MOTT MACDONALD

Hydrogen Production Facility Proposed Drainage Strategy

Marubeni Bridgend Green

November 2022

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Mott MacDonald
Victory House
Trafalgar Place
Brighton BN1 4FY
United Kingdom

T +44 (0)1273 365000
mottmac.com

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Issue and Revision Record

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01	16/11/22	O. Jeffcock	A. Ruiz Diaz	P. McLoughlin	First Issue

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Contents

Executive Summary

This document outlines the drainage strategy for the green hydrogen production facility and the Solar photovoltaic electricity generating station (solar farm) as part of the Marubeni Bridgend Green Hydrogen project.

This report considers the impact that the Marubeni Bridgend Green Hydrogen project may have on the existing surface water flow paths and the existing foul water network within the area. Existing conditions, such as geology, hydrology, and flood risk, have been assessed to support the development of the drainage strategy.

This document aims to summarise the proposed drainage strategy for the development, outlining the measures taken to reduce the impact of the development on both flow rates and water quality from the site by utilising sustainable drainage systems (SuDS) to support the Planning Application for the Marubeni Bridgend Green Hydrogen project.

This report does not assess the impact of the proposed development on flood risk from surface water, fluvial, coastal or groundwater sources, or any changes to flood risk in the surrounding areas affected by the development; this is considered in a separate Flood Consequence Assessment.

1 Introduction:

1.1 Project Overview

Development of a green hydrogen production facility with electrolysers, hydrogen storage, hydrogen refuelling station, administration building, substation and hydrogen pipeline 'off-take'; with access, circulation, parking, lighting, security fencing, hard and soft landscaping, drainage infrastructure and temporary construction compound, on land at Brynmenyn, Bridgend.

Together with the installation of a solar photovoltaic electricity generating station (solar farm), comprising ground-mounted solar panels, inverters, transformer units, switch gear and a substation; with access, circulation, parking, lighting, security fencing, hard and soft landscaping, drainage infrastructure and temporary construction compound, on land at Bryncethin, Bridgend.

Sites to be connected via an electrical wire (part under and part overground).

1.2 Project scope

This report considers the impact that development of the Hydrogen production facility and the Solar PV site may have on the existing surface water flow paths within the vicinity of the area and drainage strategy for the two developments.

1.2.1 Hydrogen production facility

- **Site Platform** – Site platform to be +63.800mAOD. All of the site within the site boundary fence will be impermeable.
- **1no. Permanent Access Road** – to facilitate access to the Hydrogren production facility, a new access road is to be constructed of bitumen to provide access.
- **1no**. **Internal Road and car park**- The internal road will circle the plant to allow vehicle access on all sides.
- **HV Substation** – located within the platform.
- **Hydrogen Storage Area, Hydrogen Refuelling Station and Hydrogen Production Area** – delimited by a fire wall.
- **Administration Building** – located within the platform.

1.2.2 Solar PV

- **1no. Permanent Road** – To facilitate maintenance of the solar farm. The road will be constructed of bitumen and is anticipated to be used for maintenance work only.
- **Laydown Area** – to store materials, equipment and welfare facilities during construction.
- **HV substation –** located within the boundary of the solar PV site.

2 Site Overview

2.1 Site location

Both new sites are located in Bridgend, Wales, with the hydrogen production facility located just south of Bryncethin industrial estate and the Solar PV site located in the Brynmenyn area.

Figure 2.1 indicates the two proposed developments within Brynmenyn and Bryncethin areas. The Hydrogen site will have an access road leading from Squire Drive and the Solar PV site will have access to Blackmill Rd.

Figure 2.1: Marubeni Bridgend Green Hydrogen project location.

Source: Google Earth Pro (2022)

2.2 Data Sources

The following data sources have been used for this assessment:

File Name	File Ref	Source	Data Received	Revision
Solar PV Site Layout	108939-MMD-BRGR-XX-DR-C-0014	Mott MacDonald	2022	01
Hydrogen Production Facility Site Layout	108939-MMD-BRGR-XX-DR-C-002	Mott MacDonald	2022	01
OS Mapping	N/A	Ordnance Survey	2022	N/A
Aerial maps, Openstreet maps, Magic Map Website	N/A	Google Maps and Earth, Bing, Environment Agency (EA)	2022	N/A
British Geological Survey (BGS) Website	N/A	BGS website	2022	N/A
Bryncethin Solar Farm Phase 1 Desk Study	108939-T-RP-0002	Mott MacDonald	2022	P01
Brynmenyn Hydrogen Plant Phase 1 Desk Study	108939-T-RP-0001/2	Mott MacDonald	2022	P01

File Name	File Ref	Source	Data Received	Revision
LIDAR	N/A		2022	N/A
Topographical Survey, Woodmat Site, Brynmenyn Industrial Estate	21714	Zenith Land Surveys Ltd.	April'22	01
Topographical Survey, Brynmenyn Solar PV Project	21779	Zenith Land Surveys Ltd.	October'22	01
Tawe to Cadoxton Management Catchment Summary		Natural Resources Wales	Nov'22	N/A
		Water Watch Wales website		
Bryncethin Solar PV Project Site Constraints Map	08939-MMD-BRGR-XX-DR-Y-00	Mott MacDonald	Nov'22	

2.3 Standards and guidance

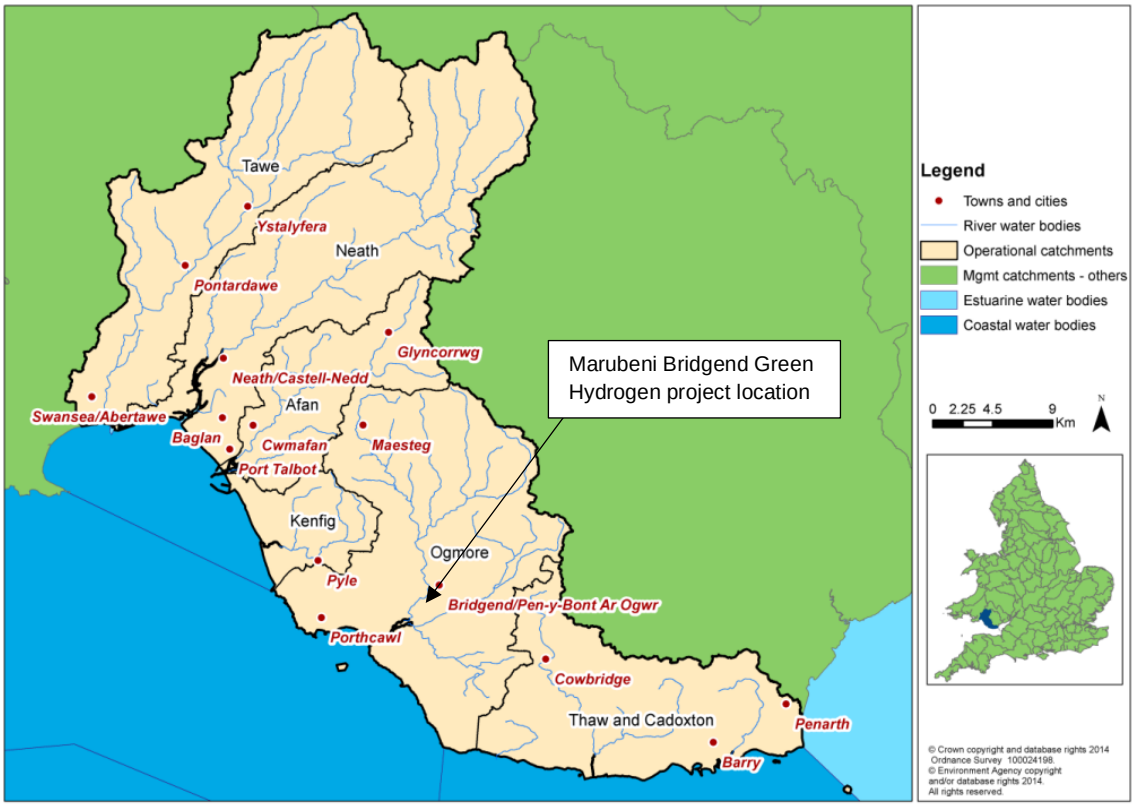
The following standards and guidance have been used for this assessment:

Document Name	Document Reference	Publisher
Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems		Welsh Government
Technical Advice Note 15: Development, Flooding and Coastal Erosion (TAN15)		Welsh Assembly Government
Flood Consequences Assessments: Climate change allowances September 2021		Welsh Assembly Government
Sewers for Adoption – 8th edition		Water UK
The SuDS Manual	C753	Construction Industry Research and Information Association
National Planning Policy Framework (NPPF) 2021	NPPF	Ministry of Housing, Communities and Local Government, UK Government
Strategic Flood Consequence Assessment of Bridgend County Borough		Bridgend County Borough

2.4 Existing Hydrology

The project sits within the Ogmore River operational catchment. The Ogmore River is a Main River regulated by Natural Resources Wales. The Figure 2.2 shows the catchment areas of the rivers in the project location.

Figure 2.2: Tawe to Cadoxton Management Catchment Summary



Source: Natural Resources Wales(NRW)

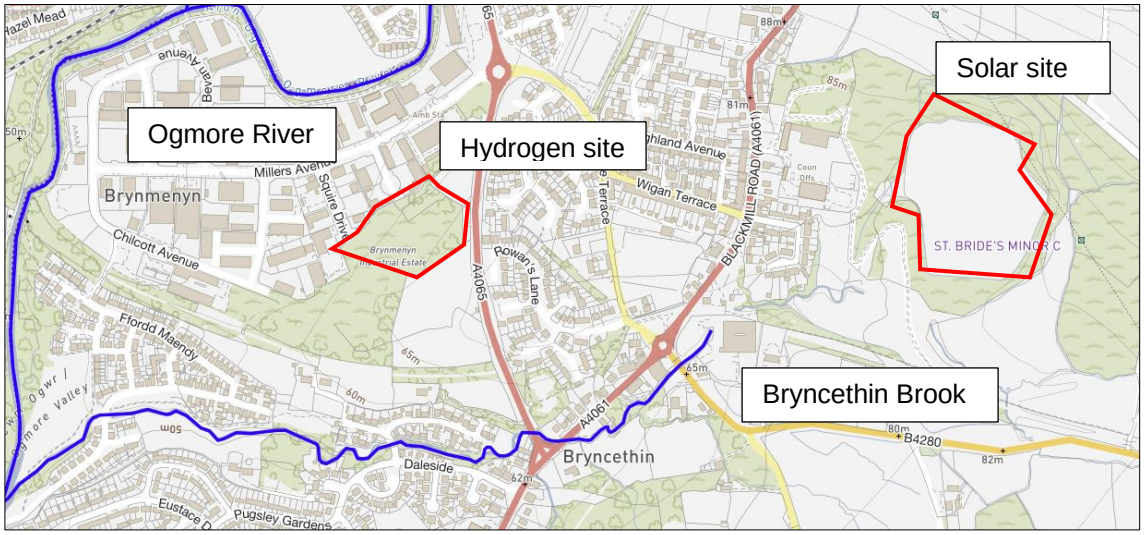
Water features are classified by the Natural Resources Wales as follows:

- Main River are rivers, larger streams and smaller watercourses of strategic drainage importance regulated by the Natural Resources Wales.
- Ordinary Watercourses are rivers, streams, ditches, drains, sluices and so on which do not form part of a main river. There are two types of Ordinary Watercourses: those regulated by Internal Drainage Boards which are usually are named; and those that are regulated by the Lead Local Flood Authorities which are usually unnamed.
- Ditches that are described as a watercourse less than 2m wide and are regulated by the Lead Local Flood Authorities.

2.4.1 Main Rivers

There are two Natural Resources Wales Main rivers nearby the proposed sites: The Ogmore River and the Bryncethin Brook, as shown on the Figure 2.3, all main rivers are shown in blue line.

Figure 2.3: Main Rivers Map



Source:Main Rivers, Natural Resources Wales, 2022.

2.4.2 Internal Drainage Boards (IDBs) in Wales

An IDB, as referred to in the Flood and Water Management Act 2010, has the same meaning as in section 1 of the Land Drainage Act 199154. IDBs were set up in areas of special drainage need to sustain both agricultural and developed land use.

In Wales there are three IDB's and there are a further 11 drainage districts in North Wales that are administered by the Environment Agency Wales.

The proposed Marubeni sites are outside an IDB area or drainage district.

2.4.3 Ordinary watercourses, and drainage ditches

For ordinary watercourses in Wales, outside an IDB area, the Lead Local Flood Authority (LLFA) of the county council for the area; or the county borough council for the area.

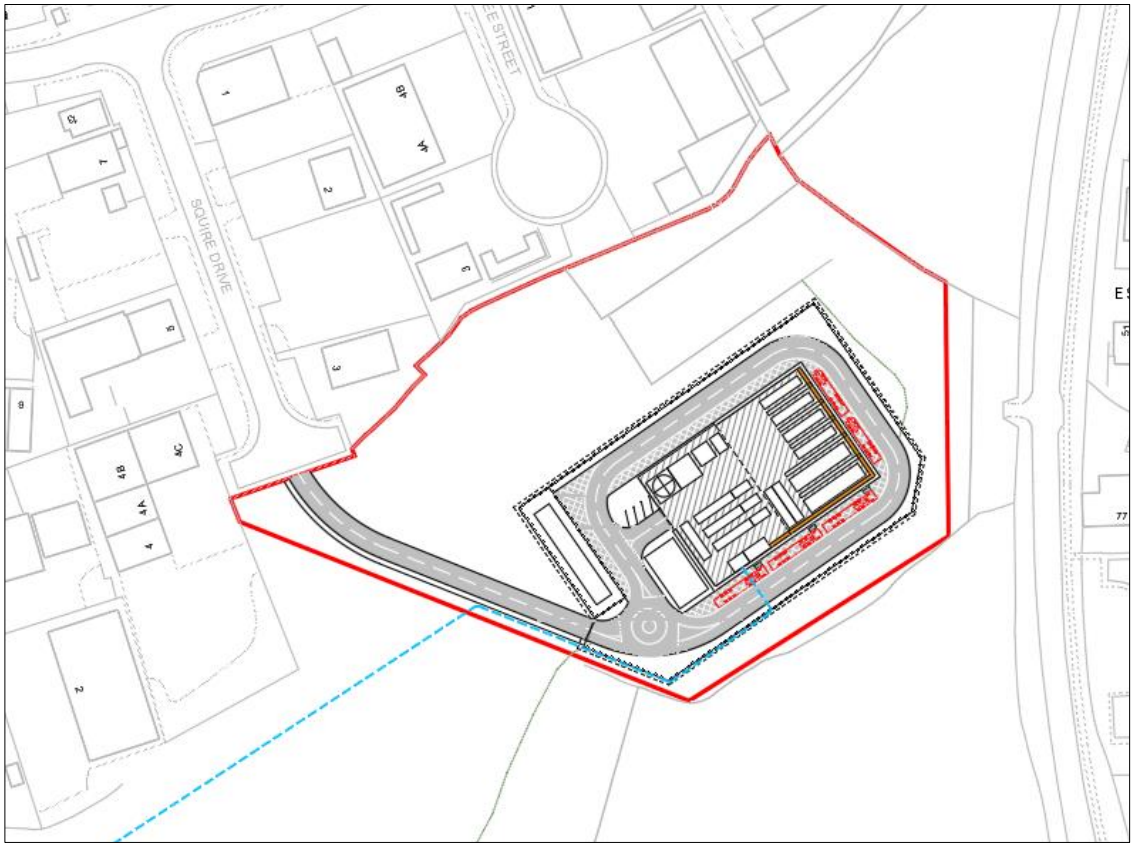
The proposed Marubeni sites are under the LLFA of the Bridgend County Borough Council.

3 Hydrogen Production Facility Background Information

3.1 Site description

The proposed hydrogenn plant location is to the south east of the Brynmenyn Industrial Estate, Bridgend, Wales. The facility is proposed to be located with grid references SS 91104 84552, SS 91137 84175, and SS 90715 84221, postcode CF32 9TQ. See Figure 3.1.

Figure 3.1: Hydrogen Production Facility Site Location



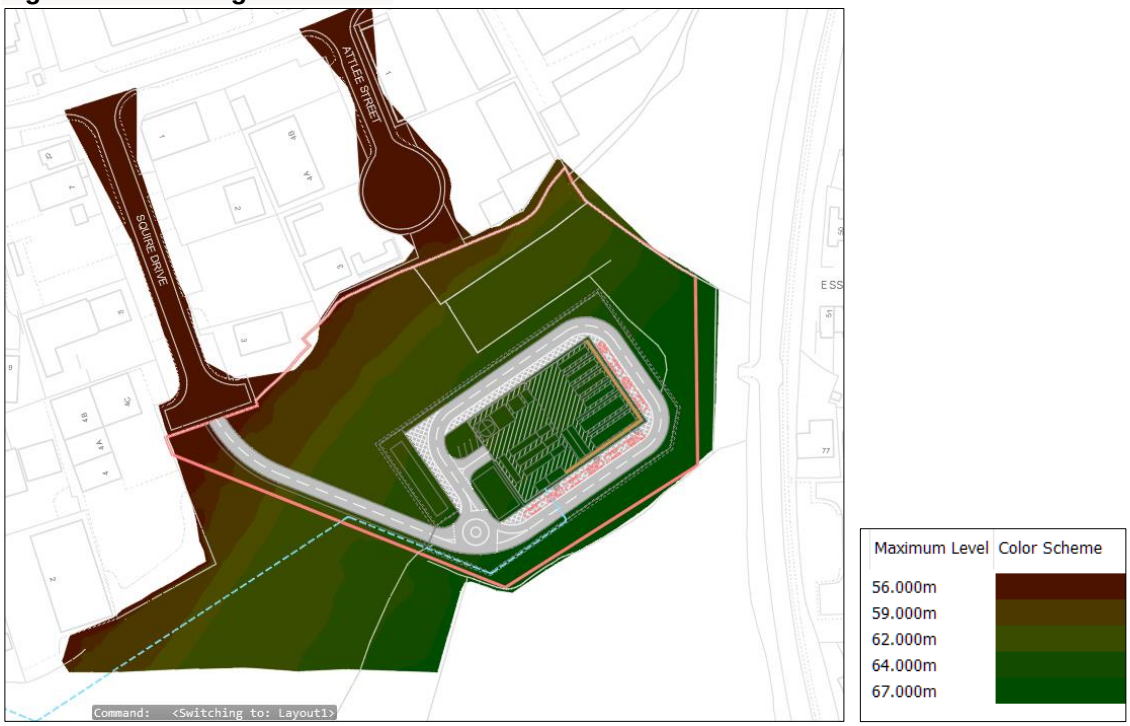
Source: Mott MacDonald, 2022.

To the north-west of the site, there is an industrial estate and the A4065 is located to the east of the site with residential areas beyond and an area of residential properties to the south and west. The site is in a green space comprising of woodland, fields, and shrubbery.

3.2 Existing Topography

A 3D topographical survey obtained in April'22 by Zenith Land Surveys Ltd. has been utilised to assess the topography of the site, see Figure 3.2. The site falls from south-east(+67.00mAOD) to north-west (+54.50mAOD), the site elevation increases approximately 13m across the site, rising from West to East.

Figure 3.2: Existing elevations.

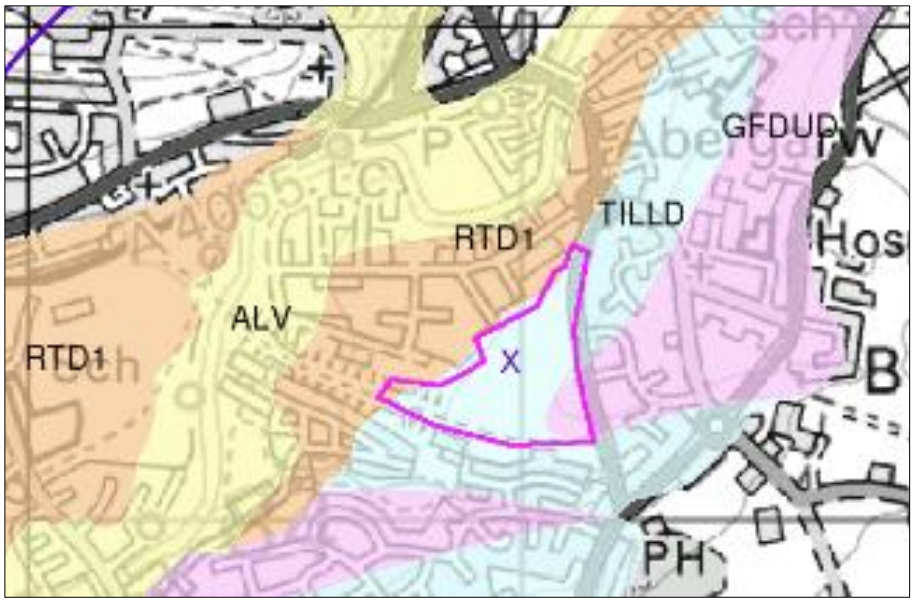


Source: Zenith Land Surveys Ltd. (April 2022).

3.3 Existing Geology

The British Geological Survey (BGS) 1:50,000 mapping indicates the site is underlain by Till, Devensian – Diamicton superficial deposits; and the South Wales Middle Coal Measures Formation – Mudstone Bedrock geology.

Figure 3.3: Superficial Geology



Source: BGS Geoindex (2022)

The desktop study Brynmenyn Hydrogen Plant Phase 1 Desk Study with reference 108939-T-RP-0001/2 have been reviewed for this assessment:

Artificial ground

It is suspected that there may be Made Ground present on site originating from the foundations of the industrial units in the Brynmenyn Industrial Estate. This may explain the change in topography between the estate and the site, but this has not been substantiated.

Superficial deposits

The site is primarily underlain by superficial deposits comprising Diamicton(as shown on light blue in the Figure 3.3), an unsorted to poorly sorted glacial till with a range in particle sizes from clay to boulders. Immediately to the north of the site the Brynmenyn Industrial Estate is underlain by River Terrace Deposits (as shown on light orange in the Figure 3.3),described by the BGS as 'Sand and gravel, locally with lenses of silt, clay or peat.' and these deposits may extend onto site.

Bedrock geology

The site is located within the South Wales Middle Coal Measures Formation described as comprising grey coal-bearing mudstones and siltstones with seatearths and minor sandstones.

3.3.1 Permeability

Permeability of the ground influences whether the drainage strategy for the site can incorporate infiltration as a method for disposal of flows.

The Geotechnical and Geo-Environmental Ground Desk Study (108939-T-RP-0001/2) has been reviewed to understand the potential permeability of the site. The Diamicton superficial deposits typically give an infiltration rate of $3x10^{-8}$ m/s. It is proposed to complete infiltration tests as part of the scheme, where it can be confirmed if any site infiltration can be assumed for surface water drainage.

In the absence of ground investigation data, infiltration rates have been assumed based on the CIRIA C753 SuDS Manual Table 25.1 which states that till deposits have a lower end infiltration rate of 10-8m/s, as shown in the Figure 3.4

Figure 3.4: Infiltration Rates

TABLE 25.1 Typical infiltration coefficients based on soil texture (after Bettess, 1996)

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

Source: CIRIA C753, 2015

A ground investigation will be required to indicate if there is a possibility of infiltration within the site, based on the methodology in BRE Digest 365.

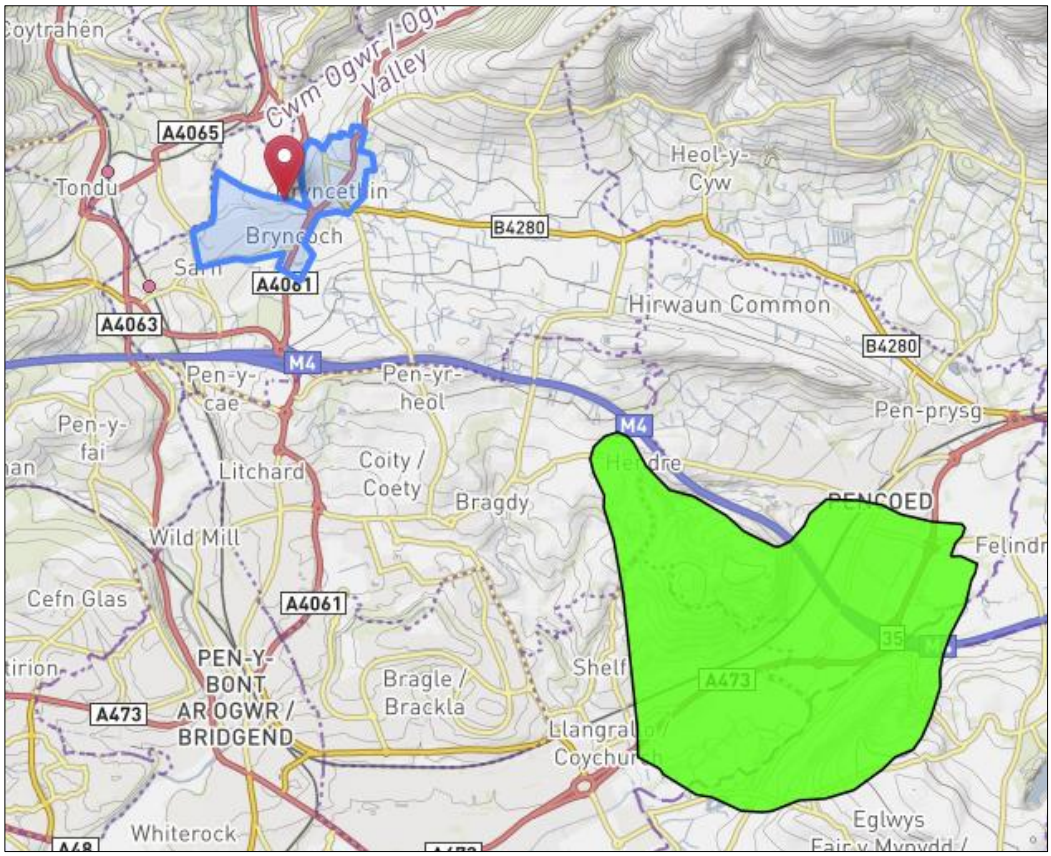
3.4 Groundwater and Source Protection Zones (SPZ)

The Geotechnical and Geo-Environmental Ground Desk Study (108939-T-RP-0001/2) establishes the lack of ground investigation information on site means that the groundwater conditions underneath the site are unknown.

Based on the local historical borehole records groundwater would be expected to be encountered at depth within the mudstone and sandstone bedrock at depths of 7- 8m bgl, There is also the possibility that perched groundwater could be encountered in the shallow sub-surface either in areas of Made Ground such as may be present in the area, if groundwater would be encountered the new attenuation pond and filter drains may require lining.

The DataMapWales has been used as a source of information for the Source Protection Zones in Wales. The Figure 3.5 indicated the site is not located within a groundwater Source Protection Zone (SPZ), and there is no SPZ nearby the site. The closest SPZ sits 2.9km from Bryncethin as shown in a green area in the Figure 3.5.

Figure 3.5: Source Protection Zones (SPZ)



Source: Natural Resources Wales website (2022).

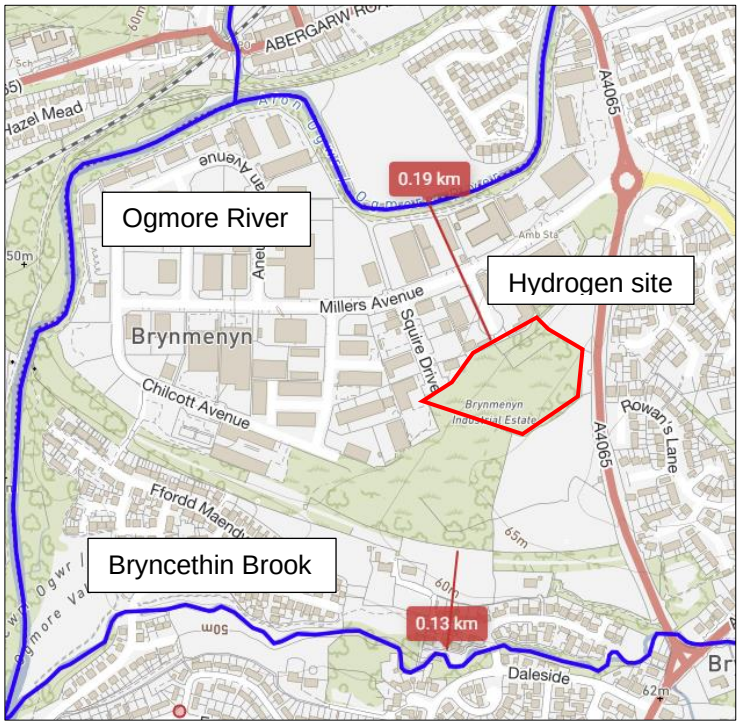
3.5 Contamination

There is not sufficient available information to confirm the chemistry of the soil on site. With the information available, it is assumed that there will be Made Ground across the site extents where these historic land use of the Brynmenyn Industrial Estate.

3.6 Existing Hydrology

There are no watercourses within the proposed Hydrogen site. The nearest watercourses are the Ogmore Main River located approximately 190m to the north of the site; and the Bryncethin Brook Main River that sits 190m from the site, as per shown on the Figure 3.6; all main rivers are shown in blue line.

Figure 3.6: Main Rivers Hydrogen Site



Source:Main Rivers, Natural Resources Wales, 2022.

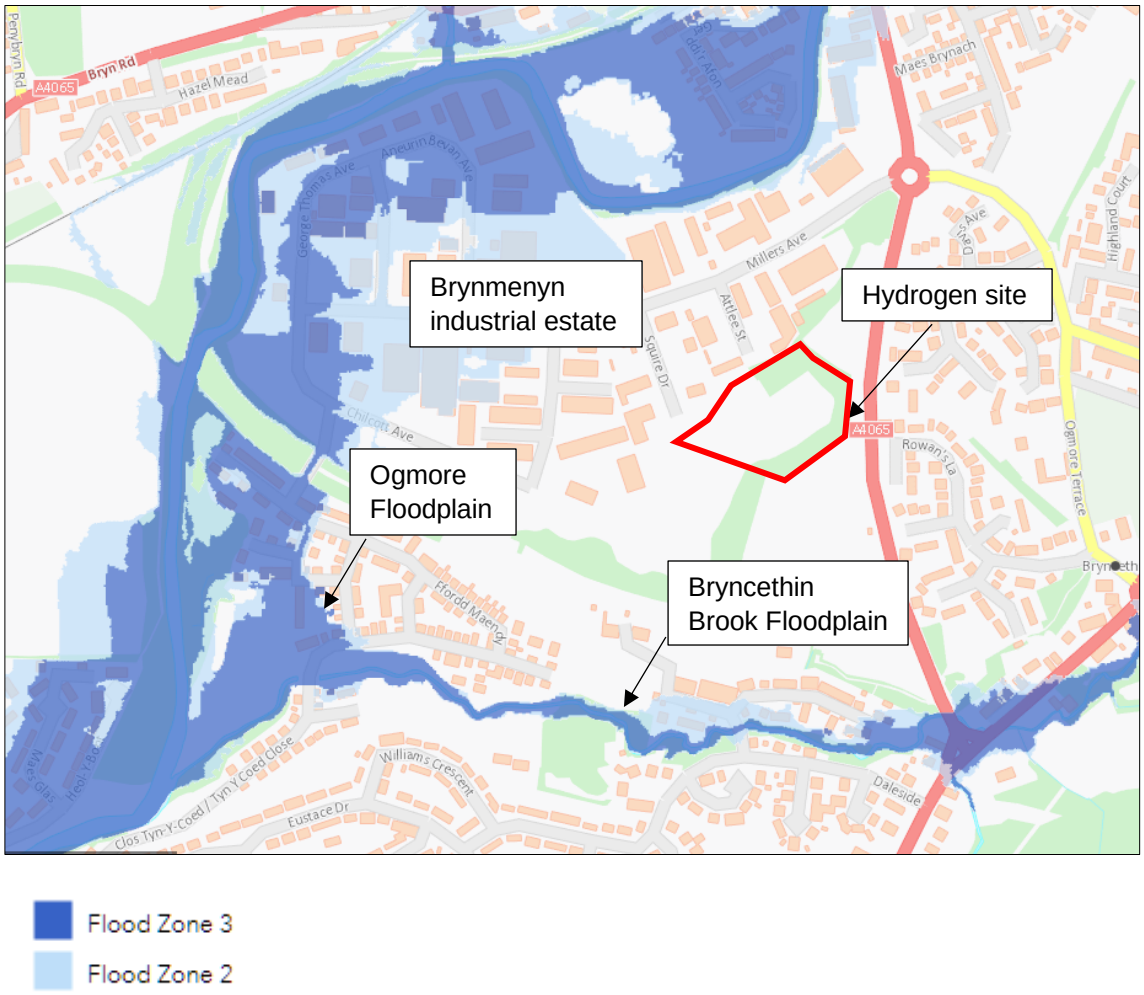
3.7 Flood Risk

The site is outside the floodplain of the Ogmore River and the Bryncethin Brook floodplain.

The NRW Flood Risk Map indicated there is no risk associated with flood risk from the rivers, the site sits within Flood Zone 1, are those that have less than a 0.1% Annual Exceedance Probability.

There is a medium to low flood risk from surface water and small watercourses where the site borders Brynmenyn Industrial Estate to the NW and very small areas of low flood risk just south of the site and along the bordering A40654.

Figure 3.7: Flood Zone 2 and 3



Source:Main Rivers, Natural Resources Wales, 2022.

This report does not consider the flood risk from surface water, fluvial, coastal or groundwater sources of the proposed development, or any changes to flood risk in the surrounding areas affected by the development; this should be considered in a Flood Consequence Assessment (FCA) document.

It should be noted that the drainage strategy is not an FCA and should not be treated as one.

3.7.1 Sequential and Exception Tests

The aim of the flood risk guidance in the National Planning Policy Framework (NPPF) is to steer new development to Flood Zone 1. If following application of the Sequential Test, it is not possible for a development to be located in zones with a lower probability of flooding, the Exception Test can be applied if deemed appropriate.

The proposed development is in Flood Zone 1 and it is therefore considered that the Sequential Test has been passed.

3.8 Existing Drainage

3.8.1 Public Sewers

A Welsh Water combined sewer runs southwest to northeast, north of the site; and a Welsh Water main water is located on the east part of the site. There are existing sewers to the east of the site that supply the village of Bryncethin.

See Appendix A for existing utilities.

3.8.2 Field Drainage

At this stage of design, no field drainage records/surveys have been provided and a review of natural overland flow paths on steeply sloping ground has not been undertaken. The effect of the works on any potential local field drainage is therefore unknown. Should diversion of existing field drainage systems be required, or where natural overland runoff flow paths are diverted due to the construction swathe header drains, clean water balancing ponds maybe required to mitigate flood risk at receiving watercourses.

Where the field drains are severed by the scheme, they should be diverted, rather than truncated, to avoid water backing up the system and flooding upstream areas. Where the anticipated site works require cutting into local land, a cut off filter drain has been proposed as part of the drainage strategy.

Land drains should be sealed, upslope and downslope, where they cross the site and care taken to ensure that the land upslope will not become waterlogged or flood as a result.

CIRIA 648 notes that the main contractor can be held responsible for the quality of water diverted through the works and discharged from an outfall used during construction. The contractor must therefore be aware of any activities upstream (such as muck-spreading or plough) that may cause polluted water to enter the diverted land drains. It is proposed that attenuation / sediment control ponds are installed on the line of the diversion, upstream of the receiving watercourse, to balance run-off rates and mitigate the risk of pollutants entering the watercourse.

4 Solar Farm Site Background Information

4.1 Site description

The site is located approximately 100m north of the B4280 road in Bryncethin,a small village in Bridgend, Wales. It is centred roughly at grid reference SS917844. The new green hydrogen power plant is approximately 0.6 km west of this site. See Figure 4.1.

Figure 4.1: Solar Farm Site Location

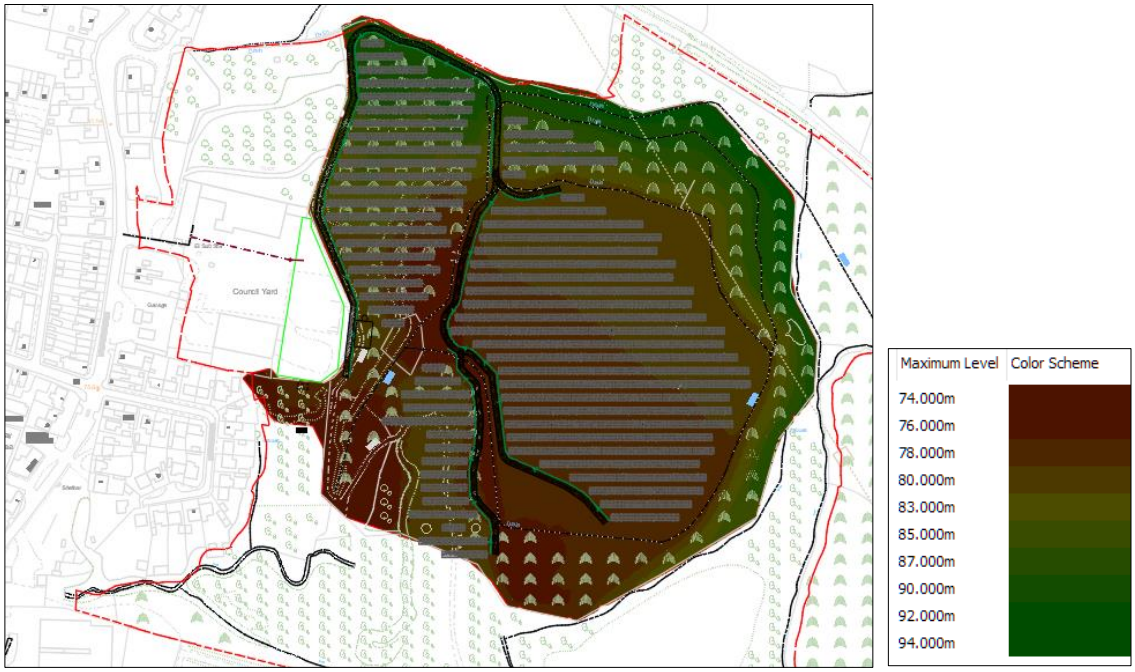
4.2 Existing Topography

The site slopes from east to west however there is a substantial depression in the centre of the site with the northern, eastern, and southern boundaries sloping towards the central area. This central area is slightly domed within the centre with an elevation change of approximately 1m between the centre and the edges. The western boundary drops away from the rest of the site towards a surface stream.

A 3D topographical survey obtained in October'22 by Zenith Land Surveys Ltd. has been utilised to assess the topography of the site .

The site falls north(+90mAOD) to south (+71mAOD). The central area averages +77m AOD.

Figure 4.2: Existing elevations.

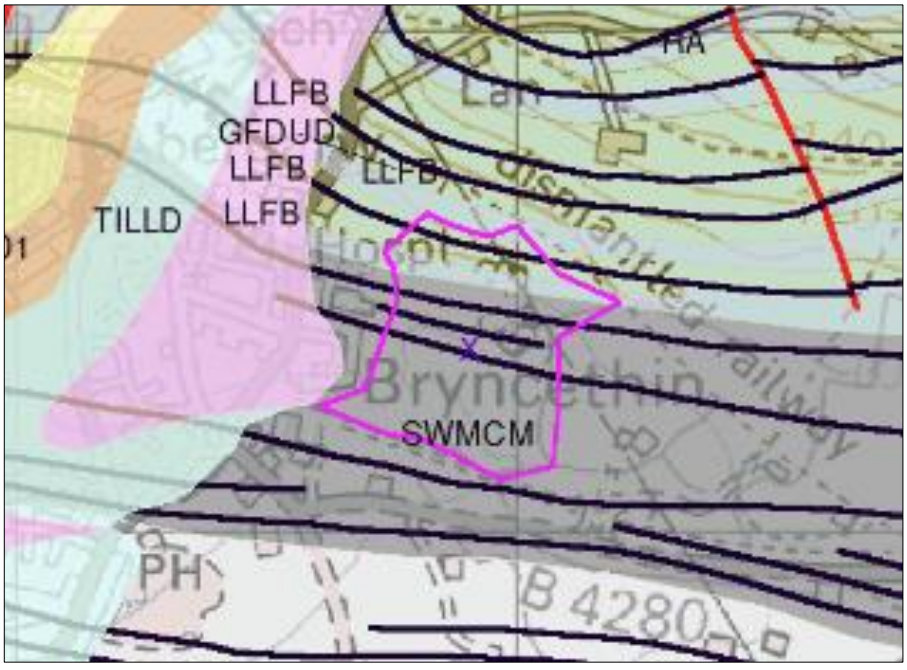


Source: Zenith Land Surveys Ltd. (October 2022).

4.3 Existing Geology

The British Geological Survey (BGS) 1:50,000 mapping indicates there is not superficial deposits; and the South Wales Middle Coal Measures Formation – Mudstone Bedrock geology, see Figure 4.3.

Figure 4.3: Superficial Geology



Source: BGS Geoindex (2022)

The desktop study Bryncethin Solar Farm Phase 1 Desk Study with reference 108939-T-RP-0002 have been reviewed for this assessment:

Artificial ground

It is likely that there is made ground as the site has a complex history of reworking and infilling. The walkover found evidence of limestone gravel, redundant and relic brick structures, vegetated stockpiles and capped mine shafts at the surface. There is likely more unseen made ground, as the site has a long mining history.

Superficial deposits

The majority of the site is shown to have no superficial deposits.

Bedrock geology

The site is located within the South Wales Middle Coal Measures Formation described as comprising grey coal-bearing mudstones and siltstones with seat earths and minor sandstones.

4.3.1 Permeability

There is no permeability on the solar site, as there is no superficial deposits.

4.4 Groundwater and Source Protection Zones (SPZ)

The Geotechnical and Geo-Environmental Ground Desk Study (108939-T-RP-0002) has been taken as a reference for the groundwater of the site. It states that there are no historical borehole records or standpipes installed at the site, so groundwater conditions are currently unknown.

As stated in the Section 3.4 there is no SPZ nearby the site.

4.5 Contamination

There is not sufficient available information to confirm the chemistry of the soil on site. With the information available, it is assumed that there will be Made Ground across the site extents where these historic land uses were located and therefore there is the potential for contamination.

4.6 Existing Hydrology and Flood Risk

The tributary of Bryncethin Brook, Nant Bryncethin, is approximately 60m south of the site.

There are several inland ditches within the site extents. The drawing Bryncethin Solar PV Project Site Constraints Map-108939-MMD-BRGR-XX-DR-Y-0011 states the existing ditches within the site (shown in light blue), the buildable area (shown on purple colour) where the solar panels are proposed, and the flood risk extent. The drawing is included in the Appendix B.

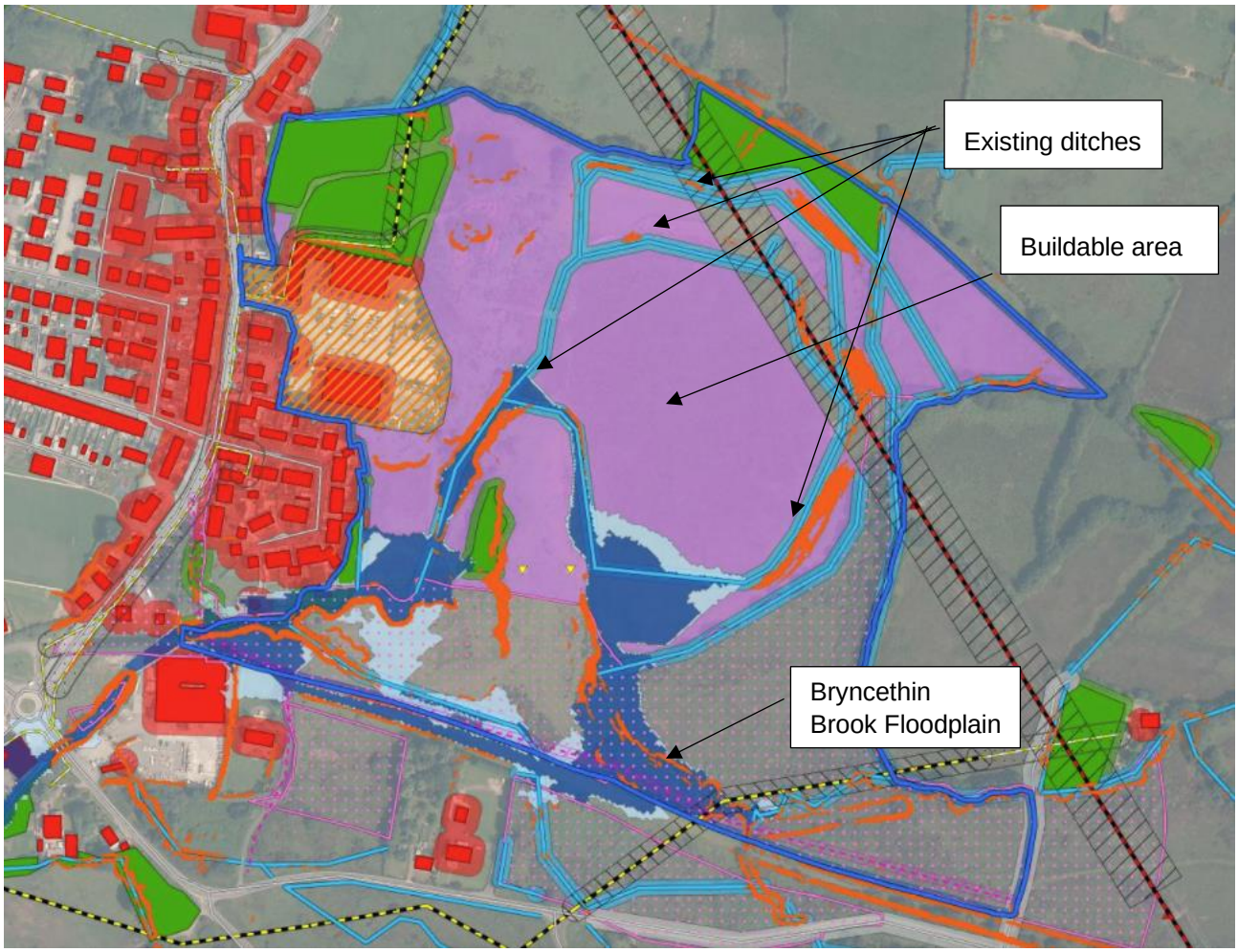
There are several watercourses located within the development site at Bryncethin, an ordinary watercourse consent will be required for works or connections to the ordinary watercourses.

The buildable area is defined as the area outside the floodplain of the Bryncethin Brook floodplain, the Flood Zone 1 area, are those that have less than a 0.1% Annual Exceedance Probability as per the NRW Flood Risk Map indicated there is no risk associated with flood risk from the rivers.

Comparing the ground levels across the site with the with the floodplain extent, the buildable area sits in a no risk of flooding area, after comparing the following:

1. As per Section 4.2, site elevations range from +94mAOD to +74mAOD.
2. Checking the flood depths of the NRW Flood Risk Map, the river floodplain extent for the 3.3% probability of flooding and for the 1% probability of flooding located at the south of the site sits approximately around +73.00mAO elevation based on the LIDAR existing surface.
3. The Site is not currently served by any public surface water or combined sewers; therefore soil permeability and slopes govern existing runoff patterns. Rainfall that does not soak into the ground would flow overland towards the Bryncethin Brook, therefore a substantial freeboard in this extreme event would also remain (minimum 1m).

Figure 4.4: Site Constraints Map



Source: Mott MacDonald, 2022.

This report does not consider the flood risk from surface water, fluvial, coastal or groundwater sources of the proposed development, or any changes to flood risk in the surrounding areas affected by the development; this should be considered in a Flood Consequence Assessment (FCA) document.
It should be noted that the drainage strategy is not an FCA and should not be treated as one.

4.6.1 Sequential and Exception Tests

The aim of the flood risk guidance in the NPPF is to steer new development to Flood Zone 1. If following application of the Sequential Test, it is not possible for a development to be located in zones with a lower probability of flooding, the Exception Test can be applied if deemed appropriate.

The proposed development is in Flood Zone 1 and it is therefore considered that the Sequential Test has been passed.

4.7 Existing Drainage

The Appendix A includes the Extract Map of Utilities of the site, public sewers and private drains.

4.7.1 Public Sewers

A Welsh Water combined sewer runs North to south along Blackmill Road to the west of the site.

4.7.2 Private Drainage

There is a private sewer that is connected to the combined sewer and runs into the industrial estate where the temporary construction compound will be located. Field Drainage

4.7.3 Field Drainage

Refer to section 3.8.2

5 Foul Water Drainage

The strategy of the drainage design is established via two independent networks:

- Temporary foul water: construction compounds
- Permanent foul water: the drainage of the permanent features will consider the drainage from the buildings and the normal use of these features

5.1 Temporary foul water

It is proposed that there will be an independently managed foul drainage system at the construction compounds to contain waste produced from welfare and toilet facilities. It is expected that the foul water will be contained on site and regularly pumped, emptied, and transported off site. Therefore, there is no requirement for any formal piped foul drainage on site or any offsite connection.

5.1.1 Hydrogen Site

There are no proposed temporary foul water premises within the solar site for the construction phase cover in this report.

5.1.2 Solar Site

A proposed temporary connection for the construction compound facilities in the Solar site is proposed to the private foul water network of the Industrial site where the new construction compound is proposed.

5.2 Permanent foul water

5.2.1 Hydrogen Site

There will be onsite welfare facilities in the administration building within the Hydrogen production facility, therefore permanent foul sewage is required. The proposed foul water flows from the site will be infrequent and of low volume.

The building regulations H1 state that foul drainage should be connected to a public foul or combined sewer wherever this is reasonably practicable. Therefore, it is proposed that foul flows form the administration building with the Hydrogen production facility into the Welsh Water combined sewer north of the site that runs southwest to northeast. This will be subject to approval from Welsh Water.

5.2.2 Solar Site

There are no proposed permanent foul water premises within the solar site.

6 Surface Water Drainage Strategy

6.1 Overview

This section gives the proposed drainage design strategy for each component of the site. These principles have been followed to produce preliminary drainage drawings below. These should be referred to in conjunction with this drainage strategy.

Drawing Number	Title
108939-MMD-BRGR-XX-DR-C-044	Marubeni Green Hydrogen Production Facility Drainage Layout
108939-MMD-BRGR-XX-DR-C-009	Marubeni Green Hydrogen Solar PV Drainage Layout

6.2 Design Guidance and Policy

The drainage strategy for the proposed development has been developed based on the following guidance:

- The SuDS Manual (C753)
- National Planning Policy Framework (NPPF25)
- Technical Advice Note 15: Development and Flood Risk
- Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems.

The proposed design seeks to improve the local run-off profile using systems that can either attenuate run-off or reduce peak flow rates on the existing flood profile

The Flood Estimation Handbook (FEH) rainfall data was obtained from the UK Centre for Ecology & Hydrology webservice for development of the drainage strategy.

The Sustainable Drainage Systems Standards for Wales (G2.30, G2.31, G2.34 and G2.37) establishes the minimum criteria for new site drainage:

- All the runoff from the site for the 1:100 year event should be discharged at either a rate of 2 l/s/ha or the average annual peak flow rate (i.e. the mean annual flood, QBAR), whichever is the greater
- 1 in 30-year rainfall event – no flooding on site
- 1 in 100-year rainfall event – no flooding on operational area of the site (car parks may flood in this scenario)
- In both 1 in 30-year and 1 in 100-year scenarios, the design shall ensure that excess runoff from the drainage system does not impact adjacent third-party land.
- Where discharge consents or downstream capacity restrictions are in place the design shall restrict flows and incorporate attenuation to achieve the requirement.

6.2.1 SUDS Approving Body (SAB) Application:

Schedule 3 of the Flood and Water Management Act 2010 establishes SAB (SuDS Approving Body) in local authorities. Since the 7th of January 2019, developments greater than 100m^2 or developments containing more than one building will be required to submit a SAB application. This application requires developers to utilise Sustainable Drainage Systems (SuDS) in their

surface water management for a development. This report forms part of the overall SAB application for this project and should be read in conjunction with the remaining sections of the application. Sections of the application intended to be covered by this report include:

Compliance with Statutory National Standards for SUDS (SAB application item 7)	Section for reference in this report
S1 – surface water runoff destination	6.2.5
S2 – surface water runoff Hydraulic control	6.3
S3 – Water Quality	7
S5– Design of drainage for Construction and Maintenance and Structural Integrity	6.2.3
Surface Water Discharge Hierarchy	6.2.5

6.2.2 Permanent Works

The permanent works include the normal features of a hydrogen and solar site: substation, transformers, buildings, internal roads, car parks and external access road. The substation design life is 40 years (20 years first life maintenance).

The surface water system for the permanent works shall be designed and constructed so that flooding does not occur in any part of the site in a 1 in 30-year return period design storm flood frequency, with no flooding of the operational area during a 1 in 100-year period design storm flood frequency. A percentage uplift to allow for the effect of climate change should be included to understand flooding implication for a 40% climate change allowance, as stated in the Section 6.2.4.

6.2.3 Temporary Works

Temporary construction works are anticipated to occur for up to 3 years (this may vary depending on project development).

During the time of this assessment, the project has assumed a construction compound adjacent to the solar site and it is anticipated the contractor will procure an existing, off site, construction laydown area for the hydrogen site works

In view of the short design life and nature of the usage, it is considered appropriate that the surface water system for the temporary works is designed for no flooding in a 1 in 5-year storm return period design storm flood frequency.

Design criteria for flows from the proposed temporary works including climate change allowance (1 in 5-year storm with a 10% allowance for climate change proposed).

6.2.4 Climate change

The Welsh Assembly guidance requires, in accordance with the Government's PPG-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Natural Resources Waled (NRW) and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of Approval for new developments. In addition, all drainage systems should be sized to accommodate the runoff arising from a 1 in 100-year rainfall event and should include a further allowance to account for the further effects of climate change.

Table 2 from the Flood Consequences Assessment Climate Change Note September 2021 shows the anticipated changes in peak rainfall intensity for use in small catchments. The upper estimates has been assessed to understand the range of impact.

Table 2 - Change to extreme rainfall intensity (compared to a 1961-90 baseline)

Applies across all of Wales	Total potential change anticipated for 2020s (2015-2039)	Total potential change anticipated for 2050s (2040-2069)	Total potential change anticipated for 2080s (2070-2115)
Upper estimate	10%	20%	40%
Central estimate	5%	10%	20%

6.2.5 Disposal of flows

It should be acknowledged that the satisfactory collection, control and discharge of storm water is now a principal planning and design consideration. This is reflected in recently implemented guidance and the National SuDS Standards.

The NPPF states that for new developments, the best way of reducing flood risk within the development is to:

- Control the water at source through sustainable system (SUDS).
- Consider exceedance flow route when the capacity of the drainage system is exceeded.

SUDS should mimic natural drainage and reduce the amount and rate of water flow by:

- Infiltration into the ground,
- Holding water in storage areas, and
- Slowing the flow of water.

6.3 Proposed Drainage Strategy

The strategy of the drainage is established via two independent networks as per the quality of the water to be discharge into them:

- **Permanent surface water drainage network:**

Drainage of the permanent features considers surface runoff from the substation plot, including transformers, buildings and internal roads, and the external access road.

- **Temporary surface water drainage network**

Drainage of the temporary surfaces associated with the construction stage is considered “dirty water” due to the possibility of contamination. The design will include pollution controls and the contractor will implement suitable mitigation measures to manage contamination risk during construction.

6.3.1 Proposed Drainage Strategy: Hydrogen Site

The drainage strategy for the Hydrogen site only includes permanent works associated with the Hydrogen substation. Drainage strategy for the permanent works is to accommodate surface runoff from the proposed impermeable areas for the design storm event plus the allowance for climate change. Runoff will be conveyed to an attenuation pond via a site surface drainage system.

As per stated in the Section 6.2.5 following the hierarchy of the disposal of flows, due to the lack of watercourses nearby the site and the no-permeability of the site, the hydrogen site surface water drainage is proposed to discharge into existing Welsh Water storm drain manhole, located at the southern end of Squire drive.

The pond will discharge into an existing manhole by Welsh Water at limited flow rate of 5l/s. Preliminary attenuation volumes are quoted in the drainage drawings in Appendix C and Appendix D for drainage calculations.

6.3.1.1 Catchment Areas

The permanent works include the hydrogen site and the external access road which will provide access to the substation from the existing road network.

- **Hydrogen platform, buildings and internal roads:** These impermeable areas will runoff to gullies and channel drains which will direct flows to the site drainage system and proposed attenuation pond before discharge to the existing Welsh Water manhole. The proposed attenuation pond will be designed with 1:3 slopes, vegetated, non-permeable geo-textile lined with an inlet forebay. This will provide treatment of the runoff by allowing for settlement of silts, heavy metals and the removal of oxygen demanding material.
- **The proposed cut embankments** within the platform will drain via infiltration trenches that will be linked to the site drainage system due to the low permeability of the ground.
- **External access road:** Surface runoff from the external access road will flow to filter drains within infiltration trenches alongside either side of the access road. Due to the uncertainty of the infiltration capacity of the ground, infiltration trenches will provide an overflow that will direct flows to the nearest Welsh Water manhole via a restricted flow.

The MicroDrainage Network Module has been used to provide an initial estimate of attenuation storage volumes required to limit run-off from the site to greenfield rates. See drainage drawings in Appendix C for details of proposed attenuation sizing and Appendix D for drainage calculations.

6.3.1.2 Post-Development Discharge Rates

The proposed discharge rate shall be controlled by an Hydrobrake manhole or an orifice control approximately 75mm in diameter equating to a control rate of 4-5l/s. The advisable minimum Hydrobrake control rate is 5l/sec to avoid blockages. If an orifice control is used, it would be installed in a catchpit with an overflow to reduce the risk of blockages.

Engagement with the relevant water authorities will be required to obtain a consent to discharge to the receiving existing Welsh Water drainage.

The existing QBAR calculations are in the Appendix E .

6.3.2 Proposed Drainage Strategy: Solar Site

The drainage strategy for the Solar site includes permanent works associated with the Solar PV Site and temporary works for the construction phase. Drainage strategy for the permanent works is to accommodate surface runoff from the proposed impermeable areas(access roads and substation) for the design storm event plus the allowance for climate change. Runoff will be conveyed to an attenuation pond via a site surface drainage system.

The pond will discharge to the nearest watercourse at limited flow rate of 5l/s. See drainage drawings in Appendix C for details of proposed attenuation sizing and Appendix D for drainage calculations.

The hydrology of the site is discussed in Section 4 of this report. Following the hierarchy of the SuDS guidance Section 6.2.5 where it is not possible to infiltrate into the ground, discharging to the closest watercourse at a restricted discharge rate is proposed. The solar site will propose to discharge into an existing watercourse.

Constructing a new outfall to the river would require consent from the LLPA.

6.3.2.1 Catchment Areas

The permanent works include the substation and the external access road which will provide access to the solar panels:

- **Substation**: The substation will direct flows to the site drainage system to a proposed attenuation pond before discharge to the nearest watercourse. The proposed attenuation pond will be designed with a minimum of 1:3 slopes, vegetated, non-permeable geo-textile lined with an inlet forebay. This will provide treatment of the runoff by allowing for settlement of silts, heavy metals and the removal of oxygen demanding material.
- **External access road:** Surface runoff from the external access road will flow to filter drains within infiltration trenches alongside either side of the access road. Due to the uncertainty of the infiltration capacity of the ground, infiltration trenches will provide an overflow that will direct flows to the new attenuation pond.

The temporary works consider the construction compound that will be removed and reinstated to the previous industrial estate use when construction is complete.

Construction compound includes areas of hardstanding, lay down and storage areas for construction materials and equipment, areas for vehicular parking, welfare facilities, wheel washing facilities, workshop facilities, and temporary fencing or other means of enclosure.

Construction compounds have been assumed to be 100% impermeable within their gross site areas to provide a worst-case assessment.

A temporary pond is proposed to attenuate the runoff from the compound prior to discharging into the permanent pond with a flow rate restricted to 5l/s.

The MicroDrainage Network Module has been used to provide an initial estimate of attenuation storage volumes required to limit run-off from the site to greenfield rates for the permanent phase. See drainage drawings in Appendix D for details of proposed attenuation sizing.

Preliminary attenuation volumes for the temporary drainage are quoted in the drainage drawings in Appendix D.

6.3.2.1 Post-Development Discharge Rates

The proposed discharge rate shall be controlled by an Hydrobrake manhole or an orifice control approximately 75mm in diameter equating to a control rate of 4-5l/s. The advisable minimum Hydrobrake control rate is 5l/sec to avoid blockages. If an orifice control is used, it would be installed in a catchpit with an overflow to reduce the risk of blockages.

Engagement with the LLFA will be required to obtain a consent to discharge to the receiving existing watercourse.

The existing QBAR calculations are in the Appendix E.

7 Water Quality Control

The drainage systems on site will be designed to meet the water quality design criteria and good practice pollution control measures as outlined in the CIRIA SuDS manual. The different areas of the site will be categorised by the appropriate pollution hazard level from Table 26.2 of The SuDS Manual.

When considering the site characteristics, proposed use, and site constraints, SuDS are likely to be incorporated via a combination of the following components, but will need to be investigated further during design development of both Marubeni sites, Hydrogen and Solar Site:

- The access road will be drained via filter drains. The filter drains will clean any possible pollutants from the vehicle traffic when the water passes through them.
- Pond to act as storage during high intensity rainfall events for permanent phase. Oil separator to treat runoff from the Hydrogen platform, prior to discharge to the storage/infiltration tank or pond.

A **Construction Environmental Management Plan (CEMP)** will be set out for the contractor to manage environmental risks associated with the construction phase. This shall include the following items associated with temporary site drainage:

- A Surface Water and Drainage Management Plan should be prepared which describes the approach to surface water and foul water drainage, and water supply during construction phase.
- A Flood Management Plan for the construction phase.
- Construction Method Statements for Protection of Onshore Water
- Watercourse Crossing Method Statement
- Groundwater Protection Method Statement

7.1.1 Water quality control during the construction phase

Surface water and groundwater are highly vulnerable to pollution and impact of construction activities.

The activities that are regulated in this section include:

- Uncontrolled sediment erosion and contaminated silty runoff.
- Refuelling facilities and handling areas.
- Polluted drainage from the site.
- Works within water.

During the planning of this drainage strategy is proposed:

- For the Solar Site establish the appropriate land take for temporary treatment works during construction. Land take is required during construction and will be restored to the original land.
- Agreeing working practices with the environmental regulator and securing discharge consents.

The mitigation measures that will be taken to avoid water pollution:

- Use prefabricated concrete products for outfalls and culverts.

- Design shallow slopes in cutting /embankments to reduce the runoff, increase the infiltration and trap sediment.
- Proposing sealed manholes will reduce the risk of water spillage.

7.1.2 Water quality in construction compounds

The Solar Site proposed a construction compound within the existing Industrial estate nearby. Early planning for the storage of potentially polluting materials, for supply and disposal of water, and for controlling runoff will reduce the risks of water pollution on site. The following has been considered in the proposed development:

- Locate the compound away from watercourses (including ditches) and aquifers.
- Avoid locations that are designated conservation areas.
- Identify areas with permitted access by public main road (reducing the need for haul roads).
- Identify locations that have services in place (eg hardstanding, water supply, power and connection to foul drainage system).

The construction compound will require:

- Obtain agreement for wastewater disposal with Welsh water and the owner of the industrial estate where the compound is located.
- Select suitable refuelling area(s) on hardstanding with drainage via oil interceptor.
- Provide adequate measures to control runoff from compounds and haul routes.
- Provide a suitable vehicle wash area on hardstanding and draining to foul sewer.

To minimise the pollution in the construction compounds the following mitigations have been considered:

- Attenuation ponds will be provided to reduce the discharge of runoff to the existing watercourses.
- Prevent runoff entering the site from adjacent ground, as this creates additional polluted waste.

Compounds could implement water conservation measures:

- Vehicle washing should only be used in a bunded area where the runoff can be contained and channelled to a treatment area, such as a settlement pond, prior to discharge. Runoff from washes and vehicle wash bays must not be allowed to enter surface water or foul water drainage systems without permission.
- Storage areas should sit away from sensitive receptors, at least 10m from a watercourse or a drain.

7.1.3 Discharging water into a river

To avoid existing water to be contaminated by suspended sediment, the exist velocity at the outfall should be reduced using baffles, blocks in the outfall apron or an energy-dissipater. Same consideration should be taken when over pumping water along a watercourse.

Scour protection should be provided for permanent and temporary outfalls.

Outfalls should be angled at 45° to the water flow; small pipes (less than 300 mm diameter) can be at a maximum of 90° to the flow.

Penstock valves will be installed to close or isolate the outfall in the event of a pollution incident.

Appendices

A.Existing Utilities

STANDARD

Utility Search Map

Order ID:
113119

Client Ref:
Bridgend Green

Company Name:
Mott Macdonald

Issue Date:
02/11/2022

Version:
1

PAS 128 Level:
D

Drawn:
AnD/AD/SKJJKG

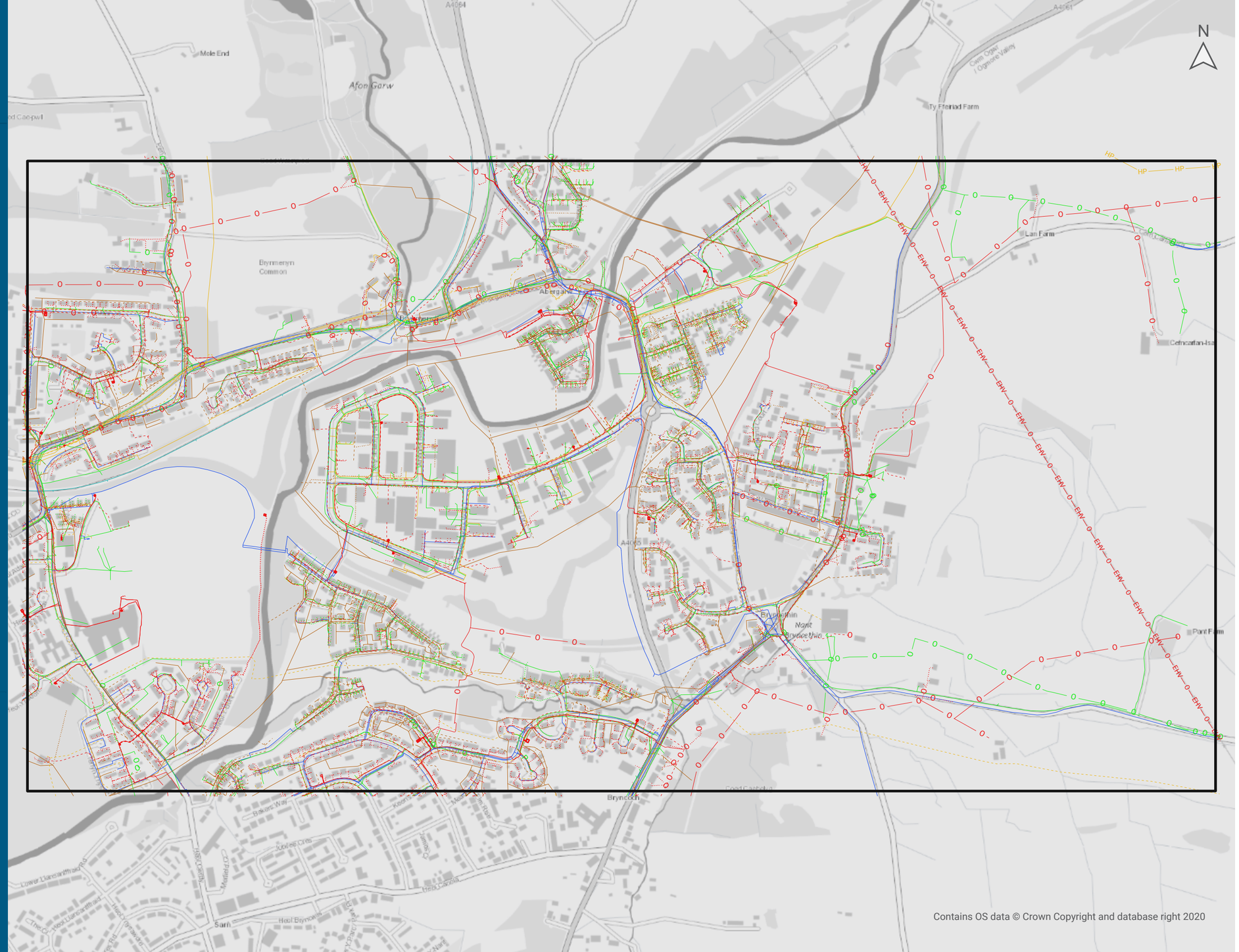
Checked:
MEw

Approved
NHu

ATKINS
Member of the SNC-Lavalin Group

Utility Solutions

Information on buried services is provided for information only and is based upon records available at the time of issue. Accuracy of information cannot be guaranteed and must be verified prior to undertaking any works.



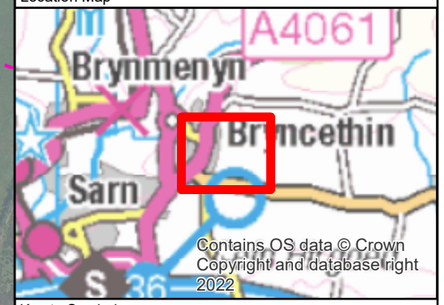
Legend

- Site Boundary
- **Electric**
  - Scottish and Southern Electricity, Service
  - Scottish and Southern Electricity, Low Voltage
  - EHV — National Grid Electricity Transmission, Extra High Voltage, Overhead
  - National Grid Electricity Distribution, Service
  - National Grid Electricity Distribution, Service, Overhead
  - National Grid Electricity Distribution, Pilot
  - National Grid Electricity Distribution, Pilot, Overhead
  - National Grid Electricity Distribution, Low Voltage
  - National Grid Electricity Distribution, Low Voltage, Overhead
  - National Grid Electricity Distribution, High Voltage, 11kV
  - National Grid Electricity Distribution, High Voltage, 11kV, Overhead
  - National Grid Electricity Distribution, Earth
  - ESP Utilities Group, Service
  - ESP Utilities Group, Low Voltage
  - ESP Utilities Group, Earth
  - Scottish and Southern Electricity, Substation
  - National Grid Electricity Distribution, Substation
- **Gas**
  - Wales and West Utilities, Medium Pressure
  - Wales and West Utilities, Low Pressure
  - Wales and West Utilities, Intermediate Pressure
  - HP — Wales and West Utilities, High Pressure
  - SSE Utility Solutions Limited, Low Pressure
  - GTC, Service
  - GTC, Low Pressure
  - ESP Utilities Group, Low Pressure
- **Rail**
  - Network Rail, DC Asset Line
  - Network Rail, DB Asset Line
- **Sewerage**
  - Dwr Cymru Welsh Water, Surface Water Lateral Drain
  - Dwr Cymru Welsh Water, Surface Sewer
  - Dwr Cymru Welsh Water, Surface Sewer Private
  - Dwr Cymru Welsh Water, Private Surface Water Sewer Transfer
  - Dwr Cymru Welsh Water, Private Foul Sewer Transfer
  - Dwr Cymru Welsh Water, Private Combined Sewer Transfer
  - Dwr Cymru Welsh Water, Not Specified (S)
  - Dwr Cymru Welsh Water, Foul Sewer
  - Dwr Cymru Welsh Water, Foul Sewer Private
  - Dwr Cymru Welsh Water, Foul Sewer Outfall
  - Dwr Cymru Welsh Water, Foul Sewer Lateral Drain
  - Dwr Cymru Welsh Water, Combined Sewer
  - Dwr Cymru Welsh Water, Combined Sewer Private
  - Dwr Cymru Welsh Water, Combined Sewer Outfall
  - Dwr Cymru Welsh Water, Combined Sewer Lateral Drain
- **Telecom**
  - P — Openreach - [British Telecommunications], Proposed
  - PO — Openreach - [British Telecommunications], Proposed, Overhead
  - Openreach - [British Telecommunications], Not Specified
  - O — Openreach - [British Telecommunications], Overhead
  - Openreach - [British Telecommunications], Duct
- **Water**
  - Dwr Cymru Welsh Water, Water Main
  - Dwr Cymru Welsh Water, Not Specified (W)

Centre Coordinates: 291102E 184507N
Scale: 1:7,250

B. Bryncethin Solar PV - Site Constraints Map

Location Map



Key to Symbols

- Site boundary
- Buildable area
- Council site (assumed unbuildable)
- Disused coal mine shafts (capped)
- Public Rights of Way (PRoW)
- Electricity transmission OHL
- Electricity distribution 11kV Overhead Line (OHL)
- Electricity distribution 11kV buried cable
- Electricity transmission OHL tower
- Building
- Road
- Waterbody
- Watercourse
- Woodland
- PRoW buffer 6m
- Electricity transmission OHL buffer 23m
- Electricity distribution OHL buffer 10m
- Buried electricity distribution cable buffer 10m
- Inner site boundary buffer 5m
- Building buffer 10m
- Road buffer 8m
- Waterbody buffer 6m
- Watercourse buffer 6m
- Woodland buffer 6m
- Areas of slope over 20 degrees
- *Flood zone 3
- *Flood zone 2
- *Common land (open access)

Notes

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6. Contains National Grid UK data © National Grid UK 2021.
7. Contains Bridgend County Borough Council data (from ArcGIS Online)

*Common Land can potentially be developed via approval from the Welsh Government; similarly flood zones 2 and 3 via flood risk assessment. At this time all three areas are considered a constraint.

Rev	Date	Drawn	Description	Ch'k'd	App'd
-	-	-	-	-	-
P1	01/09/22	MH	Preliminary Issue	LM	OV

MOTT MACDONALD
10TempleBack
Bristol
BS16FL
UnitedKingdom
T +44(0) 117906950
W www.mottmac.com

Client

Marubeni Europower

Title

Bryncethin Solar PV Project
Site Constraints Map

Designed	M Hayward	MH	Eng Check	L Morales	LM
Drawn	M Hayward	MH	Coordination	M Hayward	MH
GIS Check	L Morales	LM	Approved	O Velasco	OV

Scale at A3	Status	Rev	Security
1:3,000	PRE	P1	STD

Drawing Number

108939-MMD-BRGR-XX-DR-Y-0011

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 50 100 150 200 250 Metres

C:\Users\HAY81147\Mott MacDonald\OGH Marubeni Bridgend Green H2 DE UK - Fee Project - Develop\GIS\Workspaces\ArcMap\GIS_MMD_Bryncethin_SolarPVconstraintsMap_A3.mxd

C.Proposed Drainage Layouts

Sheep Dip

87.5m

81.1m

75.6m

LB

Grenan

Dunraven Apartments

Shelter

Council Yard

Track

Drain

New culvert. Size TBC

New culvert. Size TBC

New culvert. Size TBC

Proposed road with minimum cross fall of 1:40 to ensure all water from runoff discharges into the filter drains

New foul water connection to be approved by Welsh Water and the Industrial estate owner

Construction Compound

El Sub Sta

Existing private foul water drain

New drainage interfaces with existing drain. Detail of crossing to be developed during later design stage and agreed with owner of the drain

Substation

Temporary pond to provide a minimum storage volume of 65m³ for the construction compound surface water drainage for the 1 in 5year storm event plus 10% climate change allowance. Design criteria for temporary phase under approval of LLFA.
Pond depth = 1m.
Total contributing area of 3576m².
Temporary pond to be filled for the permanent phase.

New flow control device to discharge 5l/sec into the new permanent attenuation pond

New attenuation pond to provide a minimum storage volume of 325m³ for the 1 in 100 year storm event plus 40% climate change allowance.
Basin in 1m in depth with 0.3m freeboard and pond slope 1:3.
Total contributing area of 4076m²

Outfall location and discharge rate to be agreed with LLFA.
Invert level = +68.000mAOD based on LIDAR surface. Invert level of proposed outfall be confirmed on site to ensure adequacy of the connection.

Outlet

Pond

New flow control device to discharge 5l/sec into the existing watercourse. Consent to be approved by LLFA.

Tributary of the river Ogmore assumed. TBC by LLFA

Proposed filter drains to attenuate the runoff of the new tarmac road for the 1 in 100 year + 40% climate change allowance storm event. Filter drain based on the infiltration rate of the existing Glacial Till superficial deposits.
Maximum filter drain attenuation volume of 136m³ based on 30% porosity of permeable granular material.
Filter drain size: 1m deep, 0.5m wide with 225mm diameter pipe to have gradient equal to the road.
Filter drains to clean pollutants from road runoff. Due to the uncertainty of the soakage capacity of the existing ground, filter drain will be designed with an overflow to discharge into the proposed pond.

1:1000 0 50m 100m

Notes

1. Do not scale from this drawing.
2. All dimensions are in metres/millimetres unless otherwise stated.
3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. All spatial coordinates relate to the Ordnance Survey, British National Grid (OSGB36).
6. All levels are in meters and relate to AOD (Ordnance Survey, Newlyn).
7. Existing watercourses based on LIDAR data and OSMap. © crown copyright and database rights 2022 ordnance survey (0100031673).
8. All suds (drainage systems including attenuation basins, ponds, swales etc.) are to be constructed in accordance with CIRIA753, the SUDS Manual 2015.
9. It is anticipated that there will be no significant increase in runoff rate through the outfall as the system has been designed to maintain reduced discharge rates via flow control. refer to the drainage strategy for details (108939-MMD-BRGR-XX-TN-C-0045).
10. Access roads to be provided with a camber/crossfall to allow runoff to discharge into proposed filter drain.
11. All proposed drainage to follow the Highways Construction Details (HDC) MCHW Volume 3 Section 1, Series F Drainage.
12. Proposed access road and filter drains to follow the Highways Construction Details (HDC) MCHW Volume 3 Section 1, Series B Edge of Pavement Details.
13. Pipe to be encased in concrete when minimum cover < 1200mm under access roads as per Type Z HCD Trench and Bedding Details Drawing F1.
14. All filter drains to be Type M HCD Filter Drains and Trench and Bedding Details drawing F2 and for details of section of the drain with the surface level refer to Type 1A(flexible carriageway) drawing B1 series.
15. Contractor required to ensure temporary drainage arrangements (including temporary excavations required for drainage, temporary management of flows in existing drainage systems and temporary protection of existing structures and utilities) during the delivery of the works.

Key to symbols

- NEW SURFACE WATER FILTER DRAIN WITH 225Ø PERFORATED PIPE
- NEW SURFACE WATER PIPE
- NEW SURFACE WATER/FOUL WATER MANHOLE
- NEW FOUL WATER PIPE
- SITE BOUNDARY
- IMPERMEABLE AREA
- EXISTING WATER COURSES
- MANHOLE WITH FLOW DEVICE
- EXISTING FOUL WATER PRIVATE DRAIN

Reference drawings

108939-MMD-BRGR-XX-DR-C-0014 General PV Layout

Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	07/11/2022	OJ	First Issue	ARD	SA

Status Stamp

NOT FOR CONSTRUCTION

MOTT MACDONALD

Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom

T +44 (0)1273 365000
F +44 (0)20 8681 5706
W www.mottmac.com

Client

Marubeni

95 Gresham Street
London
EC2V 7AB
+44 (0)20 7826 8811
www.marubeni-europower.com

Title

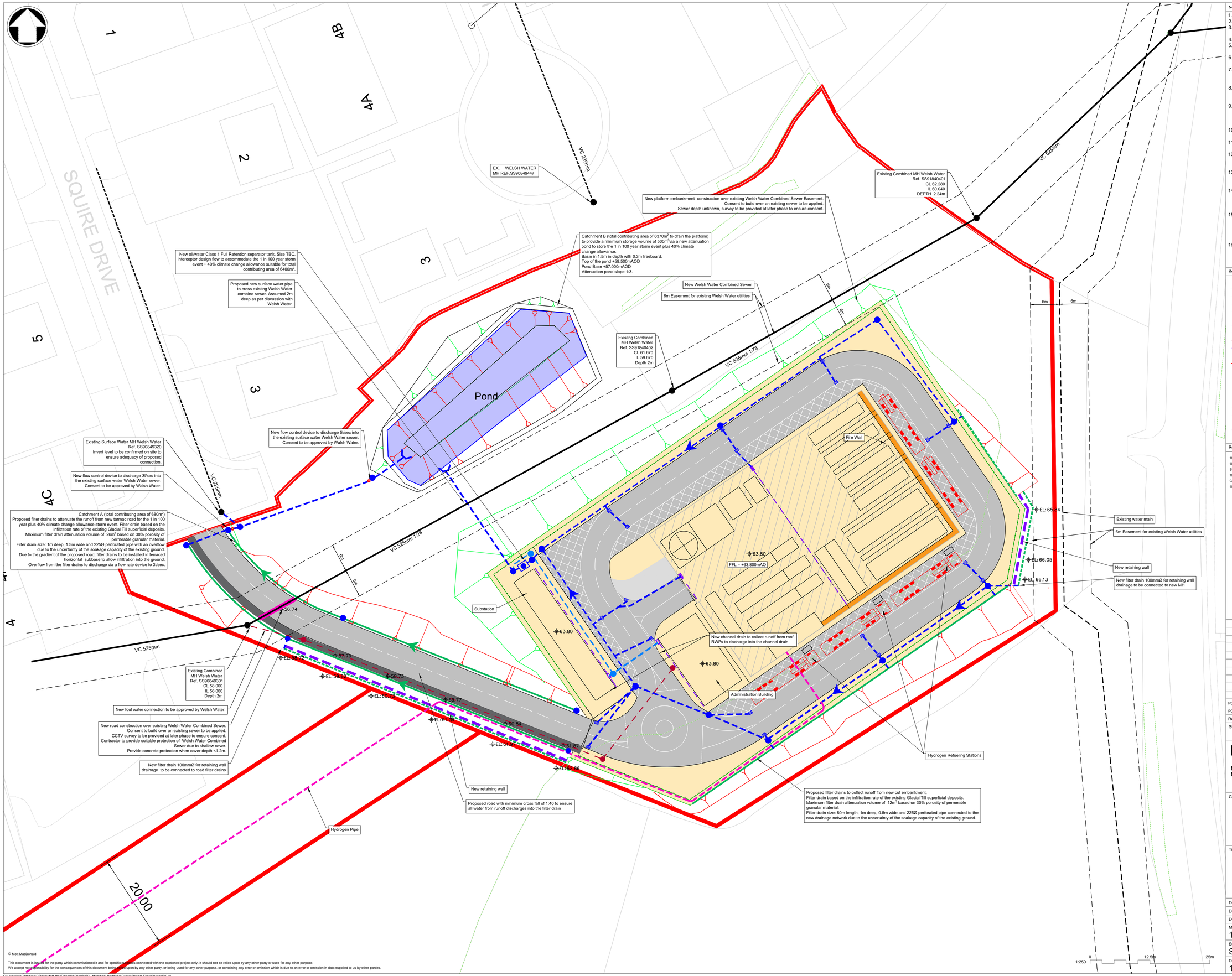
Marubeni Bridgend Green Solar PV Drainage Layout

Designed	A.Ruiz-Diaz	ARD	Eng check	T.King	TK
Drawn	O.Jeffcook	OJ	Coordination	T.King	TK
Dwg check	A.Ruiz-Diaz	ARD	Approved	S.Anantharam	SA

MMD Project Number	Scale at A1	Security
108939	1:1000	STD

Suitability Description	Suit. Code
Suitable for Review & Comment	S3

Drawing Number	Revision
108939-MMD-BRGR-XX-DR-C-0009	P01



C:\Users\kinZ3165\ACCDocs\Mott MacDonald\100108939 - Marubeni Bridgend Green\Project Files\S0-WORK IN PROGRESS\01-MML\MML-CIVDR\108939-MMD-BRGR-XX-DR-C-0044.dwg Nov 15, 2022 - 5:47PM KIN23165

Notes

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8. All suds (drainage systems including attenuation basins, ponds, swales etc.) are to be constructed in accordance with CIRIA753, the SUDS Manual 2015.
9. It is anticipated that there will be no significant increase in runoff rate through the outfall as the system has been designed to maintain reduced discharge rates via flow control. refer to the drainage strategy for details (108939-MMD-BRGR-XX-TN-C-0045).
10. Access roads to be provided with a camber/crossfall to allow runoff to discharge into proposed filter drain.
11. All proposed drainage to follow the Highways Construction Details (HDC) MCHW Volume 3 Section 1, Series F Drainage.
12. Proposed access road and filter drains to follow the Highways Construction Details (HDC) MCHW Volume 3 Section 1, Series B Edge of Pavement Details.
13. Pipe to be encased in concrete when minimum cover < 1200mm under access roads as per Type Z HCD Trench and Bedding Details Drawing F1.
14. All filter drains to be Type M HCD Filter Drains and Trench and Bedding Details drawing F2 and for details of section of the drain with the surface level refer to Type 1A(flexible carriageway) drawing B1 series.
15. Contractor required to ensure temporary drainage arrangements (including temporary excavations required for drainage, temporary management of flows in existing drainage systems and temporary protection of existing structures and utilities) during the delivery of the works.
16. Existing Welsh Water drainage information based on preliminary information. Contractor to provide CCTV surveys of affected sewers.

Key to symbols

- EXISTING WELSH WATER MAN HOLE
- EXISTING WELSH WATER COMBINED SEWER
- EXISTING WELSH WATER FOUL WATER SEWER
- EXISTING WELSH WATER SURFACE WATER SEWER
- NEW SURFACE WATER FILTER DRAIN WITH 225Ø PERFORATED PIPE
- NEW SURFACE WATER PIPE/OILY WATER
- NEW SURFACE WATER PIPE/CLEAN WATER
- NEW FOUL WATER PIPE
- NEW CHANNEL DRAIN
- NEW SURFACE / FOUL WATER MANHOLE
- SITE BOUNDARY
- CONCRETE SURFACE PLATFORM (FFL=+63.800mAOD)
- TARMAC SURFACE ROAD
- TARMAC SURFACE FOOTPATH
- GULLY
- NEW OIL/WATER SEPARATOR WATER
- EARTHWORKS CUT/FILL
- HYDROGEN PIPE
- MANHOLE WITH FLOW DEVICE
- PROPOSED PIPE CONCRETE PROTECTION

Reference drawings

108939-MMD-BRGR-XX-DR-C-0046 Hydrogen Production Facility - Earthworks
108856-MMD-BRGR-XX-DR-C-0047 Sheet 01 Hydrogen Production Facility - Earthworks Longitudinal Sections
108856-MMD-BRGR-XX-DR-C-0047 Sheet 02 Hydrogen Production Facility - Earthworks Longitudinal and Cross Sections
108856-MMD-BRGR-XX-DR-C-0002 Bridgend Green Hydrogen - Site Layout

Rev	Date	Drawn	Description	Ch'k'd	App'd
P02	15/11/2022	OJ	Seconds Issue	ARD	PM
P01	07/11/2022	OJ	Preliminary	ARD	SA

Status Stamp

NOT FOR CONSTRUCTION

MOTT MACDONALD
Victory House
Trafalgar Place
Brighton, BN1 4FY
United Kingdom
T +44 (0)1273 36500
F +44 (0)20 8681 5706
W www.mottmac.com

Client

Marubeni

95 Gresham Street
London
EC2V 7AB
+44 (0)20 7826 8811
www.marubeni-europower.com

Title

Marubeni Bridgend Green Hydrogen Production Facility Drainage Layout

Designed	A. Ruiz-Diaz	ARD	Eng check	A. Ruiz-Diaz	ARD
Drawn	O. Jeffcock	OJ	Coordination	T. King	TK
Dwg check	T. King	TK	Approved	S. Anantharam	SA

MMD Project Number 108939	Scale at A0 1:250	Security STD
Suitability Description Suitable for Review & Comment		Suit. Code S3
Drawing Number 108939-MMD-BRGR-XX-DR-C-0044		Revision P02

D.Proposed Drainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	0.75
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	26.647	0.107	250.0	0.066	15.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	39.523	0.158	250.0	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	45.294	0.657	69.0	0.157	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	26.927	0.108	250.0	0.104	15.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	29.118	0.116	250.0	0.059	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	29.952	0.120	250.0	0.113	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	34.734	0.271	128.0	0.083	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	3.063	0.007	450.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	4.638	0.013	350.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	15.45	62.611	0.066	0.0	0.0	0.0	0.99	70.0	8.9
1.001	50.00	16.11	62.504	0.103	0.0	0.0	0.0	0.99	70.0	13.9
1.002	50.00	16.51	62.346	0.260	0.0	0.0	0.0	1.90	134.0	35.3
2.000	50.00	15.45	62.305	0.104	0.0	0.0	0.0	0.99	70.0	14.1
2.001	50.00	15.94	62.197	0.163	0.0	0.0	0.0	0.99	70.0	22.1
2.002	50.00	16.45	62.081	0.277	0.0	0.0	0.0	0.99	70.0	37.5
2.003	50.00	16.87	61.961	0.359	0.0	0.0	0.0	1.39	98.1	48.6
1.003	50.00	16.93	61.615	0.620	0.0	0.0	0.0	0.85	93.6	83.9
1.004	50.00	17.01	61.608	0.620	0.0	0.0	0.0	0.96	106.3	83.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.005	25.197	3.600	7.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	9.242	0.005	1848.4	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.007	7.941	0.020	397.1	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
1.008	25.539	2.413	10.6	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
3.000	52.470	3.498	15.0	0.024	15.00	0.0	1.500	o	225	Pipe/Conduit	
3.001	30.964	2.064	15.0	0.010	0.00	0.0	1.500	o	225	Pipe/Conduit	
4.000	58.244	3.236	18.0	0.018	15.00	0.0	1.500	o	225	Pipe/Conduit	
4.001	33.920	1.696	20.0	0.010	0.00	0.0	1.500	o	225	Pipe/Conduit	
4.002	9.313	0.228	40.8	0.001	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	6.971	0.069	101.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.009	6.048	0.133	45.6	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	17.07	61.595	0.620	0.0	0.0	0.0	6.88	760.4	83.9
1.006	50.00	17.37	57.005	0.620	0.0	0.0	0.0	0.51	110.8	83.9
1.007	50.00	17.49	57.000	0.620	0.0	0.0	0.0	1.12	242.0	83.9
1.008	50.00	17.55	56.980	0.620	0.0	0.0	0.0	6.91	1496.4	83.9
3.000	50.00	15.29	60.547	0.024	0.0	0.0	0.0	2.97	118.2	3.2
3.001	50.00	15.47	57.000	0.034	0.0	0.0	0.0	2.97	118.2	4.6
4.000	50.00	15.36	60.096	0.018	0.0	0.0	0.0	2.71	107.9	2.4
4.001	50.00	15.58	56.860	0.028	0.0	0.0	0.0	2.57	102.3	3.8
4.002	50.00	15.65	55.164	0.029	0.0	0.0	0.0	2.06	81.7	3.9
3.002	50.00	15.74	54.936	0.063	0.0	0.0	0.0	1.30	51.7	8.5
1.009	50.00	17.58	54.567	0.682	0.0	0.0	0.0	3.32	719.3	92.4

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SWMH01	63.736	1.125	Open Manhole	1200	1.000	62.611	300				
SWMH02	63.773	1.269	Open Manhole	1200	1.001	62.504	300	1.000	62.504	300	
SWMH03	63.718	1.371	Open Manhole	1200	1.002	62.346	300	1.001	62.346	300	
SWMH04	63.730	1.425	Open Manhole	1200	2.000	62.305	300				
SWMH05	63.762	1.565	Open Manhole	1200	2.001	62.197	300	2.000	62.197	300	
SWMH06	63.628	1.548	Open Manhole	1200	2.002	62.081	300	2.001	62.081	300	
SWMH07	63.593	1.632	Open Manhole	1200	2.003	61.961	300	2.002	61.961	300	
SWMH08	63.800	2.185	Open Manhole	1350	1.003	61.615	375	1.002	61.690	300	
								2.003	61.690	300	
SWMH09	63.800	2.192	Open Manhole	1350	1.004	61.608	375	1.003	61.608	375	
SWMH10	63.800	2.205	Open Manhole	1350	1.005	61.595	375	1.004	61.595	375	
SWMH11	58.500	1.495	Open Manhole	1	1.006	57.005	525	1.005	57.995	375	840
SWMH12	58.500	1.500	Open Manhole	1	1.007	57.000	525	1.006	57.000	525	
SWMH13	58.500	1.520	Open Manhole	1500	1.008	56.980	525	1.007	56.980	525	
SWMH14	61.972	1.425	Open Manhole	1200	3.000	60.547	225				
SWMH15	57.662	0.662	Open Manhole	1200	3.001	57.000	225	3.000	57.049	225	49
SWMH17	61.521	1.425	Open Manhole	1200	4.000	60.096	225				
SWMH18	57.302	0.442	Open Manhole	1200	4.001	56.860	225	4.000	56.860	225	
SWMH19	55.800	0.636	Open Manhole	1200	4.002	55.164	225	4.001	55.164	225	
SWMH20	55.500	0.564	Open Manhole	1200	3.002	54.936	225	3.001	54.936	225	
								4.002	54.936	225	
SWMH21	55.500	0.933	Open Manhole	1500	1.009	54.567	525	1.008	54.567	525	
								3.002	54.867	225	
	55.500	1.066	Open Manhole	0		OUTFALL		1.009	54.434	525	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH01	291071.066	184402.317	291071.066	184402.317	Required	
SWMH02	291055.036	184423.604	291055.036	184423.604	Required	
SWMH03	291022.270	184401.503	291022.270	184401.503	Required	
SWMH04	291078.124	184368.041	291078.124	184368.041	Required	
SWMH05	291056.165	184352.456	291056.165	184352.456	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH06	291032.288	184335.791	291032.288	184335.791	Required	
SWMH07	291004.556	184347.108	291004.556	184347.108	Required	
SWMH08	290984.977	184375.798	290984.977	184375.798	Required	
SWMH09	290982.964	184373.488	290982.964	184373.488	Required	
SWMH10	290979.002	184371.076	290979.002	184371.076	Required	
SWMH11	290964.955	184391.994	290964.955	184391.994	Required	
SWMH12	290956.203	184394.964	290956.203	184394.964	Required	
SWMH13	290949.614	184390.531	290949.614	184390.531	Required	
SWMH14	290992.249	184341.990	290992.249	184341.990	Required	
SWMH15	290943.471	184361.324	290943.471	184361.324	Required	
SWMH17	290990.506	184333.601	290990.506	184333.601	Required	
SWMH18	290936.400	184355.165	290936.400	184355.165	Required	
SWMH19	290910.774	184376.514	290910.774	184376.514	Required	
SWMH20	290919.534	184379.675	290919.534	184379.675	Required	
SWMH21	290924.888	184384.140	290924.888	184384.140	Required	
	290920.817	184388.613			No Entry	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	Paved	100	0.044	0.044	0.044
	Classification	Paved	100	0.015	0.015	0.059
	Classification	Landscape Earthwork	21	0.031	0.006	0.066
1.001	Classification	Paved	100	0.010	0.010	0.010
	Classification	Paved	100	0.027	0.027	0.037
1.002	Classification	Paved	100	0.036	0.036	0.036
	Classification	Paved	100	0.009	0.009	0.045
	Classification	Paved	100	0.057	0.057	0.102
	Classification	Paved	100	0.055	0.055	0.157
2.000	Classification	Paved	100	0.036	0.036	0.036
	Classification	Paved	100	0.008	0.008	0.044
	Classification	Paved	100	0.057	0.057	0.100
	Classification	Verge	16	0.022	0.004	0.104
2.001	Classification	Paved	100	0.042	0.042	0.042
	Classification	Paved	100	0.012	0.012	0.054
	Classification	Landscape Earthwork	21	0.010	0.002	0.056
	Classification	Landscape Earthwork	21	0.015	0.003	0.059
2.002	Classification	Paved	100	0.035	0.035	0.035
	Classification	Verge	16	0.008	0.001	0.036
	Classification	Verge	16	0.007	0.001	0.037
	Classification	Paved	100	0.076	0.076	0.113
2.003	Classification	Paved	100	0.044	0.044	0.044
	Classification	Paved	100	0.031	0.031	0.075
	Classification	Paved	100	0.007	0.007	0.083
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
3.000	Classification	Paved	100	0.018	0.018	0.018
	Classification	Landscape Earthwork	21	0.021	0.004	0.022
	Classification	Landscape Earthwork	21	0.008	0.002	0.024
3.001	Classification	Landscape Earthwork	21	0.006	0.001	0.001
	Classification	Paved	100	0.001	0.001	0.002
	Classification	Paved	100	0.008	0.008	0.010
4.000	Classification	Paved	100	0.018	0.018	0.018
4.001	Classification	Verge	16	0.002	0.000	0.000
	Classification	Paved	100	0.001	0.001	0.002
	Classification	Paved	100	0.008	0.008	0.010
4.002	Classification	Verge	16	0.004	0.001	0.001
3.002	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.791	0.682	0.682

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	SWMH01	300	0.825	0.969	Unclassified	1200	0	0.825	Unclassified
1.001	SWMH02	300	0.962	1.101	Unclassified	1200	0	0.969	Unclassified
1.002	SWMH03	300	1.071	1.810	Unclassified	1200	0	1.071	Unclassified
2.000	SWMH04	300	1.125	1.265	Unclassified	1200	0	1.125	Unclassified
2.001	SWMH05	300	1.248	1.295	Unclassified	1200	0	1.265	Unclassified
2.002	SWMH06	300	0.871	1.332	Unclassified	1200	0	1.248	Unclassified
2.003	SWMH07	300	1.332	1.810	Unclassified	1200	0	1.332	Unclassified
1.003	SWMH08	375	1.810	1.817	Unclassified	1350	0	1.810	Unclassified
1.004	SWMH09	375	1.817	1.830	Unclassified	1350	0	1.817	Unclassified
1.005	SWMH10	375	0.130	1.830	Unclassified	1350	0	1.830	Unclassified
1.006	SWMH11	525	0.970	0.975	Unclassified	1	0	0.970	Unclassified
1.007	SWMH12	525	0.975	0.995	Unclassified	1	0	0.975	Unclassified
1.008	SWMH13	525	0.408	0.995	Unclassified	1500	0	0.995	Unclassified
3.000	SWMH14	225	0.388	1.200	Unclassified	1200	0	1.200	Unclassified
3.001	SWMH15	225	0.181	0.437	Unclassified	1200	0	0.437	Unclassified
4.000	SWMH17	225	0.217	1.200	Unclassified	1200	0	1.200	Unclassified
4.001	SWMH18	225	0.217	0.411	Unclassified	1200	0	0.217	Unclassified
4.002	SWMH19	225	0.045	0.411	Unclassified	1200	0	0.411	Unclassified
3.002	SWMH20	225	0.339	0.408	Unclassified	1200	0	0.339	Unclassified
1.009	SWMH21	525	0.408	0.541	Unclassified	1500	0	0.408	Unclassified

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009		55.500	54.434	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SWMH12, DS/PN: 1.007, Volume (m³): 2.0

Unit Reference	MD-SCL-0076-2800-1000-2800
Design Head (m)	1.000
Design Flow (l/s)	2.8
Flush-Flo™	Calculated
Objective	Minimise blockage risk
Application	Surface
Sump Available	Yes
Diameter (mm)	76
Invert Level (m)	57.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.8	Kick-Flo®	0.563	2.2
Flush-Flo™	0.246	2.8	Mean Flow over Head Range	-	2.4

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	2.3	1.200	3.0	3.000	4.6	7.000	6.9
0.200	2.8	1.400	3.3	3.500	5.0	7.500	7.1
0.300	2.8	1.600	3.5	4.000	5.3	8.000	7.3
0.400	2.7	1.800	3.7	4.500	5.6	8.500	7.5
0.500	2.4	2.000	3.8	5.000	5.9	9.000	7.8
0.600	2.2	2.200	4.0	5.500	6.2	9.500	8.0
0.800	2.5	2.400	4.2	6.000	6.4		
1.000	2.8	2.600	4.3	6.500	6.7		

Hydro-Brake® Optimum Manhole: SWMH21, DS/PN: 1.009, Volume (m³): 7.1

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	54.567
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	Mean Flow over Head Range	-	4.4

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

Hydro-Brake® Optimum Manhole: SWMH21, DS/PN: 1.009, Volume (m³): 7.1

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.7	1.400	5.4	3.500	8.3	7.500	11.8
0.300	5.0	1.600	5.7	4.000	8.8	8.000	12.2
0.400	5.0	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.9	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.7	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

Storage Structures for Storm

Tank or Pond Manhole: SWMH12, DS/PN: 1.007

Invert Level (m) 57.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	256.9	0.500	349.2	1.000	455.6	1.300	526.3

Trench Soakaway Manhole: SWMH15, DS/PN: 3.001

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00011	Trench Length (m)	52.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	56.511	Cap Infiltration Depth (m)	1.000

Trench Soakaway Manhole: SWMH18, DS/PN: 4.001

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00011	Trench Length (m)	58.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	56.213	Cap Infiltration Depth (m)	1.000

Trench Soakaway Manhole: SWMH19, DS/PN: 4.002

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00011	Trench Length (m)	35.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	56.062	Cap Infiltration Depth (m)	1.000

Trench Soakaway Manhole: SWMH20, DS/PN: 3.002

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00011	Trench Length (m)	30.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	0.30	Cap Volume Depth (m)	1.000
Invert Level (m)	54.214	Cap Infiltration Depth (m)	1.000

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH01	30 minute 100 year Summer I+40%	63.736	62.951	0.040	0.000	0.35		22.0
1.001	SWMH02	30 minute 100 year Summer I+40%	63.773	62.933	0.128	0.000	0.60		38.7
1.002	SWMH03	30 minute 100 year Summer I+40%	63.718	62.891	0.244	0.000	0.73		91.6
2.000	SWMH04	30 minute 100 year Summer I+40%	63.730	63.377	0.772	0.000	0.60		37.7
2.001	SWMH05	30 minute 100 year Summer I+40%	63.762	63.347	0.850	0.000	0.84		53.3
2.002	SWMH06	30 minute 100 year Summer I+40%	63.628	63.282	0.901	0.000	1.40		88.8
2.003	SWMH07	30 minute 100 year Summer I+40%	63.593	63.037	0.776	0.000	1.33		120.3
1.003	SWMH08	30 minute 100 year Summer I+40%	63.800	62.537	0.547	0.000	2.54		210.5
1.004	SWMH09	30 minute 100 year Summer I+40%	63.800	62.243	0.260	0.000	2.71		211.2
1.005	SWMH10	30 minute 100 year Summer I+40%	63.800	61.740	-0.229	0.000	0.32		211.3
1.006	SWMH11	960 minute 100 year Winter I+40%	58.500	58.346	0.816	0.000	0.25		29.1
1.007	SWMH12	960 minute 100 year Winter I+40%	58.500	58.346	0.821	0.000	0.02		3.2
1.008	SWMH13	960 minute 100 year Winter I+40%	58.500	56.987	-0.518	0.000	0.00		3.2
3.000	SWMH14	30 minute 100 year Winter I+40%	61.972	60.585	-0.187	0.000	0.07		7.6
3.001	SWMH15	60 minute 100 year Winter I+40%	57.662	57.033	-0.192	0.000	0.05		5.7
4.000	SWMH17	30 minute 100 year Winter I+40%	61.521	60.130	-0.191	0.000	0.05		5.8
4.001	SWMH18	480 minute 100 year Winter I+40%	57.302	56.876	-0.210	0.000	0.01		1.4
4.002	SWMH19	480 minute 100 year Winter I+40%	55.800	55.187	-0.202	0.000	0.02		1.4
3.002	SWMH20	600 minute 100 year Winter I+40%	55.500	55.027	-0.133	0.000	0.08		3.1
1.009	SWMH21	600 minute 100 year Winter I+40%	55.500	55.026	-0.066	0.000	0.02		5.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH01	SURCHARGED
1.001	SWMH02	SURCHARGED
1.002	SWMH03	SURCHARGED
2.000	SWMH04	SURCHARGED
2.001	SWMH05	SURCHARGED
2.002	SWMH06	SURCHARGED
2.003	SWMH07	SURCHARGED
1.003	SWMH08	SURCHARGED
1.004	SWMH09	SURCHARGED
1.005	SWMH10	OK
1.006	SWMH11	FLOOD RISK
1.007	SWMH12	FLOOD RISK
1.008	SWMH13	OK
3.000	SWMH14	OK
3.001	SWMH15	OK
4.000	SWMH17	OK
4.001	SWMH18	OK
4.002	SWMH19	OK
3.002	SWMH20	OK
1.009	SWMH21	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH01	30 minute 30 year Winter I+40%	63.736	62.716	-0.195	0.000	0.27		16.8
1.001	SWMH02	15 minute 30 year Winter I+40%	63.773	62.670	-0.134	0.000	0.40		26.0
1.002	SWMH03	15 minute 30 year Winter I+40%	63.718	62.637	-0.009	0.000	0.68		85.0
2.000	SWMH04	15 minute 30 year Winter I+40%	63.730	62.915	0.310	0.000	0.47		29.4
2.001	SWMH05	15 minute 30 year Winter I+40%	63.762	62.897	0.399	0.000	0.68		43.4
2.002	SWMH06	15 minute 30 year Winter I+40%	63.628	62.854	0.473	0.000	1.12		70.9
2.003	SWMH07	15 minute 30 year Winter I+40%	63.593	62.694	0.433	0.000	1.08		97.0
1.003	SWMH08	15 minute 30 year Winter I+40%	63.800	62.359	0.370	0.000	2.14		177.5
1.004	SWMH09	15 minute 30 year Winter I+40%	63.800	62.155	0.172	0.000	2.27		177.1
1.005	SWMH10	15 minute 30 year Winter I+40%	63.800	61.727	-0.243	0.000	0.27		176.4
1.006	SWMH11	960 minute 30 year Winter I+40%	58.500	58.152	0.622	0.000	0.21		24.4
1.007	SWMH12	960 minute 30 year Winter I+40%	58.500	58.152	0.627	0.000	0.02		3.0
1.008	SWMH13	960 minute 30 year Winter I+40%	58.500	56.986	-0.519	0.000	0.00		3.0
3.000	SWMH14	30 minute 30 year Winter I+40%	61.972	60.580	-0.192	0.000	0.05		6.0
3.001	SWMH15	180 minute 30 year Winter I+40%	57.662	57.025	-0.200	0.000	0.03		3.1
4.000	SWMH17	30 minute 30 year Winter I+40%	61.521	60.126	-0.195	0.000	0.04		4.5
4.001	SWMH18	720 minute 30 year Winter I+40%	57.302	56.869	-0.217	0.000	0.01		0.7
4.002	SWMH19	720 minute 30 year Winter I+40%	55.800	55.177	-0.213	0.000	0.01		0.8
3.002	SWMH20	960 minute 30 year Winter I+40%	55.500	54.967	-0.194	0.000	0.04		1.6
1.009	SWMH21	720 minute 30 year Winter I+40%	55.500	54.713	-0.378	0.000	0.02		4.4

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH01	OK
1.001	SWMH02	OK
1.002	SWMH03	OK
2.000	SWMH04	SURCHARGED
2.001	SWMH05	SURCHARGED
2.002	SWMH06	SURCHARGED
2.003	SWMH07	SURCHARGED
1.003	SWMH08	SURCHARGED
1.004	SWMH09	SURCHARGED
1.005	SWMH10	OK
1.006	SWMH11	SURCHARGED
1.007	SWMH12	SURCHARGED
1.008	SWMH13	OK
3.000	SWMH14	OK
3.001	SWMH15	OK
4.000	SWMH17	OK
4.001	SWMH18	OK
4.002	SWMH19	OK
3.002	SWMH20	OK
1.009	SWMH21	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	2
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH01	30 minute 2 year Winter I+40%	63.736	62.680	-0.231	0.000	0.12		7.7
1.001	SWMH02	30 minute 2 year Winter I+40%	63.773	62.594	-0.210	0.000	0.19		12.6
1.002	SWMH03	15 minute 2 year Winter I+40%	63.718	62.459	-0.187	0.000	0.30		37.6
2.000	SWMH04	30 minute 2 year Winter I+40%	63.730	62.394	-0.211	0.000	0.19		12.2
2.001	SWMH05	30 minute 2 year Winter I+40%	63.762	62.313	-0.184	0.000	0.32		20.0
2.002	SWMH06	15 minute 2 year Winter I+40%	63.628	62.247	-0.134	0.000	0.58		36.9
2.003	SWMH07	15 minute 2 year Winter I+40%	63.593	62.121	-0.140	0.000	0.55		49.5
1.003	SWMH08	15 minute 2 year Winter I+40%	63.800	61.999	0.010	0.000	0.95		78.9
1.004	SWMH09	15 minute 2 year Winter I+40%	63.800	61.982	0.000	0.000	1.01		78.6
1.005	SWMH10	15 minute 2 year Winter I+40%	63.800	61.680	-0.290	0.000	0.12		78.5
1.006	SWMH11	960 minute 2 year Winter I+40%	58.500	57.737	0.207	0.000	0.13		15.5
1.007	SWMH12	960 minute 2 year Winter I+40%	58.500	57.736	0.211	0.000	0.02		2.8
1.008	SWMH13	360 minute 2 year Summer I+40%	58.500	56.986	-0.519	0.000	0.00		2.8
3.000	SWMH14	30 minute 2 year Winter I+40%	61.972	60.571	-0.201	0.000	0.02		2.8
3.001	SWMH15	720 minute 2 year Winter I+40%	57.662	57.007	-0.218	0.000	0.01		0.7
4.000	SWMH17	30 minute 2 year Winter I+40%	61.521	60.117	-0.204	0.000	0.02		2.1
4.001	SWMH18	2880 minute 2 year Winter I+40%	57.302	56.862	-0.223	0.000	0.00		0.2
4.002	SWMH19	2880 minute 2 year Winter I+40%	55.800	55.167	-0.222	0.000	0.00		0.2
3.002	SWMH20	2880 minute 2 year Winter I+40%	55.500	54.947	-0.214	0.000	0.01		0.4
1.009	SWMH21	2880 minute 2 year Winter I+40%	55.500	54.650	-0.442	0.000	0.01		2.8

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH01	OK
1.001	SWMH02	OK
1.002	SWMH03	OK
2.000	SWMH04	OK
2.001	SWMH05	OK
2.002	SWMH06	OK
2.003	SWMH07	OK
1.003	SWMH08	SURCHARGED
1.004	SWMH09	OK
1.005	SWMH10	OK
1.006	SWMH11	SURCHARGED
1.007	SWMH12	SURCHARGED
1.008	SWMH13	OK
3.000	SWMH14	OK
3.001	SWMH15	OK
4.000	SWMH17	OK
4.001	SWMH18	OK
4.002	SWMH19	OK
3.002	SWMH20	OK
1.009	SWMH21	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	21.000	Add Flow / Climate Change (%)	0
Ratio R	0.200	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.035	4-8	0.295	8-12	0.091

Total Area Contributing (ha) = 0.421

Total Pipe Volume (m³) = 43.296

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	54.757	0.543	100.8	0.051	5.00	0.0	1.500	o	150	Pipe/Conduit	
1.001	13.603	0.135	100.8	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit	
1.002	24.910	0.247	100.8	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit	
1.003	11.281	0.112	100.7	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit	
1.004	47.306	0.469	100.9	0.103	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.005	75.356	6.280	12.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.006	5.776	0.116	50.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.007	13.976	1.398	10.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	48.44	6.05	88.036	0.051	0.0	0.0	0.0	0.87	15.4	6.7
1.001	47.73	6.31	87.493	0.051	0.0	0.0	0.0	0.87	15.4	6.7
1.002	46.50	6.78	87.358	0.051	0.0	0.0	0.0	0.87	15.4	6.7
1.003	45.97	7.00	87.111	0.051	0.0	0.0	0.0	0.87	15.4	6.7
1.004	44.38	7.69	86.924	0.153	0.0	0.0	0.0	1.14	45.4	18.4
1.005	43.57	8.07	86.455	0.153	0.0	0.0	0.0	3.32	132.1	18.4
1.006	43.44	8.12	80.175	0.153	0.0	0.0	0.0	1.63	64.6	18.4
1.007	43.31	8.19	80.060	0.153	0.0	0.0	0.0	3.64	144.8	18.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.008	61.087	1.527	40.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.009	43.759	1.094	40.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.000	27.009	0.225	120.0	0.068	5.00	0.0	1.500	o	225	Pipe/Conduit	
2.001	22.449	0.187	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.002	37.162	0.310	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.003	60.172	0.501	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.004	23.233	0.194	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.005	12.516	0.104	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
3.000	61.551	5.730	10.7	0.032	5.00	0.0	1.500	o	225	Pipe/Conduit	
4.000	50.630	0.506	100.1	0.018	5.00	0.0	1.500	o	225	Pipe/Conduit	
3.001	8.073	0.146	55.3	0.055	0.00	0.0	1.500	o	225	Pipe/Conduit	
3.002	34.001	0.680	50.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
3.003	30.647	0.383	80.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
3.004	18.504	1.850	10.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
3.005	18.593	0.186	100.0	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit	
2.006	7.977	0.066	120.0	0.000	0.00	0.0	1.500	o	150	Pipe/Conduit	
5.000	17.632	0.147	119.9	0.062	5.00	0.0	1.500	o	225	Pipe/Conduit	
5.001	6.433	0.054	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
5.002	13.566	0.113	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.008	42.20	8.75	78.662	0.153	0.0	0.0	0.0	1.82	72.3	18.4
1.009	41.45	9.15	77.135	0.153	0.0	0.0	0.0	1.82	72.3	18.4
2.000	50.00	5.43	75.141	0.068	0.0	0.0	0.0	1.05	41.6	9.3
2.001	49.17	5.79	74.916	0.068	0.0	0.0	0.0	1.05	41.6	9.3
2.002	47.53	6.38	74.729	0.068	0.0	0.0	0.0	1.05	41.6	9.3
2.003	45.17	7.34	74.419	0.068	0.0	0.0	0.0	1.05	41.6	9.3
2.004	44.34	7.71	73.918	0.068	0.0	0.0	0.0	1.05	41.6	9.3
2.005	43.91	7.90	73.724	0.068	0.0	0.0	0.0	1.05	41.6	9.3
3.000	50.00	5.29	82.903	0.032	0.0	0.0	0.0	3.51	139.7	4.3
4.000	49.33	5.74	77.679	0.018	0.0	0.0	0.0	1.15	45.6	2.4
3.001	49.07	5.82	77.173	0.105	0.0	0.0	0.0	1.55	61.5	13.9
3.002	48.09	6.17	77.027	0.105	0.0	0.0	0.0	1.63	64.6	13.9
3.003	47.04	6.57	76.347	0.105	0.0	0.0	0.0	1.28	51.1	13.9
3.004	46.82	6.65	75.964	0.105	0.0	0.0	0.0	3.64	144.8	13.9
3.005	45.94	7.01	74.113	0.105	0.0	0.0	0.0	0.88	15.5	13.9
2.006	43.55	8.07	73.620	0.173	0.0	0.0	0.0	0.80	14.1«	20.4
5.000	50.00	5.28	74.784	0.062	0.0	0.0	0.0	1.05	41.7	8.3
5.001	50.00	5.38	74.637	0.062	0.0	0.0	0.0	1.05	41.6	8.3
5.002	49.73	5.60	74.583	0.062	0.0	0.0	0.0	1.05	41.6	8.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.003	11.085	0.092	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
5.004	16.839	0.140	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
5.005	19.222	0.160	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
5.006	41.645	0.347	120.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
5.007	32.327	0.269	120.2	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
2.007	73.682	0.614	120.0	0.033	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.010	40.591	2.030	20.0	0.000	0.00	0.0	1.500	o	225	Pipe/Conduit	
1.011	35.535	0.237	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.012	61.237	2.100	29.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.003	49.21	5.78	74.470	0.062	0.0	0.0	0.0	1.05	41.6	8.3
5.004	48.45	6.04	74.378	0.062	0.0	0.0	0.0	1.05	41.6	8.3
5.005	47.61	6.35	74.238	0.062	0.0	0.0	0.0	1.05	41.6	8.3
5.006	45.93	7.01	74.077	0.062	0.0	0.0	0.0	1.05	41.6	8.3
5.007	44.73	7.53	73.730	0.062	0.0	0.0	0.0	1.05	41.6	8.3
2.007	41.28	9.24	73.461	0.268	0.0	0.0	0.0	1.05	41.6	29.9
1.010	40.81	9.51	72.847	0.421	0.0	0.0	0.0	2.57	102.3	46.6
1.011	40.03	9.97	70.742	0.421	0.0	0.0	0.0	1.28	90.6	46.6
1.012	39.35	10.39	70.800	0.421	0.0	0.0	0.0	2.43	96.7	46.6

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SWMH1	89.236	1.200	Open Manhole	1050	1.000	88.036	150				
SWMH2	88.729	1.236	Open Manhole	1050	1.001	87.493	150	1.000	87.493	150	
SWMH3	88.526	1.168	Open Manhole	1050	1.002	87.358	150	1.001	87.358	150	
SWMH4	88.314	1.203	Open Manhole	1050	1.003	87.111	150	1.002	87.111	150	
SWMH5	88.001	1.077	Open Manhole	1200	1.004	86.924	225	1.003	86.999	150	
SWMH6	87.760	1.305	Open Manhole	1200	1.005	86.455	225	1.004	86.455	225	
SWMH7	81.246	1.071	Open Manhole	1200	1.006	80.175	225	1.005	80.175	225	
SWMH8	81.001	0.941	Open Manhole	1200	1.007	80.060	225	1.006	80.060	225	
SWMH9	79.644	0.981	Open Manhole	1200	1.008	78.662	225	1.007	78.662	225	
SWMH10	78.304	1.169	Open Manhole	1200	1.009	77.135	225	1.008	77.135	225	
SWMH11	76.341	1.200	Open Manhole	1050	2.000	75.141	225				
SWMH12	76.459	1.543	Open Manhole	1200	2.001	74.916	225	2.000	74.916	225	
SWMH13	76.566	1.837	Open Manhole	1200	2.002	74.729	225	2.001	74.729	225	
SWMH14	76.256	1.837	Open Manhole	1200	2.003	74.419	225	2.002	74.419	225	
SWMH15	77.116	3.198	Open Manhole	1200	2.004	73.918	225	2.003	73.918	225	
SWMH16	77.144	3.420	Open Manhole	1200	2.005	73.724	225	2.004	73.724	225	
SWMH17	84.103	1.200	Open Manhole	1050	3.000	82.903	225				
SWMH18	78.871	1.192	Open Manhole	1050	4.000	77.679	225				
SWMH19	78.398	1.225	Open Manhole	1050	3.001	77.173	225	3.000	77.173	225	
								4.000	77.173	225	
SWMH20	78.207	1.180	Open Manhole	1200	3.002	77.027	225	3.001	77.027	225	
SWMH21	77.223	0.876	Open Manhole	1200	3.003	76.347	225	3.002	76.347	225	
SWMH22	77.031	1.067	Open Manhole	1200	3.004	75.964	225	3.003	75.964	225	
SWMH23	75.151	1.038	Open Manhole	1200	3.005	74.113	150	3.004	74.114	225	
SWMH24	76.982	3.363	Open Manhole	1200	2.006	73.620	150	2.005	73.620	225	
								3.005	73.927	150	307
SWMH25	75.984	1.200	Open Manhole	1050	5.000	74.784	225				
SWMH26	76.171	1.534	Open Manhole	1200	5.001	74.637	225	5.000	74.637	225	
SWMH27	76.398	1.815	Open Manhole	1200	5.002	74.583	225	5.001	74.583	225	
SWMH28	77.475	3.005	Open Manhole	1200	5.003	74.470	225	5.002	74.470	225	
SWMH29	76.713	2.335	Open Manhole	1200	5.004	74.378	225	5.003	74.378	225	
SWMH30	76.521	2.283	Open Manhole	1200	5.005	74.238	225	5.004	74.238	225	
SWMH31	76.124	2.047	Open Manhole	1200	5.006	74.077	225	5.005	74.077	225	
SWMH32	77.373	3.643	Open Manhole	1200	5.007	73.730	225	5.006	73.730	225	
SWMH33	76.092	2.631	Open Manhole	1200	2.007	73.461	225	2.006	73.553	150	17
								5.007	73.461	225	
SWMH34	77.447	4.600	Open Manhole	1200	1.010	72.847	225	1.009	76.041	225	3194
								2.007	72.847	225	
SWMH35	72.710	1.968	Open Manhole	1200	1.011	70.742	300	1.010	70.817	225	
SWMH36	72.000	1.494	Open Manhole	1200	1.012	70.800	225	1.011	70.506	300	
37	69.000	0.300	Open Manhole	0		OUTFALL		1.012	68.700	225	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH1	291843.547	184619.107	291843.547	184619.107	Required	
SWMH2	291794.119	184642.668	291794.064	184642.497	Required	
SWMH3	291780.712	184644.971	291780.776	184645.139	Required	
SWMH4	291759.388	184657.846	291759.368	184657.668	Required	
SWMH5	291748.645	184654.405	291748.764	184654.327	Required	
SWMH6	291754.282	184607.436	291754.141	184607.452	Required	
SWMH7	291729.077	184536.421	291729.219	184536.413	Required	
SWMH8	291730.380	184530.794	291730.237	184530.795	Required	
SWMH9	291727.212	184517.182	291727.354	184517.195	Required	
SWMH10	291751.397	184461.086	291751.256	184461.065	Required	
SWMH11	291933.249	184305.748	291933.249	184305.748	Required	
SWMH12	291915.089	184325.739	291914.999	184325.629	Required	
SWMH13	291895.815	184337.251	291895.752	184337.123	Required	
SWMH14	291861.162	184350.672	291861.274	184350.760	Required	
SWMH15	291853.125	184410.305	291852.900	184410.213	Required	
SWMH16	291839.194	184428.898	291839.060	184428.696	Required	
SWMH17	291850.557	184589.678	291850.557	184589.678	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH18	291897.810	184539.785	291897.810	184539.785	Required	
SWMH19	291848.532	184528.160	291848.532	184528.160	Required	
SWMH20	291842.364	184522.952	291842.482	184522.873	Required	
SWMH21	291831.766	184490.644	291831.906	184490.615	Required	
SWMH22	291828.659	184460.155	291828.530	184460.215	Required	
SWMH23	291815.949	184446.708	291816.091	184446.700	Required	
SWMH24	291827.010	184431.762	291827.010	184431.762	Required	
SWMH25	291846.885	184279.582	291846.885	184279.582	Required	
SWMH26	291848.123	184297.171	291847.981	184297.160	Required	
SWMH27	291846.708	184303.446	291846.583	184303.378	Required	
SWMH28	291837.069	184312.992	291837.262	184313.138	Required	
SWMH29	291831.585	184322.626	291831.723	184322.664	Required	
SWMH30	291831.585	184339.465	291831.727	184339.449	Required	
SWMH31	291835.915	184358.193	291835.773	184358.205	Required	
SWMH32	291833.884	184399.789	291833.649	184399.729	Required	
SWMH33	291819.606	184428.792	291819.606	184428.792	Required	
SWMH34	291746.783	184417.571	291746.783	184417.571	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH35	291738.007	184377.940	291737.847	184378.023	Required	
SWMH36	291714.073	184351.674	291713.946	184351.802	Required	
37	291667.969	184311.371			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	SWMH1	89.236	88.036	1.050	Open Manhole	1050
1.001	o	150	SWMH2	88.729	87.493	1.086	Open Manhole	1050
1.002	o	150	SWMH3	88.526	87.358	1.018	Open Manhole	1050
1.003	o	150	SWMH4	88.314	87.111	1.053	Open Manhole	1050
1.004	o	225	SWMH5	88.001	86.924	0.852	Open Manhole	1200
1.005	o	225	SWMH6	87.760	86.455	1.080	Open Manhole	1200
1.006	o	225	SWMH7	81.246	80.175	0.846	Open Manhole	1200
1.007	o	225	SWMH8	81.001	80.060	0.716	Open Manhole	1200
1.008	o	225	SWMH9	79.644	78.662	0.756	Open Manhole	1200
1.009	o	225	SWMH10	78.304	77.135	0.944	Open Manhole	1200
2.000	o	225	SWMH11	76.341	75.141	0.975	Open Manhole	1050
2.001	o	225	SWMH12	76.459	74.916	1.318	Open Manhole	1200
2.002	o	225	SWMH13	76.566	74.729	1.612	Open Manhole	1200
2.003	o	225	SWMH14	76.256	74.419	1.612	Open Manhole	1200
2.004	o	225	SWMH15	77.116	73.918	2.973	Open Manhole	1200
2.005	o	225	SWMH16	77.144	73.724	3.195	Open Manhole	1200
3.000	o	225	SWMH17	84.103	82.903	0.975	Open Manhole	1050
4.000	o	225	SWMH18	78.871	77.679	0.967	Open Manhole	1050
3.001	o	225	SWMH19	78.398	77.173	1.000	Open Manhole	1050
3.002	o	225	SWMH20	78.207	77.027	0.955	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	54.757	100.8	SWMH2	88.729	87.493	1.086	Open Manhole	1050
1.001	13.603	100.8	SWMH3	88.526	87.358	1.018	Open Manhole	1050
1.002	24.910	100.8	SWMH4	88.314	87.111	1.053	Open Manhole	1050
1.003	11.281	100.7	SWMH5	88.001	86.999	0.852	Open Manhole	1200
1.004	47.306	100.9	SWMH6	87.760	86.455	1.080	Open Manhole	1200
1.005	75.356	12.0	SWMH7	81.246	80.175	0.846	Open Manhole	1200
1.006	5.776	50.0	SWMH8	81.001	80.060	0.716	Open Manhole	1200
1.007	13.976	10.0	SWMH9	79.644	78.662	0.756	Open Manhole	1200
1.008	61.087	40.0	SWMH10	78.304	77.135	0.944	Open Manhole	1200
1.009	43.759	40.0	SWMH34	77.447	76.041	1.180	Open Manhole	1200
2.000	27.009	120.0	SWMH12	76.459	74.916	1.318	Open Manhole	1200
2.001	22.449	120.0	SWMH13	76.566	74.729	1.612	Open Manhole	1200
2.002	37.162	120.0	SWMH14	76.256	74.419	1.612	Open Manhole	1200
2.003	60.172	120.0	SWMH15	77.116	73.918	2.973	Open Manhole	1200
2.004	23.233	120.0	SWMH16	77.144	73.724	3.195	Open Manhole	1200
2.005	12.516	120.0	SWMH24	76.982	73.620	3.137	Open Manhole	1200
3.000	61.551	10.7	SWMH19	78.398	77.173	1.000	Open Manhole	1050
4.000	50.630	100.1	SWMH19	78.398	77.173	1.000	Open Manhole	1050
3.001	8.073	55.3	SWMH20	78.207	77.027	0.955	Open Manhole	1200
3.002	34.001	50.0	SWMH21	77.223	76.347	0.651	Open Manhole	1200

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH1	15 minute 100 year Winter I+40%	89.236	89.036	0.850	0.000	1.34		20.3
1.001	SWMH2	15 minute 100 year Winter I+40%	88.729	88.131	0.488	0.000	1.35		19.4
1.002	SWMH3	15 minute 100 year Winter I+40%	88.526	87.887	0.379	0.000	1.34		20.0
1.003	SWMH4	15 minute 100 year Winter I+40%	88.314	87.639	0.378	0.000	1.49		21.2
1.004	SWMH5	15 minute 100 year Winter I+40%	88.001	87.579	0.430	0.000	1.36		59.6
1.005	SWMH6	15 minute 100 year Winter I+40%	87.760	86.563	-0.117	0.000	0.46		59.9
1.006	SWMH7	15 minute 100 year Winter I+40%	81.246	80.453	0.053	0.000	1.25		59.7
1.007	SWMH8	15 minute 100 year Winter I+40%	81.001	80.167	-0.118	0.000	0.46		59.4
1.008	SWMH9	15 minute 100 year Winter I+40%	79.644	78.822	-0.065	0.000	0.84		59.4
1.009	SWMH10	15 minute 100 year Winter I+40%	78.304	77.295	-0.065	0.000	0.85		58.9
2.000	SWMH11	15 minute 100 year Winter I+40%	76.341	75.315	-0.051	0.000	0.92		36.3
2.001	SWMH12	15 minute 100 year Winter I+40%	76.459	75.088	-0.053	0.000	0.94		36.3
2.002	SWMH13	15 minute 100 year Winter I+40%	76.566	74.897	-0.057	0.000	0.89		35.7
2.003	SWMH14	15 minute 100 year Winter I+40%	76.256	74.583	-0.061	0.000	0.84		34.1
2.004	SWMH15	15 minute 100 year Winter I+40%	77.116	74.215	0.072	0.000	0.76		29.4
2.005	SWMH16	15 minute 100 year Winter I+40%	77.144	74.122	0.172	0.000	0.86		31.9
3.000	SWMH17	15 minute 100 year Winter I+40%	84.103	82.956	-0.172	0.000	0.13		17.0
4.000	SWMH18	15 minute 100 year Winter I+40%	78.871	77.751	-0.153	0.000	0.22		9.6
3.001	SWMH19	15 minute 100 year Winter I+40%	78.398	77.423	0.025	0.000	1.09		56.2
3.002	SWMH20	15 minute 100 year Winter I+40%	78.207	77.202	-0.050	0.000	0.91		55.9
3.003	SWMH21	15 minute 100 year Winter I+40%	77.223	76.661	0.089	0.000	1.12		54.2
3.004	SWMH22	15 minute 100 year Winter I+40%	77.031	76.223	0.035	0.000	0.38		50.9
3.005	SWMH23	15 minute 100 year Winter I+40%	76.000	75.988	1.725	0.000	3.21		47.2
2.006	SWMH24	15 minute 100 year Winter I+40%	76.982	74.062	0.143	0.000	1.12		72.2
5.000	SWMH25	15 minute 100 year Winter I+40%	75.984	74.948	-0.061	0.000	0.86		32.9

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH1	FLOOD RISK
1.001	SWMH2	SURCHARGED
1.002	SWMH3	SURCHARGED
1.003	SWMH4	SURCHARGED
1.004	SWMH5	SURCHARGED
1.005	SWMH6	OK
1.006	SWMH7	SURCHARGED
1.007	SWMH8	OK
1.008	SWMH9	OK
1.009	SWMH10	OK
2.000	SWMH11	OK
2.001	SWMH12	OK
2.002	SWMH13	OK
2.003	SWMH14	OK
2.004	SWMH15	SURCHARGED
2.005	SWMH16	SURCHARGED
3.000	SWMH17	OK
4.000	SWMH18	OK
3.001	SWMH19	SURCHARGED
3.002	SWMH20	OK
3.003	SWMH21	SURCHARGED
3.004	SWMH22	SURCHARGED
3.005	SWMH23	FLOOD RISK
2.006	SWMH24	SURCHARGED
5.000	SWMH25	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
5.001	SWMH26	15 minute 100 year Winter I+40%	76.171	74.825	-0.037	0.000	1.00		32.6
5.002	SWMH27	15 minute 100 year Winter I+40%	76.398	74.747	-0.062	0.000	0.87		32.6
5.003	SWMH28	15 minute 100 year Winter I+40%	77.475	74.636	-0.059	0.000	0.89		32.6
5.004	SWMH29	15 minute 100 year Winter I+40%	76.713	74.539	-0.064	0.000	0.86		32.6
5.005	SWMH30	15 minute 100 year Winter I+40%	76.521	74.397	-0.065	0.000	0.84		32.3
5.006	SWMH31	15 minute 100 year Winter I+40%	76.124	74.237	-0.065	0.000	0.79		31.6
5.007	SWMH32	15 minute 100 year Winter I+40%	77.373	74.096	0.141	0.000	0.66		26.2
2.007	SWMH33	15 minute 100 year Winter I+40%	76.092	73.981	0.220	0.000	1.16		100.5
1.010	SWMH34	15 minute 100 year Winter I+40%	77.447	73.041	-0.106	0.000	0.75		154.6
1.011	SWMH35	30 minute 100 year Winter I+40%	72.710	71.901	0.783	0.000	1.83		152.9
1.012	SWMH36	480 minute 100 year Winter I+40%	72.000	71.626	0.601	0.000	0.05		5.0

PN	US/MH Name	Status
5.001	SWMH26	OK
5.002	SWMH27	OK
5.003	SWMH28	OK
5.004	SWMH29	OK
5.005	SWMH30	OK
5.006	SWMH31	OK
5.007	SWMH32	SURCHARGED
2.007	SWMH33	SURCHARGED
1.010	SWMH34	OK
1.011	SWMH35	SURCHARGED
1.012	SWMH36	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160
Return Period(s) (years)	30
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH1	15 minute 30 year Winter I+40%	89.236	88.570	0.384	0.000	1.20		18.1
1.001	SWMH2	15 minute 30 year Winter I+40%	88.729	87.846	0.203	0.000	1.19		17.1
1.002	SWMH3	15 minute 30 year Winter I+40%	88.526	87.656	0.148	0.000	1.16		17.2
1.003	SWMH4	15 minute 30 year Winter I+40%	88.314	87.420	0.159	0.000	1.25		17.8
1.004	SWMH5	15 minute 30 year Winter I+40%	88.001	87.354	0.205	0.000	1.18		51.7
1.005	SWMH6	15 minute 30 year Winter I+40%	87.760	86.554	-0.126	0.000	0.40		51.8
1.006	SWMH7	15 minute 30 year Winter I+40%	81.246	80.410	0.009	0.000	1.08		51.9
1.007	SWMH8	15 minute 30 year Winter I+40%	81.001	80.158	-0.126	0.000	0.40		51.8
1.008	SWMH9	15 minute 30 year Winter I+40%	79.644	78.807	-0.081	0.000	0.73		51.4
1.009	SWMH10	15 minute 30 year Winter I+40%	78.304	77.279	-0.081	0.000	0.74		51.2
2.000	SWMH11	15 minute 30 year Winter I+40%	76.341	75.289	-0.077	0.000	0.74		29.2
2.001	SWMH12	15 minute 30 year Winter I+40%	76.459	75.063	-0.078	0.000	0.75		29.2
2.002	SWMH13	30 minute 30 year Winter I+40%	76.566	74.952	-0.002	0.000	0.62		24.8
2.003	SWMH14	30 minute 30 year Winter I+40%	76.256	74.910	0.265	0.000	0.52		21.2
2.004	SWMH15	30 minute 30 year Winter I+40%	77.116	74.855	0.713	0.000	0.52		20.2
2.005	SWMH16	30 minute 30 year Winter I+40%	77.144	74.821	0.872	0.000	0.59		21.8
3.000	SWMH17	15 minute 30 year Winter I+40%	84.103	82.951	-0.177	0.000	0.10		13.7
4.000	SWMH18	15 minute 30 year Winter I+40%	78.871	77.743	-0.161	0.000	0.18		7.8
3.001	SWMH19	15 minute 30 year Winter I+40%	78.398	77.342	-0.056	0.000	0.90		46.3
3.002	SWMH20	15 minute 30 year Winter I+40%	78.207	77.175	-0.077	0.000	0.75		45.9
3.003	SWMH21	15 minute 30 year Winter I+40%	77.223	76.521	-0.051	0.000	0.95		45.8
3.004	SWMH22	15 minute 30 year Winter I+40%	77.031	76.055	-0.134	0.000	0.34		45.6
3.005	SWMH23	30 minute 30 year Winter I+40%	75.151	75.154	0.891	2.886	2.07		30.5
2.006	SWMH24	30 minute 30 year Winter I+40%	76.982	74.796	1.026	0.000	2.90		36.7
5.000	SWMH25	15 minute 30 year Winter I+40%	75.984	74.925	-0.084	0.000	0.70		26.5

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH1	SURCHARGED
1.001	SWMH2	SURCHARGED
1.002	SWMH3	SURCHARGED
1.003	SWMH4	SURCHARGED
1.004	SWMH5	SURCHARGED
1.005	SWMH6	OK
1.006	SWMH7	SURCHARGED
1.007	SWMH8	OK
1.008	SWMH9	OK
1.009	SWMH10	OK
2.000	SWMH11	OK
2.001	SWMH12	OK
2.002	SWMH13	OK
2.003	SWMH14	SURCHARGED
2.004	SWMH15	SURCHARGED
2.005	SWMH16	SURCHARGED
3.000	SWMH17	OK
4.000	SWMH18	OK
3.001	SWMH19	OK
3.002	SWMH20	OK
3.003	SWMH21	OK
3.004	SWMH22	OK
3.005	SWMH23	FLOOD
2.006	SWMH24	SURCHARGED
5.000	SWMH25	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
5.001	SWMH26	15 minute 30 year Winter I+40%	76.171	74.794	-0.068	0.000	0.82		26.7
5.002	SWMH27	15 minute 30 year Winter I+40%	76.398	74.725	-0.084	0.000	0.72		26.8
5.003	SWMH28	15 minute 30 year Winter I+40%	77.475	74.615	-0.081	0.000	0.72		26.4
5.004	SWMH29	15 minute 30 year Winter I+40%	76.713	74.518	-0.085	0.000	0.70		26.6
5.005	SWMH30	30 minute 30 year Winter I+40%	76.521	74.419	-0.044	0.000	0.59		22.7
5.006	SWMH31	30 minute 30 year Winter I+40%	76.124	74.388	0.086	0.000	0.52		20.8
5.007	SWMH32	30 minute 30 year Winter I+40%	77.373	74.341	0.386	0.000	0.38		15.2
2.007	SWMH33	30 minute 30 year Winter I+40%	76.092	74.300	0.614	0.000	1.34		54.5
1.010	SWMH34	30 minute 30 year Winter I+40%	77.447	73.252	0.180	0.000	0.98		96.0
1.011	SWMH35	480 minute 30 year Winter I+40%	72.710	71.491	0.449	0.000	0.33		27.3
1.012	SWMH36	480 minute 30 year Winter I+40%	72.000	71.486	0.461	0.000	0.05		5.0

PN	US/MH Name	Status
5.001	SWMH26	OK
5.002	SWMH27	OK
5.003	SWMH28	OK
5.004	SWMH29	OK
5.005	SWMH30	OK
5.006	SWMH31	SURCHARGED
5.007	SWMH32	SURCHARGED
2.007	SWMH33	SURCHARGED
1.010	SWMH34	SURCHARGED
1.011	SWMH35	SURCHARGED
1.012	SWMH36	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 291650 184300 SS 91650 84300
Data Type	Catchment
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160
Return Period(s) (years)	2
Climate Change (%)	40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
1.000	SWMH1	15 minute 2 year Winter I+40%	89.236	88.128	-0.058	0.000	0.65		9.8
1.001	SWMH2	15 minute 2 year Winter I+40%	88.729	87.584	-0.059	0.000	0.68		9.7
1.002	SWMH3	15 minute 2 year Winter I+40%	88.526	87.447	-0.061	0.000	0.66		9.7
1.003	SWMH4	15 minute 2 year Winter I+40%	88.314	87.202	-0.059	0.000	0.68		9.7
1.004	SWMH5	15 minute 2 year Winter I+40%	88.001	87.050	-0.099	0.000	0.58		25.6
1.005	SWMH6	15 minute 2 year Winter I+40%	87.760	86.523	-0.157	0.000	0.20		25.4
1.006	SWMH7	15 minute 2 year Winter I+40%	81.246	80.292	-0.108	0.000	0.53		25.4
1.007	SWMH8	15 minute 2 year Winter I+40%	81.001	80.127	-0.157	0.000	0.20		25.5
1.008	SWMH9	15 minute 2 year Winter I+40%	79.644	78.756	-0.131	0.000	0.36		25.2
1.009	SWMH10	15 minute 2 year Winter I+40%	78.304	77.229	-0.131	0.000	0.36		25.3
2.000	SWMH11	15 minute 2 year Winter I+40%	76.341	75.234	-0.132	0.000	0.35		13.6
2.001	SWMH12	15 minute 2 year Winter I+40%	76.459	75.009	-0.132	0.000	0.35		13.7
2.002	SWMH13	15 minute 2 year Winter I+40%	76.566	74.819	-0.134	0.000	0.34		13.4
2.003	SWMH14	15 minute 2 year Winter I+40%	76.256	74.508	-0.136	0.000	0.32		12.9
2.004	SWMH15	15 minute 2 year Winter I+40%	77.116	74.052	-0.091	0.000	0.30		11.7
2.005	SWMH16	15 minute 2 year Winter I+40%	77.144	74.025	0.075	0.000	0.37		13.6
3.000	SWMH17	15 minute 2 year Winter I+40%	84.103	82.934	-0.194	0.000	0.05		6.4
4.000	SWMH18	15 minute 2 year Winter I+40%	78.871	77.723	-0.181	0.000	0.08		3.6
3.001	SWMH19	15 minute 2 year Winter I+40%	78.398	77.269	-0.129	0.000	0.38		19.4
3.002	SWMH20	15 minute 2 year Winter I+40%	78.207	77.114	-0.138	0.000	0.32		19.5
3.003	SWMH21	15 minute 2 year Winter I+40%	77.223	76.445	-0.127	0.000	0.39		19.1
3.004	SWMH22	15 minute 2 year Winter I+40%	77.031	76.021	-0.168	0.000	0.14		19.2
3.005	SWMH23	15 minute 2 year Winter I+40%	75.151	74.378	0.115	0.000	1.28		18.8
2.006	SWMH24	15 minute 2 year Winter I+40%	76.982	74.005	0.235	0.000	2.15		27.1
5.000	SWMH25	15 minute 2 year Winter I+40%	75.984	74.873	-0.136	0.000	0.32		12.4

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Status
1.000	SWMH1	OK
1.001	SWMH2	OK
1.002	SWMH3	OK
1.003	SWMH4	OK
1.004	SWMH5	OK
1.005	SWMH6	OK
1.006	SWMH7	OK
1.007	SWMH8	OK
1.008	SWMH9	OK
1.009	SWMH10	OK
2.000	SWMH11	OK
2.001	SWMH12	OK
2.002	SWMH13	OK
2.003	SWMH14	OK
2.004	SWMH15	OK
2.005	SWMH16	SURCHARGED
3.000	SWMH17	OK
4.000	SWMH18	OK
3.001	SWMH19	OK
3.002	SWMH20	OK
3.003	SWMH21	OK
3.004	SWMH22	OK
3.005	SWMH23	SURCHARGED
2.006	SWMH24	SURCHARGED
5.000	SWMH25	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
5.001	SWMH26	15 minute 2 year Winter I+40%	76.171	74.734	-0.128	0.000	0.38		12.5
5.002	SWMH27	15 minute 2 year Winter I+40%	76.398	74.673	-0.135	0.000	0.34		12.5
5.003	SWMH28	15 minute 2 year Winter I+40%	77.475	74.561	-0.134	0.000	0.34		12.4
5.004	SWMH29	15 minute 2 year Winter I+40%	76.713	74.467	-0.136	0.000	0.33		12.4
5.005	SWMH30	15 minute 2 year Winter I+40%	76.521	74.325	-0.137	0.000	0.32		12.4
5.006	SWMH31	15 minute 2 year Winter I+40%	76.124	74.163	-0.139	0.000	0.30		12.1
5.007	SWMH32	15 minute 2 year Winter I+40%	77.373	73.815	-0.140	0.000	0.30		11.9
2.007	SWMH33	15 minute 2 year Winter I+40%	76.092	73.673	-0.013	0.000	0.99		40.4
1.010	SWMH34	15 minute 2 year Winter I+40%	77.447	72.980	-0.092	0.000	0.65		64.3
1.011	SWMH35	480 minute 2 year Winter I+40%	72.710	71.181	0.138	0.000	0.20		16.5
1.012	SWMH36	480 minute 2 year Winter I+40%	72.000	71.174	0.149	0.000	0.05		5.0

PN	US/MH Name	Status
5.001	SWMH26	OK
5.002	SWMH27	OK
5.003	SWMH28	OK
5.004	SWMH29	OK
5.005	SWMH30	OK
5.006	SWMH31	OK
5.007	SWMH32	OK
2.007	SWMH33	OK
1.010	SWMH34	OK
1.011	SWMH35	SURCHARGED
1.012	SWMH36	SURCHARGED

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	75.549	0.549	5.0	27.9	O K
30 min Summer	75.671	0.671	5.0	37.4	O K
60 min Summer	75.769	0.769	5.0	46.1	Flood Risk
120 min Summer	75.831	0.831	5.0	52.2	Flood Risk
180 min Summer	75.855	0.855	5.0	54.7	Flood Risk
240 min Summer	75.867	0.867	5.0	55.9	Flood Risk
360 min Summer	75.874	0.874	5.0	56.6	Flood Risk
480 min Summer	75.869	0.869	5.0	56.1	Flood Risk
600 min Summer	75.858	0.858	5.0	55.0	Flood Risk
720 min Summer	75.842	0.842	5.0	53.4	Flood Risk
960 min Summer	75.804	0.804	5.0	49.6	Flood Risk
1440 min Summer	75.710	0.710	5.0	40.7	Flood Risk
2160 min Summer	75.499	0.499	5.0	24.3	O K
2880 min Summer	75.334	0.334	5.0	14.2	O K
4320 min Summer	75.164	0.164	4.7	6.0	O K
5760 min Summer	75.115	0.115	4.1	4.0	O K
7200 min Summer	75.100	0.100	3.6	3.5	O K
8640 min Summer	75.091	0.091	3.2	3.1	O K
10080 min Summer	75.085	0.085	2.9	2.9	O K
15 min Winter	75.600	0.600	5.0	31.7	O K
30 min Winter	75.731	0.731	5.0	42.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	47.163	0.0	31.6	18
30 min Summer	33.049	0.0	44.4	32
60 min Summer	22.441	0.0	60.2	60
120 min Summer	14.956	0.0	80.3	104
180 min Summer	11.732	0.0	94.5	138
240 min Summer	9.862	0.0	105.9	172
360 min Summer	7.711	0.0	124.2	242
480 min Summer	6.470	0.0	139.0	312
600 min Summer	5.645	0.0	151.6	382
720 min Summer	5.049	0.0	162.7	452
960 min Summer	4.233	0.0	181.8	588
1440 min Summer	3.299	0.0	212.6	854
2160 min Summer	2.571	0.0	248.5	1208
2880 min Summer	2.154	0.0	277.6	1528
4320 min Summer	1.678	0.0	324.5	2204
5760 min Summer	1.406	0.0	362.4	2912
7200 min Summer	1.226	0.0	395.0	3672
8640 min Summer	1.096	0.0	423.8	4400
10080 min Summer	0.997	0.0	449.8	5056
15 min Winter	47.163	0.0	35.4	18
30 min Winter	33.049	0.0	49.7	32

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	75.841	0.841	5.0	53.2	Flood Risk
120 min Winter	75.915	0.915	5.0	61.1	Flood Risk
180 min Winter	75.938	0.938	5.0	63.6	Flood Risk
240 min Winter	75.948	0.948	5.0	64.7	Flood Risk
360 min Winter	75.945	0.945	5.0	64.4	Flood Risk
480 min Winter	75.927	0.927	5.0	62.4	Flood Risk
600 min Winter	75.901	0.901	5.0	59.5	Flood Risk
720 min Winter	75.869	0.869	5.0	56.1	Flood Risk
960 min Winter	75.796	0.796	5.0	48.8	Flood Risk
1440 min Winter	75.574	0.574	5.0	29.7	O K
2160 min Winter	75.255	0.255	5.0	10.1	O K
2880 min Winter	75.134	0.134	4.5	4.8	O K
4320 min Winter	75.099	0.099	3.5	3.4	O K
5760 min Winter	75.086	0.086	3.0	2.9	O K
7200 min Winter	75.078	0.078	2.6	2.6	O K
8640 min Winter	75.072	0.072	2.3	2.4	O K
10080 min Winter	75.068	0.068	2.1	2.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	22.441	0.0	67.5	60
120 min Winter	14.956	0.0	89.9	114
180 min Winter	11.732	0.0	105.8	144
240 min Winter	9.862	0.0	118.6	184
360 min Winter	7.711	0.0	139.1	262
480 min Winter	6.470	0.0	155.6	340
600 min Winter	5.645	0.0	169.7	416
720 min Winter	5.049	0.0	182.2	488
960 min Winter	4.233	0.0	203.6	634
1440 min Winter	3.299	0.0	238.1	896
2160 min Winter	2.571	0.0	278.3	1188
2880 min Winter	2.154	0.0	310.9	1476
4320 min Winter	1.678	0.0	363.4	2200
5760 min Winter	1.406	0.0	405.9	2928
7200 min Winter	1.226	0.0	442.4	3632
8640 min Winter	1.096	0.0	474.6	4312
10080 min Winter	0.997	0.0	503.7	4992

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.900	Shortest Storm (mins)	15
Ratio R	0.228	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.358

Time (mins) From:	To:	Area (ha)
0	4	0.358

Model Details

Storage is Online Cover Level (m) 76.000

Tank or Pond Structure

Invert Level (m) 75.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	31.5	0.400	59.9	0.800	97.4
0.200	44.6	0.600	77.5	1.000	119.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	75.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

E. Greenfield Runoff Calculations

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by: Balaji Naik

Site name: Marubeni Bridgend Green

Site location: Bryncethin

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude: 51.54792° N

Longitude: 3.56317° W

Reference: 3802285287

Date: Oct 26 2022 15:44

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.421

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics	Default	Edited
SAAR (mm):	1408	1408
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	2.74	2.74
1 in 1 year (l/s):	2.41	2.41
1 in 30 years (l/s):	4.88	4.88
1 in 100 year (l/s):	5.97	5.97
1 in 200 years (l/s):	6.74	6.74

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Marta Garcia Hernansanz
Site name:	Marubeni Bridgend
Site location:	Bridgend

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.54721° N
Longitude:	3.5739° W
Reference:	3357310520
Date:	Oct 25 2022 09:35

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 0.63

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics	Default	Edited
SAAR (mm):	1387	1387
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	4.03	4.03
1 in 1 year (l/s):	3.54	3.54
1 in 30 years (l/s):	7.17	7.17
1 in 100 year (l/s):	8.78	8.78
1 in 200 years (l/s):	9.91	9.91