

**WESTERN BIO ENERGY LIMITED
PROTIUM GREEN HYDROGEN SUPPLY LIMITED**



**DRAINAGE STRATEGY FOR
HYDROGEN PRODUCTION FACILITY
AT WESTERN WOOD BIOMASS PLANT**

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Project Quality Assurance

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Prepared for : Protium Green Hydrogen Supply Limited
Unit 110
164 – 180 Union Street
London
SE1 0LH

Issued by : Sirius Environmental Limited
4245 Park Approach
Thorpe Park
Leeds
LS15 8GB

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1	15/04/2024	Amendments following Client review	JD	AK

Purpose

This document was prepared as a Drainage Strategy for Western Bio Energy (WBE) as the applicant and Protium Green Hydrogen Supply Limited (Protium) as the agent, to support a planning application for a Hydrogen Production Facility (HPF) on land at the existing Western Wood Biomass Plant in Margam, Port Talbot.

Sirius Environmental Limited (Sirius) accepts no responsibility or liability for any use, that is made of this document, other than by the Client for the purposes for which it was originally commissioned and prepared.

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1 INTRODUCTION

1.1 General

Sirius Environmental Limited (Sirius) were commissioned by Sirius Planning Limited (SPL) on behalf of, Western Bio Energy Limited (WBE) as the applicant and Protium Green Hydrogen Supply Limited (Protium) as the agent, to produce a drainage strategy to support the planning application for a Hydrogen Production Facility (the proposed development).

The proposed development is located within the boundary of the existing Western Wood Biomass Plant. Western Wood Biomass Plant is situated approximately 4.5km south west of the town of Port Talbot in South Wales.

The proposed development is located off Longland Lane, Margam, Port Talbot, SA13 2NR. The site entrance is at Ordnance Survey (OS) grid reference **SS 791 862**.

This drainage strategy shall detail the proposed methods for dealing with any surface water generated as a result of the Hydrogen Production Facility (HPF).

Figure 1 below shows the site location along with the planning boundary in red and the concrete slab extension area in black.

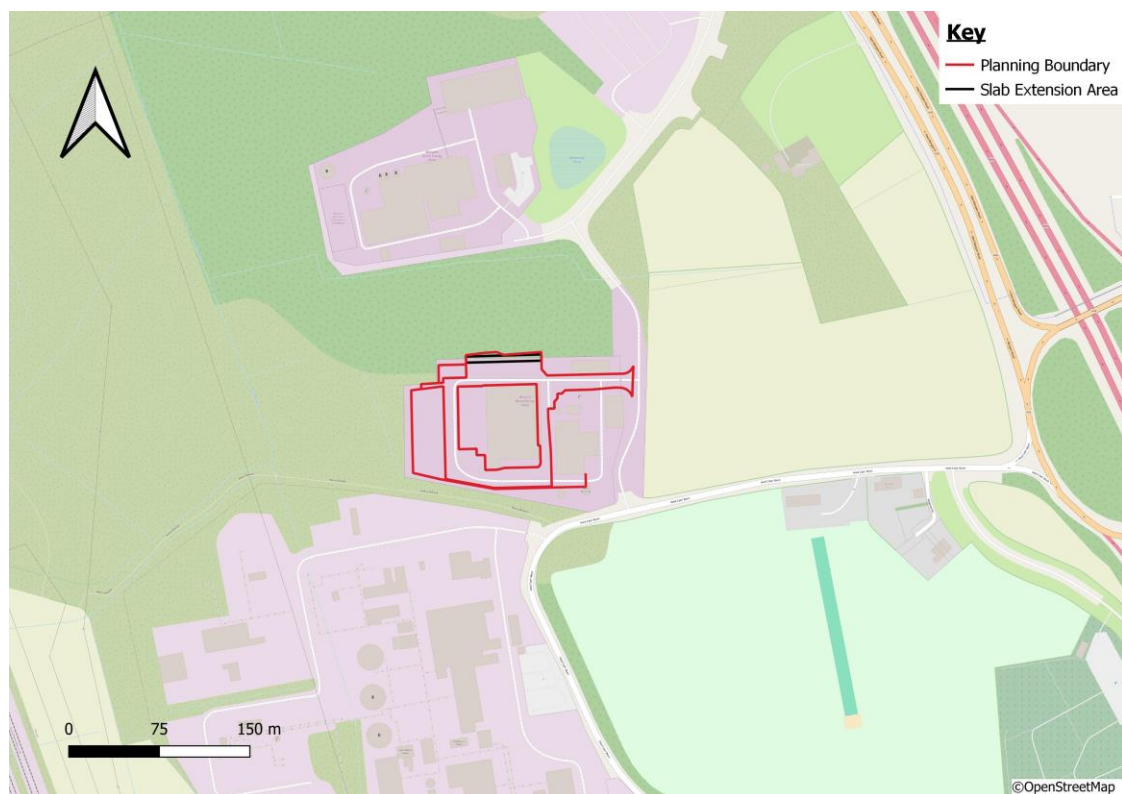


Figure 1 – Site Location Plan

1.2 Current Surface Water Drainage Guidance

In Wales the flood and water management Act 2010, known as Schedule 3, came into force on the 7th January 2019 and requires all new developments to include Sustainable Drainage Systems (SuDS) features to manage any surface water generated. As a result of Schedule 3 being implemented, a set of statutory standards were development which must be followed when undertaking drainage design within Wales.

The six standards are as follows;

1. Standard S1 – Surface Water Runoff Destination;
2. Standard S2 – Surface Water Hydraulic Control;
3. Standard S3 – Surface Water Quality;
4. Standard S4 – Amenity;
5. Standard S5 – Biodiversity; and
6. Standard S6 - Design of drainage for Construction, Operation and Maintenance and Structural Integrity.

These statutory standards must be followed where the proposed development area equals or exceeds 100m².

As part of the Schedule 3 implementation, the introduction of SuDS Approval Body (SAB) was created. Prior to commencement of construction, approval on the drainage scheme shall be required from the SAB.

2 DEVELOPMENT PROPOSALS

Planning permission is being sought by Protium to install a Hydrogen Production Facility comprising of the following:

- An Electrolytic Hydrogen Production Facility (HPF) and associated compression and storage;
- A Hydrogen Tube-Trailer Filling Station (HTTFS); and
- Renewable electricity provision from a co-located biomass plant via private wire.

This HPF shall mainly be located on the existing concrete hardstanding at the site which drains to the existing surface water drainage system installed at Western Wood Biomass Plant. However, there shall be an additional area of concrete slab constructed to the north of the existing concrete hardstanding to accommodate the HPF proposal. The proposed concrete pad extension area measures 342m² including fire wall.

The proposed development layout is shown on Figure 2 below.

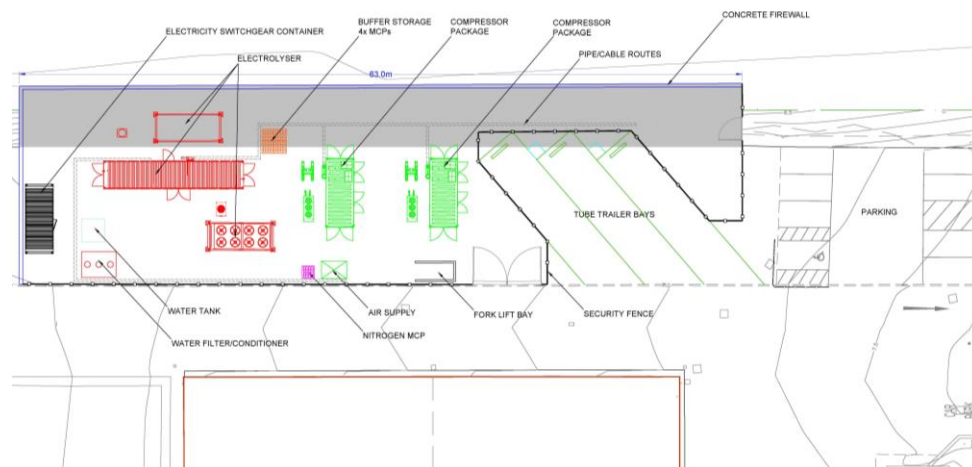


Figure 2 – Proposed Development Layout

3 TOPOGRAPHY

A topographic survey of the site was conducted in October 2023. Generally the site falls from east to west. The eastern boundary of the site has the highest elevation with a level of approximately 9.50mAOD, with the lowest elevation occurring on the western boundary with an elevation of approximately 4.50mAOD.

4 GEOLOGY

As part of this drainage strategy, the British Geology Survey (BGS) maps have been studied to determine the underlying geology for the proposed development area. The BGS maps show that the superficial deposits, varies across the development area. The superficial deposits are either Devensian Glaciofluvial Ice Contact Deposits comprising sand and gravels or Tidal Flat Deposits comprising either clay, silt and sand. The bedrock geology is formed from the South Wales Middle Coal Measures formation which comprises mudstones, siltstones and sandstones.

It is therefore anticipated that the ground shall be receptive and suitable for infiltration/soakaway methods to deal with any surface water runoff generated from the proposed additional area of concrete slab.

5 EXISTING SITE SURFACE WATER DRAINAGE

The as-built drawings for the currently installed surface water drainage network at the Western Wood Biomass Plant have been reviewed.

The existing site access road and concrete hardstanding areas drain via a series of road gullies, which subsequently fall into underground carrier pipework of varying diameters. The carrier pipework for the external hardstanding areas then generally falls in a westerly direction where all surface water passes through a full retention separator, before draining into the attenuation pipe for subsequent infiltration into the underlying geological strata and any overflow discharged into the local ditch network in the north western corner of the site.

The drainage from the roofs of the existing structures present at the site, collect runoff via rainwater gullies. This water is then subsequently transferred into a separate set of underground carrier pipework, as this does not need to be directed through the retention separator, due to risk of contamination being low. These carrier pipes then fall in a westerly direction where they eventually connect into the attenuation pipework, where this is then infiltrated into the underlying geological strata and any overflow discharged into the local ditch network in the north western corner of the site.

The as-built surface water drainage drawings are presented in Appendix 1.

Part of the proposed HPF is located on the existing slab where the existing surface water drainage is currently installed. Where the HPF is located on existing hardstanding, this area will not increase the amount of hardstanding/impermeable area draining to the existing surface water drainage network on the site and therefore shall not increase the flood risk. As a result of this, the existing drainage network and areas of HPF located on the existing slab have not been assessed further in this drainage strategy.

6 PROPOSED SURFACE WATER DRAINAGE FOR CONCRETE SLAB EXTENSION AREA

6.1 General

As stated in previous sections of this drainage strategy, in 2019 Schedule 3 was implemented in Wales meaning that SuDS drainage systems have to be included within all new development.

Therefore the surface water drainage design associated with the proposed concrete pad extension area is based on the principles stated within the “Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems”.

This section shall document the proposed strategy for dealing with any surface water runoff generated as a result of the proposed development associated with the concrete slab extension, as well as detailing how the six standards shall be achieved.

No formal SAB pre-app consultation has been undertaken. However, the design has been made with suitable consideration to ensure compliance with the guidance requirements.

6.2 SuDS Standards Compliance

6.2.1 Standard S1 – Surface Water Runoff Destination

This standard looks at where the generated surface water is discharged too. Within the guidance the locations available for surface water discharge are split into 5 levels, with level 1 being the preferred option and level 5 being the least preferred option which should only be used in exceptional circumstances.

Level 1 is collecting surface water for reuse. As there are no water supply concerns it is deemed that to install a rainwater harvesting system would not be cost effective for the development. Also the area that is being drained shall be an external area which is deemed to not be suitable for rainwater harvesting systems. Therefore, a level 2 or greater disposal method shall be considered.

Level 2 is infiltrating surface water runoff into the ground. A review of the British Geological Survey maps show that there are sand and gravel deposits present within the vicinity of the proposed development. These deposits are considered to have a high enough infiltration rate to mean that infiltration into the ground is a suitable method for dealing with surface water from the additional concrete slab area.

As part of the SAB application infiltration tests shall be undertaken in accordance with Building Research Establishment (BRE) Digest 365 document to confirm the infiltration rate.

Any changes to infiltration structure sizing resulting from the infiltration testing shall be undertaken as part of the SAB application.

6.2.2 Standard S2 – Surface Water Hydraulic Control

This standard looks at ensuring that the discharge rate from any proposed development does not exceed the greenfield runoff rate for the site, pre development, or does not exceed the current brownfield rate if the site is already developed.

The greenfield runoff rate for the additional concrete slab extension area has been calculated. The calculated runoff rates are presented in Table 1 below.

Table 1 – Calculated Greenfield Runoff Rates	
	Runoff Rate (l/s)
Q _{Bar}	0.14
Q ₁	0.13
Q ₃₀	0.26
Q ₁₀₀	0.32

As the geology is indicated to be suitable for infiltration no formal attenuation storage is required as would be the case if the proposed development was draining to a water course or sewer.

The proposed infiltration structure/structures shall be sized to cater for the 1% Annual Exceedance Probability (AEP) event with an additional allowance of 40% for climate change. Where possible the infiltration structures shall meet the half drain time requirements for all events up to and including the 1% AEP event with an additional allowance of 40% for climate change. However if the infiltration rate is equal to or lower than $K=1 \times 10^{-6}$ m/s it is likely that it will not be possible to achieve the half drain time for the 1% AEP event without making the structures excessively large. Therefore, in accordance with Ciria C753 the half drain time for a lower infiltration rate would be achieved for the 3.3% AEP event. For the purpose of this drainage strategy and to allow initial sizing of the infiltration structure to be undertaken, it has been assumed based on previous experience and also taking a conservative approach that the infiltration rate of the sand and gravel shall be $K = 5 \times 10^{-6}$ m/s.

Urban creep is not considered appropriate for this drainage strategy as any future extensions shall be regulated through the planning process.

6.2.3 Standard S3 – Surface Water Quality

The surface water quality can be assessed using the Simple Index Approach (SIA) which is set out in the SuDS manual. The SIA uses a pollution hazard index which varies for each pollution hazard level and then mitigation indices for each component within the treatment train or the characteristics of material overlying infiltration structure. To ensure that the surface water quality is maintained for any proposed development the mitigation indices must exceed the pollution hazard index for the pollution hazard level within which the proposed development falls.

The proposed extension to the concrete slab shall not be subject to any vehicle movements and only minimal parts of the HPPF are located on it, so it is very unlikely any contamination of surface water shall occur. Therefore the proposed extension to the concrete slab shall be assigned a low pollution hazard level and is more likely to have a pollution hazard index linked to an industrial roof (0.3 for Total Suspended Solids, 0.2 for metal and 0.05 for hydrocarbons) rather than a low pollution hazard level linked to vehicle movements.

Above the infiltration structure there shall be a dense layer of grassed vegetation and this shall overlie a 300mm thick layer of top soil. This shall provide the following mitigation indices; for Total Suspended Solids (TSS) 0.6, for metals 0.5 and for hydrocarbons 0.6.

The total mitigation indices shall exceed the pollution hazard index and ensure that the surface water quality is maintained.

6.2.4 Standard S4 – Amenity

Although an infiltration structure generally does not have any inherent amenity value, the use of the infiltration structure/structures as a surface water control for the proposed development shall allow for the drainage to be installed sub surface. This shall allow for a grassed finish to be achieved on top of the structure resulting in this blending into the existing landscape.

6.2.5 Standard S5 – Biodiversity

As the infiltration structure is proposed to be subsurface, this shall allow a permeable top soil layer to be placed above the structure to allow for this to be grassed following completion. By grassing the top of the structure this shall link into the local natural species and habitats that are already present within the area especially the wetland areas to the north of the site.

The area where the proposed structure is to be located is currently grassed so this will ensure continue of biodiversity once the construction works are completed.

6.2.6 Standard S6 – Design of Drainage for Construction, Operation and Maintenance and Structural Integrity

All SuDS features have been designed in accordance with the requirements set out in the SuDS manual CIRIA C753 and shall be constructed in accordance with the requirements stated in Ciria C768.

To minimise the risk to personnel, the surface water drainage system for the proposed concrete slab extension has been designed to operate with minimal human interaction. The location of infiltration structures has been considered as part of this drainage strategy and has been located to the north of the proposed additional concrete slab area to allow for easy access for any maintenance works that maybe required in the future. The infiltration structures shall remain in private ownership and any maintenance/remedial requirements shall be the responsibility of the clients.

The surface water system associated with the proposed concrete slab extension shall require maintenance from time to time to ensure the surface water drainage system remains effective at dealing with the surface water runoff generated. As the proposed surface water system only comprises an infiltration structure this is the only component that shall require maintenance. Table 2 below shows the maintenance requirements for the infiltration structures.

Table 2 – Maintenance Requirements for Infiltration Structure		
Maintenance Schedule	Required Actions	Typical Frequency
Regular Maintenance	Cut grass above infiltration structure	Half yearly minimum or as required during spring and summer months
	Inspect infiltration structure for sediment and debris accumulations on the top surface of the infiltration structure	Once a year minimum
	Trimming any roots that maybe causing blockages within the infiltration structure	Once a year (or as required)
	Remove any litter or debris that may have collected on top of the infiltration structure	Monthly
Occasional Maintenance	Remove sediment from top surface of the infiltration structure if required based on inspections	As required based on inspections
Remedial Actions	Reconstruct infiltration structure and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of infiltration structure)	As required
Monitoring	Check infiltration structure to ensure that the structure is emptying correctly	Once a year

*Table recreated from SuDS manual (Ciria C753) for infiltration structures.

All maintenance on the proposed surface water drainage system shall be undertaken by the client for whom this drainage strategy has been prepared for.

6.3 Overview of Infiltration Structure Sizing

To ensure the infiltration structure is of sufficient size to deal with the proposed additional concrete slab area, drainage calculations were undertaken in Microdrainage 2020.1. The drainage calculations were analysed for events up to and include the 1% Annual Exceedance Probability (AEP) with an additional allowance of 40% for climate change. Within the Microdrainage calculations a runoff coefficient (Cv) of 1 has been used, in accordance with latest guidance, to ensure that all runoff generated from the additional concrete slab shall enter the drainage system.

The infiltration rate of the surrounding strata has been assumed, for the purpose of this drainage strategy, to be 5×10^{-6} m/s. This value used is deemed to be conservative for sand and gravel deposits which make up the geology in the location where the infiltration structure is proposed. The SuDS manual recommends typical infiltration rates for sand and gravel of between 3×10^{-2} m/s for gravel and 1×10^{-5} m/s for sand. Full infiltration testing shall be undertaken as part of the SAB application.

Due to land ownership boundary constraints the infiltration structure shall need to be split into a smaller and larger structure. The larger structure shall drain an area of approximately 230m² with the smaller structure draining an area of 90m². These areas are slightly less than the total slab area as approximately 20m² around the perimeter shall have a fire wall constructed on it. Based on an infiltration rate of 5×10^{-6} m/s the larger infiltration structure shall need to cover an area of approximately 52m² and be 1.2m deep, with the smaller structure covering an area of 21m² and again being 1.2m deep. A porosity of 30% has been assumed based on the use of Type B filter media in accordance with the specification for highway works. The Microdrainage calculations show that there is no flooding recorded for either of the infiltration structures, for any events analysed, up to and including the 1% AEP event with an additional allowance of 40% for climate change. Therefore indicating that the infiltration structures are of sufficient size. The Microdrainage calculations are presented in Appendix 3.

To allow for surface water runoff from the concrete slab extension to reach the infiltration structures there shall be 150mm diameter pipes installed at the base of the firewall at a maximum of 5m centres.

As the infiltration structures shall be to the north of the existing Western Wood Biomass Plant and the proposed hydrogen production facility, along with the ground naturally sloping away to the north, the consequences of failure of the infiltration system would be deemed to cause no inconvenience nor cause any damage. Therefore in accordance with Table 25.2 of the SuDS manual a factor of safety of 1.5 has been within the calculations.

The half drain time recorded from the Microdrainage calculations, for the 1% AEP event with an additional allowance of 40% for climate change, is 581 minutes for the larger structure and 497 minutes for the smaller structure. Therefore, this meets the requirement to be half full in less than the 1440 minute (24hrs).

The details of the proposed surface water scheme and infiltration structures are shown on Drawing PRO1002/01/01 presented in Appendix 2.

6.4 Electrical Substation Area

The area where the electrical substation is to be installed shall have a gravelled surface. By installing a gravelled surface this shall ensure that the amount of impermeable surfacing is not increased leading to no increase in the amount of surface water runoff generated. This shall ensure that the surface water post installation mimics what currently happens on site in this area.

As a result of this the surface water drainage for the electrical substation area has not been assessed further in this report as it will not increase the flood risk on or off site.

7 CONCLUSIONS

This drainage strategy has assessed the proposals for dealing with the surface water runoff that shall be generated by the additional concrete slab area as part of the proposed Hydrogen Production Facility. The geology in the area, from the geological maps, show that it is likely to be suitable for infiltration into the surrounding strata.

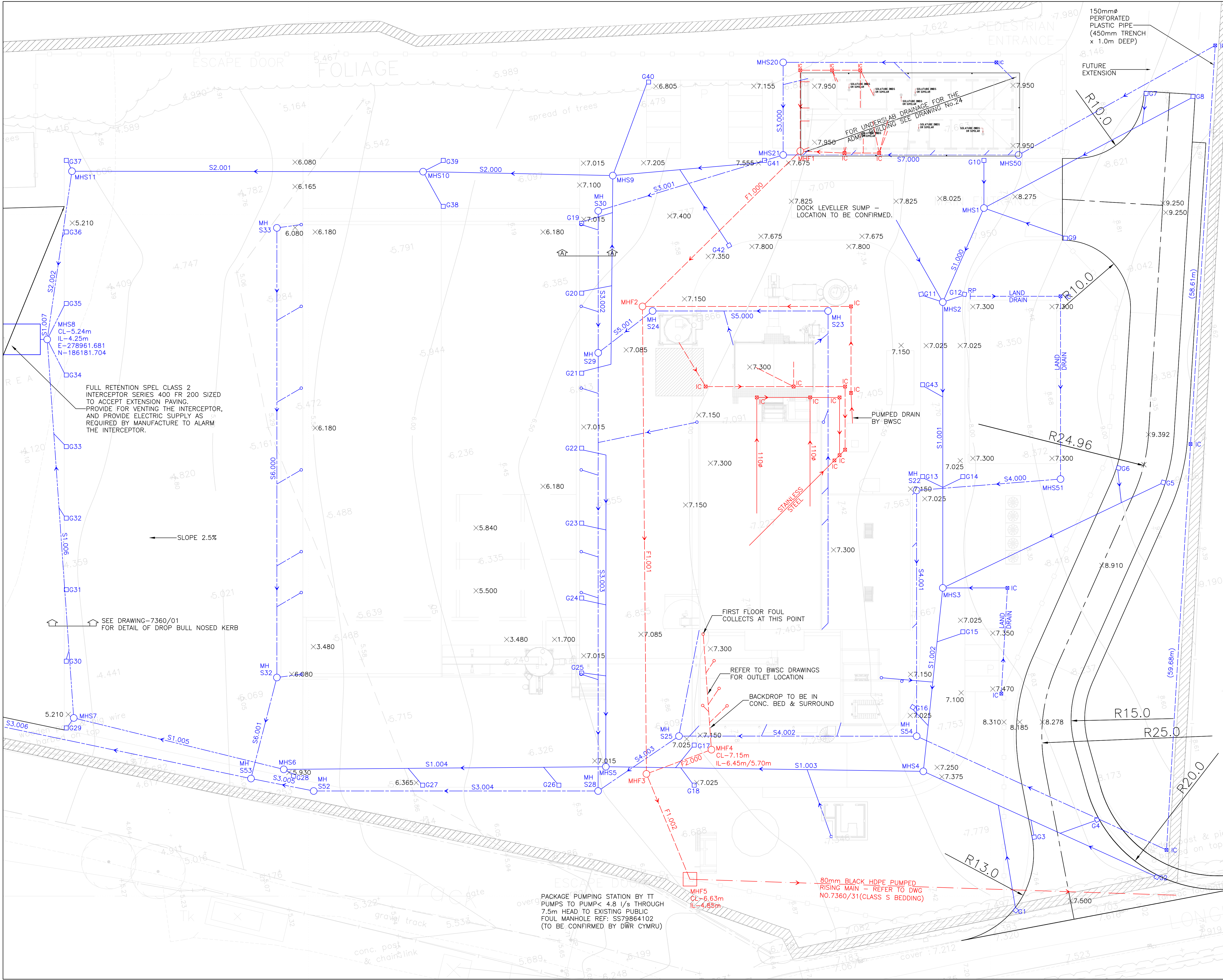
The surface water drainage system shall comprise a larger and a smaller infiltration structure to the north of the hydrogen production facility, which shall have dimensions similar to 52m² for the larger structure and 21m² for the smaller structure with both being 1.2m deep. The Microdrainage calculations show that the infiltration structures can appropriately deal with the 1% Annual Exceedance Probability event with an additional allowance of 40% for climate change.

The existing surface water drainage system shall continue to be used for the existing hardstanding areas as the proposals do not increase the amount of impermeable area draining to the existing drainage system.

Whilst the drainage system remains subject to SAB approval, this drainage strategy has shown that surface water can be effectively managed and follows the principles of a SAB compliant surface water drainage system with sufficient detail to support the planning application for the proposed Hydrogen Production Facility.

APPENDIX 1

AS-BUILT DRAINAGE DRAWING FOR WESTERN WOOD BIOMASS PLANT



- NOTES**
- 1.FOR DRAINAGE DETAILS SEE DRAWING No.7360/30-31
 - 2.FOR ROAD AND KERB DETAILS SEE DRAWING No.7360/01
 - 3.LAND DRAINS SHOWN ARE PROVISIONAL.
 - 4.FOR MANHOLE & GULLY SCHEDULE REFER TO DRAWING No.7360/21
 - 5.FOR SECTION A-A REFER TO DRAWING No.7360/30
 6. A MANHOLE TO BE ADDED ON F1.001 IF RUN EXCEEDS A LENGTH OF 60m.
 7. FOR ADMINISTRATION BUILDING INTERNAL DRAINAGE REFER TO DRAWING 7360/105.
- POSITION OF ASH SILO AS GIVEN BY ALUN GRIFFITHS CONTRACTORS.
- FOR CONSTRUCTION UNLESS NOTED OTHERWISE

DRAINAGE KEY	
	SURFACE WATER DRAINAGE
	ROOF WATER DRAINAGE
	LAND DRAIN
	CONC. BED & SURROUND
	FOUL DRAINAGE
	PUMPED FOUL
	DRAINAGE BY BWSC
	STORM MANHOLE
	FOUL MANHOLE
	GULLY
	RODDING POINT STORM
	RODDING POINT FOUL
	INSPECTION CHAMBER FOUL
	INSPECTION CHAMBER STORM
	SOIL VENT PIPE

REV	REVISION	BY	DATE
S	ADMIN BUILDING DRAINAGE AMENDED (NOTE 7 ADDED)	ACV	09.08.07
R	MHF2 & F1.000-F1.001 AMENDED (NOTE 6 ADDED)	ACV	24.07.07
Q	MHF2 & F1.000-F1.001 AMENDED	ACV	20.07.07
P	AS SHOWN IN REVISION CLOUD	ACV	26.06.07
N	DRAINAGE AMENDED	ACV	10.05.07
M	DRAINAGE AMENDED	ACV	30.04.07
L	DRAINAGE AMENDED	ACV	25.04.07
K	DRAINAGE AMENDED AS SHOWN	ACV	23.04.07
J	PROVISIONAL CLOUD OMITTED & DRAIN FROM ASH SILO ADDED	ACV	02.04.07
H	DRAIN FROM TRANSFORMER BAYS ADDED (AS SHOWN) AND GULLY 43 ADDED ON RUN S1.001 (AS SHOWN)	ACV	16.03.07
G	INTERCEPTOR REFERENCE AMENDED	ACV	12.03.07
F	DRAINAGE AMENDED & LAND DRAIN OMITTED	ACV	05.03.07
E	DRAINAGE AMENDED	ACV	02.03.07
D	NOTES AMENDED	ACV	06.02.07
C	PROVISIONAL CLOUD ADDED	ACV	24.01.07
B	DRAINAGE AND MH SCHEDULE REVISED	ACV	22.01.07
A	DRAINAGE AND MH SCHEDULE REVISED	ACV	17.01.07

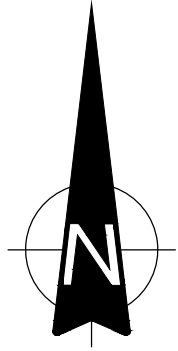
DO NOT SCALE THIS DRAWING.
ENGINEERS TO BE NOTIFIED OF ANY DISCREPANCIES IN FIGURED DIMENSIONS.
CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE.
THIS DRAWING IS COPYRIGHT.



CLIENT		ALUN GRIFFITHS CONTRACTORS LTD	
PROJECT		BIOMASS POWER STATION PORT TALBOT	
DRAWING TITLE		GENERAL ARRANGEMENT SITE DRAINAGE (1 OF 2)	
SCALE	DESIGNED	BY	CHECK
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@ A1			
PROJECT NO.	DRAWING NO.	DATE	
7360	20	NOV. 2006	
		S	

APPENDIX 2

PROPOSED SURFACE WATER DRAINAGE DRAWING



PROPOSED LARGER BELOW GROUND INFILTRATION STRUCTURE. INFILTRATION STRUCTURE TO HAVE AN AREA OF APPROXIMATELY 52m² IN ORDER TO DRAIN AN AREA OF 230m². INFILTRATION STRUCTURE TO BE FILLED WITH TYPE B FILTER MEDIA IN ACCORDANCE WITH CLAUSE 505 OF SPECIFICATION FOR HIGHWAY WORKS TO ACHIEVE A POROSITY OF 30%. INFILTRATION TRENCH TO BE WRAPPED IN GEOTEXTILE SURROUND. 300mm OF TOP SOIL SHALL BE PLACED ABOVE THE INFILTRATION STRUCTURE FOR SURFACE WATER QUALITY MEASURES WHICH SHALL ALLOW FOR WELL ESTABLISHED VEGETATION TO FORM.

PROPOSED HYDROGEN PRODUCTION FACILITY

PROPOSED SMALLER BELOW GROUND INFILTRATION STRUCTURE. INFILTRATION STRUCTURE TO HAVE AN AREA OF APPROXIMATELY 21m² IN ORDER TO DRAIN AN AREA OF 90m². INFILTRATION STRUCTURE TO BE FILLED WITH TYPE B FILTER MEDIA IN ACCORDANCE WITH CLAUSE 505 OF SPECIFICATION FOR HIGHWAY WORKS TO ACHIEVE A POROSITY OF 30%. INFILTRATION TRENCH TO BE WRAPPED IN GEOTEXTILE SURROUND. 300mm OF TOP SOIL SHALL BE PLACED ABOVE THE INFILTRATION STRUCTURE FOR SURFACE WATER QUALITY MEASURES WHICH SHALL ALLOW FOR WELL ESTABLISHED VEGETATION TO FORM.

150mm DIAMETER PIPES TO BE INSTALLED AT THE BASE OF THE FIRE WALL AT A MAXIMUM OF 5m CENTRES TO ALLOW SURFACE WATER RUNOFF TO DRAIN THROUGH THE WALL AND INTO THE INFILTRATION STRUCTURES.

WHERE THE PIPEWORK THROUGH THE WALL IS INSTALLED THE LEVELS ON THE CONCRETE SLAB SHALL ADJUSTED SO THAT A FALL IS ENGINEERED TOWARDS THE PIPEWORK SO THAT NO PONDING WATER OCCURS ON THE SURFACE AND THERE IS NO RESTRICTION TO THE FLOW.

WEIGHBRIDGE

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NOTES

1. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS IN METRES ABOVE ORDNANCE DATUM.
2. DO NOT SCALE FROM THIS DRAWING.
3. ANY ANOMALIES IDENTIFIED WITH THE DETAILS SHOWN ON THIS DRAWING ARE TO BE BROUGHT TO THE ATTENTION OF SIRIUS ENVIRONMENTAL PRIOR TO CONSTRUCTION WORKS COMMENCING.
4. THE EXISTING CONCRETE HARDSTANDING AREAS SHALL CONTINUE TO DRAIN TO THE EXISTING SURFACE WATER DRAINAGE SYSTEM AS CURRENTLY DOES ON SITE.
5. ONLY THE PROPOSED CONCRETE SLAB EXTENSION SHALL DRAIN TO THE INFILTRATION STRUCTURES.

KEY

- 150mm PIPEWORK
- FILTRATION GEOTEXTILE
- PROPOSED CONCRETE EXTENSION
- EXISTING CONCRETE HARDSTANDING
- INFILTRATION STRUCTURE
- TYPE B FILTER MEDIA
- TOP SOIL

1	LAYOUT OF HYDROGEN PLANT AMENDED	15/04/24	JD
REV	DESCRIPTION	DATE	BY

CLIENT

PROTIUM



4245 Park Approach, Thorpe Park, Leeds. LS15 8GB. 0113 264 9960

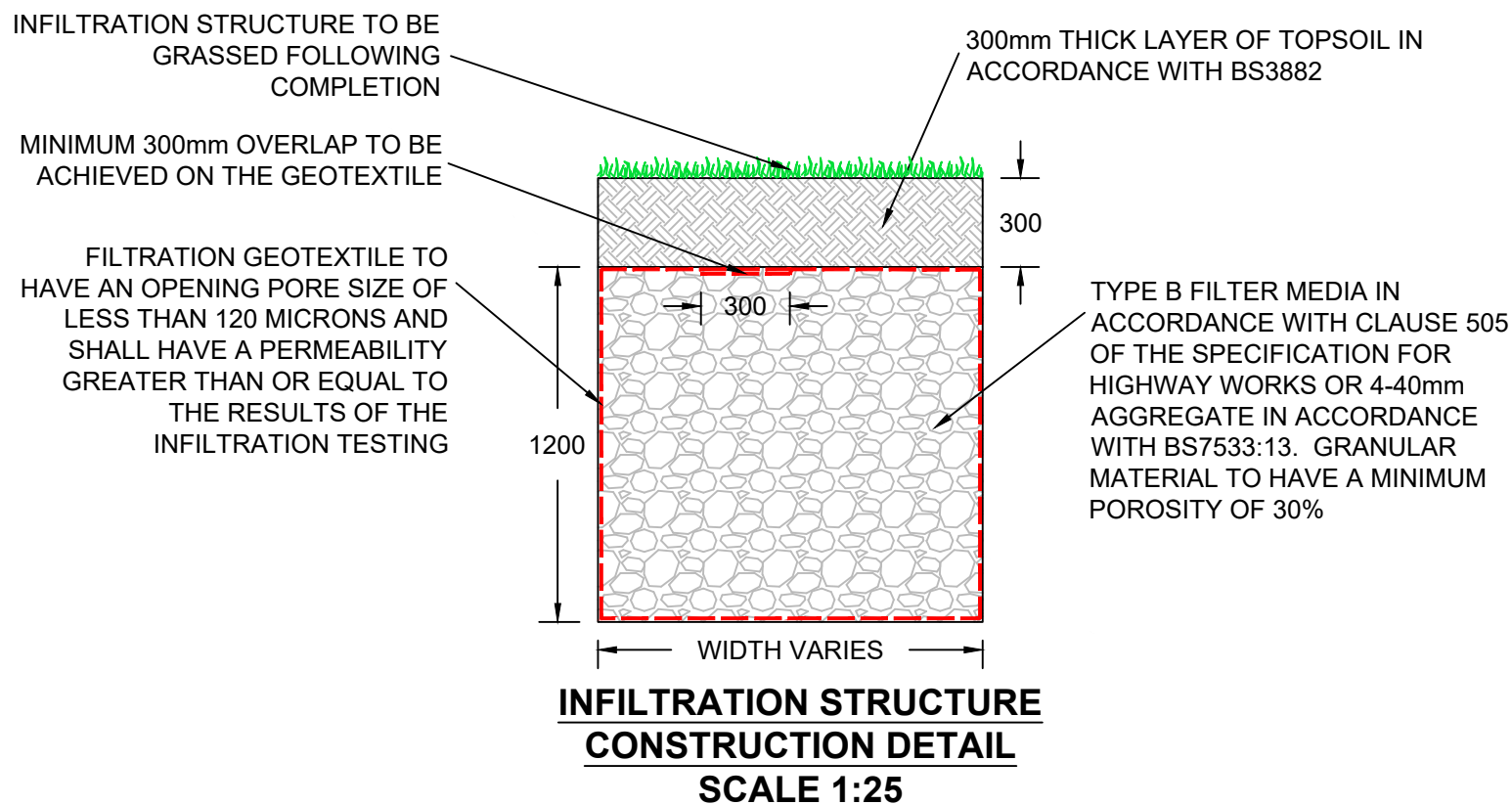
JOB TITLE

MARGRAM HYDROGEN
PRODUCTION FACILITY

DRAWING TITLE

SURFACE WATER
GENERAL ARRANGEMENT

DRAWN	DATE	APPROVED	DATE
J.D	04/04/2024	A.K	04/04/2024
SCALE	SHEET	DRAWING NUMBER	REVISION
1:250	A1L	PRO1002/01/01	0



APPENDIX 3

SURFACE WATER DRAINAGE CALCULATIONS

Sirius Environmental Ltd				Page 1																																																																																																																																																																																																																			
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Summer</td><td>1.044</td><td>1.044</td><td>0.3</td><td>16.3</td><td>O K</td></tr><tr><td>600 min Summer</td><td>1.050</td><td>1.050</td><td>0.3</td><td>16.4</td><td>O K</td></tr><tr><td>720 min Summer</td><td>1.051</td><td>1.051</td><td>0.3</td><td>16.4</td><td>O K</td></tr><tr><td>960 min Summer</td><td>1.042</td><td>1.042</td><td>0.3</td><td>16.3</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>1.008</td><td>1.008</td><td>0.3</td><td>15.7</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>0.947</td><td>0.947</td><td>0.3</td><td>14.8</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>0.883</td><td>0.883</td><td>0.2</td><td>13.8</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>0.758</td><td>0.758</td><td>0.2</td><td>11.8</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>0.646</td><td>0.646</td><td>0.2</td><td>10.1</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>0.547</td><td>0.547</td><td>0.2</td><td>8.5</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>0.459</td><td>0.459</td><td>0.2</td><td>7.2</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>0.384</td><td>0.384</td><td>0.2</td><td>6.0</td><td>O K</td></tr><tr><td>15 min Winter</td><td>0.368</td><td>0.368</td><td>0.2</td><td>5.7</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>107.385</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>75.433</td><td>0.0</td><td>33</td></tr><tr><td>60 min Summer</td><td>50.812</td><td>0.0</td><td>64</td></tr><tr><td>120 min Summer</td><td>33.028</td><td>0.0</td><td>122</td></tr><tr><td>180 min Summer</td><td>25.207</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>20.598</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>15.515</td><td>0.0</td><td>360</td></tr><tr><td>480 min Summer</td><td>12.662</td><td>0.0</td><td>466</td></tr><tr><td>600 min Summer</td><td>10.802</td><td>0.0</td><td>516</td></tr><tr><td>720 min Summer</td><td>9.480</td><td>0.0</td><td>578</td></tr><tr><td>960 min Summer</td><td>7.705</td><td>0.0</td><td>710</td></tr><tr><td>1440 min Summer</td><td>5.736</td><td>0.0</td><td>982</td></tr><tr><td>2160 min Summer</td><td>4.256</td><td>0.0</td><td>1404</td></tr><tr><td>2880 min Summer</td><td>3.437</td><td>0.0</td><td>1816</td></tr><tr><td>4320 min Summer</td><td>2.543</td><td>0.0</td><td>2596</td></tr><tr><td>5760 min Summer</td><td>2.057</td><td>0.0</td><td>3400</td></tr><tr><td>7200 min Summer</td><td>1.745</td><td>0.0</td><td>4176</td></tr><tr><td>8640 min Summer</td><td>1.526</td><td>0.0</td><td>4920</td></tr><tr><td>10080 min Summer</td><td>1.364</td><td>0.0</td><td>5640</td></tr><tr><td>15 min Winter</td><td>107.385</td><td>0.0</td><td>18</td></tr></tbody></table>						Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	15 min Summer	0.368	0.368	0.2	5.7	O K	30 min Summer	0.510	0.510	0.2	8.0	O K	60 min Summer	0.672	0.672	0.2	10.5	O K	120 min Summer	0.840	0.840	0.2	13.1	O K	180 min Summer	0.927	0.927	0.3	14.5	O K	240 min Summer	0.973	0.973	0.3	15.2	O K	360 min Summer	1.026	1.026	0.3	16.0	O K	480 min Summer	1.044	1.044	0.3	16.3	O K	600 min Summer	1.050	1.050	0.3	16.4	O K	720 min Summer	1.051	1.051	0.3	16.4	O K	960 min Summer	1.042	1.042	0.3	16.3	O K	1440 min Summer	1.008	1.008	0.3	15.7	O K	2160 min Summer	0.947	0.947	0.3	14.8	O K	2880 min Summer	0.883	0.883	0.2	13.8	O K	4320 min Summer	0.758	0.758	0.2	11.8	O K	5760 min Summer	0.646	0.646	0.2	10.1	O K	7200 min Summer	0.547	0.547	0.2	8.5	O K	8640 min Summer	0.459	0.459	0.2	7.2	O K	10080 min Summer	0.384	0.384	0.2	6.0	O K	15 min Winter	0.368	0.368	0.2	5.7	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	107.385	0.0	19	30 min Summer	75.433	0.0	33	60 min Summer	50.812	0.0	64	120 min Summer	33.028	0.0	122	180 min Summer	25.207	0.0	182	240 min Summer	20.598	0.0	242	360 min Summer	15.515	0.0	360	480 min Summer	12.662	0.0	466	600 min Summer	10.802	0.0	516	720 min Summer	9.480	0.0	578	960 min Summer	7.705	0.0	710	1440 min Summer	5.736	0.0	982	2160 min Summer	4.256	0.0	1404	2880 min Summer	3.437	0.0	1816	4320 min Summer	2.543	0.0	2596	5760 min Summer	2.057	0.0	3400	7200 min Summer	1.745	0.0	4176	8640 min Summer	1.526	0.0	4920	10080 min Summer	1.364	0.0	5640	15 min Winter	107.385	0.0	18
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4245 Park Approach Leeds LS15 8GB						
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Innovyze			Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status	
30 min Winter	0.511	0.511	0.2	8.0	O K	
60 min Winter	0.674	0.674	0.2	10.5	O K	
120 min Winter	0.843	0.843	0.2	13.1	O K	
180 min Winter	0.930	0.930	0.3	14.5	O K	
240 min Winter	0.979	0.979	0.3	15.3	O K	
360 min Winter	1.035	1.035	0.3	16.1	O K	
480 min Winter	1.057	1.057	0.3	16.5	O K	
600 min Winter	1.061	1.061	0.3	16.6	O K	
720 min Winter	1.056	1.056	0.3	16.5	O K	
960 min Winter	1.042	1.042	0.3	16.3	O K	
1440 min Winter	0.990	0.990	0.3	15.4	O K	
2160 min Winter	0.893	0.893	0.2	13.9	O K	
2880 min Winter	0.793	0.793	0.2	12.4	O K	
4320 min Winter	0.610	0.610	0.2	9.5	O K	
5760 min Winter	0.455	0.455	0.2	7.1	O K	
7200 min Winter	0.326	0.326	0.2	5.1	O K	
8640 min Winter	0.220	0.220	0.2	3.4	O K	
10080 min Winter	0.137	0.137	0.2	2.1	O K	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)			
30 min Winter	75.433	0.0	33			
60 min Winter	50.812	0.0	62			
120 min Winter	33.028	0.0	120			
180 min Winter	25.207	0.0	178			
240 min Winter	20.598	0.0	236			
360 min Winter	15.515	0.0	348			
480 min Winter	12.662	0.0	458			
600 min Winter	10.802	0.0	560			
720 min Winter	9.480	0.0	594			
960 min Winter	7.705	0.0	740			
1440 min Winter	5.736	0.0	1052			
2160 min Winter	4.256	0.0	1496			
2880 min Winter	3.437	0.0	1932			
4320 min Winter	2.543	0.0	2764			
5760 min Winter	2.057	0.0	3528			
7200 min Winter	1.745	0.0	4256			
8640 min Winter	1.526	0.0	5008			
10080 min Winter	1.364	0.0	5648			
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Innovyze	Source Control 2020.1									
Model Details Storage is Online Cover Level (m) 1.200 Infiltration Basin Structure Invert Level (m) 0.000 Safety Factor 1.5 Infiltration Coefficient Base (m/hr) 0.01800 Porosity 0.30 Infiltration Coefficient Side (m/hr) 0.01800 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>52.0</td><td>1.200</td><td>52.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	52.0	1.200	52.0
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Summer</td><td>0.426</td><td>0.426</td><td>0.1</td><td>2.7</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>0.356</td><td>0.356</td><td>0.1</td><td>2.2</td><td>O K</td></tr><tr><td>15 min Winter</td><td>0.372</td><td>0.372</td><td>0.1</td><td>2.3</td><td>O K</td></tr></tbody></table> <table><thead><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Time-Peak (mins)</th></tr></thead><tbody><tr><td>15 min Summer</td><td>107.385</td><td>0.0</td><td>19</td></tr><tr><td>30 min Summer</td><td>75.433</td><td>0.0</td><td>33</td></tr><tr><td>60 min Summer</td><td>50.812</td><td>0.0</td><td>62</td></tr><tr><td>120 min Summer</td><td>33.028</td><td>0.0</td><td>122</td></tr><tr><td>180 min Summer</td><td>25.207</td><td>0.0</td><td>182</td></tr><tr><td>240 min Summer</td><td>20.598</td><td>0.0</td><td>242</td></tr><tr><td>360 min Summer</td><td>15.515</td><td>0.0</td><td>360</td></tr><tr><td>480 min Summer</td><td>12.662</td><td>0.0</td><td>414</td></tr><tr><td>600 min 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Summer	0.516	0.516	0.1	3.2	O K	60 min Summer	0.677	0.677	0.1	4.3	O K	120 min Summer	0.842	0.842	0.1	5.3	O K	180 min Summer	0.924	0.924	0.1	5.8	O K	240 min Summer	0.966	0.966	0.1	6.1	O K	360 min Summer	1.007	1.007	0.1	6.3	O K	480 min Summer	1.022	1.022	0.1	6.4	O K	600 min Summer	1.027	1.027	0.1	6.5	O K	720 min Summer	1.027	1.027	0.1	6.5	O K	960 min Summer	1.016	1.016	0.1	6.4	O K	1440 min Summer	0.976	0.976	0.1	6.2	O K	2160 min Summer	0.909	0.909	0.1	5.7	O K	2880 min Summer	0.840	0.840	0.1	5.3	O K	4320 min Summer	0.712	0.712	0.1	4.5	O K	5760 min Summer	0.602	0.602	0.1	3.8	O K	7200 min Summer	0.507	0.507	0.1	3.2	O K	8640 min Summer	0.426	0.426	0.1	2.7	O K	10080 min Summer	0.356	0.356	0.1	2.2	O K	15 min Winter	0.372	0.372	0.1	2.3	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)	15 min Summer	107.385	0.0	19	30 min Summer	75.433	0.0	33	60 min Summer	50.812	0.0	62	120 min Summer	33.028	0.0	122	180 min Summer	25.207	0.0	182	240 min Summer	20.598	0.0	242	360 min Summer	15.515	0.0	360	480 min Summer	12.662	0.0	414	600 min Summer	10.802	0.0	476	720 min Summer	9.480	0.0	542	960 min Summer	7.705	0.0	676	1440 min Summer	5.736	0.0	954	2160 min Summer	4.256	0.0	1364	2880 min Summer	3.437	0.0	1784	4320 min Summer	2.543	0.0	2556	5760 min Summer	2.057	0.0	3344	7200 min Summer	1.745	0.0	4104	8640 min Summer	1.526	0.0	4840	10080 min Summer	1.364	0.0	5552	15 min Winter	107.385	0.0	18
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180 min Winter	25.207	0.0	178																																																																																																																																																																																																	
240 min Winter	20.598	0.0	234																																																																																																																																																																																																	
360 min Winter	15.515	0.0	346																																																																																																																																																																																																	
480 min Winter	12.662	0.0	450																																																																																																																																																																																																	
600 min Winter	10.802	0.0	488																																																																																																																																																																																																	
720 min Winter	9.480	0.0	562																																																																																																																																																																																																	
960 min Winter	7.705	0.0	720																																																																																																																																																																																																	
1440 min Winter	5.736	0.0	1024																																																																																																																																																																																																	
2160 min Winter	4.256	0.0	1468																																																																																																																																																																																																	
2880 min Winter	3.437	0.0	1900																																																																																																																																																																																																	
4320 min Winter	2.543	0.0	2720																																																																																																																																																																																																	
5760 min Winter	2.057	0.0	3464																																																																																																																																																																																																	
7200 min Winter	1.745	0.0	4248																																																																																																																																																																																																	
8640 min Winter	1.526	0.0	4928																																																																																																																																																																																																	
10080 min Winter	1.364	0.0	5552																																																																																																																																																																																																	
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Sirius Environmental Ltd		Page 3								
4245 Park Approach Leeds LS15 8GB										
Date 09/04/2024 11:28 File REVISED INFILTRATION TR...	Designed by jdavies Checked by									
Innovyze	Source Control 2020.1									
Model Details Storage is Online Cover Level (m) 1.200 Infiltration Basin Structure Invert Level (m) 0.000 Safety Factor 1.5 Infiltration Coefficient Base (m/hr) 0.01800 Porosity 0.30 Infiltration Coefficient Side (m/hr) 0.01800 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>21.0</td><td>1.200</td><td>21.0</td></tr></tbody></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	21.0	1.200	21.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	21.0	1.200	21.0							
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