SBK

Flood Consequence Assessment And Sustainable Drainage Strategy

Plot 1C Llantarnam Industrial Park
Cwmbran

July 2024

SBK-23-258-FCA-001

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Dated:	05.07.24
Revision:	P01

SBK

CONTENTS

APPENDICES

1.00 INTRODUCTION

1.01 SBK was commissioned by Opus Land Ltd on behalf of MGTS St John High Income Property ICVC Bank of New York Mellon (International) Ltd (the 'Applicant') to prepare a Flood Consequence Assessment and Sustainable Drainage Strategy for the outline planning application for a new development in Cwmbran.

1.02 The Flood Consequence Assessment will be part of a planning application to be made to Torfaen County Borough Council (Bwrdeistref Sirol Torfaen).

1.03 The proposed development is for a planning application comprising the erection of a new build, two-storey unit for use class B1/B2/B8 to provide operational/warehousing space, office accommodation and associated yards and parking (the 'Proposed Development'), located at Plot 1C Llantarnam Industrial Park, Cwmbran, Torfaen, NP44 3SE.

1.04 The development lies entirely within Flood Zone 1 (Low) with the eastern boundary immediately adjacent to Flood zones 2 (Medium) and 3 (High).

1.05 This Flood Consequence Assessment follows government and local guidance on development and flood risk (Planning Policy Wales[1]) and is undertaken in consultation with the relevant bodies. Further reference is made to Technical Advice Note 15[2] (TAN 15), although currently suspended pending further consultation.

1.06 The primary objective of the Flood Consequence Assessment is to develop a full appreciation of:

- The risk and consequence of flooding on the development.
- The risk and consequence (i.e. the overall impacts) of the development on flood risk elsewhere.

1.07 All new developments of more than one dwelling or where the area covered by construction works equals or exceeds 100m^2 also require approval from the SuDS Approval Body (SAB) before construction can commence.

1.08 The general limitations of this assessment are that:

- A number of data sources have been used in compiling this report. Whilst SBK believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
- This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.

[1] Welsh Government, February 2024, Planning Policy Wales Edition 12
[2] Welsh Government, December 2021, Technical Advice Note 15, Development, flooding and coastal erosion.

- This report has been written with a planning application in mind and it therefore does not include detailed design information and is not suitable for construction purposes.

2.00 SITE LOCATION AND DESCRIPTION

2.01 The development site is at Plot C1 Llantarnam Industrial Park, Cwmbran, Torfaen, NP44 3SE. The Ordnance Survey National Grid reference to the centre of the site is E:329937, N:193014.

2.02 The neighbouring land use is as follows:

- North Industrial premises
- East Dowlais Brook and Llantarnam Park Way
- South Industrial premises.
- West Offices and open land.

2.03 A Google Map screenshot of the site location is shown below in Figure 1. A location plan can be found in **Appendix 1**.

Figure 1 - Site location with approximate red line boundary (source Google Maps ©2024)

2.04 The site comprises an undeveloped coarse vegetated plateaued plot with a road access point to the west, set amongst adjacent industrial developed plots.

2.05 The site is largely flat at a level of approx. 40.5m AOD, but falls steeply down to the Dowlais Brook at approx. 33.5m AOD immediately east of the site boundary. A topographical survey of the site undertaken by Greenhatch Group can be found in **Appendix 2**.

2.06 The nearest watercourse to the site is the Dowlais Brook which is immediately east of the site boundary, at lower level. A swale and open basin are present east of the brook serving the Llantarnam Park Way. The brook ultimately discharges into the Afon Lwyd River 2.5km east of the site.

3.00 DEVELOPMENT PROPOSALS

3.01 The development is subject to an outline planning application. Pre-application advice has been sought under reference 23/PE/0431/PREAPP. Reference should be made to the Design and Access Statement for further detail on the planning application.

3.02 The proposed development is for the erection of a new build, two-storey unit for use class B1/B2/B8 to provide operational/warehousing space, office accommodation and associated yards and parking.

3.03 Figure 2 below shows an indicative development layout. The full suite of parameter plans can be found in **Appendix 3**.

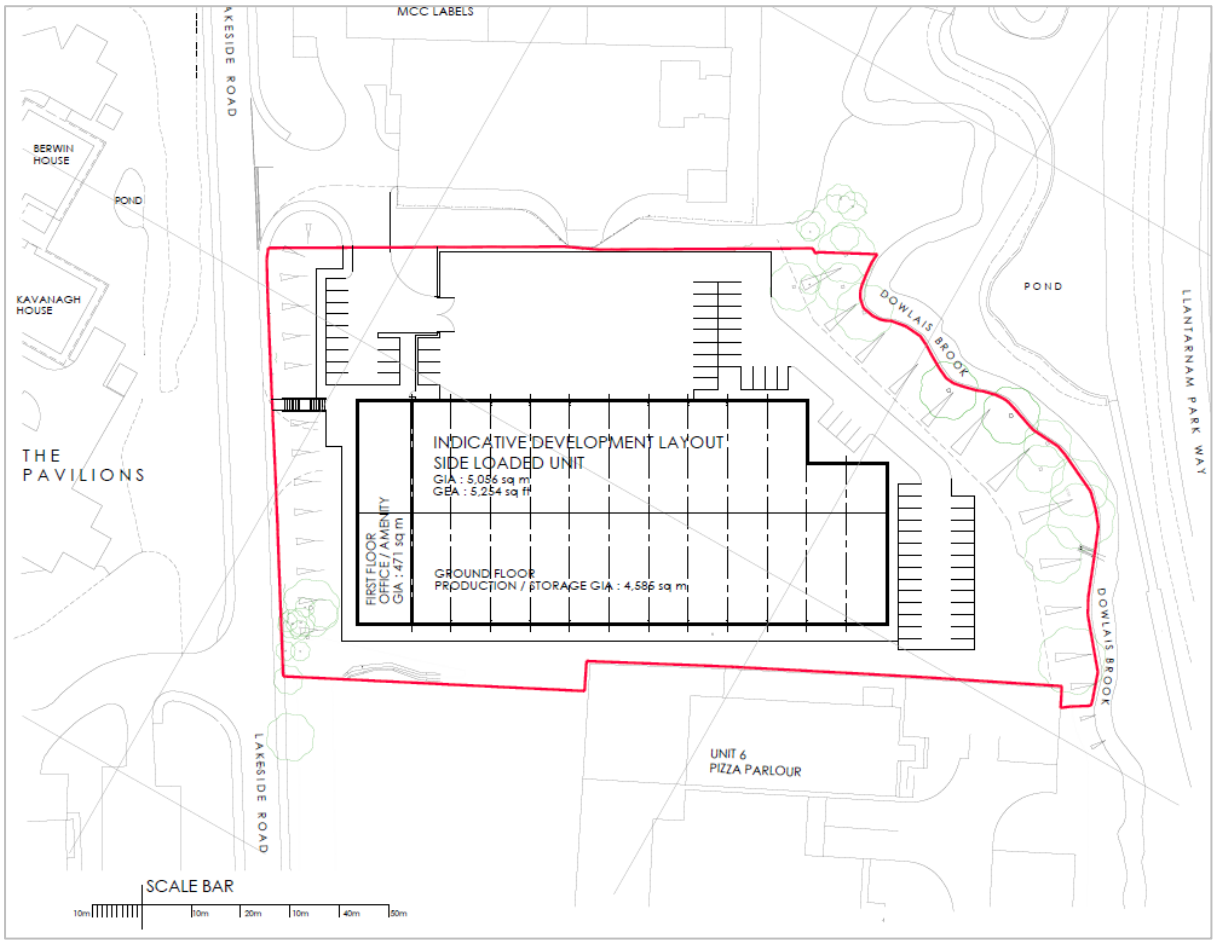


Figure 2 – Indicative Development Layout (by Garrett McKee Architects)

4.00 EXISTING GROUND CONDITIONS

4.01 Site Geology and Hydrology

4.01.1 At the outline stage no physical site investigation has been undertaken.

4.01.2 Reference has been made to BGS borehole data[3] for adjacent development sites for identification of anticipated below ground geology.

4.02 Ground Conditions

4.02.1 Ground Geology

- General Fill/Made Ground to 0.5m depth
- Silty Clay to 3.0m depth
- Hard Friable Mudstone to depth

4.02.2 Hydrogeology (subsurface water features)

The site is located in a Secondary A Aquifer Zone that may support local water supplied, but is not in a source protection zone.

4.02.3 Soakaway Design

Given the presence of clay and mudstone as the primary strata on the site, infiltration is not anticipated to be a viable means of water disposal.

4.02.4 Hydrology (surface water features)

- The nearest watercourse to the site is the Dowlais Brook which is immediately east of the site boundary, at lower level.
- A swale and open basin are present east of the brook serving the Llantarnam Park Way.
- The brook ultimately discharges into the Afon Lwyd River 2.5km east of the site.
- There are no known structures immediately in the vicinity of the site which may influence local hydraulics.

[3] British Geological Survey, BGS ST29SE32, ST29SE98, ST39SW348.

5.00 CONSULTATION AND POLICY

5.01 Drainage Authority

5.01.1 Welsh Water (Dwr Cymru) Sewer records have been obtained and indicate a foul water sewer in the estate road. Refer to **Appendix 4** for records.

5.02 Private Drainage

5.02.1 Site survey has identified an existing 600mm diameter storm pipe passing through the northern edge of the plot discharging via a headwall into the Dowlais Brook at an invert of approximately 34.36m AOD.

5.02.2 Visual evidence indicates that there is a 150mm diameter pipe passing within the adjacent site along the far south boundary, discharging at high level into the Dowlais Brook within the proposed sites boundary extents.

5.03 Local Government

5.03.1 The Local Government is the Welsh Government (Llywodraeth Cymru). The latest Planning Policy was published in February 2024.

5.03.2 Additional guidance is given by Technical Advice Note 15 (TAN 15) however this is currently suspended subject to further consultation.

5.04 Local Planning Authority

5.04.1 The Local Planning Authority is Torfaen County Borough Council (TCBC) (Cyngor Bwrdeisdref Sirol Torfaen).

5.04.2 TCBC have published a Local Development Plan[4] (LDP) to 2021. A revised plan is currently under consultation and it has therefore been presumed that the recommendations of the 2013 plan remain current.

5.04.3 The site is identified in the LDP as employment land reference EET 1/4.

5.04.4 Within the LDP policies S2 Sustainable Development and S3 Climate Change are most applicable to this report. Key considerations of these policies are:

- Reduce surface water run-off and flood risk through the use of Sustainable Drainage Schemes (SuDS) unless uneconomic or impractical.
- Promote water efficiency by reducing water demand.
- Explore opportunities to maintain habitat connectivity.

[4] Torfaen County Borough Council, December 2013, Local Development Plan

5.05 Lead Local Flood Authority

5.05.1 The Lead Local Flood Authority (LLFA) is TCBC.

5.05.2 TCBC have published a Local Flood Risk Management Strategy[5] which defines flooding and drainage requirements.

5.05.3 Key items within the Strategy are:

- Social - Reduce distress, community disruption, risk to life and disruption to critical infrastructure.
- Economic – Reduce economic damage and cost of management.
- Environment – Reduce damage to conservation, nature and geological sites, improve naturalness and improve water quality.

5.05.4 TCBC have also published a Section 19 Flood Investigation Report[6] for the area of the site. This focusses on major flood events in 2014 and actions arising from them. Key findings of this report are:

- The steep sided nature of valleys in the area contributed to the rate of water concentration during the storm events.
- The storm was in excess of 1 in 100 year event and therefore extremely rare.
- Various culverts along Dowlais Brook were directly responsible for area of flooding due to being overloaded and potentially blocked by debris in the storm.
- As a result any changes to Dowlais Brook must be agreed with LLFA so as not to increase risk of debris runoff.

5.06 Natural Resources Wales

5.06.1 Natural Resources Wales (NRW) (Cyfoeth Naturiol Cymru) identifies Dowlais Brook to be classified as Main River at the point adjacent to the development site.

5.06.2 Flood mapping data for the site (subject to formal adoption of TAN15), shows the developable area to be within the lowest category of flood risk. The site however borders directly onto medium and high risk areas associated with the Dowlais Brook.

[5] Torfaen County Borough Council, July 2013, Local Flood Risk Management Strategy
[6] Torfaen County Borough Council, September 2014, Flood and Water Management Act 2010 Section 19 Flood Investigation Report - Cwmbran

5.07 SuDS Approval Body

5.07.1 TCBC use Caerphilly County Borough Council (CCBC) (Cyngor Bwrdeistref Sirol Caerffili) to undertake their SuDS Approving Body (SAB) role.

5.07.2 CCBC make reference to the Welsh Government Statutory Standards for Sustainable Drainage Systems[7]. This document details the principles and six standards required to be met for a development in Wales. These principles can be summarised as:

- Manage surface water as close to source as possible.
- Ensure pollution is prevented at source.
- Manage rainfall to prevent increased flood risk including future allowances.
- Use a SuDS Management Train.
- Maximise benefits for amenity and biodiversity.
- Take into account long term maintenance costs.

5.07.3 Pre-application advise has been sought for this scheme from CCBC application number 24/0039/TCBC in March 2024. Refer to **Appendix 5** for a copy of the response.

5.07.4 The advice will be incorporated into future detailed planning application or reserved matters submissions, and inform a full SAB application process at the appropriate time.

[7] Welsh Government, 2018, Statutory Standards for Sustainable Drainage Systems – designing, constructing, operating and maintaining surface water drainage systems.

6.00 FLOOD CONSEQUENCE

6.01 An appraisal was made of the site and surrounding areas to assess the potential consequences of flooding at the site from the various sources:

6.01.1 Sea (Tidal) and River (Fluvial) – Online flood mapping indicates the site to be located within Flood Zone 1. Flood Zone 1 is defined as having a low probability of flooding, less than 1 in 1000 annual probability of river or sea flooding. Therefore the site is at negligible risk of tidal and fluvial flooding, nor will it increase risk off site.

The area immediately adjacent to the east of the site is within Flood Zone 2 (Medium) and Flood Zone 3 (High). It is not proposed to develop in this area, with ground level to remain as existing. Therefore there will be no increase in risk off site.

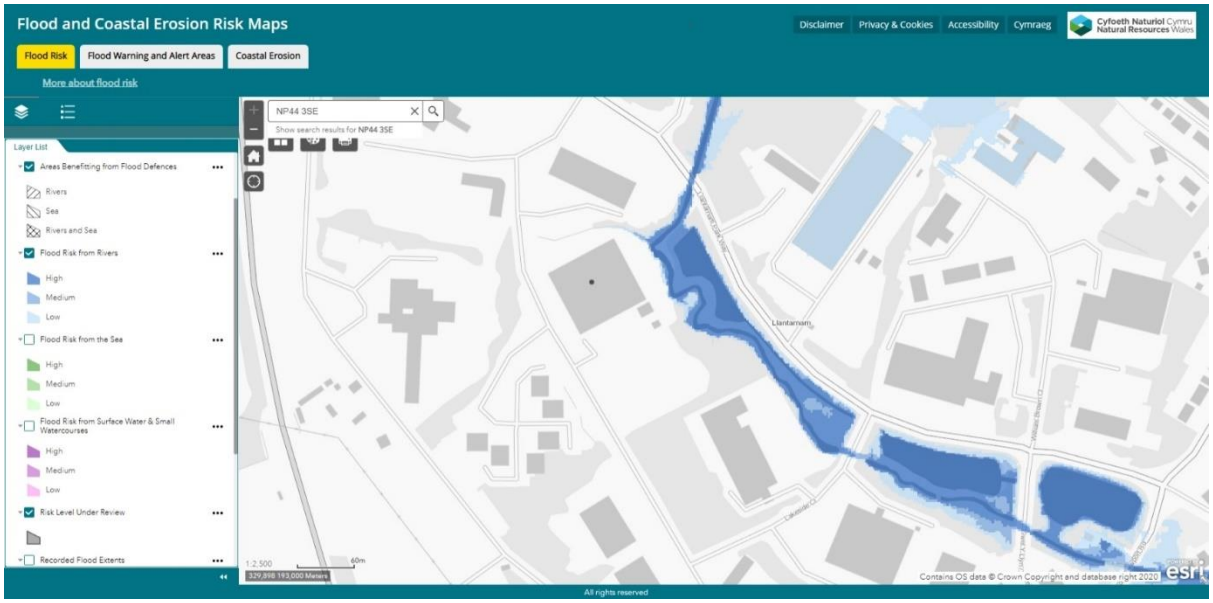


Figure 3 - Flooding from Rivers or Seas

6.01.2 Surface (Pluvial) – Online flood mapping plans indicate that there is no current flood risk from overland flow. The site has been plateaued for future development and future development levels will ensure surface water flows are directed away from any building and controlled safely on site. Therefore the site is at negligible risk of pluvial flooding nor will it increase risk off site.

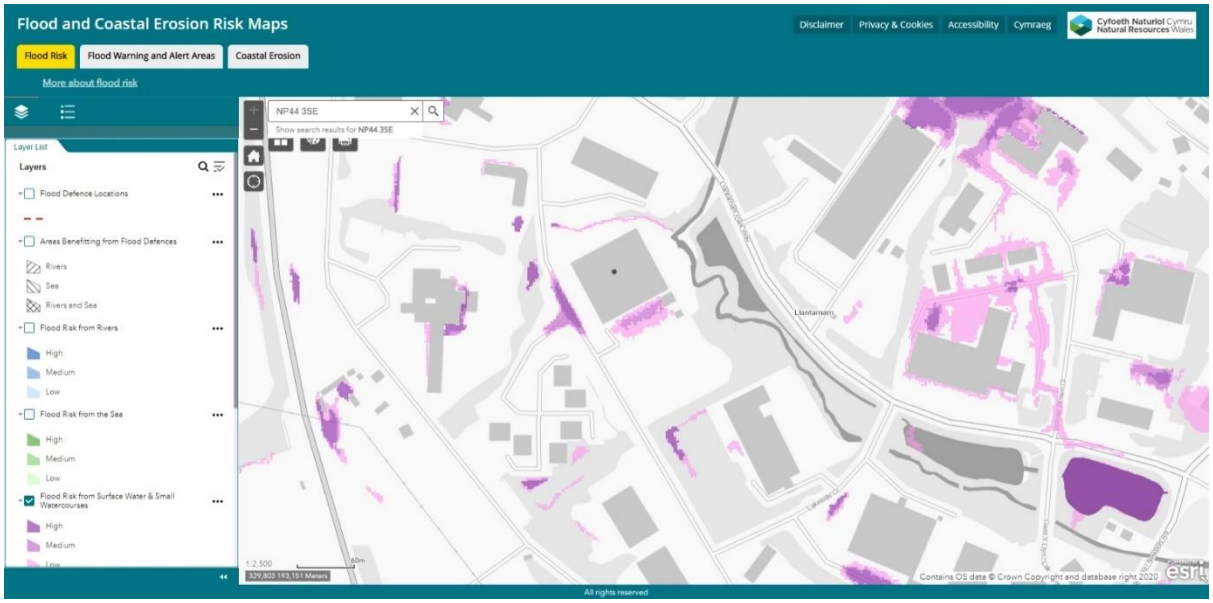


Figure 4 - Flooding from Surface Water

6.01.3 Sewers – There is no record of sewer flooding on the development plot. The proposed drainage will be designed in accordance with best practice and industry guidance; therefore there will be negligible risk of flooding from sewers. Discharge rates will be restricted to a greenfield equivalent and therefore pose no increased risk off site.

6.01.4 Groundwater – Groundwater levels are anticipated to be at a level equivalent to the adjacent Dowlais Brook water level, some 7m below proposed ground level. Therefore the site is at negligible risk of groundwater flooding nor will it increase risk off site.

6.01.5 Artificial Sources – There are no major artificial sources of water such as retained waterbodies in the vicinity of the site and therefore flood risk is considered to be negligible form artificial sources, with no increased risk off site.

6.01.6 Breach of Defences – The Dowlais Brook does not have any flood defences in the vicinity of the site, therefore no assessment of the consequence of a breach is required.

Table 1 - Flood Consequence Assessment Summary

Aspects of Flood Consequence	Assessment/Comment
Area liable to flooding	The development site lies almost entirely within Flood Zone 1 (Low) of the Natural Resources Wales Flood Zone Mapping. Areas to the immediate east fall into Flood Zones 2 and 3, but are not to be developed.
Probability of flooding occurring	Flooding from surface water at the site will be considered during the level and drainage design.
Standard of existing flood defences and their effectiveness	No existing defences present.
Likely depth of flooding	N/A
Rates of flow likely to be involved	N/A
Likelihood of impacts to other areas, properties and habitats	Any increase in the surface area, SuDS will be used for surface water management.
Effects of climate	The effects of climate change on flooding at the site are likely to be limited, due to the use of SuDS techniques and the system will be designed for 1 in 100 year storm event plus 40% climate change.

6.02 Justification Test

6.02.1 The Justification Test is not applicable as the developable site area is located in Flood Zone 1 and the proposed site use is in the less vulnerable development category.

6.02.2 Peak flood depths and extents are not therefore required as part of this assessment.

7.00 SUSTAINABLE DRAINAGE PROPOSALS

7.01 Storm Water Management and SuDS

7.01.1 Sustainable Drainage Systems (SuDS) involve the management of storm water from developments effectively in order to reduce the impact of run-off both to the site in question and properties downstream, and not to exacerbate existing problems. This is achieved by not increasing peak flows that will otherwise result from the development. The philosophy of SuDS is to mimic as closely as possible, the natural drainage from a site before development, and to ensure that storm water runoff is treated so there is no detriment to water quality of the receiving watercourse.

Using SuDS may provide water quantity and quality control, as well as increased amenity value. Appropriately designed and maintained schemes may improve the sustainable water management at the site by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing the volume, rate of discharge, and the frequency of water flowing directly to watercourses or sewers from the developed sites.
- Improving water quality compared with conventional surface water sewers by removing pollutants.

7.01.2 The following section represents the considered views on suitable SuDS options appropriate to this site as part of the outline illustrative masterplan. Both the Welsh Government Statutory Standards for Sustainable Drainage Systems and CIRIA C753[8] The SuDS Manual were consulted to examine the use of SuDS on this site. Conclusions are based on the assessment of the site and the evaluation of the relevant design requirements and regulatory consultation.

7.02 Potential SuDS Techniques Considered for this Site

7.02.1 Green and Blue Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.

The sloping roof of traditional portal frame structures associated with the use class intended for the site does not lend itself to the introduction of green or blue roof provision.

Not recommended for the site.

[8] CIRIA, 2016. The SuDS Manual C753

7.02.2 Rainwater Harvesting

Rainwater harvesting is the collection of surface water from roof structures into storage tanks, from where the water can then be used in processes on site. This both helps to control surface water discharge, and also reduce potable water demand for the site.

The intended site usage is not anticipated to require significant water demand, and as such directing all of the roof areas to such systems would be unviable. However collection of proportions of the roof for reuse as grey water in on site welfare facilities may be viable subject to the end user.

Recommended and proposed for small roof catchment areas and welfare facility processes only.

7.02.3 Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, precast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular geocellular units. Soakaways provide storm water attenuation, storm water treatment and groundwater recharge.

Infiltration testing has not yet been undertaken on site, but the anticipated underlying clay and mudstone strata would not be expected to be compatible with widescale infiltration.

Not viable for the site.

7.02.4 Swales and Gravel Land Drains

Swales are open linear vegetated drainage features and land drains are linear drainage features containing open graded stone, in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the storm water runoff to settle out, thus providing effective pollutant removal. Roadside swales can replace conventional gullies and drainage pipes.

Both swales and land drains are have been incorporated into the landscape design and will reduce the run-off rates, volumes and offer water quality enhance and biodiversity corridors.

Recommended and proposed for the site.

7.02.5 Pervious Pavements

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored between infiltration to the ground, reuse or discharge to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment.

The wider industrial use yard is inappropriate for permeable surfacing due to the heavy duty nature of usage. However the parking areas will utilise permeable block pavement, to attenuate water and enhance water quality.

Recommended and proposed for the site in areas of lighter vehicle use such as parking.

7.02.6 Geo-cellular/Modular Systems

Modular plastic geo-cellular systems with a high void ratio that can be used to create a below ground storage structure.

Modular tanks can be used for runoff attenuation but requires silt trap protection and a suitable means of access for cleaning and inspection.

Recommended and proposed for the site where additional attenuation not provide by other means is needed.

7.02.7 Ponds/Infiltration Basin

Ponds can provide both storm water attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline. Run off from each rain event is detained and treated in the pool. The retention time promotes removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations.

The developable area does not lend itself to large open water features, with the loss of land making the site uneconomical to develop.

Not recommended for the site.

7.03 Sustainable Drainage Maintenance

7.03.1 In accordance with SAB Standard S6 – Design of Drainage for Construction and Maintenance and Structural Integrity, the various SuDS features will remain privately owned and be maintained by the Development's Maintenance team. The exact details of this arrangement will be defined with the future development.

7.03.2 The SuDS operation and maintenance strategy will be in accordance with CIRIA C753 best practice, as tabled below:

Table 2– SuDS Operation and Maintenance Requirements

Type of maintenance	Details	Frequency	Duration	Large plant required	Cost
Routine maintenance	Inspect flow control chamber for evidence of poor operation.	Monthly for 3 months then annually.	1hr	✗	Low
	Remove debris from catchment surface.	Monthly	2hr	✓	Low
	Remove sediment from catch-pits, flow control sumps, swales. Remove oil and silt from interceptors.	Annually, or as required by inspection	0.5 day	✓	Medium
Remedial actions	Replace malfunctioning flow control parts.	As required	1 day	✓	High
Monitoring	Inspect all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually	0.5 day	✗	Low
	Weed and re-sand joints of permeable block paving	Annually	0.5 day	✗	Low
	Survey inside of attenuation tanks for sediment build up and remove if necessary.	Every 5 years or as required by inspection.		✓	Medium

8.00 DRAINAGE STRATEGY – SURFACE WATER

8.01 Drainage Strategy

8.01.1 The SAB Standard S1 – Surface Water Runoff Destination, outlines the surface water drainage discharge hierarchy to be as follows:

1. Into the ground (infiltration);
2. To a surface water body;
3. To a surface water sewer, highway drain, or another drainage system;
4. To a combined sewer.

8.01.2 The underlying clay and mudstone strata is not anticipated to be suitable for widescale infiltration.

8.01.3 The adjacent Dowlais Brook therefore serves as the ideal source of discharge for the site. Reuse of the existing 600mm diameter outfall will remove the need to undertaken intrusive works in the river bank area.

8.02 Proposed Surface Water Runoff Rate

8.02.1 The SAB Standard S2 – Surface Water Runoff Hydraulic Control recommends that discharge rates are limited to be as close to greenfield runoff equivalent values as practical.

8.02.2 Based on the Modified Rational Method the existing site areas theoretical brownfield run-off rate is estimated to be 181 l/s in the 50mm/hour intensity storm.

8.02.3 Greenfield runoff rate for the site has been calculated using IH124 Methodology for the 1.31ha site. The results are contained below in Table 3.

Table 3– Greenfield Runoff Rates

Return Period	Greenfield Runoff Rate (l/s)
Q_{bar}	4.18
1 in 1 year	3.68
1 in 30 year	7.43
1 in 100 year	9.10

8.02.4 It is proposed to discharge at the Q_{bar} rate of 4.1 l/s in up to the 1 in 100 + climate change event.

8.02.5 The design life for the development will be up to 75 years. Based on UK Government Climate Change Allowances[9] table 2, the peak rainfall intensity for the upper estimate should be 40%.

8.02.6 The proposed discharge rate of 4.1 l/s offers a betterment of more than 97% when compared to the theoretical brownfield run-off rate.

8.02.7 The greenfield discharge volume for the site has been calculated as 279m^3 based on a 6 hour 1 in 100 year storm. The proposed discharge volume from site will not exceed this value.

8.03 Attenuation and Flood Storage Volumes

8.03.1 Attenuation is provided via a combination of open swales, oversized gravel land drains and permeable paving. Below ground tank structures will only be utilises to accommodate any excess volume required.

8.03.2 No flood storage volumes are required as no development is taking place outside of Flood Zone 1 areas.

8.04 Water Quality

8.04.1 In accordance with SAB Standard S3 – Water Quality, a SuDS treatment train has been included in the proposed drainage strategy. In hardstanding areas this will aim to control the first 5mm event runoff on site.

- Yards will be drained via gravel filter drains, swales and a full retention class 1 oil interceptor.
- Parking areas will be drained via pervious paving, and swales prior to discharge
.
- Roof areas drain to open swales prior to discharge. Selected roof areas will drain to rainwater harvesting systems as determined by the end user demand.
- An emergency closure value will be fitted prior to the final outfall, to enable full lockdown of the site in the event of a major pollution event, and prevent contamination of the site system in the event of flooding of the Dowlais Brook.

8.05 Exceedance Flows and Evacuation Routing

8.05.1 Site levels will be developed to ensure that levels fall away from any building. Exceedance flows will thus be directed away from the building and be directed to the perimeter land drains and swales, where they can be controlled until discharge is possible.

[9] Welsh Government Planning Policy Branch, September 2021, Flood Consequence Assessments: Climate Change Allowances,.

8.05.2 No evacuation routes are required as the site is not at risk of flooding. Access to and from the site in an emergency will be via the Lakeside estate road.

8.06 Hydraulic Calculations

8.06.1 SBK have prepared a surface water strategy drawing based on the indicative design to demonstrate viability of the scheme. Refer to **Appendix 6** for this design.

8.06.2 Supporting hydraulic calculations for a full range of return periods and durations are included for this indicative design. Refer to **Appendix 7** for these calculations.

9.00 DRAINAGE STRATEGY – FOUL WATER

9.01 The proposed foul drainage strategy is to utilise the existing foul sewer in Lakeside (Glanllyn) Road.

9.02 A formal S106 connection approval will need to be sought from Welsh Water.

10.00 CONCLUSIONS

10.01 SBK was commissioned by Opus Land Ltd on behalf of MGTS St John High Income Property ICVC Bank of New York Mellon (International) Ltd (the 'Applicant') to prepare a Flood Consequence Assessment and Sustainable Drainage Strategy for the outline planning application for a new development in Cwmbran.

10.02 The Flood Consequence Assessment will be part of a planning application to be made to Torfaen County Borough Council.

10.03 The proposed development is for a planning application comprising the erection of a new build, two-storey unit for use class B1/B2/B8 to provide operational/warehousing space, office accommodation and associated yards and parking (the 'Proposed Development') located at Plot 1C Llantarnam Industrial Park, Cwmbran, Torfaen, NP44 3SE.

10.04 Foul water will discharge into an existing foul sewer in the estate road.

10.05 Surface water will be restricted to the greenfield runoff rate of 4.1 l/s, and discharge to the adjacent Dowlais Brook using an existing 600mm diameter outfall and headwall.

10.06 Surface water will be designed to cater for storm events up to 1 in 100 plus 40% climate change.

10.07 Soakaways and infiltration techniques are not suitable for the site due to the underlying clay and mudstone strata anticipated to be present.

10.08 The use of sustainable drainage systems (SuDS) has been considered and can be incorporated within the design in accordance with Welsh Government Statutory Standards for Sustainable Drainage Systems.

10.09 A SAB Pre-Application has been submitted and the resulting comments will be incorporated into any subsequent detailed planning or reserved matters applications, alongside a full SAB application at the appropriate time.

10.10 The development is classified as low vulnerability usage and the area of the site to be developed is in Flood Zone 1 and the Justification Test is not therefore applicable.

10.11 The site does not pose any increased flood risk to the site itself or adjacent developments and is not susceptible to flooding by other techniques.

10.12 This report has been prepared to meet the requirements of Planning Policy Wales and TAN 15 (currently suspended pending further consultation).

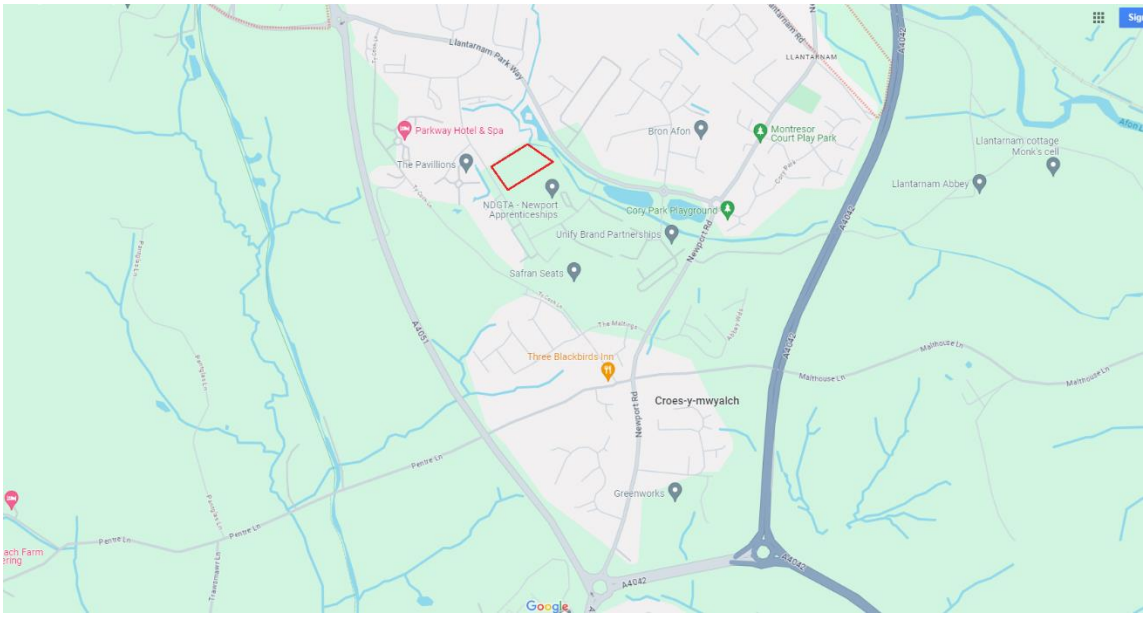
APPENDICES

Appendix 1 – Location Plan and Aerial View

SBK

SBK-23-258
Plot 1C Llantarnam Park, Cwmbran

Location Plan



Google Map Data ©2024

Appendix 2 – Topographical Survey

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OS Note:

Surveyed Buildings

This survey has been orientated to the Ordnance Survey (O.S) National Grid OSGB36(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSGB36 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Legend:

Buildings, Wall, Kerb line, Line marking, Drop kerb, Centre line, Top of bank, Station and Name, Station Level, Tree / Bush / Sapling, Area of Undergrowth, Woodland, Ridge Level, Eaves Level, Flat Roof Level, Gate

Fence types: FW Interwoven; IR Iron Railings; WM Wire Mesh; PR Post & Rail; PW Post & Wire; CL Chain Link; WP Wooden Panels; CB Close Boarded; SP Steel Palisade

Overhead Cable, Concrete edge, Tarmac edge, Grass verge, Canopy/Overhang, Verge, Bottom of bank

CVR Cover (generic), IC Inspection chamber, Pinv Pipe invert, Gy Gully, Bg Back gully, Dp Down pipe, Pipe Pipe above ground, MH Manhole, WL Water level, Fl Flood light, Lp Lamp post, Tp Telegraph post, Ep Electricity post, Tl Traffic light, Bus Bus stop, Sv Stop valve, Sl Stop tap, Er Earth rod, Wm Water meter, Gas Gas valve, Av Air valve, ICU Unidentified inspection, Wo Wash out, Re Rodding eye, BB Beliaha beacon, CTV Cable tv, Mkr Marker post, Gmkr Gas marker post, Sn Soffit, Fh Fire hydrant

D/Duct Drainage duct, Bo Bollard, Bl Illuminated bollard, Bin Rubbish bin, Vp Vent pipe, Gri Ground light, Lbox Letter box, Stmp Tree Stump, Sty Stile, IFL Internal floor level, THL Threshold level, Sp Sign post, TH Trialhole, ELC Electric, BT British Telecom, CBox Control box, TT Tactile, BP Brick paved, CPS Concrete paving slabs, Cvr Cover, RWall Retaining wall, TWL Top of Wall Level, TCL Tree canopy level, Girth, MG Multi girth, IC Inspection chamber, CL Cover level, IL Invert level, UTR Unable to raise

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH1	329889.022	192965.260	42.905
GH2	329856.998	193016.634	41.728
GH3	329919.528	192916.165	44.154
GH4	329921.022	192986.256	41.565
GH5	329947.363	192870.138	45.087

Rev	Date	Description	Drawn	Q. Ref

greenhatch group

- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044
admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

St Albans: Unit B, The Courtyard, Alban Park, St Albans, Hertfordshire, AL4 0LA, t. (01727) 854481

Newcastle: 24 Riverside Studios, Amethyst Road, Newcastle Bus. Park, Newcastle-U-Tyne, NE4 7YL, t. (01912) 736391

London: 27, Cornwall Terrace Mews, Regents Park, London, NW1 5LL, t. (02072) 241806

CLIENT
Opus Land Ltd

PROJECT
Plot C1, Llantarnam Park, Cwmbran, NP44 3DE

TITLE
Topographical Survey

SCALE	DATE SURVEYED
A2@ 1: 500	13.12.23
DRAWN: ALS	QUALITY REF: GH19359

Level datum	See note
Grid orientation	See note
Job number	49461
Drawing No.	49461_T
Rev.	0

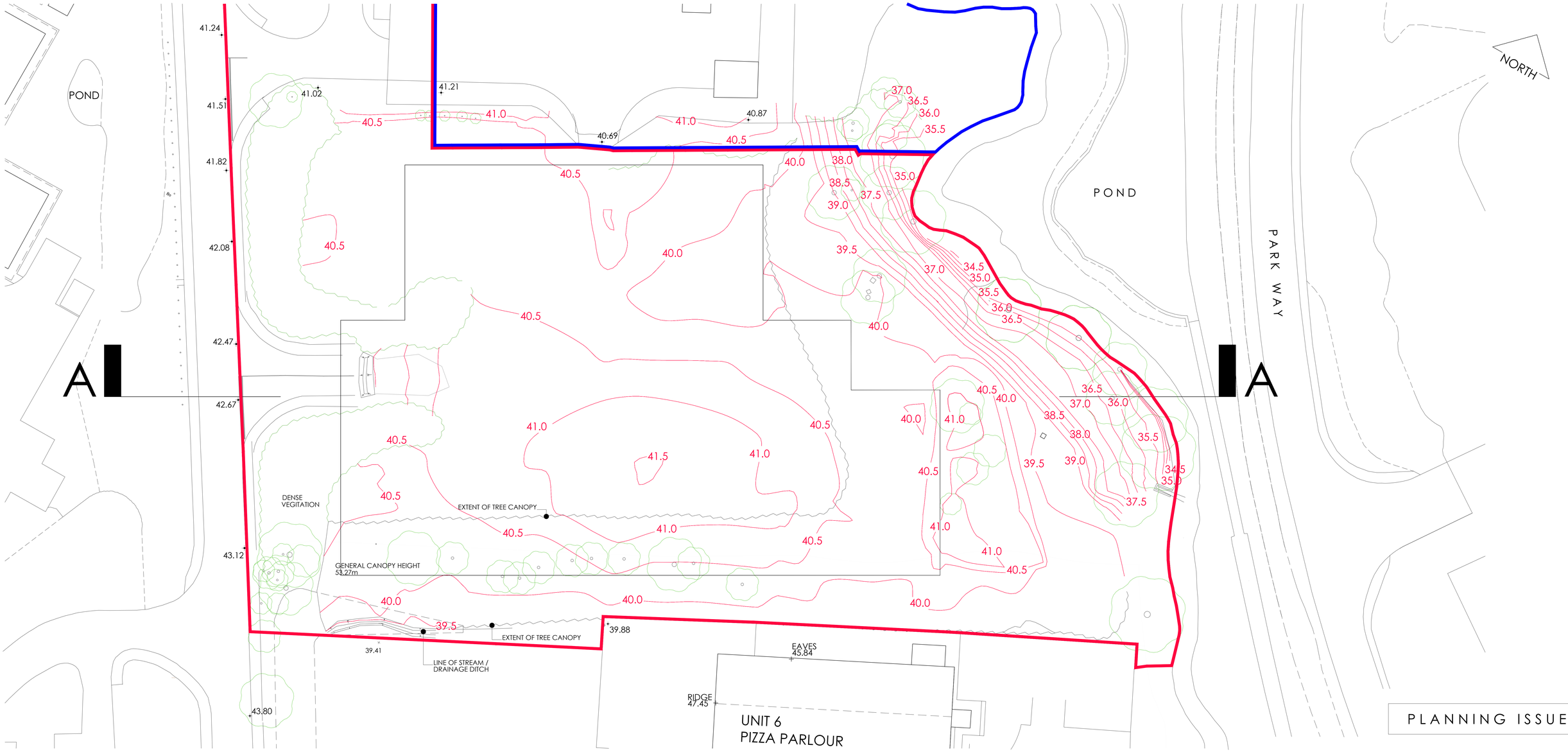
Comments:
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

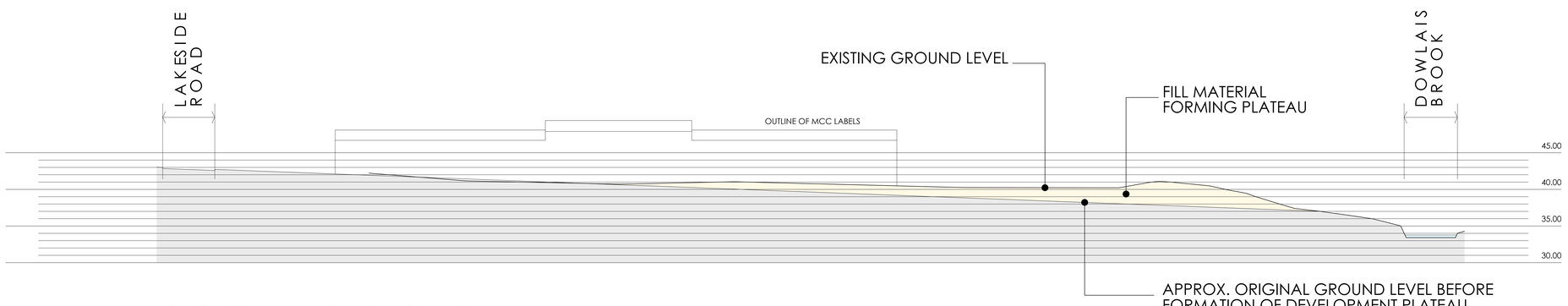
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

Appendix 3 – Indicative Development Layout



PLANNING ISSUE



SECTION THROUGH SITE ON LINE A-A

SCALE BAR

10m 10m 20m 10m 40m 50m

client :
OPUS LAND

project :
POTENTIAL DEVELOPMENT

site :
PLOT C1
LLANTARNAM PARK
CWMBRAN, NP44 3DE

content :
SURVEY CONTOURS AND INDICATIVE SECTION SHOWING EXTENT OF FILL TO FORM DEVELOPMENT PLATEAU

MAY 2024

1:250 @ A0

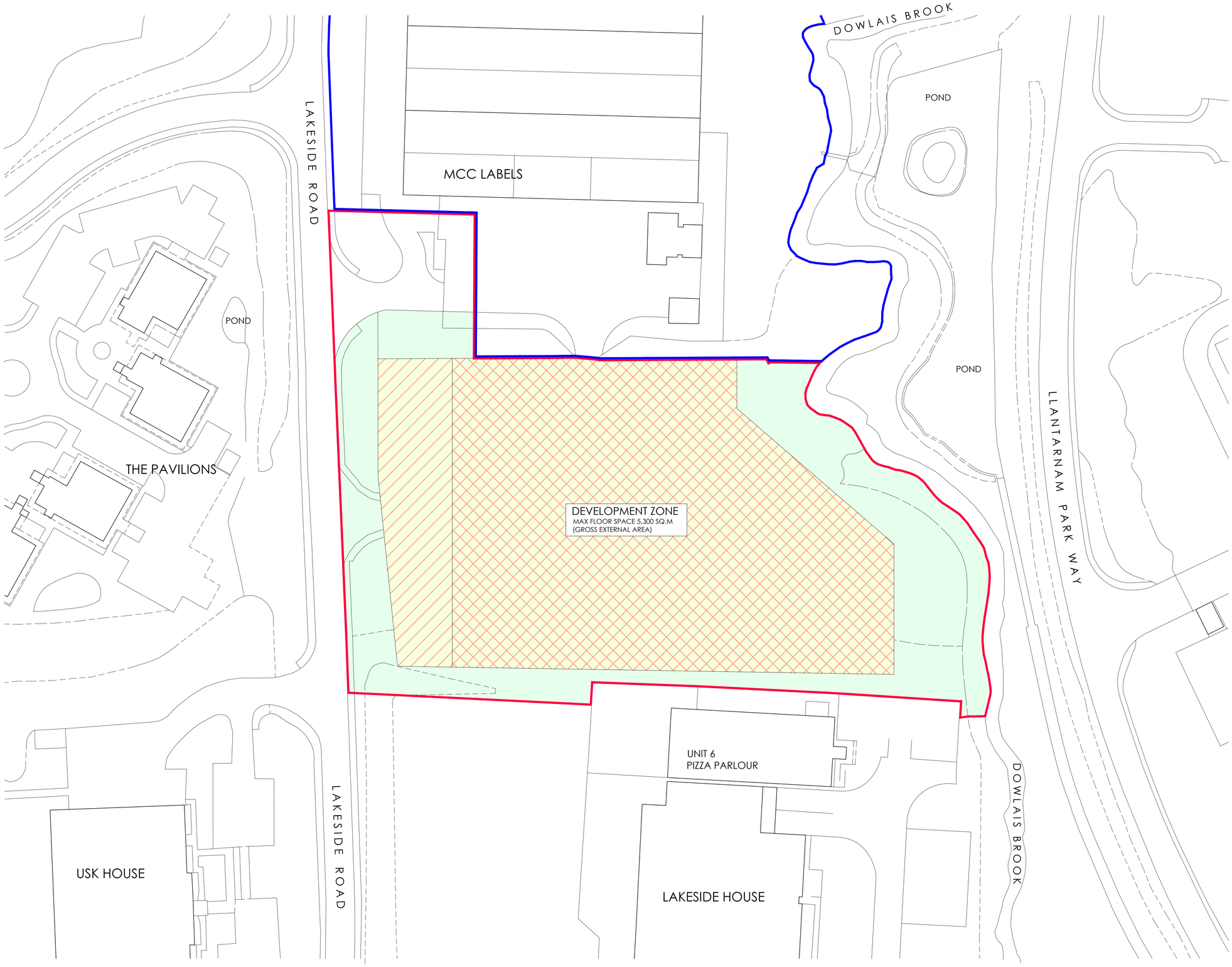
ALL DIMENSIONS TO BE CHECKED ON SITE.DO NOT SCALE

GARRETT | McKEE
ARCHITECTS

RILEY HOUSE
RILEY ROAD
MARLOW
BUCKINGHAMSHIRE
SL7 2PH
T 01628 907000

drg.no : 2540/PL202

revision :



SCALE

10m 10m 20m 30m 40m 50m

KEY

PLANNING APPLICATION BOUNDARY

ADDITIONAL LAND UNDER THE APPLICANTS OWNERSHIP

DEVELOPMENT ZONE

Area for Use Classes : B1(c) Light Industrial, B2 General Industrial, B8 Storage & Distribution & Ancillary Office Accommodation

Area to contain buildings with a maximum height of 58.00m AOD hard and soft landscaping, car parking, yard areas, road and SuDS features

Area to contain buildings with a maximum height of 51.00m AOD hard and soft landscaping, car parking, yard areas, road and SuDS features

LANDSCAPE ZONE

Area to contain landscaping including amenity areas, swales, SuDS features and ecology initiatives

PLANNING ISSUE

client :
OPUS LAND

project :
POTENTIAL DEVELOPMENT

site :
PLOT C1
LLANTARNAM PARK
CWMBRAN, NP44 3DE

content :
PARAMETERS PLAN

MAY 2024

1:500 @ A1

ALL DIMENSIONS TO BE CHECKED ON SITE.DO NOT SCALE

GARRETT | McKEE
ARCHITECTS

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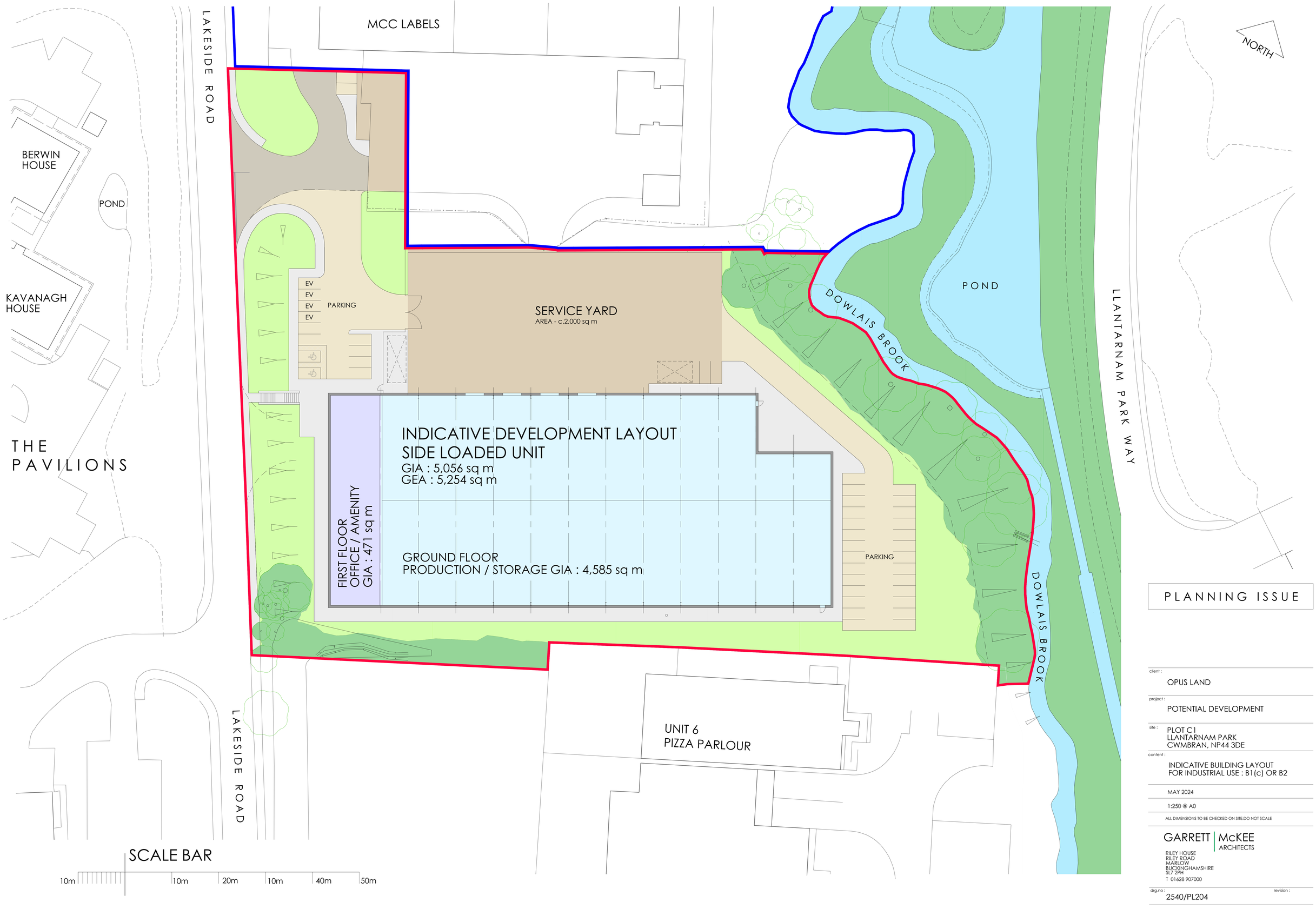
drg.no : 2540/PL203

revision :



PLANNING ISSUE

client :
OPUS LAND

project :
POTENTIAL DEVELOPMENT

site :
PLOT C1
LLANTARNAM PARK
CWMBRAN, NP44 3DE

content :
INDICATIVE BUILDING LAYOUT
FOR INDUSTRIAL USE : B1(c) OR B2

MAY 2024

1:250 @ A0

ALL DIMENSIONS TO BE CHECKED ON SITE.DO NOT SCALE

GARRETT | McKEE
ARCHITECTS
RILEY HOUSE
RILEY ROAD
MARLOW
BUCKINGHAMSHIRE
SL7 2PH
T 01628 907000

drg.no : 2540/PL204

revision :

PLANNING ISSUE

client :
OPUS LAND

project :
POTENTIAL DEVELOPMENT

site :
PLOT C1
LLANTARNAM PARK
CWMBRAN, NP44 3DE

content :
INDICATIVE BUILDING LAYOUT
FOR WAREHOUSING USE : B8

MAY 2024

1:250 @ A0

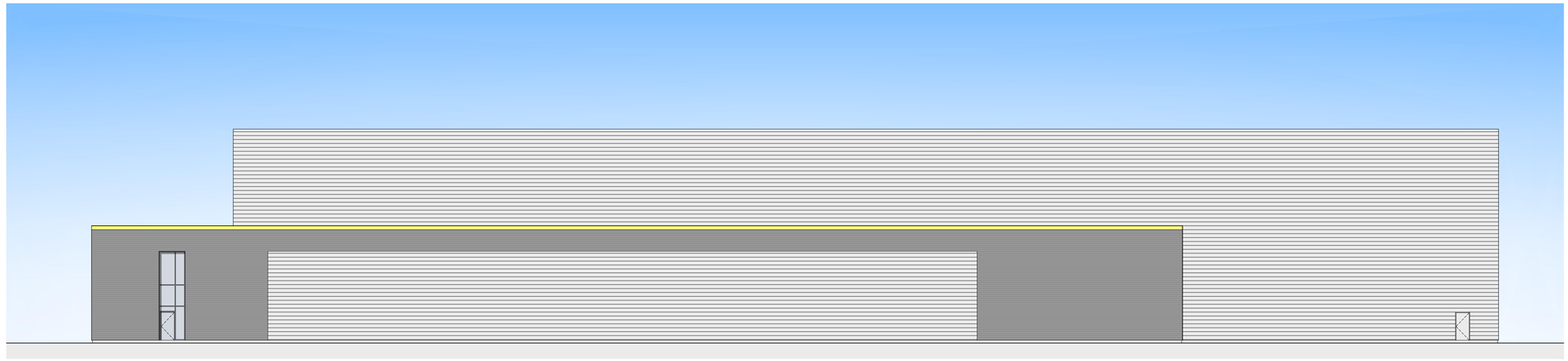
ALL DIMENSIONS TO BE CHECKED ON SITE.DO NOT SCALE

GARRETT | McKEE
ARCHITECTS

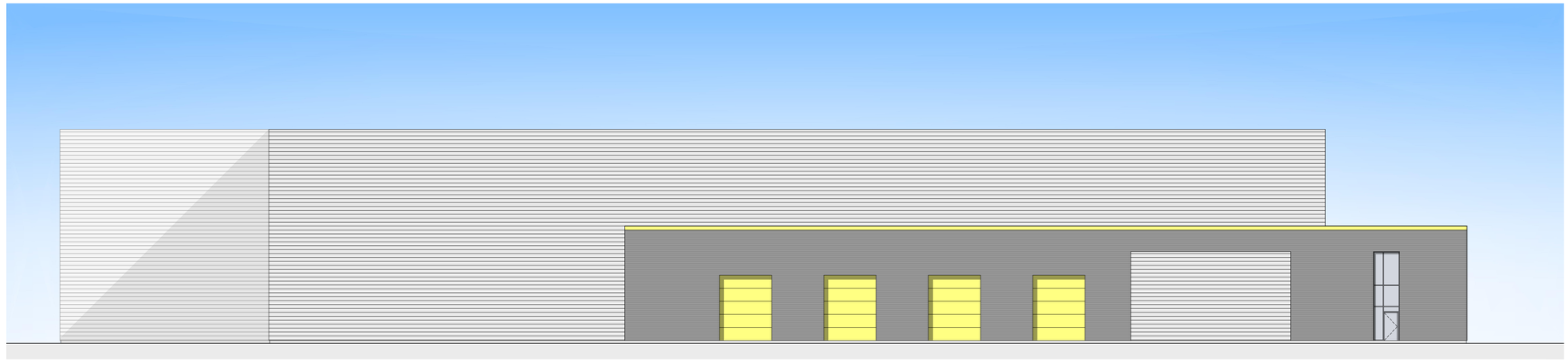
RILEY HOUSE
RILEY ROAD
MARLOW
BUCKINGHAMSHIRE
SL7 2PH
T 01628 907000

drg.no : 2540/PL205

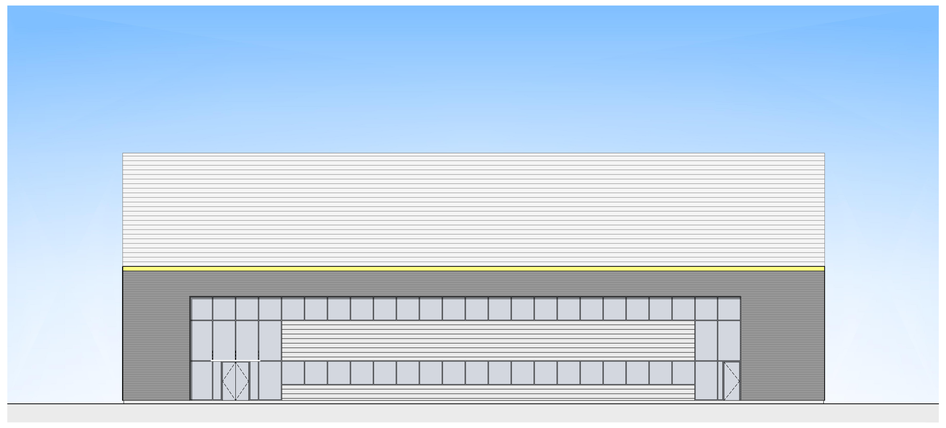
revision :



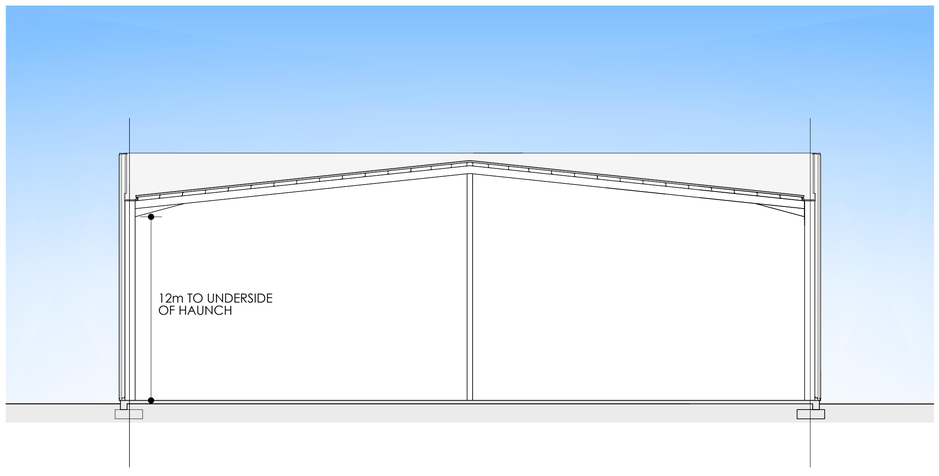
ELEVATION FACING PIZZA PARLOUR UNIT



ELEVATION FACING SERVICE YARD



ELEVATION FACING LAKESIDE ROAD



PLANNING ISSUE

client :
OPUS LAND

project :
POTENTIAL DEVELOPMENT

site :
PLOT C1
LLANTARNAM PARK
CWMBRAN, NP44 3DE

content :
SITE PLAN SHOWING POSSIBLE
SPECULATIVE UNIT
SKETCH ELEVATIONS & SECTION

MAY 2024

1:200 @ A1

ALL DIMENSIONS TO BE CHECKED ON SITE.DO NOT SCALE

GARRETT | McKEE
ARCHITECTS

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RILEY ROAD
MARLOW
BUCKINGHAMSHIRE
SL7 2PH
T 01628 907000

drg.no :
2540/PL206

revision :

Appendix 4 – Sewer Records

Gwent Police Headquarters
Llantarnam
ESS
Dowlais
Pond
Brook
Beacon House
Brecon House
Pond
Kavanagh House
The Pavilions
Machen House
Oakley
Clawdd-du
Pond
Marford House
Penrhyn House
Pond
Usk House
El Sub Sta
Henry Thomas House
50.9m
Track
Track
Mast
ETL
VC 150 mm.
CONC 225 mm.
VC 150 mm.
VC 300 mm.
CONC 375 mm.
CONC 525 mm.
VC 150 mm.
VC 150 mm.
CONC 525 mm.
VC 150 mm.
CONC 600 mm.
VC 150 mm.
PVC 100 mm.
VC 150 mm.

Dŵr Cymru
Welsh Water

Lakeside Road, Cwmbran, Torfaen, NP44 3SE

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Map Ref:	329938,193014
Map scale:	1:2000
Printed by:	Tyrieque Golding
Printed on:	03 Jul 2024

Appendix 5 – SAB Pre-Application Advice

To whom it may concern

Giri Senthil
Highway Development Controlled Engineer

Cysylltwch â / Contact: Marc Smith
Ein Cyf / Our Ref: 24/0039/TCBC
Ffon / Telephone: 07752 445853
E Bost / Email: sab@caerphilly.gov.uk
Dyddiad / Date: 14/05/2024

Dear Sir / Madam,

Flood and Water Management Act 2010 (Schedule 3) – Sustainable Drainage – Pre-Application Advice Report

Application Number: **24/0039/TCBC**
Development Name: **Plot C1 Llantarnam Park, Cwmbran**
Location: **Plot C1, Llantarnam Industrial Estate, Cwmbran, NP44 3XS**

Further to your submission for sustainable drainage pre-application advice made valid on **12/03/2024**, please find enclosed the pre-application informative report.

Caerphilly County Borough Council (CCBC) are working collaboratively with Torfaen County Borough Council (TCBC) to deliver the Sustainable Drainage Approval function, therefore communication in relation to pre-application advice may be received from CCBC.

Marc Smith is your case officer, and we would be grateful if you would quote your application reference number **24/0039/TCBC** in any correspondence. Failure to do so may result in communication delays.

Where further advice is requested, we reserve the right to charge for this advice as outlined in our "Pre-Application Fees and Charges" information on our website at www.caerphilly.gov.uk/sab. Any charges will be agreed and must be paid prior to the commencement of any services requested.

Should you wish to discuss your application, please contact the above named case officer on the details provided.

Yours Sincerely,

Ratnam Senthil

Giri Senthil
Highway Development Controlled Engineer

Sustainable Drainage Pre-Application Advice Report

This pre-application report is provided in good faith and without prejudice of any final determination. The main purpose of this report is to screen the submitted documents and plans against the requirements of the National Standards (*Statutory Standards for sustainable drainage systems – designing, constructing, operating and maintaining surface water drainage systems 2018*)

The sustainable drainage (SuDS) approach mimics natural drainage, managing surface runoff at or close to the surface and as close to its source as practicable, controlling flow rate and volume and providing a range of additional benefits. Drainage systems should be considered at the earliest stages of the design and should be informed by the topography and existing watercourses, ditches, vegetative areas and drainage features. By doing so, biodiversity, amenity and cost effectiveness can be maximised.

SuDS proposals should be underpinned by the following Principles and 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.

Contents

Development Summary:

Application Ref:	24/0039/TCBC
Development Name:	Plot C1, Llantarnam Park, Cwmbran
Development Type:	Industrial
Construction Area:	1.31 Ha
Supposition Statement:	In line with the requirements of the National Standards, should the application be submitted in its current form, then it would be unlikely to be favourable determined. Further investigation work is required along with supporting documentation as indicated throughout this pre application written advice.
Completed by:	Marc Smith
Date:	14/05/2024

The pre-application advice within this report is for the construction of an industrial unit with associated infrastructure, which includes seventy-one parking spaces and associated landscaping.

Location Plan:

Validation Requirements Checklist:

Welsh Government Validation Requirement	Information Provided With Submission	Meets Validation Criteria?	Additional Comments
A plan specifying the construction area and the extent of the drainage system, drawn to a recognised scale and showing the direction of north	The proposed drainage strategy plan provides all the criterions mentioned.	Yes	No additional information required.
Information on how the construction work will comply with the Statutory SuDS Standards	The applicant provides some information on how the construction works will comply with the Statutory SuDS Standards.	No	More information required, as per advice provided throughout report.
A statement on whether or not the application relates to a development that is the subject of an EIA	The applicant has selected that a EiA is not required for the proposed development.	Yes	No additional information required.
The appropriate application fee	The appropriate pre-application fee has been paid.	Yes	Based on the proposed Ha, the fee for a full application would be **£1,030.00**
Proposals for a maintenance plan and the means of funding for the scheme for its design life	A maintenance plan has not been provided at this stage.	No	A fully funded plan for maintenance, is a validation requirement for the full SAB application. The Welsh Government Statutory Guidance on SuDS outlines the following key requirements for a funded plan for maintenance: a) The type of maintenance activities that are required to ensure that the drainage system operates as designed to manage flood risk and deliver multiple benefits b) The anticipated frequencies of those activities c) The estimated duration of those activities

			d) Any specific plant and equipment required to undertake those activities e) **The estimated costs to complete those activities**. This must include anticipated costs for disposal of wastes where required. f) A site plan showing maintenance area, access routes and the location where maintenance activities are anticipated g) A statement describing any secondary function (e.g. recreation area) above or within the SuDS component and details describing how this function is to be managed and by whom

Standard S1- Surface water runoff destination:

Priority Level 1 – Rainwater collected for use

The applicant has proposed the use of partial rainwater harvesting on the proposed site. A rainwater harvesting tank has been proposed that will be stored below ground. It was discussed within a recent pre-application meeting that it is not possible to use solely rainwater harvesting as a discharge method on the site. Therefore, a lower priority level will be utilised as the main source of discharge.

Additional information needed with reference to this standard?

As mentioned within the recent pre-application meeting, in order to satisfy the exception criteria for priority level one, one of more of the following points will need to be evidenced when submitting a full application:

- There is no foreseeable demand for non-potable water on the site throughout its design life;
- There is no foreseeable need to harvest water at the site as the relevant water undertaker's water resources and drought management plans do not identify potential stresses on mains water supplies;
- 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.

Evidence will need to be provided with regards to the proposed rainwater harvesting system also. The design of the system will need to be in accordance with BS 8515 appendix A (2009, revision 2013), or BS EN 16941.

Further to this, evidence will need to be provided of how the system aligns with the proposed drainage network. For example, the connection of discharge into the rainwater harvesting system and where the overflow will discharge. Alongside this, we will require a construction detail of the proposed system.

Useful Resources:

- UK Rainwater Management Association - https://ukrma.org/
- BS16941-1:2018 On-site non-potable water systems
- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html

Priority Level 2 – Discharge of surface water into the ground

It was discussed within a recent pre-application meeting that infiltration is not sought to be a viable option for the proposed parcel of land, based on prior site investigation on neighbouring plots, and desk-top studies of the soil type within the area. However, it was discussed that a full site investigation report will be a requirement when submitting a full application.

Additional information needed with reference to this standard?

As identified above, a full site investigation report that includes infiltration testing conducted in accordance with BRE Digest 365 will need to be submitted as evidence when submitting a full application.

If infiltration is not considered to be a viable option for the proposed site, one or more of the following exception criterions will need to be evidenced.

- Permeability: the use of infiltration drainage is not practicable due to the lack of permeability of the soil for disposing of runoff;
- Ground Instability: the use of infiltration drainage would result in a risk of instability through ground movement or subsidence;
- Pollution of groundwater or receiving surface waters: the use of infiltration drainage would pose an unacceptable risk of pollution of groundwater or surface water bodies: - as a result of existing contaminants on the site being mobilised; or - as a result of activities in the area draining to the infiltration device (for example an area where there is the storage or handling of chemicals or fuels); or - as a result of the sensitivity of the groundwater or surface waterbody;
- Groundwater flooding: the use of infiltration drainage would result in an unacceptable risk of flooding from groundwater;
- Infiltration into a combined sewer: the use of infiltration may cause ingress of flow into a combined sewer which might result in an increased risk of flooding or pollution on the site or downstream.

Useful Resources:

- UK SuDS Website - http://www.uksuds.com/
- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html

Priority Level 3 – Discharge to a surface water body

The applicant has identified that there is an existing connection on the proposed site that can be utilised to discharge surface water runoff from the site. The applicant should seek clarification from Torfaen that the existing outfall is acceptable and specifics on discharge rates are accepted.

Additional information needed with reference to this standard?

A CCTV survey will be required of the proposed discharge method, from the point of discharge to the point of outfall. We will also require a full capacity and condition survey of the system as evidence.

Priority Level 4 – Discharge to a surface water sewer or highway drain

Higher priority level proposed.

Additional information needed with reference to this standard?

No additional information required.

Priority Level 5 – Discharge to a combined sewer

Higher priority level proposed.

Additional information needed with reference to this standard?

No additional information required.

Standard S2 – Surface water runoff hydraulic control

General advice in relation to calculations:

- Post-development calculations shall use the most recent available data for the area (typically this will be FEH22 data). Point data should be used in preference to catchment data in most cases

- Post-development calculations shall assume 100% run-off from all contributing areas with volumetric co-efficient (Cv) values set at 1.0 for both summer and winter storms unless lower values are shown to be appropriate on a site specific basis and through the use of a variable run-off model.

- When using QMED for small catchments (<1.0 Ha), recommendations from the EA research project SC090031 should be followed (Review of methodology for estimating flood peaks and hydrographs for small catchments - GOV.UK (www.gov.uk)).

- Free plot scale peak flow rates and volume data sets are available at Review of methodology for estimating flood peaks and hydrographs for small catchments - GOV.UK (www.gov.uk). These should be used in preference to IH124, ICPSuDS or ADAS 345 methods and are suitable preliminary screening and are appropriate for use at the pre-planning / SAB pre-application advice stages of development. The results are generally more conservative than the FEH ReFH2 method (that is, they are biased towards underestimating greenfield peak flow rates and runoff volume). However, as conservative estimates are not guaranteed for any individual point, it is recommended that ReFH2-FEH22 method is used for most catchments (especially urban catchments) or FEH statistical method for permeable catchments.

- For single dwelling and minor developments the lower / more conservative values from the EA plot scale data set or the ICPSuDS method is likely to be acceptable for full SAB applications in most cases. Both sets of values should be presented within the full application for comparison.

- Climate change shall be added at 30% to all storm events.

- Urban creep shall typically be accounted for at 10% unless an alternative value is shown to be appropriate through the use of site-specific criteria.

1) Interception of runoff

It was discussed within a recent pre-application meeting that in its current state, the site does not appear to be interception compliant. It was mentioned within the meeting that in order to provide further interception benefits to the proposed development, further interception mechanisms will need to be introduced. Evidence of interception compliance calculations will need to be submitted with the Full SAB application.

2) Morphological protection of receiving surface water bodies

The full application should provide calculations demonstrating that the 1 in 1 year or 1 in 2 year plus climate change event discharges at greenfield equivalent or Qbar / Qmed.

3) Flood risk mitigation for receiving surface water bodies

The parcel of land at which the site is located has been identified as a greenfield parcel of land. The agent has submitted evidence identifying the pre-development greenfield runoff rate, using the IH124 estimation approach. It was discussed within the pre-application meeting that the IH124 estimation approach will not be accepted when submitting a Full SAB Application. When submitting a Full SAB Application, both pre and post greenfield rates will need to be calculated using the ReFH2 methodology.

4) Flood protection for the site

The agent has submitted drainage calculations for a 1:2, 1:30 and 1:100 year storm event. An additional percentage of 40% has been applied to the 1:100 year storm event calculation. These calculations should demonstrate no flooding on site for 1 in 30 year / 1 in 100 year plus climate change events (G2.34).

5) Extreme event exceedance management of surface water runoff

Flow routes need to be considered when all on site drainage systems have been overwhelmed by an event of greater intensity than the design criteria. The impact of exceedance flows from and on adjacent land should also be considered.

6) Evaluation of impact of potential failure of a drainage system

An exceedance event plan has not been provided as evidence for the proposed development. No information has been provided on potential system failure. The full application should be supported by a designer's risk assessment on failure modes and should mitigate against these where possible through design and / or maintenance approaches.

Additional information needed with reference to this standard?

When submitting a Full SAB Application, the following information and evidence must be submitted:

All drainage calculations requested below must include the following inputs:

- Cv values 1.0 for both summer and winter, unless site specific Cv values are provided.
- Climate change shall be added at 30%
- Urban creep shall be added at 10%
- ReFH2 or FEH22 rainfall data

Interception of runoff

The agent should refer to pages 21-24 of the *Statutory National Standards for Sustainable Drainage Systems*, where further information is provided with respects of interception compliance.

Interception can be delivered using one or a combination of processes: Rainwater Harvesting, Infiltration and Evapotranspiration. As identified prior, at current, your proposed interception appears relatively low. As per advice provided within the email sent following the pre-application meeting, please use Box 24.3 of the CIRIA Manual to calculate the required square meterage of evapotranspiration required on your proposed site, in order to meet interception compliance. Site-specific figures will need to be used for the calculations within the Box 24.3 method.

Morphological protection of receiving surface water bodies

Flood risk mitigation for receiving surface water bodies

Pre-development greenfield discharge rates will need to be evidenced for the proposed site, using the ReFH2 or FEH22 methodology.

Proposed 1:1 and/ or 1:2 year storm event discharge rates must be shown to be reduced to pre-development greenfield discharge rates.

Flood protection for the site

1:30 & 1:100 year storm event calculations will need to be provided, demonstrating no flooding on site.

Extreme event exceedance event management of surface water runoff

Evaluation of impact of potential failure of a drainage system

A 1:200 year plus climate change storm event will need to presented to demonstrate the sites status in the event of an exceedance event.

An exceedance flow plan will need to be provided, and exceedance flow paths will need to be demonstrated away from buildings and critical infrastructure.

Information will need to be provided on potential system failure also. The agent should refer to Points G2.39 – G2.40 (Page 28) of the *Statutory National Standards for Sustainable Drainage Systems* for further guidance.

Useful Resources:

- UK SuDS Website - http://www.uksuds.com/
- FEH Web Service - Home Page - FEH Web Service (ceh.ac.uk)

- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html
- TAN 15 - https://gov.wales/sites/default/files/publications/2018-09/tan15-development-flood-risk.pdf
- Trees Design and Action Group - http://tdag.org.uk/

Standard S3 – Water Quality

Standard S3, which aims to ensure SuDS effectively manage sediment and other pollutants, ensuring discharges from the systems are of an acceptable quality and will not cause a pollution risk.

The agent has not provided a water quality risk assessment for the proposed development within submitted evidence for review as part of the pre-application package.

Additional information needed with reference to this standard?

When submitting a Full SAB Application, the following information and evidence must be submitted:

A water quality risk assessment for the proposed development, identified adequate mitigation for identifies pollutive land uses.

Clarity is required with regards to what “Land Use” the proposed development will fall within. The agent will need to refer to Table G3.1 of the *Statutory National Standards for Sustainable Drainage Systems* (Pages 33-34), where the treatment requirements and design strategies for discharges of surface water runoff to surface waters, from different land use types is identified. It is advised that the agent provides some form of evidence to help justify the choice of “Land Use.” All evidence will need to be submitted, as per guidance within Table G3.1.

Useful Resources:

- UK SuDS Website - http://www.uksuds.com/
- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html
- Simple Index Approach Tool - https://www.susdrain.org/resources/SuDS_Manual.html
- Table G3.2 of the National Standards provides sources of information on Sensitivity

Standard S4 – Amenity

A key aim for sustainable drainage is to provide an improved local environment which integrates the surface water drainage function with open space, providing amenity and recreation opportunities where possible. This Section (and Section 5 Biodiversity standard) provides guidance on how to ensure that SuDS can work for people and nature. This section shows how SuDS can add amenity value by contributing towards:

- making sites pleasant places to live or work;
- reducing hazards from climate change;
- creation of amenity space - contributing to green space accessibility standards; and
- promoting the well-being of site users.

Additional information needed with reference to this standard?

When submitting a Full SAB Application, the following information and evidence must be submitted:

A detailed landscape plan identifying all proposed amenity and biodiversity features.

The introduction of additional amenity features to the proposed drainage design.

Useful Resources:

- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html
- RSPB / WWT SuDS Guide – Maximising the potential for people and wildlife - http://ww2.rspb.org.uk/Images/SuDS_report_final_tcm9-338064.pdf

Standard S5 – Biodiversity

A key aim for sustainable drainage is to provide an improved local environment which integrates the surface water drainage function with open space providing habitat opportunities where possible. SuDS can add biodiversity value by:

- Supporting and promoting natural local habitat and species,

- Contributing to the delivery of local biodiversity objectives,

- Contributing to habitat connectivity, delivering wider biodiversity benefits,

- Creating diverse, self-sustaining, resilient local ecosystems.

Additional information needed with reference to this standard?

When submitting a Full SAB Application, the following information and evidence must be submitted:

A planting plan identifying the use of native species.

Construction details of all proposed amenity and biodiversity features.

Maintenance plan that gives due regard to biodiversity.

Useful Resources:

- NRW Standing Advice - Natural Resources Wales / How to comply with Sustainable Drainage Systems (SuDS) standards
- GB Non-Native Species Secretariat Website - Home - GB non-native species secretariat
- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html
- SEPA Ponds Pools and Lochans Good Practice Guide - https://www.sepa.org.uk/media/151336/ponds_pools_lochans.pdf
- Freshwater Habitats Trust - https://freshwaterhabitats.org.uk/
- RSPB / WWT SuDS Guide – Maximising the potential for people and wildlife - http://ww2.rspb.org.uk/Images/SuDS_report_final_tcm9-338064.pdf
- Trees Design and Action Group - http://tdag.org.uk/
- NRW map of designated / protected sites (sensitive receptors) - Natural Resources Wales / Browse map of data about the natural environment

- B-Lines Cymru network of pollinator habitats - Downloadable B-Lines Maps - Buglife / B-Lines Wales - Buglife

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

1) Construction

The agent has provided limited information in relation to the construction of the proposed development. A preliminary drainage layout has been provided for review alongside a topographical survey of the site.

2) Operation and Maintenance

The agent has provided no information on the proposed operation and maintenance of the proposed drainage features.

3) Structural Integrity

The agent has provided no information on the structural integrity of proposed drainage features.

Additional information needed with reference to this standard?

When submitting a Full SAB Application, the following information and evidence will need to be submitted:

Construction

Construction details for all proposed drainage features. Construction details must be site-specific, and not typical. Drawings will need to be clearly annotated identified specific materials of the features, alongside required depths of materials.

Additional engineering drawings to assist in visualising the proposed drainage design. These should include, but are not limited to:

- Proposed site levels
- Proposed drainage layout
- Proposed drainage construction details
- Proposed catchment areas
- Proposed cross-sections
- Exceedance flow routes

A one metre wide coarse gravel land drain with a perforated pipe has been proposed for the Northern boundary of the site. It is suggested changing this feature from a land drain to a green feature such as a swale and/ or rain garden, which will assist in increasing the interception compliance on the proposed development.

Similarly, there are locations on the site shaded in a light orange/ sandy colour. See screenshot below.

Ecology and Amenity Landscape area

These are suggested to be proposed ecology and amenity landscape areas. These are locations on the site that could be introduced as a green feature such as a swale or rain garden, which again, will assist in increasing the interception compliance on the proposed development and boosting elements like water quality, amenity and biodiversity.

Operation and maintenance

A maintenance plan will be required for all proposed drainage features. The maintenance plan will need to address:

- Inspection and maintenance required for the system to function as designed with regard to meeting the performance levels set by compliance with these Standards.
- Inspection and maintenance required during the establishment of vegetative components and for the long term management of that vegetation.
- Locations where sediment removal is necessary to ensure sediment control measures continue to function as designed, together with the anticipated frequency and appropriate means of sediment removal and disposal.
  Guidance on the production of such a plan is provided in the SuDS Manual.

A fully funded plan for maintenance, is a validation requirement for the full SAB application. The Welsh Government Statutory Guidance on SuDS outlines the following key requirements for a funded plan for maintenance:

a) The type of maintenance activities that are required to ensure that the drainage system operates as designed to manage flood risk and deliver multiple benefits
b) The anticipated frequencies of those activities
c) The estimated duration of those activities
d) Any specific plant and equipment required to undertake those activities
e) **The estimated costs to complete those activities**. This must include anticipated costs for disposal of wastes where required.
f) A site plan showing maintenance area, access routes and the location where maintenance activities are anticipated
g) A statement describing any secondary function (e.g. recreation area) above or within the SuDS component and details describing how this function is to be managed and by whom

Structural Integrity

It is suggested on the proposed drainage layout that the proposed rainwater harvesting tank will be located below ground, in a location where vehicular traffic is considered likely. CIRIA C737 calculations will be required for the proposed below ground rainwater harvesting tank, to ensure adequate cover is provided.

Data sheets and BBA certifications will also be required for the other SuDS features across site.

Useful Resources:

- CIRIA C753 The SuDS Manual - https://www.susdrain.org/resources/SuDS_Manual.html
- CIRIA C737 Structural and geotechnical design of modular geocellular drainage systems

- RoSPA guidance on inland waters - https://www.rospa.com/Leisure-Safety/Water/Advice.aspx

Consultee Responses

Statutory consultees were not consulted as part of this pre-application report.

Non-Performance Bond

Due to the nature and location of the proposed development, on an industrial estate, it is likely that a non-performance bond will be required.

The bond is intended to underpin and to facilitate the provision of sustainable drainage on new development. It provides a vital safeguard to ensure the SAB has the means to remediate poorly constructed or incomplete SUDS.

In the event that the constructed system does not comply with the approved design, or the construction is not completed the SAB will request the developer to undertake the necessary work to achieve compliance. Where the develop does not, for any reason, undertake the necessary work, the SAB may need to utilise some, or all, of the bond to undertake the work itself.

Where a bond has not been drawn down and the SAB is satisfied that the drainage system has been constructed in accordance with approved proposals, including any conditions of the approval which may specify a defect period and/or establishment period, the SAB must release the bond.

To assist the SAB team in calculating the non-performance bond, the agent is requested to submit a full schedule of rates for all drainage features, and estimated costs for constructing all drainage features on the site.

Commuted Sum

The proposed drainage design is only considered to serve one dwelling, on this basis, a commuted sum will not be required.

Inspection Charges

Mandatory inspections will be required at a statutory fee of £168 per visit. Provision of an outline construction schedule at full application stage will help to inform and rationalise the inspection schedule.

Supposition Statement

In line with the requirements of the National Standards, should the application be submitted in its current form, then it would be unlikely to be favourably determined.

The construction methods and spatial planning of the proposed development in its current form are likely to result in a less cost-effective solution with higher embedded carbon than would appear possible from the information provided.

When submitting your full application, please ensure that the application form is completed in full and that all supporting evidence outlined in Table A and Table B of the full application form is completed.

Additional Advice and Technical Support

Should you require additional technical support as you develop your proposals, this is available at an hourly rate as outlined on our website.

Notes

- Sustainable Drainage Approval is an independent technical approval separate from the Planning/ Building Regulations process; you are advised to contact the Local Planning Authority (LPA) separately. The LPA has not been consulted in relation to this proposal.
- Developers should demonstrate compliance with the National Standards in submitting planning applications.
- Where you propose to connect or interact with Dwr Cymru Welsh Water (DCWW) assets you are recommended to consult DCWW for a formal response prior to submitting a full Sustainable Drainage Application. DCWW can be contacted at developer.services@dwrcymru.com.
- Reference should be made to the standing advice available on the Natural Resources Wales website at https://naturalresources.wales/guidance-and-advice/business-sectors/planning-and-development/advice-for-developers/how-to-comply-with-sustainable-drainage-systems-standards/?lang=en
- The purpose of discretionary services is for the developer to have initial contact with the sustainable drainage approval body to explain the nature of the development, and for officers to bring the National Standards or issues of concern to the developer's attention. Officers will not be in a position at this stage to resolve issues or come to any final conclusions about the scheme.
- This will be an opportunity for the developer to become aware of those views, and take account of them in the submission of a formal application. At this stage, the Council cannot review detailed design submissions such as hydraulic calculations, environmental statements or viability assessments.

Appendix 6 – Indicative Surface Water Drainage Strategy

INDICATIVE NORTH

INDICATIVE LAYOUT ONLY

DOWLAIS BROOK

LAKESIDE

1.0m wide coarse gravel land drain with perforated pipe, to drain yard area

2.0m wide swale to collect southern pitch of roof drainage

Rain Water Harvester Tank collecting office roof area

Class 1 Full Retention Interceptor NSB060

Ø150

Ø300

Ø600

Ø225

S1 HB @ 4.1 l/s

S12 Emergency Penstock

Ex Outfall HRV

Existing pipe to be reused

Key

- Existing Private Surface Water Drain
- Proposed Surface Water Drain
- Proposed Surface Water Manhole
- Proposed Storm Gully (D400)
- Permeable Block Paving (Tanked)
- Rainwater Harvesting (min 400kPa)
- Ecology and Amenity Landscape area
- Proposed Surface Rain Water Pipe
- Proposed Flow Control Chamber
- Proposed Class 1 Full Retention Separator (Alarmed and Vented)
- Exceedance Flow Route
- Perforated Pipe with 150mmØ access

NOTES

1. This drawing is to be read in conjunction with all relevant Architects, Engineers and other specialist details and specifications.
2. Drawing issued for outline planning approval only. Following receipt of further information and comments the scheme may be revised.
3. Drawing based upon Garrett McKee Architects layout drawing: Ref 2540/PL205. All setting out including internal drainage points is to be based on Architects information unless otherwise stated.
4. Topographical Survey data drawing is from Greenhatch Group Ltd Dated December 2023. The survey information used in the preparation of this drawing is not warranted. The contractor shall check all dimensions and levels on site.
5. The location and level of all existing services are to be identified prior to construction and the engineer advised of any clashes.
6. All external drainage works shall be constructed in accordance with the Civil Engineering Specification for the Water Industry Edition 7, together with the relevant Sewerage Undertaker's requirements.
7. S106 approval required prior to any connection works to public sewer.
8. Prior to commencing work on the drainage, all existing drains, sewers manholes and outfalls to remain shall be located, identified and a CCTV condition survey carried out. Where necessary, protection to the existing drainage infrastructure shall be provided.
9. Refer to standard details drawings for further specification details.
10. All pipework with less than 1.2m cover in trafficked areas, or less than 0.9m cover in public open space, to have concrete surround or similar protection. The contractor is to protect all buried pipes and tree roots from damage caused by loads imposed by construction plant.
11. All concrete to drainage, manholes bases, surrounds etc to be in accordance with the BRE Special Digest 1. Refer to site investigation report for sulphate class.
12. All external pipes shall be plastic to BS EN 13476 and 1401, unless otherwise stated on the drawings.
13. All abandoned sewers are to be removed and trench suitably reinstated.
14. All manhole and drainage channel covers shall comply with BS EN 124. Manhole covers within external block paved areas & internal to buildings shall be recessed.
15. Ventilation shall be provided at the head of foul drainage runs. Access for rodding shall be provided to all soil and rainwater down pipes above finished floor level.
16. All pipes within the building footprint are to be 100mmØ and laid at a gradient of 1 in 40 unless stated otherwise on this drawing.
17. The discharge rate of 4.1 l/s based on greenfield runoff rate.
18. Attenuation storage via swale and land drains is based on 1 in 100 year + 40% return period. A 100mm dia vent pipe is required, and maintained access from both ends.
19. Soakaways are not feasible due to an depth of underlying predominantly clay strata .
20. Additional drainage may cross the site and due to change in legislation in October 2011, these former private sewers may now be the responsibility of the Sewerage Undertaker, but not be shown on their records.

Rev.	Amendments	Date	By	Chkd.
P01	Issued for Outline Planning Approval	04.07.24	AH	APH

Drawing Status

PRELIMINARY

Civil & Structural Consultants
45 Frederick Street, Birmingham, B1 3HN
Email: officeadmin@sbkconsult.com

Plot C1
Llantarnam Industrial Park
Cwmbran

Indicative Drainage Strategy
Outline Planning Application

Drawing Number			Revision
SBK-23-258-531			P01
Drawn by	AH	Checked by	APH
Date	June 2024	Scale	1:250 @ A1

Appendix 7 – Indicative Surface Water Drainage Calculations

Drainage Design Report

Flow+

v10.7

Network	Storm Network
Filename	SBK-23-258-SWS SAB v1.pfd
Username	Matthew Endacott (matthew.endacott@sbkconsult.com)
Last analysed	27/02/2024 11:05:25
Report produced on	28/06/2024 10:58:23

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Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

Rainfall Methodology	FSR
Return Period (years)	100
Additional Flow (%)	40
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	1.000
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	Yes
Enforce best practice design rules	Yes

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type		Link	IL (m)	Dia (mm)	Link Type
S1	329904.883	192979.637	41.500	2.200				Junction						
										0	1.000	39.300	500	Ditch
S1 Junction	329924.129	192943.714	41.500	2.885	3500			Sealed Manhole	Adoptable	1	1.000	38.615	500	Ditch
										0	1.001	38.615	1000	Ditch
S2 Junction	329979.658	192973.116	41.500	3.142	3500			Sealed Manhole	Adoptable	1	1.001	38.358	1000	Ditch
										0	1.002	38.358	1000	Ditch
S2	330051.757	193011.586	40.500	2.394				Manhole	Adoptable	1	1.002	38.106	1000	Ditch
										0	1.003	38.106	525	Circular
S3	329912.288	192997.012	41.450	1.500	1200			Manhole	Adoptable					
										0	2.000	39.950	300	Circular
S4	329921.396	193001.959	41.450	1.603	1200			Manhole	Adoptable	1	2.000	39.847	300	Circular
										0	2.001	39.847	300	Circular
S5	329954.635	193019.728	41.450	1.825	1200			Manhole	Adoptable	1	2.001	39.625	300	Circular
										0	2.002	39.625	300	Circular
S6	329906.746	193025.113	40.700	2.200				Junction						
										0	3.000	38.500	500	Ditch
S7	329967.763	193057.469	40.700	2.885				Junction		1	3.000	37.815	500	Ditch
										0	3.001	37.815	450	Circular
S8	329976.395	193048.718	40.500	2.977				Junction		1	4.000	38.523	150	Ditch

										2	3.001	37.673	450	Circular
										0	3.002	37.523	600	Circular
S9	329987.481	193037.408	41.450	3.976	1500			Manhole	Adoptable	1	3.002	37.474	600	Circular
										2	2.002	39.472	300	Circular
										0	2.003	37.474	600	Circular
S10	330012.336	193038.856	40.500	1.350				Junction						
										0	4.000	39.150	150	Ditch
S11	330021.499	193030.872	41.100	3.843	1500			Manhole	Adoptable	1	2.003	37.257	600	Circular
										2	1.003	37.882	525	Circular
										0	1.004	37.257	150	Circular
S12	330025.161	193033.706	40.900	3.774	1500			Manhole	Adoptable	1	1.004	37.126	150	Circular
										0	1.005	37.126	150	Circular
EX O/F	330049.063	193035.326	35.540	1.996	1500			Manhole	Adoptable	1	1.005	33.544	150	Circular

Rainfall Methodology	FSR		Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
FSR Region	England and Wales		2	0	0	0
M5-60 (mm)	20.000		30	0	0	0
Ratio-R	0.400		100	0	0	0
Summer CV	1.000		100	40	0	0
Winter CV	1.000					
Analysis Speed	Normal					
Skip Steady State	No					
Drain Down Time (mins)	240					
Additional Storage (m³/ha)	0.0					
Storm Durations (mins)	15					
	30					
	60					
	120					
	180					
	240					
	360					
	480					
	600					
	720					
	960					
	1440					
Check Discharge Rate(s)	Yes					
100 year (l/s)	9.1					
Check Discharge Volume	Yes					
100 year 360 minute (m³)						

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	1.310
SAAR (mm)	1129
Soil Index	2
SPR	0.30
Region	9
Growth Factor 1 year	0.85
Growth Factor 30 year	1.95
Growth Factor 100 year	2.48
Betterment (%)	0
QBar	4.2
Q 1 year (l/s)	
Q 30 year (l/s)	
Q 100 year (l/s)	

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	1.310
Soil Index	2
SPR	0.30
CWI	
Return Period (years)	100
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
PR	
Runoff Volume (m³)	

Hydro-Brake®

Node	Flap Valve	Online / Offline	Downstream Link	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
S11	No	Online		Yes		37.257	2.500	4.1	(HE) Minimise upstream storage	Yes	CTL-SHE-0078-4100-2500-4100	0.100	1200

Depth/Area/Inf Area									
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
S11	0.00000	0.00000	2.0	0.30	37.257		0.000	230.0	0.0
							0.300	230.0	0.0
							0.301	0.0	0.0
S2	0.00000	0.00000	2.0	0.30	38.106		0.000	288.0	0.0
							0.300	288.0	0.0
							0.301	0.0	0.0
S3	0.00000	0.00000	2.0	0.30	39.950	3	0.000	120.0	0.0
							0.300	120.0	0.0
							0.301	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S1	11	39.328	0.028	6.5	0.0000	0.0000	OK	15 minute summer	1.000	S1 Junction	6.3	0.123	0.008	2.2752	
480 minute winter	S1 Junction	464	38.764	0.149	5.2	1.4337	0.0000	OK	480 minute winter	1.001	S2 Junction	5.2	0.179	0.003	16.3427	
480 minute winter	S2 Junction	464	38.764	0.406	10.0	3.9067	0.0000	OK	480 minute winter	1.002	S2	7.6	0.147	0.005	50.5255	
480 minute winter	S2	464	38.764	0.658	14.4	25.9632	0.0000	SURCHARGED	480 minute winter	1.003	S11	-9.1	0.306	-0.102	7.7517	
15 minute summer	S3	12	40.011	0.061	12.7	2.2522	0.0000	OK	15 minute summer	2.000	S4	9.9	0.671	0.090	0.1572	
15 minute summer	S4	11	39.947	0.100	21.3	0.1134	0.0000	OK	15 minute summer	2.001	S5	20.9	0.773	0.246	1.0228	
15 minute summer	S5	11	39.770	0.145	32.8	0.1638	0.0000	OK	15 minute summer	2.002	S9	31.8	0.980	0.449	1.2103	
480 minute winter	S6	464	38.764	0.264	2.6	0.0000	0.0000	OK	480 minute winter	3.000	S7	3.2	0.042	0.006	58.6647	
480 minute winter	S7	464	38.764	0.949	12.0	0.0000	0.0000	SURCHARGED	480 minute winter	3.001	S8	-6.7	0.379	-0.089	1.9476	
480 minute winter	S8	464	38.764	1.241	7.1	0.0000	0.0000	SURCHARGED	480 minute winter	3.002	S9	-6.3	0.230	-0.067	4.4609	
480 minute winter	S9	456	38.764	1.290	9.5	2.2800	0.0000	SURCHARGED	480 minute winter	2.003	S11	9.5	0.559	0.018	9.7573	
15 minute summer	S10	11	39.175	0.025	4.9	0.0000	0.0000	OK	15 minute summer	4.000	S8	4.3	0.429	0.068	0.3750	
480 minute winter	S11	456	38.765	1.508	11.3	23.3986	0.0000	SURCHARGED	480 minute winter	Hydro-Brake®	S12	3.2				
480 minute winter	S12	464	37.163	0.037	3.2	0.0654	0.0000	OK	480 minute winter	1.005	EX O/F	3.2	0.966	0.518	0.0805	118.3
480 minute winter	EX O/F	464	33.581	0.037	3.2	0.0000	0.0000	OK								

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	S1	11	39.341	0.041	12.3	0.0000	0.0000	OK	15 minute summer	1.000	S1 Junction	11.9	0.151	0.016	3.6172	
720 minute winter	S1 Junction	705	39.199	0.584	6.7	5.6215	0.0000	OK	720 minute winter	1.001	S2 Junction	5.9	0.169	0.004	59.8304	
720 minute winter	S2 Junction	705	39.199	0.841	9.3	8.0928	0.0000	OK	720 minute winter	1.002	S2	6.4	0.123	0.004	125.1509	
720 minute winter	S2	705	39.199	1.093	12.2	25.9632	0.0000	SURCHARGED	720 minute winter	1.003	S11	-6.9	0.304	-0.077	7.7517	
15 minute summer	S3	12	40.042	0.092	24.1	3.3998	0.0000	OK	15 minute summer	2.000	S4	19.8	0.793	0.179	0.2694	
15 minute summer	S4	11	39.994	0.147	42.1	0.1661	0.0000	OK	15 minute summer	2.001	S5	41.9	0.903	0.493	1.7413	
15 minute summer	S5	11	39.856	0.231	64.5	0.2609	0.0000	OK	15 minute summer	2.002	S9	62.6	1.178	0.884	1.9887	
720 minute winter	S6	705	39.199	0.699	5.0	0.0000	0.0000	SURCHARGED	720 minute winter	3.000	S7	-3.2	0.035	-0.006	126.1466	
720 minute winter	S7	705	39.199	1.384	8.6	0.0000	0.0000	SURCHARGED	720 minute winter	3.001	S8	-4.5	0.334	-0.059	1.9476	
720 minute winter	S8	705	39.199	1.676	5.2	0.0000	0.0000	SURCHARGED	720 minute winter	3.002	S9	-4.6	0.192	-0.049	4.4609	
720 minute winter	S9	690	39.199	1.725	8.8	3.0473	0.0000	SURCHARGED	720 minute winter	2.003	S11	7.9	0.558	0.015	9.7573	
720 minute winter	S10	705	39.199	0.049	0.7	0.0000	0.0000	OK	720 minute winter	4.000	S8	0.7	0.206	0.011	16.6444	
720 minute winter	S11	690	39.200	1.943	10.2	24.1675	0.0000	SURCHARGED	720 minute winter	Hydro-Brake®	S12	3.6				
720 minute winter	S12	705	37.165	0.039	3.6	0.0694	0.0000	OK	720 minute winter	1.005	EX O/F	3.6	0.999	0.582	0.0875	177.0
720 minute winter	EX O/F	705	33.583	0.039	3.6	0.0000	0.0000	OK								

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
720 minute winter	S1	705	39.413	0.113	1.2	0.0000	0.0000	OK	720 minute winter	1.000	S1 Junction	1.2	0.056	0.002	24.3799	
720 minute winter	S1 Junction	705	39.413	0.798	8.7	7.6780	0.0000	OK	720 minute winter	1.001	S2 Junction	6.3	0.168	0.004	89.9183	
720 minute winter	S2 Junction	705	39.413	1.055	11.3	10.1505	0.0000	SURCHARGED	720 minute winter	1.002	S2	6.2	0.140	0.004	173.2152	
720 minute winter	S2	705	39.413	1.307	11.8	25.9632	0.0000	SURCHARGED	720 minute winter	1.003	S11	-9.7	0.267	-0.109	7.7517	
15 minute summer	S3	12	40.060	0.110	31.3	4.0705	0.0000	OK	15 minute summer	2.000	S4	26.3	0.846	0.237	0.3371	
15 minute summer	S4	11	40.020	0.173	55.2	0.1958	0.0000	OK	15 minute summer	2.001	S5	54.9	0.947	0.645	2.1208	
15 minute summer	S5	11	39.937	0.312	84.1	0.3526	0.0000	SURCHARGED	15 minute summer	2.002	S9	81.1	1.231	1.144	2.3575	
720 minute winter	S6	705	39.413	0.913	5.7	0.0000	0.0000	SURCHARGED	720 minute winter	3.000	S7	-3.4	0.030	-0.006	169.0753	
720 minute winter	S7	705	39.413	1.598	10.1	0.0000	0.0000	SURCHARGED	720 minute winter	3.001	S8	-4.2	0.324	-0.056	1.9476	
720 minute winter	S8	705	39.413	1.890	4.2	0.0000	0.0000	SURCHARGED	720 minute winter	3.002	S9	-3.5	0.213	-0.038	4.4609	
720 minute winter	S9	705	39.413	1.939	11.3	3.4266	0.0000	SURCHARGED	720 minute winter	2.003	S11	10.0	0.571	0.018	9.7573	
720 minute winter	S10	705	39.413	0.263	0.9	0.0000	0.0000	SURCHARGED	720 minute winter	4.000	S8	0.9	0.202	0.014	28.9662	
720 minute winter	S11	705	39.414	2.157	12.8	24.5453	0.0000	SURCHARGED	720 minute winter	Hydro-Brake®	S12	3.8				
720 minute winter	S12	705	37.166	0.040	3.8	0.0711	0.0000	OK	720 minute winter	1.005	EX O/F	3.8	1.013	0.611	0.0906	186.0
720 minute winter	EX O/F	705	33.584	0.040	3.8	0.0000	0.0000	OK								

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.02%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	S1	945	39.749	0.449	1.6	0.0000	0.0000	OK	960 minute winter	1.000	S1 Junction	1.3	0.050	0.002	49.6522	
960 minute winter	S1 Junction	945	39.749	1.134	9.6	10.9081	0.0000	SURCHARGED	960 minute winter	1.001	S2 Junction	5.0	0.150	0.003	148.7576	
960 minute winter	S2 Junction	945	39.749	1.391	12.2	13.3807	0.0000	SURCHARGED	960 minute winter	1.002	S2	-6.0	0.137	-0.004	263.7054	
960 minute winter	S2	945	39.749	1.643	12.3	25.9632	0.0000	SURCHARGED	960 minute winter	1.003	S11	-10.5	0.274	-0.118	7.7517	
15 minute summer	S3	12	40.167	0.217	44.7	8.0584	0.0000	OK	15 minute summer	2.000	S4	44.3	0.975	0.400	0.6479	
15 minute summer	S4	12	40.157	0.310	66.5	0.3501	0.0000	SURCHARGED	15 minute summer	2.001	S5	67.5	0.996	0.794	2.6541	
15 minute summer	S5	11	40.034	0.409	102.2	0.4629	0.0000	SURCHARGED	15 minute summer	2.002	S9	96.1	1.390	1.357	2.4442	
960 minute winter	S6	945	39.749	1.249	5.6	0.0000	0.0000	SURCHARGED	960 minute winter	3.000	S7	-3.0	0.033	-0.005	248.9522	
960 minute winter	S7	945	39.749	1.934	10.4	0.0000	0.0000	SURCHARGED	960 minute winter	3.001	S8	-2.6	0.336	-0.034	1.9476	
960 minute winter	S8	945	39.749	2.226	3.9	0.0000	0.0000	SURCHARGED	960 minute winter	3.002	S9	-3.2	0.221	-0.034	4.4609	
960 minute winter	S9	945	39.749	2.275	12.5	4.0195	0.0000	SURCHARGED	960 minute winter	2.003	S11	10.3	0.563	0.019	9.7573	
960 minute winter	S10	945	39.749	0.599	1.7	0.0000	0.0000	SURCHARGED	960 minute winter	4.000	S8	1.0	0.190	0.016	55.0843	
960 minute winter	S11	945	39.749	2.492	13.5	25.1374	0.0000	SURCHARGED	960 minute winter	Hydro-Brake®	S12	4.1				
960 minute winter	S12	945	37.168	0.042	4.1	0.0736	0.0000	OK	960 minute winter	1.005	EX O/F	4.1	1.032	0.654	0.0950	247.2
960 minute winter	EX O/F	945	33.585	0.041	4.1	0.0000	0.0000	OK								