Pell Frischmann

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ENVIROPARKS PHASE 2

Flood Consequence Assessment

December 2016

RQ80023/PH2/R002

Submitted by Pell Frischmann

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1. INTRODUCTION

Pell Frischmann have been commissioned by Enviroparks (Wales) Ltd to undertake a Flood Consequences Assessment (FCA) for Enviroparks Phase 2 at Hirwaun Industrial Estate. The FCA forms part of the updated Environmental Statement for Enviroparks Phase 2.

The Enviroparks site, located to the north of Fifth Avenue on the Hirwaun Industrial Estate (Hirwaun), straddles the boundaries of Rhondda Cynon Taff County Borough Council (RCTCBC) and the Brecon Beacons National Park Authority (BBNPA); the associated planning approvals are referenced 15/1346/10 (25th January 2016) and 15/12787/FUL (13th January 2016) respectively. The aforementioned planning approvals follow Enviroparks Phase 1 planning permissions BBNPA 08/02488/FUL and RCT 08/1735/10.

The proposed Enviroparks Phase 2 forms part of the strategy by Enviroparks (Wales) Ltd to develop an Energy from Waste recycling centre off Fifth Avenue in Hirwaun Industrial Park.

As part of Enviroparks Phase 1 an outline Flood Risk Assessment dated October 2008 was prepared and informed the Environmental Statement for the purposes of planning approval. This assessment will form the basis for the surface water strategy however the Enviroparks Phase 2 FCA will also seek to recognise the latest advisory notes, associated regulation and works completed under Enviroparks Phase 1.

1.1 SCOPE OF WORK

The following scope of work has been undertaken to provide an FCA (hitherto identified as Flood Risk Assessment) to meet the requirements set out in the Planning Policy Wales Technical Advice Note 15: Development and Flood Risk (TAN 15) and the associated planning guidance. The scope of work is briefly explained as:

- Collate and undertake a desk based review of publically available flood risk information, such as Development Advice Mapping (DAM), Strategic Flood Risk Assessments (SFRAs) and local guidance to identify potential sources of flooding;
- Undertake a desktop review of other data that has been made available, such as topographic surveys, as built utilities records and existing drainage plans;
- Request Dwr Cymru Welsh Water asset records and identify sewers within or adjacent to site;

- Undertake a review of the Enviroparks Phase 1 surface water drainage strategy and update in accordance with latest TAN 15 supplementary guidance the combined Phase 1 and 2 surface water strategy;

- Based on above undertake an outline surface water drainage design in accordance with TAN 15 and supplementary guidance;

- Undertake an estimation of attenuation volume requirements and provide an outline surface water management strategy appropriate for the site; and,

- Provide an assessment based on the above information to accompany the planning application.

1.2 SOURCES OF INFORMATION

A review of relevant information from a range of sources has been undertaken and includes the following:

- Flood and Water Management Act 2010

- Rhondda Cynon Taf County Borough Council
  Local Flood Risk Management Strategy Summary

- Rhondda Cynon Taf County Borough Council
  Local Flood Risk Management Strategy

- Brecon Beacons National Park Authority Local Development Plan
  Strategic Flood Risk Assessment September 2011

- Planning Policy Wales: Technical Advice Note (TAN) 15, Development and Flood Risk July 2004

- Update of TAN 15 Development Advice Maps and approval of Shoreline Management Plans, January 2015

- CL-03-16: Guidance on climate change allowances for planning purposes (dated 23 August 2016) & Detailed guidance on Flood Consequence Assessments (CL-03-16): Climate Change Allowances (applied to planning applications submitted from 1 December 2016)

- Development Advice Mapping (located: http://data.wales.gov.uk/apps/floodmapping/)

- The SuDS Manual C753 – CIRIA (2015) and associated Ciria guidance;

- Soil Mechanics Geotech Interpretative Report Interpretive Report On Site Investigation (H8076, January 2009);

- Flood Risk Assessment for Enviroparks Hirwaun Ltd (Issue 1, October 2008)

2. THE SITE

2.1 SITE LOCATION

The Enviroparks site is located at the north-west end of the Cynon Valley on the outskirts of the village of Hirwaun in the County Borough of Rhondda Cynon Taf, South Wales.

The location of the Enviroparks site is approximately identified by the red outline in Figure 2.1 below; the centre of the site is also given by the National Grid Reference (NGR) SN 93875 06828. The Enviroparks development area is formed of three phases, each of which are being brought forward to planning application in a phased manner, according to the development programme.

This FCA however serves to addresses flood risk primarily in relation to Enviroparks Phase 2.

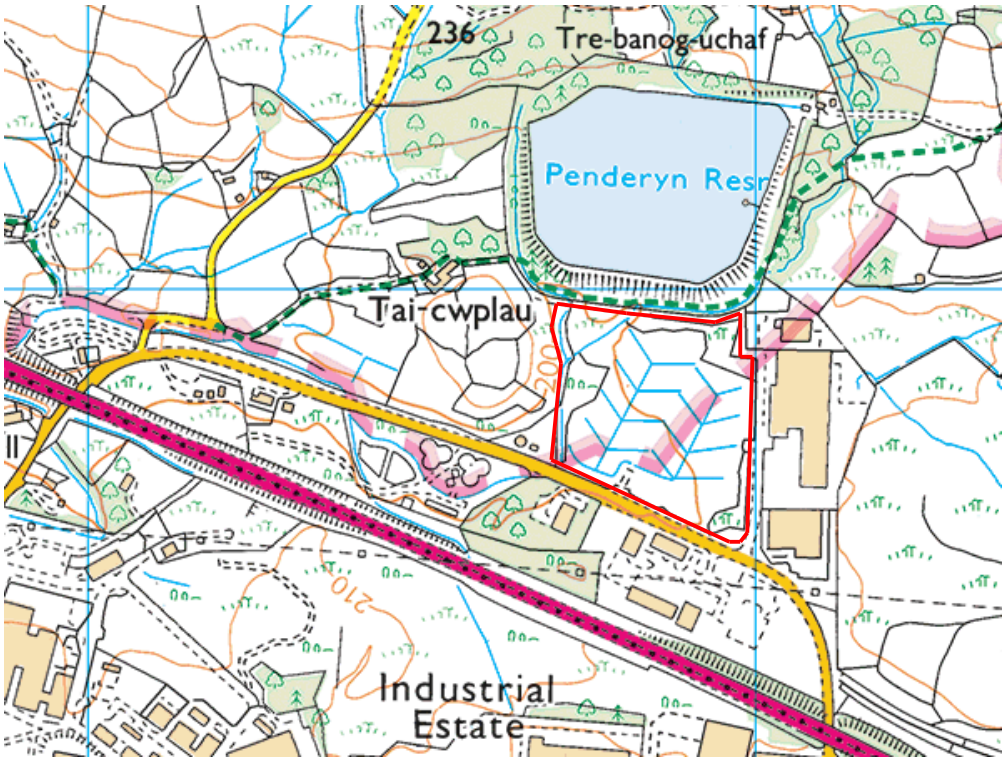


Figure 2.1: Enviroparks Site location, approximate boundary illustrated in red (Crown Copyright, All Rights Reserved; Licence Number 100004912).

2.2 SITE DESCRIPTION

The Enviroparks site is bounded to the north by the Penderyn Reservoir, which is a source of potable water owned by Welsh Water. It is bounded to the east by Ninth Avenue and an area of large industrial and commercial properties. To the south it is

bounded by Fifth Avenue and to the west by open countryside in which flows a stream; the upper reaches of the river Camnant.

As indicated above, Enviroparks Phase 1 works have already been completed; comprising of Material Reception Facility (MRF), access roads and associated hardstandings for the MRF building. The extent of Phase 1 is shown on the Waterman drawing CIV-SA-90-0100-E10 in Appendix A; and completed in spring 2016. This layout drawing illustrates the existing and proposed impermeable areas during the temporary Phase 1 state; the total Enviroparks site area (including all phases) is approximately 8.541 hectares. Further details on areas of impermeability are covered under Section 7 below.

2.3 DEVELOPMENT PROPOSALS

The development proposals associated with the Phase 2 planning application and corresponding pre-commencement conditions dated 21st March 2016 form part of the Enviroparks' Energy from Waste development off Fifth Avenue in Hirwaun.

The Phase 2 proposals follow the recent completion of the Phase 1 works in Spring 2016 which comprised new access roads off Fifth and Ninth Avenue, MRF building, associated hardstandings and drainage network including preliminary surface water attenuation (SuDS).

The Phase 2 proposals primarily consist of the Gasification Facility, Fuel Storage Hall, Turbine Hall, cooling tanks with associated hardstandings and corresponding drainage network; illustrated on drawing KQ80023C101 containing the EPT Partnership "Proposed Overall Site Layout" (refer to Appendix B).

As part of the Phase 2 proposals, the existing SuDS features constructed under Phase 1 will be increased in size in accordance with the final landscaping arrangement and updated surface water strategy. To facilitate the enhancements existing public foul water sewers shall be diverted to within the public highway (Fifth Avenue).

2.4 WATERCOURSES

A stream on the western side of the Enviroparks site flows into the river Camnant south of Fifth Avenue. At the confluence, further downstream and south of the A465, of the Nant Wyrfa and Camnant, the Sychryd drains to the north; flowing south to north the Sychryd discharges into the Afon Mellte. This suggests the Enviroparks site surface water runoff will flow to the Ogmore to Tawe Catchment.

To the north of the Enviroparks site lies the Penderyn Reservoir and resulting earth bund, which to a large degree, creates a natural watershed.

2.5 TOPOGRAPHY

The topography of the Enviroparks site is typically falling from north east corner to the south west corner. Historic mapping records of the site illustrate a land drainage system comprising mostly an open channel falling in a north south direction however following Enviroparks Phase 1 works this has mostly been removed.

The north east corner peaks at 203.5m AOD whilst the south west corner drops to 198.5m AOD, topography falling at an average gradient of 1:46. The Enviroparks site also falls gently from east to west at an approximate gradient of 1:60.

The construction of Phase 1 works can also be recognised in the aerial mapping; the new access roads into the Enviroparks site are generally at grade. The surface water outfall location is located at the south west corner of the site, adjacent to Fifth Avenue, and outfalls to the existing stream running along the boundary fence.

Figure 2.2: Aerial view of current Enviroparks site, post-Phase 1 construction (Google Earth Licence Number: JCPMB2ZBMMAWBHP)

3. GEOLOGICAL

3.1 GEOLOGY

The published geological map covering the site, BGS Sheet 231 (1979) shows the surface of the site to be covered by Alluvium over the south and Glacial Till to the north. The Glacial Till probably underlies the Alluvium. Bedrock at the site comprises the Lower Coal Measures, a sequence of mainly mudstones and sandstones with rare coal seams. An unnamed coal seam is shown to outcrop with an east to west strike through the centre of the site. However, a 1993 mining report which states that it is extremely unlikely that mining has been undertaken under the site in the past, or will be in the future.

A number of phases of Ground Investigation (GI) have been undertaken at the site. The most recent site wide investigation was undertaken by Soil Mechanics and reported in 2009; a summary of the investigation findings are below in Table 3.1:

Material	Outline description	Minimum Thickness (m)	Maximum Thickness (m)
Made Ground	Medium dense dark brownish grey to black clayey gravel of slate and granite. Occasional wood and plastic.	0.1	3.5
Granular Glacial Till	Medium dense to very dense grey brown clayey GRAVEL with low to high cobble content.	0.2	8.5
Cohesive Glacial Till	Firm to stiff grey slightly sandy, gravelly CLAY with medium cobble content.	0.3	3.4
Weathered Bedrock	Dense slate Gravel becoming strong dark grey and yellow brown SLATE.	Encountered at levels ranging from 187.54 and 194.07m AOD	

Table 3.1 - Typical description of soils across the Enviroparks site

3.2 AQUIFER

In addition to above, monitored groundwater levels have been recorded in standpipes within the Enviroparks Phase 2 development area; values ranged from 0.10 m (Borehole 109) to 2.04 to 2.13 m (Boreholes 103 & 105). This watertable

information is provided in the Table 3.2 below and included in Appendix C in layout format.

Monitoring Well	Average m bgl	Max m bgl	Min m bgl	Average m aOD	Max m aOD	Min m aOD
BH103	2.11	2.13	2.10	197.66	197.64	197.67
BH105	2.05	2.06	2.04	197.48	197.47	197.49
BH109	0.13	0.16	0.10	199.74	199.71	199.77

Table 3.2 - Typical description of soils across the Enviroparks site

The Material Resource Wales Groundwater Mapping suggests the Enviroparks site is located within the groundwater zone “Swansea Carboniferous Coal Measure” in south-east Wales. It is classified as the follows:

Quantitative: good

Chemical: poor

There is one significant abstraction point located directly to the north at Penderyn Reservoir; this is a key Dwr Cymru Welsh Water (DCWW) potable water facility. The nearby Water Treatment Works off Ninth Avenue provides primary treatment with secondary treatment provided offsite.

In conclusion the upper underlying strata consists either of made ground or a clayey gravel, in both cases subjected to high watertable; it is considered to be sub-artesian in nature. This renders the ground unsuitable for soakaways.

4. EXISTING FLOOD RISK

4.1 SURFACE WATER AND FLUVIAL FLOOD RISK

The Development Advice Maps produced by the Welsh Government illustrate the TAN 15 Data. The Enviroparks site is considered to be predominantly Zone B with the north east zone falling within Zone A. These zones are described as follows:

- Zone A: Considered to be at little or no risk of fluvial or coastal/tidal flooding.
- Zone B: Areas known to have been flooded in the past.

Given the close proximity to the upper reaches of the river Camnant and associated DAM information, it suggest a low flood risk associated to Surface Water (Pluvial) and Fluvial consequences.

Notwithstanding this, previously supplied mapping information from the 2008 FRA for Enviroparks Phase 1 suggests the development site has a less than 1 in 1000 (0.1%) annual probability of river or sea flooding.

4.2 GROUNDWATER FLOOD RISK

The borehole data available within the 2009 Soil Mechanics Geotech Interpretative Report indicates the groundwater levels to be ranging from 0.1m to 2.13m below ground level.

The watertable with the Enviroparks Phase 2 development area is considered to be sub-artesian in nature and relatively high but given that the majority of the Enviroparks site will be ultimately paved there is limited flood risk from groundwater.

4.3 COASTAL & TIDAL FLOOD RISK

There is no risk of Coastal or Tidal flooding given the geographical location of the Enviroparks site; it is therefore not considered further within the FCA.

4.4 ARTIFICIAL SOURCES FLOOD RISK

The only artificial source of flood risk is the Penderyn Reservoir but given that this reservoir forms part of the DCWW managed water supply, reservoir flooding is considered to be at very low risk.

There are no other raised water features (ponds, canals etc.) identified from Ordnance Survey mapping that are considered to pose a flood risk to the site.

The site is considered to be at very low risk from artificial sources of flooding and is not considered further within this assessment.

4.5 SEWER FLOOD RISK

A review of available information relating to sewer flooding has not identified any flooding on the foul or surface water sewerage.

Rhonda Cynon Taf County Borough Council's Flood Risk Management Plan indicates minimal risk of flooding from surface water within the Rhigos area which incorporates the Enviroparks site off Fifth Avenue.

As all of the on-site drainage infrastructure constructed under Enviroparks Phase 1 is new, the site is considered to be at very low risk from flooding sewers and is not considered further within this assessment.

5. POLICY AND GUIDANCE

5.1 NATIONAL POLICY AND GUIDANCE

The operation of TAN 15's precautionary framework is governed by:-
A Development Advice Map containing three zones (A, B and C with subdivision into C1 and C2) which should be used to trigger the appropriate planning tests.

In accordance with TAN 15 (Section 3) the "*policy seeks to direct new development away from those areas which are at high risk of flooding (Zone Cs)."*

The Development Advice Maps are based on Environment Agency's extreme flood outlines (zone C) and the British Geological Survey (BGS) drift data (zone B).

Further Natural Resources Wales guidance on Flood Consequence Assessments states that *"climate projections should be incorporated into FCAs accompanying planning applications submitted from 1 December 2016."*

5.2 LOCAL POLICY AND GUIDANCE

Brecon Beacons National Park Authority Strategic Flood Risk Assessment September 2011

"Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further."

5.3 NATURAL RESOURCES WALES

Natural Resources Wales (formerly the Environment Agency) have considered the Enviroparks site previously under the earlier planning applications for Enviroparks Phase 1; attached is the correspondence dated 31st October 2012 in Appendix D.

The guiding principles for the discharge of surface water and determination of restricted discharge are set out within this correspondence; the following are excerpts from the correspondence:

> *"The 1 in 1 year Greenfield runoff rate for this 7 Hectare site is specified as 124.7 l/s, which is equivalent to 17.8 l/l/s/ha. This is a suitable rate for this site. An appropriate increase in rainfall for climate change has been accounted for the 100 year event."*
>
> *"Our guidance document on Surface Water advises that suitable storage is required for the 30 year event. Additionally the volume of water from events up to and including the 100 year event, should be contained within the site."*

5.4 CLIMATE CHANGE IMPACTS

The potential impact of climate change is expected to cause an increase in the magnitude and frequency of extreme weather events as outlined in the TAN 15. The proposed development should seek to mimic the existing drainage situation through the use of SuDS where practicable and an allowance for climate change should be included.

Guidance set out within the Flood Consequence Assessments: Climate change Allowances (dated March 2016):

> "*it is recommended that the central estimate, or change factor, for the 2080s for the relevant river basin district should be used to assess the potential impact of climate change as part of a flood consequence assessment."*

Change factor /central estimate (2080) for the West Wales region advises 30% provision for increase in rainfall intensity.

This is considered an appropriate allowance for the proposal a lies between the central and upper estimate for climate change as per the guidance.

6. FOUL WATER DRAINAGE

6.1 EXISTING FOUL WATER DRAINAGE

The record information from DCWW indicates limited existing foul and surface water sewers within the carriageway or parallel within the Enviroparks site; asset records of DCWW apparatus are included within Appendix E.

The existing dia300mm foul water sewer running parallel and slightly to the north of Fifth Avenue will require diverting to within the adjacent public highway in order to fully develop out the SuDS. The diversion will facilitate a wider and larger swale, thus providing greater surface water storage volume.

Private foul water sewers have been constructed as part of Enviroparks Phase 1; these were designed and built to adoptable standards. This drainage serves the newly constructed MRF building and other areas where future expansion is expected (under Phase 2 and subsequent phases).

7. SURFACE WATER DRAINAGE

7.1 EXISTING SURFACE WATER DRAINAGE

The record information from DCWW indicates existing foul and surface water sewers running either within the carriageway or parallel within the Enviroparks site; asset records of DCWW apparatus are included within Appendix E.

A section of dia225mm surface water sewer runs adjacent to Ninth Avenue within the Enviroparks site, but presently does not affect any development proposals. It shall remain in place; not diverted.

Private surface water sewers have been constructed as part of Enviroparks Phase 1; these were designed and built to adoptable standards. This drainage serves the newly constructed MRF building, associated forecourt, access roads and also areas where future expansion is expected (under Phase 2 and subsequent phases). A number of bypass separators are included within the network, providing means to intercept hydrocarbons and detritus.

The proposed Enviroparks Phase 2 flood risk mitigation measures and associated surface water drainage will interface with existing Enviroparks Phase 1 surface water network. Further details contained within Section 7.4 below.

7.2 EXISTING SURFACE WATER RUNOFF RATES

Natural Resources Wales (formerly the Environment Agency) stated in the correspondence of 31st October 2012 that the restricted discharge from the Enviroparks development shall be based upon a greenfield rate. The overarching surface water strategy recognises this position; Phase 1 accommodated this strategy and subsequent phases will likewise. An excerpt from the said correspondence is given below:

> *"The 1 in 1 year Greenfield runoff rate for this 7 Hectare site is specified as 124.7 l/s, which is equivalent to 17.8 l/s/ha."*

This specified greenfield rate per hectare is applied in subsequent sections to inform the Enviroparks Phase 2 drainage strategy and resulting surface water attenuation requirements.

7.3 INFILTRATION SYSTEMS

Supporting geotechnical information indicates underlying strata is varying with a high watertable; this is not conducive to suitable infiltration rates and therefore infiltration systems are not recommended.

7.4 SURFACE WATER DRAINAGE STRATEGY – PHASE 2

This FCA serves to addresses flood risk primarily in relation to Enviroparks Phase 2, based upon the surface water strategy from the outline FRA for Enviroparks Phase 1 and also with consideration for the Enviroparks Phase 1 works already completed.

Within this section the resulting surface water drainage strategy for Enviroparks Phase 2 is discussed in more detail; it comprises two primary components. The first comprises, as stated previously, the existing Phase 1 works which includes foul and surface water drainage; private drainage installed during the 2015 construction of the Enviroparks Phase 1 works.

The second component relates to the proposed Enviroparks Phase 2 works informed by the updated masterplan by EPT Partnership "Proposed Overall Site Layout" drawing number ENV_EPT_GEN_DR_A_6004. The resulting and proposed Enviroparks Phase 2 flood risk mitigations measures and associated drainage interfaces and in places shall adapt to the existing surface water drainage constructed under Enviroparks Phase 1.

In terms of adaption, the existing linear swale feature shall be enhanced to increase storage capacity and shall aim to meet final landscaping arrangements as illustrated on EPT Partnership "Proposed Overall Site Layout" in Appendix B.

In terms of supplementing the existing surface water mitigation measures, an assessment incorporating the latest requirements of climate change and EPT Partnership "Proposed Overall Site Layout" level of impermeability has been completed including updated surface water modelling. Further details contained within Section 7.5 below.

The outfall location remains unchanged with surface water flows entering the upper reaches of the river Camnant via the enhanced swale system. Proposed restricted discharge rates to be based upon specified greenfield rate. By restricting the post development runoff rates to greenfield rates, the aim of surface water strategy is to provide a betterment over existing surface water flows.

The proposed level of impermeability for the Enviroparks development area at the pre-planning stage for Enviroparks Phase 2 is set out in Table 7.3 below:

Description	**Area (Ha)**	**Notes**
Phase 1	1.5186	Construction complete spring 2016
Phase 2 (SW)	2.3693	South west, includes access road
Infill Parcel	0.1000	South east corner
Phase 3 (NW)	1.6090	Future phase
Phase 3 (NE)	0.9780	Future phase
Total area	**6.5749**	

Table 7.3 - Proposed level of impermeability

The final proposed area of impermeability for the Enviroparks development area is 6.575 ha; within the context of the total site area of 8.541 ha this equates to a level of impermeability of 76.98% (for the whole development area). Based upon the agreed greenfield rate, the restricted discharge(s) are set out below in Table 7.4:

Description	**Area (Ha)**	**l/sec**
Phase 1	1.5186	27.03
Phase 2 (SW)	2.3693	42.18
Infill Parcel	0.1000	1.78
Phase 3 (NW)	1.6090	28.64
Phase 3 (NE)	0.9780	17.41
Total area	**6.5749**	**117.04**

Table 7.4 – Restricted discharge rate(s)

The primary discharge of surface water will be to the south west corner to the upper reaches of river Camnant at a restricted discharge of 117 l/sec based upon greenfield runoff.

The modelled surface water network based upon the Enviroparks Phase 1 works constructed and supporting FRA dated October 2008 have been informed by the latest EPT Partnership layout. A simplified network layout is included in Appendix F showing pipe numbers for reference. The resulting surface water network in accordance with the prescribed restricted discharge rate has been tested against appropriate storm events to determine the level of attenuation set out in Section 7.5 below.

7.5 SURFACE WATER ATTENUATION

The assessment of surface water attenuation required to meet TAN 15 and supporting documents shall include for a 1 in 100 year return storm events plus 30% allowance for climate change according to the West Wales river basin district. Restricted discharges are based upon pre-development greenfield runoff agreed under Enviroparks Phase 1 planning approval.

By restricting the post development runoff rates to greenfield rates, the aim of surface water strategy is to provide a betterment over existing surface water flows. The surface water attenuation takes different forms depending upon topographical location and whether in an area of hardstanding or open green space.

The surface water attenuation provision has been assessed by carrying out modelling according to the 1 in 100 year storm criteria; the primary surface water volumetric provision is set out in Table 7.5 below.

Location	Approximate attenuation volume (m^3)	Notes
SuDS / swale	1900	Linear feature along southern boundary
Phase 2 (SW)	30	DS pipe 4.001, nominal storage US
Phase 3 (NW)	450	DS pipe 1.001, underground tank
Phase 3 (NE)	40	DS pipe 9.001, nominal storage US
Total	**2420**	

Table 7.5 - Identifies volumetric provision for surface water attenuation

The above table does not include likely storage volume within the existing surface water pipework; this will however be taken into account during modelling and simulation of the network.

Inclusion of rainwater harvesting tanks which may form part of Enviroparks Phase 2 detailed design or future phases may be considered and incorporated within the modelling design thereby reducing the attenuation requirements. Such provision will need to be considered both in terms of inflow and outflow.

The model network and simulation outputs using Microdrainage are contained within Appendix G.

7.6 OUTFALL LOCATIONS

The primary outfall location for the discharge of surface water is located to the south west corner of the Enviroparks site, to the upper reaches of the river Camnant.

Secondary drainage outfall locations are identified with the modelled network; a contributing impermeable area is allocated to each pipe run. This is considered the future phase connection.

7.7 INTERCEPTION OF HYDROCARBONS

The interception of hydrocarbons from the development hardstandings (or from within a building) shall be required to reduce the risk of contamination to the river Camnant and local groundwater.

The proposed surface water drainage system shall incorporate sumped gullies and at appropriate locations provision of oil interception shall be provided. The type of oil interceptor shall be determined through application of Pollution Prevention Guidelines 3 (PPG 3); oil separators to be either full retention, bypass or forecourt as required. Any provision shall need to consider Enviroparks Phase 1 works already constructed.

7.8 MAINTENANCE OF SURFACE WATER DRAINAGE

The surface water drainage system will require regular maintenance. Table 7.6 is taken from CIRIA guidance, the SuDS Manual (C753), which outlines the operation and maintenance requirements for attenuation basins.

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Remove litter and debris.	Monthly
	Cut grass – for spillways and access routes.	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin.	Half yearly (spring before nesting season and autumn)
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt remonval frequencies.	Monthly (for first year), then annually or as required.
	Check any penstocks and other mechanical devices.	Annually
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from inlets, outlet and forebay.	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually.
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided
Remedial actions	Repair of erosion or other damage by reseeding or re-turfing	As required

	Realignment of rip rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels.	As required

Table 7.6 – Recommended Maintenance for Above Ground Attenuation Basins

The ownership and maintenance of the drainage and attenuation features on the site will need to be considered with a regular inspection and maintenance regime put in place throughout the lifespan of the development.

8. SUMMARY AND RECOMMENDATIONS

Pell Frischmann has been commissioned by Enviroparks (Wales) Ltd to undertake a Flood Consequence Assessment (FCA) in accordance with TAN 15 in support of the planning application for the proposed Enviroparks Phase 2 development. This FCA will also form an update to the existing surface water strategy set out within the FRA completed as part of the Enviroparks Phase 1 planning permission.

Along the western boundary of the site the upper reaches of the river Camnant is located, into which an existing outfall constructed under Enviroparks Phase 1 discharges. This will be maintained and will restrict the development surface water flows to the agreed greenfield rate based upon the final level of development hardstandings and roofs (impermeability).

Modelling of the surface water network to determine indicative attenuation storage requirements are based upon a 1 in 100 year return period plus 30 % allowance for climate change; in line with the West Wales river basin requirements. Infiltration is not deemed to be feasible due to the varying ground conditions and high watertable.

Approximately 2420m^3 of surface water attenuation will be required to manage surface water flows from the proposed development taking into consideration all phases; the present level of impermeability is 76.98% for the total development. It is proposed that a variety of sustainable drainage systems could be used to attenuate the runoff such as oversized pipes, storage tanks (precast concrete or polyethylene), balancing ponds and swales or possibly rainwater harvesting facilities. It should be noted that as part of Enviroparks Phase 1 a portion of the balancing pond and swale arrangement has been undertaken; this linear feature will be enhanced as part of Enviroparks Phase 2 to provide greater volumetric capacity.

Review of the TAN 15 Development Advice Maps indicates the proposed Enviroparks Phase 2 development area is considered at low risk of flooding from surface water and fluvial consequences. For this purpose the restricted discharge from the development area is set at an agreed greenfield rate with the surface water strategy including both underground tanks and open ponds/swales to enable surface water flows to be managed.

The proposed surface water drainage system shall incorporate sumped gullies and at appropriate locations provision of oil interception shall be provided. The type of oil interceptor shall be determined through application of relevant pollution prevention guidance.

The maintenance of the drainage and attenuation features on the site will need to be considered with a regular inspection and maintenance regime put in place throughout the lifespan of the development.

9. LIMITATIONS AND UNCERTAINTIES

This report has been prepared by Pell Frischmann with all reasonable skill, care and diligence.

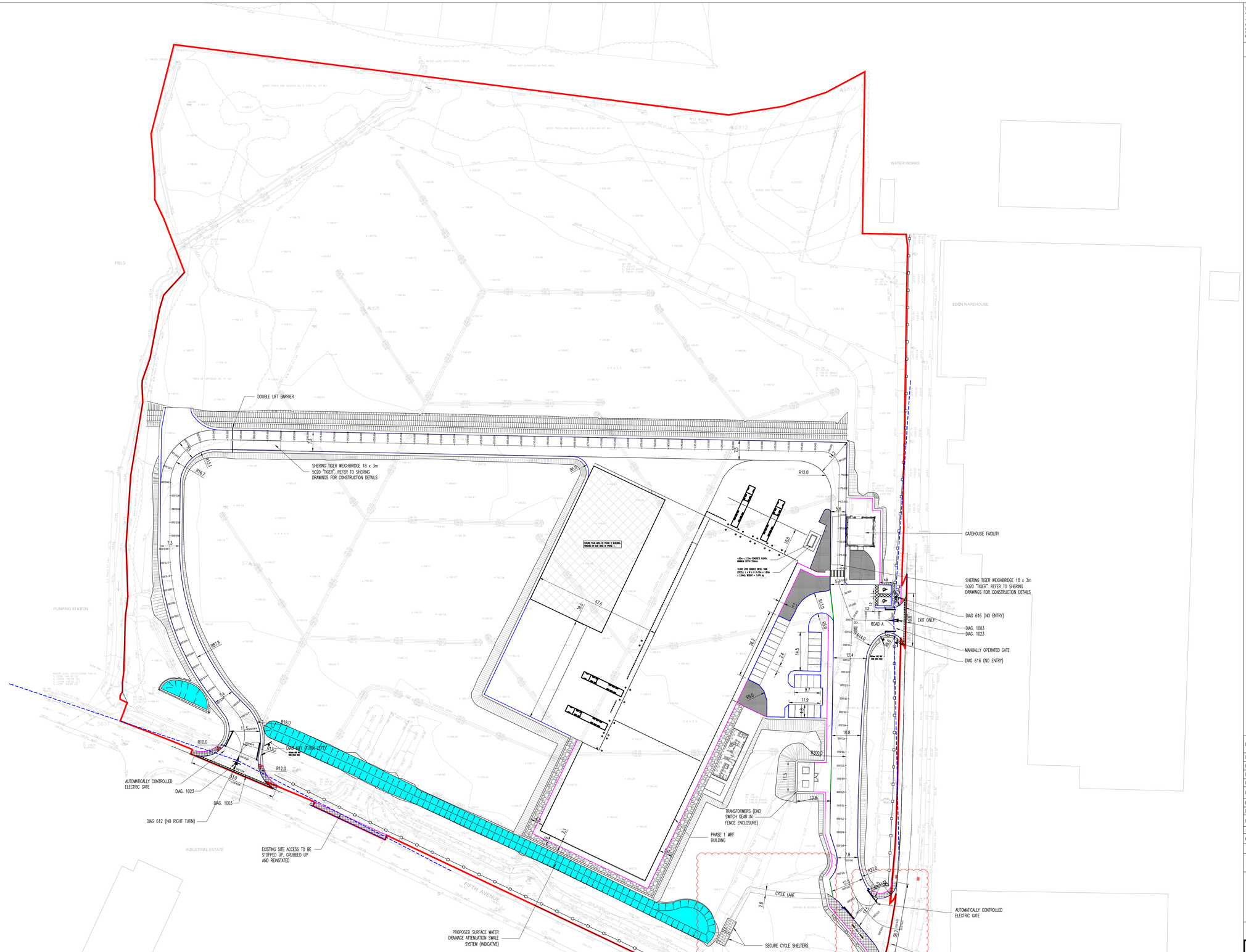
The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true representative data with respect to site conditions. The information reported herein is based on the interpretation of data collected during a desk based assessment of flood risk including information held by third parties for which we cannot be held responsible. Should additional information become available that may influence the opinions expressed in this report, Pell Frischmann reserves the right to review such information and, if warranted, to alter the opinions accordingly.

The evaluation and conclusions do not preclude the existence of other site conditions which could not reasonable have been revealed at the time of writing. This report should be used for information purposes only and should not be construed as a comprehensive characterisation of all site conditions. In addition, this report has been prepared solely for the use of the client, and may not be relied upon by other parties without written consent from Pell Frischmann.

Pell Frischmann disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of work.

APPENDIX A

ENVIROPARKS PHASE 1 LAYOUT
(WATERMAN DRAWING)



This drawing should not be scaled. Dimensions to be verified on site.
Any discrepancies should be referred to the Engineer prior to work being put in hand.

This drawing is the property of Waterman Infrastructure & Environment Limited, and the drawing is issued on the condition that it is not copied reproduced, retained or disclosed to any unauthorised person, either wholly or in part without the consent in writing of Waterman Infrastructure & Environment Limited
Pickfords Wharf, Clink Street, London SE1 9DG t 020 7928 7888 f 03333 444 501

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEER'S, ARCHITECT'S OR OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
2. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BY THE CONTRACTOR PRIOR TO PREPARING ANY WORKING DRAWINGS OR COMMENCING ON SITE.
3. THE CONTRACTOR MUST ENSURE AND WILL BE HELD RESPONSIBLE FOR THE OVERALL STABILITY OF THE BUILDING/STRUCTURE/EXCAVATION AT ALL STAGES OF THE WORK.
4. ALL WORK BY THE CONTRACTOR MUST BE CARRIED OUT IN SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
5. ALL WORK IS TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT STATUTORY AUTHORITIES AND REGULATIONS.

KEY:

SITE BOUNDARY

JUNCTION VISIBILITY SPLAY (4.5m X 90.0M)

Rev	Date	Description	By
E10	22:10:15	SERVICE YARD AND HAMMERHEAD AMENDED. TACTILES ADDED ON SITE ENTRANCE. SITE ENTRANCE IN ABEYANCE.	EF
E09	19:10:15	SERVICE YARD AMENDED AND HAMMERHEAD ADDED	EF
E08	13:10:15	LAYOUT UPDATED.	VCH
E07	02:09:15	ROADS RENAMED TO SUIT UPDATED ROAD LONGSECTIONS	ROS
E06	01:09:15	PLANT WASHDOWN AREA ADDED.	EF
E05	19:06:15	V-DITCH LAYOUT AMENDED. VERGE WIDENING ON SERVICE ROAD TO 750mm	EF
E04	05:06:15	RADIUS ADDED TO SERVICE YARD	BW
E03	01:06:15	FUEL TANK IN ABEYANCE	EF
E02	12:05:15	ROAD LABELS AMENDED, CYCLE SHELTER AND LANE IN ABEYANCE, VISIBILITY SPLAYS ADDED.	ROS
E01	11:05:15	ISSUED FOR CONSTRUCTION	ROS

Amendments

Project: ENVIROPARKS, HIRWAUN

Title: GENERAL ARRANGEMENT PLAN

Client: DAWNUS CONSTRUCTION LTD

Waterman
38 Cathedral Road Cardiff CF11 9LL
t 029 2038 4400 f 03333 444 501
mail@watermangroup.com www.watermangroup.com

Drawing Status: CONSTRUCTION

Designed by	ROS	Checked by	BW	Project No	14979
Drawn by	ROS	Date	MAY 2015		
Scales @ A0 work to figured dimensions only	1:500			Computer File No	CIV-1479-SA-90-0100-E10.dwg

Publisher	Zone	Category	Number	Revision
CIV	SA	90	0100	E10

File Path: X:\Projects\1479 - Eastgate Hirwaun\CAD\90-GENERAL\

A0-Waterman-S, CIV-14979-SA-NS-BASE, CIV-14979-SA-NS-LAYOUT, CIV-14979-SA-NS-ROAD LAYOUT, CIV-14979-SA-NS-SITE BOUNDARY

APPENDIX B

LATEST MASTERPLAN WITH PHASE 2 EXTENT

PRELIMINARY
PHASE 2 BOUNDARY

OVERALL IMPERMEABILITY	(Ha)
PHASE 1	1.5186
PHASE 2 (SW)	2.3693
INFILL PARCEL	0.10
PHASE 3 (NW)	1.6090
PHASE 3 (NE)	0.9780
TOTAL	6.5749

0 5 10 20 30 40 50m

REV	DESCRIPTION	DRN	CHK	APP	DATE
P3	Layout revised	RE			
P2	N.E. Corner removed from Phase 2	RE			
P1	First issue				

Pell Frischmann
10 Warren Yard, Warren Park Stratford Road,
Milton keynes MK12 5NW
Telephone +44 (0)1908 690620 Facsimilie +44 (0)1908 663010
Email: pfmkeynes@pellfrischmann.com
www.pellfrischmann.com

Client
enviroparks
reuse, recycle recover

Project
HIRWAUN ENVIROPARK

Drawing Title
ENVIROPARKS
PHASE 2
IMPERMEABLE AREAS

	Name	Date
Drawn	RE	12.12.16
Designed	DES	DEC 16
Checked		
Approved		

Scale @ A1 N.T.S
File No. DQ80023
Drawing Status INFORMATION
Drawing No. DQ80023C101
Revision P3

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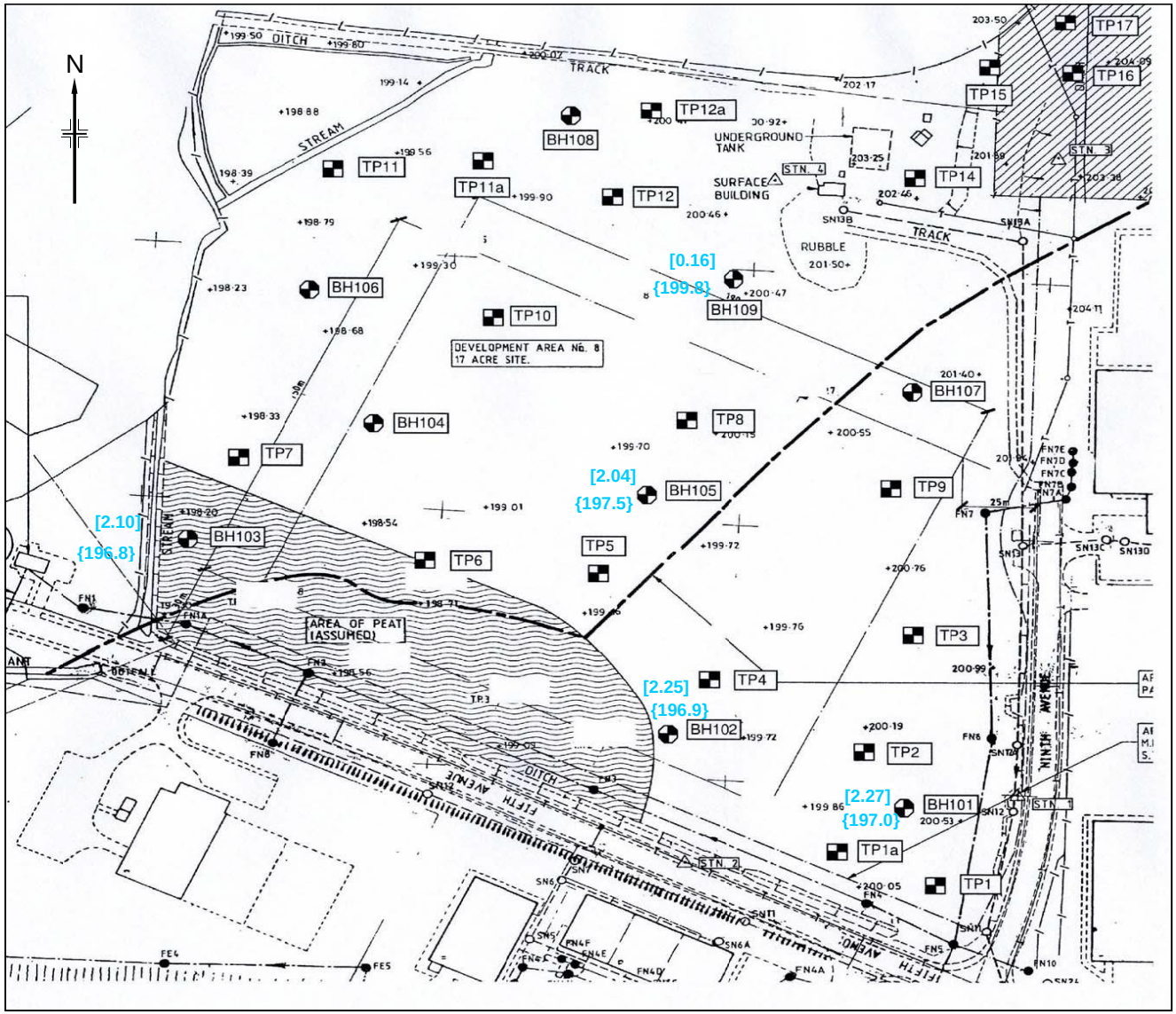
P:\Data\Q8000-Q80023 ENVIROPARK SITE SUPERVISION\PHASE 2 - PLANNING SUBMISSION\PF Drawings\DQ80023C100_101.dwg Plotted on 23/12/16 at 10:39 by begerton

APPENDIX C

GROUNDWATER LEVELS
(DERIVED FROM GEOTECHNCIAL REPORT)

Groundwater Depths and Reduced Levels

Soil Mechanics



Key:

[2.01]	Depth to Groundwater (m)
{186.9}	Top of groundwater table reduced levels (m OD)

Notes:

Only holes included where standpipe readings were taken

Not to scale

Notes Not to scale	**Project** Hirwaun Industrial Estate Project No H8076 Carried out for Enviroparks Limited	**Drawing** 5 Sheet 1 of 1

APPENDIX D

EA CORRESPONDENCE DATED 31/10/12

Ms Helen Montgomery
Pell Frischman
Millers 3 Southmill Road
Bishop's Stortford
Hertfordshire
CM23 3DH

Ein cyf/Our ref: SE/2012/115828/01-L01
Eich cyf/Your ref: 08/1735/10

Dyddiad/Date: 31 October 2012

Annwyl Ms Montgomery / Dear Ms Montgomery

ENQUIRY REGARDING GREENFIELD RUN-OFF RATES FOR DEVELOPMENT OF A SUSTAINABLE WASTE RESOURCE RECOVERY AND ENERGY PRODUCTION PARK AT FIFTH AVENUE, HIRWAUN INDUSTRIAL ESTATE, HIRWAUN, ABERDARE

Thank you for your enquiry regarding the above proposed development, which we received 28 September 2012.

We have reviewed the MicroDrainage report dated 18 September 2012. We consider that a suitable Greenfield runoff rate has been applied for this site.

The 1 in 1 year Greenfield runoff rate for this 7 Hectare site is specified as 124.7 l/s, which is equivalent to 17.8 l/l/s/ha. This is a suitable rate for this site. An appropriate increase in rainfall for climate change has been accounted for the 100 year event.

Our guidance document on Surface Water advises that suitable storage is required for the 30 year event. Additionally the volume of water from events up to and including the 100 year event, should be contained within the site. We attach a copy of this guidance note for your information.

Should you have any further queries, please do not hesitate to contact us.

Yn ddiffuant / Yours sincerely

Miss Gemma Beynon
Swyddog Cynllunio / Planning Liaison Officer

Deialu uniongyrchol/Direct dial 029 20245297

E-bost uniongyrchol/Direct e-mail gemma.beynon@environment-agency.gov.uk

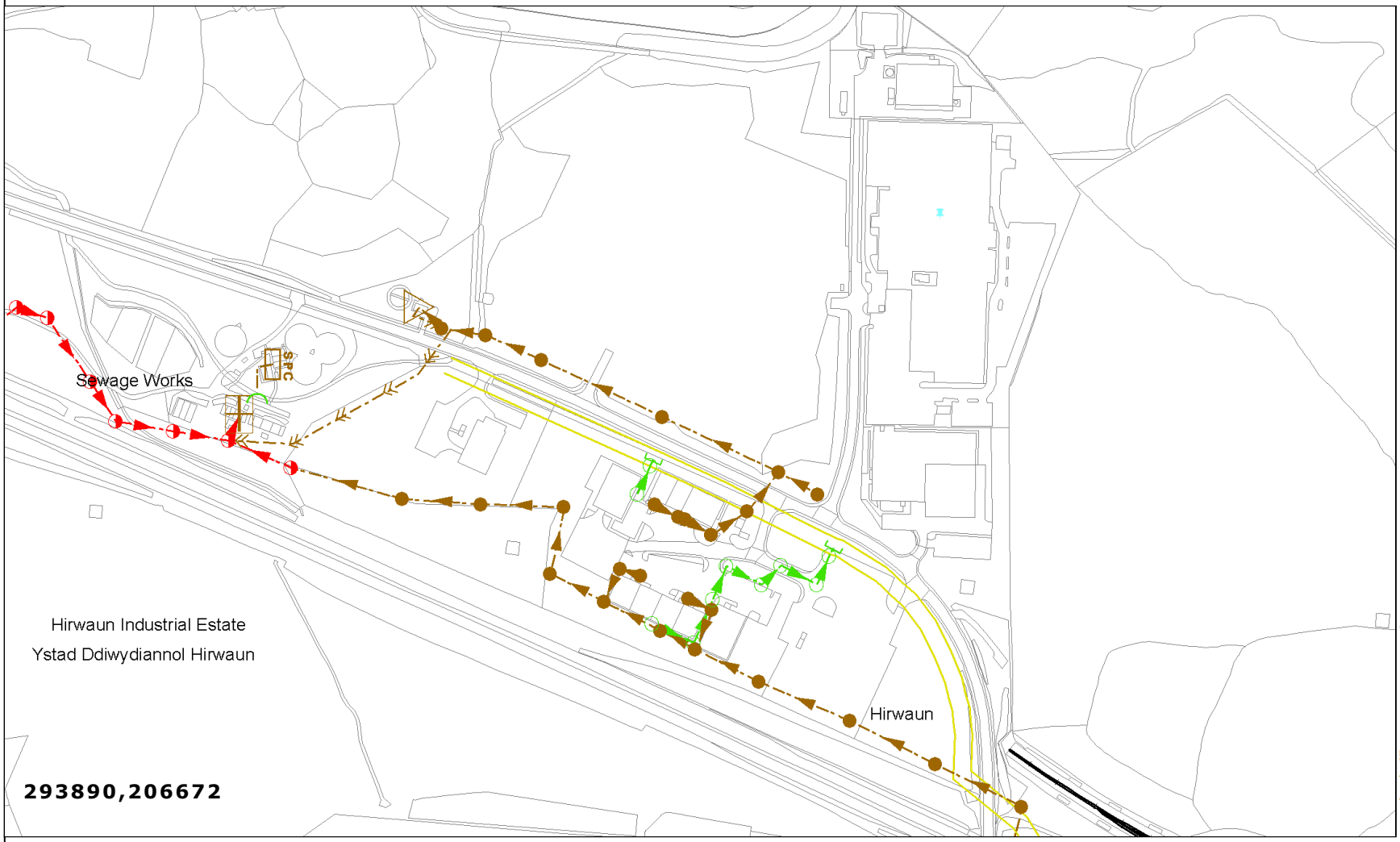
APPENDIX E

DCWW ASSET RECORDS

Dŵr Cymru
Welsh Water

27/08/2013

Fifth Avenue, Hirwaun Industrial Estate, Hirwaun, Aberdare, CF44 9YN



LEGEND

Clean Water

- Sluice Val
- Air Val, SINGLE
- Tap
- Pressure Reducing Valve
- Meter
- BULK Meter
- FH
- Cap
- Existing Main
- NON COMPANY

Sewerage External

- Foul
- Surface Water
- Combined
- Rising Main
- Private
- Treatment Works
- Pumping Station
- Special Purpose
- Unknown End
- Change, Combined Overflow
- Outfall, FOUL
- Lamp Hole, Foul
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

Dwr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the Company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based upon the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

EXACT LOCATION OF ALL APPARATUS TO BE DETERMINED ON SITE

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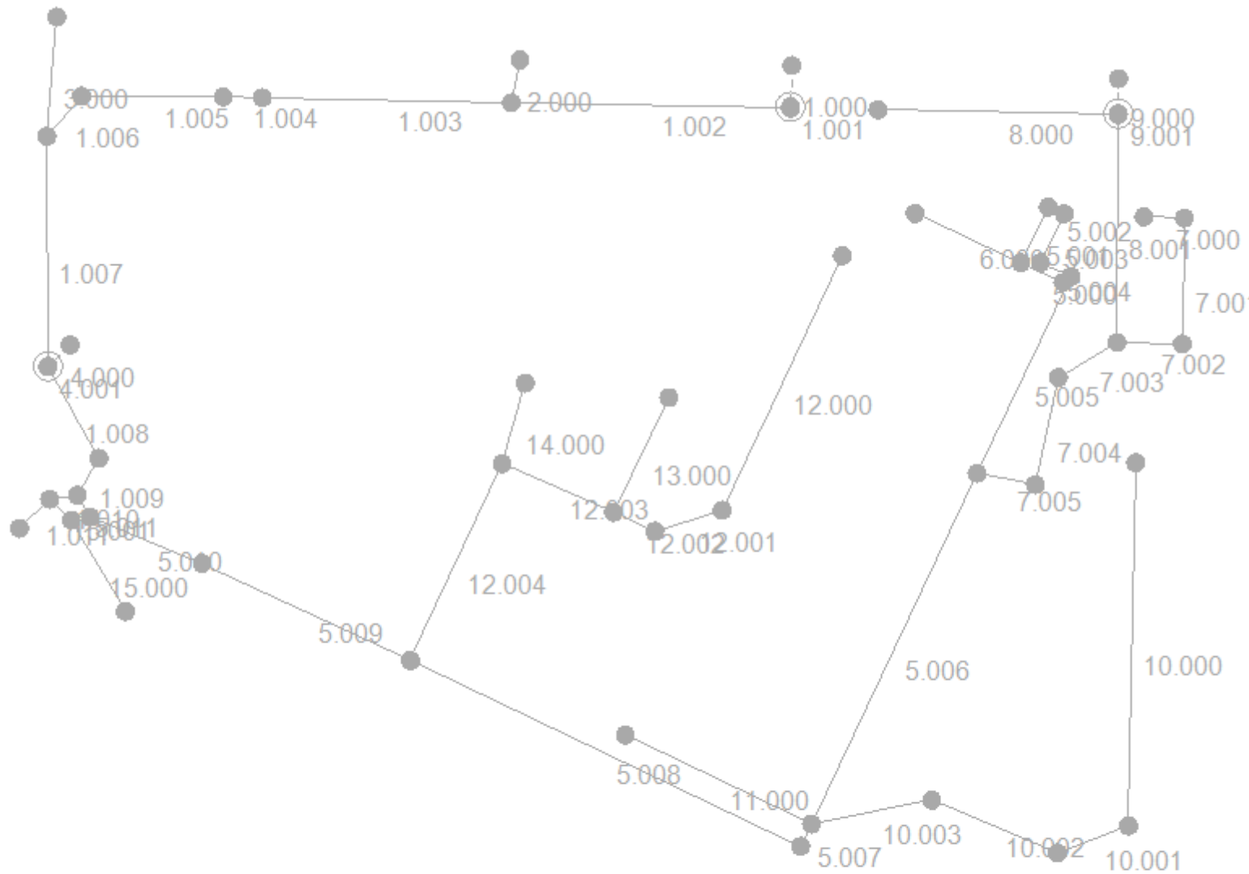
Scale: 1:4784

APPENDIX F

MODELLING PIPE NUMBERS (FROM MICRODRAINAGE)

Pell Frischmann		Page 1
Norfolk House East 108 Saxon Gate West Milton Keynes MK9 2AH		
Date 14/12/2016 10:23 File CIV14979 150904 CF EF - Surface Water Drainage Network - NEW PF UPDATE 13.mdx	Designed by dhoman Checked by	
Micro Drainage	Network 2016.1	



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APPENDIX G

SURFACE WATER MODELLING AND ATTENUATION

PIPELINE SCHEDULES for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

Upstream Manhole

- Indicates pipe length does not match coordinates

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	[]	11	Spur 1	200.500	197.750	1.750	Open Manhole	1800
1.001	o	225	2	200.350	197.666	2.459	Open Manhole	3000
1.002	o	900	24	200.350	197.600	1.850	Open Manhole	1800
2.000	o	225	Spur 2	199.000	197.568	1.207	Open Manhole	1800
1.003	o	900	25	199.870	197.500	1.470	Open Manhole	1800
1.004	o	375	25A	200.050	197.370	2.305	Open Manhole	1800
1.005	o	900	26A	199.950	197.350	1.700	Open Manhole	1800
1.006	o	900	26B	199.380	197.278	1.202	Open Manhole	1800
3.000	o	225	Spur 3	199.000	197.433	1.342	Open Manhole	1050
1.007	o	900	26	199.150	197.250	1.000	Open Manhole	1800
4.000	o	300	Spur 4	199.275	197.600	1.375	Open Manhole	1800
4.001	[]	4	12	199.250	197.450	1.000	Open Manhole	3000
4.002	o	450	12	199.000	197.321	1.229	Open Manhole	3000
1.008	o	900	27	199.250	197.120	1.230	Open Manhole	1800

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	225.000#	3409.1	2	200.350	197.684	1.666	Open Manhole	3000
1.001	9.868#	149.5	24	200.350	197.600	2.525	Open Manhole	1800
1.002	64.250	642.5	25	199.870	197.500	1.470	Open Manhole	1800
2.000	10.082	148.3	25	199.870	197.500	2.145	Open Manhole	1800
1.003	57.307	440.8	25A	200.050	197.370	1.780	Open Manhole	1800
1.004	9.011	450.5	26A	199.950	197.350	2.225	Open Manhole	1800
1.005	32.569	452.3	26B	199.380	197.278	1.202	Open Manhole	1800
1.006	12.215	436.3	26	199.150	197.250	1.000	Open Manhole	1800
3.000	27.584	150.7	26	199.150	197.250	1.675	Open Manhole	1800
1.007	53.071	408.2	27	199.250	197.120	1.230	Open Manhole	1800
4.000	50.000#	400.0	12	199.250	197.475	1.475	Open Manhole	3000
4.001	25.000#	227.3	12	199.000	197.340	0.860	Open Manhole	3000
4.002	7.175#	247.4	27	199.250	197.292	1.508	Open Manhole	1800
1.008	24.334	468.0	28	199.225	197.068	1.257	Open Manhole	1800

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PIPELINE SCHEDULES for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

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)
1.009	o	900	28	199.225	197.068	1.257	Open Manhole	1800
5.000	o	225	6B	200.300	198.950	1.125	Open Manhole	1050
6.000	o	150	5	200.250	198.850	1.250	Open Manhole	1800
5.001	o	225	6A	200.300	198.730	1.345	Open Manhole	1050
5.002	o	375	6	200.093	198.690	1.028	Open Manhole	1200
5.003	o	375	7	200.027	198.650	1.002	Open Manhole	1200
5.004	o	450	8	200.226	198.470	1.306	Open Manhole	1500
5.005	o	450	9	200.200	198.400	1.350	Open Manhole	1500
7.000	o	150	37	200.050	199.433	0.467	Open Manhole	1050
7.001	o	150	36	199.700	199.380	0.170	Open Manhole	1050
7.002	o	150	35	201.250	199.194	1.906	Open Manhole	1200
8.000	o	750	1	200.230	198.601	0.879	Open Manhole	1800
9.000	o	300	Spur 5	201.200	198.750	2.150	Open Manhole	1200
9.001	[]	10	28	201.000	198.505	1.495	Open Manhole	3000
9.002	o	450	26	200.821	198.504	1.867	Open Manhole	3000

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)
1.009	9.839	109.3	HEADWALL 9	199.000	196.978	1.122	Open Manhole	2495
5.000	10.700	10700.0	6A	200.300	198.949	1.126	Open Manhole	1050
6.000	26.838	223.7	6A	200.300	198.730	1.420	Open Manhole	1050
5.001	14.247	14247.0	6	200.093	198.729	1.139	Open Manhole	1200
5.002	3.973	99.3	7	200.027	198.650	1.002	Open Manhole	1200
5.003	12.481	118.9	8	200.226	198.545	1.306	Open Manhole	1500
5.004	7.750	110.7	9	200.200	198.400	1.350	Open Manhole	1500
5.005	50.376	236.5	14	200.150	198.187	1.513	Open Manhole	1800
7.000	9.333	176.1	36	199.700	199.380	0.170	Open Manhole	1050
7.001	29.002	155.9	35	201.250	199.194	1.906	Open Manhole	1200
7.002	14.996	17.9	11	200.724	198.358	2.216	Open Manhole	1800
8.000	55.349	401.1	4	200.494	198.463	1.281	Open Manhole	1800
9.000	60.000#	300.0	28	201.000	198.550	2.150	Open Manhole	3000
9.001	25.000#	641.0	26	200.821	198.466	1.355	Open Manhole	3000
9.002	8.261#	201.5	4	200.494	198.463	1.581	Open Manhole	1800

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PIPELINE SCHEDULES for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

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)
8.001	o	900	4	200.494	198.463	1.131	Open Manhole	1800
7.003	o	900	11	200.724	198.358	1.466	Open Manhole	1800
7.004	o	900	12	200.273	198.326	1.047	Open Manhole	1800
7.005	o	375	13	200.541	198.242	1.924	Open Manhole	1800
5.006	o	900	14	200.150	198.187	1.063	Open Manhole	1800
10.000	o	225	16	201.050	199.675	1.150	Open Manhole	1800
10.001	o	300	17	201.150	199.119	1.731	Open Manhole	1200
10.002	o	300	18	200.500	199.044	1.156	Open Manhole	1200
10.003	o	300	19A	200.500	198.887	1.313	Open Manhole	1200
11.000	o	225	2	200.150	198.925	1.000	Open Manhole	1200
5.007	o	900	19	200.150	198.100	1.150	Open Manhole	1800
5.008	o	900	Headwall 1	199.395	197.500	0.995	Open Manhole	1800
12.000	o	300	20	200.050	198.725	1.025	Open Manhole	1050
12.001	o	300	21	200.030	198.400	1.330	Open Manhole	1050
12.002	o	600	21A	199.750	198.290	0.860	Open Manhole	1500

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)
8.001	52.463	499.6	11	200.724	198.358	1.466	Open Manhole	1800
7.003	15.767	492.7	12	200.273	198.326	1.047	Open Manhole	1800
7.004	25.409	302.5	13	200.541	198.242	1.399	Open Manhole	1800
7.005	13.669	248.5	14	200.150	198.187	1.588	Open Manhole	1800
5.006	89.074	1023.8	19	200.150	198.100	1.150	Open Manhole	1800
10.000	83.451	150.1	17	201.150	199.119	1.806	Open Manhole	1200
10.001	17.489	233.2	18	200.500	199.044	1.156	Open Manhole	1200
10.002	31.339	199.6	19A	200.500	198.887	1.313	Open Manhole	1200
10.003	28.203	150.8	19	200.150	198.700	1.150	Open Manhole	1800
11.000	47.494	316.6	19	200.150	198.775	1.150	Open Manhole	1800
5.007	5.688	56.9	Headwall 1	199.395	198.000	0.495	Open Manhole	1800
5.008	99.453	1989.1	HEADWALL 3	199.680	197.450	1.330	Open Manhole	1200
12.000	64.916	199.7	21	200.030	198.400	1.330	Open Manhole	1050
12.001	16.215	147.4	21A	199.750	198.290	1.160	Open Manhole	1500
12.002	10.470	40.3	23A	199.920	198.030	1.290	Open Manhole	1500

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PIPELINE SCHEDULES for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

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)
13.000	o	375	22	199.950	198.275	1.300	Open Manhole	1350
12.003	o	600	23A	199.920	198.030	1.290	Open Manhole	1500
14.000	o	450	Spur 5	199.500	197.878	1.172	Open Manhole	1350
12.004	o	600	23	200.100	197.800	1.700	Open Manhole	1500
5.009	o	900	HEADWALL 3	199.680	197.382	1.398	Open Manhole	1200
5.010	oo	-8	HEADWALL 6	199.000	197.280	0.670	Open Manhole	1800
5.011	\/	-11	HEADWALL 7	199.000	196.980	0.520	Open Manhole	2495
1.010	\/	-1	HEADWALL 9	199.000	196.970	1.280	Open Manhole	2495
15.000	o	225	40	199.000	197.800	0.975	Open Manhole	1800
15.001	\/	-1	Headwall 10	199.000	196.980	1.270	Open Manhole	1800
1.011	o	900	HEADWALL 8	199.000	196.960	1.140	Open Manhole	1800

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)
13.000	29.464	245.5	23A	199.920	198.155	1.390	Open Manhole	1500
12.003	27.948	83.7	23	200.100	197.696	1.804	Open Manhole	1500
14.000	19.465	6.5	23	200.100	194.878	4.772	Open Manhole	1500
12.004	49.846	422.4	HEADWALL 3	199.680	197.682	1.398	Open Manhole	1200
5.009	52.876	528.8	HEADWALL 6	199.000	197.282	0.818	Open Manhole	1800
5.010	27.818	154.5	HEADWALL 7	199.000	197.100	0.850	Open Manhole	2495
5.011	5.876	587.6	HEADWALL 9	199.000	196.970	0.530	Open Manhole	2495
1.010	6.410	278.7	HEADWALL 8	199.000	196.947	1.303	Open Manhole	1800
15.000	24.382	29.7	Headwall 10	199.000	196.980	1.795	Open Manhole	1800
15.001	6.910	345.5	HEADWALL 8	199.000	196.960	1.290	Open Manhole	1800
1.011	9.668	358.1	30	199.150	196.933	1.317	Open Manhole	1500

Free Flowing Outfall Details for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011	30	199.150	196.933	0.000	1500	0

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Simulation Criteria for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

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	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Storm Duration (mins)	30
Ratio R	0.200		

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Online Controls for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

Hydro-Brake Optimum® Manhole: 2, DS/PN: 1.001, Volume (m³): 472.9

Unit Reference	MD-SFP-0218-2800-1200-2800
Design Head (m)	1.200
Design Flow (l/s)	28.0
Flush-Flo™	Calculated
Objective	Future Proof
Application	Surface
Sump Available	Yes
Diameter (mm)	218
Invert Level (m)	197.666
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	28.0	Kick-Flo®	0.784	22.8
Flush-Flo™	0.340	27.8	Mean Flow over Head Range	-	23.2

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	7.8	1.200	28.0	3.000	43.4	7.000	65.4
0.200	22.6	1.400	30.1	3.500	46.8	7.500	67.7
0.300	27.8	1.600	32.1	4.000	49.9	8.000	69.8
0.400	27.7	1.800	34.0	4.500	52.8	8.500	71.9
0.500	27.1	2.000	35.7	5.000	55.6	9.000	73.9
0.600	26.3	2.200	37.4	5.500	58.2	9.500	75.9
0.800	23.1	2.400	39.0	6.000	60.7		
1.000	25.7	2.600	40.5	6.500	63.1		

Hydro-Brake Optimum® Manhole: HEADWALL 8, DS/PN: 1.011, Volume (m³): 40.2

Unit Reference	MD-SHE-0414-1170-1600-1170
Design Head (m)	1.600
Design Flow (l/s)	117.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	414
Invert Level (m)	196.960
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	117.0	Kick-Flo®	1.212	102.3
Flush-Flo™	0.649	117.0	Mean Flow over Head Range	-	95.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-

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Hydro-Brake Optimum® Manhole: HEADWALL 8, DS/PN: 1.011, Volume (m³): 40.2

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	11.2	1.200	103.2	3.000	158.9	7.000	240.6
0.200	40.4	1.400	109.7	3.500	171.3	7.500	248.9
0.300	78.7	1.600	117.0	4.000	182.9	8.000	256.9
0.400	112.1	1.800	123.9	4.500	193.8	8.500	264.6
0.500	115.5	2.000	130.4	5.000	204.0	9.000	272.2
0.600	116.9	2.200	136.6	5.500	213.8	9.500	279.5
0.800	116.0	2.400	142.5	6.000	223.1		
1.000	112.1	2.600	148.2	6.500	232.0		

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Storage Structures for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

Tank or Pond Manhole: Spur 3, DS/PN: 3.000

Invert Level (m) 197.433

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	400.0	0.500	400.0	1.000	400.0
0.250	400.0	0.750	400.0		

Tank or Pond Manhole: Headwall 1, DS/PN: 5.008

Invert Level (m) 197.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	162.0	1.000	900.0	2.000	1800.0
0.500	450.0	1.500	1350.0	2.500	2250.0

Tank or Pond Manhole: HEADWALL 3, DS/PN: 5.009

Invert Level (m) 197.382

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	0.500	450.0	1.500	1350.0	2.500	2250.0
0.250	225.0	1.000	900.0	2.000	1800.0		

Tank or Pond Manhole: HEADWALL 6, DS/PN: 5.010

Invert Level (m) 197.280

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	135.0	1.000	900.0	2.000	1800.0
0.500	450.0	1.500	1350.0	2.500	2250.0

Tank or Pond Manhole: HEADWALL 8, DS/PN: 1.011

Invert Level (m) 196.960

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	200.0	0.500	200.0	1.000	200.0
0.250	200.0	0.750	200.0	1.500	200.0

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Summary of Critical Results by Maximum Level (Rank 1) for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

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	FSR	Ratio R	0.200
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
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, 4320
Return Period(s) (years)	100
Climate Change (%)	30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	Spur 1	360 Winter	100	+30%	100/120 Winter				200.322
1.001	2	360 Winter	100	+30%	100/15 Summer				200.322
1.002	24	480 Winter	100	+30%	100/180 Winter				198.593
2.000	Spur 2	480 Winter	100	+30%	100/15 Summer				198.590
1.003	25	480 Winter	100	+30%	100/120 Winter				198.590
1.004	25A	480 Winter	100	+30%	100/15 Summer				198.588
1.005	26A	480 Winter	100	+30%	100/120 Summer				198.578
1.006	26B	480 Winter	100	+30%	100/60 Winter				198.575
3.000	Spur 3	360 Winter	100	+30%	100/15 Summer				198.592
1.007	26	480 Winter	100	+30%	100/60 Winter				198.574
4.000	Spur 4	30 Summer	100	+30%	100/15 Summer				198.973
4.001	12	480 Winter	100	+30%	100/120 Summer				198.574
4.002	12	480 Winter	100	+30%	100/15 Summer				198.573
1.008	27	480 Winter	100	+30%	100/60 Summer				198.571
1.009	28	480 Winter	100	+30%	100/30 Winter				198.567
5.000	6B	180 Winter	100	+30%					198.950
6.000	5	30 Winter	100	+30%					198.874
5.001	6A	30 Winter	100	+30%					198.889
5.002	6	30 Winter	100	+30%					198.897
5.003	7	30 Winter	100	+30%					198.890
5.004	8	30 Winter	100	+30%					198.862
5.005	9	30 Winter	100	+30%					198.829
7.000	37	180 Winter	100	+30%					199.433

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Summary of Critical Results by Maximum Level (Rank 1) for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	Spur 1	1.572	0.000	0.10		100.8	FLOOD RISK	
1.001	2	2.431	0.000	2.16		33.3	FLOOD RISK	
1.002	24	0.093	0.000	0.05		34.0	SURCHARGED	
2.000	Spur 2	0.797	0.000	0.01		0.3	SURCHARGED	
1.003	25	0.190	0.000	0.04		34.9	SURCHARGED	
1.004	25A	0.843	0.000	0.63		34.8	SURCHARGED	
1.005	26A	0.328	0.000	0.05		35.9	SURCHARGED	
1.006	26B	0.397	0.000	0.08		35.9	SURCHARGED	
3.000	Spur 3	0.934	0.000	0.69		26.9	SURCHARGED	
1.007	26	0.424	0.000	0.08		64.3	SURCHARGED	
4.000	Spur 4	1.073	0.000	2.66		138.1	SURCHARGED	
4.001	12	0.324	0.000	0.04		58.5	SURCHARGED	
4.002	12	0.802	0.000	0.45		58.2	SURCHARGED	
1.008	27	0.551	0.000	0.13		83.3	SURCHARGED	
1.009	28	0.599	0.000	0.09		85.9	SURCHARGED	
5.000	6B	-0.225	0.000	0.00		0.0	OK	
6.000	5	-0.126	0.000	0.02		0.2	OK	
5.001	6A	-0.066	0.000	0.19		2.1	OK	
5.002	6	-0.168	0.000	0.47		50.5	OK	
5.003	7	-0.135	0.000	0.40		50.1	OK	
5.004	8	-0.058	0.000	0.27		46.4	OK	
5.005	9	-0.021	0.000	0.53		100.8	OK	
7.000	37	-0.150	0.000	0.00		0.0	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
7.001	36	180 Winter	100	+30%				
7.002	35	180 Winter	100	+30%				
8.000	1	30 Winter	100	+30%				
9.000	Spur 5	15 Winter	100	+30%	100/15 Summer	100/15 Summer		
9.001	28	30 Winter	100	+30%				
9.002	26	30 Winter	100	+30%	100/15 Summer			
8.001	4	30 Winter	100	+30%				
7.003	11	30 Winter	100	+30%				
7.004	12	30 Winter	100	+30%				
7.005	13	30 Winter	100	+30%	100/15 Summer			
5.006	14	30 Winter	100	+30%				
10.000	16	30 Summer	100	+30%	100/15 Summer			
10.001	17	15 Winter	100	+30%	100/15 Winter			
10.002	18	30 Summer	100	+30%				
10.003	19A	30 Summer	100	+30%				
11.000	2	30 Summer	100	+30%	100/15 Summer	100/15 Summer		
5.007	19	480 Winter	100	+30%				
5.008	Headwall 1	360 Winter	100	+30%	100/120 Winter			
12.000	20	15 Winter	100	+30%	100/15 Summer			
12.001	21	15 Winter	100	+30%	100/15 Summer			
12.002	21A	15 Winter	100	+30%	100/15 Summer			
13.000	22	15 Winter	100	+30%	100/15 Summer			
12.003	23A	15 Winter	100	+30%	100/15 Summer			
14.000	Spur 5	30 Summer	100	+30%	100/15 Summer	100/15 Summer		
12.004	23	15 Winter	100	+30%	100/15 Summer			
5.009	HEADWALL 3	360 Winter	100	+30%	100/60 Winter			
5.010	HEADWALL 6	360 Winter	100	+30%	100/120 Summer			
5.011	HEADWALL 7	480 Winter	100	+30%	100/180 Winter	100/2880 Winter		
1.010	HEADWALL 9	480 Winter	100	+30%	100/15 Summer			
15.000	40	360 Winter	100	+30%	100/60 Summer			
15.001	Headwall 10	480 Winter	100	+30%	100/15 Summer			
1.011	HEADWALL 8	480 Winter	100	+30%	100/30 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
7.001	36	199.380	-0.150	0.000	0.00		0.0	OK	
7.002	35	199.194	-0.150	0.000	0.00		0.0	OK	
8.000	1	199.253	-0.098	0.000	0.00		2.2	OK	
9.000	Spur 5	201.201	2.151	1.387	3.01		182.9	FLOOD	4
9.001	28	199.459	-0.046	0.000	0.11		166.0	OK	
9.002	26	199.405	0.451	0.000	1.97		296.0	SURCHARGED	
8.001	4	199.253	-0.110	0.000	0.34		249.3	OK	
7.003	11	199.158	-0.100	0.000	0.50		220.8	OK	
7.004	12	199.135	-0.091	0.000	0.29		233.0	OK	
7.005	13	199.070	0.453	0.000	2.36		234.9	SURCHARGED	
5.006	14	198.732	-0.355	0.000	0.63		346.9	OK	

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Summary of Critical Results by Maximum Level (Rank 1) for EXPORT FOR PDS - SW NETWORK PHASE 1.SWS

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
10.000	16	200.965	1.065	0.000	1.63		67.1	FLOOD RISK	
10.001	17	199.421	0.002	0.000	1.05		65.4	SURCHARGED	
10.002	18	199.269	-0.075	0.000	0.91		64.9	OK	
10.003	19A	199.091	-0.096	0.000	0.80		65.1	OK	
11.000	2	200.155	1.005	4.691	2.79		77.4	FLOOD	5
5.007	19	198.594	-0.406	0.000	0.19		178.7	OK	
5.008	Headwall 1	198.587	0.187	0.000	0.26		147.4	SURCHARGED	
12.000	20	199.885	0.860	0.000	0.72		53.7	FLOOD RISK	
12.001	21	199.691	0.991	0.000	1.14		88.1	SURCHARGED	
12.002	21A	199.547	0.657	0.000	0.18		94.0	FLOOD RISK	
13.000	22	199.851	1.201	0.000	1.98		221.9	FLOOD RISK	
12.003	23A	199.357	0.727	0.000	0.76		438.5	SURCHARGED	
14.000	Spur 5	199.508	1.180	7.994	0.31		302.6	FLOOD	5
12.004	23	199.133	0.733	0.000	2.64		771.6	SURCHARGED	
5.009	HEADWALL 3	198.583	0.301	0.000	0.71		232.7	SURCHARGED	
5.010	HEADWALL 6	198.569	0.239	0.000	0.05		142.7	SURCHARGED	
5.011	HEADWALL 7	198.565	0.085	0.000	0.03		125.4	SURCHARGED	
1.010	HEADWALL 9	198.565	0.845	0.000	0.08		162.7	SURCHARGED	
15.000	40	198.564	0.539	0.000	0.01		0.3	SURCHARGED	
15.001	Headwall 10	198.564	0.834	0.000	0.00		0.6	SURCHARGED	
1.011	HEADWALL 8	198.564	0.704	0.000	0.23		116.7	SURCHARGED	

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