SuDS Strategy

Proposed Velo Park, Llanfoist, Abergavenny

On Behalf of

Monmouthshire County Council

Quality Management

Prepared by:	Tom Paltridge BSc MSc FGS	
Reviewed by:	Mike Willis BSc MSc FGS	
Reviewed and authorised by:	Chris Betts MSc FGS CGeol	
Calculations approved by:	Chris Betts MSc FGS CGeol	
Date:	November 2020	
Revision:	Final	
Project Number:	HYG637	
Document Reference:	cx	
Document File Path:	E:\	

Hydrogeo Ltd,
Unit 4 Waddington House,
Llanover Business Centre, Llanover,
Abergavenny NP7 9HA
T: 01873 856 813
E: info@hydrogeo.co.uk
W: www.hydrogeo.co.uk

Contents

Figures and Tables

Appendices

1 Introduction

1.1 Background

This SuDS Strategy provides details of the method that will be used to discharge the surface water runoff in accordance with the six standards requiring evaluation as part of a SuDS Approval Body (SAB) pre-application enquiry for a new cycling centre on land at Racecourse Farm, Llanfoist, Abergavenny.

It is recognised that consideration of flood issues should not be confined to the flood plain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development Site.

Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

1.2 Standards

This SuDS Strategy complies with the principles of Sustainable Drainage Systems (SuDS) presented in the document 'Statutory Standards for Sustainable Drainage Systems – Designing, constructing, operating and maintaining surface water drainage systems'.

The six standards that need to be met are as follows:

- S1 – Surface water runoff destination
- S2 – Surface water runoff hydraulic control
- S3 – Water Quality
- S4 – Amenity
- S5 – Biodiversity
- S6 – Designing drainage for construction, operation, maintenance and structural integrity

1.3 What are SuDS?

SuDS is designed to replicate, as closely as possible, the natural drainage from a Site (before development) to ensure that the flood risk downstream of that Site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the Site and can enhance the amenity and biodiversity that a Site has to offer.

1.4 Climate Change

Projections of future climate change (CC) in the UK indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. A rainfall increase of 30% has been taken into account within the drainage strategy for the Site.

2 Location & Development Description

2.1 Site Location

The Site is located at Llanfoist, Abergavenny, NP7 9HE as shown in Figure 2-1. The Site is located at National Grid Reference 329557, 212961.

Figure 2-1 Site location

2.2 Existing Development

The Site is a greenfield site that was originally part of the Racecourse Farm. A former landfill exists to the north of the Site and the Site borders areas of amenity importance to the west of the Site.

2.3 Proposed Development

The proposal is for a hub, or 'velo park' is proposed with a mix of different cycling facilities built around a core closed road circuit (CRC) for road-based activity, as well as developing

opportunities for other forms of cycling e.g. cyclocross, trails, skills, family use (see Appendix A).

2.4 Ground Levels

A topographical survey of the Site has recently been undertaken (see Appendix B). The Site is undulating with the Site levels ranging from 61.57mAOD to 43.60mAOD.

2.5 Catchment Hydrology / Surface Water Drainage

The nearest recorded surface water features comprise a drainage ditch to the east of the Site flowing west to east which flows into the River Usk and a wetland area to the west of the Site. The River Usk (Main River) flows approximately 300m to the north east of the site.

The lower level land to the east of the site is located within Development Advice Map (DAM) Zone C2 and the Natural Resources Wales Flood Zones 2/3). A Flood Consequence Assessment has been prepared given the proximity to the Flood Zone (and wider site boundary).

2.6 Flood Consequence Assessment

A Flood Consequence Assessment (FCA) has been undertaken for the proposed development[1] (see Appendix C).

2.7 Existing Surface Water Drainage

The existing Site has no formal drainage system, the rainfall either infiltrates into the soil substrate of discharges from the Site into the adjacent drainage ditches and ultimately the River Usk.

2.8 Ground Conditions

There are contrasting ground conditions across the site (glaciofluvial deposits in the west, made ground in the north, alluvial deposits in the east).

The British Geological Survey (BGS) map indicates that the superficial deposits consist of Alluvium - clay, silt, sand and gravel. Superficial deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by rivers. The bedrock

[1] Hydrogeo. Flood Consequence Assessment. Ref. HYG637 R 200804 CB Abergavenny Velo Park _FCA

underlying the site consists of the Maughans Formation - argillaceous rocks and sandstone, interbedded. Sedimentary bedrock formed approximately 393 to 419 million years ago in the Devonian Period. Local environment previously dominated by rivers.

Information from the National Soil Resources Institute details the site area as being situated on freely draining slightly acid loamy soils

The Flood Studies Report WRAP soil map classification is Type 2: i) very permeable soils with shallow ground water; ii) permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils; (fragipan - a natural subsurface horizon having a higher bulk density than the solum above. Seemingly cemented when dry but showing moderate to weak brittleness when moist. The layer is low in organic matter, mottled and slowly or very slowly permeable to water. It is found in profiles of either cultivated or virgin soils but not in calcareous material); and iii) moderately permeable soils, some with slowly permeable subsoils.

2.9 Groundwater

The superficial and bedrock deposits are designated as a Secondary A Aquifer. There are no source protection zones or licensed groundwater abstraction licences within the vicinity of the Site.

No BGS borehole records are held for positions located within the site however, borehole records nearby show that groundwater is likely to be more than 1.50m below the ground surface and the groundwater is not expected to be vulnerable to contamination.

2.10 Permeability/Infiltration Rate

In determining the future surface runoff from the Site, the potential of using infiltration devices has been considered. Site soakaway tests to BRE 365 methodology were conducted as part of a Site Investigations undertaken by Hydrogeo in February 2020 (see Appendix D).

The ground conditions and soakaway test results show that there will be limited infiltration in the natural deposits at the Site. Small scale and diffuse infiltration methods such as permeable paving, filter drains, swales and bio-retention areas will work.

3 S1: Surface Water Runoff Destination

3.1 Surface Water Runoff Destination

As part of the SuDS Standards the management of runoff from developments should be prioritised as to the choice of discharge destination. The priority hierarchy is listed below:

- Collect for re-use;
- Infiltrate to ground;
- Discharge to a surface water body;
- Discharge to a surface water sewer/highway drain; and
- Discharge to a combined sewer.

3.2 Collect for Re-use

The reuse of water to provide grey (non-potable) water for flushing WCs within buildings can reduce storm runoff without the need for treatment or oil separators since the risk of spillage or contamination is low.

Such a system would require one or more tanks and under optimum conditions these would be kept as near as full as possible to ensure a reliable water supply. For the purposes of a worst-case design scenario it is assumed that the tanks would be full at the start of an extreme rainfall event and hence all storm rainfall would enter the surface water drainage system rather than grey water storage. Whilst there may be merit in including such a scheme in the overall designs these are not considered appropriate in the SuDS assessment.

Whilst the first priority is to collect rainwater for re-use, rainwater harvesting was considered and deemed not suitable. From a cost/benefit approach, individual single property systems are considered to be unsuitable. The daily water requirement per person is minimum.

The proposed site layout in Appendix A show that there is no foreseeable non-portable water demand at the Site. The use of rainwater harvesting is not a viable / cost effective approach for the management of surface water runoff at the Site, taking into account the potential water supply benefits of such systems. In accordance with G1.4 of the SuDS standards is, rainwater harvesting is not proposed for the Site as:

1. There is no foreseeable need to harvest water at the Site.

2. The relevant water undertaker's water resources and drought management plans do not identify potential stresses on mains water supplies.

3. The use of rainwater harvesting is not a viable / cost-effective part of the solution for managing surface water runoff on the Site, taking account of the potential water supply benefits of such a system.

4. The rainfall yield exceeds demand, rainwater harvesting is not feasible for storm water control under BS8515:2009+A1:2013 detailed design approach.

With regards to the third point above, the costs of rainwater harvesting systems (unit costs, installation costs, running costs and maintenance costs) outweigh the water saving costs. Furthermore, section G1.6 of the SuDS Standards states that; 'in most cases, rainwater harvesting alone will not be adequate to deal with the Site drainage and provision will be required for an overflow to a Level 2 or lower priority runoff destination.'

3.3 Infiltrate to Ground

Small scale infiltration methods such as permeable paving filter drains, swales and bio-retention areas will work. It is therefore proposed that filter drains, swales and bio-retention areas will be used to convey water within the Site.

3.4 Discharge to a Surface Water Body

The nearest recorded surface water feature is a drainage ditch to the east of the Site flowing west to east which flows into the River Usk and a wetland area to the west of the Site; therefore it will be possible to discharge surface water runoff into a water body.

3.5 Discharge to a Surface Water Sewer

Due to the possibility of discharge to a surface watercourse, this option has not been considered at this stage.

3.6 Discharge to a Combined Sewer

Due to the possibility of discharge to a surface watercourse, this option has not been considered at this stage.

4 S2: Surface Water Runoff Hydraulic Control

4.1 Surface Water Runoff Rates

The proposed impermeable area of the Site is 9,682m^2 or 0.968 hectares (ha). An estimation of surface water runoff is required to permit effective Site surface water management and prevent any increase in flood risk to off-Site receptors. The SuDS Manual states the Flood Estimation Handbook (FEH) Revitalised Flood Hydrograph rainfall-runoff method version 2 (ReFH2) is a suitable method to assess peak runoff rates and volumes for both greenfield and developed Site scenarios. ReFH2 is considered as an appropriate method for estimating plot-scale runoff and is primarily the preferred approach to the Institute of Hydrology 124 (IH124). The greenfield runoff rates from the Site are shown in Table 4-1.

QBAR has been calculated to be 2.70 litres/second. The greenfield 1 in 100 year 6 hour rainfall event has been calculated to have a volume of 74m^3 and the developed Site 1 in 100 year 6 hour rainfall event has been calculated to have a volume of 138m^3, as calculated using the ReFH2 Method, as shown in Table 4-2. The calculated runoff rates and volumes from the Site have been attached in Appendix E.

Table 4-1 Greenfield Runoff Rates

Return Period (years)	Runoff Rate (l/s)
1	2.30
2 (QBAR)	2.70
30	6.50
100	8.80

Table 4-2 6 Hour Rainfall Calculations

Rainfall Event: 6 hours	Volume (m^3)	
	Greenfield	Developed Site
100	74	138
100 (+30%)	96	179

4.2 SuDS

Current guidance requires sustainable water management through the use of SuDS. SuDS measures should be used to control the surface water runoff from the Site therefore, managing the flood risk to the Site and surrounding areas from surface water runoff.

One of the aims of the SuDS standards is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of

amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement of the SuDS standards that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

A hierarchy of techniques is identified[2]:

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

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

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

[2] CIRIA (2004) Report C609, Sustainable Drainage Systems – Hydraulic, Structural and Water Quality advice.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of the SuDS Manual requires that runoff from Sites is not only restricted to meet the greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses. The SuDS Manual and the SuDS standards guidance apply a sustainability hierarchy to the various types of SuDS systems; this is summarised in Table 4-3.

Table 4-3 Sustainability Hierarchy

Most Sustainable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - Soakaways	✓	✓	✓
	Permeable surfaces and filter drains - Gravelled areas - Solid paving blocks - Permeable paving	✓	✓	
Least Sustainable	**Tanked systems** - Over-sized pipes/tanks - Cellular storage	✓		

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific

scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy.

The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found. Thus, source control techniques such as soakaways, rainwater harvesting and/or infiltration trenches, if suitable on a Site, are considered preferable to permeable conveyance and passive treatment systems such as tanks or ponds. The various options have been considered.

4.3 SuDS Design

The objective of this SuDS Design is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site. It is necessary to demonstrate that the surface water from the proposed development can be discharged safely and sustainably. The SuDS Design takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-Site as a result of the development.
- No surface water flooding of the Site.
- A 30% increase in rainfall intensity due to climate change during the next 100 years which is the lifetime of the development.
- A 10% increase in the impermeable areas due to urban creep.
- Maintain / improve surface water quality.
- Provide amenity and biodiversity benefits.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. A hierarchical approach to surface water management has been adopted within this SuDS Design. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. The SuDS Design comprises:

- **Discharge to Ground and Surface Water Body:**
    - Permeable paving
    - Linear filter trenches along the verge of the cycle track
    - Swales
    - Bio-retention areas
    - Detention basins
    - Restricted outfall to the drainage ditch and wetland area

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for the Site. The adoption SuDS features for the Site represents an enhancement from the current conditions as the current surface water runoff from the Site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS features will reduce the risk of flooding to the Site and off-Site locations.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream. The SuDS Design schematic is shown in Appendix F.

4.4 Interception

The following SuDS features will provide interception storage:

- Permeable surfaces
- Permeable car parking surface
- Linear filter trenches
- Swales
- Bio-retention areas
- Detention basins

All permeable surfaces whether lined or not, can be assumed to comply provided there is no additional area drained to the permeable surface. The SuDS features will provide interception storage via filtration and evaporation.

There will be no runoff from the area for the majority of small rainfall events, as per 18.4.2 of The SuDS Manual. The water will soak into the filter medium and will be removed by evapotranspiration.

4.5 Morphological Protection / Flood Risk Mitigation of Receiving Surface Water Bodies

The provision of suitable water storage to mitigate the flood risk resulting from the development will be a key factor in the evolution of the development layout. One of the aims of the SuDS Standards is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity.

It is therefore proposed that linear filter trenches, bio-retention areas and detention basins with a restricted outfall to the drainage ditch and wetland area will be used. By restricting runoff rates to Greenfield runoff rates the receiving watercourse will be protected from erosion and the resulting morphological, ecological damage and increasing flood risk.

Runoff Rate Control

QBAR (rural) has been calculated to be 2.70 litres/second therefore, a value of 2.70 litres/second has been used as the limiting discharge rate before discharge to the drainage ditch and wetland area, for all events up to and including the 1 in 100 year (+30%) event.

Runoff Volume Control

Permeable Paving

Gravel paving grids will be used within the car parking areas (e.g. Core Drive 50-35 HD). A permeable/open-graded (reduced fines) sub-base layer (i.e. Type 3 with a void ratio of 30%) will be used as a drainage layer below the permeable surfaces which will be sufficiently permeable to allow water to drain through and to store water temporarily. The selected gravel fill and bedding should be clean, free-draining, angular shaped material in the specified size range. The proposed construction profile of the gravel paving grids is shown in Figure 4.1.

The system also encourage biological treatment of flow and extraction of oils and heavy metals from the runoff. The permeable paving will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the development within the subbase material. There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing areas with an easement for a sewer or stand-off for a basin.

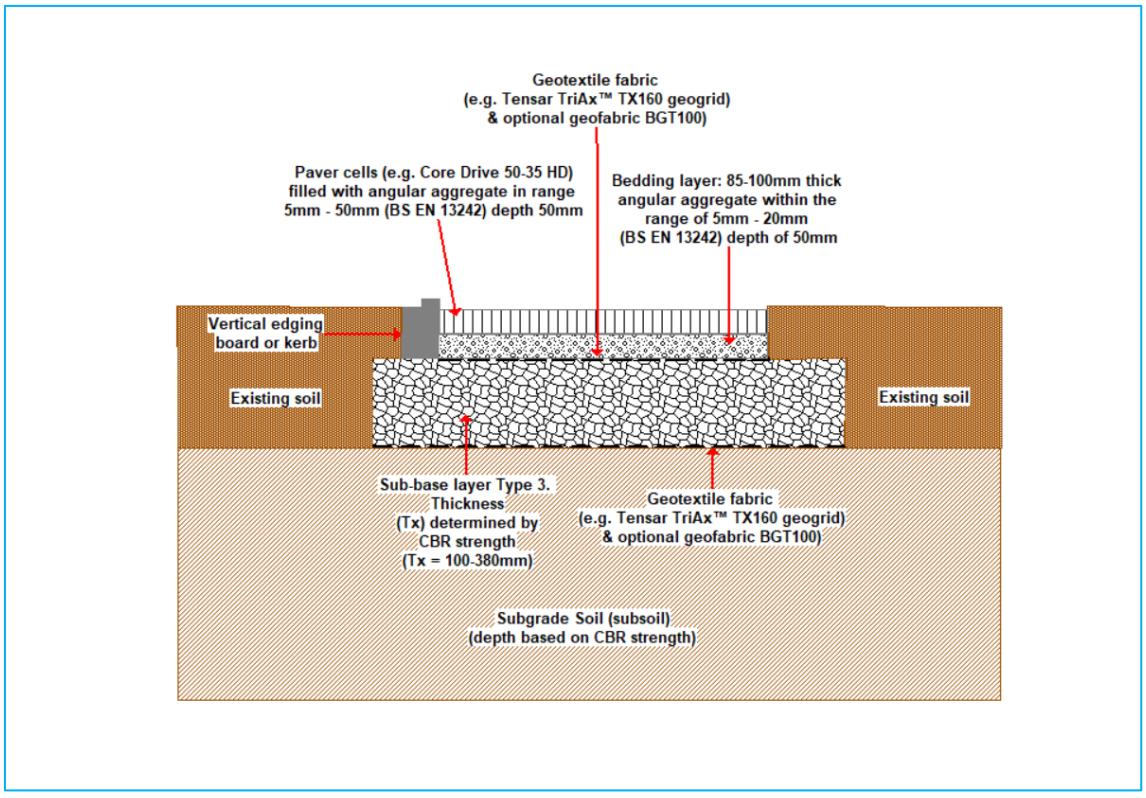
Permeable paving will provide storage for the first 5mm (interception storage) as a minimum. It is should be noted that any permeable paving system to be installed by a developer must have an infiltration rate of at least 30mm/hr (0.03m/hr) to avoid ponding

on the surface before it reaches the natural soil (permeable paving systems generally would have an infiltration rate in excess of 30mm/hr).

These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the runoff. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration
- Absorption
- Biodegradation
- Sedimentation

Figure 4-1 Proposed Construction Profile Gravel Paving Grids



Linear Filter Trenches

Linear filter trenches will be used along the runoff areas running parallel to the cycle track. Figure 4.2 shows the British Cycling typical circuit construction detail.

The surface water sheet flow from the track will runoff onto a grass filter strip and then into the linear filter trenches. The filer trenches will discharge to swale and bio-retention areas.

The use of linear filter trenches will negate the need for the use of kerbs and gullies adjacent to the cycle track and will be incorporated into the SuDS treatment train in conjunction with other SuDS components to safely pass and store extreme storm flows.

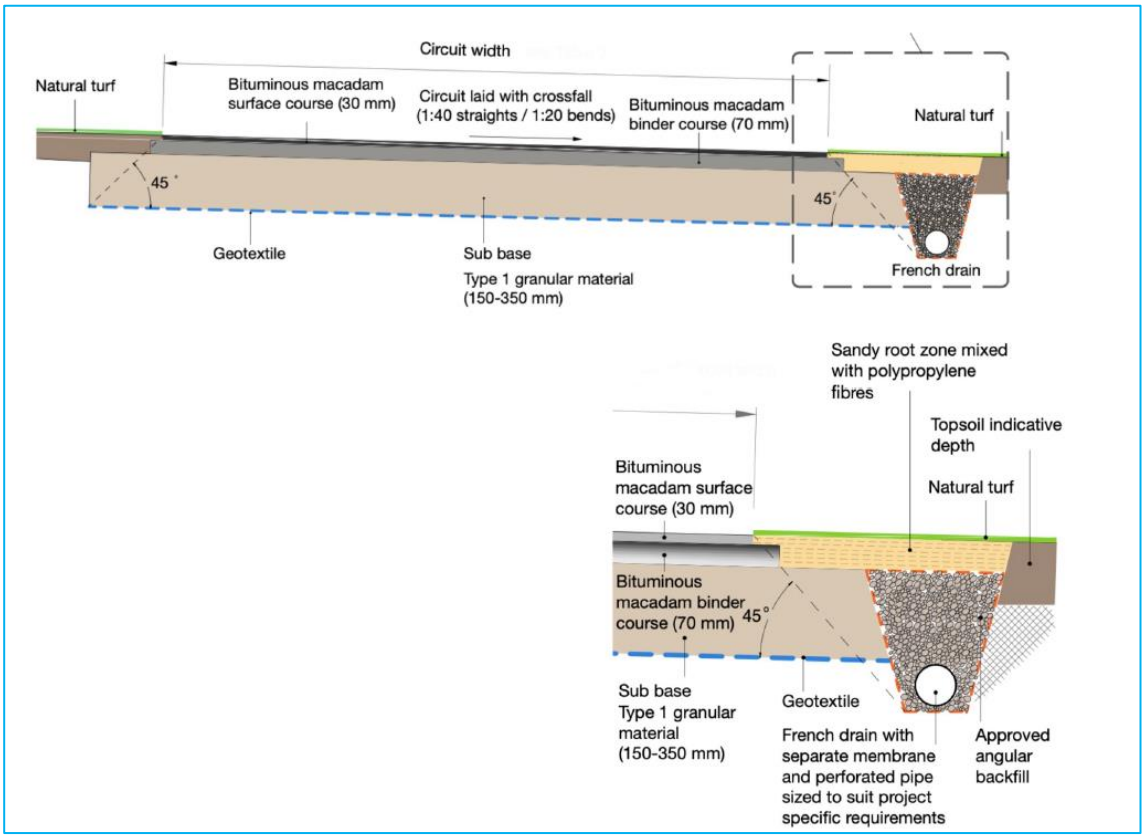
The system also encourage biological treatment of flow and extraction of potential pollutants and sediments from the runoff. The filter trenches will also assist in reducing the flood profile of the Site by significantly attenuating the runoff from the cycle track within the filter material. There is no specific amenity provided by the system other than enabling the areas to be incorporated as part of the landscaping rather than potentially sterilizing areas with an easement for a sewer or stand-off for a basin.

As it would be undesirable to have a stone filled trench finished with loose stone immediately adjacent to the cycle track which could present a hazard, the stones in the filter trenches will be covered with a topsoil layer on a geotextile layer and planted with grass. The linear filter trenches will provide storage for the first 5mm (interception storage) as a minimum.

These systems also encourage biological treatment of flow and extraction of potential pollutants from the runoff. Treatment processes that occur within the surface structure and the geotextile layers include:

- Filtration
- Absorption
- Biodegradation
- Sedimentation

Figure 4-2 British Cycling Typical Circuit Construction Detail



Swales, Bio-retention Areas and Detention Basins

Swales, bio-retention areas and detention basins are proposed to be installed within the areas adjacent the cycle track circuit. The series of linear filter drains will outfall directly into the swales and detention basins

The swales, bio-retention areas and detention basins will be used as a flexible surface water management component which will be integrated into the landscape using a variety of shapes, dimensions and planting. These will be areas of land with a variety of planting for biodiversity, taking the form of amenity grass, meadow planting with smaller areas of more substantial planting. The gradients will not be steeper than 1 in 4 but will have a variety of gradients to create interest. The bio-retention areas will provide interest visually and ecologically.

The size of the swales, bio-retention areas and detention basins have been calculated such that the development has the capacity to accommodate the 1 in 100 year rainfall event including a 30% increase in rainfall intensity that is predicted to occur as a result of climate change. The proposed impermeable area of the site is 7,292m^2. With a 10% increase in impermeable to account for urban creep the proposed impermeable area used

within the calculations is 8,021.20m^2. Consequently, all areas drained have been designed to accommodate a 100 year (+30% climate change) event.

Table 4-4 shows the volume of storage required for the proposed impermeable surfaces estimated using the MicroDrainage Software for the critical 1 in 100 year event with a 30% allowance for climate change (increase in peak rainfall) (see Appendix G).

It is proposed that the impermeable areas of the site will be discharged to linear filter trenches with outfall to bio-retention areas and detention basins with a minimum capacity of 771.20m^3 before discharging off the site to the drainage ditch at a restricted runoff rate of 2.70 litres/second.

Table 4-4 Storage Volume

Return Period (yrs)	Limiting Discharge Rate (l/s)	Volume (m^3)
100 +30%	2.70	771.20

G2.28 of the SuDS Standards for Wales, 2018 states that *"Ideally, the volumetric control of runoff should be demonstrated to meet greenfield runoff behaviour for all events and particularly those relevant for the mitigation of flood risk in the receiving watercourse. However, this would require the use of time series rainfall as part of a modelling exercise. Until this approach becomes standard industry practice, a simple method using the 1:100 year, 6 hour rainfall event is sufficient for design purposes, as it represents a suitable event for smaller watercourses that are most at risk from the effects of urban development. As designs for Interception will help control runoff volumes from smaller events, a single requirement for large events is considered a pragmatic solution."*

The greenfield 1 in 100 year 6 hour rainfall event has been calculated to have a volume of 74m^3 and the developed site 1 in 100 year 6 hour rainfall event has been calculated to have a volume of 138m^3. Therefore, the detention basin will have the capacity to store the 1 in 100 year 6 hour rainfall event. The site will adhere Greenfield runoff rates for all events up to and including the 1 in 100 year (+30%) rainfall event. Therefore, the surface water runoff from the developed site will be no greater than existing.

The remainder of the site that is not formally drained, i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through linear drainage channels and contouring of the hardstanding areas.

4.6 Design Exceedance / Designing for Local Drainage System Failure

Appendix F shows the exceedance routes. When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event or potential failure of the drainage system through the blockage of pipes, blockage of outlet structures and risk of impediments across flood routing paths.

The SuDS Design applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section is therefore associated with the way the residual risk is managed.

As part of the SuDS Design it must be demonstrated that the flooding of property would not occur in the event of design exceedance or local drainage system failure. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. It is also very unlikely that a catastrophic failure would occur.

The SuDS features have been designed to accommodate the 1 in 100 year event plus climate change (+30%) including a 10% increase in the impermeable areas due to urban creep therefore, flooding would not occur for all events up to the 1 in 100 year (+30%) event. It should also be noted that additional storage is provided within linear filter trenches which will provide betterment over and above the 1 in 100 year (+30%) event. Flows resulting from a rainfall event in excess of the 1 in 100 year (+30%) event (exceedance event) will be managed to that minimise the risks to people and property.

A freeboard of 300mm will be provided above the temporary water level within the detention basins this will provide additional storage should an exceedance event occur. Furthermore, additional storage will be provided within the linear filter trenches, bio-retention areas.

Where required, exceedance flow route will be installed to prevent overtopping and will take the form of a simple channel with a 300mm freeboard. This will protect the embankment from structural damage and has been located to not put downstream people and property at risk.

As such, it is considered that a failure of the drainage network would not pose a significant risk to property and people. Consequently, the impact of an exceedance event or local drainage system is not considered to represent any significant flood hazard. The above manages and mitigates the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite.

5 S3: Water Quality

5.1 Sensitivity of Receiving Watercourse

It is proposed to discharge the surface water runoff from the site into a drainage ditch and wetland area. The superficial and bedrock deposits are designated as a Secondary A Aquifer. There are no source protection zones or licensed groundwater abstraction licences within the vicinity of the Site.

There are no immediately adjacent sensitive receptors e.g. Ramsar, Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) and Special Protection Areas (SPA), heritage/landscape sites and Biodiversity Action Plan (BAP) habitats.

The impact on human health, quality of life and the environment is low, the sensitivity of the receiving watercourse is low.

5.2 Pollution Hazard

According to the SuDS standards the proposed development is a high hazard as shown in Table 5-1.

Table 5-1 Level of hazard

Hazard	Source of hazard
Low	Roof drainage
Medium	Residential, amenity, commercial, industrial uses including car parking spaces and roads
High	Areas used for handling and storage or chemicals and fuels, handling of storage and waste (including scrap-yards)

The proposed development has a ‘medium’ pollution hazard level (Table 5-2), as per Table 26.2 of the SuDS Manual.

Table 5-2 Pollution hazard indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads)	Low	0.50	0.40	0.40

* Indices values range from 0-1.

5.3 SuDS Mitigation Indices

To deliver adequate treatment, the SuDS features should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type). Water treatment will be provided via the SuDS components included throughout the drainage network. It is therefore considered that adequate water quality treatment can be provided via SuDS components.

With the inclusion of the listed treatment features, the SuDS design for the Site provides sufficient treatment to the runoff as shown Tables 5-3 and 5-4 as per Tables 26.3 and 26.4 the SuDS Manual.

Table 5-3 SuDS Mitigation Indices

Type of SuDS Component	TSS	Metals	Hydro-carbons
Filter drains	0.40	0.40	0.40
Permeable paving	0.70	0.60	0.70
Swale	0.25*	0.30*	0.30*
Bio-retention system	0.40*	0.40*	0.40*
Detention Basin	0.35*	0.35*	0.35*

* a factor of 0.50 is used to account for the reduced performance of secondary components associated with already reduced inflow concentrations.

Table 5-4 SuDS Mitigation Indices for Discharges to Groundwater

Type of SuDS Component	TSS	Metals	Hydro-carbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential	0.60	0.50	0.60

The filter drains will receive the runoff from the impermeable parts of the cycle track and parking area. The filter drains will flow into the swales, bio-retention areas and detention basins. The design of the system will allow any silt and debris from the impermeable areas an opportunity to settle. The permeable paving, linear filter drains, swales, bio-retention areas and vegetation within the detention basins will naturally filter potentially suspended solids contained in the surface water runoff from any hardstanding.

6 S4: Amenity

6.1 Amenity Benefits

The proposed Velo Park is an amenity development.

The proposed Planting Plan is included within Appendix H. In accordance with the SuDS Manual, maintaining landscape and grass zones associated with the development will provide air quality improvements.

The proposed drainage scheme for the Site aims to incorporate linear filter drains, and a variety of swales and detention basins with vegetation around the sides. These features will create a more aesthetically pleasing environment, as well as allowing for interception and volume control. The swales and detention basins will provide features which can be incorporated into part of the scheme utilised for off-road cycling disciplines incorporating features such as rock gardens technical trails and steps

The increased plant diversity provided would support additional flora and fauna for the benefit of the development community. In addition to the amenity benefits of the SuDS features, the Client has included amenity areas for use by cyclists and visitors. These are understood to include grassed/planted areas. The SuDS features will deliver health and wellbeing benefits by providing areas for recreation and relaxation.

7 S5: Biodiversity

7.1 Biodiversity Opportunities

Planting will use a variety of native species of local provenance to ensure opportunities for biodiversity and sustain habitat within the development. The proposed Planting Plan is included within Appendix H. Carrying out grass cuts and managing vegetaiton will also improve biodiversity of landscaped areas.

Planting within otherwise grassed areas will ensure opportunities for biodiversity and sustain habitat within the development. The surface water drainage scheme has been designed to integrate with overall aesthetic of the proposals. Species should be been selected for both their suitability to thrive in the prevailing Site conditions and their enhancement of biodiversity through provision of habitat, food and pollen.

7.2 Detention Basin, Basin Edge, Swales and Bio-Retention Areas

A range of habitats will be created, with an aquatic bench for marginal planting and open water for deep water plants. One seed mix will be sown in the intermittently inundated soil at the bases (which are expected to be predominantly wet), and a different mix will be sown on the drier soil of the sides and in other areas marked for meadow grassland planting:

- **Drier pond slopes and surrounding meadow grassland areas** - Emorsgate EM1 General Purpose Meadow Grass Mixture, sown at 5g/sqm. This is suitable for the ground conditions in these areas.
- **Intermittently inundated areas** - The EP1 seed mix or similar, sown at 4 g/sqm is recommended.

7.3 Scrub and Trees

Areas of scrub and trees will be retained and improved. These will provide important terrestrial habitat cover and act as a windbreak. Trees and scrub will attract a greater variety of insects and birds to the Site and will provide terrestrial habitat for amphibians.

7.4 Features

The land surrounding the swales and detention basins will include features beneficial to wildlife. This will include log / deadwood piles, embankments and hibernacula. Hibernacula generally comprise mounds of timber or other material covered by turf to provide damp, sheltered habitat. If available, inert discarded bricks or rubble from the Site can be used. Soil from excavating the swales and detention basin can be used to create

an embankment, which is particularly beneficial if sited near the swale/basin edge. This will create habitat for reptile basking.

Arisings from trees or bushes that have been cut down could be used to create log / deadwood piles, which are beneficial to a range of species, particularly insects.

8 S6: Designing Drainage for Construction, Operation, Maintenance and Structural Integrity

8.1 Maintenance Responsibility

The system will be maintained by Monmouthshire County Council and will be adopted by the SuDS Approving Body (SAB) delivered by Monmouthshire County Council. An Operation and Maintenance Manual will be developed, the Operation and Maintenance Manual shall be passed on to subsequent future owners.

8.2 Phasing

The surface water drainage scheme will be installed and fully operational before occupation of the Site occurs.

8.3 Construction Phase Surface Water Impacts

The Proposed Development has the potential to introduce contaminants from the associated machinery, infrastructure, transportation, importation of constructions materials and maintenance and storage of plant equipment as discussed below:

Excavated Ground and Exposed Ground

Recently disturbed and vegetation free ground allows for relatively low velocity runoff to erode the surface. This leads to increased runoff and sedimentation of receiving waters, thereby increasing flood risk / potential impacts on water quality.

Stockpiles

Rainfall could lead to erosion of material should a stockpile be uncovered. This could lead to siltation of drainage or receiving watercourses and therefore an increase in flood risk / potential impact on water quality.

Oils and Hydrocarbons

The use of oils and hydrocarbons on construction Sites provide a risk of leakages and spillages, leading to pollution incidents. This could affect the water quality in drainage / receiving watercourses and aquifers.

8.4 Construction Phase Surface Water Management Plan

The following Section provides detail on Site drainage during the Construction Phase, this will reduce the potential for vehicle movement on wet ground, which can increase the potential for compaction.

In summary, the withdrawn Pollution Prevention Guidance[3] (PPG), Guidance for Pollution Prevention (GPPs) and Government guidance[4] states that the following methods of surface water management should be put in place during the construction phase to ensure pollution, sediment and erosion control:

Excavated Ground and Exposed Ground

To limit the volume of runoff reaching the exposed ground, runoff diversion or interception devices / bunds can be placed upstream of exposed ground. To help control sediment in runoff from leaving the Site or entering drainage, silt fences, bunds, hay bales or ditches can be placed downstream of exposed ground to intercept runoff.

Stockpiles

Soil stockpiles will be located away from any Site drainage systems and measures to intercept runoff will be incorporated, such as a silt fence or small perimeter bunds around the base of the stockpiles. Concrete should also be stored to prevent release into drains.

Oils and Hydrocarbons

Simple measures can be taken to prevent oil and hydrocarbons becoming pollutants, such as:

- Maintenance of machinery and plant
- Drip trays
- Regular checking of machinery and plant for oil leaks

[3] Pollution Prevention Guidelines PPG1: Understanding Your Environmental Responsibilities (July 2013).
Guidance for Pollution Prevention GPP2: Above ground oil storage tanks (January 2018).
Guidance for Pollution Prevention GPP5: Works and maintenance in or near water (January 2017).
Pollution Prevention Guidelines PPG6: Working at construction and demolition sites (March 2012).
Pollution Prevention Guidelines PPG7: The safe operation of refuelling facilities (July 2011).
Guidance for Pollution Prevention GPP8: Safe storage and disposal of used oils (July 2017).
Guidance for Pollution Prevention GPP13: Vehicle washing and cleaning (April 2017).
Guidance for Pollution Prevention GPP21: Incident Response Planning (July 2017).
Guidance for Pollution Prevention GPP22: Dealing with spills (October 2018).
Guidance for Pollution Prevention GPP23: Safe storage - drums and intermediate bulk containers (February 2019).
[4] https://www.gov.uk/guidance/storing-oil-at-a-home-or-business, May 2015.
https://www.gov.uk/guidance/manage-waste-on-land-guidance-for-land-managers, May 2014.

- Correct storage facilities
- Check for signs of wear and tear on tanks
- Care with specific procedures when refuelling
- Designated areas for refuelling
- Emergency spill kit located near refuelling area
- Regular emptying of bunds
- Tanks located in secure areas to stop vandalism

Ground Compaction

In order to minimise ground compaction, the following measures will be implemented.

- A temporary hardcore surface will be placed as the construction Site access road (to be removed at the end of the Construction Phase).
- Vehicle movements on bare soil will be minimised.
- Vehicle movements on wet ground will be minimised.

The pollution, sediment and erosion control mitigation measures as detailed above will ensure that the effects on receptors during the construction phase are negligible.

8.5 Construction Requirements

Where possible the swales, bio-retention areas and detention basins have been designed avoiding the use of straight sides. Curves and edges are beneficial for creating a greater diversity of micro-habitats for plant and animal life.

The minimum design requirements for swales, bio-retention areas and detention basins are shown in Table 8-1 and for the gravel paving grids are shown in Table 8-2.

The swales, bio-retention areas and detention basins will include some shallow, shelved areas. A range of heights will be incorporated, including shelves at approximately 0.10m and 0.40m in depth during typical conditions.

The inlet and outlet details are provided on the plans together with any necessary erosion control. The SuDS features will have gradually sloping sides to allow wildlife access in and out and to allow marginal vegetation to flourish.

The bottom and side slopes, including any benches, will be carefully prepared to ensure that they are structurally sound. Any embankments will be checked to ensure that they

meet their design criteria. The preparation will also ensure that the SuDS features will satisfactorily retain the surface water runoff without significant erosion damage.

Backfilling against inlet and outlet structures will be controlled to minimise settlement and erosion. The soils used to finish the side slopes above the retained level will be suitably fertile, porous and of sufficient depth to ensure healthy vegetation growth. An earth bund around the inflow and outflow pipes will help prevent silt and sediment being churned up in the pool during times of high flow.

When landscaping and preparing the ground, avoid importing soils with high nutrient content, which will wash into the SuDS features, lowering water quality. Lower nutrient soil is also better for native wildflower species, whereas nutrient rich topsoil will encourage rapid weed growth.

Table 8-1 Design Requirements: Swales, Bio-retention Areas and Detention Basins

Parameter	Design Requirements
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below any permanent water level	400mm
Maximum side slopes of safety bench (where required)	1 in 15
Width of safety bench (where required)	3.50
Freeboard above temporary water level	300mm

Table 8-2 Specification Gravel Paving Grids

Description	Data
Bedding Layer	35-50mm thick of 5-20mm clean, angular aggregate (BSEN13242)
Paver Fill	To top of cells using 5-20mm clean, angular aggregate (BSEN13242)
Sub-base Type	Modified permeable Type 3 sub-base
Sub-base Reinforcement	Geogrid (e.g Tensar TriAx™ TX160)
Geotextile Fabric	BGT100 Geotextile where appropriate

8.6 Operation / Maintenance and Structural Integrity

The SuDS features have been designed for easy maintenance to comprise:

- Regular day to day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS feature.
- Occasional tasks – checking the SuDS feature and removing any silt that builds up in the SuDS feature.
- Remedial Work – repairing damage where necessary.

As far as is reasonably practicable the surface water drainage system has been designed so that the SuDS features can be constructed easily, safely, cost effectively and in a timely manner.

The surface water drainage scheme will be installed and fully operational before occupation of the Site occurs. The surface water drainage scheme will be regularly maintained. The key maintenance requirements are regular inspection of silt traps, manholes, pipework, with removal of sediment and debris as required.

The structural integrity of the drainage components will be designed to withstand the anticipated loading conditions over the design life of the development, accounting for reasonable levels of maintenance. The maintenance will be the responsibility of the property owner as the SuDS features will serve a single property.

The use of parts of the SuDS features as part of the off-circuit cycling scheme (eg cyclocross) may mean that more frequent inspection and maintenance may be required in these areas.

8.7 SuDS Scheme Checklist

The following lists the SuDS components and extra features which are found on Site.

- **Discharge to Ground and Surface Water Body:**
  - Permeable paving
  - Linear filter trenches along the verge of the cycle track
  - Swales
  - Bio-retention areas
  - Detention basins
  - Restricted outfall to the drainage ditch and wetland area

8.8 Design Life

The design life of the development is likely to exceed the design life of each of the SuDS components listed above. During the routine inspections of any SuDS components it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability repairs should be the first-choice solution where practicable. If this is not the case, then it will be necessary to undertake complete replacement of the component in question.

When undertaking maintenance, repairs or replacement, all engineering drawings used in the design, construction and installation of the SuDS components should be referred to for construction and specification details. This will help to ensure satisfactory performance of each of the SuDS components.

8.9 Areas Where Activities are Prohibited

No stock piling of materials should take place on the SuDS features (e.g. areas of permeable paving) as this will cause the surface to block and prevent the through flow of rainwater.

8.10 SuDS Maintenance Specification (to be provided to the Facility Owner)

General Requirements

- Avoid use of weed-killers and pesticides to prevent chemical pollution.
- Avoid de-icing agents wherever possible.
- Protect all below ground drainage through careful selection and placement of hard and soft landscaping.

Table 8-2 details the general requirements.

Table 8-2 General Requirements

General Requirements	Frequency
Maintenance activities comprise • Regular maintenance • Occasional tasks • Remedial work	------
• Generally • Litter • Collect all litter or other debris and remove it from the Site at each visit	Monthly

8.9.1 Detention Basin

Detention basins are designed to provide attenuation and storage of surface water. Table 8-3 provides details of the maintenance requirements.

Table 8-3 Detention Basin

General Requirements	Frequency
• Litter removal	Monthly
• Grass cutting – public areas	Monthly (during growing season)
• Grass cutting – meadow grass	Half yearly (spring, before nesting season, and autumn)
• Inspect vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
• Hand cut submerged and emergent aquatic plants (at minimum of 0.10m above. Include max 25% of surface)	Annually
• Remove 25% of bank vegetation from water's edge to a minimum of 1 m above water level	Annually
• Tidy all dead growth before start of growing season	Annually
• Remove sediment from forebay	1–5 years, or 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 removal frequencies	Monthly (for first year), then annually or as required
• Check mechanical devices	Annually
Occasional Tasks	**Frequency**
• 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 permanent pools when required	Every 5 years, or as required (likely to be minimal requirements)
Remedial Work	**Frequency**
• Repair of erosion or other damage	As Required
• Aerate permanent pool when signs of eutrophication are detected	As Required
• Realignment of damage	As Required
• Repair / rehabilitation of inlets, outlets and overflows	As Required
• Realignment of rip-rap	As Required
• Relevel uneven surfaces and reinstate design levels	As Required

Sediments excavated from permanent pools that receive runoff from the track area are generally not toxic or hazardous material and can be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols.

It will be acceptable to distribute the sediment on Site if there is an appropriate safe and acceptable location to do so. If any permanent pools are to be drawn down, care should be taken to prevent downstream discharge of sediments and anoxic water.

It should be ensured that in the first five years, while vegetation is establishing, certain plant growth is controlled, such as invasive plants, particularly Common Bulrush (Typha latifolia). As it is not desirable for all new permanent pools to be bulrush dominated. After this period, permanent pools can usually be allowed to develop naturally, recognising that, unless the margins are occasionally managed, they are likely to become dominated by trees and shrubs.

Eutrophication of any SuDS permanent pools can occur during the summer months. Eutrophication is best alleviated by controlling the nutrient source or providing a continuous baseflow to the pool. Unless eutrophication is severe, aeration can be used as a stop-gap measure to save aquatic animal species and reduce risks to receiving waters. However, the addition of barley straw bales, dredging or rendering the nutrients inactive by chemical means can also be successful.

Swales/Bio-retention Areas

Swales/Bio-retention areas are shallow planted depression that allow runoff to pond temporarily on the surface before filtering through vegetation and soils or being discharge downstream. Table 8-4 provides details of the maintenance requirements.

Table 8-4 Swales/Bio-retention Areas

General Requirements	Frequency
• Inspect infiltration surfaces for silting and ponding, record de-watering time and assess standing water levels to determine if maintenance is necessary	Quarterly
• Check operation of drains by inspection of flows after rain	Annually
• Assess plants for disease infection, poor growth, invasive species etc. and replace as necessary	Quarterly
• Inspect inlets and outlets for blockage	Quarterly
• Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
• Replace any plants, to remain population density	As Required
• Remove sediment, litter and debris build-up from around inlets	Quarterly to biannually
Occasional Tasks	**Frequency**
• Infill any holes or scour in the filter medium, improve erosion protection if required	As Required
• Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As Required
Remedial Work	**Frequency**
• Remove and replace filter medium and vegetation	As required but likely to be > 20 years

Permeable Paving

Permeable paving is porous to allow rain to percolate through the surface into underlying drainage layers. They must be protected from silt, sand, compost, mulch, etc. Table 8-5 provides details of the maintenance requirements.

Table 8-5 Pervious surfaces

Regular maintenance	Frequency
• Brushing where applicable (standard cosmetic sweep over whole surface)	Once per year, after autumn leaf fall, or reduced frequency as required based on site-specific observations of clogging or manufacturer's recommendations. Pay particular attention to areas where water runs onto pervious surfacing from adjacent impermeable areas as this is the most likely to collect sediment.
Occasional maintenance	**Frequency**
• Stabilise and mow contributing and adjacent areas	As required
• Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	**Frequency**
• Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
• Remediation work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required
• Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)

Monitoring	Frequency
• Initial inspection	Monthly or three months after installation
• Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hours after large storms in first six months
• Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually

Flow Control Device

A flow control device controls the flow of water leaving the Site. Table 8-6 provides details of the maintenance requirements.

Table 8-6 Flow Control Device

General Requirements	Frequency
• Inspect and identify any areas that are not operating correctly and clear out any debris from chamber	Monthly for first 3 months then every 6 months
Remedial Work	**Frequency**
• Repair physical damage if necessary	As Required

Inlet structures and Inspection Chambers

Inlet structures should be free from obstruction at all times to allow free flow through the SuDS. Inspection chambers and rodding eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary. Table 8-7 provides details of the maintenance requirements.

Table 8-7 Inlet Structures and Inspection Chambers

General Requirements	Frequency
Inlet Structures • Inspect rainwater downpipes, channel drains and road gullies, removing obstructions and silt as necessary • Check there is no physical damage • Strim vegetation 1.00m minimum surrounding structures and keep area free from silt and debris	Monthly
Inspection Chambers and below ground control chambers • Remove cover and inspect, ensuring that the water is flowing freely and that the exit route for water is unobstructed • Removed debris and silt	Annually
Occasional Tasks	**Frequency**
• Check topsoil levels are 20mm above edges of chambers to avoid mower damage	As Required
Remedial Work	**Frequency**
• Repair physical damage if necessary	As Required

Below Ground Drainage Pipes

Below ground drainage pipes convey water to the SuDS system through the linear filter drains. They should be free from obstruction at all times to allow free flow. Table 8-8 provides details of the maintenance requirements.

Table 8-8 Below Ground Drainage Pipes

General Requirements	Frequency
• Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for first 3 months then annually
• Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
• Remove sediment from pre-treatment inlet structures and inspection chambers	Annually or as required
• Maintain vegetation to designed limits within vicinity of below ground drainage pipes and tanks to avoid damage to system	Annually or as required

Occasional Tasks	Frequency
• Check topsoil levels are 20mm above edges of chambers to avoid mower damage	As Required
Remedial Work	**Frequency**
• Repair physical damage if necessary	As Required

Overflow and Flood Routes

Overflows are overland across weirs, through gratings or within chambers and must be kept clear at all times to protect areas from flooding. They allow onward flow when part of the SuDS system is blocked.

Flood routes (exceedance routes) allow water volumes that exceed the capacity of the SuDS system to pass through or round the Site without causing damage to property. These routes must be clear of obstructions at all times. Table 8-9 provides details of the maintenance requirements.

Table 8-9 Overflow and Flood Routes

Regular Maintenance	Frequency
Overflow • Jet pipes leading from overflow structures annually and check by running water through the overflow	Monthly for first 3 months then annually
• Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
Flood Routes • Make visual inspection. Check route is not blocked by new fences, walls, soil, or other rubbish. Remove as necessary	Monthly
Remedial Works	**Frequency**
Overflow • If overflow is not clear, then dismantle structure and reassemble to design detail	As Required

8.11 Alterations

If any alterations are proposed to the development, the design engineer must be notified so that the impact/implications of the work can be assessed.

8.12 Spillage – Emergency Action

Health and safety consideration are a priority and addressing accidental spillages should only be attempted if the nature of the spillage is known and its potential hazardous properties are understood.

Most spillages on developments are of compounds that do not pose a serious risk to the environment if they enter the drainage in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommended by Natural Resources Wales, with residual spillage allowed to bioremediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then isolate the spillage with soil, turf or fabric and block outlet pipes from chamber(s) downstream of the spillage with a bung(s), (A bung for blocking pipes may be made by wrapping soil or turf in a plastic sheet or closely woven fabric.)

Contact Natural Resources Wales immediately. Tel: 0300 065 3000.

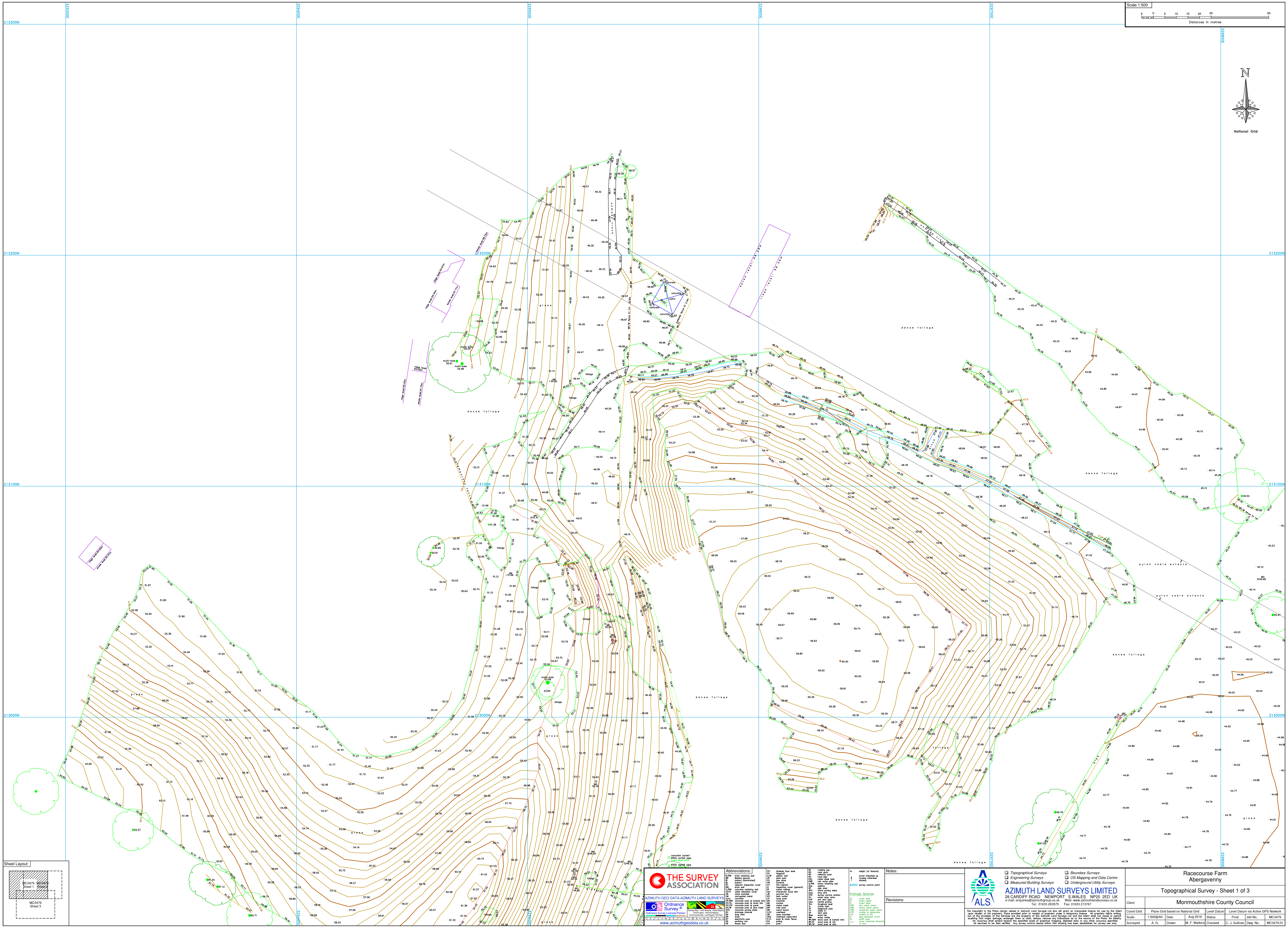
Appendices

Appendix A

Proposed Site Layout

Appendix B

Topographical Survey



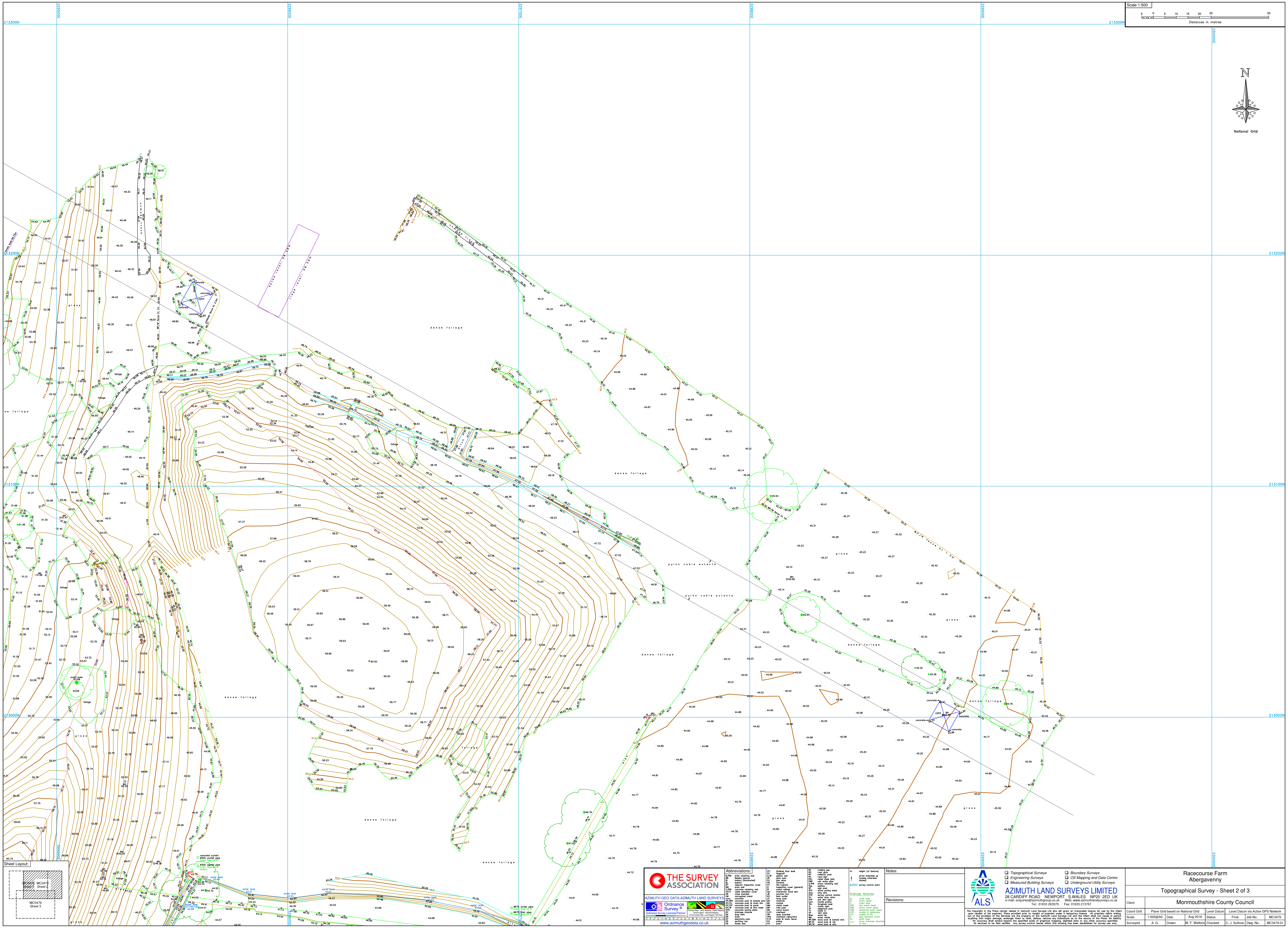
- Topographical Surveys
- Engineering Surveys
- Measured Building Surveys
- Boundary Surveys
- OS Mapping and Data Centre
- Underground Utility Surveys

AZIMUTH LAND SURVEYS LIMITED
28 CARDIFF ROAD NEWPORT S.WALES NP20 2ED UK
e-mail: enquiries@azimuthgroup.co.uk Web: www.azimuthlandsurveys.co.uk
Tel: 01633 263575 Fax: 01633 213767

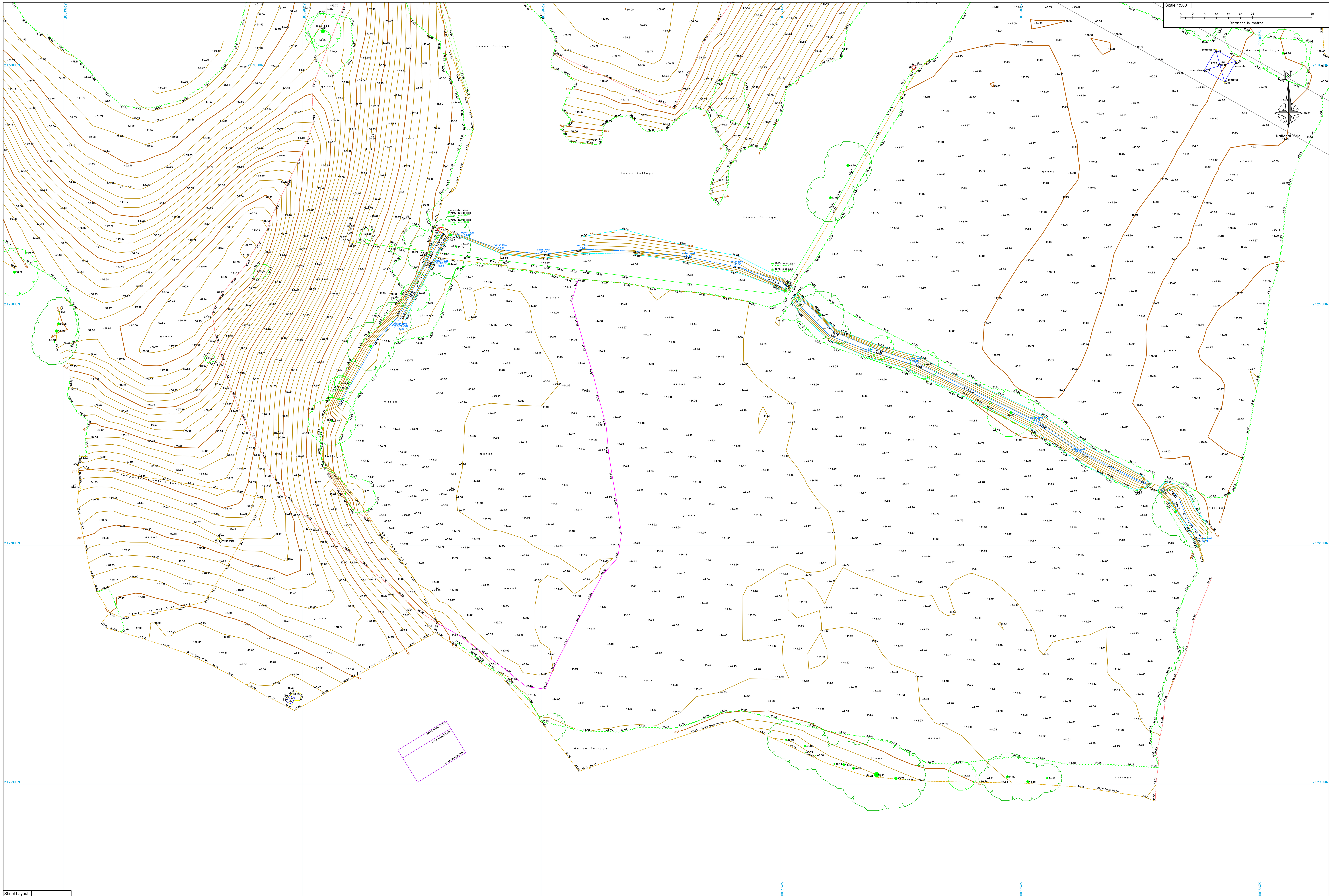
Racecourse Farm
Abergavenny

Topographical Survey - Sheet 1 of 3

Client	Monmouthshire County Council						
Coord Grid	Plane Grid based on National Grid			Level Datum	Level Datum via Active GPS Network		
Scale	1:500@A0	Date	Aug 2018	Status	Final	Job No.	MC3479
Surveyed	A. G.	Drawn	M. F. Watkins	Checked	C. J. Sullivan	Dwg. No.	MC3479-01



Scale 1:500
Distances in metres
National Grid
213300N
213200N
213100N
213000N
329900E
330000E
dense foliage
grass
pylon cable extents
Sheet Layout:
MC3479 Sheet 2
MC3479 Sheet 3
THE SURVEY ASSOCIATION
AZIMUTH GEO DATA-AZIMUTH LAND SURVEYS
Ordnance Survey
www.azimuthgeodata.co.uk
Abbreviations:
Notes:
Revisions:
Topographical Surveys
Engineering Surveys
Measured Building Surveys
Boundary Surveys
OS Mapping and Data Centre
Underground Utility Surveys
ALS
AZIMUTH LAND SURVEYS LIMITED
28 CARDIFF ROAD NEWPORT S.WALES NP20 2ED UK
e-mail: enquiries@azimuthgroup.co.uk Web: www.azimuthlandsurveys.co.uk
Tel: 01633 263575 Fax: 01633 213767
The Copyright in the Plans remain vested in Azimuth Land Surveys Ltd who will grant an irrevocable licence for use by the Client upon receipt of full payment. Plans provided prior to receipt of payment under a temporary licence. All propriety rights arising out of the provision of the Services are the property of the Azimuth Land Surveys Ltd and the Client shall not cause or permit anything that might damage, endanger them or alter, deface, remove any indications as to the source of the Plans. No liability for accuracy shall extend beyond the specified scale of graphical mapping, digitised data or any other accuracy specified. All services to be field verified. Any survey control issued within this drawing has been established for survey use only.
Racecourse Farm
Abergavenny
Topographical Survey - Sheet 2 of 3
Client
Monmouthshire County Council
Coord Grid
Plane Grid based on National Grid
Level Datum
Level Datum via Active GPS Network
Scale
1:500@A0
Date
Aug 2018
Status
Final
Job No.
MC3479
Surveyed
A. G.
Drawn
M. F. Watkins
Checked
C. J. Sullivan
Dwg. No.
MC3479-01



Topographical Surveys
Engineering Surveys
Measured Building Surveys
Boundary Surveys
OS Mapping and Data Centre
Underground Utility Surveys

AZIMUTH LAND SURVEYS LIMITED
28 CARDIFF ROAD NEWPORT S.WALES NP20 2ED UK
e-mail: enquiries@azimuthgroup.co.uk Web: www.azimuthlandsurveys.co.uk
Tel: 01633 263575 Fax: 01633 213767

Racecourse Farm
Abergavenny

Topographical Survey - Sheet 3 of 3

Client	Monmouthshire County Council						
Coord Grid	Plane Grid based on National Grid			Level Datum	Level Datum via Active GPS Network		
Scale	1:500@A0	Date	Aug 2018	Status	Final	Job No.	MC3479
Surveyed	A. G.	Drawn	M. F. Watkins	Checked	C. J. Sullivan	Dwg. No.	MC3479-01

Appendix C

Flood Consequence Assessment

Appendix D

Site Investigations

Appendix E

Surface Water Runoff Calculations

HYDROGEO Groundwater and Environment

Date 17/09/2020 12:45	Designed by Emma
File	Checked by
Innovyze	Source Control 2020.1

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	2
FEH Rainfall Version	2013
Site Location	GB 329459 212947 SO 29459 12947
Data Type	Point
Season	Summer
Country	England/Wales/Northern Ireland
Area (ha)	0.968
SAAR (mm)	1106
BFIHOST	0.757
FARL	0.000
SPRHOST	0.000
URBEXT (2000)	0.0000

Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	2.7	2.7
Q1	2.3	2.3
Q2	2.7	2.7
Q5	3.9	3.9
Q10	4.9	4.9
Q30	6.5	6.5
Q50	7.4	7.4
Q75	8.2	8.2
Q100	8.8	8.8
Q200	10.5	10.5
Q1000	17.6	17.6

Date 17/09/2020 12:43	Designed by Emma
File	Checked by
Innovyze	Source Control 2020.1

ReFH2 Greenfield Runoff Volume

Input

Return Period (Years)	100
Storm Duration (min)	360
FEH Rainfall Version	2013
Site Location	GB 329459 212947 SO 29459 12947
Data Type	Point
Season	Winter
Country	England/Wales/Northern Ireland
Area (ha)	0.968
SAAR (mm)	1106
BFIHOST	0.757
FARL	0.000
SPRHOST	0.000
URBEXT (2000)	0.0000

Results

Percentage Runoff (%)	13.05
Greenfield Runoff Volume (m^3)	74.029

Appendix F

SuDS Design

N

SCALE 1 : 1000

m 10 0 100 m

2.4m x

5.5m access road with asphalt concrete finish

Cycle parking (6 no. Sheffield stands)

3 no. shipping containers for secure storage

30m x 3m cellular gravel hardstanding warm up area

Car parking (cellular gravel) - 80 spaces including10 disabled and 11 longer spaces to accommodate vans

CAR PARK

Cycle parking (4 no. Sheffield stands)

Cycle parking (6 no. Sheffield stands)

Potential overspill parking within field for large events (approx. 110 spaces)

Potential overspill parking within field for large events (approx. 210 spaces)

Cutting slope 1:2 along this section

NORTH

NORTHERN ZONE 198 m³
AREA 395m²
SWALE 0.5m DEEP

Cut through

Cut through

HIGH POINT

Embankment slope 1:2 along this section

50m long 3m wide hardstanding

Start / finish line

WEST

WESTERN ZONE 328.2m³
AREA 656.4m²
SWALE 0.5m DEEP

SOUTH

SOUTHERN ZONE 245m³
AREA 490m²
SWALE 0.5m DEEP

Rev.	Date:	Notes:	By:
A	06.11.20	DRAINAGE UPDATED	AP

HYDROGEO
Groundwater and Environment

Job:	ABERGAVENY VELO PARK
Client:	MONMOUTHSHIRE COUNTY COUNCIL
Drawing Title:	INITIAL SuDS DESIGN
Date:	SEPTEMBER 2020
Drawing No:	HYG637-01 revision: A
Scale:	1:1000 @ A1
Drawn:	AP
Status:	

Appendix G

Attenuation Storage Calculations

HYDROGEO Groundwater and Environment

Micro Drainage

Date 30/10/2020 12:46	Designed by Emma
File Storage calcs (pond) FE...	Checked by
Innovyze	Source Control 2020.1

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1353 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	50.719	0.219	2.8	1.9	4.7	218.5	O K
30 min Summer	50.806	0.306	2.9	1.9	4.8	306.1	O K
60 min Summer	50.907	0.407	2.9	1.9	4.8	406.8	O K
120 min Summer	51.005	0.505	2.9	1.9	4.8	505.0	O K
180 min Summer	51.070	0.570	3.0	1.9	4.8	569.5	O K
240 min Summer	51.117	0.617	3.0	1.9	4.8	616.9	O K
360 min Summer	51.180	0.680	3.0	1.9	4.8	680.3	O K
480 min Summer	51.218	0.718	3.0	1.9	4.8	718.0	O K
600 min Summer	51.241	0.741	3.0	1.9	4.8	741.3	O K
720 min Summer	51.255	0.755	3.0	1.9	4.8	755.4	O K
960 min Summer	51.266	0.766	3.0	1.9	4.8	766.0	O K
1440 min Summer	51.254	0.754	3.0	1.9	4.8	754.2	O K
2160 min Summer	51.239	0.739	3.0	1.9	4.8	739.3	O K
2880 min Summer	51.229	0.729	3.0	1.9	4.8	729.4	O K
4320 min Summer	51.217	0.717	3.0	1.9	4.8	717.0	O K
5760 min Summer	51.210	0.710	3.0	1.9	4.8	710.2	O K
7200 min Summer	51.208	0.708	3.0	1.9	4.8	707.9	O K
8640 min Summer	51.209	0.709	3.0	1.9	4.8	708.9	O K
10080 min Summer	51.213	0.713	3.0	1.9	4.8	712.9	O K
15 min Winter	50.719	0.219	2.8	1.9	4.7	218.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	111.545	0.0	221.0	25
30 min Summer	78.393	0.0	306.1	39
60 min Summer	52.608	0.0	421.4	68
120 min Summer	33.300	0.0	533.3	128
180 min Summer	25.470	0.0	610.5	186
240 min Summer	21.017	0.0	669.1	246
360 min Summer	15.936	0.0	748.7	366
480 min Summer	13.001	0.0	783.0	484
600 min Summer	11.061	0.0	786.2	604
720 min Summer	9.671	0.0	783.9	722
960 min Summer	7.793	0.0	775.4	962
1440 min Summer	5.715	0.0	752.7	1288
2160 min Summer	4.238	0.0	1223.0	1668
2880 min Summer	3.461	0.0	1328.5	2056
4320 min Summer	2.642	0.0	1382.7	2900
5760 min Summer	2.213	0.0	1703.1	3752
7200 min Summer	1.949	0.0	1875.2	4608
8640 min Summer	1.771	0.0	2044.9	5448
10080 min Summer	1.644	0.0	2214.7	6256
15 min Winter	111.545	0.0	221.0	25

HYDROGEO Groundwater and Environment

Micro Drainage

Date 30/10/2020 12:46	Designed by Emma
File Storage calcs (pond) FE...	Checked by
Innovyze	Source Control 2020.1

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	50.806	0.306	2.9	1.9	4.8	306.2	O K
60 min Winter	50.907	0.407	2.9	1.9	4.8	407.0	O K
120 min Winter	51.006	0.506	2.9	1.9	4.8	505.5	O K
180 min Winter	51.070	0.570	3.0	1.9	4.8	570.3	O K
240 min Winter	51.118	0.618	3.0	1.9	4.8	617.9	O K
360 min Winter	51.182	0.682	3.0	1.9	4.8	681.8	O K
480 min Winter	51.220	0.720	3.0	1.9	4.8	720.1	O K
600 min Winter	51.244	0.744	3.0	1.9	4.8	744.1	O K
720 min Winter	51.259	0.759	3.0	1.9	4.8	758.9	O K
960 min Winter	51.271	0.771	3.0	1.9	4.8	771.2	O K
1440 min Winter	51.261	0.761	3.0	1.9	4.8	761.0	O K
2160 min Winter	51.236	0.736	3.0	1.9	4.8	736.2	O K
2880 min Winter	51.218	0.718	3.0	1.9	4.8	717.7	O K
4320 min Winter	51.181	0.681	3.0	1.9	4.8	681.0	O K
5760 min Winter	51.148	0.648	3.0	1.9	4.8	647.7	O K
7200 min Winter	51.119	0.619	3.0	1.9	4.8	618.7	O K
8640 min Winter	51.093	0.593	3.0	1.9	4.8	592.8	O K
10080 min Winter	51.070	0.570	3.0	1.9	4.8	570.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	78.393	0.0	306.1	39
60 min Winter	52.608	0.0	421.4	68
120 min Winter	33.300	0.0	533.3	126
180 min Winter	25.470	0.0	610.5	184
240 min Winter	21.017	0.0	669.1	242
360 min Winter	15.936	0.0	748.6	358
480 min Winter	13.001	0.0	782.8	476
600 min Winter	11.061	0.0	785.8	590
720 min Winter	9.671	0.0	783.5	706
960 min Winter	7.793	0.0	774.9	930
1440 min Winter	5.715	0.0	752.8	1360
2160 min Winter	4.238	0.0	1223.0	1712
2880 min Winter	3.461	0.0	1328.8	2168
4320 min Winter	2.642	0.0	1399.3	3116
5760 min Winter	2.213	0.0	1703.1	4032
7200 min Winter	1.949	0.0	1875.2	4904
8640 min Winter	1.771	0.0	2044.9	5792
10080 min Winter	1.644	0.0	2214.7	6656

HYDROGEO Groundwater and Environment

Micro Drainage

Date 30/10/2020 12:46	Designed by Emma
File Storage calcs (pond) FE...	Checked by
Innovyze	Source Control 2020.1

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 329459 212947 SO 29459 12947
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.802

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.355	4	8	0.355	8	12	0.092

Model Details

Storage is Online Cover Level (m) 52.000

Infiltration Basin Structure

Invert Level (m) 50.500 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.02000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1000.0	1.500	1000.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2700-2000-2700
Design Head (m)	2.000
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	50.500
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.7
Flush-Flo™	0.289	1.9
Kick-Flo®	0.594	1.6
Mean Flow over Head Range	-	2.0

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	1.6	1.200	2.1	3.000	3.3	7.000	4.8
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.0
0.300	1.9	1.600	2.4	4.000	3.7	8.000	5.2
0.400	1.9	1.800	2.6	4.500	3.9	8.500	5.3
0.500	1.8	2.000	2.7	5.000	4.1	9.000	5.4
0.600	1.6	2.200	2.8	5.500	4.3	9.500	5.6
0.800	1.8	2.400	2.9	6.000	4.5		
1.000	2.0	2.600	3.0	6.500	4.7		

Appendix H

Planting Plan

Notes:

1. The copyright of the drawing is vested in Element Urbanism LLP and it may not be reproduced in whole or part of used for the manufacture of any artclue with express permission of the copyright holder.
2. Work to figured dimensions only.
3. This drawing to be read in conjunction with relevant drawings and specifications.

Planting Schedule

Existing Trees Retained
(Root Protection Area dotted line)

Proposed Tree Planting Species

Species		*Ht*	*Spec*	*Form*
Acer campestre (Ac)	MS 3	3.5-4.0m	CG/DS	Feathered
Quercus robur (Qr)	18-20	3.5-4.0m	CG/DS	Feathered

Proposed Native Structure Planting
(1 plant per 1.5m² planted in random groups of 5-10 per species)

Species	*Ht*	*Spec*	*Form*
15% Acer campestre	100-125cm	BR 1+2	3brks
15% Corylus avellana	100-125cm	BR 1+2	3brks
10% Crataegus monogyna	100-125cm	BR 1+2	3brks
15% Ilex aquilifolium	60-80cm	3L	Leader/Laterals
10% Malus sylvestris	100-125cm	BR 1+2	3brks
15% Prunus avium	100-125cm	BR 1+1	2brks
10% Quercus robur	100-125cm	BR 1+2	3brks
10% Viburnum opulus	100-125cm	BR 1+2	3brks

Proposed Native Hedge Planting (New & Infill Areas)
(5 plants per linear metre, double staggered row 300mm apart)

Species	*Ht*	*Spec*
15% Acer campestre	100-125cmHt	(1+1) BR
20% Corylus avellana	100-125cmHt	(1+1) BR
35% Crataegus monogyna	100-125cmHt	(1+1) BR
20% Ilex aquifolium	60-80cm Ht	3L
10% Prunus spinosa	60-90cm Ht	(1+1)BR

Proposed Amenity Grass

Wildflower Meadow: Slopes
Special General Purpose Meadow Mixture EM3 by Emorsgate Seeds or sim/app.
(Supplemented by plugs from Monmouthshire Meadows Group approved supplier)

Wildflower Meadow : Swale
Meadow Mixture for Wetlands EM8 by Emorsgate Seeds or sim/app.
(Supplemented by plugs from Monmouthshire Meadows Group approved supplier)

Groundcover Planting Mix : Car Park
(Planted at a density of 5/m²)

Matrix Species (65% of be - min groups 5 plants per species)

Species	*Ht*	*Spec*	*Density*
Ajuga reptans (20%)	20-30cm	1.5L	5/m²
Carex muskingumensis (20%)	20-30cm	1.5L	5/m²
Galium odoratum (10%)		1.5L	4/m²
Geranium Cantabrigiense 'H' (10%)	20-30cm	1.5L	5/m²
Persicaria affinis (20%)	20-30cm	1.5L	
Vinca minor (20%)	20-30cm	1.5L	5/m²

Accent Species (35% of bed: Equal proportions scattered)

Aquilegia vulgaris	1.5L	5/m²
Dryopteris filix-mas (10%)	1.5L	5/m²
Persicaria bistorta (15%)	1.5L	5/m²
Polystichum setiferum	1.5L	4/m²
Polypodium vulgare	1.5L	4/m²
Rudbeckia hirta	1.5L	5/m²
Veronicastrum virginicum	1.5L	5/m²

Habitat Creation
Provision of insect hotels & hibernacula

Timber Benches
Woodscape or sim/app

Amphibian Tunnels
(Refer to Ecologist's Details)

REV:	DESCRIPTION:	BY:	DATE:

STATUS: PLANNING ISSUE

ELEMENT
URBANISM & LANDSCAPE

CLIENT:
Monmouthshire Council
County Hall
The Rhadyr, Usk
Monmouthshire, NP15 1GA

CONSULTANT:
Element Urbanism
Wyastone Business Park
Monmouth
NP25 3SR

SITE:
Abergavenny Velo Park

TITLE:
Illustrative Landscape Masterplan

SCALE AT A1/A3:	DATE:	DRAWN:	CHECKED:
1:1000/1:2000	25/10/20	JS	ES
PROJECT NO:	DRAWING NO:		REVISION:
1517	1521-101		/

IllUSTRATIVE LANDSCAPE MASTERPLAN

1:1000 @ A1

Planning Title Sheet.dwg

14.10.2003