

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

**Land at Woodside Drive,
Almondsbury
BS32 4AB**

Project No: 10165FDL5

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TABLE OF CONTENTS

1.0	INTRODUCTION.....	3
2.0	EXISTING SITE.....	6
3.0	PROPOSED DEVELOPMENT.....	10
4.0	FLOOD RISK ASSESSMENT.....	12
5.0	FLOOD RISK MANAGEMENT AND MITIGATION MEASURES.....	18
6.0	OUTLINE DRAINAGE STRATEGY.....	19
7.0	CONCLUSION.....	26

APPENDICES

APPENDIX A	Site Location Plan
APPENDIX B	Topographical Survey
APPENDIX C	Existing Sewer Record Maps & Correspondence
APPENDIX D	Development Proposals
APPENDIX E	Flood Maps
APPENDIX F	Drainage Strategy Calculations
APPENDIX G	Drainage Strategy Drawings
APPENDIX H	Flood Routing Plan & Maintenance Schedule

1.0 INTRODUCTION

APPOINTMENT AND BRIEF

- 1.1. Structural Solutions has been appointed to produce a Flood Risk Assessment and Outline Drainage Strategy to support the planning application for the proposed development at Land at Woodside Drive, Almondsbury. The development consists of a new industrial development comprising of up to 21 industrial units, with supporting carparks.
- 1.2. The development is located north of Junction 16 of the M5, off Gloucester Road. The closest postcode is BS32 4AB and the site has an approximate central Ordnance Survey Grid Reference of X360526, Y183616. The site comprises approximately 1.22 hectares of land and is identified within the Local Plan as potential land for development.
- 1.3. The Lead Local Flood Authority (LLFA) is South Gloucestershire Council and the Water Authority is Wessex Water.
- 1.4. A site location plan is included in **Appendix A** and shown in the figures below.

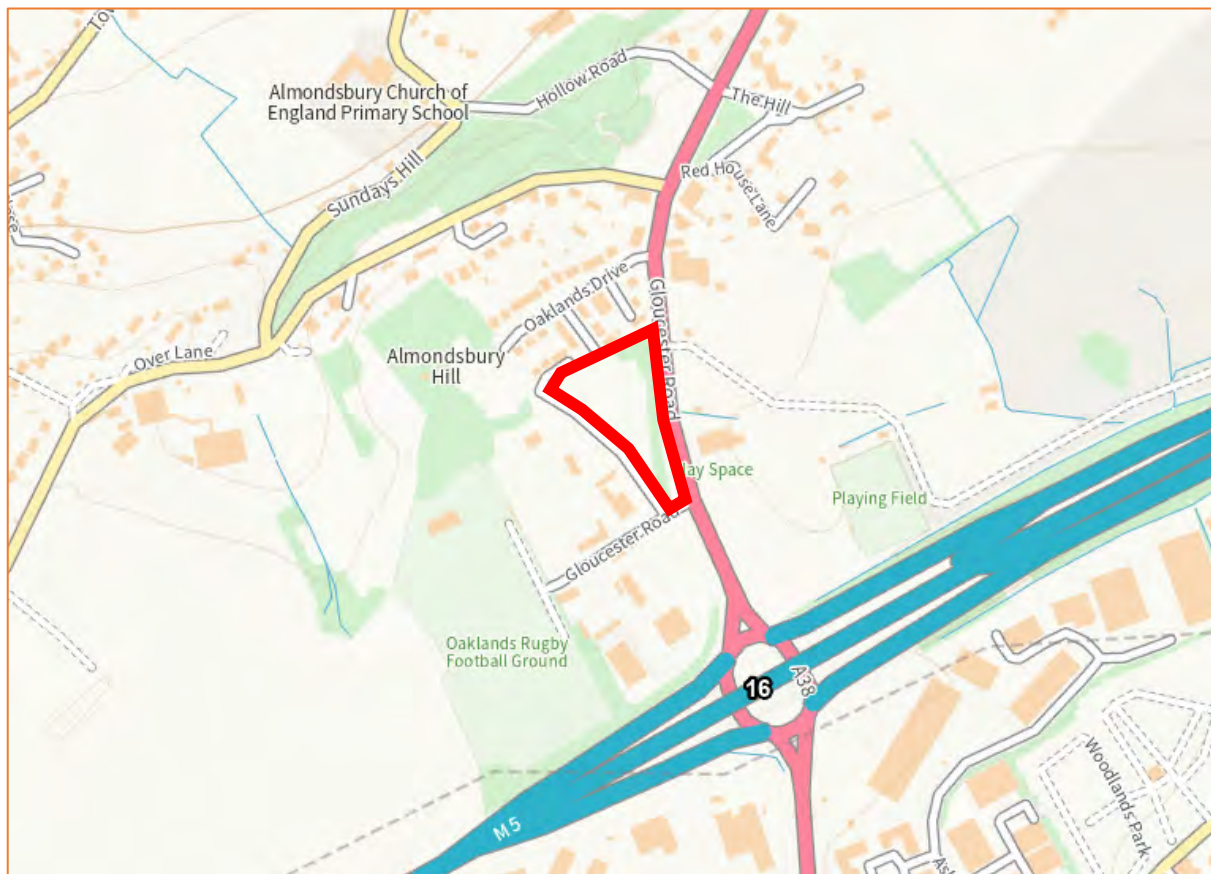


Figure 1a Site Location – OS Map



Figure 1b Site Location – Satellite Imagery

STUDY OBJECTIVE

- 1.5. This report investigates flood risk on site and in the area and establishes the mitigation measures required to ensure the sustainability and safety of the proposed development over its lifetime.
- 1.6. The report has been produced in line with the requirements of the National Planning Policy Framework (NPPF) and the Environment Agency (EA) Standing Advice, as well as the requirements of South Gloucestershire Council.
- 1.7. Development must be located, designed and laid out to ensure that it is safe; the risk from flooding is minimised whilst not increasing the risk of flooding elsewhere; and that residual risks are safely managed. The site lies fully in Flood Zone 1, that is having a low probability of flooding from rivers, and an FRA is required as the site area is over 1 ha.
- 1.8. The following documents and guidance have been reviewed to inform this report:
 - South Gloucestershire Local Flood Risk Management Strategy 2022-2027 (Summary Report)
 - South Gloucestershire Local Flood Risk Management Strategy 2022-2027 (Final)
 - South Gloucestershire Council Sustainable Drainage SPD (June 2021)
 - South Gloucestershire Council Strategic – Level 1 Strategic Flood Risk Assessment (Nov 2021)
 - West of England Sustainable Drainage Developer Guide Section 1 (March 2015)
 - Site Topographical Survey by Clifton Surveys Ltd (September 2015)
 - Wessex Water Sewer Asset Records (August 2023)
 - DEFRA Non-statutory technical standards for sustainable drainage systems (2015)
 - CIRIA SuDS Manual (CIRIA C753) (2015)

- Part H of the Building Regulations HM Government (2015)
- Water UK Design and Construction Guidance (DCG) in Appendix C of the Sewerage Sector Guidance (SSG) (2019)
- British Geological Society (BGS) Online Viewer
- DEFRA's online Multi-Agency Geographical Information for the Countryside (MAGIC) Map
- GOV.UK's online Flood Map for Planning and Long Term Flood Maps.
- Cranfield Soil and AgriFood Institute (CSAI) Soilscales mapping.

LIMITATIONS

- 1.9. This report is based on the interpretation and assessment of data provided by third parties.
- 1.10. Whilst every care has been taken to ensure this information is accurate and up-to-date, Structural Solutions is not responsible for the accuracy of the third party data and the conclusions and findings of this report may change if the data is amended or updated after the date of consultation.

2.0 EXISTING SITE SITE LOCATION

- 2.1. The development is located north of Junction 16 of the M5, off Gloucester Road. The closest postcode is BS32 4AB and the site has an approximate central Ordnance Survey Grid Reference of X360526, Y183616. The site comprises approximately 1.22 hectares of land. A Site Location Plan is included in **Appendix A**.

SITE DESCRIPTION

- 2.2. Table 1 describes the general site characteristics, a copy of the site topographical survey is included in **Appendix B**.

TABLE 1		EXISTING SITE CHARACTERISTICS
Site Area		The total site area within the red line boundary is approximately 1.22 ha.
Existing Use		The site currently comprises undeveloped land, and is considered to be greenfield.
General Topography		The site falls from northwest to southeast, with a level of 54.40m AOD at a high point in the northwest and 50.49m AOD in the southern tip (1:50 average gradient). The site is generally vegetated, with the perimeter lined by trees and hedges on the north and eastern sides.
Boundaries	North	Residential properties along Oaklands Drive.
	South	Gloucester Road, beyond which is a Highways depot.
	East	A38 Gloucester Road, beyond which are a tennis club and electrical distribution centre.
	West	Woodside Drive, beyond which is a football club with stadium.
Access		Vehicle access is gained through over a dropped kerb and at the end of a wooden fence (temporarily hoarded off to prevent fly-tipping) at the north-western end of the site off Woodside Drive. Footpath access is also gained through an opening in the stone fence by the bus stop along the A38 on the eastern side of the site.
Flood Zone		The site lies in flood zone 1 (low risk).

GEOLOGY AND HYDROGEOLOGY

- 2.3. British Geological Survey (BGS) mapping indicates that superficial deposits are absent across the site. For the majority of the site, the underlying bedrock geology consists of Penarth Group - Mudstone. For the eastern and southern edges of the site, the underlying bedrock geology consists of Blue Lias Formation - Limestone and mudstone, interbedded.
- 2.4. The Soilsmap mapping identifies the site comprising of slowly permeable seasonally wet, slightly acid but base-rich, loamy and clayey soils with impeded drainage.
- 2.5. According to DEFRA's online Magic Map for Source Protection Zones (SPZ), the site is not located within a groundwater Source Protection Zone or in a Drinking Water Safeguard Zone (Surface Water).

- 2.6. Based on DEFRA's online Magic Map for Groundwater Vulnerability Zones, the bedrock is classified as having a high vulnerability to pollutant discharge. The Magic Map also identifies that significant soluble rocks are likely to be present, which are considered to enable the rapid movement of a pollutant.
- 2.7. The Environment Agency (EA) classifies the underlying bedrock as a Secondary A Aquifer in the south and Secondary (undifferentiated) Unproductive in the north of the site.

EXISTING HYDROLOGY, FLOOD DEFENCES AND STRUCTURES

- 2.8. The topographical survey and OS maps indicate the presence of an ordinary watercourse flowing west to east on the opposite side of the A38 on the east boundary of the site. The watercourse does not enter the site.
- 2.9. SFRA mapping shows no flood defences and no known artificial watercourses in the vicinity of the site.
- 2.10. There is a main river, Patchway Brook, located approximately 600m east from the southernmost point of the site, flowing north to south, downstream of the watercourse described above.



Figure 2 Extract from EA Maps showing Main Rivers and ordinary watercourses

EXISTING SITE DRAINAGE

- 2.11. Extracts from the Wessex Water Statutory Sewer Map have been compiled together and is shown in **Figure 3** below and a copy included in **Appendix C**. The following Wessex Water assets have been identified within and in the vicinity of the site:
- An abandoned 100mm diameter rising main running south to north across the west of the site (which may impede any proposed excavations).
 - 100mm diameter rising main running south to north, just outside the western boundary of the site.
 - A hatch box for access to the rising foul main is located in the southern tip of the site.
 - A network of 150mm and 175mm diameter foul sewers north of the site, serving the residential properties there.
 - A public surface water sewer of unknown size and route is believed to cross the site, as a single Wessex Water surface water manhole is located in the north western corner of the site, believed to serve the residential properties to the north. A CCTV survey will be required to determine its extents.
- 2.12. The rising main sewer described above connect the leisure and commercial plots south of the site (football club and Highways depot) to the foul sewer network north of the site. Wessex Water have confirmed that the 100mm diameter rising main crossing through the site will be subject to a minimum offset easement of 3m on either side of the pipe to allow access for maintenance.
- 2.13. Wessex Water have also confirmed that a foul water connection to the sewer at MH 4605 would be acceptable in principle, but would be subject to a capacity assessment (**Appendix C**).
- 2.14. The upstream and downstream routes of the public surface water sewer are unknown, but there is a short section of public surface water sewer shown north of the site, in the neighbouring residential area, and a private surface water sewer crossing the centre of the site, west to east. A CCTV survey will be required to locate the extents of the public surface water sewer within the site.
- 2.15. Wessex Water maps identified an existing private surface water sewer crossing the site, from west to east and discharging to a local watercourse east of the A38, but do not show its upstream connections. A CCTV survey will be required to locate the extents of the private surface water sewer within the site, and to determine its ownership from upstream connections.
- 2.16. As the site is undeveloped (greenfield), there is no expected private drainage serving the site. Most of the manholes identified by the topographical survey are recorded on Wessex Water maps as either serving public sewers or other ownership private sewers (**Appendix B**). The few unaccounted for manholes will require a CCTV survey to determine the extents and connections.



Figure 3 Compiled extracts from Wessex Water Sewer Records

3.0 PROPOSED DEVELOPMENT

SUMMARY

- 3.1. The proposed development comprises: up to 21 industrial units, accompanying car parks and access roads, and a new public footway along the east side of Woodside Drive
- 3.2. A copy of the development proposals is shown in **Figure 4** and is included in **Appendix D**.

VULNERABILITY CLASSIFICATION

- 3.3. The site use of general industry and accompanying car parks is classified as “less vulnerable” based on Annex 3 in the GOV.UK Flood risk and coastal change guidance.
- 3.4. The site lies in Flood Zone 1.

SEQUENTIAL AND EXCEPTION TESTS

- 3.5. As stated in the NPPF (July 2021), a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.
- 3.6. The development falls in Flood Zone 1 and from Table 2 of the NPPF (extract below), is considered to be in an appropriate location for industrial development and therefore no sequential or exception tests need to be performed.

Table 2: Flood risk vulnerability and flood zone ‘incompatibility’

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓ *

Key:
 ✓ Exception test is not required
 X Development should not be permitted



Figure 4 Proposed Development Layout

4.0 FLOOD RISK ASSESSMENT

- 4.1. The SFRA and other LLFA documents have been used, where appropriate, along with UK Government Flood Mapping in this section of the report to identify fluvial, tidal, groundwater, reservoir, and surface water flooding. Relevant maps are included in **Appendix E**.

FLUVIAL/TIDAL FLOODING

- 4.2. Based on the online GOV.UK Flood Map for Planning, the site is located in Flood Zone 1 (**Figure 5**) where the probability of river or sea flooding is less than 0.1% (1 in 1000) chance in any given year. This is confirmed in the SFRA mapping.
- 4.3. Historical flood records included in the SFRA maps show no flood outlines in the vicinity of the site. The SFRA Flood warning and alert map confirms the site lies outside any affected areas.
- 4.4. Based on the information available, the probability of fluvial and tidal flooding can be assessed as **low**.

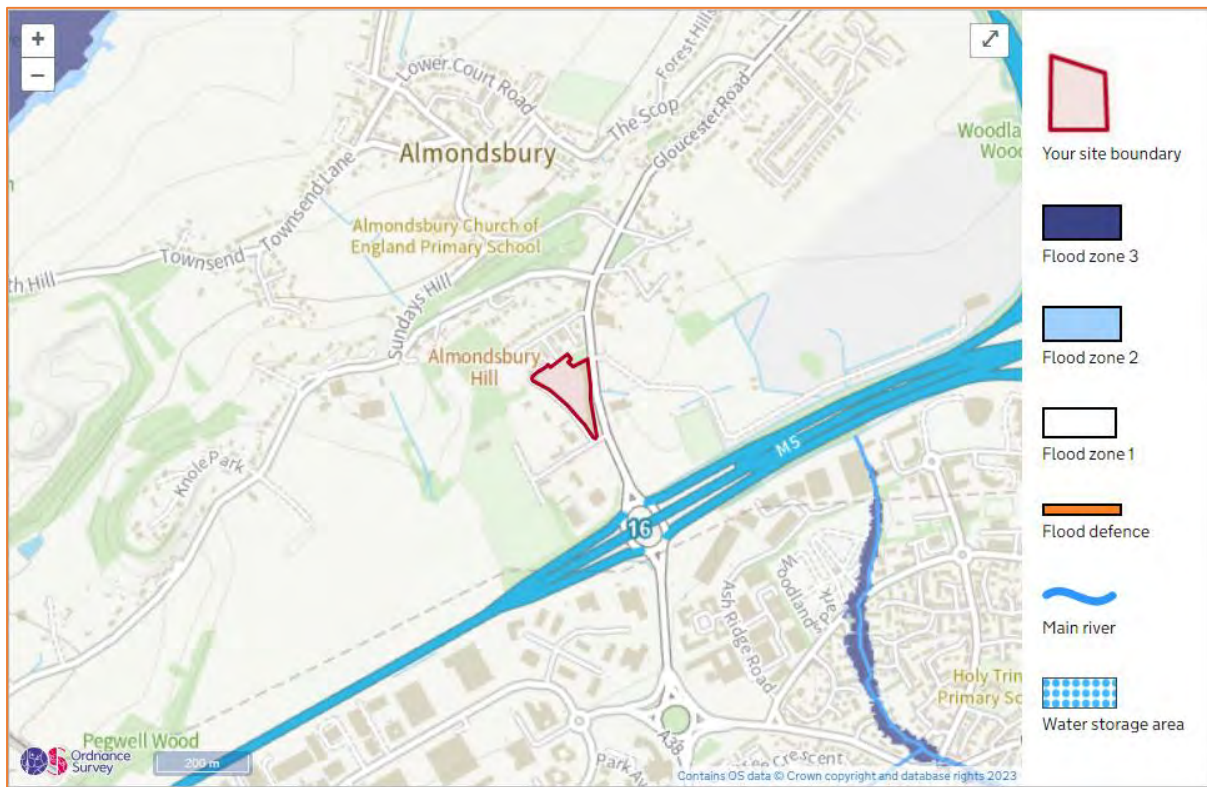


Figure 5 Flood Map for Planning

GROUNDWATER FLOODING

- 4.5. Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather.
- 4.6. Areas Susceptible to Ground Water Flooding (AStGWF) mapping included in the South Gloucestershire Council Preliminary FRA (**Figure 6a**) and the Ground Water Flooding mapping included in the South Gloucestershire Council SFRA (**Figure 6b**) identifies the site at a less than 25% risk.
- 4.7. Based on the information available and the assessment undertaken, the probability of groundwater flooding impacting the site is assessed as being **low**.

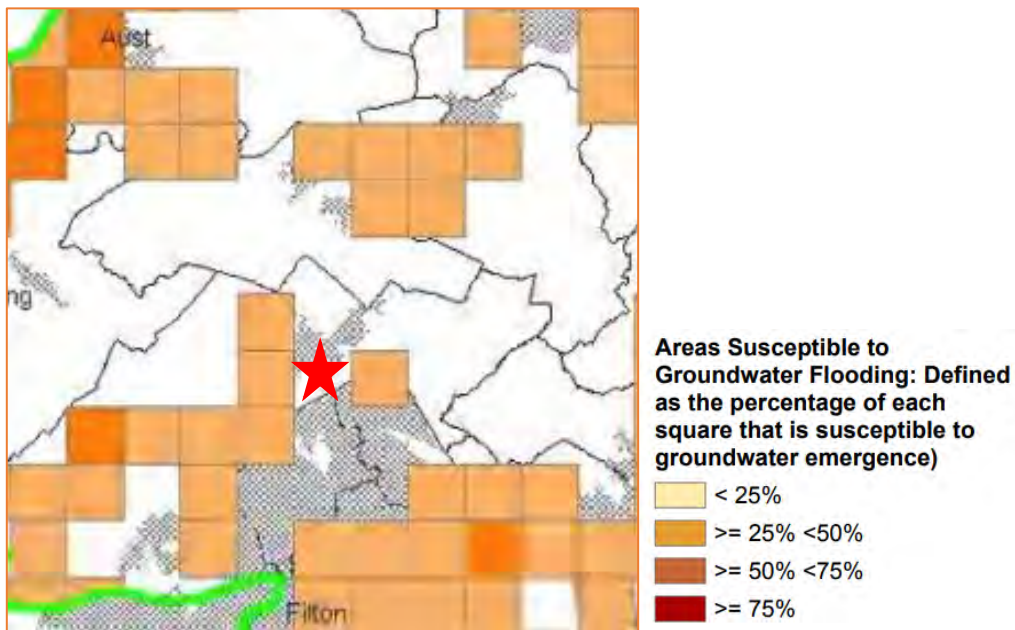


Figure 6a South Gloucestershire Council Preliminary Flood Risk Assessment

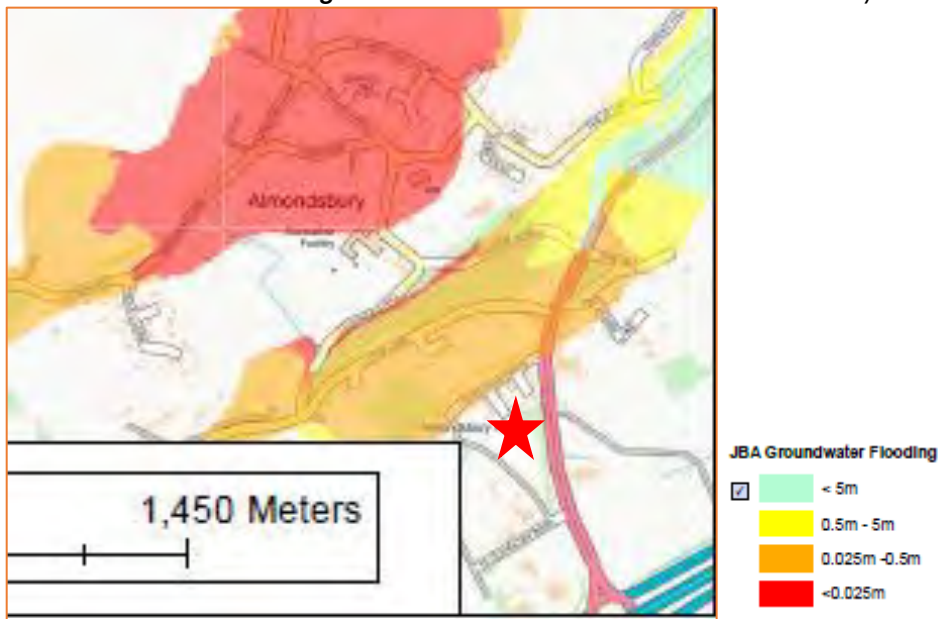


Figure 6b South Gloucestershire Council SFRA Appendix A

SURFACE WATER FLOODING

- 4.8. Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. Localised flooding can be attributed to topographic depressions, insufficient capacity within ordinary watercourses and culverts, as well as obstructions to surface water flow paths.
- 4.9. The online GOV.UK Long Term Flood Risk map identifies that there is generally a very low risk of surface water flooding across most of the site, with a small area of low risk south of centre of the site (where the site gradient becomes much shallower at a local low spot), refer to **Figure 7**.
- 4.10. However, the A38 and Gloucester Road along the western and southern site boundaries are identified as areas of low to high risk (with the high risk area adjacent to the south eastern edge of the site). This is echoed in the SFRA Surface Water Flood Risk mapping where the risk is identified as 1 in 30 year. It is likely that runoff from the site contributes to this surface water ponding, leading to the medium-high overland flow route flowing to the east.
- 4.11. There are also areas of low risk surface water flooding on Woodside Drive and the football club property beyond, bounding the west of the site.
- 4.12. Based on the available information, the probability of surface water flooding within the site is considered **low**. In its existing state, the site contributes to offsite surface water flooding to the southeast.

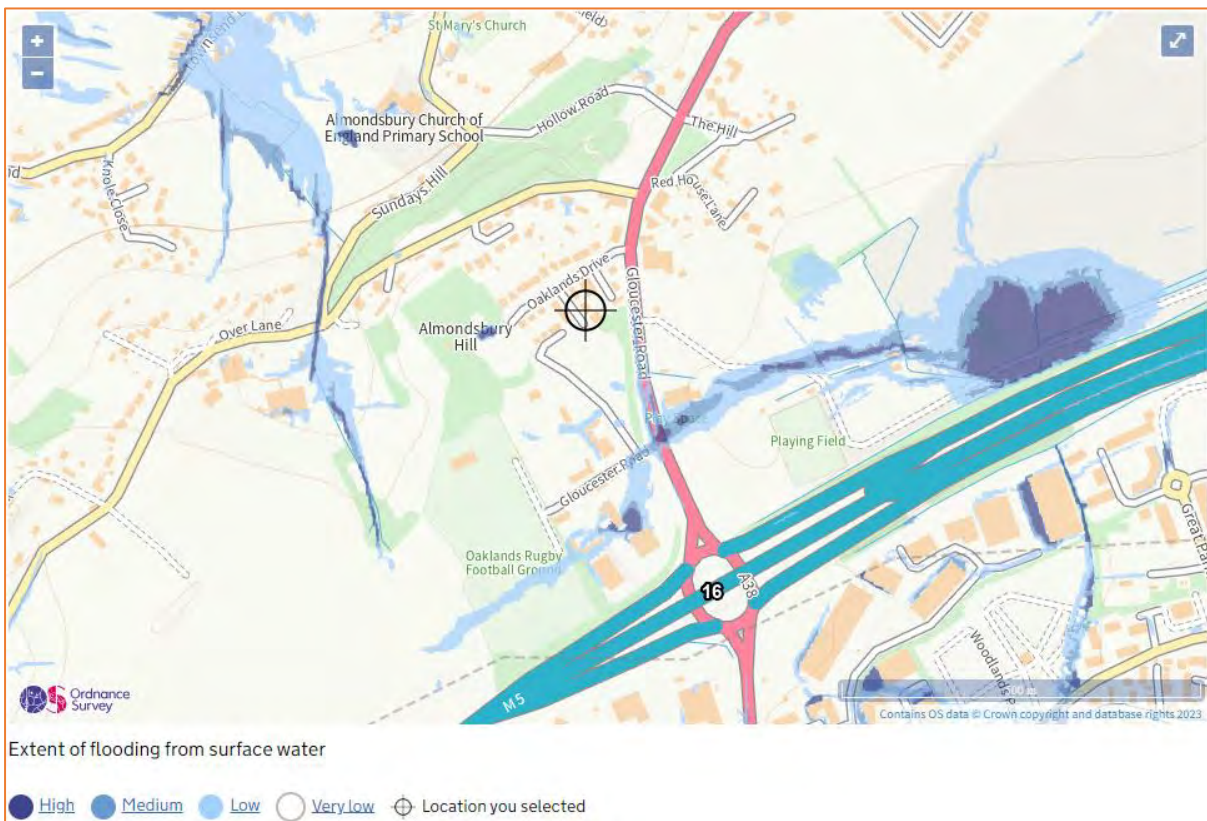


Figure 7 GOV.UK's Long Term Flood Risk Map for Surface Water Flooding

SEWER FLOODING

- 4.13. During heavy rainfall, flooding from the sewer system can occur if:
- The rainfall event exceeds the capacity of the sewer system/drainage system
 - The system becomes blocked by debris, sediment or fat
 - The system surcharges due to high water levels in receiving watercourses
- 4.14. Neither the EA nor LLFA have any records of flooding occurring on site. In the SFRA, Wessex Water provides records of incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. For confidentiality reasons, this data is supplied on a postcode basis from the Sewer Incident Report Form (SIRF) hydraulic overload database. Data covers all reported incidents within the borough between April 2004 and August 2020. The information from the SIRF database shown in the SFRA identifies no incidents within the site postcode.
- 4.15. Based on the information available the probability of sewer flooding impacting the site can be assessed as **low**.

RISK OF FLOODING FROM RESERVOIRS

- 4.16. The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. According to the online GOV.UK's Long Term Flood Risk Map, flooding is unlikely. An area is considered at risk if people's lives could be threatened in the event of a dam or reservoir failure. The site does not lie within the maximum extent of flooding from a breach in reservoirs.
- 4.17. Based on the available information, the probability of flooding from artificial sources can be assessed as **low**.

IMPACT OF CLIMATE CHANGE ON THE PROPOSED DEVELOPMENT

- 4.18. The site is located within Flood Zone 1 where the probability of fluvial and tidal flooding is lower than 0.1% in any year.
- 4.19. The SFRA includes mapping which identifies areas of at risk of impact by climate change on peak river flows. The map provides indicative information on areas which may be sensitive to increases in fluvial flood risk as a result of climate change based on their location in the vicinity of watercourses and floodplains and on local topography. The site is not near any such areas (**Figure 8**).
- 4.20. Surface water runoff could also represent a risk to the site, especially when the effects of climate change are considered. A Drainage Strategy has been produced as part of this study which takes into account the potential impact of climate change.

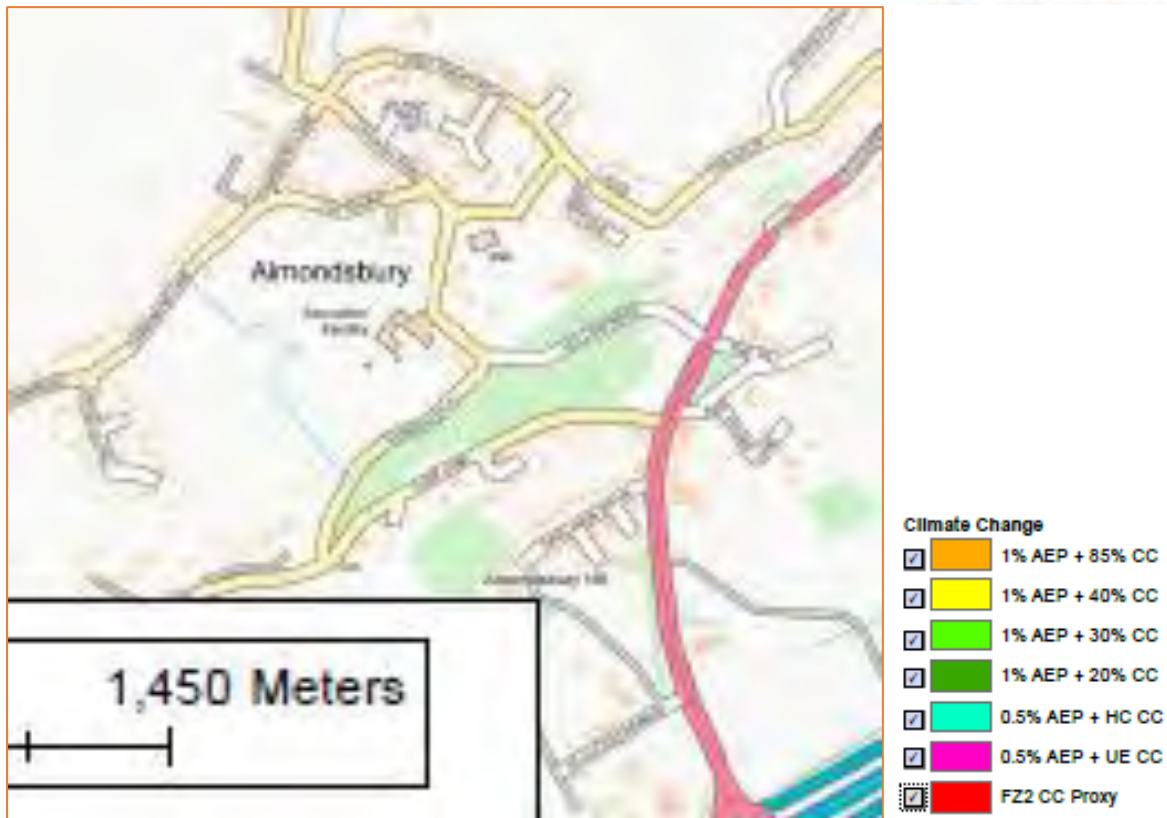


Figure 8 South Gloucestershire Council SFRA Climate Change to Peak River Flows

- 4.21. In May 2022, the peak rainfall allowances in the EA guidance ‘Flood risk assessments: climate change allowances’ were updated so they reflect the latest projections. The main changes are as follows:
- Peak rainfall allowances are provided for ‘management catchments’ rather than a set of single national allowances for England.
 - The 1% and the 3.3% annual exceedance probability events are covered.
 - Two epochs are provided rather than three as previously –the ‘2050s’ and ‘2070s’. 2050s epoch should be used for development with a lifetime up to 2060 and 2070s epoch for development with a lifetime between 2061 to 2125 respectively.
 - Central and upper end allowances are provided as previously, but there is a focus on using the central allowance for development with a lifetime to 2100 and the upper end for development with a lifetime to 2125.
- 4.22. Based on this, the contingency peak rainfall and river flow allowances for climate change that are potentially applicable to this site are as set out in the EA’s Climate Change Allowances mapping as follows:

TABLE 3: AVON BRISTOL AND NORTH SOMERSET STREAMS MANAGEMENT CATCHMENT PEAK RAINFALL ALLOWANCES		
3.3% ANNUAL EXCEEDANCE RAINFALL EVENT		
Epoch	Central Allowance	Upper End Allowance
2050s	20%	35%
2070s	25%	40%
1% ANNUAL EXCEEDANCE RAINFALL EVENT		
Epoch	Central Allowance	Upper End Allowance
2050s	25%	40%
2070s	25%	45%

- 4.23. The Drainage Strategy demonstrates that the drainage network at the site is designed to accommodate runoff during all events up to and including the 100 year plus 45% climate change allowance within the site and therefore prevents potential exceedance flows off-site in line with best practice.
- 4.24. Based on the information available, the risk of flooding from the impacts of climate change can be assessed as **medium**.

SUMMARY OF FLOOD RISK

- 4.25. Structural Solutions have assessed the risk of flooding to the site from all current and future potential sources of flooding. Table 3 summarises the findings of the assessment.

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TABLE 4: DEGREE OF RISK FROM EACH SOURCE OF FLOODING	
Source	Risk
Fluvial / Tidal	Low
Groundwater	Low
Surface Water	Low, offsite flooding can be reduced subject to Flood Risk Management
Sewer	Low
Reservoir	Low
Climate Change	Medium, can be reduced to Low subject to Flood Risk Management

5.0 FLOOD RISK MANAGEMENT AND MITIGATION MEASURES

- 5.1. This section of the report details the flood risk mitigation measures required to manage the identified risk of flooding from different sources. The information below is based on best practice as well as EA and LLFA advice.
- 5.2. As discussed in the previous sections, the potential source of flooding identified that has a reasonable probability of affecting the site area, based on the information collected, is surface water. The effects of climate change could also have an impact on the site.

SITE LOCATION AND LAYOUT

- 5.3. The Environment Agency's Flood Map for Planning indicates that the development is located within Flood Zone 1. 'More vulnerable' land uses (residential developments) are acceptable in Flood Zone 1 as stated in Table 2 of the Flood Risk and Coastal Change Chapter of the Planning Practice Guidance.

SITE LEVELS

- 5.4. Finished site levels should be engineered to provide positive drainage, prevent ponding and channel flows away from the premises during exceedance events. The accumulation of standing water would therefore not occur and thus not pose a risk to the development.
- 5.5. The SFRA does not recommend any minimum floor levels for developments in Flood Zone 1 and finished floor levels may be set a minimum of 150mm above surrounding ground levels. This will mitigate against any flood risk that may occur during an extreme rainfall event and taking future climate change into consideration.

SITE ACCESS AND EGRESS

- 5.6. As the site access and surrounding area are located in Flood Zone 1 with low surface water flood risk, safe routes for access and egress should not be affected by flooding.

SURFACE WATER DRAINAGE STRATEGY

- 5.7. The flood risk is deemed to be low as the site is within Flood Zone 1 however there is a potential risk of surface water flooding from the proposed development if not correctly managed. A new fit-for-purpose drainage system designed with the capacity to safely attenuate surface water runoff to greenfield rates from storms up to and including the 1 in 100-year event, plus a 45% allowance for climate change is proposed in the site surface water drainage strategy.
- 5.8. Details of the proposed outline surface water drainage strategy are included in the following section.
- 5.9. It is unlikely that development on the site would increase flood risk elsewhere with a surface water management scheme in place and would effectively reduce the extent of offsite flooding.

6.0 OUTLINE DRAINAGE STRATEGY

OVERVIEW

- 6.1. It is essential for any new development that surface water is managed effectively to limit the risk off-site as well as on site.
- 6.2. Best practice for the management of surface water based on local SuDS guidance and Building Regulations 2010 Part H states that surface water runoff from a site shall discharge to one of the following in order of priority:
 - Into the ground by infiltration
 - Into a surface water body such as a river, ditch, pond or stream
 - Into a surface water sewer
 - Into a combined sewer.
- 6.3. Sustainable drainage systems (SuDS) will be used to mimic the natural drainage patterns and provide water quantity (storage), water quality (pollution), amenity and biodiversity benefits.

EXISTING SURFACE WATER DISCHARGE REGIME

- 6.4. The site is currently undeveloped (greenfield) and discharges to the highways along the south and eastern site boundaries, following the site topography.
- 6.5. Based on a site area of 1.22 ha, the greenfield runoff rate for the site has been calculated using the loH124 method (ICP SUDS) as 5.5 l/s/ha. A copy of the calculations is included in **Appendix F**.

PROPOSED SURFACE WATER DISCHARGE REGIME

Method of disposal

- 6.6. From the desk study, the underlying bedrock geology comprises primarily of Penarth group-mudstone, with the eastern and southern edges of the site comprising Blue Lias formation – limestone and mudstone, interbedded. The Soilsmap mapping identifies the site comprising of slowly permeable seasonally wet, slightly acid but base-rich, loamy and clayey soils with impeded drainage. It is therefore unlikely that infiltration will provide a suitable method of disposal of surface water.
- 6.7. Where infiltration is not feasible, the drainage hierarchy recommends surface water should be discharged into a watercourse. The closest watercourse lies to the east of the site on the opposite side of the A38, approx. 32m from the site boundary. However, topographical levels, third party land issues and the cost (and disruption to public) in crossing the A38 to form this connection is not viable for the proposed development.
- 6.8. Where connecting to a watercourse is not feasible, the discharge should be to a surface water sewer. Wessex Water sewer maps show a single public surface water manhole on site (in the north western area of site), though the sewer's exact location and size needs to be confirmed. Wessex Water sewer maps also show there are private surface water sewers that run through (west to east) and alongside the site's western boundary (south to north), discharging at the watercourse on the opposite side of the A38.
- 6.9. Drainage surveys will be required to establish the size and location of the existing surface water sewers (both public and private), to determine where a connection can be made. Based on the maps currently available, it appears that connecting to the private surface water sewer would be

the best option, but would necessitate negotiating with the private sewer owner and/or arranging for Wessex Water to adopt the private sewer.

Allowable Discharge Rate

- 6.10. The site's runoff will be restricted to the greenfield rate of 5.5 l/s/ha. This rate will be applied to the proposed impermeable area measured for the development to determine the corresponding proposed discharge rate.
- 6.11. Based on the proposed impermeable area of 6,062m² measured from the masterplan layout (Figure 10), the total allowable discharge rate for the site has been calculated as 3.3 l/s. This will be restricted by a flow control device or pumped outfall.

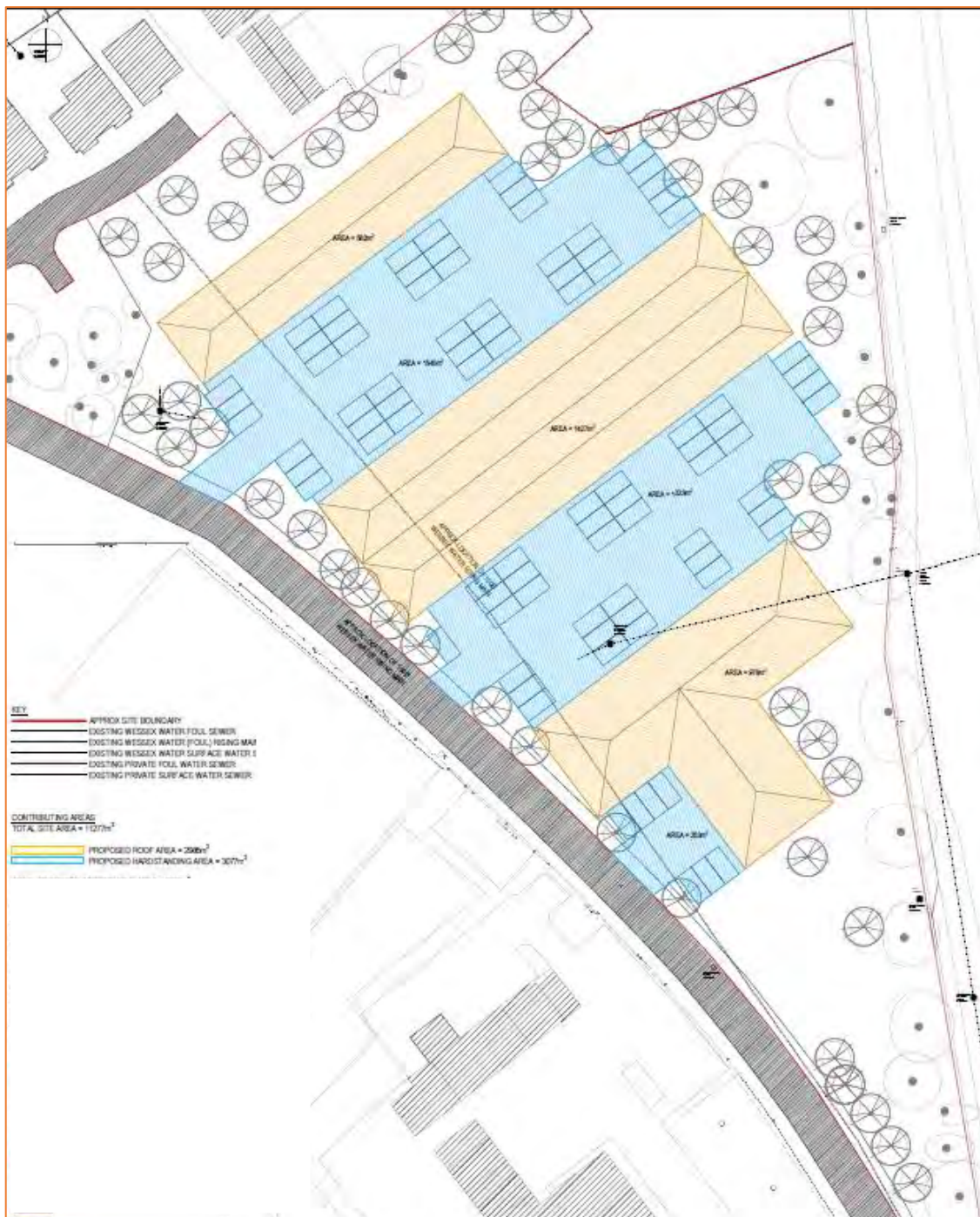


Figure 10 Proposed Site Impermeable Area 6,062m²

Attenuation Storage Requirements

- 6.12. The storage volume for managing surface water to the required rates outlined above was identified through using the HR Wallingford online resource, the surface water storage estimation tool.
- 6.13. The attenuation storage volume was calculated based on the impermeable area of 6,062m² and allowable discharge rate of 3.3 l/s. The total required attenuation storage for the 1 in 100 year plus 45% climate change storm event has been calculated as 465m³. A copy of the hydraulic calculations is included in **Appendix F**.
- 6.14. The storage volume calculated is provisional and should be finalised at the detailed design stage once the site layout has been agreed, and the extent of impermeable surfaces confirmed.
- 6.15. Despite being indicative in nature, through providing the volumes of storage identified above it is demonstrated that no flooding of the site will be caused by rainfall events up to and including the critical 1 in 100 year with 45% climate change event.
- 6.16. National design standards state that there should be no external surface flooding for up to a 1 in 30 year return period design storm and buildings should not be at risk of flooding for up to a 1 in 100 year design storm, plus an allowance for climate change.

Surface Water Sustainable Drainage (SuDS) Features

- 6.17. The SuDS appraisal method defined in the SuDS Manual C753 has been used to identify the most appropriate methods of providing a sustainable surface water attenuation and conveyance to support the development proposals. Potential SUDS features are summarised in the table below.

TABLE 4: SUDS FEATURES						
Type of SuDS	Suitability for Development Proposals and comment					
Rain Gardens/ Raised Planter	Yes	Potential solution for roof runoff depending on location on downpipes (access for maintenance)				
Green Roof	No	Not suitable for pitched roofs proposed				
Permeable Paving	Yes	Potential solution for parking bays				
Swale	N	Not suitable for development due to levels and available space in tree root protection zones				
Geo-cellular Storage (lined)/ PCC tank/ Oversized Pipe	Yes	Potential solution for full development				
Attenuation Basin / Pond	No	Not suitable for development due to levels and associated earthworks required				
Soakaways / infiltration trench	No	Not suitable for development due to poor infiltration on site.				
In-Pipe storage	Yes	Potential solution for full development				
Rainwater Harvesting	Yes	Potential solution i.e. water-butts				

Water Quantity
 Water Quality
 Amenity
 Biodiversity

- 6.18. The use of above ground features on the site to provide amenity and biodiversity benefits will be restricted by the steep gradients at the site and the necessary earthworks and corresponding land take requirements.
- 6.19. The Proposed Drainage Strategy Layout in **Appendix G** shows the proposed attenuation proposals comprising of a below ground storage tank located at the site low point to the south. Permeable paving will be used in parking bays to provide interception as well as water quality benefits at the site. If vehicle loadings rule out the use of permeable paving at the site, an oil interceptor upstream of the attenuation tank should be installed. From a review of the topographical levels, it is likely that a pumped surface water drainage outfall connection will be required.
- 6.20. The surface water drainage strategy is prepared in outline only to demonstrate the proposed development can meet national and local requirements, i.e. in a sustainable manner without increasing the risk of flooding to neighbouring properties for events up to and including the 1 in 100 year storm plus climate change.

WATER QUALITY

- 6.21. Sustainable drainage design must ensure that the quality of any receiving water body is not adversely affected and preferably enhanced before it leaves the site. The simple index approach to water quality risk management outlined in Chapter 26 of the SuDS Manual (CIRIA C753) is therefore adopted.
- 6.22. Table 26.2 of C753 outlines pollution hazard indices for the expected land uses and is summarised in the table below.

TABLE 5: POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS				
Land use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Commercial/industrial Roofs	Low	0.30	0.20 (up to 0.80 where there is potential for metals to leach from the roof)	0.05
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.70	0.60	0.70

6.23. In order to ensure removal of the pollutant loadings as indicated above, a treatment system of SuDS should be used to ensure no onward pollution of the natural aquatic environment. Table 26.3 of C753, summarised in the table below, outlines pollution mitigation potential of various SuDS components

TABLE 6: INDICATIVE SUDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATERS			
SuDS Component	TSS	Metals	Hydrocarbons
Permeable Pavement	0.70	0.60	0.70
Proprietary treatment systems eg oil interceptor	These must demonstrate that they can address each of the contaminant types to acceptable levels to frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

6.24. Through use of the SuDS hierarchy outlined in the table above, it is anticipated that there will be adequate removal of pollutant loadings.

6.25. The site highways drainage will incorporate roadside gullies and silt traps which will also provide a further measure of pollution control of runoff from highways.

OPERATION AND MAINTENANCE

6.26. The new surface water drainage network is expected to be maintained privately and will be designed to be operated and maintained for the lifetime of the development with appropriate access available and management systems in place.

6.27. The SuDS Maintenance Schedule for the development has been included in **Appendix H**.

OVERLAND FLOW & MANAGEMENT OF RESIDUAL RISK

Extreme Storm Event

6.28. As well as managing the surface water generated by the development, any overland flow routes need to be managed within the scheme proposals. The risk of surface water flooding to the site associated with the exceedance of the capacity of the drainage system during an extreme event in excess for which the drainage system was designed can be managed through the following:

- Engineering site levels to ensure flow is directed away from buildings and towards less vulnerable receptors; and
- Construction of a suitably designed drainage system with adequate capacity and storage volume to manage the site surface water runoff, including a suitable allowance for climate change.

6.29. There is a local depression running along the south eastern part of the site, which overland flows would gather in. There is a minimal chance that some water could spill over onto Woodside Drive at the south western edge of the site, from the lowest edge of the depression, but this would be picked up by highways drainage before impacting neighbouring properties.

6.30. A Flood Routing Plan included in **Appendix H** shows the exceedance routes for runoff in extreme events.

Drainage System Failure

6.31. There is a risk associated with blockage or operational failure of the drainage system which could cause flooding. This could include blockage of pipes and/or obstruction of flow control devices and outfalls.

- 6.32. This risk can be reduced through ensuring that the drainage system and SuDS measures are adequately maintained to ensure the drainage system remains serviceable. This includes periodic inspection of outfalls, SuDS features and manholes to ensure inlets and outlets do not become clogged. The SuDS Maintenance Schedule included in **Appendix H** outlines the maintenance regime proposed for the development.

FOUL WATER

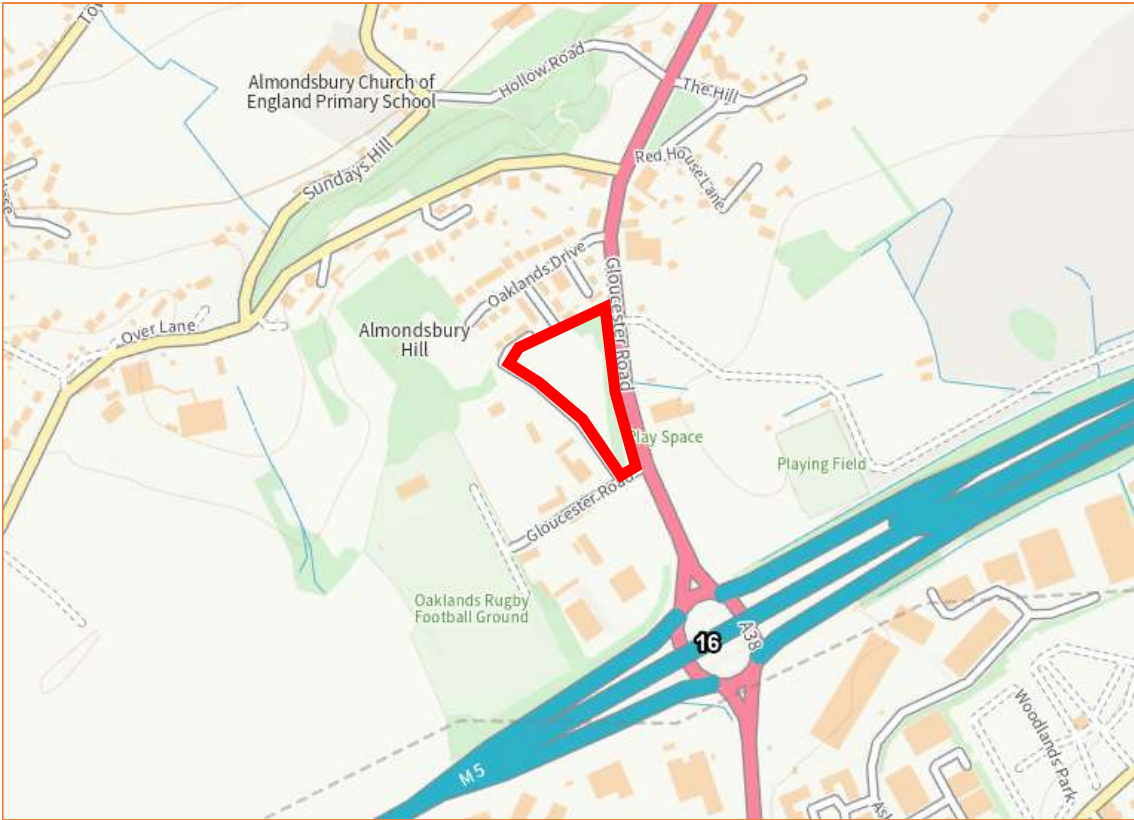
- 6.33. An initial assessment indicates that a foul water gravity connection will not be feasible. Instead, a pumped offsite rising main connection to the 150mm diameter public foul sewer along Oaklands Drive is proposed. This is based on the preliminary ground levels identified on the topographic survey, and by the Wessex Water sewer maps showing existing rising mains along and adjacent to the site.
- 6.34. The exact volume of trade effluent discharge would need to be determined during the detailed design stage.
- 6.35. In their response to an enquiry, Wessex Water agreed to the connection in principle but advised that a capacity assessment would have to be undertaken to ensure that the development was included in planned network upgrades.
- 6.36. The proposed foul drainage strategy showing sewer routes at the site is included on the layout drawing in **Appendix G**.
- 6.37. The new foul water rising main is expected to be adopted and maintained by Wessex Water and will be designed to adoptable standards. to ensure it can be operated and maintained for the lifetime of the development with appropriate access available and management systems in place. The foul water system upstream of the rising main will be privately maintained.

7.0 CONCLUSION

- 7.1. This FRA has been prepared to support the planning application for the proposed development at Land at Woodside Drive, Almondsbury. The development consists of a new industrial development comprising of up to 21 industrial units, with supporting car parks and access roads. The site comprises approximately 1.22 hectares of undeveloped greenfield and is located west of A38 Gloucester Road, at BS32 4AB.
- 7.2. The GOV.UK Flood Map for Planning identifies that the site is located in Flood Zone 1 where the probability of river or sea flooding is less than 0.1% (1 in 1000) chance in any given year and the probability of fluvial flooding is therefore assessed as negligible.
- 7.3. There is an area of high surface water flood risk along the watercourse adjacent to the eastern site boundary. Surface Water from the new development and the effects of climate change could in theory be a source of flood risk. This however has been mitigated by the design of an outline drainage strategy which demonstrates the ability to restrict surface water runoff from the site to greenfield rates during all events up to and including the 100 year plus an appropriate climate change allowance to prevent potential exceedance flows off-site. As such the proposed development will reduce the probability of surface water flooding at the site and in the surroundings.
- 7.4. The site is assessed to be at a medium risk from surface water flooding and climate change. By providing flood management measures (surface water drainage system, locating development in low risk areas) this risk can be reduced to low. The site is at low risk or not at risk from all other sources of flooding.
- 7.5. For the surface water drainage strategy the use of Sustainable Drainage Systems (SuDS) has been integrated into the design. The proposed drainage strategy is summarised as follows:
 - Runoff Destinations – Infiltration is not feasible due to underlying ground conditions. The system will have a pumped discharge to the adjacent surface water sewer which ultimately discharges to watercourse.
 - Peak Flow Control - The discharge rate for draining to the watercourse will be the existing greenfield rate of runoff, calculated by the IoH124 (ICP SuDS) method, as 5.5 l/s/ha and the allowable discharge rate will be 3.3 l/s.
 - Attenuation Storage - All flows will be retained on site for up to the 1 in 100 year design storm plus 45% climate change. Storage will be provided in a below ground tank.
 - Maintenance and Adoption – The offsite foul water rising main will cross into public areas and will be constructed in accordance with Water UK's Code for Adoption Agreements (the Design and Construction Guidance document) and adopted by Wessex Water. All other drainage proposed will be privately operated and maintained.
 - Water Quality - The simple index approach to water quality risk management (Chapter 26 of the SuDS Manual) is applied to ensure adequate removal of the pollutant loadings for no onward pollution of the natural aquatic environment. Permeable paving installed in the development parking bays or an oil interceptor will provide the water treatment required.

APPENDIX A

Site Location



APPENDIX B

Topographical Survey

STANDARD REFERENCES	
AS/NZS 1100	AS/NZS 1100:2006
AS/NZS 1101	AS/NZS 1101:2006
AS/NZS 1102	AS/NZS 1102:2006
AS/NZS 1103	AS/NZS 1103:2006
AS/NZS 1104	AS/NZS 1104:2006
AS/NZS 1105	AS/NZS 1105:2006
AS/NZS 1106	AS/NZS 1106:2006
AS/NZS 1107	AS/NZS 1107:2006
AS/NZS 1108	AS/NZS 1108:2006
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AS/NZS 1198	AS/NZS 1198:2006
AS/NZS 1199	AS/NZS 1199:2006
AS/NZS 1200	AS/NZS 1200:2006



420.00 N

380.00 N

340.00 N

300.00 N

260.00 N

220.00 N

180.00 N

40.00 E

80.00 E

120.00 E

160.00 E

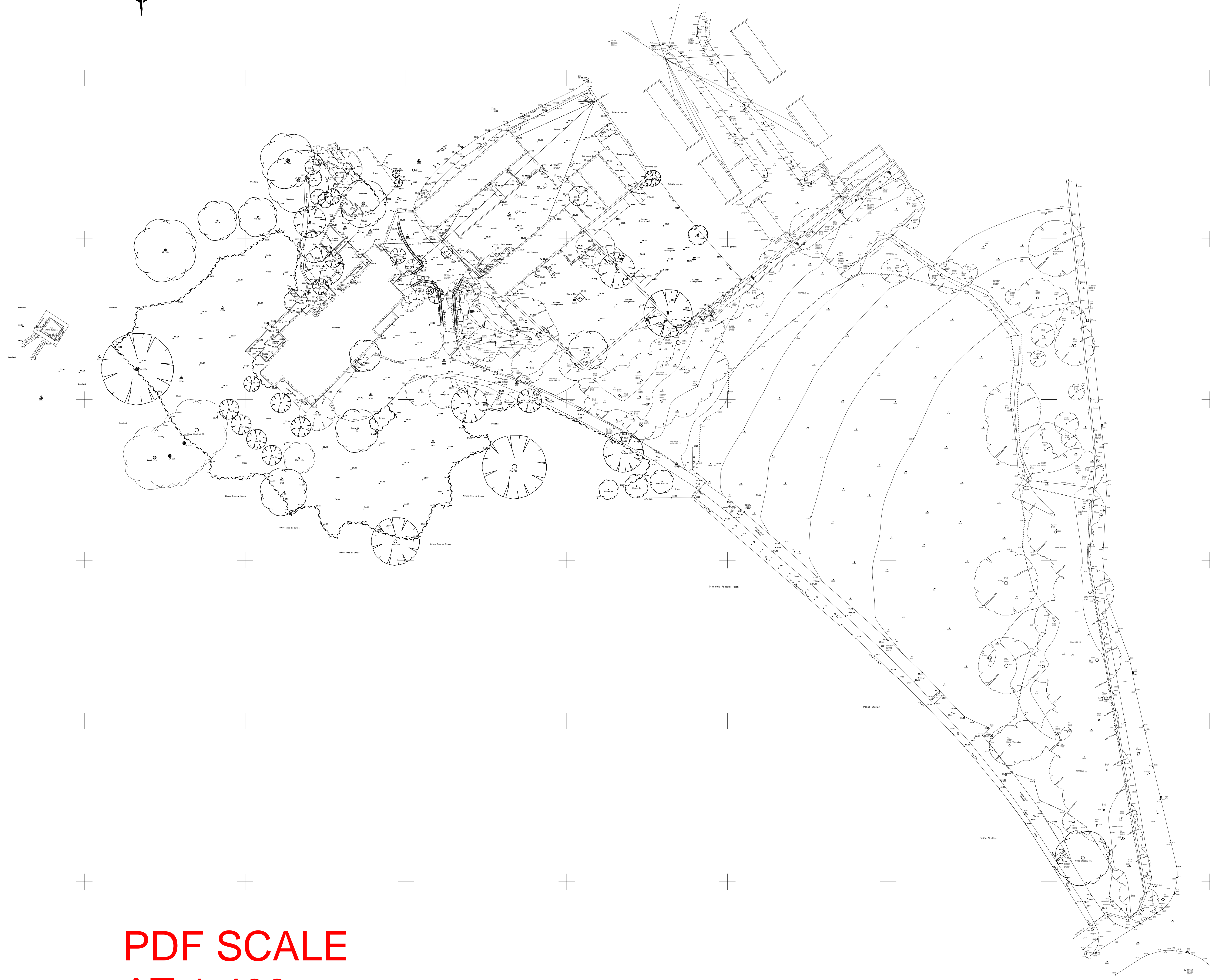
200.00 E

240.00 E

280.00 E

320.00 E

**PDF SCALE
AT 1:400**



APPENDIX C

Wessex Water Sewer Record Drawings and Correspondence (WW & LLFA)



SEWERS	STRATEGIC	PUBLIC	PRIVATE	SECTION 104	OTHER WESSEX PIPES	NON-WESSEX / UNKNOWN
Foul	Red line with arrow	Red line with arrow	Red line with arrow	Red line with arrow	Rising Mains	Private Rising Mains
Surface	Blue line with arrow	Blue line with arrow	Blue line with arrow	Blue line with arrow	Standby Rising Mains	Culverted Watercourse
Combined	Blue line with arrow	Blue line with arrow	Blue line with arrow	Blue line with arrow	Effluent Disposal	Highway Drain
Abandoned	Blue line with arrow	Blue line with arrow	Blue line with arrow	Blue line with arrow	Overflow	Use Unknown
	Blue line with arrow	Blue line with arrow	Blue line with arrow	Blue line with arrow	Syphon	Status Unknown

SKETCH

TITLE: WESSEX WATER MAP (COMBINED)

SKETCH NO: -

PROJECT NO: 10165FDL5

BY: ABK CHK: - DATE: 23/08/23

REV: - SCALE: 1:500@A1

ISSUED TO: -

Christos Sibanda

From: Teddy Takyi-Amuah <Teddy.Takyi-Amuah@wessexwater.co.uk>
Sent: 04 January 2022 10:01
To: Christos Sibanda
Cc: Nick Sibanda
Subject: WWRESP: ST68SW/ 5476 : DEV ENQ_ 12716 Oakland Drive, Almondsbury - Foul water discharge point

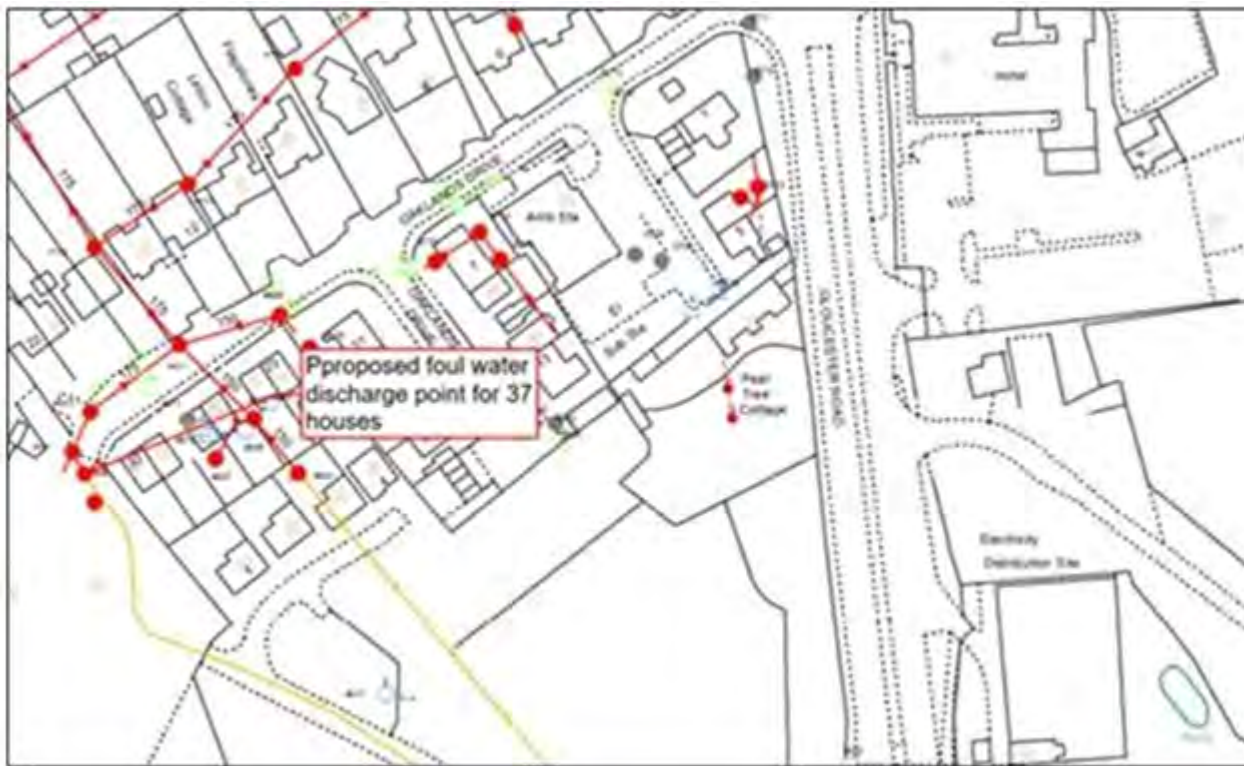
SharePoint document links:

[PT12_3329_F-SG_SITE_PLAN-4419137.pdf](#) [WWMH-4605.PDF](#) [WWMH 4617.PDF](#) [perceived site boundary.PDF](#)

Good morning Christos,

Re: Oakland Drive, Almondsbury

Many thanks for your email on the above proposal. The thread below led me to believe that there is no site layout at the moment, so I tried contacting you earlier; In the following comments, I base my conclusions on the approved site allocation (*with conditions*) and the attached "PT12/3329/F OUTLINE site boundary."



Foul drainage

Based on the attached “perceived phasing site boundary”, it was anticipated that approximately 30 dwellings would be offered for this part of the allocation. An agreed-upon point of connection was established to ST6083 4605 within Oaklands Drive, subject to planning consent which will influence the final/approved layout and method of conveyance. Pump rate and times will be agreed upon by applying for a connection.

The recorded cover level for MH 4605 is 85.850, with no invert recorded.

Surface Water

The SW comments within the thread are noted. As part of discussions on the wider allocation, MH 4617 was determined to be a public sewer under Section 105A, given its service to multiple properties north of it. Wessex water will need confirmation and locations of all public sewer lengths that need to be abandoned or diverted. A detailed CCTV survey must be conducted upstream and downstream of this sewer, as well as show all existing private pipes/connections within the site, if possible. 5502 is recorded as private.

Any findings must be reviewed with Wessex Water as the site progresses and details come forward through planning, A Section 104 and/or Section 185 application. Please note the attached WW MH 4617 showing the approximate position. Statutory easements will apply where works proposed to encroach these public assets.

I hope the above is enough to proceed with the design. A review of the contents of this email will be required where 18 months or more have elapsed. In the light of significant variations, any changes that are likely to impact upon the response (e.g. changes in drainage strategy, development numbers, or phasing) will need to be discussed with Wessex Water.

Kind regards,

Teddy Amuah
Planning Liaison / Wessex Water
Claverton Down Bath BA2 7WW
wessexwater.co.uk

From: Mark Prebble <Mark.Prebble@wessexwater.co.uk>
Sent: 21 December 2021 09:19
To: Christos Sibanda <Christos.Sibanda@craddys.co.uk>

Cc: Nick Sibanda <Nick.Sibanda@craddys.co.uk>; Planning Liaison <planning.liaison@wessexwater.co.uk>; Development North <Development.North@wessexwater.co.uk>

Subject: RE: DEV ENQ_ 12716 Oakland Drive, Almondsbury - Foul water discharge point

Hi Christos

It'll depend on how many properties but you're best off going to Planning and Liaison in the first instance for a capacity appraisal.

Mark Prebble
Development Engineer

Please note the new Sewerage Sector Guidance was implemented on April 1st 2020 and that SFA has been replaced by the Design and Construction Guidance. Further details are available here [Water UK](#) and from your local Developer Services team.

Wessex Water
Kennet Way Trowbridge BA14 8RN

Tel: 01225 522685
Mob: 07341 090056
wessexwater.co.uk

From: Christos Sibanda <Christos.Sibanda@craddys.co.uk>

Sent: 20 December 2021 15:59

To: Mark Prebble <Mark.Prebble@wessexwater.co.uk>

Cc: Nick Sibanda <Nick.Sibanda@craddys.co.uk>; Planning Liaison <planning.liaison@wessexwater.co.uk>; Development North <Development.North@wessexwater.co.uk>

Subject: RE: DEV ENQ_ 12716 Oakland Drive, Almondsbury - Foul water discharge point

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognise the sender and know the content is safe.

Hi Mark,

Further to email below, let me know if the site can discharge foul water drainage to manhole 4626, as identified below, via pumping.



Regards,

Christos Sibanda

BSc (Hons) IEng MICE
Principal Engineer
(07825854741)

CRADDYS

63 Macrae Road , Eden Office Park , Ham Green , Bristol , BS20 0DD , Tel: 01275 371333
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www.craddys.co.uk

From: Christos Sibanda

Sent: 14 December 2021 10:38

To: 'Mark Prebble' <Mark.Prebble@wessexwater.co.uk>

Cc: Nick Sibanda <nick.sibanda@craddys.co.uk>; Planning Liaison <planning.liaison@wessexwater.co.uk>; Development North <Development.North@wessexwater.co.uk>

Subject: RE: DEV ENQ_ 12716 Oakland Drive, Almondsbury - Surface water discharge point

Thanks Mark,

We shall probably discharge to the watercourse as well.

Regards,

Christos Sibanda

BSc (Hons) IEng MICE
Principal Engineer
(07825854741)

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www.craddys.co.uk

From: Mark Prebble <Mark.Prebble@wessexwater.co.uk>
Sent: 14 December 2021 09:14
To: Christos Sibanda <Christos.Sibanda@craddys.co.uk>
Cc: Nick Sibanda <Nick.Sibanda@craddys.co.uk>; Planning Liaison <planning.liaison@wessexwater.co.uk>; Development North <Development.North@wessexwater.co.uk>
Subject: DEV ENQ_ 12716 Oakland Drive, Almondsbury - Surface water discharge point

Hi Christos

The short answer is no. Our records show the SW network in this area as private and I've added some comments to your plan for reference. I also disagree with SGC's view that simply because we allocate a MH reference it's ours.

I trust this helps but please don't hesitate to get in touch if you wish to discuss any aspect of this.

Regards

Mark Prebble
Development Engineer

Please note the new Sewerage Sector Guidance was implemented on April 1st 2020 and that SFA has been replaced by the Design and Construction Guidance. Further details are available here [Water UK](#) and from your local Developer Services team.

Wessex Water
Kennet Way Trowbridge BA14 8RN

Tel: 01225 522685
Mob: 07341 090056
wessexwater.co.uk



From: Christos Sibanda <Christos.Sibanda@craddys.co.uk>
Sent: 14 December 2021 08:48
To: Development North <Development.North@wessexwater.co.uk>
Cc: Mark Prebble <Mark.Prebble@wessexwater.co.uk>; Nick Sibanda <Nick.Sibanda@craddys.co.uk>
Subject: 12716 Oakland Drive, Almondsbury - Surface water discharge point

[EXTERNAL EMAIL] DO NOT CLICK links or attachments unless you recognise the sender and know the content is safe.

Hi Mark,

We are involved in the development at Oakland Drive, Almondsbury, BS32 4AG. Could you let me know if the surface water sewer which serves the Gloucestershire Football Association and nearby properties is a public sewer because of the Blanket Adoption. Refer to the attached sketch for the sewer location.

I approached South Glos who confirmed that the drains are not Highway drains. See email below. They have confirmed that we can discharge to the sewer at greenfield runoff rates, if it is a public sewer.

Regards,

Christos Sibanda

BSc (Hons) IEng MICE
Principal Engineer
(07825854741)

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63 Macrae Road , Eden Office Park , Ham Green , Bristol , BS20 0DD , Tel: 01275 371333

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www.craddys.co.uk

From: LeadLocalFloodAuthority <LeadLocalFloodAuthority@southglos.gov.uk>

Sent: 08 December 2021 15:33

To: Nick Sibanda <Nick.Sibanda@craddys.co.uk>

Cc: Christos Sibanda <Christos.Sibanda@craddys.co.uk>

Subject: RE: 12716 Oakland Drive, Almondsbury - Surface water discharge point [EXTERNAL]

Hi Christos.,

Further to my initial email outlined below., having checked our mapping layers I can confirm that we have no recorded Highway Drainage assets within the site boundary area proposed. Our records mirror that of Wessex Water's in as much that ours show them as a limited recording of Public Sewers at **Manhole 4617 & 5502**, rather than private as within their plan you provided.

It is worth noting that in my experience, where manholes have designated node numbers they are typically Wessex vested assets which our records also suggest were transferred under a Section 105.

I would therefore re-check with Wessex to re-clarify.

Finally, The site would be required to restrict to **Greenfield Qbar** for all events up to the 100Yr + CC (currently 40%).

Best Regards

Lynton Seymour EngTech MICE
Assistant Engineer (Drainage)
(Flood & Water Management Team)
StreetCare, Transport & Waste

Department of Environment and Community Services

[Tel:01454 86 3523](tel:01454863523)
[M: 07824-081080](tel:07824081080)
[E: Lynton.Seymour@southglos.gov.uk](mailto:Lynton.Seymour@southglos.gov.uk)
[E: leadlocalfloodauthority@southglos.gov.uk](mailto:leadlocalfloodauthority@southglos.gov.uk)

Postal Address:

South Gloucestershire Council
PO BOX 1954
Drainage and Flood Risk Management Team
Bristol
BS37 0DD

<http://www.southglos.gov.uk/environment/drainage-and-flood-risk-management/>

From: LeadLocalFloodAuthority
Sent: 08 December 2021 15:06
To: 'Nick Sibanda' <Nick.Sibanda@craddys.co.uk>
Subject: RE: 12716 Oakland Drive, Almondsbury - Surface water discharge point [EXTERNAL]
Importance: High

Afternoon Christos.,

I note your email has two addresses, is this two addresses for you or two separate colleagues ? In regard to your query in this a preliminary enquiry or one attached to an ongoing or current application ? and if so do you have the application number to hand.

Best Regards

Lynton Seymour EngTech MICE
Assistant Engineer (Drainage)
(Flood & Water Management Team)
StreetCare, Transport & Waste
Department of Environment and Community Services

[Tel:01454 86 3523](tel:01454863523)
[M: 07824-081080](tel:07824081080)
[E: Lynton.Seymour@southglos.gov.uk](mailto:Lynton.Seymour@southglos.gov.uk)
[E: leadlocalfloodauthority@southglos.gov.uk](mailto:leadlocalfloodauthority@southglos.gov.uk)

Postal Address:

South Gloucestershire Council
PO BOX 1954
Drainage and Flood Risk Management Team
Bristol
BS37 0DD

<http://www.southglos.gov.uk/environment/drainage-and-flood-risk-management/>

From: Nick Sibanda [<mailto:Nick.Sibanda@craddys.co.uk>]
Sent: 07 December 2021 09:32
To: LeadLocalFloodAuthority <LeadLocalFloodAuthority@southglos.gov.uk>
Cc: Christos Sibanda <Christos.Sibanda@craddys.co.uk>
Subject: FW: 12716 Oakland Drive, Almondsbury - Surface water discharge point [EXTERNAL]

There has been a three-fold increase in ransomware attacks 2020-21

Do not click links or open attachments in emails you do not recognise. If you are unsure, contact the South Gloucestershire Council [ITD Service Desk](#).

Dear Sirs,

My client is proposing to develop the site at Oakland Drive, Almondsbury, BS32 4AG with some residential units. The site layout is not yet finalised. I attach drawing number 12716sk0002a that shows the site boundary.

Proposed surface water drainage. It is proposed to discharge surface water drainage at greenfield runoff rates to the private (highway ?) drain that passes across the site. The drain is marked-up on drawing number 12716sk0002a. It is also on the Wessex Water map.

We consulted Wessex Water and they said that they do not own the drain. See emails below.

Regards,

Christos Sibanda
BSc (Hons) IEng MICE
Principal Engineer
CRADDYS

63 Macrae Road, Eden Office Park, Ham Green, Bristol, BS20 0DD, Tel: 01275 371333
Craddy Pitchers Ltd incorporated in England and Wales registered no 4949876 VAT no 397 4590 95
www.Craddys.co.uk

From: Mapping <asset.enquiries@wessexwater.co.uk>
Sent: 25 November 2021 11:47
To: Christos Sibanda
Subject: FW: 12716 Surface water sewer at Oakland Drive, Almondsbury

I can confirm the water main is private and have provided you with clearer plans of our assets

From: Christos Sibanda <Christos.Sibanda@craddys.co.uk>
Sent: 25 November 2021 11:18
To: Mapping <asset.enquiries@wessexwater.co.uk>
Cc: Nick Sibanda <Nick.Sibanda@craddys.co.uk>
Subject: 12716 Surface water sewer at Oakland Drive, Almondsbury

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Dear Sirs,

We are involved in the development at Oakland Drive, Almondsbury, BS32 4AG. Could you let me know if the surface water sewer which serves the Gloucestershire Football Association and nearby properties is a public sewer because of the Blanket Adoption. Refer to the attached sketch for the sewer location.

Regards,

Christos Sibanda
BSc (Hons) IEng MICE
Principal Engineer
(07825854741)

CRADDYS

63 Macrae Road , Eden Office Park , Ham Green , Bristol , BS20 0DD , Tel: 01275 371333
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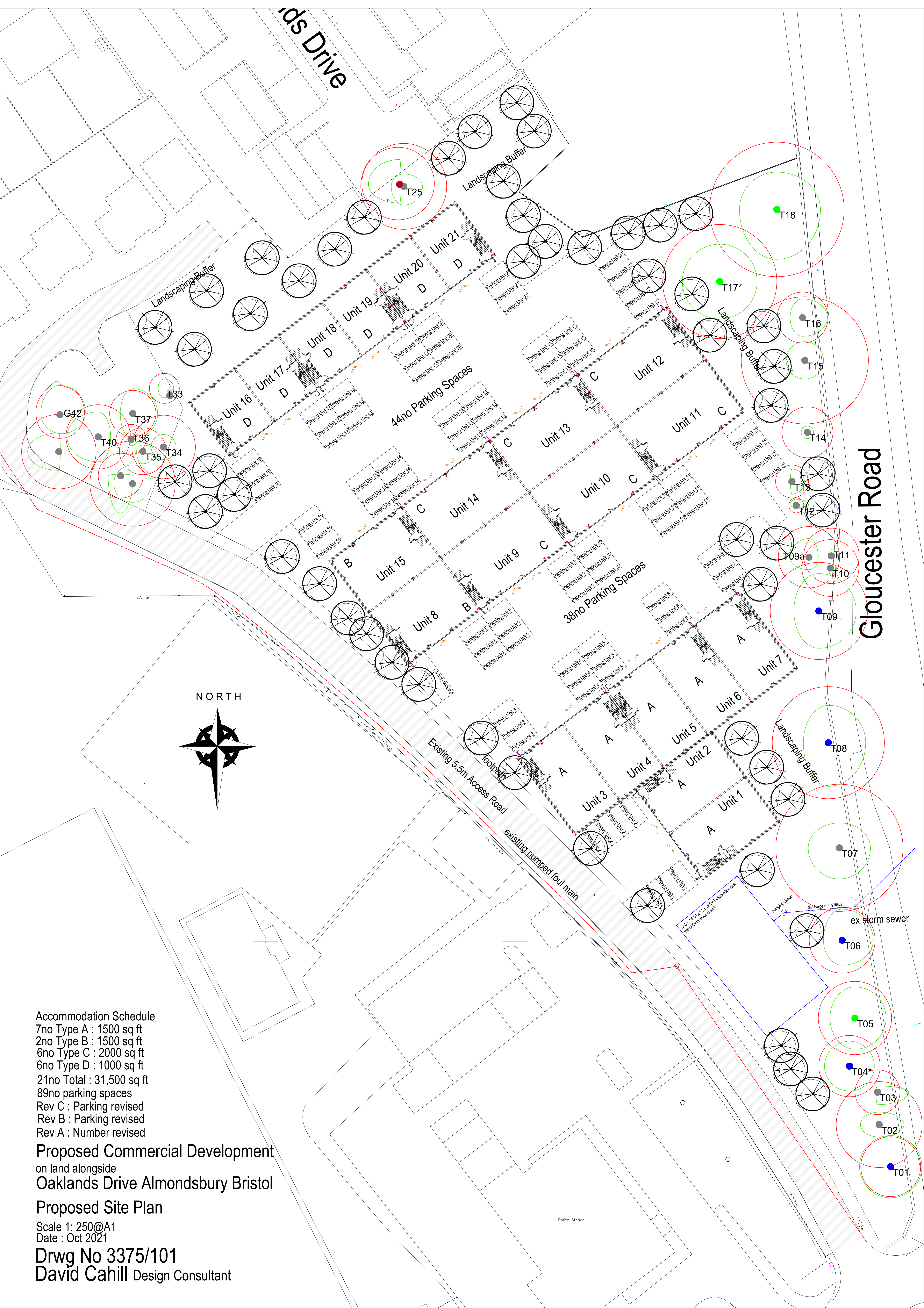
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APPENDIX D

Proposed Site Layout



Accommodation Schedule
 7no Type A : 1500 sq ft
 2no Type B : 1500 sq ft
 6no Type C : 2000 sq ft
 6no Type D : 1000 sq ft
 21no Total : 31,500 sq ft
 89no parking spaces
 Rev C : Parking revised
 Rev B : Parking revised
 Rev A : Number revised

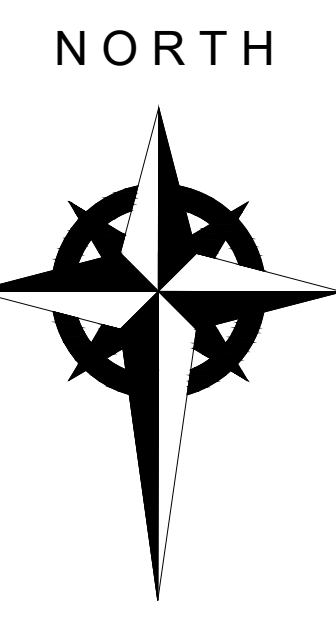
Proposed Commercial Development
 on land alongside
Oaklands Drive Almondsbury Bristol

Proposed Site Plan

Scale 1: 250@A1
 Date : Oct 2021

Drwg No 3375/101
David Cahill Design Consultant

Gloucester Road



Police Station

ex storm sewer

12.5 x 24 (0.7 x 2.2m) 600mm alternation tank
 min 60min cover to tank

pumping station
 discharge rate 2 lit/sec

0.25

0.25

0.25

0.25

0.25

0.25

0.25

0.25

0.25

0.25

0.25

0.25

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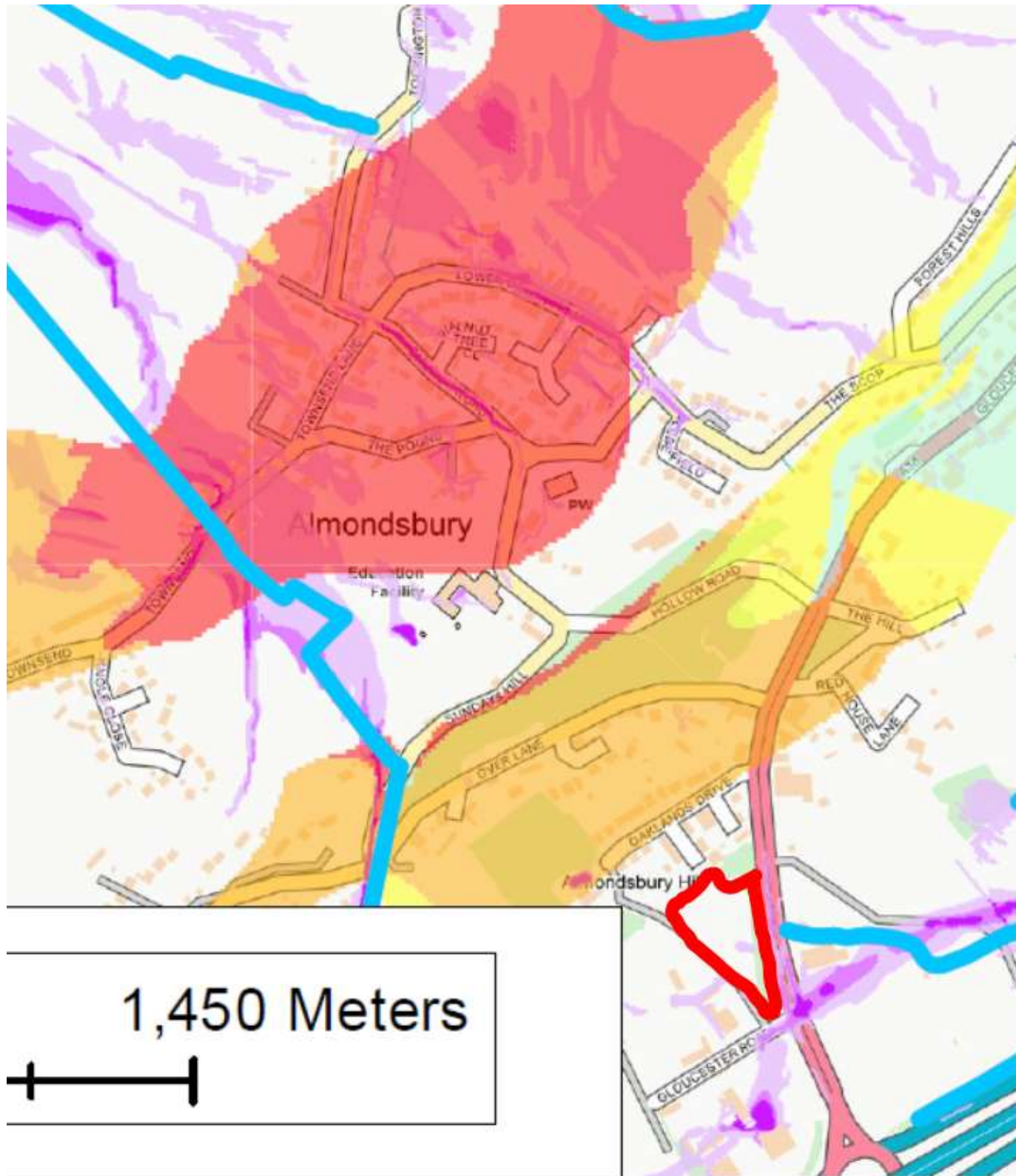
0.25

0.25

APPENDIX E

Flood Maps

South Gloucestershire Level 1 Strategic Flood Risk Assessment drawing ref C2



Legend

- South Gloucestershire Council Boundary
 - Statutory Main Rivers
 - Detailed River Network
- Environment Agency - Flood Warnings & Flood Alerts**
- Flood Warning Areas
 - Flood Alert Areas
- Flood Zones**
- Indicative Flood Zone 3b
 - Flood Zone 3b
 - Flood Zone 3a
 - Flood Zone 2
- JBA Groundwater Flooding**
- < 5m
 - 0.5m - 5m
 - 0.025m - 0.5m
 - < 0.025m
- Flood Defences**
- Demountable Defence
 - Embankment
 - Flood Gate
 - High Ground
 - Wall
 - 8m buffer
- Historic Flood Map**
- Historic Flood Map
 - Historic Flood Outlines
- Risk of Flooding from Surface Water**
- RoFSW 1 in 30 year
 - RoFSW 1 in 100 year
 - RoFSW 1 in 1000 year
- Climate Change**
- 1% AEP + 85% CC
 - 1% AEP + 40% CC
 - 1% AEP + 30% CC
 - 1% AEP + 20% CC
 - 0.5% AEP + HC CC
 - 0.5% AEP + UE CC
 - FZ2 CC Proxy

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
360513/183581

Created
24 Aug 2023 9:58

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following**:

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>

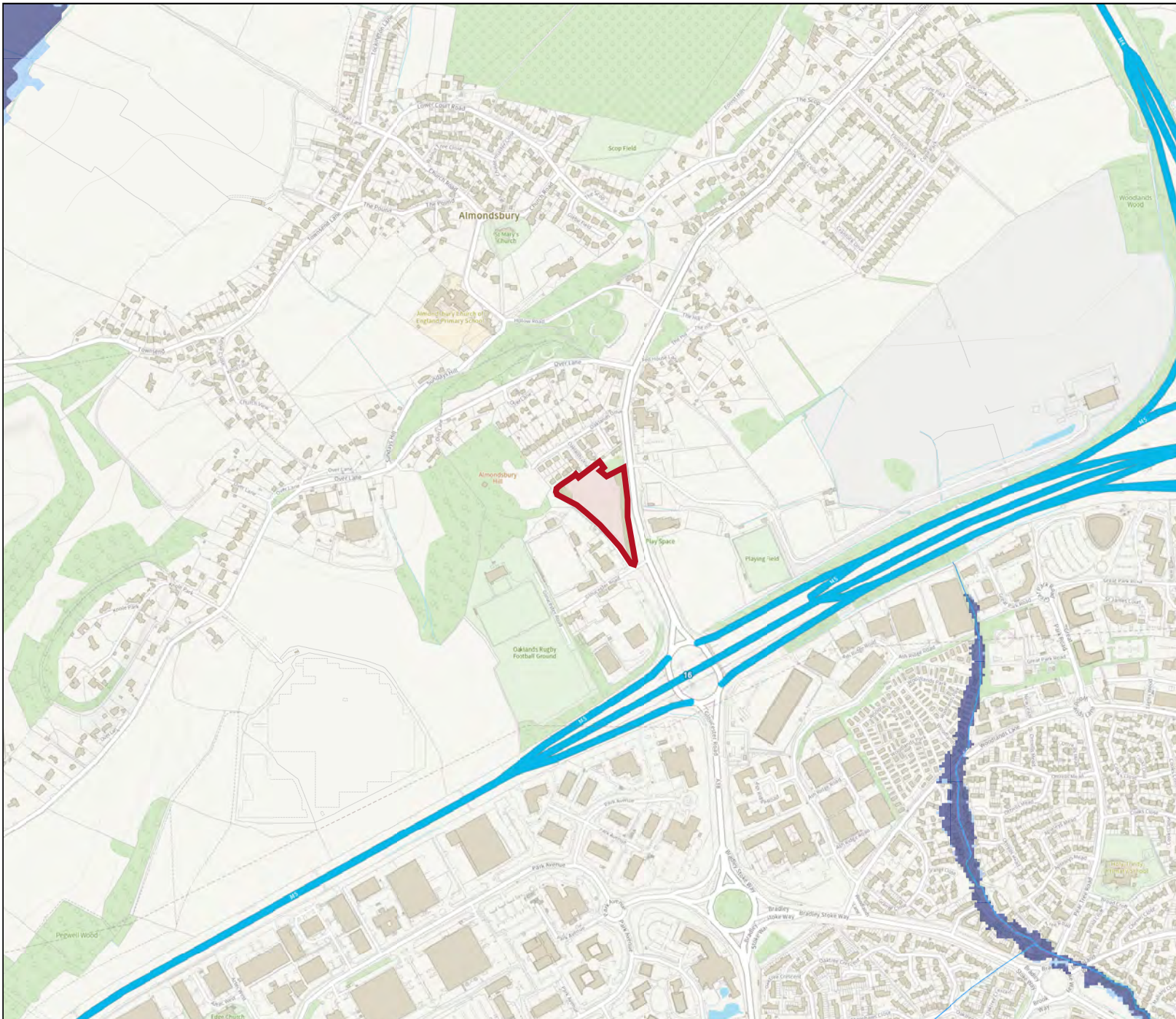
Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
360513/183581

Scale
1:10000

Created
24 Aug 2023 9:58



-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

0 100 200 300m

APPENDIX F

Drainage Strategy Calculations

Calculated by: Adam Bukowski-Kruszyna

Site name: Oaklands

Site location: Almondsbury

Site Details

Latitude: 51.54984° N

Longitude: 2.57054° W

Reference: 554613226

Date: Aug 24 2023 14:00

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	780	780
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Q_{BAR} (l/s):	6.03	6.03
1 in 1 year (l/s):	5	5
1 in 30 years (l/s):	12.05	12.05
1 in 100 year (l/s):	15.49	15.49
1 in 200 years (l/s):	18.32	18.32

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	100.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.350	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Storage	0.606	100.000	1200	0.000	0.000	3.000

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.350	Additional Storage (m ³ /ha)	0.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	45	0	0

Node Storage Online StormBrake™ Control

Flap Valve	x	Design Flow (l/s)	3.3
Replaces Downstream Link	✓	Product Code	FPM-SB1-01600-00330-1100
Invert Level (m)	97.000	Min Outlet Diameter (m)	0.150
Design Depth (m)	1.600	Min Node Diameter (mm)	1200

Node Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	97.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	308.0	0.0	1.600	308.0	0.0	1.601	0.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	Storage	360	97.271	0.271	11.4	79.5375	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
480 minute winter	Storage	StormBrake™	3.1	97.5

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
600 minute winter	Storage	585	97.748	0.748	20.5	219.7538	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
600 minute winter	Storage	StormBrake™	3.1	110.1

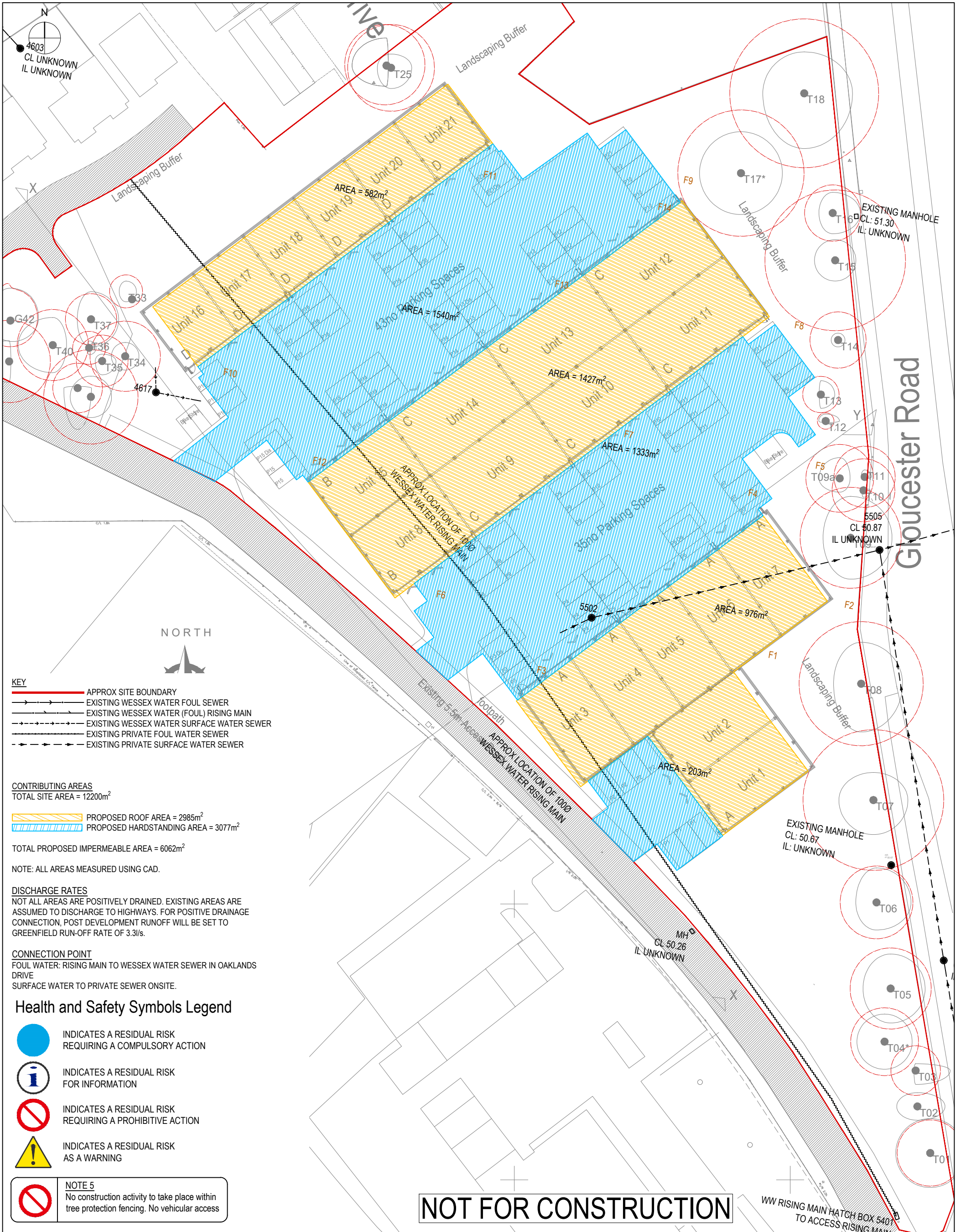
Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
960 minute winter	Storage	930	98.579	1.579	26.7	463.7438	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m ³)
960 minute winter	Storage	StormBrake™	3.3	194.4

APPENDIX G

Drainage Strategy Drawings



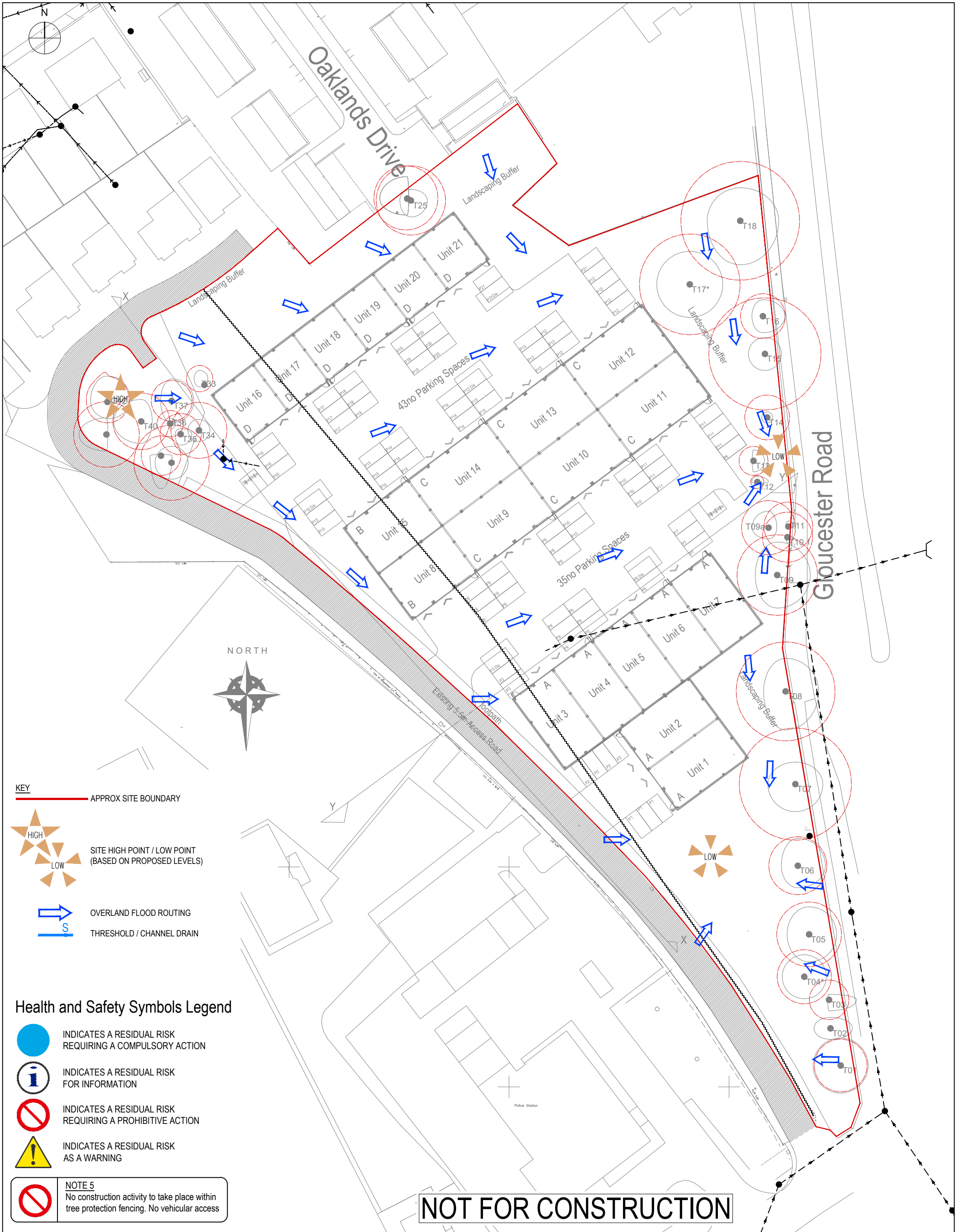
P2 28/11/23 MINOR AMENDMENTS		DT	RV	PROJECT LAND AT WOODSIDE DRIVE, ALMONDSBURY		SHEET SIZE A3
P1 06/10/23 ISSUED WITH FRA REPORT				TITLE DRAINAGE CONTRIBUTING AREAS		
REV	DATE	AMENDMENT	DT	RV	SCALE 1:500	DATE 29/08/23
DRAWING STATUS PLANNING					PROJECT NO. 10165FDL5	DRAWING NO. P501
						REV. P2

STRUCTURAL SOLUTIONS
CHARTERED ENGINEERS

DAIRY STUDIOS | 102 LINCOLN STREET | BRISTOL | BS5 0BJ T. 0117 924 5014

APPENDIX H

Flood Routing Plan & Maintenance Schedule



- KEY**
- APPROX SITE BOUNDARY
 - SITE HIGH POINT / LOW POINT (BASED ON PROPOSED LEVELS)
 - OVERLAND FLOOD ROUTING
 - THRESHOLD / CHANNEL DRAIN

Health and Safety Symbols Legend

- INDICATES A RESIDUAL RISK REQUIRING A COMPULSORY ACTION
- INDICATES A RESIDUAL RISK FOR INFORMATION
- INDICATES A RESIDUAL RISK REQUIRING A PROHIBITIVE ACTION
- INDICATES A RESIDUAL RISK AS A WARNING

NOTE 5
No construction activity to take place within tree protection fencing. No vehicular access

NOT FOR CONSTRUCTION

P2 28/11/23 MINOR AMENDMENTS		DT	RV	PROJECT LAND AT WOODSIDE DRIVE, ALMONDSBURY		SHEET SIZE A3
P1 06/10/23 ISSUED WITH FRA REPORT				TITLE DRAINAGE EXCEEDANCE FLOOD ROUTES		
REV	DATE	AMENDMENT	DT	RV	SCALE NOT TO SCALE	DATE 29/08/23
DRAWING STATUS PLANNING			PROJECT NO. 10165FDL5		DRAWING NO. P502	REV. P2

STRUCTURAL SOLUTIONS
CHARTERED ENGINEERS
DAIRY STUDIOS | 102 LINCOLN STREET | BRISTOL | BS5 0BJ T. 0117 924 5014

SUDS MAINTENANCE SCHEDULE

ATTENUATION TANK / MODULAR STORAGE CRATES

MAINTENANCE SCHEDULE	REQUIRED ACTION	FREQUENCY
KEY MAINTENANCE REQUIREMENTS: DEBRIS / SILT REMOVAL AND INSPECTION OF INLETS, OUTLETS, VENTS, ETC		
REGULAR MAINTENANCE	INSPECT AND IDENTIFY ANY AREAS THAT ARE NOT OPERATING CORRECTLY. IF REQUIRED, TAKE REMEDIAL ACTION	MONTHLY FOR 3 MONTHS THEN EVERY SIX MONTHS
	DEBRIS REMOVAL FROM CATCHMENT SURFACE (WHERE MAY CAUSE RISK TO PERFORMANCE)	MONTHLY
	CHECK INLETS, OUTLETS, CONTROL STRUCTURES AND OVERFLOWS	ANNUALLY OR AS REQUIRED
	REMOVE SEDIMENT FROM PRE-TREATMENT STRUCTURES (SILT TRAP)	ANNUALLY OR AS REQUIRED
OCCASIONAL TASKS	JETTING AND SUCTION WHERE SILT HAS SETTLED IN THE STRUCTURE	AS REQUIRED
REMEDIAL ACTION	REPAIR / REHABILITATION OF INLETS, OUTLETS, OVERFLOWS AND VENTS	AS REQUIRED
	FULL REPLACEMENT OF THE STRUCTURE IF PERMANENTLY SILTED OR STRUCTURE FAILURE	AS REQUIRED
MONITORING	INSPECT / CHECK ALL INLETS, OUTLETS, VENTS AND OVERFLOWS TO ENSURE THAT THEY ARE IN GOOD CONDITION AND OPERATING AS DESIGNED	ANNUALLY AND AFTER HEAVY STORMS

FLOW CONTROL CHAMBERS

KEY MAINTENANCE REQUIREMENTS: SILT REMOVAL / CHECK FOR BLOCKAGES		
REGULAR MAINTENANCE	INSPECT ORIFICE PLATE AND DEBRIS COWL TO ENSURE THERE ARE NO BLOCKAGES.	MONTHLY FOR 3 MONTHS THEN EVERY SIX MONTHS
	DURING THESE INSPECTIONS, ACCUMULATED SILT SHOULD BE REMOVED AND THE SUMP CLEANED OUT USING A CONVENTIONAL SUMP VACUUM CLEANER. THE OVERFLOW PIPE AND COWL CAN BE REMOVED TO ALLOW THE SYSTEM TO BE DRAINED IF THE ORIFICE BECOMES BLOCKED.	

PERMEABLE PAVEMENTS

KEY MAINTENANCE REQUIREMENTS: SWEEPING, MONITOR WEED GROWTH, REPLACE BROKEN BLOCKS		
REGULAR MAINTENANCE	BRUSHING AND VACUUMING (STANDARD COSMETIC SWEEP OVER WHOLE SURFACE)	ONCE A 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 SURFACE FROM ADJACENT IMPERMEABLE AREAS AS THIS AREA IS MOST LIKELY TO COLLECT THE MOST SEDIMENT
OCCASIONAL TASKS	STABILISE AND MOW CONTRIBUTING AND ADJACENT AREAS	AS REQUIRED
	REMOVAL OF WEEDS OR MANAGEMENT USING GLYPHOSATE APPLIED DIRECTLY INTO THE WEEDS BY AN APPLICATION RATHER THAN SPRAYING	AS REQUIRED - ONCE PER YEAR ON LESS FREQUENTLY USED PAVEMENTS.
REMEDIAL ACTION	REMEDiate ANY LANDSCAPING WHICH, THROUGH VEGETATION MAINTENANCE OR SOIL SLIP, HAS BEEN RAISED TO WITHIN 50MM OF THE LEVEL OF THE PAVING	AS REQUIRED
	REMEDiate 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
	REMOVAL OF WEEDS OR MANAGEMENT USING GLYPHOSATE APPLIED DIRECTLY INTO THE WEEDS BY AN APPLICATION RATHER THAN SPRAYING	EVERY 10 TO 15 YEARS OR AS REQUIRED (IF INFILTRATION PERFORMANCE IS REDUCED DUE TO SIGNIFICANT CLOGGING)
MONITORING	INITIAL INSPECTION	MONTHLY FOR THREE MONTHS AFTER INSTALLATION
	INSPECT FOR EVIDENCE OF POOR OPERATION AND/OR WEED GROWTH - IF REQUIRED, TAKE REMEDIAL ACTION	THREE MONTHLY, 48H AFTER LARGE STORMS IN FIRST SIX MONTHS
	INSPECT SILT ACCUMULATION RATES AND ESTABLISH APPROPRIATE BRUSHING FREQUENCIES	ANNUALLY
	MONITOR INSPECTION CHAMBERS	ANNUALLY

P1	06/10/23	ISSUED WITH FRA REPORT	DT	RV	PROJECT LAND AT WOODSIDE DRIVE, ALMONDSBURY	TITLE SUDS MAINTENANCE SCHEDULE (SHEET 1 OF 2)	SCALE NTS	DATE 29/08/23	SHEET SIZE A3
REV	DATE	AMENDMENT			PROJECT NO. 10165FDL5	DRAWING NO. P503A			REV. P1
DRAWING STATUS PRELIMINARY									

PUMPING STATION MAINTENANCE SCHEDULE

FOUL & SURFACE WATER PUMPING STATION

TYPICAL MAINTENANCE REGIME:		
REGULAR MAINTENANCE	CONDUCT REGULAR INSPECTIONS TO ENSURE THAT ALL COMPONENTS IN THE SYSTEM ARE WORKING CORRECTLY.	
	CLEAN AND EMPTY THE TANK, REMOVE ANY BLOCKAGES, AND CHECK FOR ANY DEFECTS	ANNUALLY OR AS REQUIRED
	INSPECT AND REPLACE OIL AND SEALS	ANNUALLY OR AS REQUIRED
OCCASIONAL TASKS	PUMPING STATIONS ACCUMULATE SETTLED SOLIDS OVER TIME. IT IS GOOD PRACTICE TO CHECK AND IF NECESSARY EMPTY/DESLUDGE THE PUMPING STATION AT THE SAME TIME AS ANY MECHANICAL OR ELECTRICAL SERVICING IS CARRIED OUT.	AS REQUIRED
	CONDUCT AN OVERHAUL OF THE PUMP	3 - 5 YEAR INTERVALS OR AS REQUIRED
REMEDIAL ACTION	REPLACE FAULTY PARTS AS SOON AS POSSIBLE.	AS REQUIRED
	REPLACE MECHANICAL SEALS AT OIL CHANGES	AS REQUIRED
MONITORING	CHECK CURRENT AND METER FLUCTUATIONS DAILY AND INSULATION RESISTANCE MONTHLY. IF FLUCTUATION IS GREAT, EVEN THOUGH WITHIN THE LIMITS OF PUMP RATING, FOREIGN MATTER MAY BE CLOGGING THE PUMP. IF THE QUANTITY OF LIQUID DISCHARGED FALLS SUDDENLY, FOREIGN MATTER MAY BE BLOCKING THE SUCTION INLET.	DAILY / MONTHLY

THE FOLLOWING MUST NOT BE DISCHARGED INTO DRAINS

	CLEANING RAGS	
	CLOTHS	
	SYRINGES; HYPODERMIC NEEDLES	
	MEDICINES; MEDICAL EQUIPMENT	
	FAT, OIL; GREASE. THESE PRODUCTS TEND TO COOL DOWN, SEPARATE FROM WATER AND COAGULATE WITHIN THE PUMPSTATIONS CHAMBER. (FOG'S) ENCASE THE PUMP AND FLOATS, CAUSING BLOCKAGES AND FAILURE OF PUMPS.	
	SOFT TOYS, TENNIS BALLS ETC. CAUSING BLOCKAGES OF THE DRAINS AND PUMPSTATIONS	
	FABRIC CLEANSING WIPES; NAPPY LINERS CAN BLOCK PIPEWORK OR PUMPING STATION.	

ROUTINE SERVICING:

	MECHANICAL AND ELECTRICAL SERVICING MUST BE PERFORMED BY PROPERLY TRAINED PERSONNEL SUITABLY QUALIFIED AND EXPERIENCED IN THIS TYPE OF WORK.
	REGULAR SERVICING OF PUMPSTATIONS AND PUMPING EQUIPMENT WILL PROVIDE THE EXTEND LIFE EXPECTANCY OF THE PUMPING STATION, INCREASE HYDRAULICALLY EFFICIENCY AND WILL REDUCING RUNNING COSTS AND REDUCE THE NUMBER OF UNNECESSARY CALL OUTS.

					PROJECT LAND AT WOODSIDE DRIVE, ALMONDSBURY
P1	06/10/23	ISSUED WITH FRA REPORT	DT	RV	TITLE SUDS MAINTENANCE SCHEDULE (SHEET 2 OF 2)
REV	DATE	AMENDMENT			SCALE NTS
DRAWING STATUS PRELIMINARY					DATE 29/08/23
					SHEET SIZE A3
					PROJECT NO. 10165FDL5
					DRAWING NO. P503B
					REV. P1

