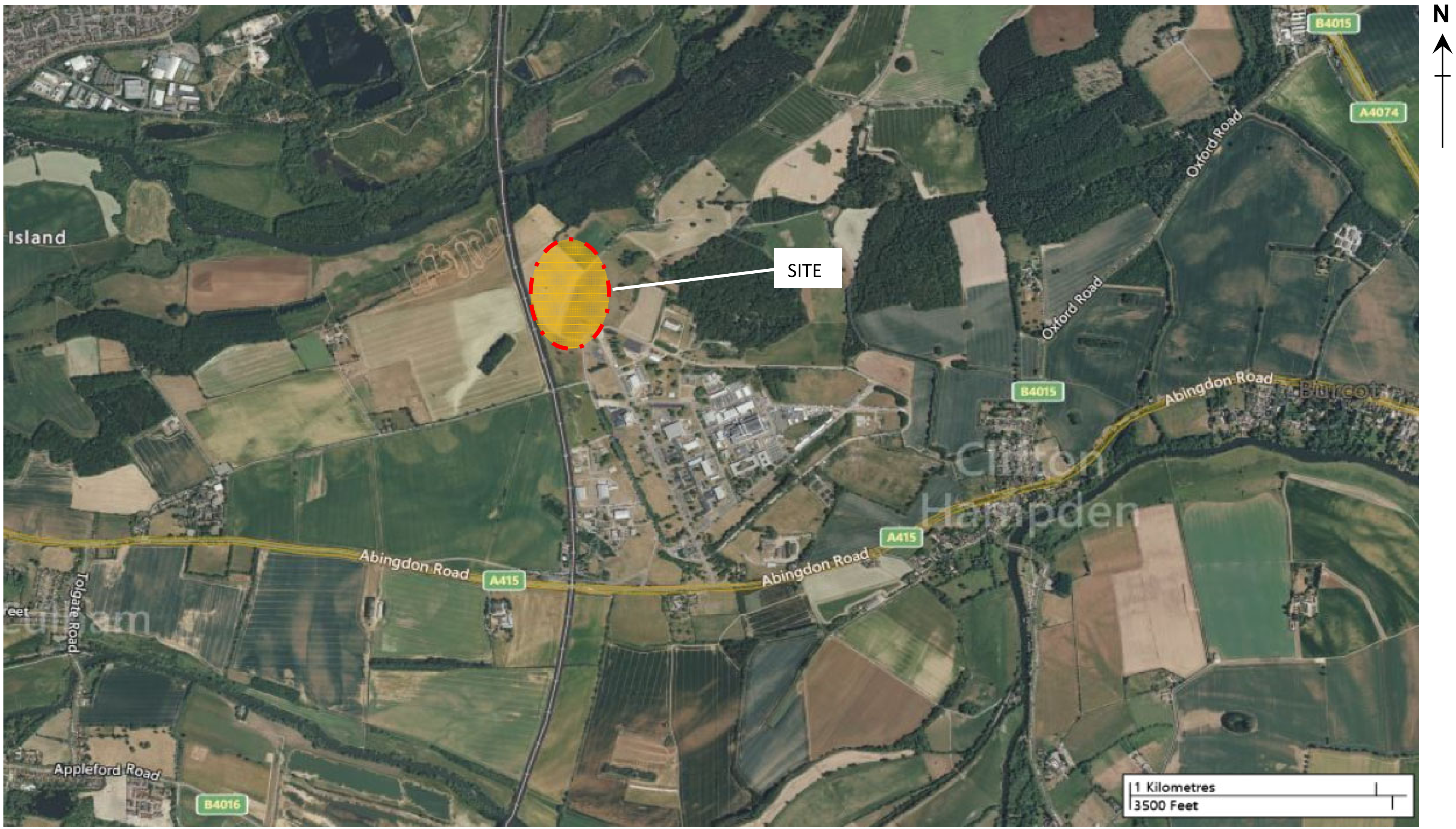
We trust that we have interpreted your instructions correctly. Please do not hesitate to contact us should you have any queries.

Yours sincerely
For and on Behalf of Geo-Environmental

SHAUN ARMITAGE BSc (Hons), FGS
Principal Consulting Engineer
shaun.armitage@gesl.net

Enclosed -	Figure 1 – Site Location Plan Figure 2 – Exploratory Hole Location Plan
	Appendix A – Exploratory Hole Logs Appendix B – Soakage Test Results Appendix C – Discovery Strategy

FIGURES



Project:	Culham, Abingdon		
Client:	Statera Energy		
Ref No:	GE21162	**Version:**	0.0
Drawn:	SA	**Date:**	05/10/2022
Figure:	1	**Scale:**	Not To Scale

Title Site Location Plan

Geo-Environmental Services Ltd
Unit 7 Danworth Farm, Cuckfield Road
Hurstpierpoint, West Sussex BN6 9GL
+44(0)1273 832972 www.gesl.net

Project Title:	**Culham, Abingdon**	**Title :**	**Figure 2 - Exploratory Hole Location Plan**
Location :	**Oxfordshire, OX14 3DB**	**Scale:**	**1:3000**
Project No. :	**GE21162**	**Engineer:**	**CG**
Client :	**Statera Energy**		

Geo-Environmental

Legend Key

- ● Locations By Type - Empty
- ▨ Locations By Type - TP
- ⌖ Locations By Type - WLS

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

APPENDIX A

Exploratory Hole Logs

Geo-Environmental

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
www.gesl.net

Borehole Log

Borehole No.
WS1
Sheet 1 of 1

Project Name:	Culham, Abingdon	Project No. GE21162	Co-ords: 453010E - 196474N	Hole Type WLS
Location:	Oxfordshire, OX14 3DB		Level:	Scale 1:25
Client:	Statera Energy		Dates: 27/09/2022	Logged By SA

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.20			Light brown silty slightly gravelly fine and medium SAND with some rootlets. TOPSOIL
					0.90			Orange brown slightly silty slightly gravelly medium SAND. Gravel is medium and coarse subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					1.20			Orange brown slightly gravelly medium and coarse SAND. Gravel is fine subrounded quartzite. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					2.20			Orange brown medium and coarse SAND. Trace of silt. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					3.70			Orange brown slightly silty slightly gravelly medium and coarse SAND. Gravel is fine subrounded quartzite. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
								End of Borehole at 3.70m

1
2
3
4
5

Dynamic Sampling Run Details			Water Strike Details (mbgl)	
Depth Top	Depth Base	Diameter	Depth Strike	Rose To

Remarks

Refused at 3.7m. No groundwater encountered. No groundwater in standpipe after 1.5 hours. No groundwater in standpipe on 29 September.

AGS

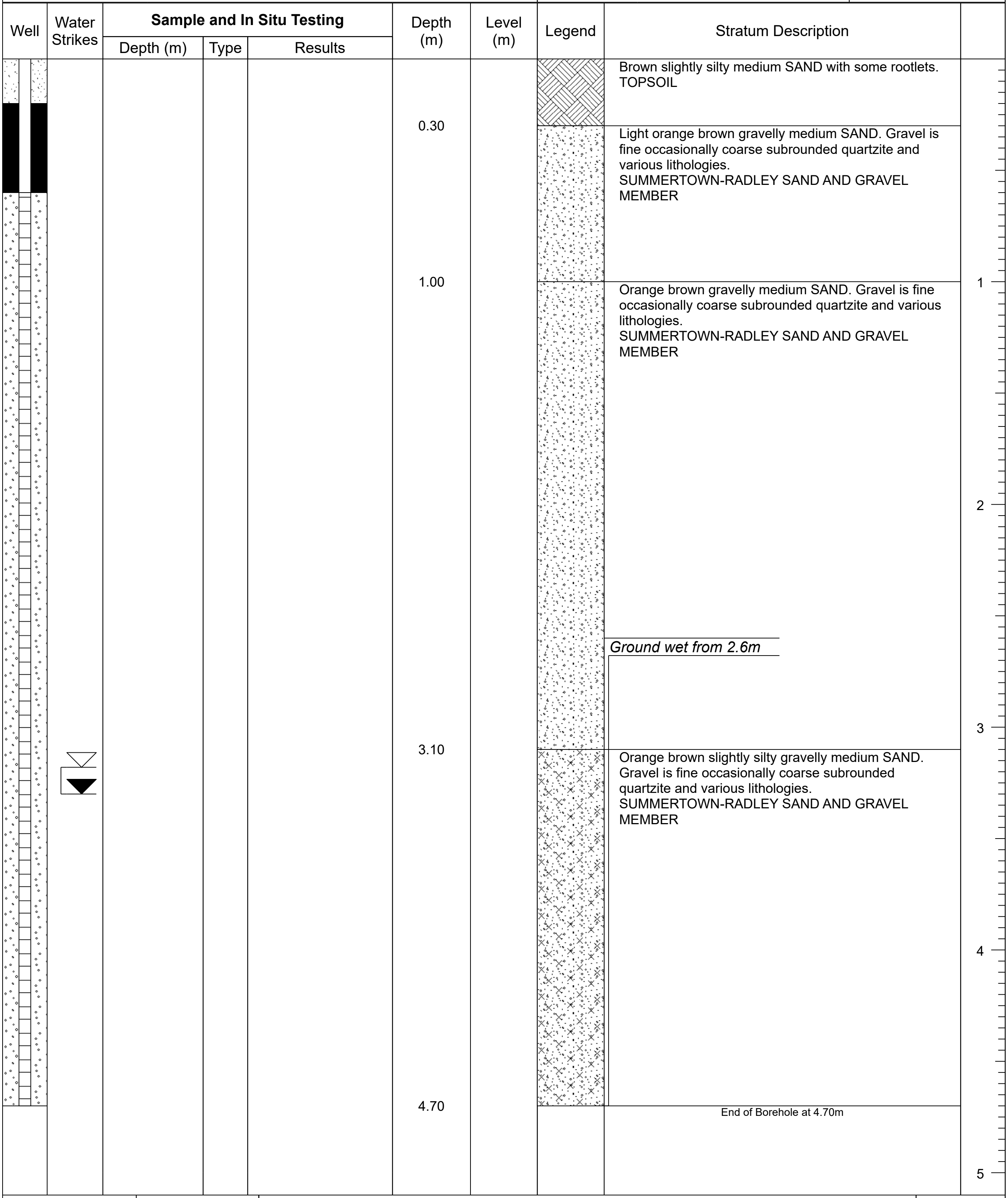
Geo-Environmental

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
www.gesl.net

Borehole Log

Borehole No.
WS2
Sheet 1 of 1

Project Name: Culham, Abingdon	Project No. GE21162	Co-ords: 452896E - 196269N		Hole Type WLS
Location: Oxfordshire, OX14 3DB		Level:		Scale 1:25
Client: Statera Energy		Dates: 27/09/2022		Logged By SA



Depth (m)	Level (m)	Stratum Description
0.30		Brown slightly silty medium SAND with some rootlets. TOPSOIL
1.00		Light orange brown gravelly medium SAND. Gravel is fine occasionally coarse subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
3.10		Orange brown gravelly medium SAND. Gravel is fine occasionally coarse subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER *Ground wet from 2.6m*
4.70		Orange brown slightly silty gravelly medium SAND. Gravel is fine occasionally coarse subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER

End of Borehole at 4.70m

Dynamic Sampling Run Details			Water Strike Details (mbgl)	
Depth Top	Depth Base	Diameter	Depth Strike	Rose To
			3.18	3.30

Remarks

Refused at 4.7m. Groundwater at 3.18m after drilling. Groundwater at 3.30m in standpipe after 3.5 hours. Groundwater at 3.01m in standpipe on 29 September.

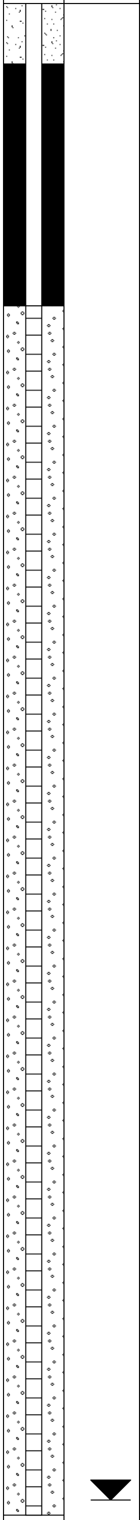
AGS

Geo-Environmental

Unit 7, Danworth Farm
Hurstpierpoint
BN6 9GL
www.gesl.net

Borehole Log

Borehole No.	**WS3**	Sheet 1 of 1		
Project Name:	Culham, Abingdon	Project No. GE21162	Co-ords: 452728E - 196561N	Hole Type WLS
Location:	Oxfordshire, OX14 3DB		Level:	Scale 1:25
Client:	Statera Energy		Dates: 27/09/2022	Logged By SA



Well	Water Strikes	Sample and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.25			Brown slightly silty gravelly medium SAND with some rootlets. TOPSOIL
					1.20			Orange brown occasionally brown silty gravelly medium SAND. Gravel is fine subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					2.00			Orange brown slightly silty medium SAND. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					2.10			Orange brown clayey medium SAND with one coarse subrounded quartzite gravel clast. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					2.80			Orange brown slightly silty medium SAND. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
					5.00			Orange medium and coarse SAND. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER
								End of Borehole at 5.00m

Dynamic Sampling Run Details			Water Strike Details (mbgl)	
Depth Top	Depth Base	Diameter	Depth Strike	Rose To
			4.95	4.95

Remarks

Groundwater at 4.95m after drilling. No groundwater in standpipe after 2.5 hours. No groundwater in standpipe on 29 September.

AGS

Geo-Environmental

Trial Pit Log

Contract Name: Culham, Abingdon		Client: Statera Energy			Trial Pit ID: TP1
Contract Number: GE21162	Date Started: 28/09/2022	Logged By: SA	Checked By: CG	Status: FINAL	Sheet 1 of 1
Easting: 452866.0	Northing: 196274.0	Ground Level:	Plant Used: JCB 3CX	Date Printed: 06/10/2022	Scale: 1:25

Weather: Sunny

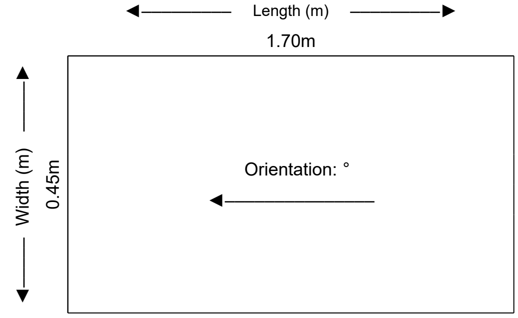
Hole Termination: Target depth reached

Stability: Sides stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
				(0.30) 0.30	▨	Brown slightly silty slightly gravelly medium SAND with occasional rootlets. TOPSOIL		
				(1.40) 1.70	▒	Orange brown slight silty slightly gravelly medium SAND. Gravel is fine occasionally coarse subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
						End of Trial Pit at 1.70m		

Dimensions:

Final Depth: 1.70m



Inclination: °

Photo:

PhotoofPit

PhotoofSpoil

Geo-Environmental

Trial Pit Log

Contract Name: Culham, Abingdon			Client: Statera Energy		Trial Pit ID: TP2 Sheet 1 of 1
Contract Number: GE21162	Date Started: 28/09/2022	Logged By: SA	Checked By: CG	Status: FINAL	
Easting: 452797.0	Northing: 196342.0	Ground Level:	Plant Used: JCB 3CX	Date Printed: 06/10/2022	Scale: 1:25

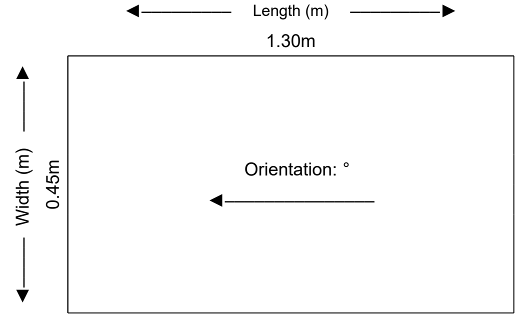
Weather: Sunny | Hole Termination: Target depth reached | Stability: Sides stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
				(0.35) 0.35	▨	Brown slightly silty slightly gravelly medium SAND with some rootlets. TOPSOIL		
				(0.75) 1.10	▨	Orange brown silty slightly gravelly medium SAND. Gravel is fine and medium subrounded quartzite and various lithologies. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
				(0.40) 1.50	▨	Brown slightly silty medium SAND with rare medium subangular sandstone and subrounded quartzite gravel. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
				(0.40) 1.90	▨	Orange brown medium SAND with rare medium subrounded quartzite gravel. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
						End of Trial Pit at 1.90m		

Depth scale: 0.5 1.0 1.5 2.0 2.5 3.0 3.5

Dimensions:

Final Depth: 1.90m



Inclination: °

Photo:


PhotoofPit


PhotoofSpoil

Geo-Environmental

Trial Pit Log

Contract Name: Culham, Abingdon			Client: Statera Energy		Trial Pit ID: TP3
Contract Number: GE21162	Date Started: 28/09/2022	Logged By: SA	Checked By: CG	Status: FINAL	Sheet 1 of 1
Easting: 453042.0	Northing: 196353.0	Ground Level:	Plant Used: JCB 3CX	Date Printed: 06/10/2022	Scale: 1:25

Weather: Sunny

Hole Termination: Target depth reached

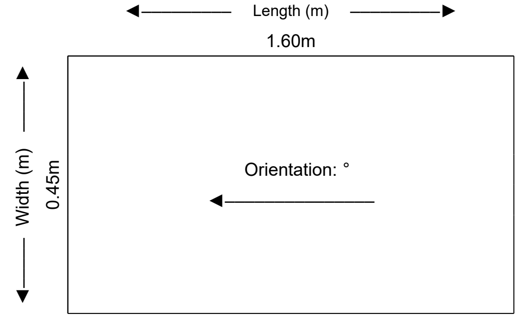
Stability: Sides stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
				(0.30) 0.30	▨	Brown slightly silty slightly gravelly medium SAND with occasional rootlets. TOPSOIL		
				(0.90) 1.20	░	Orange brown medium SAND with a trace of silt. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
				(0.40) 1.60	░	Orange brown slightly gravelly medium SAND. Gravel is fine subrounded quartzite. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
						End of Trial Pit at 1.60m		

Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5

Dimensions:

Final Depth: 1.60m



Inclination: °

Photo:

PhotoofPit

PhotoofSpoil

Geo-Environmental	Contract Name: Culham, Abingdon			Client: Statera Energy		Trial Pit ID: TP4
	Contract Number: GE21162	Date Started: 28/09/2022	Logged By: SA	Checked By: CG	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 452825.0	Northing: 196462.0	Ground Level:	Plant Used: JCB 3CX	Date Printed: 06/10/2022	Scale: 1:25

Weather: Sunny

Hole Termination: Target depth reached

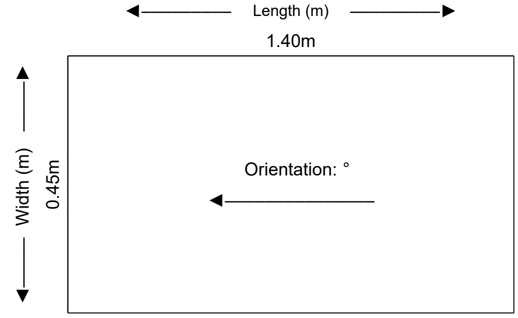
Stability: Sides stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) (Thickness)	Legend	Strata Description		
				(0.30) 0.30		Brown slightly silty slightly gravelly medium SAND with some rootlets. TOPSOIL		
				(0.70) 1.00		Orange brown slightly gravelly medium and coarse SAND. Gravel is fine subrounded quartzite. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
				(0.70) 1.70		Greenish grey and grey brown clayey medium SAND with some decayed 5-10mm roots. Slight natural organic odour. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
				(0.30) 2.00		Orange brown silty medium and coarse SAND. SUMMERTOWN-RADLEY SAND AND GRAVEL MEMBER		
						End of Trial Pit at 2.00m		

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5

Dimensions:

Final Depth: 2.00m



Inclination: °

Photo:


PhotoofPit


PhotoofSpoil

APPENDIX B

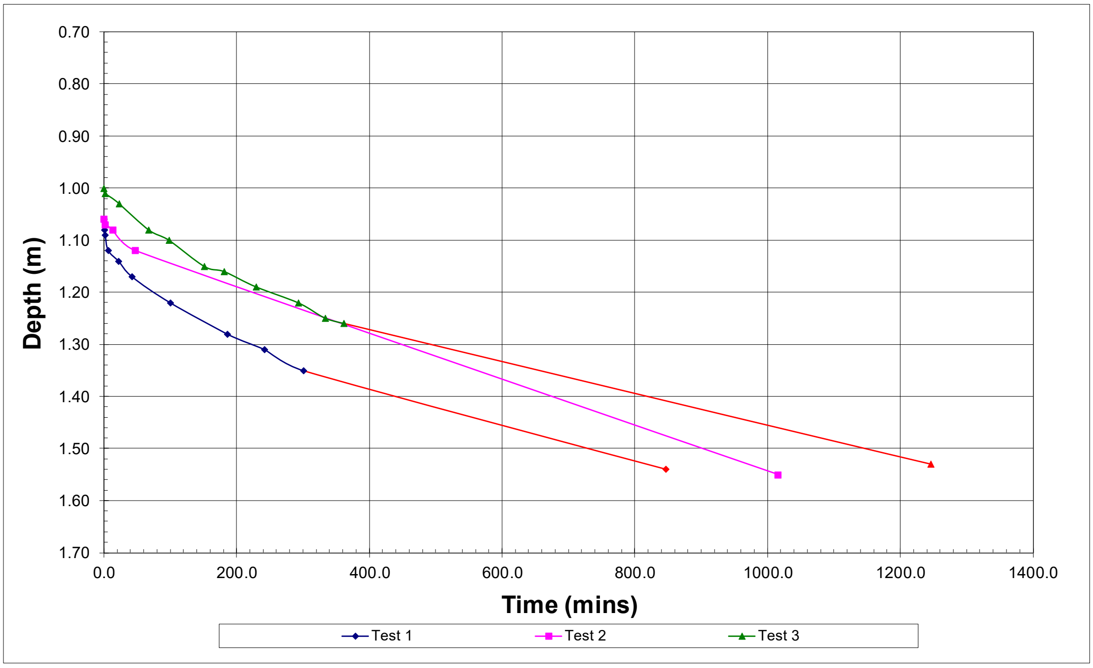
Soakage Test Results

Geo-Environmental	**Soakaway Test Results (after BRE Digest 365)**	**Geo-EnvironmentalServices Limited** **Unit 7 Danworth Farm, Cuckfield Road,** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**

Project Name :	Culham, Abingdon	**Job No. :**	GE21162
Client :	Statera Energy	**Date :**	28/09/2022 - 29/09/2022

Pit reference	**TP1**		
Test reference	Test1	Test2	Test3
Pit depth (m)	1.70	1.70	1.70
Pit width (m)	0.45	0.45	0.45
Pit length (m)	1.70	1.70	1.70
Depth to standing water (m)			

Test 1		**Test 2**		**Test 3**	
Time (min)	**Depth (m)**	**Time (min)**	**Depth (m)**	**Time (min)**	**Depth (m)**
0.0	1.06	0.0	1.06	0.0	1.00
1.0	1.08	2.0	1.07	2.0	1.01
2.0	1.09	13.0	1.08	23.0	1.03
6.0	1.12	47.0	1.12	67.0	1.08
22.0	1.14	1015.0	1.55	98.0	1.10
42.0	1.17			151.0	1.15
100.0	1.22			181.0	1.16
186.0	1.28			229.0	1.19
242.0	1.31			293.0	1.22
301.0	1.35			333.0	1.25
847.0	1.54			361.0	1.26
				1246.0	1.53



Max. depth (m)	1.70	1.70	1.70
Effective depth (m)	0.64	0.64	0.70
75% effective depth (m)	1.22	1.22	1.18
50% effective depth (m)	1.38	1.38	1.35
25% effective depth (m)	1.54	1.54	1.53
t75 (min)	100.00	270.00	220.00
t50 (min)	380.00	630.00	660.00
t25 (min)	847.00	1015.00	1246.00
Vp 75-25	0.24	0.24	0.27
ap 50	2.141	2.141	2.27
tp 75-25	747.00	745.00	1026.00

Soil infiltration rate (m/s)	**2.6E-06**	**2.6E-06**	**1.9E-06**
Soil infiltration rate (mm/hr)	**9.18E+00**	**9.21E+00**	**6.90E+00**

Notes:

1	Blue cells require input data
2	Infiltration calculated to method in 'BRE Digest 365 (1991) - Soakaway Design'
3	First line of table must be depth at time = 0
4	Extrapolated data shown in red

Geo-Environmental

Soakaway Test Results (after BRE Digest 365)

Geo-EnvironmentalServices Limited
Unit 7 Danworth Farm, Cuckfield Road,
Hurstpierpoint, West Sussex BN6 9GL
+44(0)1273 832972 www.gesl.net

Project Name : Culham, Abingdon
Client : Statera Energy
Job No. : GE21162
Date : 28/09/2022 - 29/09/2022

Pit reference	TP2		
Test reference	Test1	Test2	Test3
Pit depth (m)	1.90	1.90	1.90
Pit width (m)	0.45	0.45	0.45
Pit length (m)	1.30	1.30	1.30
Depth to standing water (m)			

Test 1

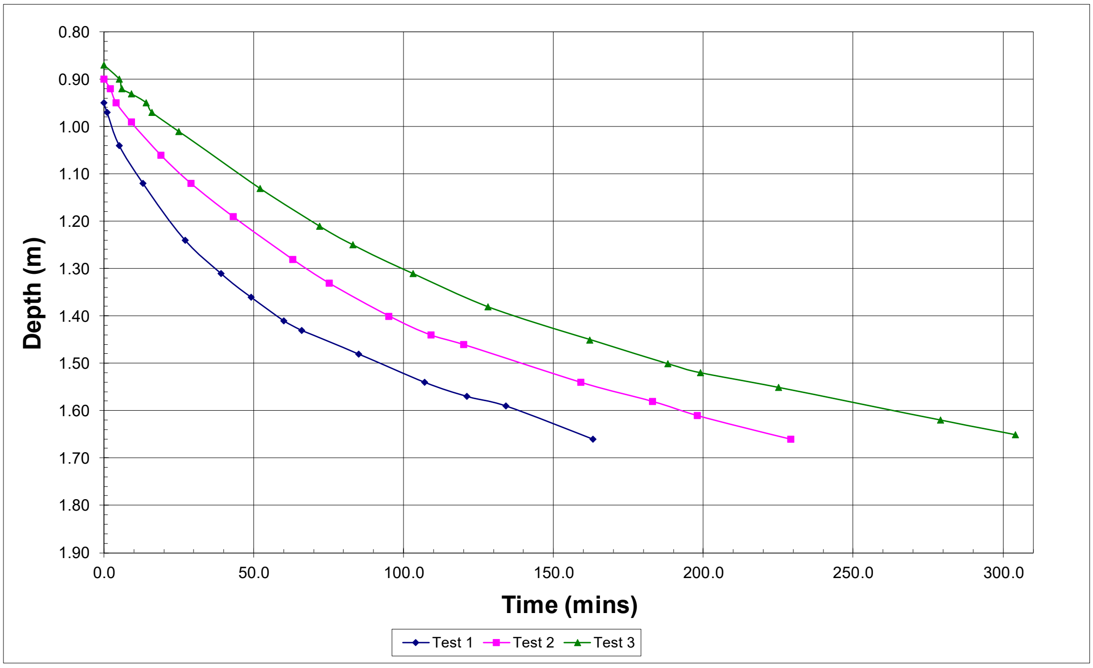
Time (min)	Depth (m)
0.0	0.95
1.0	0.97
5.0	1.04
13.0	1.12
27.0	1.24
39.0	1.31
49.0	1.36
60.0	1.41
66.0	1.43
85.0	1.48
107.0	1.54
121.0	1.57
134.0	1.59
163.0	1.66

Test 2

Time (min)	Depth (m)
0.0	0.90
2.0	0.92
4.0	0.95
9.0	0.99
19.0	1.06
29.0	1.12
43.0	1.19
63.0	1.28
75.0	1.33
95.0	1.40
109.0	1.44
120.0	1.46
159.0	1.54
183.0	1.58
198.0	1.61
229.0	1.66

Test 3

Time (min)	Depth (m)
0.0	0.87
5.0	0.90
6.0	0.92
9.0	0.93
14.0	0.95
16.0	0.97
25.0	1.01
52.0	1.13
72.0	1.21
83.0	1.25
103.0	1.31
128.0	1.38
162.0	1.45
188.0	1.50
199.0	1.52
225.0	1.55
279.0	1.62
304.0	1.65



Max. depth (m)	1.90	1.90	1.90
Effective depth (m)	0.95	1.00	1.03
75% effective depth (m)	1.19	1.15	1.13
50% effective depth (m)	1.43	1.40	1.39
25% effective depth (m)	1.66	1.65	1.64
t75 (min)	20.00	35.00	52.00
t50 (min)	66.00	95.00	135.00
t25 (min)	163.00	220.00	295.00
Vp 75-25	0.28	0.29	0.30
ap 50	2.2475	2.335	2.3875
tp 75-25	143.00	185.00	243.00

Soil infiltration rate (m/s)	**1.4E-05**	**1.1E-05**	**8.7E-06**
Soil infiltration rate (mm/hr)	**5.19E+01**	**4.06E+01**	**3.12E+01**

Notes:

1	Blue cells require input data
2	Infiltration calculated to method in 'BRE Digest 365 (1991) - Soakaway Design'
3	First line of table must be depth at time = 0

Geo-Environmental

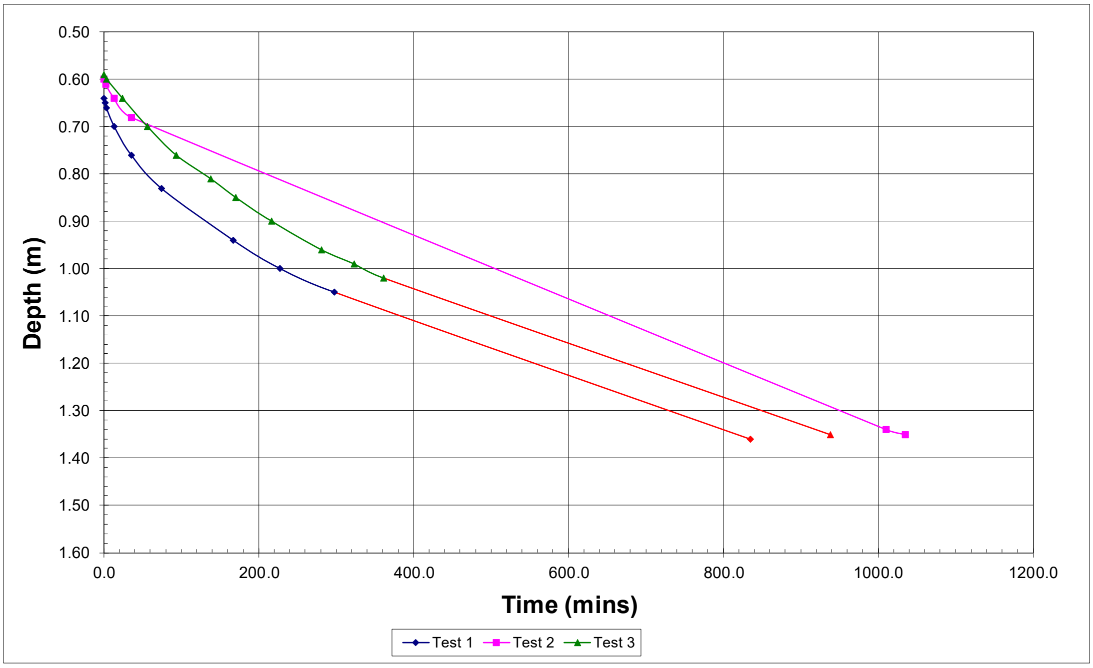
Soakaway Test Results (after BRE Digest 365)

Geo-EnvironmentalServices Limited
Unit 7 Danworth Farm, Cuckfield Road,
Hurstpierpoint, West Sussex BN6 9GL
+44(0)1273 832972 www.gesl.net

Project Name : Culham, Abingdon
Job No. : GE21162
Client : Statera Energy
Date : 28/09/2022 - 29/09/2022

Pit reference	**TP3**		
Test reference	Test1	Test2	Test3
Pit depth (m)	1.60	1.60	1.60
Pit width (m)	0.45	0.45	0.45
Pit length (m)	1.60	1.60	1.60
Depth to standing water (m)			

Test 1		**Test 2**		**Test 3**	
Time (min)	**Depth (m)**	**Time (min)**	**Depth (m)**	**Time (min)**	**Depth (m)**
0.0	0.64	0.0	0.60	0.0	0.59
1.0	0.65	2.0	0.61	3.0	0.60
3.0	0.66	13.0	0.64	24.0	0.64
13.0	0.70	35.0	0.68	56.0	0.70
35.0	0.76	1010.0	1.34	93.0	0.76
74.0	0.83	1035.0	1.35	138.0	0.81
167.0	0.94			170.0	0.85
227.0	1.00			216.0	0.90
297.0	1.05			281.0	0.96
835.0	1.36			323.0	0.99
				361.0	1.02
				938.0	1.35



Max. depth (m)	1.60	1.60	1.60
Effective depth (m)	0.96	1.00	1.01
75% effective depth (m)	0.88	0.85	0.84
50% effective depth (m)	1.12	1.10	1.10
25% effective depth (m)	1.36	1.35	1.35
t75 (min)	190.00	290.00	160.00
t50 (min)	250.00	520.00	500.00
t25 (min)	835.00	1035.00	938.00
Vp 75-25	0.35	0.36	0.36
ap 50	2.688	2.77	2.7905
tp 75-25	645.00	745.00	778.00

Soil infiltration rate (m/s)	**3.3E-06**	**2.9E-06**	**2.8E-06**
Soil infiltration rate (mm/hr)	**1.20E+01**	**1.05E+01**	**1.00E+01**

Notes:

1	Blue cells require input data
2	Infiltration calculated to method in 'BRE Digest 365 (1991) - Soakaway Design'
3	First line of table must be depth at time = 0
4	Extrapolated data shown in red

Geo-Environmental

Soakaway Test Results (after BRE Digest 365)

Geo-EnvironmentalServices Limited
Unit 7 Danworth Farm, Cuckfield Road,
Hurstpierpoint, West Sussex BN6 9GL
+44(0)1273 832972 www.gesl.net

Project Name : Culham, Abingdon
Job No. : GE21162
Client : Statera Energy
Date : 28/09/2022 - 29/09/2022

Pit reference	**TP4**		
Test reference	Test1	Test2	Test3
Pit depth (m)	2.00	2.00	
Pit width (m)	0.45	0.45	
Pit length (m)	1.40	1.40	
Depth to standing water (m)			

Test 1

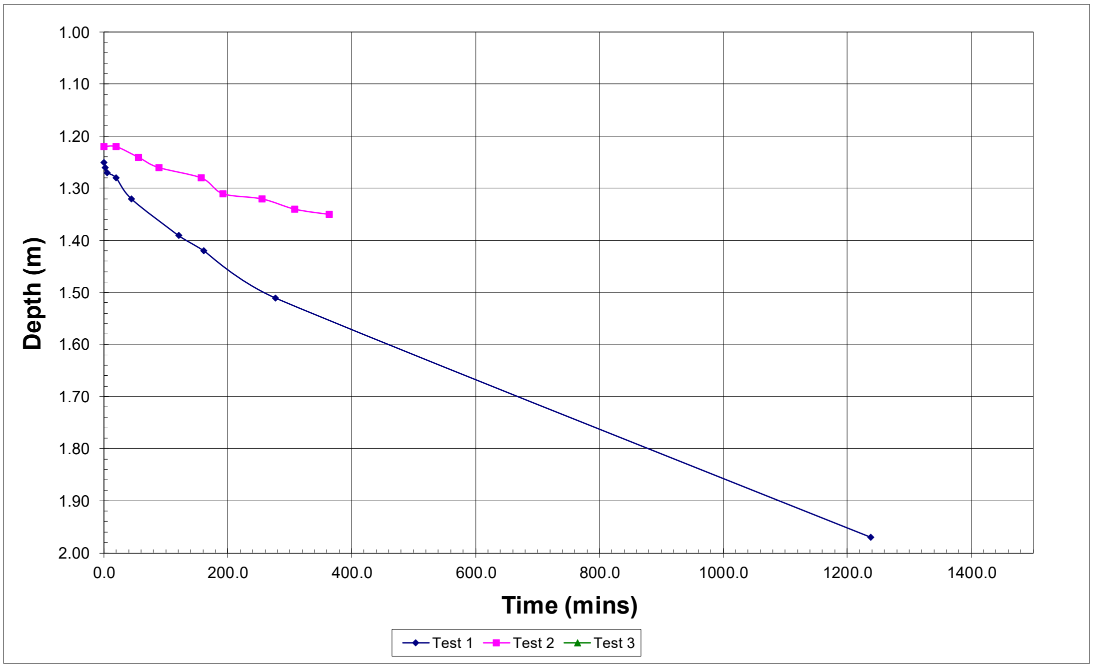
Time (min)	Depth (m)
0.0	1.25
2.0	1.26
5.0	1.27
19.0	1.28
44.0	1.32
120.0	1.39
161.0	1.42
277.0	1.51
1238.0	1.97

Test 2

Time (min)	Depth (m)
0.0	1.22
19.0	1.22
55.0	1.24
88.0	1.26
157.0	1.28
192.0	1.31
255.0	1.32
308.0	1.34
363.0	1.35

Test 3

Time (min)	Depth (m)



Max. depth (m)	2.00	2.00	0.00
Effective depth (m)	0.75	0.78	0.00
75% effective depth (m)	1.44	1.42	0.00
50% effective depth (m)	1.63	1.61	0.00
25% effective depth (m)	1.81	1.81	0.00
t75 (min)	180.00		
t50 (min)	530.00		
t25 (min)	900.00		
Vp 75-25	0.24	0.25	0.00
ap 50	2.0175	2.073	0
tp 75-25	720.00	0.00	0.00

Soil infiltration rate (m/s)	**2.7E-06**		
Soil infiltration rate (mm/hr)	**9.76E+00**		

Notes:

1	Blue cells require input data
2	Infiltration calculated to method in 'BRE Digest 365 (1991) - Soakaway Design'
3	First line of table must be depth at time = 0

APPENDIX C

Discovery Strategy

Discovery Strategy

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected ground and/or groundwater conditions may be encountered during the process of construction.

Should previously undiscovered contamination or unforeseen ground conditions be encountered during construction by the ground workers, this must be reported to the Site Manager immediately in order that the Consultant is notified.

Where deemed necessary, the Consultant shall attend the site to inspect the discovery and provide recommendations on the further actions required, if any. Where necessary the regulatory authority shall be informed. Post any additional investigation or laboratory testing the results and any proposed remedial measures shall be reported to the regulatory authority or other appropriate organisation for consent, before proceeding or implementing the remedial measures.

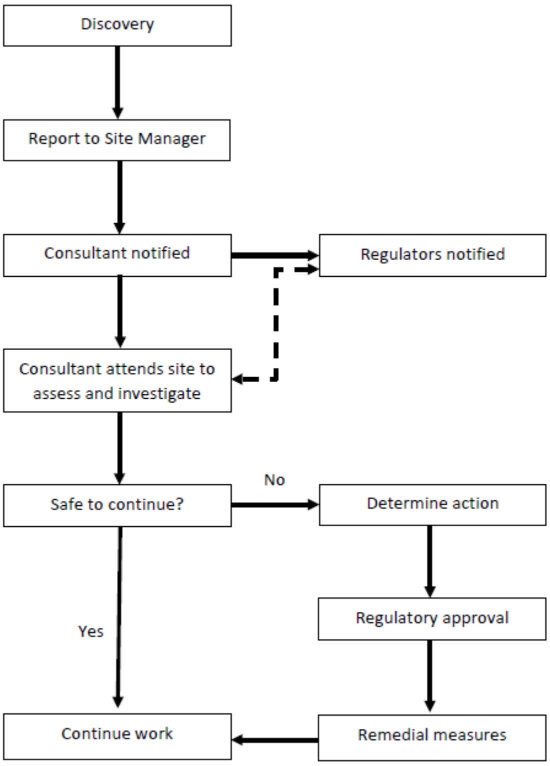
A copy of the discovery strategy must be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious, abnormal, unforeseen or contaminated ground and/or groundwater conditions they may encounter.

Depending on the type, nature and extent of any such ‘discovery’, it may be necessary to halt works in that location until such time as the assessment has been completed. This shall be reviewed on a ‘discovery’ specific basis and in conjunction with consultation with the client, other technical personnel and/or regulatory/approval organisations.

As a general guide, where such unexpected conditions are encountered the following approach is required as a minimum:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Consultant;
- Following notification from the Site Manager, the Consultant shall discuss the discovery with the Local Authority and/or other relevant parties and if considered necessary, arrange to meet on site to view the discovery;
- The Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Consultant and held on site (with copies held by the Consultant, Client and Local Authority/other relevant organisation), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the remedial action taken and validation thereof.

The process is summarised below:

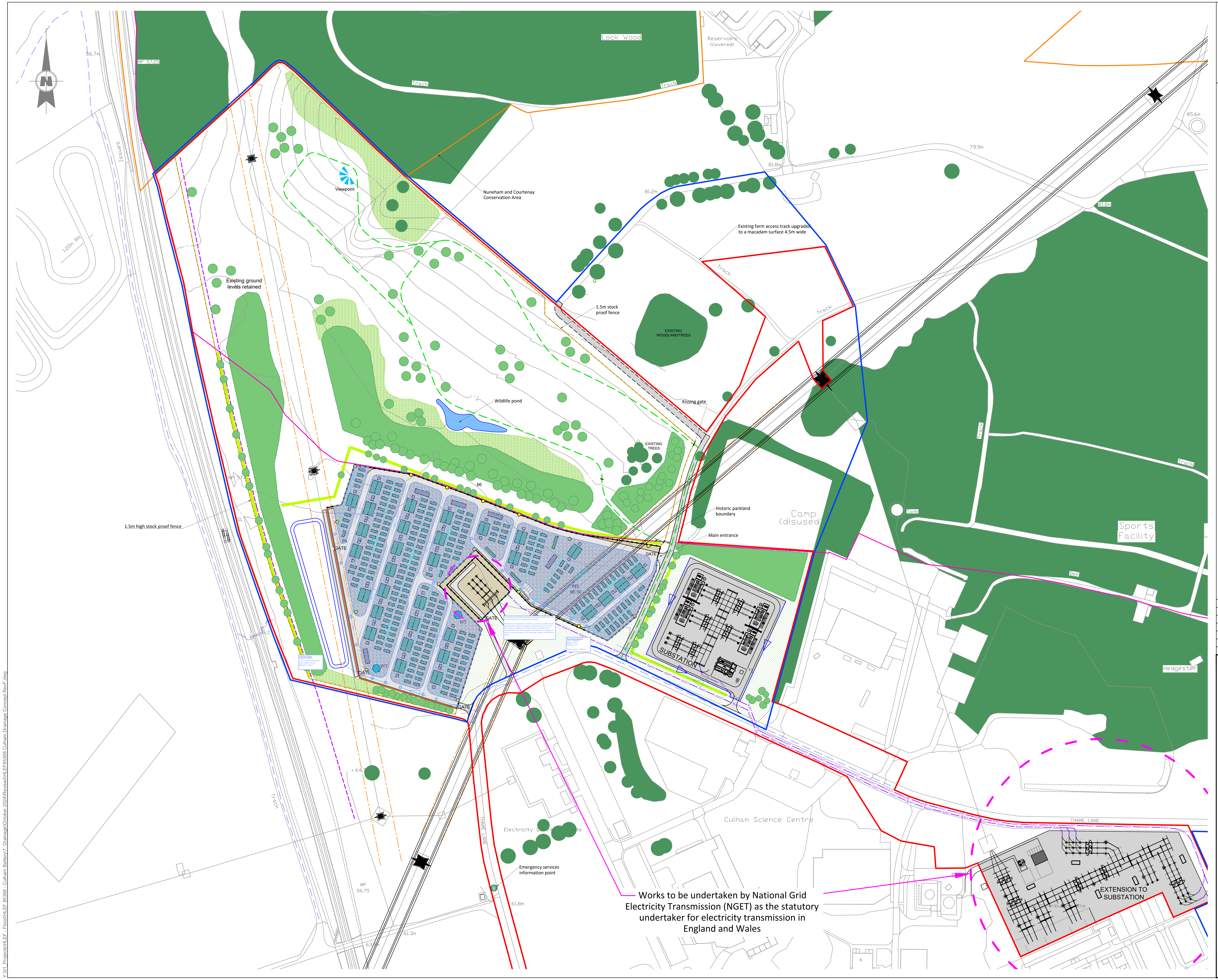

Discovery
Report to Site Manager
Consultant notified
Regulators notified
Consultant attends site to assess and investigate
Safe to continue?
No
Determine action
Regulatory approval
Yes
Continue work
Remedial measures

Appendix F - Greenfield Runoff Rate

ICP SUDS Mean Annual Flood

```
                           Input

Return Period (years)    100          Soil     0.300
            Area (ha)  1.000         Urban     0.000
            SAAR (mm)    600  Region Number  Region 6

                     Results   l/s

                   QBAR Rural  1.5
                   QBAR Urban  1.5

                   Q100 years  4.9

                      Q1 year  1.3
                    Q30 years  3.4
                   Q100 years  4.9
```

Appendix G – Conceptual Drainage Strategy



Works to be undertaken by National Grid Electricity Transmission (NGET) as the statutory undertaker for electricity transmission in England and Wales

Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

PRELIMINARY
SUBJECT TO DETAILED DESIGN

This drawing illustrates a sketch proposal only and as such is subject to detailed site investigation including ground conditions/contaminants, drainage, design and planning/density negotiations. The layout maybe based upon an enlargement of an OS sheet or other small scale plans and its accuracy will need to be verified by Survey. Full risk analysis under the CDM Regulations has not been undertaken.

KEY

Surface Water Manhole/ Inspection Chamber	◎
Interceptor Channel	— ▷ —
Surface Water Headwall	⟩
Internal Compound Surface Water Drains	—
Surface Water Outfall Routes	—
Vortex Grit Separator	Ⓢ
Attenuation Blanket	▨

QBAR Rate = 6.3l/s
1 in 1 Rate = 5.4 l/s
Impermeable Area = 4.175ha

Storage requirement for 1:100 year + 40% cc event = $3260m^3$

During normal operation, water will be directed via filter drains and lined gravel areas towards the Infiltration Basin on site.

To prevent uncontrolled infiltration, the gravel areas of the site will be lined to form an attenuation blanket.

Penstocks and inspection chambers provided at outfall of each blanket to allow for pollution containment and control in the event of a battery fire. Water will then be tested, and removed from site using specialist management companies or via the normal operation of the drainage system (via infiltration basin)

Rev	Description	By	Ckd	Date
F	Updates to Layout	JG	JM	24.10.24
E	Updates from Comments	JG	JM	02:08:24
D	Update to Drainage Approach	JG	JM	11:04:24
C	Updates to Layout	JG	JM	23:02:24
B	Updates to Layout	JG	JM	30.10.23
A	First Issue	JG	JH	09.02.23

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Client Statera

Project Culham Battery

Title Conceptual Drainage Strategy

Status	Scale	Date Created
PRELIMINARY	@A1	29.10.2024

Task Team Manager	Information Author	Task Information Manager
JM	JG	JM

Document Number
D01

RPS Project Number
HLEF85368

Revision
E

rpsgroup.com

Appendix H - MicroDrainage Calculations

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

Half Drain Time : 1060 minutes.

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Infiltration (l/s)**	**Max Volume (m³)**	**Status**
15 min Summer	63.216	0.456	20.9	1179.3	O K
30 min Summer	63.345	0.585	22.0	1535.6	O K
60 min Summer	63.472	0.712	23.0	1893.2	O K
120 min Summer	63.594	0.834	24.0	2246.8	O K
180 min Summer	63.658	0.898	24.5	2434.8	O K
240 min Summer	63.695	0.935	24.8	2543.6	O K
360 min Summer	63.726	0.966	25.1	2636.8	O K
480 min Summer	63.730	0.970	25.1	2648.6	O K
600 min Summer	63.720	0.960	25.0	2618.6	O K
720 min Summer	63.702	0.942	24.9	2564.7	O K
960 min Summer	63.658	0.898	24.5	2435.4	O K
1440 min Summer	63.580	0.820	23.9	2206.0	O K
2160 min Summer	63.488	0.728	23.1	1940.0	O K
2880 min Summer	63.416	0.656	22.5	1734.8	O K
4320 min Summer	63.303	0.543	21.6	1418.6	O K
5760 min Summer	63.214	0.454	20.9	1173.9	O K
7200 min Summer	63.142	0.382	20.3	981.0	O K
8640 min Summer	63.083	0.323	19.8	824.7	O K
10080 min Summer	63.034	0.274	19.4	696.3	O K
15 min Winter	63.268	0.508	21.3	1323.4	O K

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Time-Peak (mins)**
15 min Summer	153.813	0.0	26
30 min Summer	100.662	0.0	41
60 min Summer	62.851	0.0	70
120 min Summer	38.216	0.0	130
180 min Summer	28.256	0.0	188
240 min Summer	22.648	0.0	248
360 min Summer	16.376	0.0	366
480 min Summer	12.909	0.0	484
600 min Summer	10.688	0.0	602
720 min Summer	9.138	0.0	720
960 min Summer	7.104	0.0	830
1440 min Summer	4.953	0.0	1070
2160 min Summer	3.446	0.0	1472
2880 min Summer	2.670	0.0	1876
4320 min Summer	1.879	0.0	2680
5760 min Summer	1.476	0.0	3464
7200 min Summer	1.235	0.0	4192
8640 min Summer	1.075	0.0	4936
10080 min Summer	0.960	0.0	5656
15 min Winter	153.813	0.0	26

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	63.412	0.652	22.5	1724.1	O K
60 min Winter	63.554	0.794	23.7	2128.8	O K
120 min Winter	63.691	0.931	24.8	2533.8	O K
180 min Winter	63.764	1.004	25.4	2753.2	O K
240 min Winter	63.807	1.047	25.8	2883.8	O K
360 min Winter	63.847	1.087	26.1	3005.6	O K
480 min Winter	63.857	1.097	26.2	3035.6	O K
600 min Winter	63.851	1.091	26.1	3018.9	O K
720 min Winter	63.837	1.077	26.0	2975.7	O K
960 min Winter	63.795	1.035	25.7	2845.5	O K
1440 min Winter	63.702	0.942	24.9	2566.0	O K
2160 min Winter	63.587	0.827	23.9	2226.7	O K
2880 min Winter	63.490	0.730	23.1	1944.9	O K
4320 min Winter	63.330	0.570	21.8	1492.6	O K
5760 min Winter	63.201	0.441	20.8	1139.8	O K
7200 min Winter	63.098	0.338	20.0	864.9	O K
8640 min Winter	63.015	0.255	19.3	645.1	O K
10080 min Winter	62.947	0.187	18.7	469.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	100.662	0.0	41
60 min Winter	62.851	0.0	70
120 min Winter	38.216	0.0	128
180 min Winter	28.256	0.0	186
240 min Winter	22.648	0.0	242
360 min Winter	16.376	0.0	358
480 min Winter	12.909	0.0	474
600 min Winter	10.688	0.0	586
720 min Winter	9.138	0.0	698
960 min Winter	7.104	0.0	912
1440 min Winter	4.953	0.0	1132
2160 min Winter	3.446	0.0	1584
2880 min Winter	2.670	0.0	2028
4320 min Winter	1.879	0.0	2896
5760 min Winter	1.476	0.0	3688
7200 min Winter	1.235	0.0	4464
8640 min Winter	1.075	0.0	5192
10080 min Winter	0.960	0.0	5856

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 452975 196383 SU 52975 96383
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.175

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.392	4	8	1.392	8	12	1.392

Model Details

Storage is Online Cover Level (m) 64.260

Infiltration Basin Structure

Invert Level (m) 62.760 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.05040 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.05040

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	2466.5	1.500	3322.4

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

Half Drain Time : 5007 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	63.922	0.122	0.0	5.2	5.2	1048.8	O K
30 min Summer	63.960	0.160	0.0	5.6	5.6	1370.6	O K
60 min Summer	63.999	0.199	0.0	5.6	5.6	1707.2	O K
120 min Summer	64.041	0.241	0.0	5.6	5.6	2066.8	Flood Risk
180 min Summer	64.066	0.266	0.0	5.6	5.6	2282.6	Flood Risk
240 min Summer	64.083	0.283	0.0	5.6	5.6	2429.7	Flood Risk
360 min Summer	64.105	0.305	0.0	5.6	5.6	2614.5	Flood Risk
480 min Summer	64.118	0.318	0.0	5.6	5.6	2726.7	Flood Risk
600 min Summer	64.126	0.326	0.0	5.6	5.6	2800.6	Flood Risk
720 min Summer	64.132	0.332	0.0	5.6	5.6	2851.4	Flood Risk
960 min Summer	64.139	0.339	0.0	5.6	5.6	2910.9	Flood Risk
1440 min Summer	64.144	0.344	0.0	5.6	5.6	2952.4	Flood Risk
2160 min Summer	64.143	0.343	0.0	5.6	5.6	2941.9	Flood Risk
2880 min Summer	64.138	0.338	0.0	5.6	5.6	2900.9	Flood Risk
4320 min Summer	64.126	0.326	0.0	5.6	5.6	2794.7	Flood Risk
5760 min Summer	64.117	0.317	0.0	5.6	5.6	2725.0	Flood Risk
7200 min Summer	64.113	0.313	0.0	5.6	5.6	2685.7	Flood Risk
8640 min Summer	64.110	0.310	0.0	5.6	5.6	2659.6	Flood Risk
10080 min Summer	64.108	0.308	0.0	5.6	5.6	2640.7	Flood Risk
15 min Winter	63.937	0.137	0.0	5.5	5.5	1174.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	153.813	0.0	354.7	27
30 min Summer	100.662	0.0	452.7	42
60 min Summer	62.851	0.0	899.4	72
120 min Summer	38.216	0.0	944.2	132
180 min Summer	28.256	0.0	935.3	192
240 min Summer	22.648	0.0	924.1	250
360 min Summer	16.376	0.0	902.4	370
480 min Summer	12.909	0.0	882.7	490
600 min Summer	10.688	0.0	864.5	610
720 min Summer	9.138	0.0	847.4	730
960 min Summer	7.104	0.0	815.8	968
1440 min Summer	4.953	0.0	758.0	1446
2160 min Summer	3.446	0.0	1626.0	2164
2880 min Summer	2.670	0.0	1541.9	2884
4320 min Summer	1.879	0.0	1382.0	3860
5760 min Summer	1.476	0.0	3080.8	4552
7200 min Summer	1.235	0.0	2982.9	5264
8640 min Summer	1.075	0.0	2827.8	6056
10080 min Summer	0.960	0.0	2669.5	6864
15 min Winter	153.813	0.0	402.6	27

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m^3)	Status
30 min Winter	63.979	0.179	0.0	5.6	5.6	1535.6	O K
60 min Winter	64.023	0.223	0.0	5.6	5.6	1913.1	Flood Risk
120 min Winter	64.070	0.270	0.0	5.6	5.6	2317.1	Flood Risk
180 min Winter	64.098	0.298	0.0	5.6	5.6	2560.0	Flood Risk
240 min Winter	64.118	0.318	0.0	5.6	5.6	2725.8	Flood Risk
360 min Winter	64.142	0.342	0.0	5.6	5.6	2935.1	Flood Risk
480 min Winter	64.157	0.357	0.0	5.6	5.6	3063.4	Flood Risk
600 min Winter	64.167	0.367	0.0	5.6	5.6	3148.8	Flood Risk
720 min Winter	64.174	0.374	0.0	5.6	5.6	3208.5	Flood Risk
960 min Winter	64.182	0.382	0.0	5.6	5.6	3280.6	Flood Risk
1440 min Winter	64.189	0.389	0.0	5.6	5.6	3337.7	Flood Risk
2160 min Winter	64.190	0.390	0.0	5.6	5.6	3343.3	Flood Risk
2880 min Winter	64.186	0.386	0.0	5.6	5.6	3316.4	Flood Risk
4320 min Winter	64.176	0.376	0.0	5.6	5.6	3230.8	Flood Risk
5760 min Winter	64.164	0.364	0.0	5.6	5.6	3124.2	Flood Risk
7200 min Winter	64.155	0.355	0.0	5.6	5.6	3047.8	Flood Risk
8640 min Winter	64.150	0.350	0.0	5.6	5.6	3000.1	Flood Risk
10080 min Winter	64.145	0.345	0.0	5.6	5.6	2959.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
30 min Winter	100.662	0.0	472.4	41
60 min Winter	62.851	0.0	943.1	72
120 min Winter	38.216	0.0	943.5	130
180 min Winter	28.256	0.0	929.1	188
240 min Winter	22.648	0.0	915.0	248
360 min Winter	16.376	0.0	889.8	366
480 min Winter	12.909	0.0	867.3	484
600 min Winter	10.688	0.0	847.0	602
720 min Winter	9.138	0.0	828.2	720
960 min Winter	7.104	0.0	796.0	956
1440 min Winter	4.953	0.0	744.2	1426
2160 min Winter	3.446	0.0	1598.8	2124
2880 min Winter	2.670	0.0	1522.9	2804
4320 min Winter	1.879	0.0	1384.2	4152
5760 min Winter	1.476	0.0	3152.9	5368
7200 min Winter	1.235	0.0	3014.9	5760
8640 min Winter	1.075	0.0	2876.8	6656
10080 min Winter	0.960	0.0	2743.0	7568

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 452975 196383 SU 52975 96383
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.650

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.217	4	8	1.217	8	12	1.217

Model Details

Storage is Online Cover Level (m) 64.300

Infiltration Blanket Structure

Infiltration Coefficient Base (m/hr)	0.00000	Diameter/Width (m)	58.0
Safety Factor	2.0	Length (m)	493.3
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	63.800		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0118-5600-0500-5600
Design Head (m)	0.500
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	118
Invert Level (m)	63.800
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.500	5.6
Flush-Flo™	0.186	5.6
Kick-Flo®	0.375	4.9
Mean Flow over Head Range	-	4.6

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	4.2	1.200	8.4	3.000	13.0	7.000	19.6
0.200	5.6	1.400	9.1	3.500	14.0	7.500	20.3
0.300	5.4	1.600	9.7	4.000	14.9	8.000	20.9
0.400	5.1	1.800	10.2	4.500	15.8	8.500	21.6
0.500	5.6	2.000	10.7	5.000	16.6	9.000	22.2
0.600	6.1	2.200	11.2	5.500	17.3	9.500	22.8
0.800	7.0	2.400	11.7	6.000	18.1		
1.000	7.7	2.600	12.2	6.500	18.9		

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

Half Drain Time : 1714 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	63.186	0.426	13.8	1187.7	O K
30 min Summer	63.309	0.549	14.4	1549.2	O K
60 min Summer	63.432	0.672	15.1	1918.2	O K
120 min Summer	63.554	0.794	15.7	2296.5	O K
180 min Summer	63.622	0.862	16.1	2509.0	O K
240 min Summer	63.664	0.904	16.3	2642.4	O K
360 min Summer	63.709	0.949	16.5	2784.5	O K
480 min Summer	63.727	0.967	16.6	2843.8	O K
600 min Summer	63.732	0.972	16.7	2859.9	O K
720 min Summer	63.729	0.969	16.7	2850.5	O K
960 min Summer	63.709	0.949	16.5	2786.3	O K
1440 min Summer	63.649	0.889	16.2	2593.3	O K
2160 min Summer	63.572	0.812	15.8	2349.8	O K
2880 min Summer	63.512	0.752	15.5	2164.1	O K
4320 min Summer	63.424	0.664	15.0	1893.7	O K
5760 min Summer	63.356	0.596	14.7	1690.1	O K
7200 min Summer	63.303	0.543	14.4	1529.7	O K
8640 min Summer	63.258	0.498	14.2	1395.9	O K
10080 min Summer	63.219	0.459	14.0	1282.1	O K
15 min Winter	63.236	0.476	14.1	1331.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	153.813	0.0	27
30 min Summer	100.662	0.0	41
60 min Summer	62.851	0.0	70
120 min Summer	38.216	0.0	130
180 min Summer	28.256	0.0	190
240 min Summer	22.648	0.0	248
360 min Summer	16.376	0.0	368
480 min Summer	12.909	0.0	486
600 min Summer	10.688	0.0	606
720 min Summer	9.138	0.0	724
960 min Summer	7.104	0.0	962
1440 min Summer	4.953	0.0	1286
2160 min Summer	3.446	0.0	1628
2880 min Summer	2.670	0.0	2020
4320 min Summer	1.879	0.0	2820
5760 min Summer	1.476	0.0	3640
7200 min Summer	1.235	0.0	4464
8640 min Summer	1.075	0.0	5264
10080 min Summer	0.960	0.0	6048
15 min Winter	153.813	0.0	27

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	63.372	0.612	14.8	1738.0	O K
60 min Winter	63.509	0.749	15.5	2154.4	O K
120 min Winter	63.646	0.886	16.2	2583.5	O K
180 min Winter	63.722	0.962	16.6	2827.5	O K
240 min Winter	63.770	1.010	16.9	2982.8	O K
360 min Winter	63.822	1.062	17.2	3153.4	O K
480 min Winter	63.846	1.086	17.3	3231.2	O K
600 min Winter	63.855	1.095	17.3	3260.5	O K
720 min Winter	63.855	1.095	17.3	3261.1	O K
960 min Winter	63.840	1.080	17.2	3211.9	O K
1440 min Winter	63.785	1.025	17.0	3030.8	O K
2160 min Winter	63.693	0.933	16.5	2734.8	O K
2880 min Winter	63.621	0.861	16.1	2505.2	O K
4320 min Winter	63.503	0.743	15.5	2137.6	O K
5760 min Winter	63.407	0.647	14.9	1842.0	O K
7200 min Winter	63.327	0.567	14.5	1602.8	O K
8640 min Winter	63.259	0.499	14.2	1400.8	O K
10080 min Winter	63.200	0.440	13.9	1226.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	100.662	0.0	41
60 min Winter	62.851	0.0	70
120 min Winter	38.216	0.0	128
180 min Winter	28.256	0.0	186
240 min Winter	22.648	0.0	244
360 min Winter	16.376	0.0	362
480 min Winter	12.909	0.0	478
600 min Winter	10.688	0.0	594
720 min Winter	9.138	0.0	708
960 min Winter	7.104	0.0	936
1440 min Winter	4.953	0.0	1372
2160 min Winter	3.446	0.0	1716
2880 min Winter	2.670	0.0	2168
4320 min Winter	1.879	0.0	3072
5760 min Winter	1.476	0.0	3936
7200 min Winter	1.235	0.0	4768
8640 min Winter	1.075	0.0	5624
10080 min Winter	0.960	0.0	6368

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 452975 196383 SU 52975 96383
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.175

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.392	4	8	1.392	8	12	1.392

Model Details

Storage is Online Cover Level (m) 64.260

Infiltration Basin Structure

Invert Level (m) 62.760 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03132 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.03132

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	2666.6	1.500	3553.9