

DRAINAGE STRATEGY REPORT

**EXPANSION OF BIKE PARK WALES
GETHIN WOODLAND CENTRE
ABERCANAID
MERTHYR TYDFIL
CF48 1YZ**

Project Reference

6655

Report Reference

6655-00-XX-RP-C-001

Client

BIKE PARK WALES

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REPORT CONTROL SHEET

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This document is intended to be a working document for further development and discussion with all concerned including Bike Park Wales, Project Design Team Members, The SuDs Approval Body and Natural Resources Wales together with all appropriate regulators.

This document has been prepared exclusively for the use of Bike Park Wales for the purposes of consultation with and approval by the regulators in connection with the specific subject scheme and should not be transferred to any other parties without the express consent of Bingham Hall Partnership Limited. The document's contents, views, conclusions and recommendations should not be used or relied upon by any third parties without the express consent of Bingham Hall Partnership Limited.

1 INTRODUCTION

Bingham Hall Partnership Limited has been commissioned by Bike Park Wales to undertake the Civil and Structural Engineering aspects of the expansion of their facility at Gethin Wood Centre, Abercanaid, Merthyr Tydfil. An activity of the commission is to prepare a Drainage Strategy Report in support of the Planning Application and The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018.

The Clients proposals will provide the following facilities:

- New parking areas for 141 vehicles;
- Overflow parking area with space for 85 vehicles;
- New area for motorhomes with separate foul drainage facilities;
- 21 camping pods, 3 shepherds huts and 5 lodges;
- Shower and toilet blocks;
- Changing village;
- Workshop storage and shed;
- 2 linen pods;
- Relocated trail maintenance yard;
- Play and picnic area;
- New highway access routes;
- New and remodelled footpath network;
- Remodelled bike tracks;
- Ground profile works;
- New foul drainage infrastructure to accommodate the above development;
- New SuDs infrastructure to accommodate the above development;
- Landscape works.

As a result of the enactment of Schedule 3 of the Flood Water Management Act 2010 by Welsh Government, the development will be subject to The Sustainable Drainage (Approval and Adoption Procedure) (Wales) Regulations 2018 as well as planning approval in order to be constructed. This report has been produced to satisfy both approval processes.

This Drainage Strategy Report explains the initial design process that has been undertaken by Bingham Hall Partnership Limited in advance of the Planning and Sustainable Drainage (SuDS) Regulations applications, and is intended to explain the design process undertaken to date, together with the design intent for the proposed foul and surface water drainage systems serving the proposed development.

The objectives of this report are to;

- Outline both the surface water and foul water proposals for the development and also identify the requirements for suitable outfall locations for the Surface Water and Foul Drainage from the development as it has been proven by on site testing that infiltration techniques are not appropriate for this site.
- Provide a vehicle for consultation with the Lead Local Flood Authority, SuDS Approving Body (SAB) and Natural Resources Wales (NRW) regarding the proposals.
- Provide a schematic layout of the proposed foul and surface water drainage proposals.

- Demonstrate compliance with the new National SuDs design standards, specifically standards S1-S6.

2 SITE LOCATION

The site is currently operated as the Bike Park Wales mountain bike park, the proposed works are associated with the expansion of the facility to provide the additional facilities noted at section 1 of this strategy report.

The site is located in Gethin Woods approximately 0.5km west of Abercanaid, at a National Grid Reference of 305160, 203410. The site is irregular in shape and occupies an area of approximately 5 hectares. The boundaries of the site are defined by existing undeveloped and wooded areas to the north, east and west and an extensive network of bike trails and tracks utilised by the bike park to the south and southwest. The areas surrounding the site comprise woodland areas associated with the Bike Park Wales.

The site location is shown in Figure 1.1 below;



Figure 1.1 – Location Plan

3 EXISTING TOPOGRAPHY

A topographical survey of the site has been undertaken by John Vincent Surveys Limited in February 2018; a copy of the survey drawing is included in Appendix A of this report.

The site is on sloping ground towards the base of the valley and falls in a north easterly direction towards the River Taff from an approximate maximum elevation of 260m AOD to an approximate minimum elevation of 220m AOD. Offsite the ground rises more sharply to the southwest to reach a maximum elevation of 471m AOD.

Within the areas of proposed development around the existing building and car park areas the ground level has been reprofiled to form a series of plateaus.

4 SUMMARY OF SITE GROUND CONDITIONS

The 1:10,560 scale geological map of the area (SO 00 SE) indicates the site to be underlain by southerly dipping strata of the South Wales Middle Coal Measures Formation of the Carboniferous Period. The dip of strata in the vicinity of the site is indicated to be 6°-10° to the south.

These rocks typically comprise grey productive coal-bearing mudstones/siltstones, with seatearths and minor sandstones.

The conjectural outcrop of the Lower Cwmgorse Marine Band is indicated traversing approximately through the centre of the site on a northwest to southeast trend, while the conjectural outcrop of the underlying Foraminifera and Upper Cwmgorse Marine Bands are indicated just to the north and the south respectively of the site.

A number of conjectural outcrops of various coal seams are indicated in the vicinity of the site.

The known and conjectured outcrops of the Pentre Rider, the Pentre and the Lower Pentre are indicated to the north of the site. Due to the southerly strata dips these seams would be expected to underlie the northern and central parts of the site at shallow depths, deepening in a southerly direction. Former adits and shafts are recorded along these seam outcrops indicating that these seams have been mined underground in the area. The nearest of these adits are less than 200m to the north of the site.

The Graig and Abergorky seams are shown to outcrop (or conjectured to outcrop) approximately through the centre of the site just below the Lower Cwmgorse Marine Band.

Given the southerly dip of the strata, these seams would underlie the southern half of the site at shallow depths. An adit is shown on the Graig/Abergorky outcrop, approximately 150m to the northwest of the site, again indicating that these seams have been mined underground in the area.

The conjectural outcrop of the Hafod seam is indicated to pass beneath the site, running approximately parallel to the south western edge and therefore this seam could also be shallow beneath these parts of the site.

The solid strata are indicated to be overlain by superficial deposits of Devensian Till of the Quaternary Period. These deposits generally comprise a poorly sorted and variable composition of clays, sands and gravel, with some cobbles and occasional boulders. Superficial deposits are not indicated to overly the bedrock along the southwest edge of the site.

Ground investigation works have been carried out on the site and are documented in the following Integral Geotechnique Site Investigation Reports: -

- Reference 12329/LP/18/DS – Desk Top Study Report dated November 2018
- Reference 12329/LP/18/CMRA – Coal Mining Risk Assessment dated November 2018
- Reference 12329/LW/19/S – Desk Top Study Report dated February 2019

The results of the ground investigation works referenced above were consistent with the anticipated geology. Generally, the ground conditions encountered in the exploratory holes comprised topsoil or made/reworked natural ground over superficial deposits consisting of glacial till deposits.

The glacial till comprised of a vertically and laterally variable sequence of medium dense brown to brown grey silty clayey sandy gravel and firm silty sandy gravelly clay. The gravel consisted of siltstone, mudstone and sandstone with cobbles and boulders encountered. The glacial till was encountered at depths of between 0.2m and 1.4m below existing ground level.

An indicative soakaway test was undertaken in one trial pit which recorded no infiltration. More extensive, proposed location and depth specific further testing has been subsequently undertaken in order to confirm the specific design parameters to inform the final drainage design.

The results of the supplementary specific soil infiltration testing are documented in Messrs Integral Geotechnique (Wales) Limited letter report referenced 12329/LW dated 26th September 2019.

To summarise three additional BRE 365 compliant soil infiltration tests and three BS 6297:2007 (Design and Installation of Drainage Fields for Use in Watercourse Treatment) compliant percolation tests were undertaken on 9th September 2019. The tests were strategically located and undertaken at depths which replicated the proposed soakaways in service.

In conclusion the above report documents that the results of the soil infiltration testing indicated that the superficial deposits consisting of glacial till at shallow depth are unsuitable for the use of sustainable drainage systems. The high clay content of the glacial till deposits prohibits and/or limits the infiltration rates within the soils. Further the results of the drainage field percolation testing indicate that the use of a drainage field for the disposal of effluent from a foul water treatment plant is unsuitable. The high clay content of the glacial till deposits is considered to prohibit the infiltration rates within the soils.

5 FLOOD RISK

Bingham Hall Partnership Limited has consulted the website of Natural Resources Wales. The Development Advice Map (as updated 2017) indicates that the subject site is completely located within Zone A, which in accordance with Technical Advice Note 15, defines an area to be at little or no risk of fluvial or tidal/coastal flooding. Refer to Figure 5.1 below.

Further the Natural Resources Wales Surface Water Flood Map has been consulted, refer to Figure 5.2, also below. The map indicates that the site is essentially outside the surface water flood risk zone, however relatively small local areas of low flood risk are indicated within the site boundary.

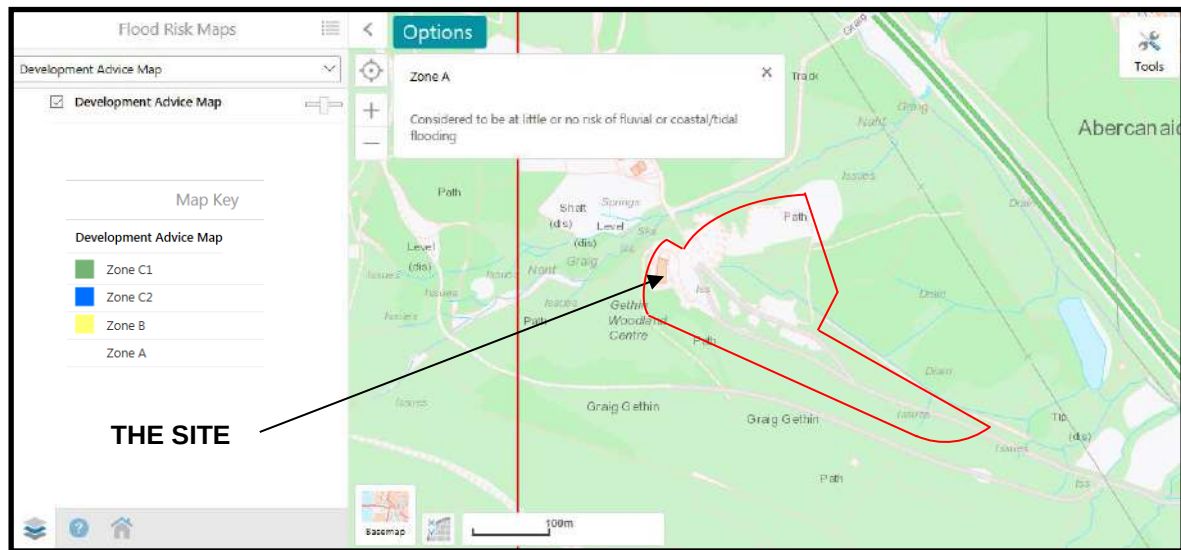


Figure 5.1 – Extract of Development Advice Map (DAM)

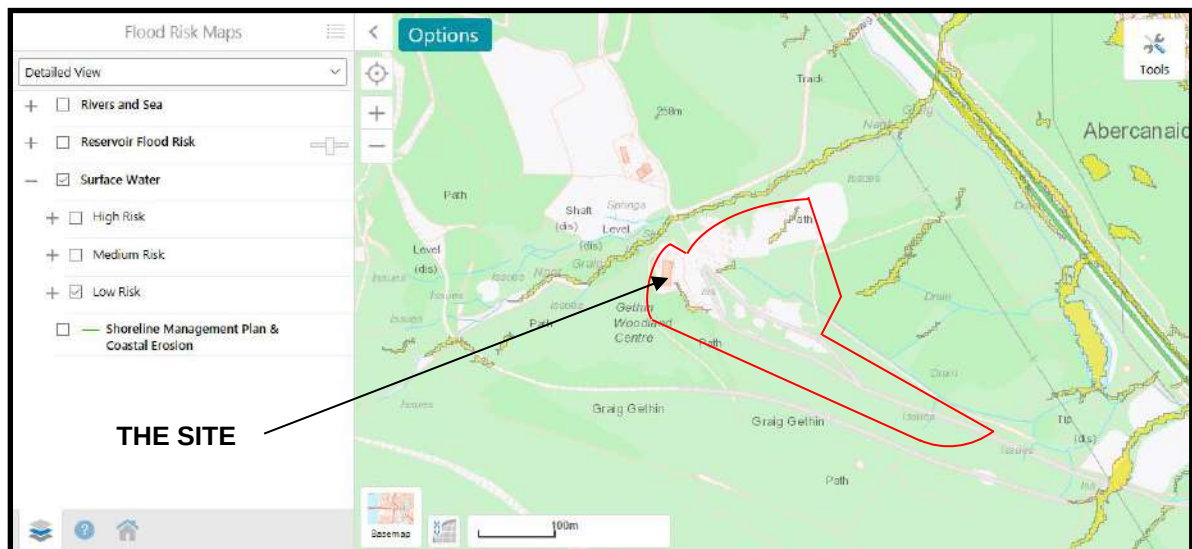


Figure 5.2 – Extract of Natural Resources Wales Surface Water Flood Map

6 DEVELOPMENT PROPOSALS

The proposed landscape masterplan drawing numbered 18/461/01I produced by Peter Quinn Associates is included in Appendix B of this report.

It is proposed that the existing Bike Park Wales facility is expanded to include the following:

- New parking areas for 141 vehicles;
- Overflow parking area with space for 85 vehicles;
- New area for motorhomes with separate foul drainage facilities;
- 21 camping pods, 3 shepherds huts and 5 lodges;
- Shower and toilet blocks;
- Changing village;

- Workshop storage and shed;
- 2 linen pods;
- Relocated trail maintenance yard;
- Play and picnic area;
- New highway access routes;
- New and remodelled footpath network;
- Remodelled bike tracks;
- Ground profile works;
- New foul drainage infrastructure to accommodate the above development;
- New SuDs infrastructure to accommodate the above development;
- Landscape works.

A planning application was previously made to Merthyr Tydfil County Borough Council by The Urbanists on behalf of Bike Park Wales. Merthyr Tydfil County Borough Council allocated the previous Planning Application Number of P/19/0073.

7 FOUL DRAINAGE

There are no DCWW public foul or combined sewer networks within relatively close proximity to the development.

We understand that the foul water drainage from the existing site is routed through a local site network to a packaged treatment plant located to the north west of the site. Natural Resources Wales has advised that the treated effluent discharged from the existing treatment plant outfalls to a receiving watercourse named the Nant Graig. The Client has provided us with the Emissions and Monitoring Schedule of the current discharge permit, a copy of this schedule, reference Schedule 3, is included in Appendix C of this report.

We understand that flows from the existing bike wash areas are routed through a local site network to a reed bed also located to the north west of the site. The Client has advised that the reed bed has been specifically designed to accommodate foul flows from the bike wash. The Client has also provided us with information relating to the existing reed bed which indicates that following treatment the effluent flows, by gravity, from the reed bed to the reed bed level control chamber and onto a manhole connection downstream of the existing foul water treatment facility prior to exiting to the outfall to the above noted watercourse.

Our foul water drainage proposals are indicated on our proposed site wide external works scheme drawing referenced 6655-BHP-ZZ-XX-DR-S-(60)P01S, a copy of which is included in Appendix D of this report.

The effluent from both bike washes and the trail maintenance yard will be routed to the existing reed bed which has been appropriately designed to accommodate such effluent. The Client has advised that the proposed bike wash and trail maintenance installations will be subject to no more uses, the additional facilities merely reducing the demand on the existing.

The Client has advised that there will be no drainage provision required for the workshop and storage shed.

Generally, the proposed development foul water will be routed through a local site network to a proposed new foul water treatment facility located to the north east of the site. Appropriate measures for the trapping of grease prior to effluent entry into the treatment facility will be incorporated into the system as any fat and/or grease passing through the proposed foul drainage system into the final discharge off site to the watercourse would be detrimental. Further the final design of the foul water treatment facility will include a provision to counter fluctuating loads.

The breakdown of foul effluent proposed for discharge to the new foul water treatment facility is as noted below: -

- 5 number Cabins/Lodges
- 1 number Camping Pod converted to a Toilet Pod and 1 number Camping Pod converted to a Shower Pod
- 3 number Shepherd Huts
- 21 number camping pods
- Changing village

The proposed area with provision for 7 motorhomes will have a facility for discharge of foul waste. In consideration that such waste is likely to contain chemicals, this provision will discharge to a separate sealed cesspool which will be used to store the waste until it is pumped clean to a tanker and appropriately disposed at an off-site facility. The Client has advised that this area will be used infrequently, mainly for event days and as such it is proposed to provide an above ground storage system, the details of such a system are included in Appendix E of this report.

The 21 number camping pods do not have any water or drainage connection and will utilise the proposed shower and toilet pods and changing village.

Considering the results of the BS 6297:2007 Percolation Compliant Testing, in accordance with Approved Document H, Part H1 of the Building Regulations (for use in Wales), we would propose one of the following two options for the disposal of foul water, as the results of the above percolation testing precludes option (C)(i).

Option (C) (ii) Either a septic tank or packaged treatment plant with an outfall to a watercourse, effluent treated to 20 (BOD)/30 (Suspended Solids) 20 (NH3) quality. This option is to be approved and consented by Natural Resources Wales.

Option (D) A cesspool with a capacity of 45 days foul effluent inflow. This option is to be approved and consented by Natural Resource Wales.

In accordance with the hierarchy as set out in Part H1, Option (C) (ii) packaged treatment plant alternative is currently the preferred option and is indicated on our strategy drawing.

The design team will engage with the NRW Permitting Team at the earliest opportunity, at a stage when the design is sufficiently developed in order to obtain both a new permit for the proposed foul water treatment facility and, if necessary, an appropriate variation to any existing permit with respect to the existing packaged treatment plant.

Bike Park Wales has provided the maximum anticipated usage data and using British Water Flows and Loads 4 guidance we have estimated the following loads.

PROPOSED TREATMENT FACILITY

21 Camping Pods

168 toilet uses per day, say at 10l/use	1680l
84 shower uses per day at 40l/use	2160l

3 Shepherds Huts (2 person)

3 x 2 150l/day per person	900l
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5 Cabins (3 bedrooms, 8 person)

5 x 8 x 150l/day per person	6000l
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New Changing Village

100 toilet uses per day at 10l/use	1000l
50 shower uses per day at 40l/use	2000l

Foul Load at Maximum Usage for 1 day 13740 litres (Say 13.74m³)

Bike Park Wales has confirmed that over a one-week operating cycle the percentage of maximum usage is as follows: -

Saturday/Sunday	-	maximum usage
Monday	-	70% maximum usage
Tuesday/Wednesday/Thursday	-	50% of maximum usage
Friday	-	80% maximum usage

Total weekly anticipated usage expressed as a proportion of 700% equates to 69.25m³ per week, that is, $\frac{500}{700}$ or 0.72 maximum daily discharge for a seven day cycle.

FOUL DISCHARGE PROVISION FOR 7 NUMBER MOTORHOMES (2 person occupancy)

7 x 2 x 100 l/day per motorhome	=	1400l
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As noted in the foregoing this facility will be infrequently provided for event days and therefore foul waste is proposed to be stored above ground and tankered away as and when necessary.

8 SURFACE WATER DRAINAGE

The sustainable drainage system proposed for the site is to manage water on or as close to the surface and as close to the source of the runoff as possible. All pathways, parking and access roads are proposed to be constructed using dry bound macadam, a material which has the potential to be locally sourced, including residual hydrocarbon capture membranes where appropriate. Such surfacing facilitates a degree of permeability enabling infiltration into it to a degree, however given the permeability of the in-situ soils below full infiltration is unlikely to occur. Further, gravel porous surfacing is very effective at removing pollution from run-off. The pollutants may remain on the surface (at areas with low gradients) or may be flushed into the granular layer itself where many of the pollutants are filtered and trapped or degrade over time. Further, filter geotextiles are proposed to be incorporated into the construction make-up which will also enhance the final water quality. Aqua swirl units positioned immediately downstream of the car parking areas will also enhance the quality of the offsite flows.

Given the underlying ground conditions most of the rainfall on the paved surfaces will generate sheet flow run off which is proposed to be directed to local swales / filter drains / infiltration strips which will have flow capabilities.

Vegetation growth promoted in the swales together with the incorporation of sacrificial geotextile wrapped layers within the filter drains will be effective in trapping any silt transported off the pavement surfaces via sheet flow. At the proposed parking area to the north of the site, swales and infiltration structures have been arranged within the terrain such that excess runoff will be cascaded down to the lower structure. Across the site it is proposed to link the various SuDS structures by below ground pipework to the vicinity of the outfalls off site as noted below.

The camping pods, showers and toilet blocks have relatively small plan areas and therefore roof run-off will be to adjacent ground. Given the poor infiltration properties of the insitu soils an element of greenfield run off from these areas will migrate to the filter drains located adjacent to the proposed access road and at the car park respectively. The roof run-off from the lodges will be collected via a local network and routed towards the north west of the site prior to being discharged off site at a rate to be agreed into the Nant Graig watercourse.

It is proposed to discharge any excess runoff from the overflow parking area to the south east together with the immediately adjacent length of road, to the existing local drainage ditches at a rate to be agreed. It is proposed to route any excess runoff from the remaining drained areas to the north west of the site where it is proposed to be discharged off site at a rate to be agreed into the Nant Graig watercourse.

Given the poor infiltration properties of the insitu soils, with exception of the overflow car parking area, it will be necessary to include below ground attenuation structures within close proximity to the offsite outfalls to facilitate the limited offsite controlled discharges.

All discharges off site are subject to agreement with the SuDs Approval Body, Natural Resources Wales and other appropriate regulators.

Exceedance storage is proposed to be facilitated by the partial flooding of the lower area of the northern parking.

Statutory Standards for Sustainable Drainage Systems – Designing, Constructing, Operating and Maintaining Surface Water Drainage Systems

In October 2018, the Welsh Government published the ‘Statutory Standards for Sustainable Drainage Systems – Designing, Constructing, Operating and Maintaining Surface Water Drainage Systems’. This standard is now mandatory for new developments with either a construction area greater than 100m² or more than 1 dwelling.

The principles which underpin the design of surface water management schemes to meet the Standards are as follows;

SuDS schemes should aim to;

- Manage water on or close to the surface and as close to the source of the runoff as possible;
- Treat rainfall as a valuable natural resource;
- Ensure pollution is prevented at source, rather than relying on the drainage system to treat or intercept it;
- Manage rainfall to help protect people from increased flood risk, and the environment from morphological and associated ecological damage resulting from changes in flow rates, patterns and sediment movement caused by the development;
- Take account of likely future pressures on flood risk, the environment and water resources such as climate change and urban creep;
- Use the SuDS Management Train, using drainage components in series across a site to achieve a robust surface water management system (rather than using a single “end of pipe” feature, such as a pond, to serve the whole development);
- Maximise the delivery of benefits for amenity and biodiversity;
- Seek to make the best use of available land through multifunctional usage of public spaces and the public realm;
- Perform safely, reliably and effectively over the design life of the development taking into account the need for reasonable levels of maintenance;
- Avoid the need for pumping where possible; and
- Be affordable, taking into account both construction and long term maintenance costs and the additional environmental and social benefits afforded by the system

There are six mandatory standards to be achieved within the National SuDS standards, S1 to S6. The following sections demonstrate compliance with each of these standards.

Standard S1 – Surface Water Run-off Destination

This standard reviews the disposal routes for surface water run-off. The destinations are split into 5 levels with level 1 being the most preferential and level 5 being the least preferred and only used in exceptional circumstances.

Priority Level 1: Surface water runoff is collected for use;

The feasibility of utilising a rainwater harvesting or recovery system for the expansion of Bike Park Wales has been reviewed and currently cannot be included within the budgeted works. Currently fresh water is being abstracted from an on-site borehole and we understand that the proposed expansion is unlikely to take abstraction requirements beyond the parameters of the current licence. There is also obviously no demand on the mains water supply.

Priority Level 2: Surface water runoff is infiltrated to ground;

Integral Geotechnique (Wales) Limited has undertaken an intrusive site investigation on the site which included BRE Digest 365 compliant infiltration testing and BS 6297:2007 Percolation Compliant Testing. No groundwater infiltration was recorded within the subject test pits and therefore no infiltration rate could therefore be calculated. The reports concluded that the site is unsuitable for any form of infiltration drainage.

The writer is referred to section 4 of this report and Messrs Integral Geotechnique (Wales) Limited site investigation reports as noted below:

- Reference 12329/LP/18/DS - Desk Top Study Report dated November 2018
- Reference 12329/LP/18/CMRA - Coal Mining Risk Assessment dated November 2018
- Reference 12329/LW/19/S - Desk Top Study Report dated February 2019
- Reference 12329/LW - Letter Report dated 26th September 2019.

Priority Level 3: Surface water runoff is discharged to a surface water body;

Surface water features cross the site, however the nearest watercourse to the development is the Ordinary Watercourse to the north east known as Nant Graig.

We understand that existing discharges from the existing reed bed, foul treatment plant and surface water sewer network currently outfall to the Nant Graig under restricted flow rates which have been agreed with the relevant regulators.

It is proposed to similarly discharge the majority of flows into the surface water features that cross the site, and, also, the Nant Graig Ordinary Watercourse at greenfield or controlled runoff rates, subject to agreement with the SuDs Approval Body, Natural Resources Wales and other relevant regulators.

Standard S2 – Surface Water runoff hydraulic control

Greenfield Run-off Rates

The Greenfield Runoff rate for the proposed development site has been calculated using the IH124 method. The calculations undertaken for the development have been divided into its two isolated networks.

Network 1 depicted in the surface water calculations considers the car park to the north of the site along with the link road between the north and south car park. Indirectly, Network 1 also caters for a large greenfield area, central to the site; equating to 7940m². The proposed surface water network allows for 50% of this area; assuming the remaining 50% is intercepted by the vegetation, ground and via evaporation.

Network 1 has been divided into three various isolated networks to accommodate the phased construction of the area; consequently, three individual Hydrobrakes have been proposed along with 3 individual attenuation facilities; all of which accommodate, all storm durations for the 1:100 return, along with a 30% allowance for climate change.

The surface water network diagram & impermeable areas diagram, found in Appendix G of this report, outlines the distinction between the three parts of the network. Below, the restricted discharges of the three Hydrobrakes have been calculated using the Q100 Greenfield Runoff Rates and the impermeable area associated with that part of the network; reference should be made to Appendix F for the Greenfield Runoff Rates.

Network 1a;	Total Impermeable Area	= 1,970m ²
Network 1a;	Restricted Flow	= 0.197 / 50 ha x 477 l/s = 1.87 l/s (Say 2.0 l/s)
Network 1b;	Total Impermeable Area	= 7,940m ² + 530m ²
Network 1b;	Restricted Flow	= 0.847 / 50 ha x 477 l/s = 8.1 l/s
Network 1c;	Total Impermeable Area	= 2,440m ²
Network 1c;	Restricted Flow	= 0.244 / 50 ha x 477 l/s = 2.3 l/s

Network 2 depicted in the surface water calculations serves the five timber lodges located to the east of the development and considers the roof areas only; equating to 630m². The Greenfield runoff rate for this part of the development has been calculated below and stipulates the flow restriction for Network 2. Given the low Greenfield rate, a minimum discharge rate of 2.0 l/s has been adopted.

Network 2;	Total Impermeable Area	= 630m ²
Network 2;	Restricted Flow	= 0.063/ 50 ha x 477 l/s = 0.60 l/s (Say 2.0 l/s)

A summary of the catchment areas and the combined discharge rates for the two networks have been shown in Table 8.1 below:

Attenuation Volumes

In line with SUDS manual and CIRIA document C753, the attenuation volumes for the proposed networks, described above, have been calculated, based on all storm durations for the 1 in 100 return period along with a 30% allowance for climate change.

Table 8.1 – Peak Surface Water Discharge Restrictions

Network	Proposed Catchment Area (Ha)	Discharge Restriction (l/s)	Attenuation Volume (m ³)
Network 1a:	0.197	2.0	128.0
Network 1b:	0.847	8.10	240.0
Network 1c:	0.244	2.3	144.0
Network 2:	0.063	2.0	20.0

The above calculations represent the worst case scenario of zero infiltration. On this basis approximately 532m³ of below ground attenuation storage is required. The storage is proposed to be delivered by a series of SuDS features together with supplementary underground storage distributed around the site, final details will be agreed with the appropriate regulators. Given the site topography it is not possible to provide all attenuation storage above ground.

The initial surface water drainage and arrangement of SuDS features on the site are shown on drawing number 6655-BHP-ZZ-XX-DR-S-(60)001, a copy of which is included within Appendix D.

Interception of run-off

Interception mechanisms will be required to ensure compliance with the requirement of zero runoff for the first 5mm rainfall for 80% of storm events during the summer and 50% in winter.

With reference to Table G2.1 'Interception Mechanisms with Assumed Compliance' of the National SuDS Standard which are applicable for small sites, the following table 8.3 demonstrates how the proposed drainage scheme complies with this specific requirement;

Table 8.2 – Proposed Interception Mechanisms

Source of Run-off	Interception Mechanism
External paths and footways	All new external areas are to be constructed with permeable construction and will not be taking additional catchments. The permeable surfaces are therefore compliant with zero runoff for the first 5mm of rainfall.
Parking areas and new highway access routes	All new external areas are to be constructed with permeable construction and will not be taking additional catchments. The permeable surfaces are therefore compliant with zero runoff for the first 5mm of rainfall.
Roof areas	The roof areas are relatively small in comparison to the above areas. Interception mechanisms will need to be addressed during the detailed design process and SuDS application.

Standard S3 – Water Quality

A SuDS treatment train will be required to satisfy Standard S3 of the new SuDs design standards. This is necessary to prevent negative impacts on the water quality of the downstream receiving watercourses and/or drainage systems.

The number of treatment levels within the train will be dependent on the type of land use proposed and the discharge point.

The roof catchment areas would be classified as a low pollution hazard level and therefore one treatment level should be sufficient prior to discharge. All rainwater down pipes will pass through silt traps prior to entering infiltration features.

All external footpaths and roads are proposed to comprise porous construction including filtration membranes, any sheet flow from significant areas of these surfaces is proposed to be discharged to swales or filter drains which incorporate silt traps, filter materials and wraps. Also, along conveyance features silt trap manholes have been included. Car parking areas will additionally be protected by aqua swirl units.

Considering the above measures, the risk of passage of pollutants, silt and debris off site is minimised.

Standard S4 – Amenity

The purpose of Standard S4 is to ensure the design of SuDs components enhance the provision of high quality, attractive public spaces which can provide health and wellbeing benefits.

The general civil engineering design including the SuDs features has been carefully considered and integrated into the landscape architecture from the inception of the scheme.

A landscape architect has been appointed for the scheme and will be providing significant input into the overall development of the scheme from inception to completion.

Further, given that the nature of the development is leisure and sport, amenity has been given careful consideration as it renders the site more attractive to both existing and future customers.

Standard S5 – Biodiversity

Standard S5 requires the design of the surface water management system to maximise the biodiversity benefits.

The general civil engineering design including the SuDs features have been carefully considered and integrated into the landscape architecture. The seeding mixes within the SuDS features have been carefully considered by both the landscape architects and ecologist to add species diversity. The management of the features will include leaving tussocky / longer sward to facilitate reptile and amphibian cover, and to allow a full invert lifecycle (including grub / pupae in litter or tussock layer in winter).

For details and biodiversity benefits refer to landscape architects documentation and ecologists specification and statements. The surface water management system has been fully considered by both the developments landscape architect and ecologist and maximises the biodiversity benefits.

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

The SuDs solution has been designed in accordance with the SuDS Manual and is generally served by shallow SuDs features. No inherent safety issues have currently been identified with the proposed scheme and any issues which arise will be addressed via designer's risk assessments during the remainder of the design process.

All areas of the proposed SuDS infrastructure are in accessible areas for ease of maintenance.

Maintenance responsibilities of the various Suds features on site need to be clearly defined. Technically mandatory adoption by the Suds Approval Body only applies where the SuDs feature serves more than 1 property. An overland flow route plan is included in Appendix H. This demonstrates that the proposed levels design ensures that if any exceedance events occur, flows are directed to follow pre- development flood flow routes.

9 CONCLUSIONS

The foul drainage from the proposed motorhome area will discharge to a sealed cesspool which will be periodically pumped out and tankered off site for appropriate disposal.

The flows from the existing bike wash areas are routed to a reed bed which has been specifically designed to accommodate such flows. The effluent from both bike washes and the trail maintenance area will be routed to the existing reed bed. The client has advised that the proposed bike wash and trail maintenance installations will be subject to no more use, the additional facilities merely reducing the demand on the existing.

The foul drainage from the balance of the serviced development will be routed via a below ground network to a proposed on-site packaged treatment plant. The treated effluent from the treatment plant will be conveyed off site to a watercourse. Alternatively, if Natural Resources Wales / lead local flood authority object to discharge to the local ordinary watercourse a sealed cesspool will be provided to take the flow, the cesspool will be periodically pumped out and tankered off site for appropriate disposal.

All foul drainage routed to the packaged treatment plant will be passed through appropriate grease traps.

As determined in Standard S2 above, the proposed surface water for networks 1 and 2 will discharge off site with restricted flows of 5.0 l/s and 2.0 l/s respectively. A sum attenuation storage volume of 520m³ will be required for the development, designed to accommodate all storm durations for the 1 in 100 return period with a 30% allowance for climate change; this attenuation has been based on zero infiltration to the ground below.

Permeable paving will be used at the proposed parking areas, highway access routes, external paths and footways. It is likely that only minimal infiltration will be achieved with excess sheet flows which will be directed to adjacent infiltration/conveyance structures. These structures are interlinked and direct excess runoff to the lower areas of the site. Controlled outfalls to the existing offsite ordinary watercourse and site features will be required with associated below ground crated storage.

All paved areas are to comprise porous construction incorporating geotextile filters. Sheet flows from significant areas of such surfaces are proposed to be directed to swale or filter drain infiltration/conveyance structures which incorporate silt traps, filter materials and wraps. Also, along conveyance features silt trap manholes have been included. Immediately downstream of car parking areas aqua swirl units have been incorporated into the systems.

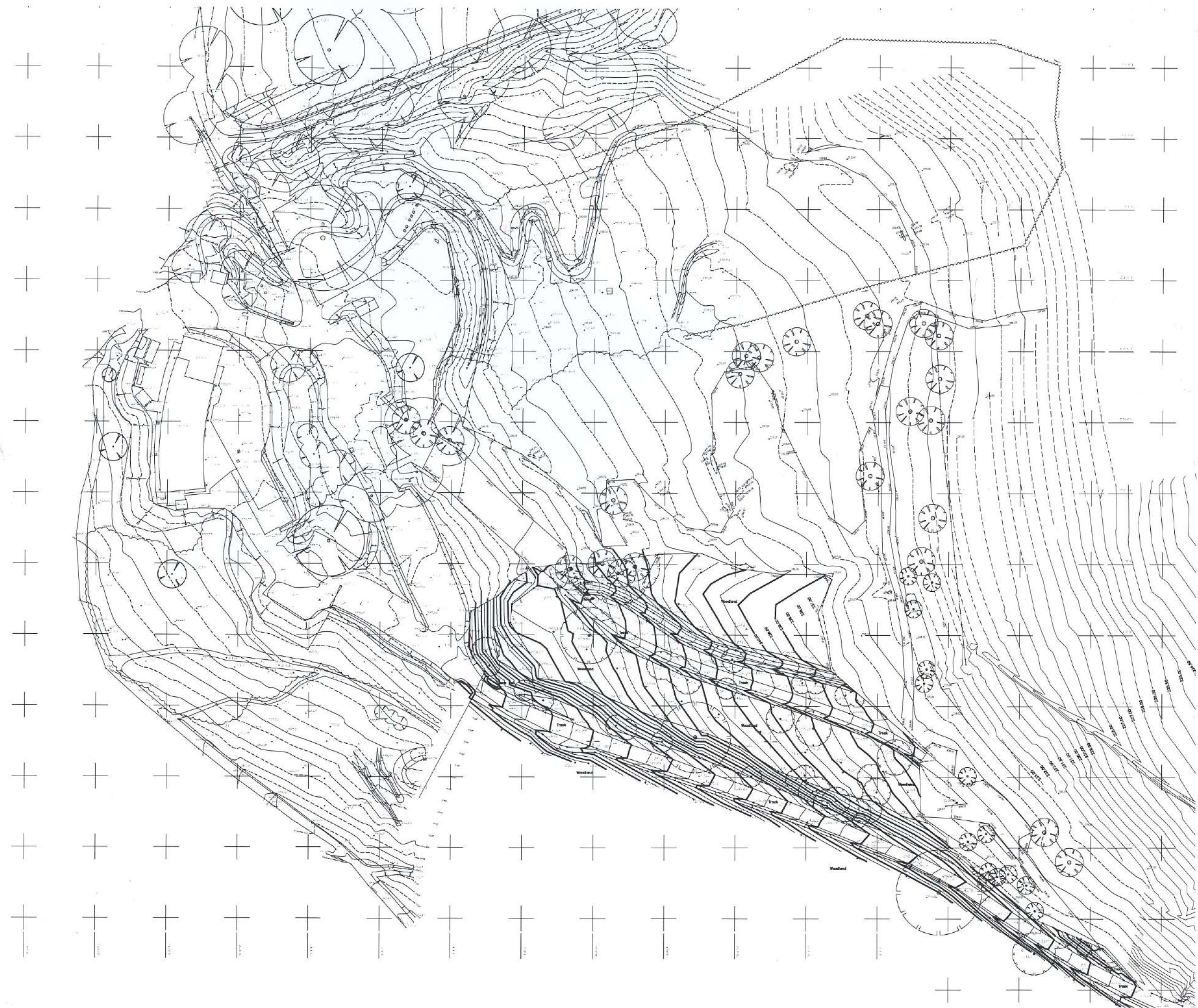
Considering the above measures, the risk of passage of pollutants, silt and debris off site will be minimised.

The overall surface water drainage strategy for all phases of this project has obtained the consent of the SuDS Approval Body (SAB). Merthyr Tydfil County Borough Council has issued a Compliance Certificate, SAB Plan Number SAB/20/0011.

All appropriate permits and consents will be obtained from the regulators, particularly Natural Resources Wales, prior to the drainage systems being put into beneficial use.

APPENDIX A

TOPOGRAPHICAL SURVEY DRAWING



APPENDIX B

LANDSCAPE MASTERPLAN DRAWING

- KEY**
- Significant trees to be retained (approximate position)
 - Woodland/shrubs to be retained (approximate extent)
 - Significant trees to be removed (approximate position)
 - Proposed native standard and feathered tree planting
 - Trees proposed as part of earlier application
 - Proposed native tree and shrub mass planting
 - Native tree and shrub mass planting proposed as part of earlier application
 - Proposed fencing
 - Proposed gabion wall with coursed stonework fill
 - Proposed topsoil bund
 - Proposed circulation
 - Existing retained building
 - Proposed building
 - Building proposed as part of earlier application
 - Existing parking
 - Proposed/amended parking or road edge
 - Proposed plastic surface reinforcement
 - Proposed/amended path/track edge
 - Proposed overflow parking
 - Proposed timber picnic tables
 - Boulders
 - Other proposed features
 - Habitat structure/timber pile
 - Electrical hook-up (motorhome parking area)
 - Suave (refer to engineering for details)
 - Foul drainage (refer to engineering for details)
 - Surface water drainage and storage (refer to engineering for details)
 - Site area (approximate)



NOTES ON THE LANDSCAPE PROPOSALS

The landscape shown on this masterplan has been designed to create a high quality amenity space that maximises habitat quality.

The design was created in order to fulfill the requirements for additional parking, buildings and other features associated with the expansion of facilities at Bike Park Wales.

The landscape proposals have evolved significantly, in response to adverse effects that were identified as being likely to result from the development of the site in line with the initial plans. The design presented is the result of series of refinements to layout and specification which are intended to avoid or reduce such effects.

SCALE
0 5 10 50m
Scale 1:500 printed at A1



PETER QUINN ASSOCIATES
LANDSCAPE ARCHITECTURE

01999 748 538
www.landscapeid.co.uk

Project title:	Bike Parks Wales, Abercanalid
Drawing title:	BPW Landscape Masterplan
Client:	Bike Parks Wales
Date:	6th November 2018
Revisions:	Rev A: 6th November 2018 - Information updated and pre- & design reviewed. Rev B: 10th December 2018 - general amendments to format. Rev C: 10th January 2019 - re-design of site parking area. Rev D: 4th March 2019 - refinement of site and overflow parking area and layout. Rev E: 14th April 2019 - amendment of proposed circulation and main parking area and associated landscape. Rev F: 4th May 2019 - detailed amendments to landscape and associated landscape. Rev G: 13th May 2019 - amendment of various proposals. Rev H: 13th May 2019 - adjustment of tree positions and associated proposals.
Drawing number:	18/461/01 H

BIKE PARK WALES: LANDSCAPE MASTERPLAN



APPENDIX C

SCHEDULE OF EMISSIONS AND MONITORING
EXISTING FOUL WATER TREATMENT PLANT

Schedule 3 – Emissions and monitoring

Table S3.1 Point Source emissions to water (other than sewer) – emission limits and monitoring requirements

Discharge source and discharge point ref. & location	Parameter	Limit (including unit)	Reference Period	Limit of effective range	Monitoring frequency	Compliance Statistic
Secondary treated sewage effluent via Outlet 1	Maximum daily discharge volume	9.0 m ³ /day	Total daily volume	N/A	N/A	Maximum
	ATU-BOD as O ₂	20 mg/l	Instantaneous (spot sample)	N/A	N/A	Maximum
	Suspended solids (measured after drying at 105° C)	30 mg/l	Instantaneous (spot sample)	N/A	N/A	Maximum
	Ammoniacal nitrogen (expressed as N)	5.45 mg/l	Instantaneous (spot sample)	N/A	N/A	Maximum
	Visible oil or grease	No significant trace present	Instantaneous (spot sample)	N/A	N/A	No significant trace

Table S3.2 Discharge points

Effluent Name	Discharge Point	Discharge point NGR	Receiving water
Secondary treated sewage effluent	Outlet 1	SO 05057 03532	Nant Graig

Table S3.3 Monitoring points

Effluent and discharge point	Monitoring type	Monitoring point NGR
Secondary treated sewage effluent via Outlet 1	Effluent sample point	SO 05057 03532

APPENDIX D

PROPOSED SITE WIDE EXTERNAL WORKS DRAWING

NOTE THE PROPERTY OF THIS DRAWING AND DESIGN IS VESTED IN BINGHAM HALL PARTNERSHIP LIMITED AND MUST NOT BE COPIED OR REPRODUCED IN ANY WAY WITHOUT THEIR WRITTEN CONSENT

NOTE
THIS DRAWING IS INTENDED TO BE A LIVE WORKING DOCUMENT FOR FURTHER DEVELOPMENT AND DISCUSSION WITH ALL CONCERNED INCLUDING BIKE PARK WALES, PROJECT DESIGN TEAM MEMBERS, THE SUO'S APPROVAL BODY AND NRW TOGETHER WITH ALL APPROPRIATE REGULATORS

V	CM	18.07.22	NATIONAL GRID REFERENCES TO OUTFALL & SAMPLE WINDOW
U	CM	24.06.22	REED BED INDICATED
T	CM	06.06.22	GABIONS OMITTED TO REAR OF BIKE HIRE CENTRE
S	CM	27.05.22	UPDATED MASTERPLAN
R	RC	11.11.20	FILTER DRAINS / SWALES CLARIFIED IN RELATION TO DETAILS SHEET - SEE CLOUDED
Q	RC	01.10.20	FLOW CONTROL CHAMBER ADDED
P	RC	01.10.20	SURFACE WATER NETWORK REVISED
O	CM	24.01.19	ADDITIONAL SDS AQUA SWIRL UNITS TO NORTH-EAST AND SOUTH EAST CAR PARKS
N	CM	13.11.19	UPDATED IN ACCORDANCE WITH LANDSCAPE MASTER PLAN REV H
M	CM	04.10.19	UPDATED TO SUIT LANDSCAPE ARCHITECTS PLAN
L	CM	02.10.19	UPDATED TO SUIT LANDSCAPE ARCHITECTS COMMENTS & INFILTRATION TEST RESULTS
K	CM	21.08.19	SCHEME UPDATED FOLLOWING SAB CONSULTATION
J	CM	11.07.19	SCHEME PROPOSAL GENERALLY UPDATED
H	PH	17.05.19	SEALED TANK PROVIDED FOR FOUL WATERS FROM MOTORHOME AREA
G	PH	14.03.19	NOTE AMENDED ON EXISTING TREATMENT PLANT
F	PH	12.03.19	LODGE AREA LAYOUT UPDATED TO LS ARCHITECTS LAYOUT, GABION WALL REMOVED.
E	PH	11.03.19	LODGE AREA LAYOUT UPDATED TO LS ARCHITECTS LAYOUT.
D	PH	04.03.19	FW PART DRAINAGE RE-ROUTED TO COMMENTS FROM LS ARCHITECT.
C	PH	01.03.19	RE-DRAWN LEVELS & BANKS ADDED.
B	PH	19.11.18	SOME VAN CAR PARK REMOVED AT BOTTOM OF SITE SECTION 7 DUE TO STEEPNESS OF EXISTING GROUND. DRAINAGE RE-ROUTED FROM LODGES, GESSPIT MOVED DUE TO STEEPNESS OF EXISTING GROUND. FW DRAINS ADDED ON SHEPHERDS HUTS, SECTION MARKS 9-11 ADDED.
A	PH	19.11.18	DRAINAGE UPDATED, NEW ARCHITECTS LAYOUT ADDED.
Rev	By	Date	Revision

Drawing Status	PLANNING			
Architect	LeTrucco			
Client	RIDE BIKE WALES			
Scale	1:500	Drawn	PH	Drawing Size
				A1
				Date
				13/11/19
				Checked
				RG

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Telephone (029) 2048 8588

Project Title	PROPOSED EXPANSION AT BIKE PARK WALES			
Drawing Title	PROPOSED SITE WIDE EXTERNAL WORKS SCHEME			
Project No.	Originator	Volume	Level	Type
6655	BHP	ZZ	XX	DR
	S	(60)	P01	
Rev	V			

Registered in England & Wales No: 05348301

APPENDIX E

PLASTIC SOLUTIONS (ALDRIDGE) LIMITED,
TUFF TANK FOUL WASTE COLLECTION SYSTEM TRADE
LITERATURE



[Home](#) > [Products](#) > [Plastic Waste Tanks](#)

TT1000 - Tuff Tank - 1000 Gallon Waste Tank

[Twitter](#) [Facebook](#)



PRODUCT DESCRIPTION:

The Tuff Tank 1000 is the market-leading, plastic, 1000 gallon waste holding tank designed to meet the needs of the portable sanitation industry - and much more. Its flat 'slide under' design allows it to be positioned alongside or underneath site accommodation, glamping huts and event industry equipment such as toilets, showers and catering units.

Whether on construction or glamping sites, at public events or campsites/pleasure boat toilet waste tipping points (or indeed, anywhere where there is insufficient or no mains sewer connection), with its simple linking kit options and range of technical advantages, the Tuff Tank is the clear product of choice to capture effluent, liquid waste and sewage. Watch our [video](#) for further details.

[Get in touch](#) to find out how the Tuff Tank 1000 will help you.

TECHNICAL DATA ^

Tank Name	Height	Width	Length	Dry Weight	Wet Weight*	Capacity
-----------	--------	-------	--------	------------	-------------	----------

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Get in touch



TECHNICAL DATA ^

Tank Name	Height	Width	Length	Dry Weight	Wet Weight*	Capacity
Mini Tuff Tank 160	400mm / 16"	1100mm / 44"	1870mm / 74"	45kgs/99lbs	765kgs/1686lbs	727 ltrs/160 glns
Tuff Tank 500	485mm / 19"	2100mm / 82"	3100mm / 122"	140kgs/308lbs	2413kgs/5309lbs	2273 ltrs/500 glns
Tuff Tank 750	690mm / 27"	2100mm / 82"	3100mm / 122"	180kgs/396lbs	3590kgs/7898lbs	3410 ltrs/750 glns
Tuff Tank 1000	900mm / 36"	2100mm / 82"	3100mm / 122"	220kgs/484lbs	4766kgs/10,485lbs	4546 ltrs/1000 glns

*Do not lift with liquid contents on board

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BLOG POST

May 16, 2018

NEW PRODUCTS

An Easier Tip for the Camping (or Glamping) Trip



A quick check on the forums for boaters, campers, caravanners, motor home owners and yachtspeople shows that disposing of the contents of chemical toilets is a major talking point. For those of you who haven't had the pleasure then the phrase "Many a slip 'twixt cup an lip" may provide an appropriate (if unappealing) explanation.

A quick check on the forums for boaters, campers, caravanners, motor home owners and yachtspeople shows that disposing of the contents of chemical toilets is a major talking point. For those of you who haven't had the pleasure then the phrase "Many a slip 'twixt cup an lip" may provide an appropriate (if unappealing) explanation.



Fundamentally, tipping the contents of a toilet bucket or cassette into a effluent tank can be quite tricky. Think heavy toilets, narrow hole in the effluent tank, difficult to access site, muddy field or in the middle of the night as just a few factors that could cause splashes or complete misses.

It's not a great experience for the "designated disposer" in the holiday party or amongst the crew. Neither is it what the owner of the site, marina or boat-yard wants to be dealing with.

So Plastic Solutions is delighted to offer a brand-new product to reduce the thrills and spills of chemical toilet emptying.

The Elsan® Tipping Point works with a variety of waste and effluent disposal tanks (and especially well with our very own Tuff Tank and Mini Tuff Tank) to provide an easy, spill-free method of toilet waste disposal. The Tipping Point stands at a convenient height of 1000mm and features a broad rim to support the toilet bucket or cassette while tipping.



In fact the Elsan® Tipping Point isn't limited to making toilet waste disposal easier. There are lots of circumstances where waste liquids have to be transferred from small to larger containers - waste oil disposal for example - where this new product could help.

Check out the product page on our website for the full specification. To get a quote today call freephone **0800 3345742** or email using our [contact form](#).

APPENDIX F

GREENFIELD RUNOFF CALCULATIONS

Bingham Hall Partnership Ltd		Page 1
5 Ty Nant Court, Morganstown Cardiff CF15 8LW		
Date 03/10/2019 09:30 File	Designed by RussellC Checked by	
Micro Drainage Source Control 2019.1		

IH 124 Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	1400	Region Number	Region 9

Results l/s

QBAR Rural	205.0
QBAR Urban	205.0
Q2 years	190.4
Q1 year	180.4
Q2 years	190.4
Q5 years	248.1
Q10 years	291.2
Q20 years	334.4
Q25 years	349.4
Q30 years	361.5
Q50 years	396.9
Q100 years	447.0
Q200 years	506.4
Q250 years	526.9
Q1000 years	654.1

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Bingham Hall Partnership Ltd		Page 1																										
5 Ty Nant Court, Morganstown Cardiff CF15 8LW																												
Date 03/10/2019 09:30 File	Designed by RussellC Checked by																											
Micro Drainage		Source Control 2019.1																										
<u>Greenfield Runoff Volume</u> FSR Data <table> <tr> <td>Return Period (years)</td> <td>100</td> </tr> <tr> <td>Storm Duration (mins)</td> <td>360</td> </tr> <tr> <td>Region</td> <td>England and Wales</td> </tr> <tr> <td>M5-60 (mm)</td> <td>19.300</td> </tr> <tr> <td>Ratio R</td> <td>0.276</td> </tr> <tr> <td>Areal Reduction Factor</td> <td>1.00</td> </tr> <tr> <td>Area (ha)</td> <td>0.794</td> </tr> <tr> <td>SAAR (mm)</td> <td>1480</td> </tr> <tr> <td>CWI</td> <td>124.440</td> </tr> <tr> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SPR</td> <td>30.000</td> </tr> </table> Results <table> <tr> <td>Percentage Runoff (%)</td> <td>34.73</td> </tr> <tr> <td>Greenfield Runoff Volume (m³)</td> <td>193.142</td> </tr> </table>			Return Period (years)	100	Storm Duration (mins)	360	Region	England and Wales	M5-60 (mm)	19.300	Ratio R	0.276	Areal Reduction Factor	1.00	Area (ha)	0.794	SAAR (mm)	1480	CWI	124.440	Urban	0.000	SPR	30.000	Percentage Runoff (%)	34.73	Greenfield Runoff Volume (m³)	193.142
Return Period (years)	100																											
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Percentage Runoff (%)	34.73																											
Greenfield Runoff Volume (m³)	193.142																											
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APPENDIX G

PROPOSED SURFACE WATER CALCULATIONS

CALCULATIONS FOR THE SURFACE WATER DRAINAGE

These calculations cover the proposed surface water drainage for the developed site. The network assessed in the following calculations, is based on the drainage scheme shown on BHPL's drawings, reference: 6655-(60)001; a copy of which have been appended to these calculations for reference. The analysis of the network has been undertaken using design software 'MicroDrainage' with the following design parameters:

M5-60 (mm) = 19.300; Ratio R = 0.275;

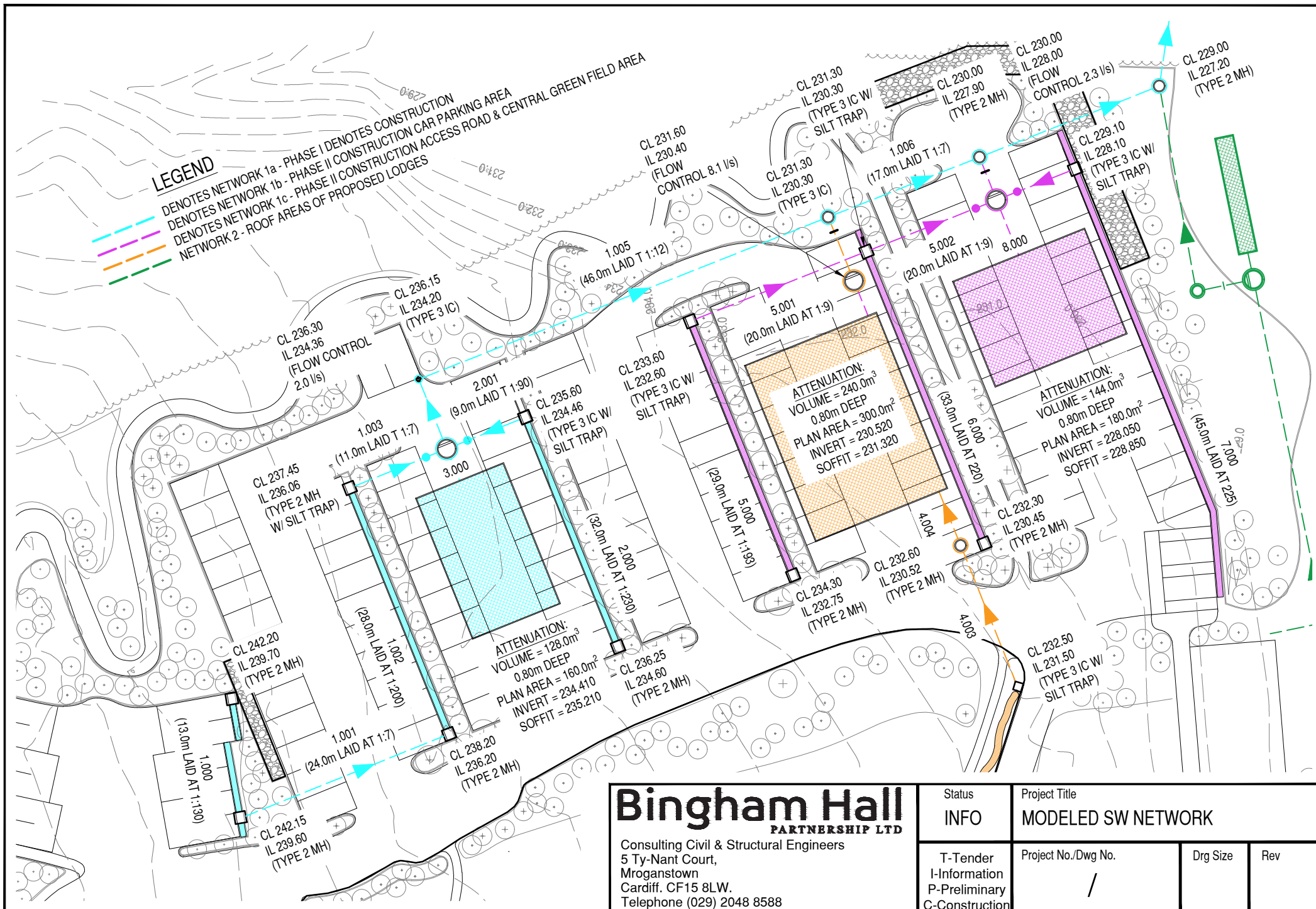
The proposed network has been designed in accordance with the SUDS manual and CIRIA document C753. The two networks considered in the following calculations have been designed with restricted flows and thus have attenuation facilities accommodating all storm durations for the 1 in 100 return period along with an allowance of 30% for climate change.

NETWORK 1:

The following network serves the car park facilities to the north of the site along with the access road between this car park and the south car park (served by a different surface water system). These impermeable areas have been identified on the following Network Diagram / Impermeable Areas Diagram. The water from the northern car park shall utilise the existing topography of the site to drain to constructed dry swales located between the rows of car parking bays. The dry swales shall act as a form of storage and treatment for the collected runoff water as well as dramatically slowing down the discharge.

In addition, to the areas described above an allowance has been made for the greenfield area, central to the site. Due to the topography of the site, this will undoubtedly drain to the swale running adjacent to the access road described above and will consequently discharge to Network 1, with its restricted flow and attenuation facility.

Network 1 has been divided into three parts, each utilising their own Hydrobrake and attenuation facility. The separate systems have been introduced to accommodate for the phased construction of the site.



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Status
 INFO

Project Title
 MODELED SW NETWORK

T-Tender
 I-Information
 P-Preliminary
 C-Construction

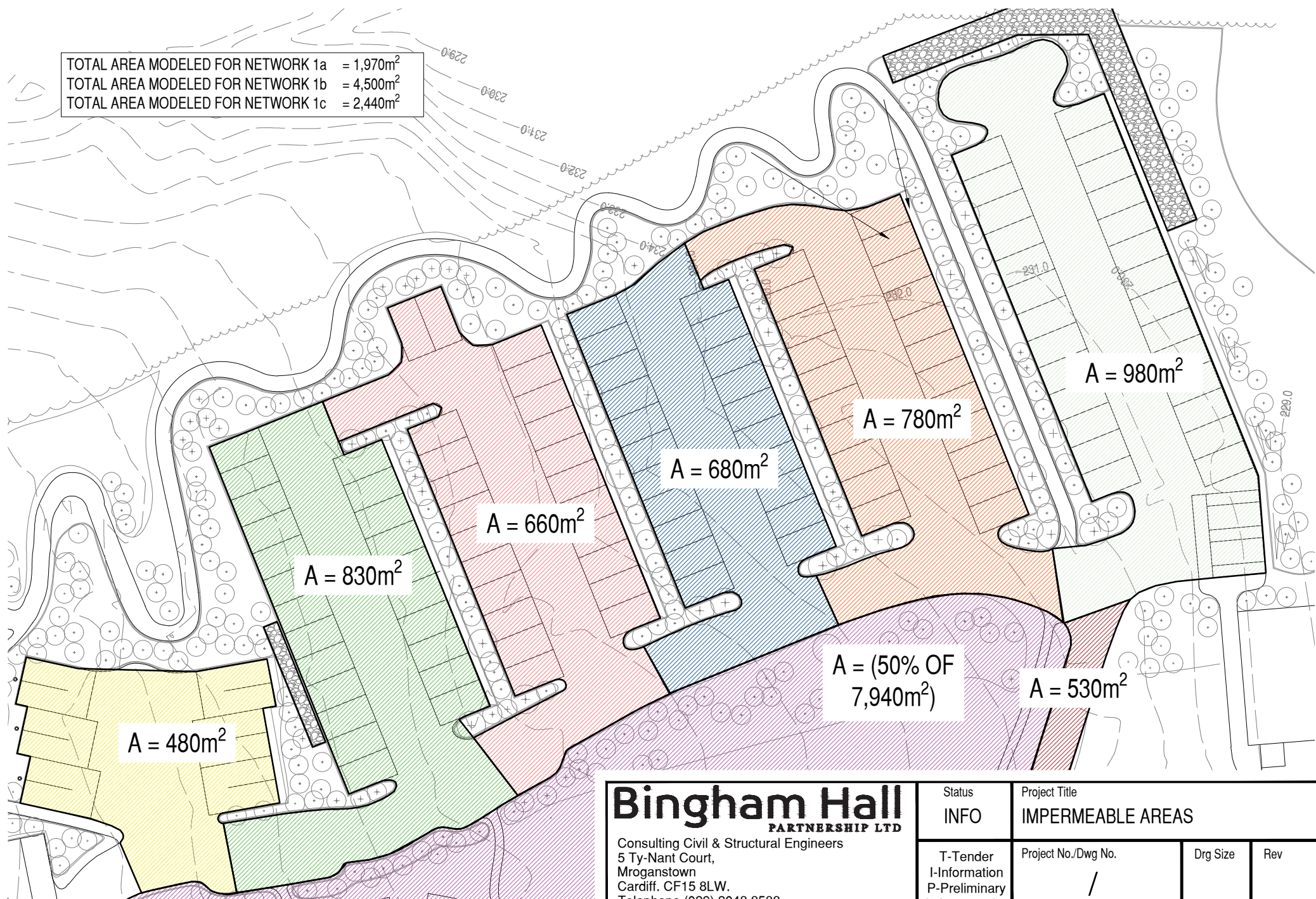
Project No./Dwg No.

/

Drg Size

Rev

TOTAL AREA MODELED FOR NETWORK 1a = 1,970m²
TOTAL AREA MODELED FOR NETWORK 1b = 4,500m²
TOTAL AREA MODELED FOR NETWORK 1c = 2,440m²



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Status
INFO

T-Tender
I-Information
P-Preliminary
C-Construction

Project Title
IMPERMEABLE AREAS

Project No./Dwg No.

/

Drg Size

Rev

Bingham Hall Partnership Ltd		Page 0
5 Ty Nant Court, Morganstown Cardiff CF15 8LW	Bike Park Wales Network 1 - SW Parameters & Q100 Simulations	
Date 02/10/2020 15:53 File 6655 - Phase II.MDX	Designed by RC Checked by RG	
Innovyze	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	19.200	Add Flow / Climate Change (%)	0
Ratio R	0.282	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.182	4-8	0.449	8-12	0.196	12-16	0.060	16-20	0.005

Total Area Contributing (ha) = 0.891

Total Pipe Volume (m³) = 245.151

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	13.000	0.100	130.0	0.048	10.00	0.0		0.035	→\-/→		Dry Swale	⚠
S1.001	24.000	3.400	7.1	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	⚠
S1.002	28.000	0.140	200.0	0.083	0.00	0.0		0.035	→\-/→		Dry Swale	⚠
S1.003	11.000	1.700	6.5	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	⚠

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	41.24	10.34	239.700	0.048	0.0	0.0	0.0	0.63	527.8	5.4
S1.001	41.04	10.45	239.600	0.048	0.0	0.0	0.0	3.82	67.5	5.4
S1.002	39.54	11.28	236.200	0.131	0.0	0.0	0.0	0.57	342.7	14.0
S1.003	39.47	11.32	236.060	0.131	0.0	0.0	0.0	3.99	70.5	14.0

Bingham Hall Partnership Ltd		Page 1
5 Ty Nant Court, Morganstown Cardiff CF15 8LW	Bike Park Wales Network 1 - SW Parameters & Q100 Simulations	
Date 02/10/2020 15:53 File 6655 - Phase II.MDX	Designed by RC Checked by RG	
Innovyze	Network 2019.1	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.000	32.000	0.140	228.6	0.066	10.00	0.0		0.035	→\-/→		Dry Swale	
S2.001	9.000	0.100	90.0	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S3.000	10.000	0.001	10000.0	0.000	10.00	0.0	0.600		o	225	Pipe/Conduit	
S1.004	8.000	0.160	50.0	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S1.005	46.000	3.900	11.8	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S4.000	100.000	0.850	117.6	0.150	10.00	0.0		0.035	→\-/→		Dry Swale	
S4.001	50.000	0.250	200.0	0.150	0.00	0.0		0.035	→\-/→		Dry Swale	
S4.002	50.000	0.900	55.6	0.150	0.00	0.0		0.035	→\-/→		Dry Swale	
S4.003	15.000	0.950	15.8	0.000	0.00	0.0		0.035	o	300	Pipe/Conduit	
S4.004	30.000	0.120	250.0	0.000	0.00	0.0		0.035	o	300	Pipe/Conduit	
S4.005	5.000	0.100	50.0	0.000	0.00	0.0		0.035	o	150	Pipe/Conduit	
S1.006	17.000	2.400	7.1	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S5.000	29.000	0.150	193.3	0.068	10.00	0.0		0.035	→\-/→		Dry Swale	
S5.001	20.000	2.150	9.3	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S6.000	33.000	0.150	220.0	0.078	10.00	0.0		0.035	→\-/→		Dry Swale	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	40.08	10.97	234.600	0.066	0.0	0.0	0.0	0.55	307.5	7.2
S2.001	39.82	11.12	234.460	0.066	0.0	0.0	0.0	1.06	18.7	7.2
S3.000	39.39	11.37	234.361	0.000	0.0	0.0	0.0	0.12	4.8	0.0
S1.004	39.23	11.46	234.360	0.197	0.0	0.0	0.0	1.43	25.2	20.9
S1.005	38.79	11.72	234.200	0.197	0.0	0.0	0.0	2.95	52.1	20.9
S4.000	38.25	12.05	233.500	0.150	0.0	0.0	0.0	0.81	540.7	15.5
S4.001	36.26	13.41	232.650	0.300	0.0	0.0	0.0	0.62	425.5	29.5
S4.002	35.32	14.12	232.400	0.450	0.0	0.0	0.0	1.17	807.3	43.0
S4.003	35.08	14.31	231.500	0.450	0.0	0.0	0.0	1.28	90.4	43.0
S4.004	33.26	15.87	230.520	0.450	0.0	0.0	0.0	0.32	22.7	43.0
S4.005	33.06	16.05	230.400	0.450	0.0	0.0	0.0	0.45	8.0	43.0
S1.006	32.98	16.13	230.300	0.647	0.0	0.0	0.0	3.81	67.3	57.8
S5.000	40.38	10.80	232.750	0.068	0.0	0.0	0.0	0.60	313.9	7.4
S5.001	40.20	10.90	232.600	0.068	0.0	0.0	0.0	3.32	58.7	7.4
S6.000	40.07	10.98	230.450	0.078	0.0	0.0	0.0	0.56	294.3	8.5

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S5.002	15.000	2.300	6.5	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
S7.000	45.000	0.200	225.0	0.098	10.00	0.0		0.035	→\-/→		Dry Swale	
S7.001	9.000	0.100	90.0	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
S8.000	10.000	0.001	10000.0	0.000	10.00	0.0	0.600		o	300	Pipe/Conduit	
S5.003	5.000	0.100	50.0	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	
S1.007	20.300	0.700	29.0	0.000	0.00	0.0	0.600		o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S5.002	39.99	11.02	230.300	0.146	0.0	0.0	0.0	5.16	205.1	15.8
S7.000	39.44	11.33	228.300	0.098	0.0	0.0	0.0	0.56	288.5	10.5
S7.001	39.26	11.44	228.100	0.098	0.0	0.0	0.0	1.38	54.8	10.5
S8.000	39.81	11.13	228.001	0.000	0.0	0.0	0.0	0.15	10.5	0.0
S5.003	39.16	11.50	228.000	0.244	0.0	0.0	0.0	1.43	25.2«	25.9
S1.007	32.79	16.31	227.900	0.891	0.0	0.0	0.0	1.88	33.2«	79.1

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.004, Volume (m³): 2.9

Unit Reference	MD-SHE-0070-2000-0800-2000
Design Head (m)	0.800
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	234.360
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.0
Flush-Flo™	0.240	2.0
Kick-Flo®	0.504	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	3.9	7.500	5.6
0.300	2.0	1.600	2.7	4.000	4.2	8.000	5.8
0.400	1.9	1.800	2.9	4.500	4.4	8.500	6.0
0.500	1.6	2.000	3.0	5.000	4.7	9.000	6.2
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.3
0.800	2.0	2.400	3.3	6.000	5.1		
1.000	2.2	2.600	3.4	6.500	5.3		

Hydro-Brake® Optimum Manhole: S14, DS/PN: S4.005, Volume (m³): 3.4

Unit Reference	MD-SHE-0134-8100-0900-8100
Design Head (m)	0.900
Design Flow (l/s)	8.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	134
Invert Level (m)	230.400
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: S14, DS/PN: S4.005, Volume (m³): 3.4

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	8.1
Flush-Flo™	0.274	8.1
Kick-Flo®	0.610	6.8
Mean Flow over Head Range	-	6.9

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-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	1.200	9.3	3.000	14.3	7.000	21.5
0.200	8.0	1.400	10.0	3.500	15.4	7.500	22.2
0.300	8.1	1.600	10.6	4.000	16.4	8.000	22.9
0.400	7.9	1.800	11.2	4.500	17.4	8.500	23.6
0.500	7.6	2.000	11.8	5.000	18.3	9.000	24.2
0.600	6.9	2.200	12.3	5.500	19.1	9.500	24.8
0.800	7.7	2.400	12.9	6.000	19.9		
1.000	8.5	2.600	13.4	6.500	20.7		

Hydro-Brake® Optimum Manhole: S17, DS/PN: S5.003, Volume (m³): 6.6

Unit Reference	MD-SHE-0068-2300-1250-2300
Design Head (m)	1.250
Design Flow (l/s)	2.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	68
Invert Level (m)	228.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.250	2.3
Flush-Flo™	0.301	2.0
Kick-Flo®	0.610	1.7
Mean Flow over Head Range	-	1.9

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-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	1.7	0.300	2.0	0.500	1.9	0.800	1.9
0.200	2.0	0.400	2.0	0.600	1.7	1.000	2.1

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Hydro-Brake® Optimum Manhole: S17, DS/PN: S5.003, Volume (m³): 6.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	2.3	2.400	3.1	5.000	4.4	8.000	5.4
1.400	2.4	2.600	3.2	5.500	4.6	8.500	5.6
1.600	2.6	3.000	3.4	6.000	4.8	9.000	5.8
1.800	2.7	3.500	3.7	6.500	4.9	9.500	5.9
2.000	2.9	4.000	3.9	7.000	5.1		
2.200	3.0	4.500	4.2	7.500	5.3		

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Storage Structures for Storm

Dry Swale Pipe: S1.000

Manning's N	0.035	Trench Length (m)	13.0
Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.30
Safety Factor	2.0	Side Slope (1:X)	3.0
Swale Porosity	1.00	Slope (1:X)	130.0
Invert Level (m)	239.700	Cap Volume Depth (m)	2.400
Trench Height (m)	2.100	Cap Infiltration Depth (m)	2.400
Trench Width (m)	0.6		

Under Drain Details

Depth above Invert Level (m)	0.000	Number of Pipes	1
Diameter (m)	0.150	Manning's N	0.035

Dry Swale Pipe: S1.002

Manning's N	0.035	Trench Length (m)	28.0
Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.30
Safety Factor	2.0	Side Slope (1:X)	3.0
Swale Porosity	1.00	Slope (1:X)	200.0
Invert Level (m)	236.200	Cap Volume Depth (m)	1.100
Trench Height (m)	0.800	Cap Infiltration Depth (m)	1.100
Trench Width (m)	0.6		

Under Drain Details

Depth above Invert Level (m)	0.000	Number of Pipes	1
Diameter (m)	0.150	Manning's N	0.035

Dry Swale Pipe: S2.000

Manning's N	0.035	Trench Length (m)	32.0
Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.30
Safety Factor	2.0	Side Slope (1:X)	3.0
Swale Porosity	1.00	Slope (1:X)	228.6
Invert Level (m)	234.600	Cap Volume Depth (m)	0.850
Trench Height (m)	0.550	Cap Infiltration Depth (m)	0.850
Trench Width (m)	0.6		

Under Drain Details

Depth above Invert Level (m)	0.000	Number of Pipes	1
Diameter (m)	0.150	Manning's N	0.035

Cellular Storage Manhole: S7, DS/PN: S3.000

Invert Level (m)	234.410	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

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<u>Cellular Storage Manhole: S7, DS/PN: S3.000</u>					
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	160.0	160.0	5.200	0.0	200.5
0.400	160.0	180.2	5.600	0.0	200.5
0.800	160.0	200.5	6.000	0.0	200.5
0.801	0.0	200.5	6.400	0.0	200.5
1.201	0.0	200.5	6.800	0.0	200.5
2.000	0.0	200.5	7.200	0.0	200.5
2.400	0.0	200.5	7.600	0.0	200.5
2.800	0.0	200.5	8.000	0.0	200.5
3.200	0.0	200.5	8.400	0.0	200.5
3.600	0.0	200.5	8.800	0.0	200.5
4.000	0.0	200.5	9.200	0.0	200.5
4.400	0.0	200.5	9.600	0.0	200.5
4.800	0.0	200.5	10.000	0.0	200.5
<u>Dry Swale Pipe: S4.000</u>					
Manning's N 0.035		Trench Length (m)		100.0	
Infiltration Coefficient Base (m/hr) 0.00000		Trench Infiltration Side (m/hr)		0.00000	
Infiltration Coefficient Side (m/hr) 0.00000		Trench Porosity		0.30	
Safety Factor 2.0		Side Slope (1:X)		3.0	
Swale Porosity 1.00		Slope (1:X)		117.6	
Invert Level (m) 233.500		Cap Volume Depth (m)		0.900	
Trench Height (m) 0.600		Cap Infiltration Depth (m)		0.900	
Trench Width (m) 0.8					
Under Drain Details					
Depth above Invert Level (m) 0.000		Number of Pipes		1	
Diameter (m) 0.150		Manning's N		0.035	
<u>Dry Swale Pipe: S4.001</u>					
Manning's N 0.035		Trench Length (m)		50.0	
Infiltration Coefficient Base (m/hr) 0.00000		Trench Infiltration Side (m/hr)		0.00000	
Infiltration Coefficient Side (m/hr) 0.00000		Trench Porosity		0.30	
Safety Factor 2.0		Side Slope (1:X)		3.0	
Swale Porosity 1.00		Slope (1:X)		200.0	
Invert Level (m) 232.650		Cap Volume Depth (m)		1.000	
Trench Height (m) 0.700		Cap Infiltration Depth (m)		1.000	
Trench Width (m) 0.8					
Under Drain Details					
Depth above Invert Level (m) 0.000		Number of Pipes		1	
Diameter (m) 0.150		Manning's N		0.035	
<u>Dry Swale Pipe: S4.002</u>					
Manning's N 0.035		Swale Porosity		1.00	
Infiltration Coefficient Base (m/hr) 0.00000		Invert Level (m)		232.400	
Infiltration Coefficient Side (m/hr) 0.00000		Trench Height (m)		0.700	
Safety Factor 2.0		Trench Width (m)		0.8	
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Dry Swale Pipe: S4.002 Trench Length (m)50.0Slope (1:X)55.6 Trench Infiltration Side (m/hr)0.00000Cap Volume Depth (m)1.000 Trench Porosity0.30Cap Infiltration Depth (m)1.000 Side Slope (1:X)3.0 Under Drain Details Depth above Invert Level (m)0.000Number of Pipes1 Diameter (m)0.150Manning's N0.035 Cellular Storage Manhole: S14, DS/PN: S4.004 Invert Level (m)230.520Safety Factor2.0 Infiltration Coefficient Base (m/hr)0.00000Porosity0.95 Infiltration Coefficient Side (m/hr)0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>300.0</td><td>300.0</td><td>5.200</td><td>0.0</td><td>355.5</td></tr><tr><td>0.400</td><td>300.0</td><td>327.7</td><td>5.600</td><td>0.0</td><td>355.5</td></tr><tr><td>0.800</td><td>300.0</td><td>355.4</td><td>6.000</td><td>0.0</td><td>355.5</td></tr><tr><td>0.801</td><td>0.0</td><td>355.5</td><td>6.400</td><td>0.0</td><td>355.5</td></tr><tr><td>1.600</td><td>0.0</td><td>355.5</td><td>6.800</td><td>0.0</td><td>355.5</td></tr><tr><td>2.000</td><td>0.0</td><td>355.5</td><td>7.200</td><td>0.0</td><td>355.5</td></tr><tr><td>2.400</td><td>0.0</td><td>355.5</td><td>7.600</td><td>0.0</td><td>355.5</td></tr><tr><td>2.800</td><td>0.0</td><td>355.5</td><td>8.000</td><td>0.0</td><td>355.5</td></tr><tr><td>3.200</td><td>0.0</td><td>355.5</td><td>8.400</td><td>0.0</td><td>355.5</td></tr><tr><td>3.600</td><td>0.0</td><td>355.5</td><td>8.800</td><td>0.0</td><td>355.5</td></tr><tr><td>4.000</td><td>0.0</td><td>355.5</td><td>9.200</td><td>0.0</td><td>355.5</td></tr><tr><td>4.400</td><td>0.0</td><td>355.5</td><td>9.600</td><td>0.0</td><td>355.5</td></tr><tr><td>4.800</td><td>0.0</td><td>355.5</td><td>10.000</td><td>0.0</td><td>355.5</td></tr></table> Dry Swale Pipe: S5.000 Manning's N0.035Trench Length (m)29.0 Infiltration Coefficient Base (m/hr)0.00000Trench Infiltration Side (m/hr)0.00000 Infiltration Coefficient Side (m/hr)0.00000Trench Porosity0.30 Safety Factor2.0Side Slope (1:X)3.0 Swale Porosity1.00Slope (1:X)193.3 Invert Level (m)232.750Cap Volume Depth (m)0.700 Trench Height (m)0.400Cap Infiltration Depth (m)0.700 Trench Width (m)0.6 Dry Swale Pipe: S6.000 Manning's N0.035Trench Length (m)33.0 Infiltration Coefficient Base (m/hr)0.00000Trench Infiltration Side (m/hr)0.00000 Infiltration Coefficient Side (m/hr)0.00000Trench Porosity0.30 Safety Factor2.0Side Slope (1:X)3.0 Swale Porosity1.00Slope (1:X)220.0 Invert Level (m)230.450Cap Volume Depth (m)0.700 Trench Height (m)0.400Cap Infiltration Depth (m)0.700 Trench Width (m)0.6			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	300.0	300.0	5.200	0.0	355.5	0.400	300.0	327.7	5.600	0.0	355.5	0.800	300.0	355.4	6.000	0.0	355.5	0.801	0.0	355.5	6.400	0.0	355.5	1.600	0.0	355.5	6.800	0.0	355.5	2.000	0.0	355.5	7.200	0.0	355.5	2.400	0.0	355.5	7.600	0.0	355.5	2.800	0.0	355.5	8.000	0.0	355.5	3.200	0.0	355.5	8.400	0.0	355.5	3.600	0.0	355.5	8.800	0.0	355.5	4.000	0.0	355.5	9.200	0.0	355.5	4.400	0.0	355.5	9.600	0.0	355.5	4.800	0.0	355.5	10.000	0.0	355.5
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																	
0.000	300.0	300.0	5.200	0.0	355.5																																																																																	
0.400	300.0	327.7	5.600	0.0	355.5																																																																																	
0.800	300.0	355.4	6.000	0.0	355.5																																																																																	
0.801	0.0	355.5	6.400	0.0	355.5																																																																																	
1.600	0.0	355.5	6.800	0.0	355.5																																																																																	
2.000	0.0	355.5	7.200	0.0	355.5																																																																																	
2.400	0.0	355.5	7.600	0.0	355.5																																																																																	
2.800	0.0	355.5	8.000	0.0	355.5																																																																																	
3.200	0.0	355.5	8.400	0.0	355.5																																																																																	
3.600	0.0	355.5	8.800	0.0	355.5																																																																																	
4.000	0.0	355.5	9.200	0.0	355.5																																																																																	
4.400	0.0	355.5	9.600	0.0	355.5																																																																																	
4.800	0.0	355.5	10.000	0.0	355.5																																																																																	

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Dry Swale Pipe: S7.000

Manning's N	0.035	Trench Length (m)	45.0
Infiltration Coefficient Base (m/hr)	0.00000	Trench Infiltration Side (m/hr)	0.00000
Infiltration Coefficient Side (m/hr)	0.00000	Trench Porosity	0.30
Safety Factor	2.0	Side Slope (1:X)	3.0
Swale Porosity	1.00	Slope (1:X)	225.0
Invert Level (m)	228.300	Cap Volume Depth (m)	0.650
Trench Height (m)	0.350	Cap Infiltration Depth (m)	0.650
Trench Width (m)	0.6		

Cellular Storage Manhole: S16, DS/PN: S8.000

Invert Level (m)	228.050	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	180.0	180.0	5.200	0.0	223.0
0.400	180.0	201.5	5.600	0.0	223.0
0.800	180.0	222.9	6.000	0.0	223.0
0.801	0.0	223.0	6.400	0.0	223.0
1.201	0.0	223.0	6.800	0.0	223.0
2.000	0.0	223.0	7.200	0.0	223.0
2.400	0.0	223.0	7.600	0.0	223.0
2.800	0.0	223.0	8.000	0.0	223.0
3.200	0.0	223.0	8.400	0.0	223.0
3.600	0.0	223.0	8.800	0.0	223.0
4.000	0.0	223.0	9.200	0.0	223.0
4.400	0.0	223.0	9.600	0.0	223.0
4.800	0.0	223.0	10.000	0.0	223.0

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Bike Park Wales
Network 1 - SW
Parameters & Q100 Simulations

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 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 Storage Structures 12
Number of Online Controls 3 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.275
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 100.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status ON

Profile(s) Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440, 2160, 2880, 4320, 5760,
7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	30 Winter	100	+30%				
S1.001	S2	30 Winter	100	+30%				
S1.002	S3	15 Winter	100	+30%				
S1.003	S4	15 Winter	100	+30%				
S2.000	S5	480 Winter	100	+30%				
S2.001	S6	480 Winter	100	+30%	100/15 Winter			
S3.000	S7	480 Winter	100	+30%	100/15 Winter			
S1.004	S7	480 Winter	100	+30%	100/15 Winter			
S1.005	S8	4320 Winter	100	+30%				
S4.000	S10	30 Winter	100	+30%				
S4.001	S10	30 Winter	100	+30%				
S4.002	S10	30 Winter	100	+30%				
S4.003	S11	30 Winter	100	+30%	100/15 Winter			
S4.004	S14	240 Winter	100	+30%	100/15 Winter			
S4.005	S14	360 Winter	100	+30%	100/15 Winter			
S1.006	S9	1440 Winter	100	+30%				
S5.000	S10	30 Winter	100	+30%				
S5.001	S11	30 Winter	100	+30%				

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

PN	US/MH Name	Water		Surcharged		Flooded		Pipe		Status	Level Exceeded
		Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)				
S1.000	S1	239.906	-2.294	0.000	0.03		16.5			OK	
S1.001	S2	239.652	-0.098	0.000	0.26		16.5			OK	
S1.002	S3	236.993	-1.207	0.000	0.17		55.1			OK	
S1.003	S4	236.168	-0.042	0.000	0.86		54.3			OK	
S2.000	S5	235.115	-1.135	0.000	0.02		4.5			OK	
S2.001	S6	235.115	0.505	0.000	0.26		4.3			SURCHARGED	
S3.000	S7	235.113	0.527	0.000	0.15		2.3			SURCHARGED	
S1.004	S7	235.113	0.603	0.000	0.09		2.0			SURCHARGED	
S1.005	S8	234.219	-0.131	0.000	0.04		2.0			OK	
S4.000	S10	233.937	-0.563	0.000	0.10		52.0			OK	
S4.001	S10	233.383	-0.367	0.000	0.20		83.7			OK	
S4.002	S10	233.061	-0.439	0.000	0.15		118.0			OK	
S4.003	S11	232.342	0.542	0.000	1.26		111.3			SURCHARGED	
S4.004	S14	231.282	0.462	0.000	0.45		10.1			SURCHARGED	
S4.005	S14	231.290	0.740	0.000	1.03		8.1			SURCHARGED	
S1.006	S9	230.340	-0.110	0.000	0.16		10.0			OK	
S5.000	S10	233.152	-1.148	0.000	0.07		23.2			OK	
S5.001	S11	232.668	-0.082	0.000	0.42		23.2			OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S6.000	S12	30 Winter	100	+30%					230.878
S5.002	S13	30 Winter	100	+30%					230.380
S7.000	S14	600 Winter	100	+30%					228.817
S7.001	S15	600 Winter	100	+30%	100/15 Winter				228.816
S8.000	S16	600 Winter	100	+30%	100/15 Winter				228.815
S5.003	S17	600 Winter	100	+30%	100/15 Winter				228.815
S1.007	S18	360 Winter	100	+30%					227.965

		Surcharged		Flooded	Pipe		Level	
PN	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	Exceeded
S6.000	S12	-1.422	0.000	0.09		26.5	OK	
S5.002	S13	-0.145	0.000	0.28		49.8	OK	
S7.000	S14	-1.183	0.000	0.02		5.6	OK	
S7.001	S15	0.491	0.000	0.12		5.3	SURCHARGED	
S8.000	S16	0.514	0.000	0.06		1.8	SURCHARGED	
S5.003	S17	0.665	0.000	0.10		2.0	SURCHARGED	
S1.007	S18	-0.085	0.000	0.39		12.1	OK	

NETWORK 2:

The following network serves the proposed accommodation to the east of the site and considers the roof areas only; see Figure 3 below, which highlights the extent of impermeable area. Surface water runoff from these roof areas shall be collected via rainwater pipes and discharged by below ground traditional gravity sewers in a northerly direction. Following this, a flow control chamber shall limit flows to a maximum discharge rate of **2.0 l/s**.



Drainage Areas Considered in the Network 2 Simulation

APPENDIX H

OVERLAND FLOW ROUTES

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B	CM	04/10/19	LAYOUT UPDATED
A	CM	12/07/15	DIRECTION OF FLOW REVERSED
Rev	By	Date	Revision
Bingham Hall PARTNERSHIP LTD			
Consulting Civil & Structural Engineers 2 Tindal Court, East Meads Road, Chase Park, Cardiff, CF24 9TD. Telephone 0303 7642 6588 Fax 0303 2040 8025			
Project Title RIDE BIKE WALES - PROPOSED EXPANSION			
Drawing Title OVERLAND FLOW ROUTES			
Architect LE TRUCCO			
Client RIDE BIKE WALES			
Drawing Status APPROVAL			
Scale SHOWN	Drawing Size A1	Drawn PH	Date March 19
Project No. 6655 - BHP - 01 - XX - DR - S - (SAB)010	Zone -	Level -	Number -
Revised RG			Rev B

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