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Proposed Commercial / Retail Development
Brookside Road, Uttoxeter

Flood Risk and Runoff Assessment

09 April 2018

Lidl UK GmbH

Mott MacDonald
4th Floor
Derwent House
150 Arundel Gate
Sheffield S1 2JY
United Kingdom

T +44 (0)114 2761242
mottmac.com

Lidl UK GmbH
19 Worple Road
Wimbledon
SW19 4JS

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Mott MacDonald Limited. Registered in England and Wales no. 1243967. Registered office: Mott MacDonald House, 8-10 Sydenham Road, Croydon CR0 2EE, United Kingdom

Lidl UK GmbH

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Contents

1 Introduction

It is proposed to redevelop an area of land to the north of Brookside Road, Uttoxeter for mixed commercial and retail use. This development will need to be assessed to determine if it is at risk from existing sources of flooding or if the development will increase material flood risk outwith the development site.

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process, to reduce future damage to property and loss of life. The NPPF – Technical guidance (NPPF-TG) identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications.

The purpose of this report is to assist our client and the local Planning Authority to make an informed decision on the flood risks associated with the site redevelopment.

Local Planning Authorities have the powers to control development in accordance with the guidelines contained in NPPF-TG, and are expected to apply a risk-based approach to development with the Sequential Test in Table 1. This sets out a sequential characterisation of flood risk in terms of annual probability of river, tidal and coastal flooding.

In accordance with the sequential test in the technical guidance, sites are to be classed as follows:

Table -1: Flood Zones – NPPF-TG Table 1

Flood Zone	Appropriate Uses
Flood Zone 1 - Low Probability – This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability – This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 10000 annual probability of sea flooding (0.5%-0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	The water-compatible and less vulnerable uses of land in Table D.2 area appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.
Flood Zone 3b - Functional Floodplain – This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and	Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to: Remain operational and safe for users in times of flood; Result in no net loss of floodplain storage; Not impede water flows; and Not increase flood risk elsewhere.

Flood Zone	Appropriate Uses
the Environment Agency, including water conveyance routes)	Essential infrastructure in this zone should pass the Exception Test.

1.1 Reference Documents

The following documents have been referenced in the compilation of this document;

1. Environment Agency on-line flood maps;
2. National Planning Policy Framework;
3. Staffordshire Strategic Flood Risk Assessment;
4. CIRIA SuDS manual (C753);
5. Geo-environmental Report – Opus International ref J-D0954.00_R1_STM.

1.2 Terms of Reference

This document is to accompany a full planning application and separate outline planning application for the redevelopment of the site identified in Section 2.1 only, and is for the sole benefit of the client (Lidl GmbH UK) and should not be used or relied upon by third-parties.

Mott MacDonald has followed accepted procedure in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, we take no liability for and give no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the service. This report has been prepared for the purposes of planning approval only and is to assist our client and the local Planning Authority to make an informed decision on the flood risks associated with the site redevelopment.

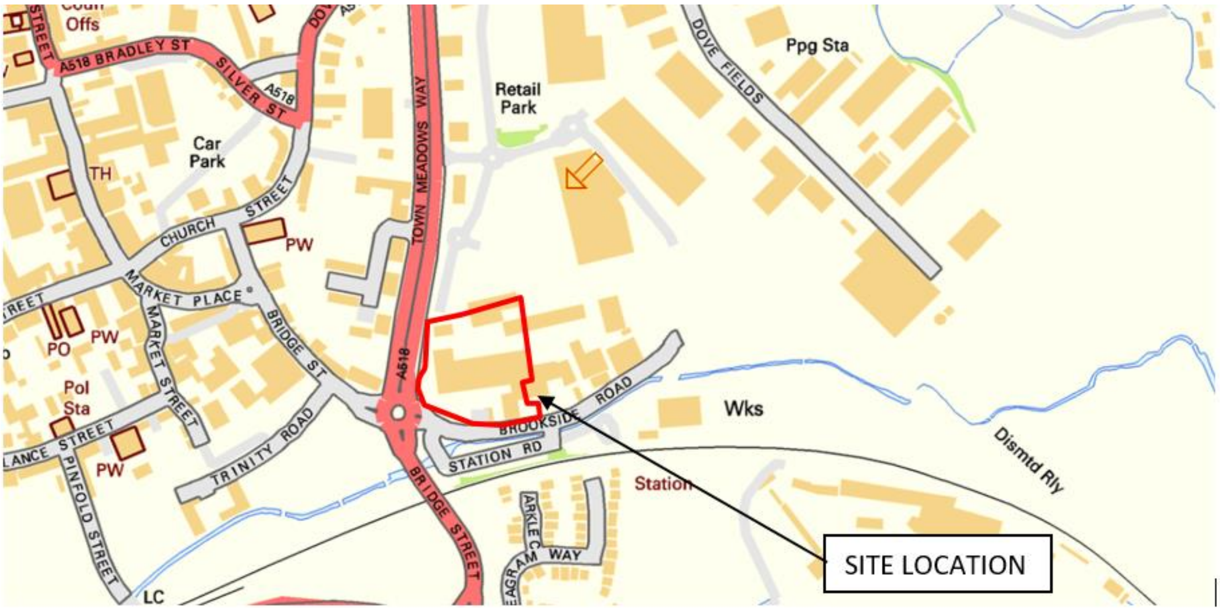
Allowance for the effects of climate change will be made in accordance with government recommendations in place and statistical data available at the time of writing this report. These recommendations may become more onerous and the statistical data may be revised in the future; we will not make any estimate of what changes may result from this. Please be aware that this, and other issues over which the Mott MacDonald has no control, may affect future flood risk at the development and require further work to be undertaken for which we accept no liability.

2 Existing Site

2.1 Site Location

The site is located to the north of Brookfield Road in the eastern part of the settlement of Uttoxeter (see Figure 2.1) approximately 500m east of the town centre and centred on National Grid Reference (NGR) 409614E, 333371N.

Figure 1: Site Location Plan



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2.2 Site Description

The total site is approximately 1.67ha in area and comprises an area allocated for a Full Application (1.41ha) and an Outline Application area (0.26ha). The site includes in-use and dis-used commercial and industrial premises with associated hardstanding and some minor landscaping and undeveloped areas.

The main entrance to the site is from Brookside Road which forms part of the southern boundary. The site is bound by existing commercial development to the north and east and Town Meadows Way to the west.

A topographical survey of the site has been undertaken and is included in Appendix A.

The survey shows that the site is relatively flat but that the site is set lower than the carriageway of Town Meadows Way along the western boundary.

The site has a minor fall from west to east falling to a central lower area and then rising again to the eastern boundary. Levels along the western boundary range between 77.5m and 77.3mAOD falling to the central area between 76.7m and 77.0mAOD before rising again to 77.0m and 77.2mAOD in the east.

The Full Application site is entirely developed yielding an impermeable area of 1.40ha, the outline area has a small area of landscaping and yields a total existing impermeable area of 0.18ha.

2.3 Existing Site Drainage

No specific drainage survey has been undertaken of the existing site, however, the topographical survey identifies surface drainage features such as manhole covers, rainwater pipes and gullies etc. to the majority of the site and it is therefore considered that the existing drainage systems is present and extensive.

The connectivity and outfall of the existing system has not been established and it is recommended that it is done before the existing buildings are demolished in order to secure the existing flow rate for the proposed site drainage system.

2.4 Existing Land Drainage

The topographical survey and the site observations confirm the existence of a drainage ditch along the northern boundary of the site.

It is understood that this was installed as part of the development of the commercial units north of this area and is therefore an active part of the drainage system in this area.

The ditch outfalls to the active flood zone east of the site and may also act as a secondary flow route for flood water.

2.5 Existing Watercourses

The site is located alongside Picknal Brook from which the access road gets its name.

This is a major tributary of the River Dove which is located 750m to the east of the site.

Both watercourses are EA main river and have been modelled as part of the River Dove catchment in the Staffordshire Strategic Flood Risk Assessment (SSFRA).

Picknal Brook in this area is characterised as highly canalised with near vertical sides to the manmade channel.

3 Sources and Extents of Flood Risk

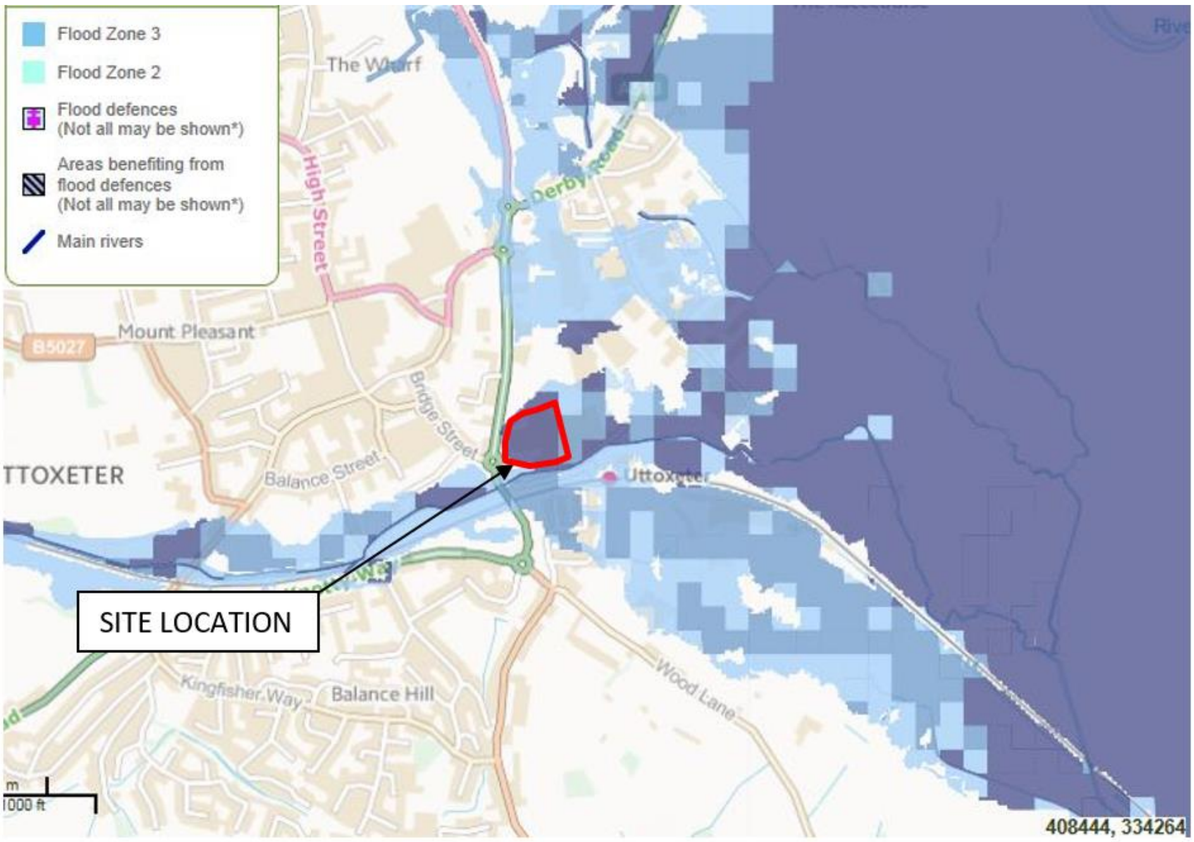
3.1 Natural Drainage

3.1.1 Fluvial Flooding

With reference to the EA's indicative flood maps, the site is shown to be in all three Flood Zones (1-3), with a larger portion in Flood Zone 3.

An extract from the EA's map is included in Figure 2 for reference.

Figure 2: Environment Agency Indicative Flood Map



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3.1.2 Pluvial Flooding and Overland flow

With reference to the EA's online mapping, data related to the risk of potential surface water inundation or flooding is also provided.

An extract from this map is shown in Figure 3.

Figure 3: Extract from EA's Online Surface Water Flooding Map

Source: Environment Agency What's in Your Backyard © Environment Agency copyright and database rights 2014. © Ordnance Survey Crown copyright. All rights reserved. Environment Agency, 100026380

The inundation exercise indicates that the site is likely to be affected by the effects of pluvial flooding. This corresponds to the route of Picknal Brook and to the drainage ditch to the north.

3.1.3 Groundwater Flooding

There are no specific features within the site which indicate the presence of elevated ground water such as marshes or ponds. The adjacent drainage ditch is a relatively good proxy for normal ground water and this indicates a level of up to 2.9m begl when observed during the geotechnical site walkover (ref J-D0954.00_R1_STM produced by Opus International Consultants in July 2012).

It is noted in the SSFRA that this area of Uttoxeter is identified as an area of potential ground water flood risk or inundation, by virtue of the likely underlying ground conditions.

3.1.4 Climate Change

The Environment Agency requires, in accordance with the Government's NPPF-TG document, that there should be no increase in the rate of surface water emanating from a newly developed site above that of any previous development. Furthermore, it is the joint aim of the Environment Agency and Local Planning Authorities, to actively encourage a reduction in the discharge of storm water as a condition of approval for new developments. In addition, all drainage systems should be sized to accommodate the runoff arising from a 1 in 100-year rainfall event, and should include a further allowance to account for the future effects of climate change. Table 2 below, shows the anticipated increases in rainfall intensities and river flows with time, and has been reproduced in part from Table 4 of NPPF-TG.

Table 2: Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities and Peak River Flows

Type	Applies across all of England	2015 to 2039	2040 to 2069	2070 to 2115
River Humber Basin	Upper End	20%	30%	50%
	Central	10%	15%	20%
Rainfall	Upper End	10%	20%	40%
	Central	5%	10%	20%

Source: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

In this instance, with a residential development having a design life of around 75-100 years, the overriding criteria will be the 20% increase in rainfall intensity and 20% for river flows.

3.2 Artificial Drainage

3.2.1 Adopted Drainage

Sewer records obtained from Severn Trent Water (STW) are included in Appendix B for reference.

The records show an extensive network of both foul and surface water drainage serving areas to the west of the site with two large diameter sewers running west to east along Brookside Road.

These appear to combine to the east of the site, potentially with some form of overflow to Picknal Brook, before continuing as a single foul sewer to the east.

3.2.2 Private Drainage Systems

Although no formal drainage investigation has taken place, the topographical survey has identified that there is extensive visual evidence of a drainage system for both rainwater and foul from the site. All hardstanding and roof areas are considered to be positively drained at present.

The total existing impermeable area is estimated to be 1.58ha and would yield a runoff of approximately 220l/s for the 50mm/hr event.

3.2.3 Highway Drainage

Site observations indicate that Brookside Road is served by a positive drainage system although it is not known if this remains as a separate highway drainage system or if it discharges to the adopted assets locally.

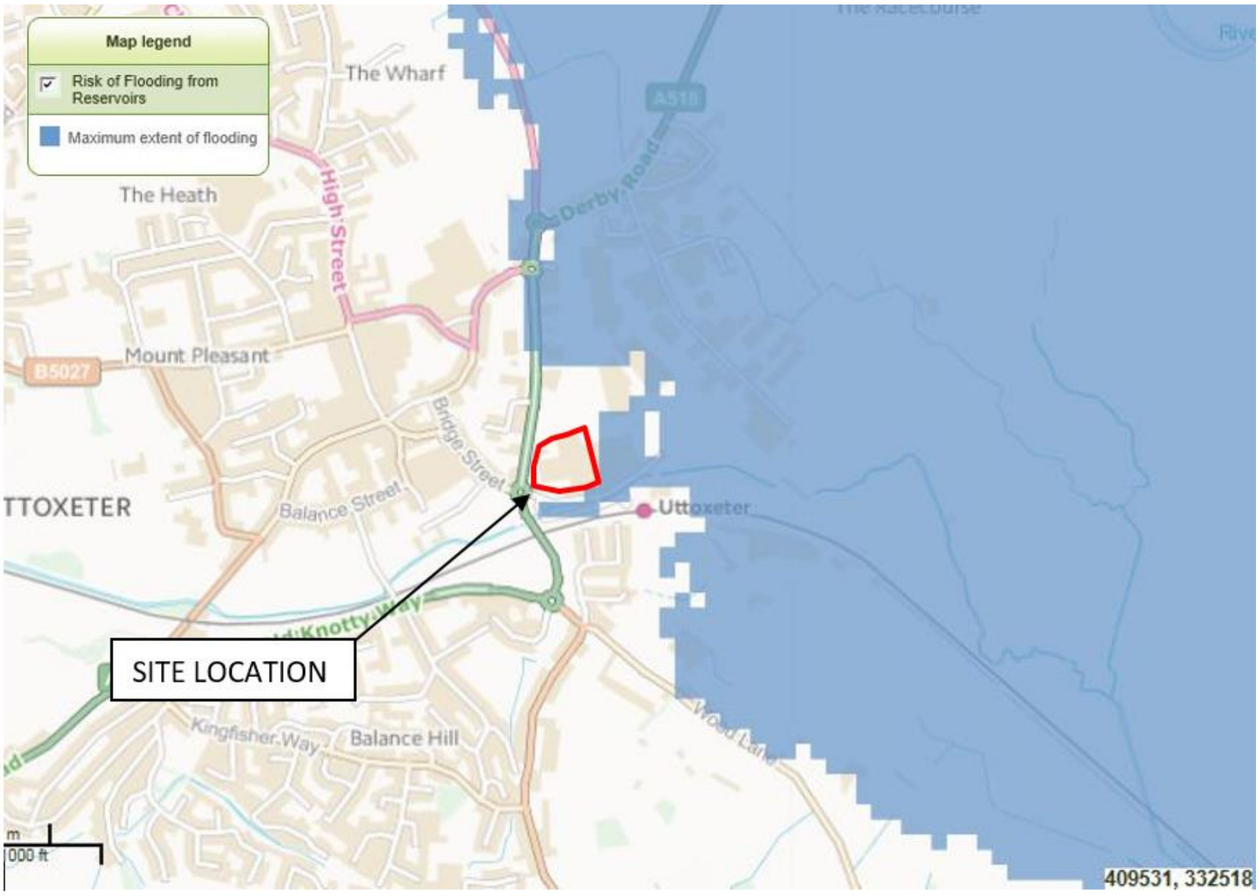
Often, in similar scenarios, highway drainage is directed to the nearest watercourse such as Picknal Brook.

3.2.4 Reservoir Flooding

The site is indicated to be adjacent to an area potentially at risk of reservoir flooding.

This flood mapping includes areas that may be affected should a catastrophic failure of a local reservoir occur.

Figure 4: Extract from EA's Online Reservoir Flood Risk Map



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3.2.5 Development Drainage

The proposed development details are included in Appendix C, and shows three proposed commercial/retail units on the site, generally located on the eastern boundary with a shared car park to the west. It is noted that the unit to the south (noted as drive-thru) is an outline application but is included herein and the flood risk and drainage strategy are interlinked with the full application site.

This arrangement will yield a total post-development impermeable area of 1.443ha comprising roof, car park and access road.

Using the Lloyd-Davies method for direct run-off, a 50mm/hr intensity event (=M30-30) would generate a typical peak runoff rate in the order of 200l/s from this area.

If left unrestricted, this concentrated outflow rate could pose a flood risk to adjacent developments.

4 Flood Risk Assessment

4.1 Natural Drainage

4.1.1 Fluvial Flooding – Main River

With reference to the EA's published flood maps (see Figure 2 in 3.1.1) the site can be shown to be within the influence of the flood envelope associated with Picknal Brook.

The EA's model identifies numerous nodes along the boundary of the site (2616 to 2583) and the watercourse and the corresponding modelled flood levels for events up to and including the 1 in 1000-year (0.1%AEP) event.

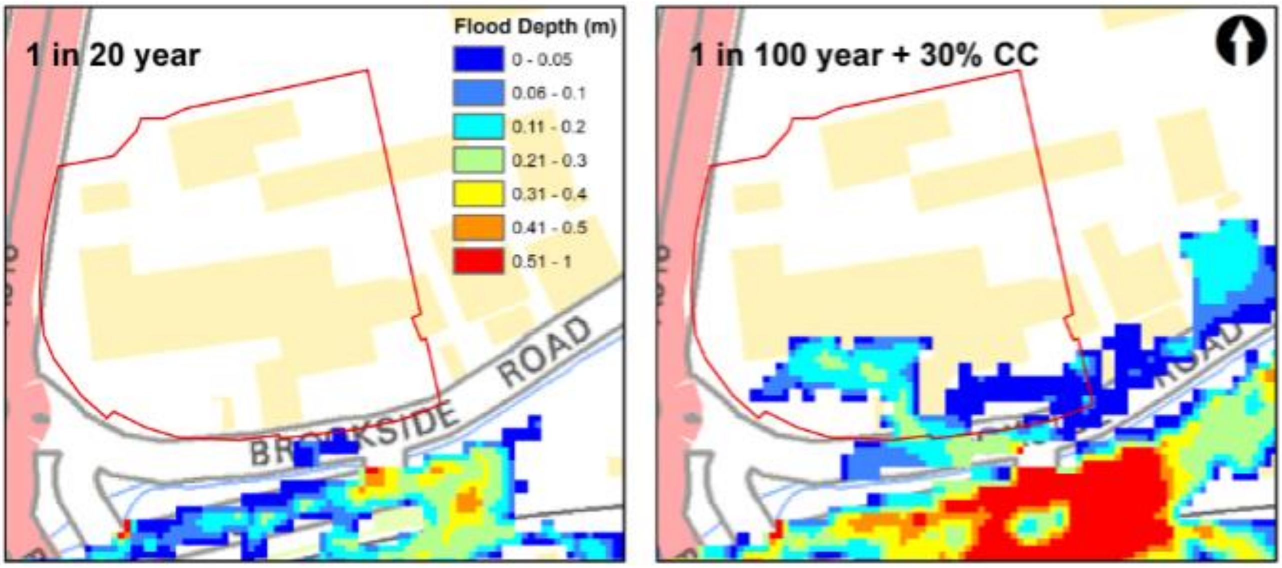
Mott MacDonald has licensed this model data with the intent of increasing the resolution of the model locally in order to more accurately determine flood risk for the development site.

By extending the model using site topographical data, LiDAR and detailed assessment of the hydrology of the watercourse, a new site-specific flood envelope has been derived for the development site. It can be seen from the outputs that the extent is considerably smaller than the published mapping.

The full hydraulic modelling report is issued under separate cover with reference R02_392669 (included as Appendix D) and should be referred to for detailed information. This report summarises the main outputs from the model which are relevant to the flood risk of the site.

The baseline flood envelope has been defined for the site using the latest topographical data. The outputs from this are shown in Figure 5 below.

Figure 5: Extracts from Baseline Modelling



Source: MM report R02_392669

The maps clearly show that the lower western part of the site is at risk of flooding for the 1%+CC AEP event but that the flood envelope is significantly smaller than indicated on the EA's online mapping.

Outputs from the model also indicate that the flooding on the site is shallow over a larger area.

4.1.2 Pluvial Flooding

The EA's inundation assessment indicates an indicative risk associated with both Picknal Brook and the existing drainage ditch to the north of the site. This is typically the case for watercourses which are identified as local low spots in topography.

It is noted that there are other significant pluvial flood risk identified on this plan which corresponds with the topography of the site noted previously.

Given the above, it is considered that the pluvial flood risk and fluvial flood risk are ostensibly the same flood event type albeit to different magnitudes of return period. As such mitigation of the fluvial flood risk, in conjunction with a surface water management plan is will provide mitigation for the pluvial flood risk by default.

4.1.3 Groundwater Flooding

The risk of ground water flooding noted in the updated 2013 SFRA published by East Staffordshire Borough Council is principally derived from the British Geological Survey data which indicates the likely presence of impermeable strata under the development site area above and stratum of permeable sands and gravels.

This is in lieu of site specific geotechnical investigation.

Reference is made to previously issued Geo-Environmental Investigation Report J-D0954.00_R1_STM produced by Opus International Consultants in July 2012.

Intrusive ground investigation was undertaken on the site and where observed, ground water levels were taken. Section 9.6 of the report comments on the suitability of soakaways for use and the site and notes that:

A drain is shown within the southern area of the site on the historical plans and on current ordnance survey sheets, groundwater levels were recorded at between 2.84m (begl) and 2.91m (begl) in WS206, within the southern area of the site. Given the relatively high groundwater levels in this area of the site, land drainage may need to be incorporated into the drainage design and the relevant authorities should be consulted regarding works within the southern area of the site.

The measured water depths of 2.84 and 2.91m below ground level, while relatively high for the use of infiltration based drainage systems, is deep in comparison to levels that would represent a risk to development on this site.

4.1.4 Climate Change

With reference to section 3.1.4, drainage systems will be designed for 20% increase in climate change and tested for 40% events.

Fluvial flooding will be assessed using 20% and 30% increases in fluvial flows.

4.2 Artificial Systems

4.2.1 Adopted Drainage

The drainage on site is private with a presumed adopted connection along the southern boundary into Picknal Brook for surface water with foul connection to the adopted assets in Brookside.

The full extent of the upstream catchment is not identified on the sewer records; however, a 300mm diameter sewer is capable of conveying a relatively significant volume of water. Should the sewer become blocked water may potentially manifest at the surface of the site.

The 300mm sewer has the potential to convey 680l/s at full bore (K_s = 1.5 @ 1v:190h). These flow rates and associated volumes are significant and should be considered as a flood risk to the site.

The 525mm diameter sewer is not considered to be a risk to the site as it is located on the opposite side of the watercourse.

4.2.2 Private Drainage

At the time of writing a utilities survey has not been undertaken, however, the topographical survey shows a number of manholes, gullies and rain water pipes across the site indicating that there is some form of private drainage system serving the current development. These are predominantly in the south west of the site in the industrial development.

As any existing drainage is to be abandoned as part of the redevelopment of the site the flood risk from this element will also be removed.

Existing connection points to the Picknal Brook may be retained for use for proposed outfalls.

4.2.3 Highway Drainage

The existing road network on Brookside Road is served by a gully system which is likely to be reconfigured as part of the proposed development and therefore does not pose a significant flooding risk to the site.

Town Meadows Way to the west and Brookside Road to the south lie slightly higher than the site boundary and could therefore propose a flood risk should the system become blocked. However, the carriageway of the road will act as secondary conveyance and channel water away from the development site.

4.2.4 Reservoir

Figure 4 indicates that the site is adjacent to an area potentially at risk of reservoir flooding should catastrophic failure of a dam occur.

Although an identified flood risk, the probability of this occurring is very low. The residual effect of an incident can be reduced by adopting resilient construction methods (see Section 7).

4.2.5 Development Drainage

It is proposed that the site is redeveloped to provide three purpose built units for commercial/retail type uses.

It will be necessary to provide a suitably designed storm water drainage system to collect, convey and attenuate the additional runoff generated by the development of this site. The net result should be that there is no net increase in flood risk to either downstream properties or assets as a result of the development.

This will be demonstrated by the developing drainage strategy of the site. This strategy should also include measures to improve run-off quality whilst maximising bio-diversity and amenity to provide a sustainable drainage system as noted in NPPF-TG.

Foul flows from the development should be drained through an entirely separate system designed to adoptable standards to minimise the risk of foul flooding occurring as a result of the development.

Picknal Brook along the southern edge of the site is at a lower level to the proposed development and therefore should be viable for a surface water gravity connection.

5 Sequential Test

5.1 Application

The Sequential Test is designed to direct development towards areas of lower flood risk, however, where suitable sites do not exist in Flood Zone 1 sites in Flood Zone 2 and then 3 may be considered.

The site is currently classed, using the EA's online mapping, as being partly in Flood Zone 3 and Flood Zone 2, and having a greater than a 1% annual probability of flooding from fluvial sources.

It is noted that the development vulnerability classification will not be altered by the development of this site, with commercial/industrial and commercial/retail both classified as 'Less Vulnerable' in accordance with NPPF Table 2.

With reference to Table 3[1] of the NPPF Flood and Coastal Change 'Less Vulnerable' development in Flood Zone 2 and 3 are deemed suitable without further testing.

As there is no proposed change in flood risk classification, the site is already developed and classified as brownfield the development is deemed to be suitable for this location.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf

6 Exception Test

6.1 Introduction

The Exception test is applied under guidance in NPPF-TG when the Sequential Test has been passed.

Reference is made to Table 3 of the NPPF guidance and the Flood Risk Vulnerability Classification therein[2].

In this case, the Less Vulnerable classification is deemed to be appropriate for Flood Zone 3a.

However, for completeness we have included the elements of the Exception Test to demonstrate that the development of this site is appropriate.

The test takes three parts, each one addressed below. The site should;

- Be developed on brownfield land;
- Provide wider sustainability benefits;
- Be safe to operate.

6.2 Previously Developed Land

The site is a clearly re-development of existing extensively developed land.

6.3 Wider Sustainability Benefits

The site is to be converted in the main from light industrial use to commercial retail. This is in keeping with the general shift in the whole area from light industrial.

The replacement of industrial units, some of which are derelict, with more economically valuable retail units will provide local impetus to the local economy by way of increasing the number of job opportunities locally.

The development of the site and the proposed mitigation along Brookside Road (see Section 8 of this report) will provide much needed amenity benefit to the river, opening up Brookside for pedestrians. The development of the site will also reduce the impermeable density of the site, and introduce a drainage attenuation system. Both elements will significantly and positively impact on the runoff profile from the site and ultimately on the local flood risk profile.

6.4 Safe Operation

The proposed layout plan has been developed to accommodate both the provision of flood mitigation along Brookside Road and the operation of the site during such operation.

The hydraulic model shows that Brookside Road is at risk of flooding from Picknall Brook and as such cannot be the only egress route from the site.

The proposed level strategy for the site provides units which are outside the flood envelope of the 1%+CC event and a dry access/egress above this level for pedestrians and customers.

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[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf

The large car park area is designed to act as a temporary surface storage area for fluvial flood water to a maximum depth of 250mm for approximately 6-hours.

Outputs from the proposed hydraulic model clearly show that this access is 'safe' and also dry for these extreme events.

It is recommended that a Flood Evacuation Plan (FEP) is developed as part of the detailed design of the site which will identify key roles and responsibilities during a flood event and describe in detail how a flood event might propagate and how to mitigate the impact whilst evacuating the site safely.

6.5 Summary

Although the development is shown to be within Flood Zone 2 and 3, the proposals show that the site can be safely developed and used for its proposed lifetime without creating a flood risk.

Therefore, the re-development can be shown to pass the Exception Test.

7 Storm Water Management

7.1 Control of Surface Water Run-off

It should be acknowledged that the satisfactory collection, control and discharge of storm water is now a principal planning and design consideration.

Part H of the Building Regulations 2015 recommends that surface water run-off shall discharge to one of the following, listed in order of priority:

- an adequate soakaway or some other adequate infiltration system, or where that is not reasonably practicable,
- a watercourse, or, where that is not reasonably practicable,
- a surface water sewer.

It is necessary to identify the most appropriate methods of controlling and discharging surface water for this site. The design should also seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak flow rates or positively impact on the existing flood profile.

7.1.1.1 Infiltration Based Systems

From the British Geological Society maps it can be seen that the superficial deposits are primarily alluvium which consists of clay, silt, sand and gravel. The bedrock is described as Mercia Mudstone.

Given these observations, it is considered that in the main, the site is likely to be unsuitable for infiltration based systems given the clayey overlying deposits and the impermeable lower strata.

7.1.1.2 Watercourse

Although no records are available, the existing site is likely to discharge to Picknal Brook to the south and it is recommended where possible to discharge the proposed surface water runoff via a new connection into this watercourse.

7.1.1.3 Adopted Sewers

The drainage on site is private with a presumed adopted connection along the southern boundary into Picknal Brook for surface water and the existing foul sewer for foul. As such the use of an existing adopted drainage system has been discounted for this site.

7.2 Allowable Site Discharge

In the absence of sewer records it is proposed to provide a new connection on the southern boundary to outfall into Picknal Brook.

The flow restriction is based on the Lloyd-Davies method from section 3.2.5 which estimates the existing peak runoff rate to be 220l/s.

It is proposed that to provide betterment as part of the development of the site that this discharge rate is reduced by 50% resulting in a revised allowable discharge of 110l/s.

The discharge allowance may be split pro-rata between several outfalls should the detailed design of the proposed drainage systems so require.

7.3 Site Attenuation

The provision of suitable attenuation on site to mitigate the flood risk resulting from the development of the site will be a key factor in the evolution of the site development layout.

The provision of large volumes of attenuation, as is likely in this case, can be achieved by a number of methods; however, not all systems can be assessed in direct comparison.

One of the aims of the NPPF is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and bio-diversity. Systems incorporating these features are often termed Sustainable Drainage Systems (SuDS) and it is the requirement of NPPF that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible.

The volume of attenuation required for the development may be estimated using design software. As this is for outline planning and to inform the developing layout and drainage strategy an example system will be evaluated.

For the purposes of the assessment a single open pond/tank with a flow control device has been used as infiltration is unlikely to be viable on this site. The software uses the FSR[3] characteristics of M5-60=19.0mm and ratio R=0.395.

Table -3 - Summary of Anticipated Attenuation Volumes

Impermeable Area	Anticipated Unrestricted Run-Off	Flow Restriction	Attenuation (1 in 100 +20%)
ha	ls^{-1}	ls^{-1}	m^3
1.443	220	110	400

This assessment is for the whole impermeable area discharging into a single system such as a pond or tank type system to give an indicative volume only.

7.4 Sustainable Drainage Systems (SuDS) and Water Quality

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

A summary of the various types of attenuation is included Table 4.

EA guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised overleaf;

3 Flood Studies Report 1975

Table 4 - SuDS Hierarchy

	SUDS technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
Most Sustainable	Living roof	√	√	√
↑	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	√	√	√
	Filter strips and swales	√	√	√
↓	Infiltration devices - soakaways - infiltration trenches and basins	√	√	√
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviors	√	√	
Least Sustainable	Tanked systems - over-sized pipes/tanks - Cellular Storage	√		

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where some systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy. However, included below are summaries of some of the main types of SuDS systems that may be applied to the development outlining the main benefits and constraints to their application.

In addition to the above hierarchy, the CIRIA SuDS Manual C697 identifies the number of treatment trains or SuDS devices through which flow should pass from various point sources of runoff. This is designed to ensure that the receiving watercourses are not put at risk of pollution by new development.

Table 5.6 in the SuDS Manual identifies the number of treatment trains as a function of runoff source and receiving water sensitivity. This site lies within a medium sensitive catchment and therefore would require two treatment trains:

Table 5 - Watercourse Sensitivity and Treatment Trains

	Receiving Watercourse Sensitivity		
Runoff Catchment Characteristic	Low	Medium	High
Roof only	1	1	1
Residential roads Parking areas Commercial zones	2	2	3
Refuse collection Industrial areas Loading bays Lorry parks Highways	3	3	4
CIRIA SuDS Manual C697 Table 5.6			

7.4.1 Living or Green Roofs

Larger areas of roof may be designated as living or green roofs to provide both point water treatment and significant enhancement of local bio-diversity. The assessed gains are such that these systems are the preferred EA option for the provision of SuDS.

If considered at the outset of the design of a unit, a green roof can be integrated within the provision of a roof terrace area to multiply the benefits, alternatively, a maintained roof can be installed that may require specialised access.

There are numerous proprietary systems available on the market to suit various specific applications and it is recommended that if these systems are being considered discussion with several suppliers is instigated as soon as possible.

While a useful system, the application of green roofs is not considered viable in this instance as the roofs of the units will likely have significant amounts of plant located on the roof which would impact its viability.

7.4.2 Ponds and Basins

The nature of these systems is such that the run-off from the development can be treated by biological action and stilling to significantly improve the quality of water discharged from the system.

Basins also provide large areas of open space that can be developed for recreational uses or as new habitat for wildlife.

Both systems do, however, take up developable land and have residual maintenance and liability issues attached to their implementation.

In this case the proposed development density on the site does not leave sufficient areas for a pond to be used as the primary means of surface water storage.

However, the use of landscaped areas as emergency and temporary attenuation for more extreme events is considered to be viable.

7.4.3 Filter Strips and Swales

Often used adjacent to roads and footpaths, swales and filter strips can be used to collect water directly from linear features, percolate some of the flow, attenuate and then discharge the flow to either a traditional system or a secondary SuDS device.

The use of these systems is more suited to linear applications such as roads as the typical cross section is relatively small and longer runs are required to provide attenuation volume.

Filter strips will be smaller in plan area than a swale although the swale can be landscaped to be incorporated in to the verge of the carriageway, combining two functions.

Land take can be relatively small in comparison to other systems and both types perform well in improving water quality. They are also ideally suited for disposal of water via secondary infiltration.

These systems may be suitable for the collection of runoff from car parks but would be limited in the suitability of collection of roof runoff. As a large volume of attenuation is required, the use of swales may be more suitable for collection and conveyance.

7.4.4 Permeable Paving

Larger areas of block paved hardstanding can easily be converted to provide significant volumes of storage. These systems also encourage biological treatment of flow and extraction of oils and heavy metals from the run-off.

Land take is reduced as storage is located under car parks and access roads. However, maintenance is potentially a long-term issue and the possibility of the paving being damaged, dug up and not properly reinstated or not regularly swept could lead to compromising the future capacity of the system.

This system will negate the need for a separate collection system such as kerbs and gullies. It will also assist in reducing the flood profile of the site by significantly attenuating the run-off from the development within the sub base material.

There is no specific amenity provided by the system other than enabling other areas to be utilised for development rather than potentially sterilizing areas with an easement for a sewer or stand-off for a basin.

These systems may be incorporated into normal car-parking areas and driveways but may not be suitable for areas accessed by larger vehicles. It is also possible to provide plot-by-plot systems connecting in to a site wide system.

There is scope for the parking areas to be used as attenuation via permeable paving on the surface and permeable sub-base beneath. Not only would this enable more efficient use of the parking area but remove the requirement of a separate attenuation feature and will help to limit the overall depth of the drainage system, ensuring a gravity connection to the watercourse is achievable.

7.4.5 Cellular Storage

Large volumes of storage can be provided under grassed and lightly trafficked areas by using proprietary plastic cellular systems. This will maximise the developable area of the site.

There is no specific mechanism within the system designed to treat flow but extended detention times will allow sedimentation reducing the suspended solids within the discharge.

There is no creation of amenity by the installation of these types of systems, indeed by maintaining access to the system small areas may need to be reserved.

If the developable footprint is tight then these systems may be advantageous, however, to ensure adoptability it is recommended that the use of these systems is discussed with the adopting authority as they are not always preferred.

In this case, geocellular attenuation could be used to supplement the permeable sub-base system noted above.

7.4.6 Tank or Culvert Storage

Hard engineered tank storage systems have traditionally been used for attenuation structures for the past decade and are often specified where large volumes of storage are required (>200m^3) and available space is an issue.

These systems have no inherent water treatment properties except potential sedimentation of the attenuated flow and offer no additional amenity benefits. In some cases, the easement to the tank or culvert is such that a significant portion of land area is sterilized from development as are certain types of landscape planting.

There are also significant costs associated with these systems in production, transportation and installation. However, once installed the long-term maintenance requirement of the system is relatively low.

With a proven record of successful installation, tanks and culverts are regularly adopted by water authorities across the country, albeit with a large associated easement that will sterilise that portion of the site.

The use of a tank or culvert would require standard cover depths to the attenuation (approx. 1.2m) which would result in an overly deep outfall to Picknal Brook. As other more sustainable attenuation features are applicable the use of tanks is not recommended.

7.4.7 Surface Storage

The use of roads, public areas and even landscaped areas as additional storage for an extreme rainfall event is becoming a widely accepted form of attenuation.

Water spilling from drainage systems can be collected via roads and kerbs and channelled to lower lying areas where it would be stored until the capacity in the existing system returns.

These systems have the advantage of requiring little additional infrastructure merely detailing of the proposed roads and grassed areas.

As these systems will only be used in extreme events when the adopted drainage system is exceeded (>1 in 30 years), they provide a very efficient way of catering for these events rather than providing permanent capacity.

There is no inherent water treatment capability in this system nor any particular increase in amenity, however, the costs associated with this provision are relatively small.

If permeable paving is used, this would enable the safe mobilisation of surface storage on the permeable paving area during extreme events.

7.4.8 Over Sized Pipework

It is often possible to provide the required volume of storage within the existing collection pipework of the proposed system. This may be incorporated by using oversized pipework designed to act as inline storage.

As the diameter of larger pipes readily available is limited the applicability of these types of systems is more suited to <200m^3 of attenuation. Above this volume the length of pipe required is excessive and difficult to suitably fit into a normal site layout.

There is no intrinsic amenity provided by the use of this system neither is there any specific level of run-off treatment over and above that of a standard pipe and gully system.

However, due to their traditional nature, the adoption of these types of systems by water authorities is straightforward and does not require any specialist input. The pipes are generally available direct from suppliers with little or no lead in time and the satisfactory long-term performance of these systems is well documented.

In this case as there are serval other more sustainable options available this is not recommended for use on this site.

7.5 Summary

The application of SuDS based systems needs to be considered as the primary measure for dealing with surface water for any proposals, these systems are the only ones that provide the required level of treatment.

The large car park area serving the units is an ideal multi-function feature that could be used for collection, conveyance and attenuation.

This type of system would also facilitate a shallow connection to Picknal Brook that would reduce the likelihood of surcharge on the outfall affecting the operation of the drainage system during high river levels.

Permeable sub-bases also negate the need for an oil separator by providing in-situ treatment of runoff form the parking area.

Given the likelihood of the full planning application part of the site and the outline progressing at different times, the use of a permeable sub-base system will allow the attenuation features to be installed separately.

7.6 Design Example

In order to give some idea of the size of attenuation features that may be required and thus begin the process of integration, it is possible to provisionally size a typical feature at this stage based upon the assumptions discussed previously.

As noted above, the attenuation for the full allocation site and the outline application will be split with regard to flow control and attenuation but can share a common outfall to Picknall Brook. The offsite discharge will be split pro-rata.

Table 6: Summary of Attenuation Options

Location	Impermeable Area (ha)	Flow Restriction (l/s)	Attenuation Volume	Key dimensions
Full Application	1.443	88.0	235m^3	Area = 5175m^2 Working Depth = 0.15 to 0.40m
Outline Application	0.7	21.7	90m^3	Area = 725m^2 Working Depth = 0.40m

Source: MMD 2018

Outputs from this indicative design are included in Appendix E for reference with a typical drainage masterplan included in Appendix F.

The 40% climate change scenario is also included which shows that the 15-minute storm slightly exceeds the discharge restriction at 116l/s and the 60-minute storm yields surface flooding in the car park of just under 40m^3, which over the lower area of the site (approximately 760m^2) equates to a maximum temporary flooding depth of 40mm, which is considered acceptable.

7.7 Flood Routing

The performance of the system during extreme events (>1 in 100 years) should also be considered at this stage.

The routing of potential storm water run-off, should the capacity of the proposed site drainage system be exceeded, needs to be built into the layout of the site such that the residual risk of flooding from this element can be easily mitigated.

The likely route, is towards the lower Picknal Brook and the carriageway of Brookside Road. The proposed levels on the site will direct water away from the development and towards the watercourse.

Brookside Road can be utilised as additional surface attenuation in this extreme circumstance with a second emergency access being located off Town Meadows Way but the principal mitigation strategy will be to maintain the drainage system in working order.

7.8 Foul Drainage

Foul drainage from the site should be discharged via a new connection towards the adopted assets shown either in Brookside Road.

This connection would need to be approved by the local water company via a Developer's Enquiry at the detailed design stage and it is recommended that this is instigated as soon as possible.

It also needs to be confirmed that the local water company have adequate treatment capacity available to accept the increased foul flow from the developed site.

8 Flood Risk Mitigation

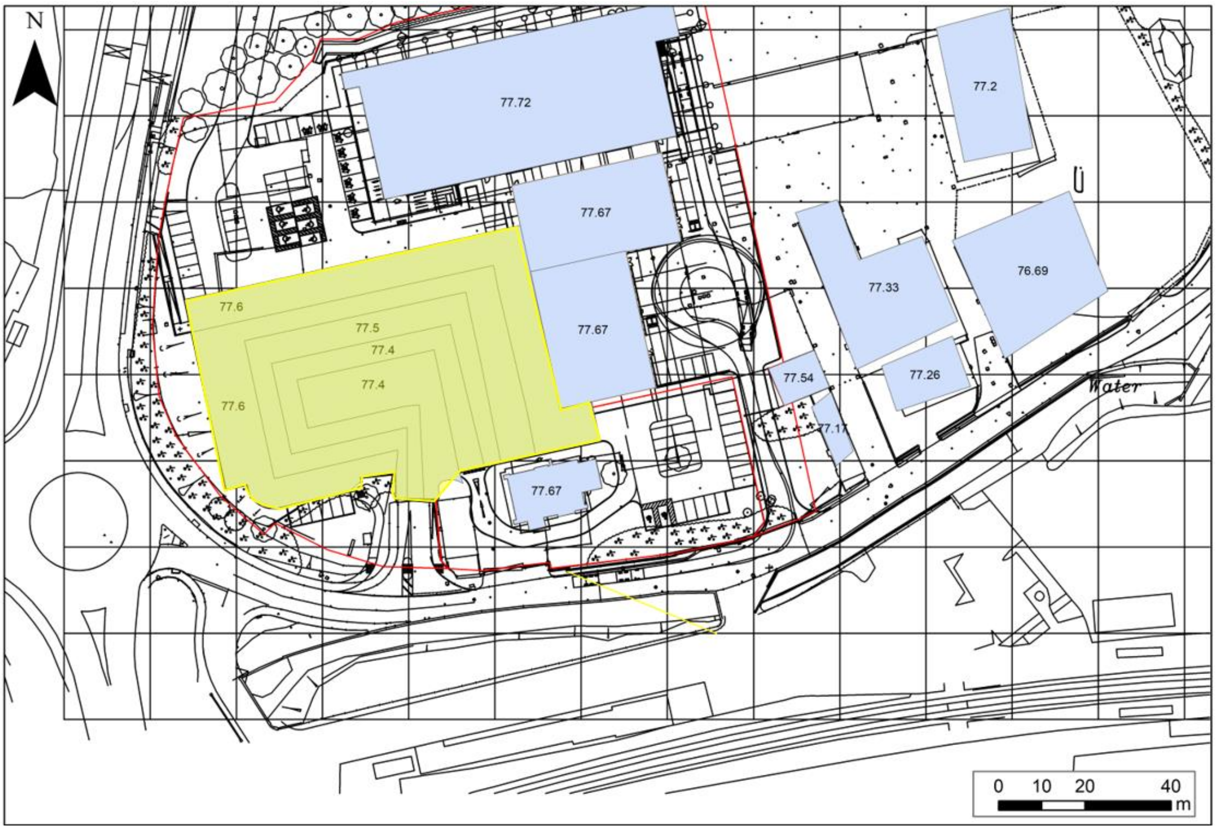
8.1 Fluvial Flooding

It is proposed that revised ground levels are used to engineer the flood extent on the site to maximise the development footprint of the site while controlling flood risk locally.

The levels of the large car park area can be used to provide surface storage during an extreme flood event in the channel. This area is shown to flood on the baseline model and will be effectively recreated.

Minimum finished floor levels of the units of 77.67mAOD will be provided with an external pedestrian access route set to 77.60mAOD. Car park levels will slope to a central lower area at 77.40mAOD. A flood flow path, emanating upstream of the existing bridge will be facilitated linking the channel of Brookside Road and the lower part of the car park using the landscaping around the proposed outline planning area. Levels in this area will be set lower than the adjacent carriageway to act as the first point of inundation on the site. Flow will pass from this area, across the existing site access at a level of 77.40mAOD, to the car park which will then act as surface storage. These are shown on the plan in Figure 6 below.

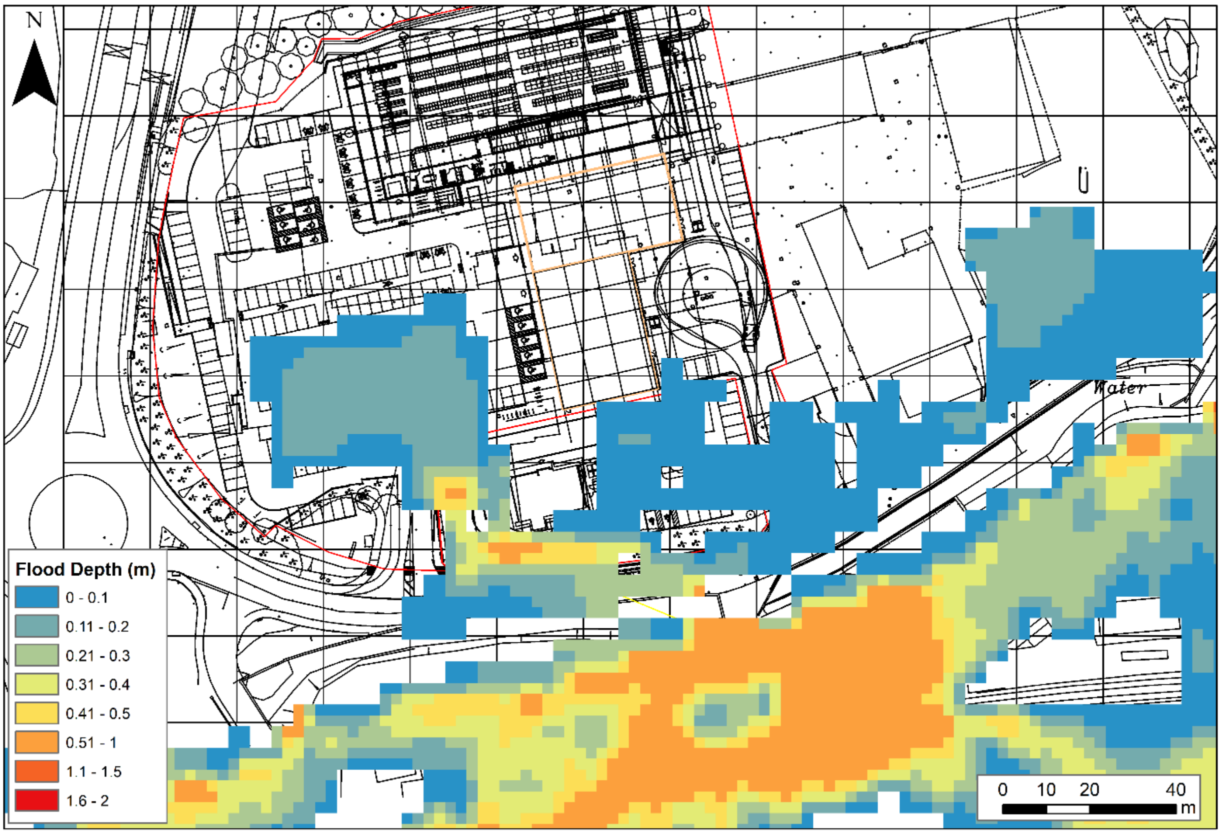
Figure 6: Proposed Level Strategy



Source: MMD 2018 – Car Park area denoted in Yellow

The resultant flood depths, extracted from the site hydraulic model are shown in Figure 7. This clearly shows how the flood path will propagate to the car park area via the landscaping and the existing site access.

Figure 7: Proposed Modelled Flood Depths



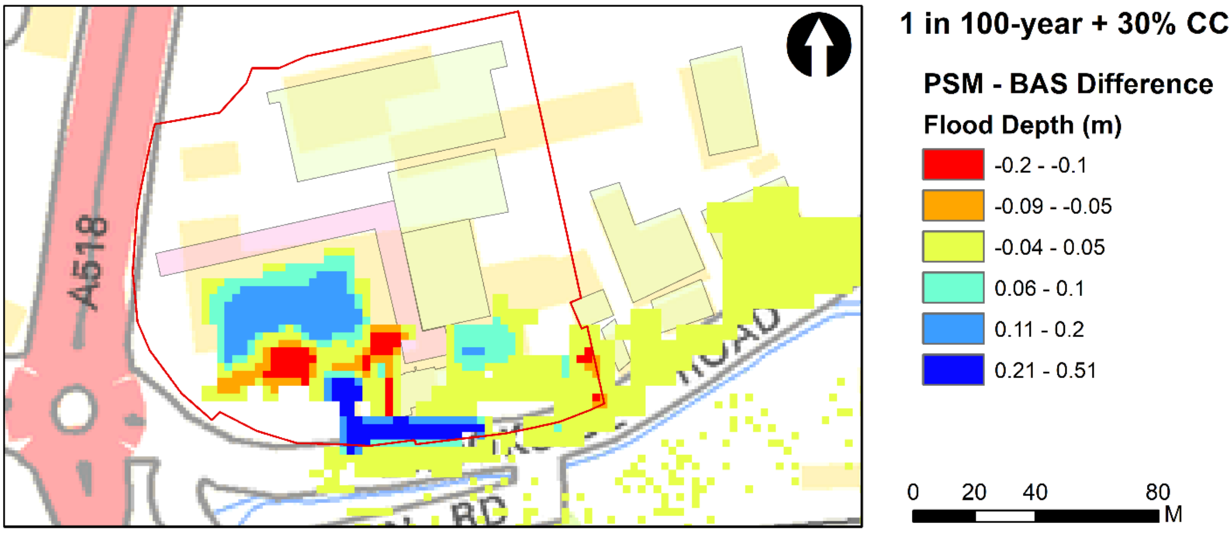
Source: MMD 2018

The proposed layout has been developed to integrate these flood mitigation and SuDS measures as a key feature of the layout. This is included in Appendix F for reference.

This layout has been tested within the baseline model to demonstrate the control of flood risk as a result of the works. More detailed outputs are included in the separately issued modelling report (ref R02_392669).

The extract from the model included in Figure 8, shows that the flood volume displaced by the development is controlled within the flood mitigation areas in the car park area combined with the other resilience features along Brookside Road will further help the area to recover from flood events that would have previously impacted properties and businesses.

Figure 8: Pre and Post-development flood depth comparison



Source: MM report R02_392669

8.2 Pluvial Flooding

As shown in Figure 3 the site is currently at risk of pluvial flooding.

The development of the site will mitigate this risk by providing positive drainage within the boundary of the developed area, rainfall will be intercepted by the new system and collected and attenuated before being discharge to the existing watercourse. This will have the effect of reducing the uncontrolled runoff entering the watercourse and thus reducing the peak flow and flood risk.

Calculations demonstrating the proposed provision of attenuation on the site are included in Appendix E.

8.3 Access and Egress

During extreme events there is a potential that access to the site will be restricted as a result of Brookside Road being allowed to flood as part of the flood mitigation strategy. As such a secondary access will therefore need to be provided to Town Meadows Way, in order to allow pedestrians to egress the site.

It is noted that flood depths on the site will be limited to depths of 200mm, which is traversable by vehicles and emergency services.

The integration of this feature is included on the proposed site plan included in Appendix F and as shown in Figure 6

In addition, a Flood Emergency Access Plan will need to be developed and provided to the occupants of each unit (similar to a Fire Evacuation Plan) with the sites included on the EA's flood watch list.

8.4 Overland Flow

The flood mitigation flow route on the site will be mobilised in reverse to act as an emergency flow route from the site drainage to the watercourse during extreme local rainfall events, with the landscaped area adjacent to the outline planning area providing additional, temporary surface storage.

8.5 Storm Water Management

A SuDS based drainage system will be required on this site in order to meet the requirements of CIRIA C753, NPPF-TG and water quality guidance.

An indicative scheme is shown on the drainage masterplan included in Appendix F based on design elements provisionally sized in Appendix E.

In summary, it is recommended that permeable paving and permeable sub-base is used to provide, collection, conveyance and attenuation on the site for both the full and outline application parts of the site.

Flow rates from the site will be limited to 110l/s which is 50% of the estimated existing peak discharge rate and will therefore provide a significant reduction in flow entering the watercourse.

It should be noted that the time to peak of the sustainable site drainage system will be an order of magnitude away from the peak river levels in Picknal Brook. This lag in the peak levels means that the site surface water systems will be substantially emptied by the time that an event that could surcharge the site outlet occurs in the channel. Therefore, the two systems can be considered to operate independently of each other for a shared return period event.

This approach will ensure that the development drainage system will remain operational during an extreme event and therefore not contribute to the fluvial flood extent.

8.6 Safe Failure Planning

If considered early in the development process, mitigation can be built in to the layout to prevent overland flows from the site either entering habitable areas or leaving the site in an uncontrolled manner with very little cost impact.

The development of the site levels to provide a route for flood water to enter the site enables this to be mobilised in reverse as a safe failure route for the proposed site drainage systems.

Testing of the storm water management system for the 40% climate change scenario indicates acceptable increases in offsite discharge (for the 15-minute storm only) and manageable and safe inundation depths on the car park area (up to 40mm).

8.7 Flood Resilience and Resistance

The development of the layout should always consider that the buildings on the site are potentially at risk from an extreme rainfall event greater than the current design requirements, and as such the incorporation of flood resilience and resistance measures is recommended for consideration at this stage.

Relatively simple measures such as raising utility entry points, using first floor or ceiling down electrical circuits and sloping landscaping away from properties can be easily and economically incorporated into the development of the site.

The development should also consider the use of flood resistant construction in the building of the new units. This would include the use of solid floors, sealed door and window cavities, locating IT infrastructure at high level and utility shut-off points.

More information can be found in the Communities and Local Government publication ' Improving the Flood Performance of New Buildings'[4].

[4] http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

9 Conclusions and Recommendations

An initial assessment of the data indicates the site to be in all three Flood Zones (1-3), with a larger portion in Flood Zone 3 with pluvial inundation occurring on the southern boundary.

The existing and proposed re-development share the safe 'Less Vulnerable' flood risk classification and so no Sequential Test is required.

A detailed hydraulic model incorporating updated local topography, hydrology and LiDAR data was developed. This has identified the baseline flood enevlope of the site and has enabled the provision of a flood mitigation option that maximise the site commercial development space whilst mitigating flood risk within the site boundaries.

The proposed external level strategy, illustrated in Figure 6, should be implemented on the site to protect both the proposed units and provide safe access and egress from the site. The mitigation proposals will manage out of channel from Picknal Brook via a controlled flood route on the proposed car park area which will accommodate displaced flood water caused by the elevation of the proposed units.

Storm water generated by the development itself will need to be managed to avoid creating a flood risk to the development and adjacent sites.

It is unlikely that infiltration based systems will be suitable for this site given the anticipated ground conditions and the relatively impermeable underlying bedrock.

It is estimated that the existing developed area will generate a peak runoff of 220l/s and as a result the proposed allowable site discharge will be 110l/s or a 50% reduction in the peak runoff for all events up to and including the 1%AEP+CC event.

Based upon the proposed development layout, it is recommended to drain the site into two surface water systems, one for the Full Application site and one for the Outline Application area. The allowable site discharge will also be split between the two applications and will incorporate attenuation methods highlighted in Table 6.

The proposed layout lends itself to the use of permeable surfacing and sub-base under the large car park area. This will provide collection, conveyance and attenuation as well as in-situ water quality improvements and to facilitate a shallow outlet from the site. The proposed drainage masterplan illustrating this is included in Appendix F.

Foul drainage from the site should be discharged using a new offsite connection towards the adopted assets shown in Brookside Road. This connection would need to be approved by the local water company via a Developer's Enquiry at the detailed design stage and it is recommended that this is instigated as soon as possible.

During peak flood events, access to the site along Brookside Road will be temporarily unavailable. A secondary pedestrian access should therefore be provided from the site to Town Meadows Way. A Flood Evacuation Plan should be implemented that details a plan of action should the watercourse flood from its banks. This would include closing the main site access road to traffic, safe evacuation of the car park and the relay of information to customers and staff on the development site.

Based on the proposed mitigation levels, it would not be necessary to evacuate or close the units for the 1%AEP + CC event. Areas of the site remain in Flood Zone 2 however, so internal property flooding may still occur for a 0.1% AEP + CC event.

Appendices

A. Topographical Survey

A.1 Green Hatch drawings ref 15541a_OGL sheet 1 - 3

N

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
TC1	409479.153	333388.338	78.229
TC2	409470.973	333301.127	81.731
TC3	409534.831	333282.266	77.728
TC4	409542.700	333327.916	77.440
TC5	409501.057	333311.650	77.624
TC6	409485.963	333340.307	77.680
TC7	409485.307	333370.726	77.555
TC8	409535.298	333370.737	77.465
TC9	409597.293	333376.996	77.384
TC10	409625.828	333376.980	77.266
TC11	409652.281	333392.143	77.029
TC12	409649.822	333425.765	76.963
TC30	409624.211	333295.364	77.317
TC31	409682.460	333331.189	76.872
TC32	409729.979	333362.786	76.625

Note:

Some services may have been omitted due to parked vehicles. The Ordnance Survey tile is to be used as a guide only.

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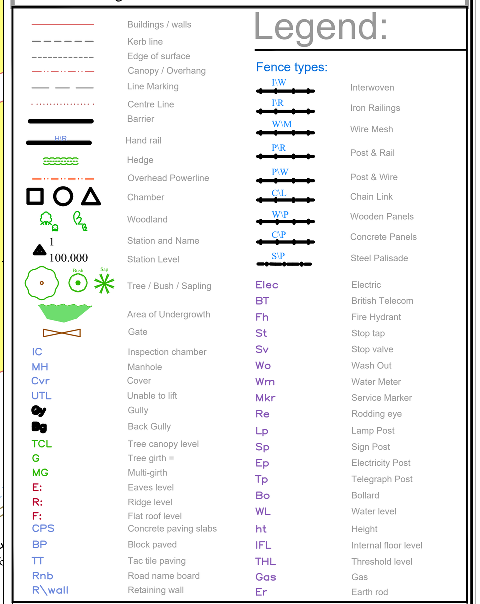
Legend:



Rev	Date	Description	Drawn	Q. Ref.

greenhatch group

Topographical Surveys
Site Engineering

Measured Building Surveys
3D Laser Scanning

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk

CLIENT

M J Barrett Developments

PROJECT

Brookside Business Park Uttoxeter

TITLE

Topographical Survey

SCALE	DATE	DRAWN	QUALITY REF
1: 200	10.03.12	TC	D0865

Level datum	OS (GPS verified)
Grid orientation	OS (GPS verified)
Job number	15541

Drawing No.	Rev.
15541a_OGL	0

Comments

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

Notes:

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Legend:

Buildings / walls
Kerb line
Edge of surface
Canopy / Overhang
Line Marking
Centre Line
Barrier
H\R Hand rail
Hedge
Overhead Powerline
Chamber
Woodland
1 Station and Name
100.000 Station Level
Bush Sap Tree / Bush / Sapling
Area of Undergrowth
Gate

IC	Inspection chamber
MH	Manhole
Cvr	Cover
UTL	Unable to lift
Gy	Gully
Bg	Back Gully
TCL	Tree canopy level
G	Tree girth =
MG	Multi-girth
E:	Eaves level
R:	Ridge level
F:	Flat roof level
CPS	Concrete paving slabs
BP	Block paved
TT	Tac tile paving
Rnb	Road name board
R\wall	Retaining wall

Fence types:

I\W	Interwoven
I\R	Iron Railings
W\M	Wire Mesh
P\R	Post & Rail
P\W	Post & Wire
C\L	Chain Link
W\P	Wooden Panels
C\P	Concrete Panels
S\P	Steel Palisade

Elec	Electric
BT	British Telecom
Fh	Fire Hydrant
St	Stop tap
Sv	Stop valve
Wo	Wash Out
Wm	Water Meter
Mkr	Service Marker
Re	Rodding eye
Lp	Lamp Post
Sp	Sign Post
Ep	Electricity Post
Tp	Telegraph Post
Bo	Bollard
WL	Water level
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THL	Threshold level
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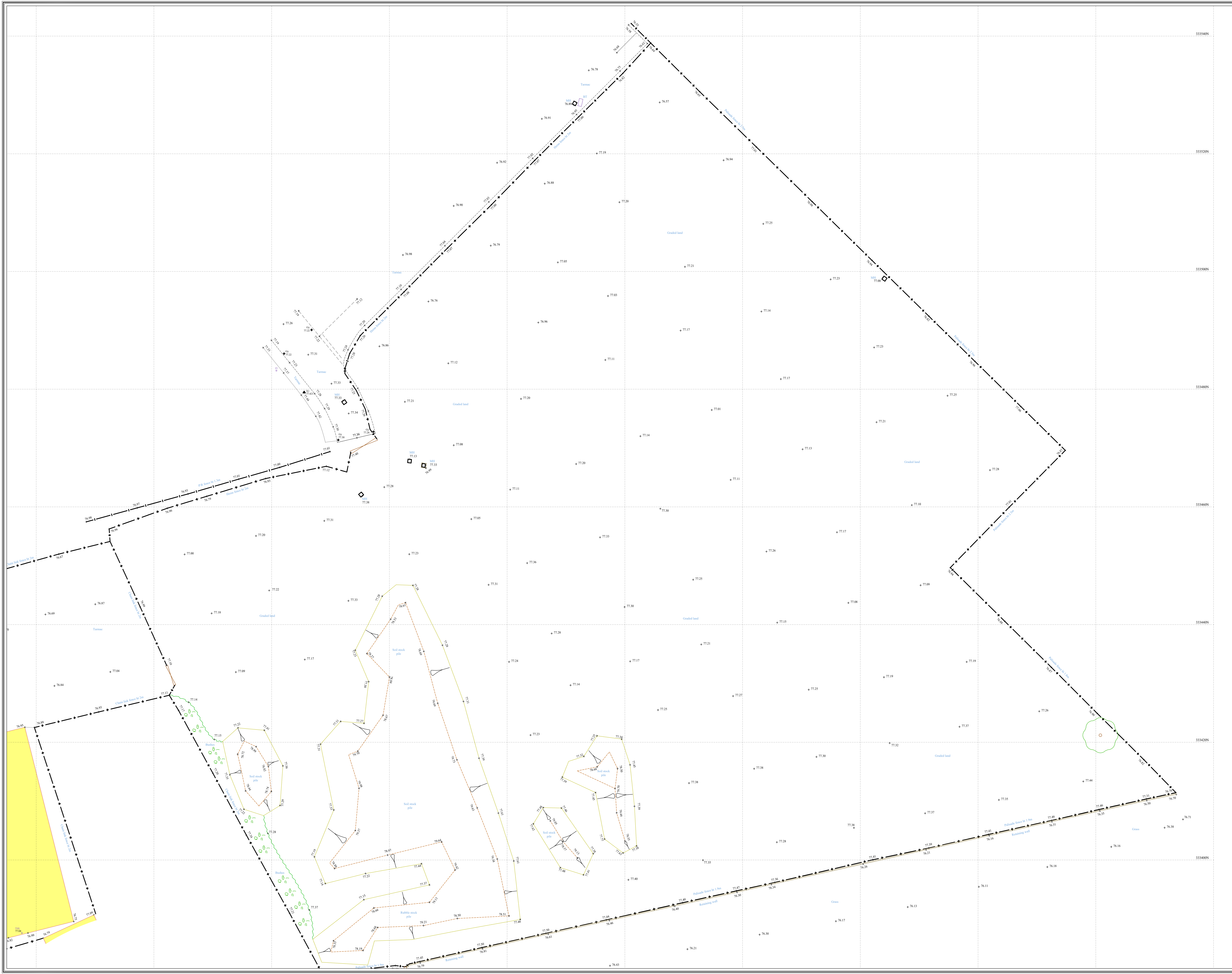

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OS Buildings | *Surveyed Buildings*

This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via a Global Position System (GPS) 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 OSTN02 & OSGM02 transformation models. The survey has been correlated to this point and a further one or more OSGB36 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.

Legend:

Buildings / walls
Kerb line
Edge of surface
Canopy / Overhang
Line Marking
Centre Line
Barrier
Hand rail
Hedge
Overhead Powerline

Fence types:
Interwoven
Iron Railings
Wire Mesh
Post & Rail
Post & Wire

Rev | Date | Description | Drawn | Q. Ref.

greenhatch group

Topographical Surveys
Site Engineering

Measured Building Surveys
3D Laser Scanning

Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk

CLIENT

M J Barrett Developments

PROJECT

Brookside Business Park Uttoxeter

TITLE

Topographical Survey

SCALE	DATE	DRAWN	QUALITY REF
1: 200	10.03.12	TC	D0865

Level datum	OS (GPS verified)
Grid orientation	OS (GPS verified)
Job number	15541

Drawing No.	Rev.
15541a_OGL	0

Comments

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

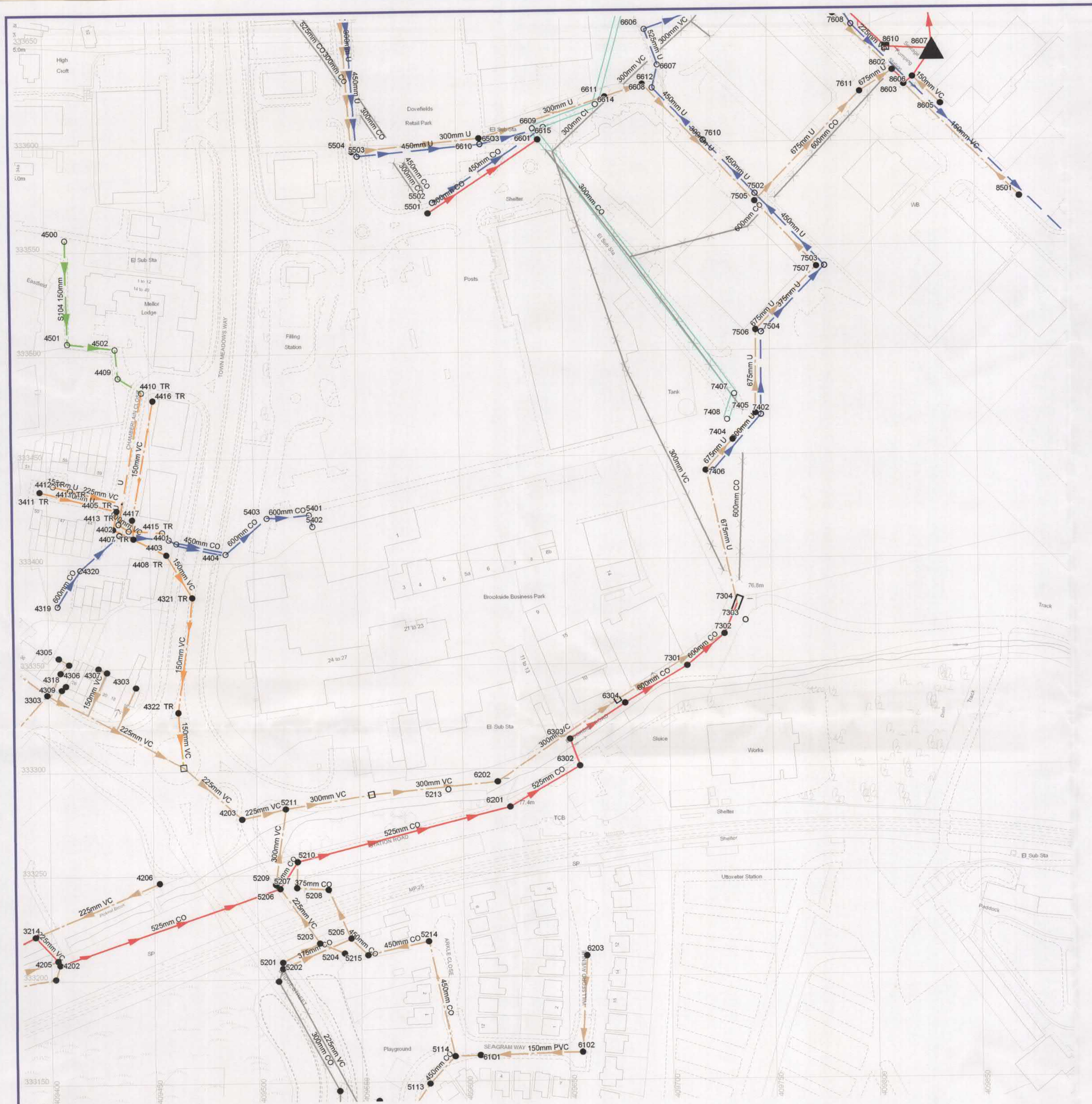
All dimensions should be checked on site prior to design and construction.

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

Notes:

DO NOT SCALE

B. Severn Trent Water Sewer Records



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SK09333214	nil	nil	75.78	C	VC	C	225	nil	0.00	nill
SK09333303	79.43	76.77	75.89	F	VC	C	225	nil	85.98	nill
SK09333411	81.25	79.60	77.55	F	U	C	150	nil	11.47	nill
SK09334201	78.65	75.46	75.43	F	CO	C	520	nil	242.67	nill
SK09334202	78.30	75.39	74.96	C	CO	C	525	nil	263.30	nill
SK09334203	77.97	75.44	75.19	F	VC	C	225	nil	86.36	nill
SK09334205	78.19	75.74	75.69	C	VC	C	225	nil	44.80	nill
SK09334206	nil	nil	nil	F	VC	C	225	nil	0.00	nill
SK09334303	78.13	77.52	nil	F	VC	C	100	nil	0.00	nill
SK09334304	79.62	78.73	nil	F	VC	C	100	nil	0.00	nill
SK09334305	79.74	78.94	78.73	F	VC	C	100	nil	27.76	nill
SK09334306	79.57	nil	nil	F	nil	nil	nil	nil	0.00	nill
SK09334307	78.57	77.73	nil	F	VC	C	150	nil	0.00	nill
SK09334308	78.50	78.10	77.84	F	VC	C	100	nil	17.19	nill
SK09334309	79.10	77.64	nil	F	VC	C	150	nil	0.00	nill
SK09334318	79.13	77.99	77.70	F	VC	C	100	nil	9.76	nill
SK09334319	81.22	78.07	77.46	S	CO	C	600	nil	35.08	2004
SK09334320	80.33	77.45	77.00	S	CO	C	600	nil	55.33	2004
SK09334321	78.95	76.67	76.55	F	VC	C	150	nil	443.12	nill
SK09334322	78.72	76.67	76.55	F	VC	C	150	nil	214.00	nill
SK09334401	78.18	76.30	76.20	S	CO	C	450	nil	241.00	2004
SK09334401	78.18	76.30	76.20	S	CO	C	450	nil	241.00	2004
SK09334402	79.26	76.65	76.40	S	CO	C	600	nil	100.00	2004
SK09334403	78.17	76.39	76.31	S	CO	C	600	nil	51.13	2004
SK09334404	77.88	76.19	76.14	S	CO	C	600	nil	510.00	2004
SK09334405	79.81	77.55	77.50	F	VC	C	150	nil	164.00	nill
SK09334406	79.14	77.50	77.42	F	VC	C	150	nil	156.56	nill
SK09334407	78.98	77.42	77.05	F	VC	C	150	nil	50.14	nill
SK09334408	78.80	77.05	76.67	F	VC	C	150	nil	63.42	nill
SK09334409	78.50	77.58	76.88	S	nil	nil	nil	nil	19.24	nill
SK09334410	78.92	76.88	76.87	S	U	R	1000	2400	6328.00	nill
SK09334411	81.08	78.88	78.50	S	U	C	150	nil	21.13	nill
SK09334412	80.51	78.50	76.87	S	VC	C	225	nil	15.78	nill
SK09334413	78.89	76.87	76.82	S	VC	C	900	nil	122.80	nill
SK09334414	78.96	76.82	76.70	S	VC	C	225	nil	137.08	nill
SK09334415	78.67	76.70	76.40	S	VC	C	225	nil	17.00	nill
SK09334416	78.90	77.87	77.53	F	VC	U	nil	nil	167.92	nill
SK09334417	79.00	77.53	77.44	F	VC	U	nil	nil	114.57	nill
SK09334500	81.77	80.57	79.00	S	nil	C	150	nil	31.71	nill
SK09334501	80.00	79.00	77.66	S	nil	C	225	nil	16.96	nill
SK09334502	78.56	77.66	77.58	S	nil	C	225	nil	162.94	nill
SK09335113	77.74	75.71	75.69	F	CO	C	450	nil	898.50	nill
SK09335114	77.64	75.66	75.56	F	CO	C	450	nil	566.70	nill
SK09335201	78.16	75.65	nil	F	CO	C	375	nil	0.00	nill
SK09335202	78.11	75.74	75.58	F	VC	C	225	nil	125.75	nill
SK09335203	77.69	75.54	75.40	F	VC	C	225	nil	247.64	nill
SK09335204	77.35	76.19	75.73	F	VC	C	225	nil	28.26	nill
SK09335205	nil	nil	75.24	F	nil	nil	nil	nil	0.00	nill
SK09335206	78.19	74.96	74.91	C	CO	C	525	nil	305.20	nill
SK09335207	78.28	75.01	74.98	F	CO	C	375	nil	433.33	nill
SK09335208	79.09	75.22	75.01	F	CO	C	375	nil	72.05	nill
SK09335209	78.11	75.39	75.37	F	CO	C	300	nil	141.50	nill
SK09335209	78.11	75.34	75.20	F	VC	C	300	nil	245.50	nill
SK09335210	77.88	74.91	74.41	C	CO	C	525	nil	209.12	nill
SK09335211	77.74	75.19	75.07	F	VC	C	300	nil	339.92	nill
SK09335214	77.56	75.54	75.43	F	CO	C	450	nil	273.18	nill
SK09335215	77.69	75.42	nil	F	CO	C	450	nil	0.00	nill
SK09335401	77.09	75.97	75.96	S	CO	C	600	nil	610.00	2004
SK09335403	77.24	76.13	73.97	S	CO	C	600	nil	8.84	2004
SK09335501	76.11	74.16	73.76	C	CO	C	300	nil	158.78	nill
SK09335502	76.36	75.23	75.12	S	CO	C	450	nil	585.91	nill
SK09335503	76.72	74.98	74.88	S	U	U	450	nil	601.52	2002
SK09335504	76.72	74.10	73.74	F	U	U	300	nil	174.31	2002
SK09336101	98.60	96.73	96.42	F	PVC	C	150	nil	39.26	nill
SK09336102	98.85	97.00	96.73	F	PVC	C	150	nil	181.85	nill
SK09336201	77.35	74.37	74.08	C	CO	C	525	nil	136.03	nill
SK09336202	77.35	74.85	74.62	F	VC	C	300	nil	301.48	nill
SK09336203	98.81	97.34	97.00	F	VC	C	150	nil	136.59	nill
SK09336302	77.25	74.11	74.08	C	CI	C	525	nil	495.67	nill
SK09336303	77.00	73.99	73.85	C	CO	C	600	nil	224.14	nill
SK09336304	76.84	73.83	73.79	C	CO	C	600	nil	862.00	nill
SK09336503	76.56	74.88	74.82	S	U	U	450	nil	604.62	2002
SK09336606	76.16	nil	nil	S	nil	nil	nil	nil	0.00	2002
SK09336607	76.19	74.77	74.73	S	U	U	525	nil	508.06	2002
SK09336608	76.22	74.79	74.77	S	U	U	525	nil	489.13	2002
SK09336610	76.50	73.74	nil	F	U	U	300	nil	0.86	2002
SK09336611	nil	nil	73.28	F	U	U	300	nil	0.00	2002
SK09336612	75.10	73.28	72.83	F	U	U	300	nil	176.47	2002
SK09336614	nil	nil	nil				nil	nil	0.00	nill
SK09336615	nil	nil	nil				nil	nil	0.00	nill
SK09337301	76.61	73.79	73.67	C	CO	C	600	nil	207.00	nill
SK09337302	76.64	73.66	73.64	C	CO	C	600	nil	808.00	nill
SK09337402	76.90	75.67	75.46	S	U	U	300	nil	181.15	2002
SK09337403	77.40	75.88	75.67	S	U	U	300	nil	181.59	2002
SK09337404	nil	nil	73.08	F	U	U	675	nil	0.00	2002
SK09337405	76.90	73.08	72.88	F	U	U	675	nil	203.79	2002
SK09337406	77.40	73.26	nil	F	U	U	675	nil	0.27	2002
SK09337407	nil	nil	nil				nil	nil	0.00	nill
SK09337408	nil	nil	nil				nil	nil	0.00	nill
SK09337502	76.10	75.00	74.94	S	U	U	450	nil	517.10	2002
SK09337503	76.10	75.15	75.00	S	U	U	450	nil	331.44	2002
SK09337504	76.70	75.38	75.23	S	U	U	375	nil	286.77	2002
SK09337505	76.10	72.46	72.09	F	U	U	675	nil	201.61	2002
SK09337506	76.70	72.88	72.67	F	U	U	675	nil	201.75	2002
SK09337507	76.10	72.67	72.46	F	U	U	675	nil	199.86	2002

Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SK09337608	75.04	73.98	73.55	S	VC	C	225	nil	368.37	nill
SK09337610	76.29	74.94	74.87	S	U	U	450	nil	508.84	2002
SK09337611	76.10	72.09	71.99	F	U	U	675	nil	203.06	2002
SK09338501	74.70	72.37	71.85	F	VC	C	150	nil	152.33	nill
SK09338602	74.98	71.92	nil	C	CO	C	720	nil	0.00	nill
SK09338603	74.98	71.85	nil	F	VC	C	225	nil	0.00	nill
SK09338605	74.90	73.88	71.74	F	VC	C	150	nil	9.25	nill
SK09338606	74.87	70.58	70.45	C	CO	C	1550	nil	128.92	nill

Abandoned Sewer
Private Combined Gravity Sewer
Private Foul Gravity Sewer
Private Surface Water Gravity Sewer
Public Combined Gravity Sewer
Public Foul Gravity Sewer
Public Surface Water Gravity Sewer
Trunk Combined Gravity Sewer
Trunk Foul Use Gravity Sewer
Trunk Surface Water Gravity Sewer
Combined Use Pressurised Sewer
Foul Use Pressurised Sewer
Surface Water Pressurised Sewer
Highway Drain
Combined Lateral Drain (SS)
Foul Lateral Drain (SS)
Surface Water Lateral Drain (SS)

Cable, Earthing
Cable Junction
Cable, Optical Fibre/Instrumentation
Cable, Low Voltage
Cable, High Voltage
Cable, Other
Housing, Building
Housing, Kiosk
Disposal Site
Sewage Treatment Works
Housing, Other
Pipe Support Structure
Sewage Pumping Facility
Sewer Facility Connection Inlet / Outlet

Blind Shaft
Combined Use Manhole
Flushing Chamber
Foul Use Manhole
Grease Trap
Head Node
Hydrobrake
Lamphole
Outfall
Overflow
Penstock
Petrol Interceptor

Sewer Chemical Injection Point
Sewer Junction
Sewerage Air Valve
Sewerage Hatch Box Point
Sewerage Isolation Valve
Soakaway
Surface Water Manhole
Vent Column
Waste Water Storage
Culverted Watercourse
Pre-1937 Properties

MATERIALS

AC - ASBESTOS CEMENT
BR - BRICK
CC - CONCRETE BOX CULVERT
CI - CAST IRON
CO - CONCRETE
CSB - CONCRETE SEGMENTS (BOLTED)
CSU - CONCRETE SEGMENTS (UNBOLTED)
DI - DUCTILE IRON
GRC - GLASS REINFORCED CONCRETE
MAC - MASONRY IN REGULAR COURSES
MAR - MASONRY RANDOMLY COURSED
PE - POLYETHLENE
PF - PITCH
PP - POLYPROPYLENE
PSC - PLASTIC STEEL COMPOSITE
PVC - POLYVINYL CHLORIDE
RPM - REINFORCED PLASTIC MATRIX
SI - SPUN (GREY) IRON
XXX - OTHER

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

CATEGORIES

W - WEIR
C - CASCADE
DB - DAMBOARD
SE - SIDE ENTRY
FV - FLAP VALVE
BD - BACK DROP
S - SIPHON
HD - HIGHWAY DRAIN
S104 - SECTION 104

SHAPE

C - CIRCULAR
E - EGG SHAPED
O - OTHER
R - RECTANGLE
S - SQUARE
T - TRAPEZOIDAL
U - UNKNOWN

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.
B. Where the node bifurcates (splits) X and Y indicates downstream sewer pipe.
C. Gradient is stated a 1 in...

PURPOSE

C - COMBINED
E - FINAL EFFLUENT
F - FOUL
L - SLUDGE
S - SURFACE WATER

N
W E
S

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (TABULAR)

O/S Map scale: 1:1250
Date of issue: 31.07.14
Sheet No. 1 of 1

This map is centred upon:
O / S Grid reference:
x : 409640
y : 333400

Disclaimer Statement:

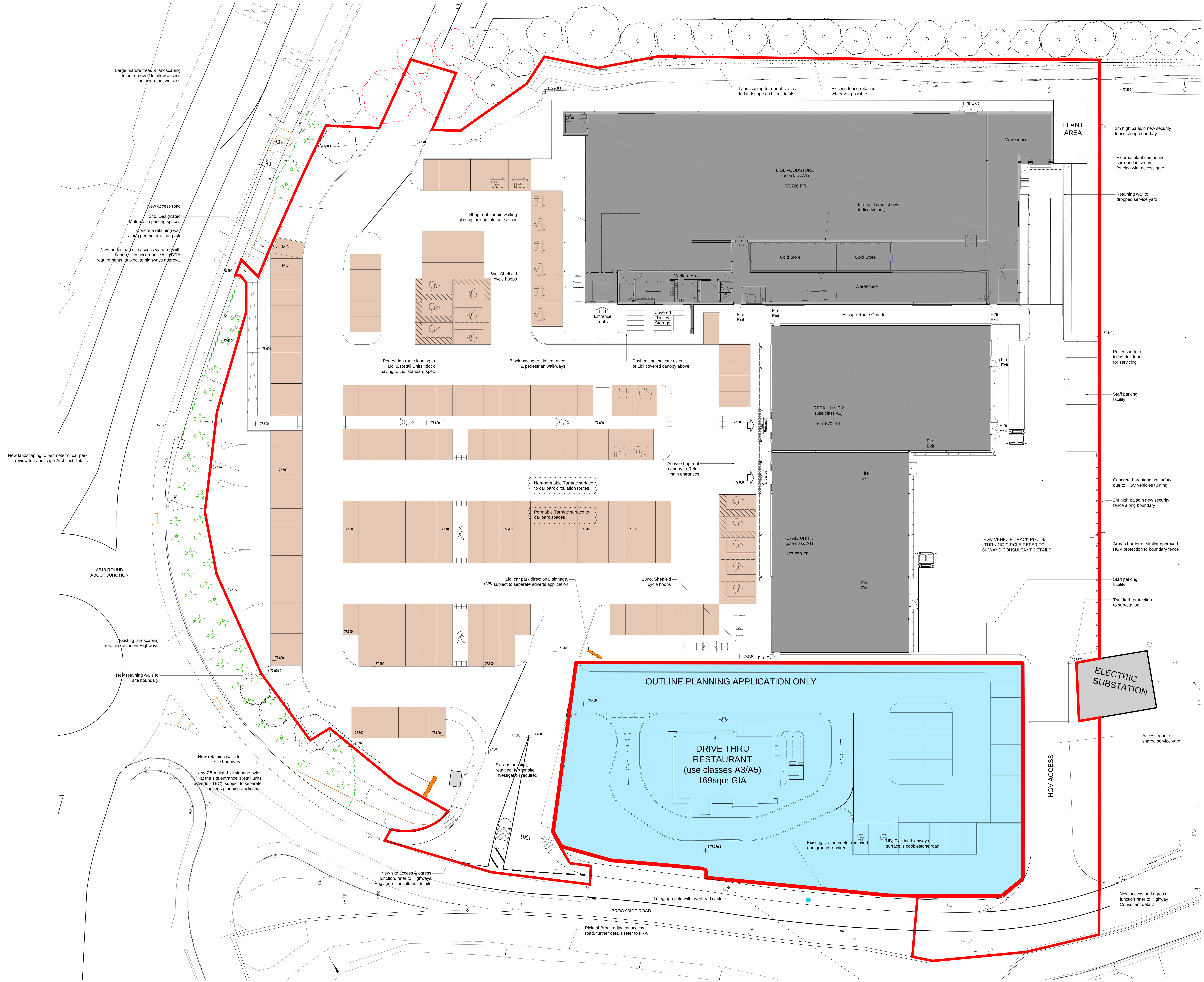
1. Do not scale off this Map.

2. This map and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this Map and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of Severn Trent Water's assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.

3. On **1 October 2011** most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012 (date to be confirmed).
Private pumping stations, which form part of these sewers or lateral drains, will transfer to the ownership of Severn Trent Water on or before 1 October 2016.
Severn Trent Water does not possess complete records of these assets.
These assets may not be displayed on this Map.

C. Proposed Site Plan

C.1 HCD – drawing reference 2017-119 - A-PL-003



NOTES:

THIS DRAWING IS STRICTLY NOT TO BE USED FOR CONSTRUCTION PURPOSES.

PROPOSED LEVELS SUBJECT TO DESIGN DEVELOPMENT.

DRAINAGE STRATEGY & RAIN WATER PIPES SUBJECT TO DESIGN DEVELOPMENT.

THIS DRAWING CONSISTS OF THE FOLLOWING THIRD PARTY INFORMATION & DRAWINGS;-

Topographical Survey by Green Hatch, drawing 15541a_OGL, received via email on 27/07/2017.

Vectos commented on Site Access & Egress junctions.

TO BE READ IN CONJUNCTION WITH HCD DRAWINGS;

A-PL-001 - SITE LOCATION PLAN
A-PL-002 - EXISTING SITE PLAN
A-PL-004 - PROPOSED STORE PLAN
A-PL-005 - PROPOSED RETAIL UNIT BUILDING PLAN
A-PL-006 - PROPOSED STORE ROOF PLAN
A-PL-007 - PROPOSED RETAIL UNIT ROOF PLAN
A-PL-008 - PROPOSED STORE ELEVATIONS
A-PL-009 - PROPOSED RETAIL UNIT ELEVATIONS
A-PL-010 - PROPOSED SITE SECTIONS

1:200 — 0 5 10 15 20 m

N

Foodstore Areas		
Sales Area	1325 m²	14,262 ft²
Gross Internal Area	2125 m²	22,873 ft²
Gross External Area	2206 m²	23,745 ft²

Retail Area Unit 2		
Gross Internal Area	700 m²	7535 ft²
Gross External Area	730 m²	7858 ft²

Retail Area Unit 3		
Gross Internal Area	700 m²	7535 ft²
Gross External Area	730 m²	7858 ft²

Car Parking Numbers	
Customer Parking	149
Disabled Parking	11
Parent & Child	12
Staff	10
Grand Total:	182

Shared Cycle Hoops on site	18
Motorcycle Parking	2

Outline Planning Application Boundary Only

	GIA	GEA	Max. Height
Drive Thru Restaurant	169m² / 1819sqft	200m² / 2153sqft	5 - 6m

PERMEABLE TARMAC AREAS

REVISION: D BY: DJW CHECKED: DATE: 09/04/2018
Scale of drawing amended to 1:200. Site levels added as per FRA. Highways consultant 6m wide road on

REVISION: C BY: DJW CHECKED: DATE: 20/02/2018
Issued for Planning. Permeable tarmac to car park spaces added and to be read in conjunction with Flood Risk Assessment. Non-permable tarmac surface to circulation routes in car park.

REVISION: B BY: DJW CHECKED: DATE: 03/01/2018
Issued for Planning. Red Line Boundaries Updated to include site access junction, service road access/ egress junction, top of pedestrian ramp and Tesco shared site access. Site Boundary area updated.

REVISION: A BY: DJW CHECKED: DATE: 22/11/2017
Issued for Planning. Application boundary updated. Cycle parking moved closer to Lidl main store entrance.

REVISION: * BY: DJW CHECKED: DATE: 15/11/2017
Issued for Planning.

PLANNING

PLOT DATE:

CLIENT:

LiDL UK GmbH
BROOKSIDE ROAD
UTTOXETER

PROJECT:

PROPOSED SITE PLAN

DRAWING:

DRAWN BY:	SCALE:	DATE:
GOV	1:200 @ A0	OCTOBER 2017

Hadfield Cawkwell Davidson
Broomgrove Lodge, 13 Broomgrove Rd, Sheffield, S10 2LZ T 0114 266 8181 www.hcd.co.uk
Architecture | Engineering | Interior Design | Masterplanning | Urban Design

JOB NO:	DRAWING NO:	REV:
2017-119	A-PL-003	D

S:\Architecture\2017-119\Drawings\DR - Plotsheets\A-PL-003_Proposed Site Plan.dwg

D. Fluvial Modelling Technical Note

D.1 Mott Macdonald Ltd – reference R02_392669

MOTT MACDONALD

Technical Note

Project:	Brookside (Uttoxeter) Modelling Update		
Our reference:	**R02_392669**	**Your reference:**	
Prepared by:	Christopher Rhodes	**Date:**	**29 March 2018**
Approved by:	**David Ocio**	**Checked by:**	**Emily Fowler**
Subject:	Picknall Brook Model Update		

1 Introduction

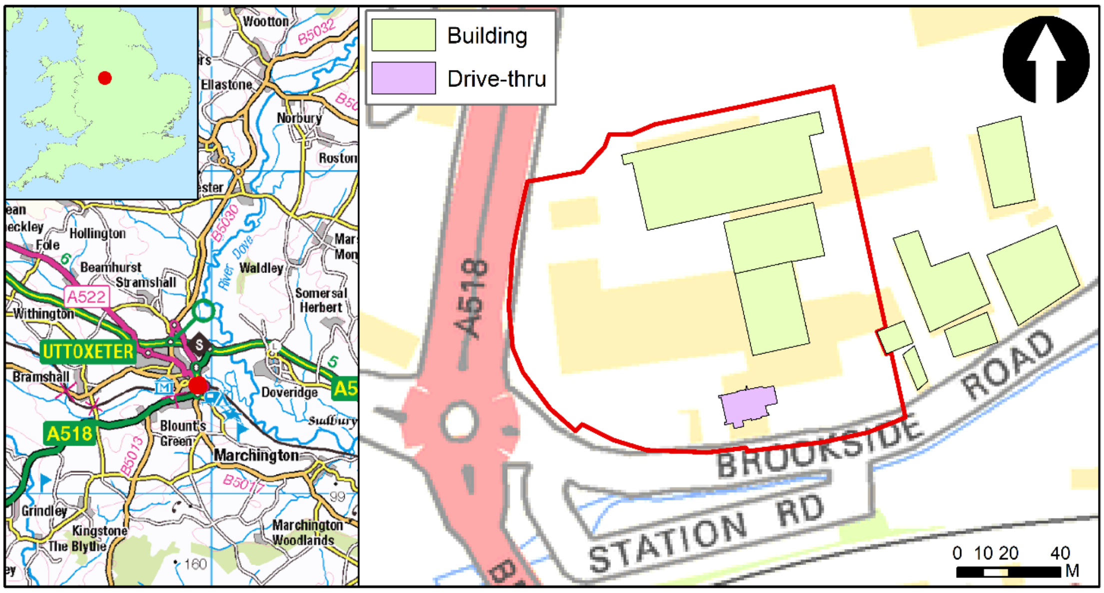
Modelling activities were undertaken in 2014 for the proposed development of land off Brookside Road in Uttoxeter (Figure 1). The Environment Agency 1D-2D ISIS-TUFLOW catchment model for the River Dove, initially developed by Halcrow in 2011, was updated to reflect the proposed development and assess the impact on fluvial flood risk, and develop mitigation measures. There have been changes since then to the proposed development and an update in climate change allowances along with a new topographic survey. These updates need to be incorporated into the modelling.

The objectives of the project are to update the model to reflect the changes to the proposed development, shown in Figure 1, and to review and amend the proposed mitigation options to ensure there is no increase in fluvial flood risk due to the proposed development.

The proposed development is located to the north of Brookside Road, and is located next to Picknall Brook, a tributary of the River Dove. The existing site is at risk of flooding from Picknall Brook and therefore the area of developable land is restricted.

This Technical Note has been prepared for the purposes outlined above. The consultant has followed accepted procedures in providing the services but given the residual risk associated with any prediction and the variability which can be experienced in flood conditions, the consultant takes no liability for and gives no warranty against actual flooding of any property (client's or third party) or the consequences of flooding in relation to the performance of the service.

Figure 1: Site location and proposed development



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1.1 Scope

The scope outlines the following key deliverables:

- Develop new 30% climate change scenario
- Review and update model with new topographic survey
- Update the post development model with the new proposed development
- Update the post development with mitigation model with agreed mitigation measures.
- Stabilise and run the following six design events for the baseline, post-development and post-development with mitigation options:
  - 1 in 20-year
  - 1 in 100-year
  - 1 in 100-year+20% climate change
  - 1 in 100-year+30% climate change
  - 1 in 1000-year
  - Blockage scenario (bridge PB_446 blocked by 50%)

2 Methodology

The climate change allowance for the Picknall Brook has increased from 20% to 30%. The new 30% climate change scenario was produced by applying a factor to the 1 in 100-year inflows. There are two inflows to the model (Pick 1 and Pick 2). Table 1 show the peak flows for the 100-year return period scenarios.

Table 1: Peak flow for the 100-year return period scenarios for Pick 1

Return Period	Peak flow (m3/s)	Increase from 100-year (%)
100	19.3	-
100+20% CC	23.2	20
100+30% CC	25.1	30

Table 2: Peak flow for the 100-year return period scenarios for Pick 2

Return Period	Peak Flow	Increase from 100-year
100	2.09	-
100+20%CC	2.51	20
100+30%CC	2.72	30

2.1 LiDAR Update

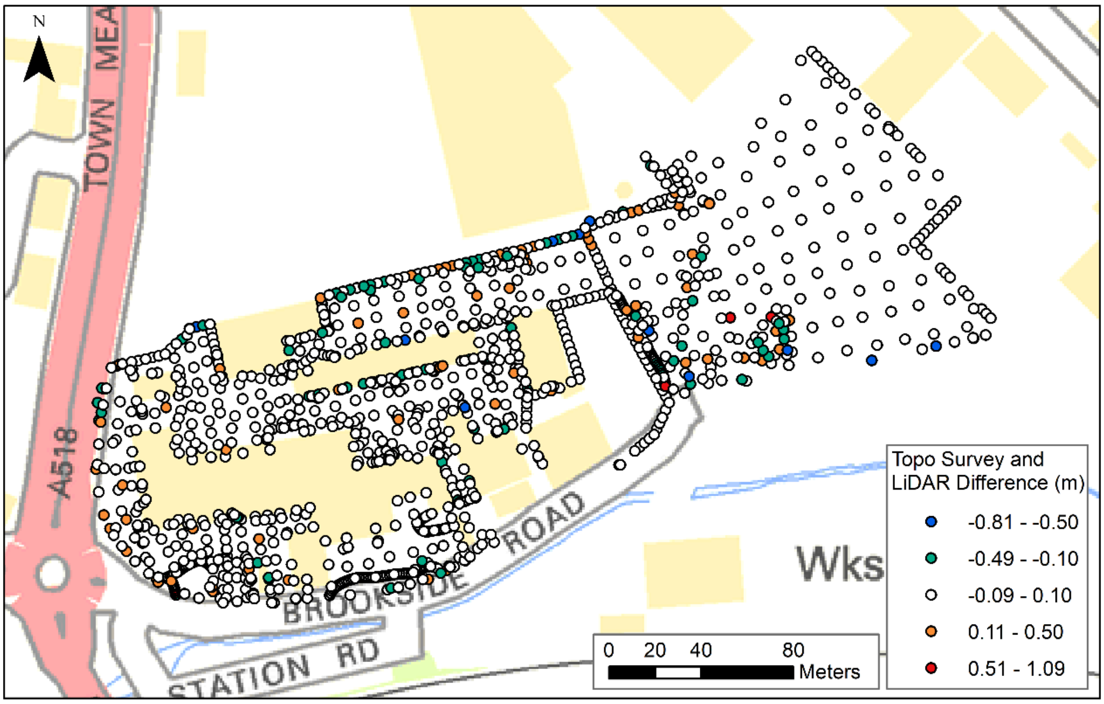
A new topographic survey was provided for this model update. Figure 2 shows a comparison of the new site topographic survey against the zpts (ground levels) in the EA model (derived from LiDAR data, 2008).

The survey comparison focuses on the proposed development area. It should be noted that the boundaries of the new survey are slightly different from the zpts (ground level), therefore only points where both the survey and zpts exist have been compared.

This comparison shows that the difference between the topographic survey and the LiDAR tends to be +/-10cm. There is a greater difference (+/-0.5m) along the north boundary of the site, along the south-west boundary of the site and at the end of Brookside Road. This latter area also exhibits differences of up to +1.09/-0.81m. These differences are likely to be a result of changes in level of the spare land and the building of a boundary wall.

The new survey appears consistent with the existing survey and a comparison between the two has not raised any major concerns. Therefore, the new survey will be used to overwrite the existing zpts (ground levels) in the model, where coverage allows.

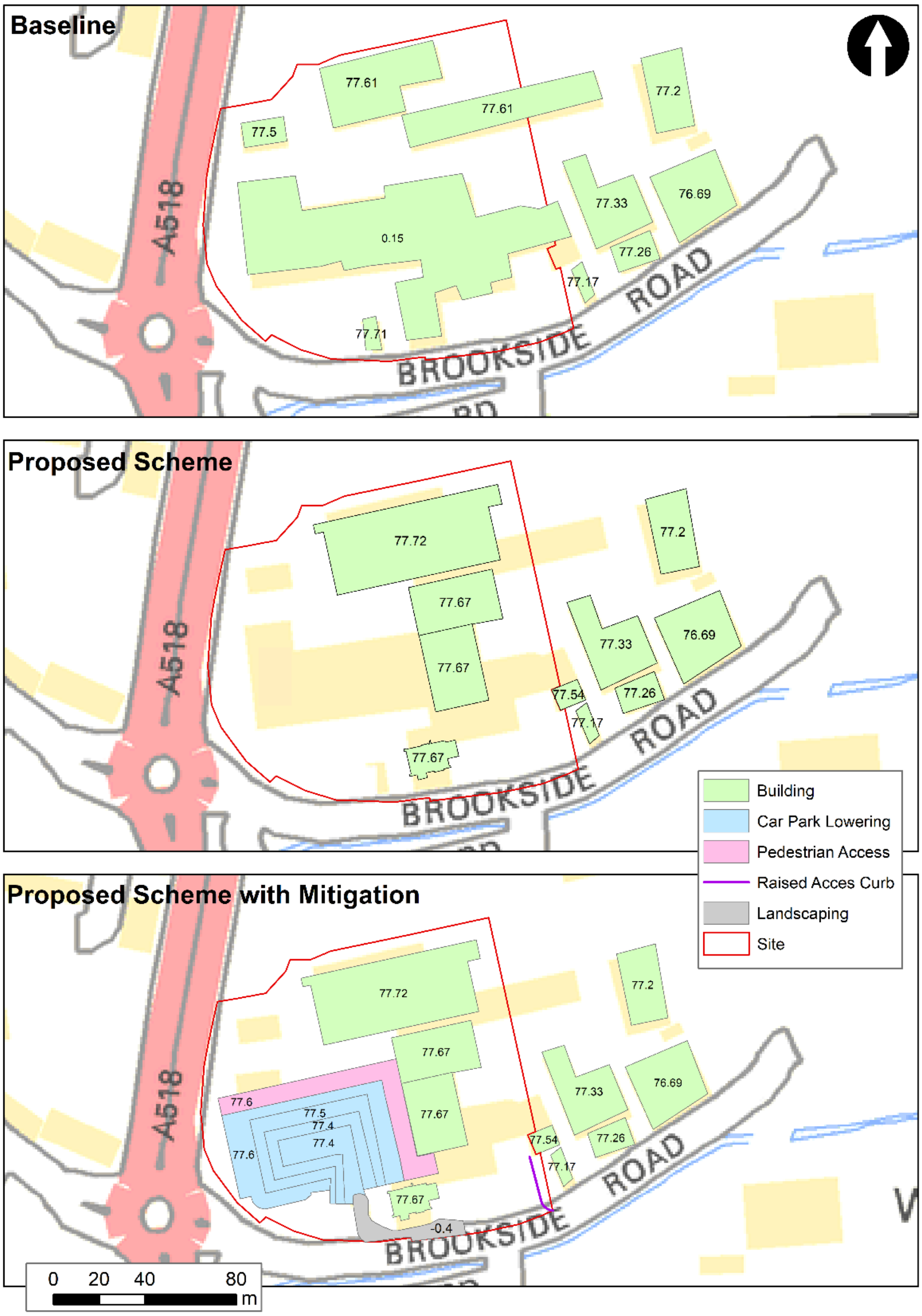
Figure 2: Topographic survey and LiDAR difference



2.2 Finalised models

The updated baseline model, proposed scheme model and proposed scheme with mitigation model are shown in Figure 3. The baseline model includes threshold levels for the existing buildings at the site. The proposed scheme model includes a threshold level for the proposed buildings at the site and the existing buildings to the east of the site. The proposed scheme with mitigation consists of the proposed scheme scenario with a pedestrian access across the car park raised (to 77.6mAOD) and car park levelling to create an area to attenuate floodwaters (with levels stepped from 77.4mAOD). This area is connected to the first spill point of the river by landscaping of -0.4m around the proposed drive-thru (see Figure 1). In addition, the roadside curb on the proposed HGV access road to the south-east of the site is raised to 77.3mAOD.

Figure 3: Finalised models with absolute elevations or adjustments to existing elevation values



Labels provided are absolute levels or relative (+/-) levels to the ground surface, as defined by the most recent survey.

3 Results

The following design events were modelled for each of the baseline, post development and post development with mitigation scenarios: 1 in 20-year, 1 in 100-year, 1 in 100-year with 20% climate change allowance, 1 in 100-year with 30% climate change allowance, 1 in 1000 year and a bridge blockage scenario. This blockage scenario assumed the 50% blockage of bridge PB_446 under the 1 in 100-year with 30% allowance for climate change scenario.

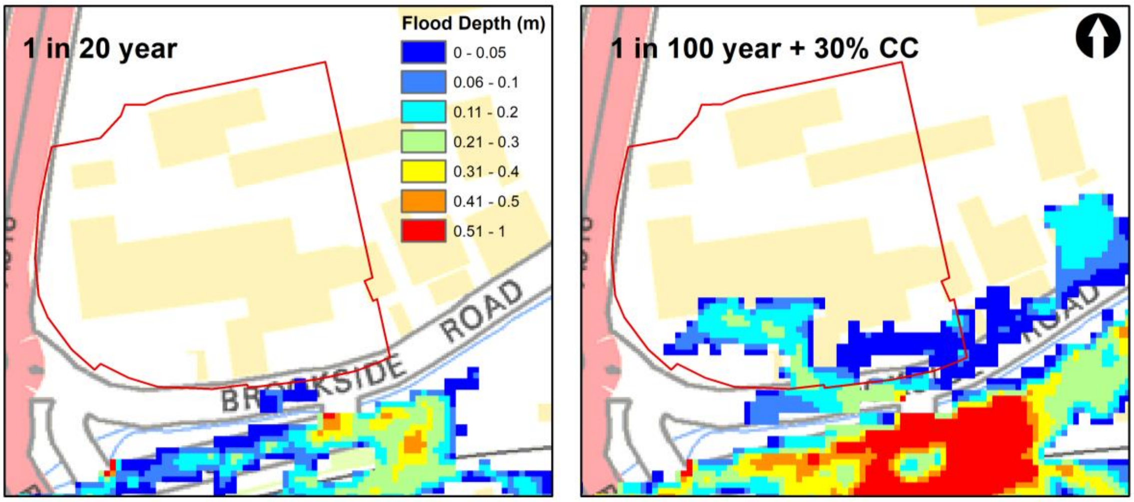
In the main body of this technical note the 20-year and 100-year with 30% climate change results are presented and considered in detail. Results for the other model scenarios are presented in Appendix A.

3.1 Baseline

The modelled flood outlines indicate that the proposed development site is at low risk from flooding during the 1 in 20-year flood event (Figure 4). During the 1 in 100-year and 1 in 100-year with climate change allowances flood events, the area at risk from flooding increases along the southern boundary, with one building particularly at risk.

The blocked scenario and 1000-year event shows a sizable increase in area at risk with the modelled flood extending further northwards from the south west corner so that it connects to flood water coming from the central southern flooded area (Appendix A).

Figure 4: Baseline model flood extents



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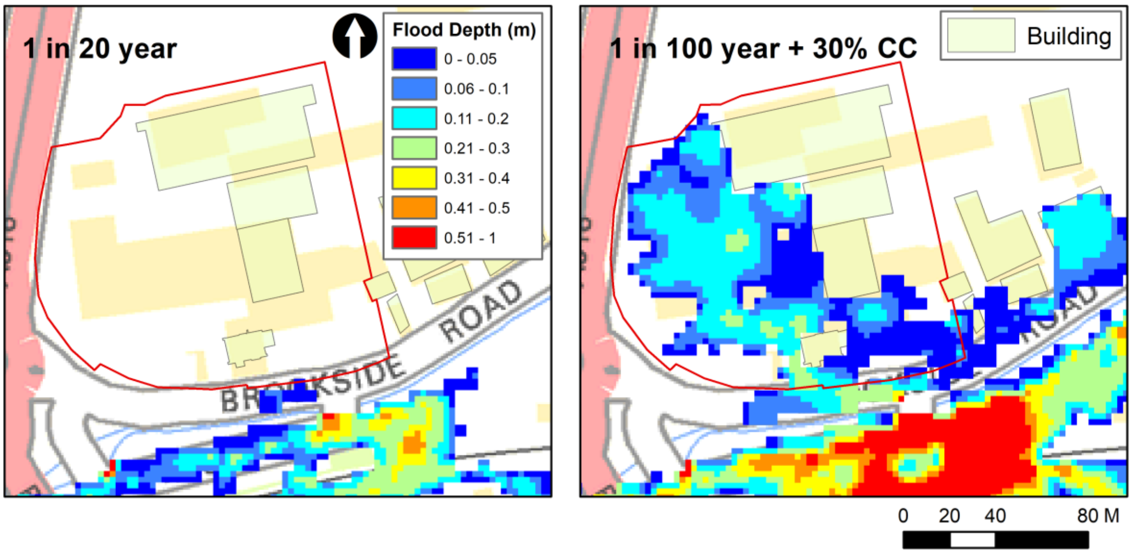
3.2 Post development

The modelled flood outlines indicate the proposed development site (without mitigation) shows a significant increase in flood extent for the 1 in 100-year + 30% climate change scenario, as discussed below.

In the 1 in 20-year flood event the modelled floodwater does not encroach on the site, therefore the post development scenario modelled flood extent and depth show no change from the baseline.

The risk from flooding during the 1 in 100-year event with 30% climate change allowance for the post development scenario is significantly greater across the west half of the site (see Figure 4). Under the baseline scenario the large building to the south of the site limits the modelled flood extent across the west half of the site. Its absence in the proposed development scenario allows modelled flood water of up to 0.3m (in places) to extend across the full length of the west of the site and to the east of the proposed drive-thru.

Figure 5: Proposed development model flood extents

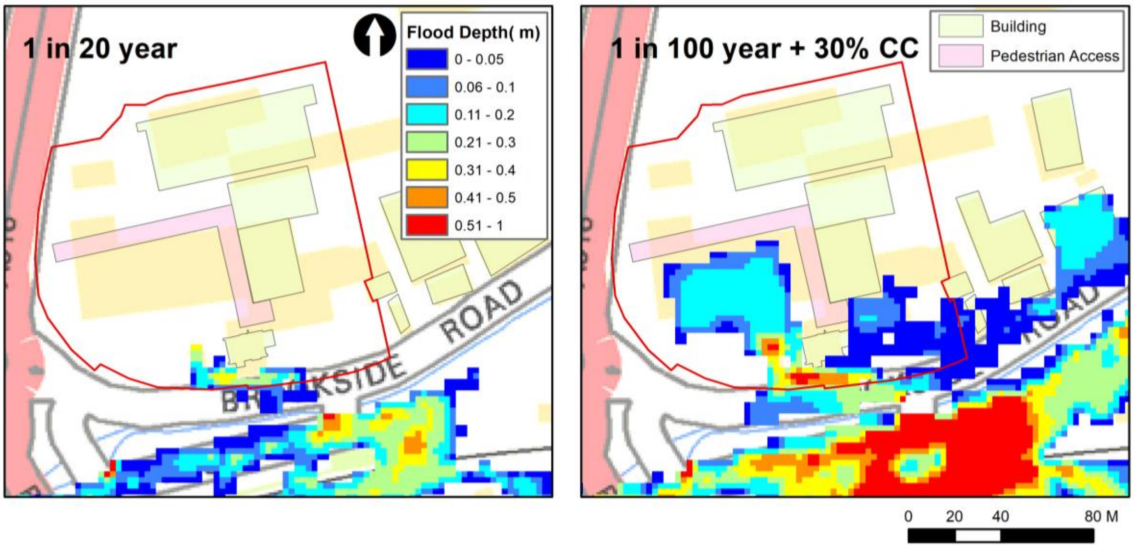


3.3 Post development with mitigation

When including mitigation there is an increase in the risk of flooding across the south of the site during the 1 in 20-year event. This is a result of the landscaping around the proposed drive-thru.

For the 1 in 100-year with a 30% allowance for climate change post development with mitigation scenario, the modelled flood extent is limited to the lowered car park area, with depths of approximately 0.11-0.2m and the pedestrian access walkway is not shown to be at risk from flooding. Additionally, the mitigation has decreased the modelled flood depths (and flood extend to a small degree) in the region to the east of the proposed drive-thru.

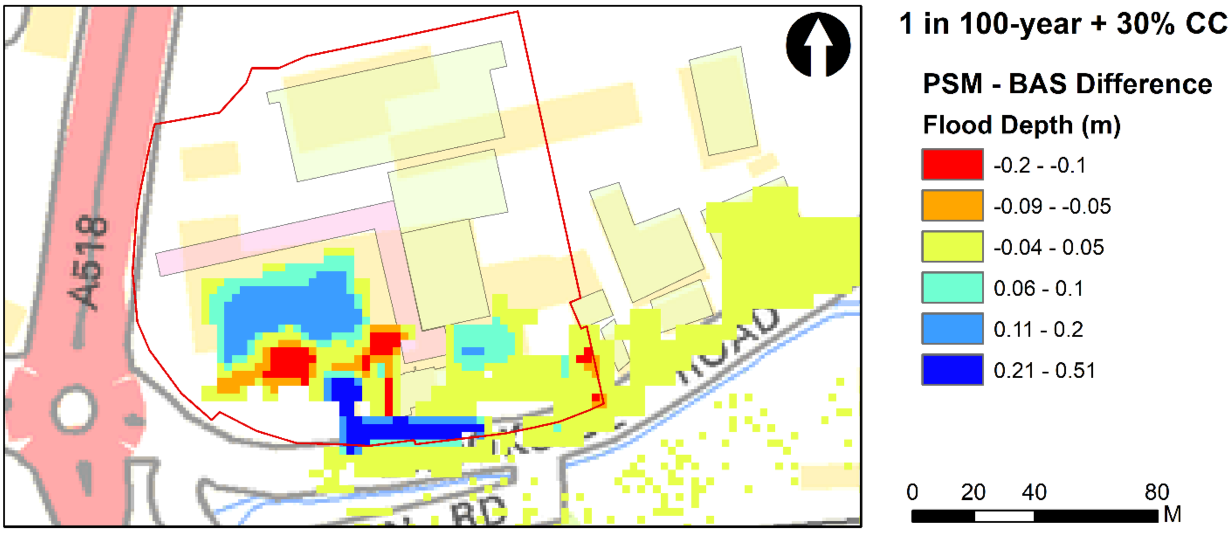
Figure 6: Post development with mitigation model flood extents



3.4 1 in 100-year with 30% climate change allowance comparison

Figure 7 shows the difference in modelled flood depth between the proposed scheme with mitigation and the baseline scenario for the 1 in 100-year with 30% climate change allowance return period. The largest increase in flood depth (up to 0.51m) is located where the landscaping has taken place (around the proposed drive-thru) and the car park levelling (up to 0.2m difference). There are noticeable decreases in water level located to the south of the main car park. These are likely to be a result of the car park levelling resulting in different ground levels and consequently different modelled flood depths.

Figure 7: Difference in flood depth between the Proposed Scheme with Mitigation and the Baseline for the 1 in 100-year with 30% climate change scenario



3.5 Post development model results off site

In line with the National Planning Policy Framework (NPPF), the proposed development should not cause an increase in flood risk off site. Figure 8 shows a comparison of the pre-development flood outlines to with the post-development flood outlines. The proposed development with mitigation alters the extent of flooding on site; however, there is no increase in the risk from flooding off site for the 1 in 100-year with 30% climate change allowance. A comparison of flood depth at seven locations off-site show no increase in flood risk (Table 3). A small decrease (1cm and 5cm) in flood depth was recorded at locations 2 and 3.

Figure 8: 1 in 100-year + 30% climate change flood outline comparison

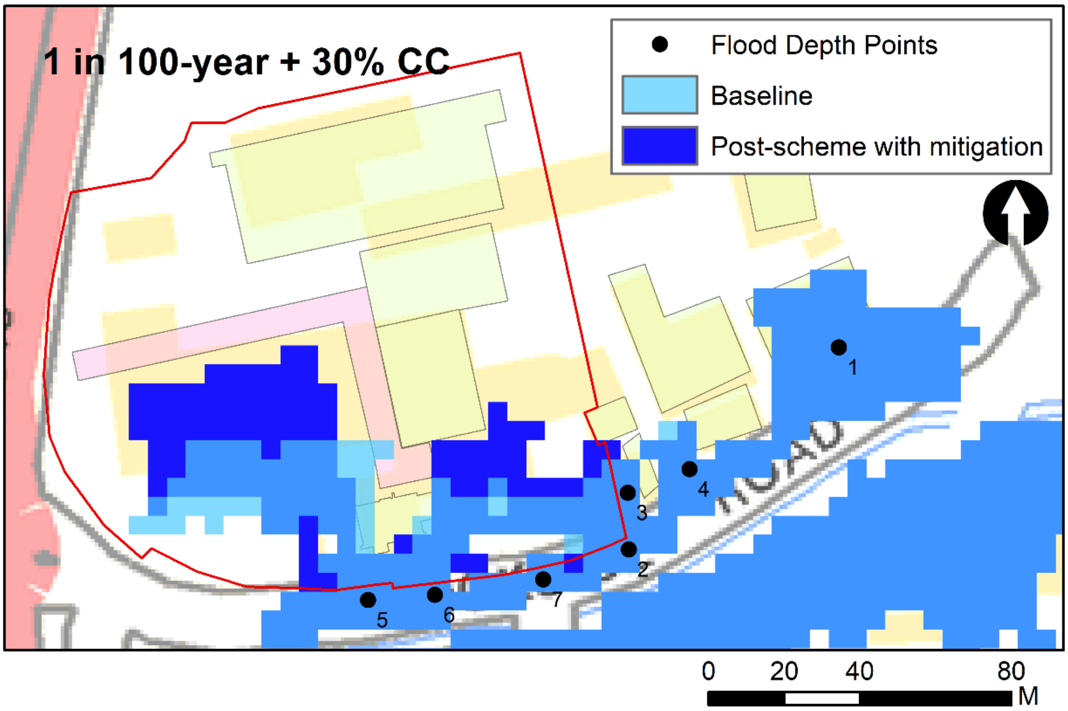


Table 3: Flood depths at locations 1 to 7 for 1 in 100-year + 30% climate change scenario

Location	Baseline (m)	Post-scheme with mitigation (m)	Difference (m)
1	0.12	0.12	0.00
2	0.05	0.03	-0.01
3	0.06	0.01	-0.05
4	0.03	0.03	0.00
5	0.18	0.18	0.00
6	0.25	0.25	0.00
7	0.10	0.10	0.00

4 Conclusions

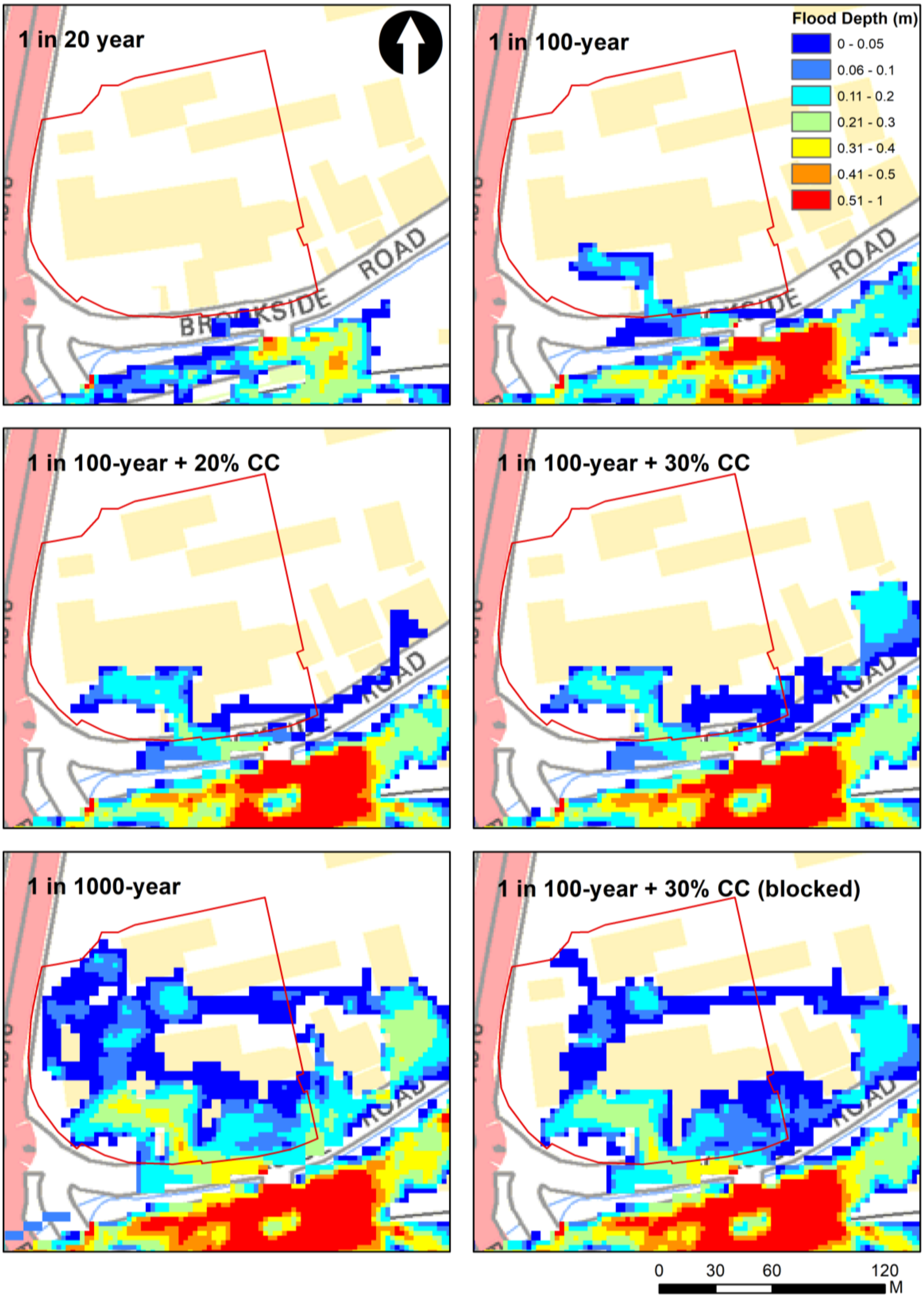
The existing Uttoxeter 1D-2D ISIS-TUFLOW model was updated with a new 30% climate change scenario and updated topographic survey. An updated baseline model was run with a further two model configurations, post development and post development with mitigation, for six scenarios.

For the 100-year with 30% climate change allowance, the baseline model shows a risk of flooding of up to 0.2m to the south of the site with flow being restricted by the presence of a large building. The proposed development updated the existing building location and threshold levels. This configuration shows extensive risk from flooding of up to 0.2m across the western half of the site, primarily due to the absence of buildings blocking the flow paths. A series of landscaping and car park levelling was used to create a post-development with mitigation configuration.

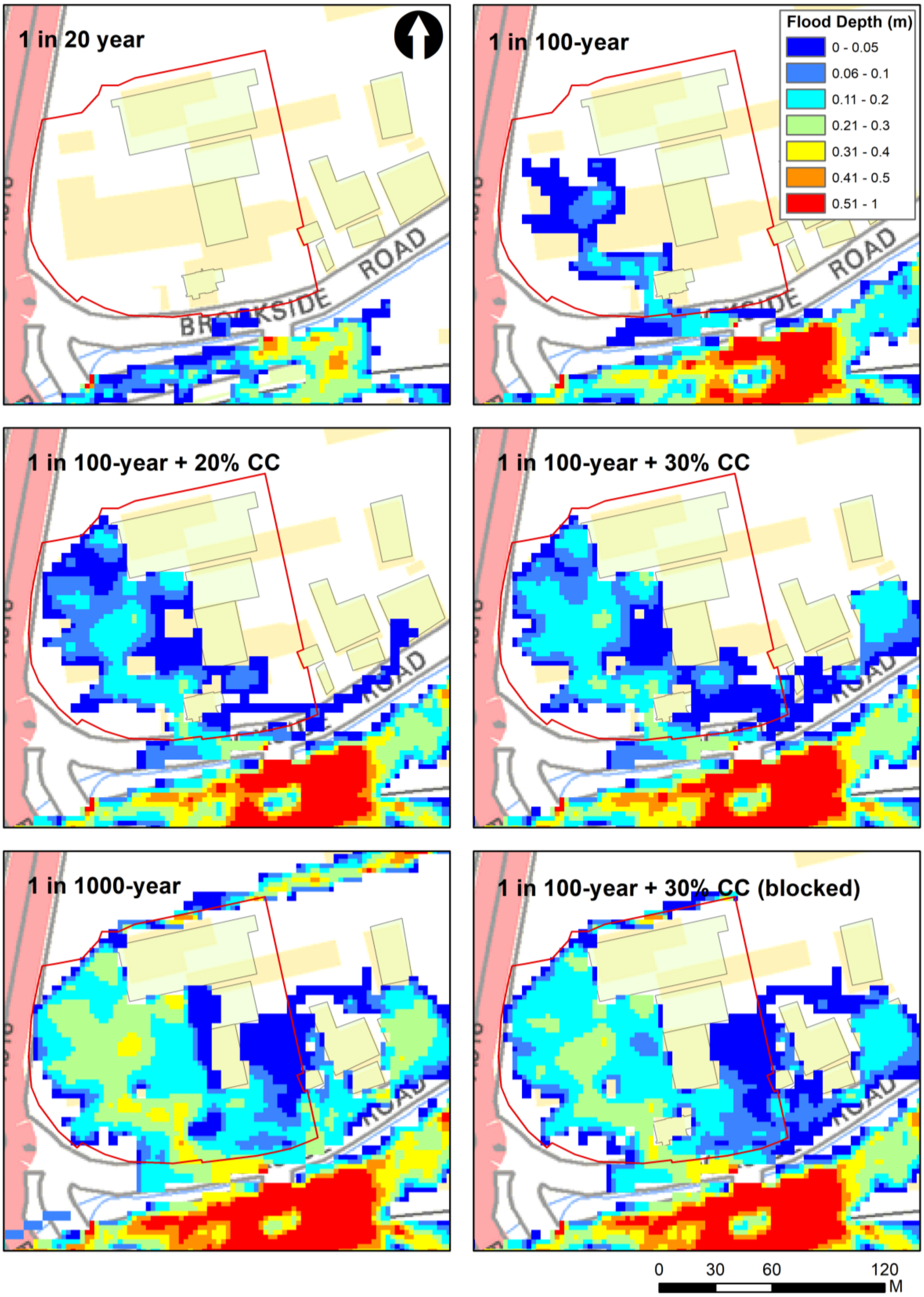
The modelled flood extent for this was restricted to the car park area in the south-west of the site (mostly 0.2m deep) and did not increase flood depths to the north-east of the proposed drive-thru nor flooding offsite.

A. Appendix A: Flood depth figures for all return periods

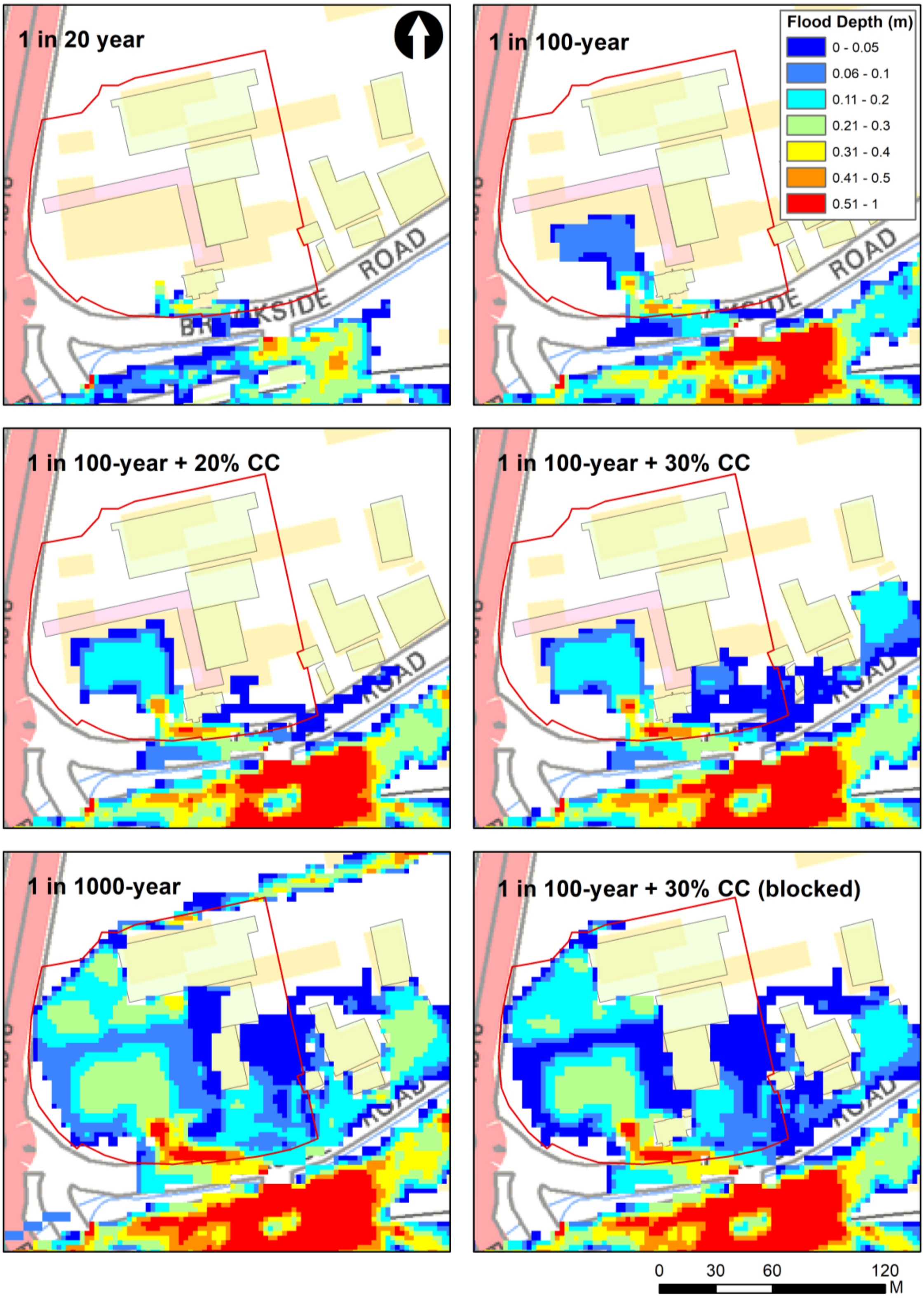
A.1 Baseline



A.2 Proposed scheme



A.3 Proposed scheme with mitigation



Note: The detailed car park levelling has not been included in these figures but is shown in Figure 3.

E. Preliminary Design Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.359	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.600
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.372	8-12	0.141	16-20	0.141	24-28	0.141	32-36	0.001
4-8	0.254	12-16	0.141	20-24	0.141	28-32	0.111		

Total Area Contributing (ha) = 1.443

Total Pipe Volume (m³) = 13.556

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	3.002	0.100	30.0	0.786	30.00	0.0	0.600	o	350	Pipe/Conduit	
S2.000	26.837	0.179	149.9	0.095	30.00	0.0	0.600	o	225	Pipe/Conduit	
S2.001	33.360	0.222	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	60.12	30.00	76.700	0.786	0.0	0.0	0.0	3.18	305.6	128.1
S2.000	60.12	30.00	77.195	0.095	0.0	0.0	0.0	1.07	42.4	15.4
S2.001	60.12	30.00	77.016	0.095	0.0	0.0	0.0	1.07	42.4	15.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S2.002	9.263	0.062	150.0	0.033	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	52.082	0.347	150.1	0.312	0.00	0.0	0.600	o	350	Pipe/Conduit	
S1.002	37.909	0.245	154.7	0.042	0.00	0.0	0.600	o	350	Pipe/Conduit	
S3.000	6.676	0.294	22.7	0.175	30.00	0.0	0.600	o	225	Pipe/Conduit	
S3.001	6.676	0.406	16.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	13.680	0.091	150.3	0.000	0.00	0.0	0.600	o	350	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.002	60.12	30.00	76.794	0.128	0.0	0.0	0.0	1.07	42.4	20.8
S1.001	60.12	30.00	76.600	1.226	0.0	0.0	0.0	1.41	136.0«	199.7
S1.002	60.12	30.00	76.253	1.268	0.0	0.0	0.0	1.39	133.9«	206.4
S3.000	60.12	30.00	76.825	0.175	0.0	0.0	0.0	2.76	109.6	28.5
S3.001	60.12	30.00	76.531	0.175	0.0	0.0	0.0	3.24	128.9	28.5
S1.003	60.12	30.00	76.000	1.443	0.0	0.0	0.0	1.41	135.9«	234.9

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.786	0.786	0.786
2.000	User	-	100	0.095	0.095	0.095
2.001	-	-	100	0.000	0.000	0.000
2.002	User	-	100	0.033	0.033	0.033
1.001	User	-	100	0.312	0.312	0.312
1.002	User	-	100	0.042	0.042	0.042
3.000	User	-	100	0.175	0.175	0.175
3.001	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.443	1.443	1.443

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.003	S	77.470	75.909	75.750	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.359		

Online Controls for Storm

Crown Vortex Valve® Manhole: S4, DS/PN: S1.001, Volume (m³): 0.8

Design Head (m) 0.800 Vortex Valve® Type R3 SW Only Invert Level (m) 76.600
Design Flow (l/s) 88.0 Diameter (mm) 302

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	10.6	1.200	107.7	3.000	170.4	7.000	260.2
0.200	28.1	1.400	116.4	3.500	184.0	7.500	269.4
0.300	46.5	1.600	124.4	4.000	196.7	8.000	278.2
0.400	61.2	1.800	132.0	4.500	208.7	8.500	286.8
0.500	69.6	2.000	139.1	5.000	219.9	9.000	295.1
0.600	76.2	2.200	145.9	5.500	230.7	9.500	303.2
0.800	88.0	2.400	152.4	6.000	240.9		
1.000	98.4	2.600	158.6	6.500	250.8		

Hydro-Brake® Optimum Manhole: S7, DS/PN: S3.001, Volume (m³): 0.5

Unit Reference	MD-SHE-0203-2100-1000-2100
Design Head (m)	1.000
Design Flow (l/s)	21.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	203
Invert Level (m)	76.531
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	21.0	Kick-Flo®	0.724	18.0
Flush-Flo™	0.345	21.0	Mean Flow over Head Range	-	17.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	1.200	22.9	3.000	35.5	7.000	53.6
0.200	19.3	1.400	24.7	3.500	38.3	7.500	55.4
0.300	20.9	1.600	26.3	4.000	40.8	8.000	57.1
0.400	20.9	1.800	27.8	4.500	43.2	8.500	58.8
0.500	20.6	2.000	29.2	5.000	45.5	9.000	60.5
0.600	19.9	2.200	30.6	5.500	47.6	9.500	62.1
0.800	18.9	2.400	31.9	6.000	49.7		
1.000	21.0	2.600	33.2	6.500	51.7		

Storage Structures for Storm

Porous Car Park Manhole: SA, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	57.5
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	1437.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	77.050	Cap Volume Depth (m)	0.150

Porous Car Park Manhole: S6, DS/PN: S3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	29.0
Membrane Percolation (mm/hr)	1000	Length (m)	25.0
Max Percolation (l/s)	201.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	77.220	Membrane Depth (mm)	0

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.359
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SA	60 Winter	1	+20%	30/15 Summer				77.034
S2.000	S1	60 Winter	1	+20%	101/60 Winter				77.249
S2.001	S2	60 Winter	1	+20%	101/15 Summer				77.072
S2.002	S3	60 Winter	1	+20%	1/60 Winter				77.034
S1.001	S4	60 Winter	1	+20%	1/60 Summer	101/60 Winter			77.026
S1.002	S5	60 Winter	1	+20%					76.436
S3.000	S6	30 Winter	1	+20%	30/30 Winter				76.879
S3.001	S7	60 Winter	1	+20%	30/30 Winter				76.650
S1.003	S8	60 Winter	1	+20%	101/15 Summer				76.222

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SA	-0.016	0.000	0.40		43.1	OK	
S2.000	S1	-0.171	0.000	0.13		5.1	OK	
S2.001	S2	-0.169	0.000	0.13		5.1	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.002	S3	0.016	0.000	0.21		7.2	SURCHARGED	
S1.001	S4	0.076	0.000	0.50		63.7	SURCHARGED	2
S1.002	S5	-0.167	0.000	0.54		65.7	OK	
S3.000	S6	-0.171	0.000	0.12		9.2	OK	
S3.001	S7	-0.106	0.000	0.10		9.4	OK	
S1.003	S8	-0.128	0.000	0.73		74.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.359
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SA	60 Winter	30	+20%	30/15 Summer				77.129
S2.000	S1	60 Winter	30	+20%	101/60 Winter				77.281
S2.001	S2	15 Winter	30	+20%	101/15 Summer				77.156
S2.002	S3	15 Winter	30	+20%	1/60 Winter				77.137
S1.001	S4	60 Winter	30	+20%	1/60 Summer	101/60 Winter			77.134
S1.002	S5	15 Winter	30	+20%					76.471
S3.000	S6	60 Winter	30	+20%	30/30 Winter				77.227
S3.001	S7	60 Winter	30	+20%	30/30 Winter				77.499
S1.003	S8	30 Summer	30	+20%	101/15 Summer				76.271

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SA	0.079	0.000	0.62		67.0	SURCHARGED	
S2.000	S1	-0.139	0.000	0.31		12.3	OK	
S2.001	S2	-0.085	0.000	0.23		9.3	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.002	S3	0.118	0.000	0.56		19.6	SURCHARGED	
S1.001	S4	0.184	0.000	0.55		70.3	FLOOD RISK	2
S1.002	S5	-0.132	0.000	0.70		85.6	OK	
S3.000	S6	0.177	0.000	0.29		21.9	SURCHARGED	
S3.001	S7	0.743	0.000	0.23		20.9	FLOOD RISK	
S1.003	S8	-0.079	0.000	0.96		98.4	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.359
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100, 101
Climate Change (%)	20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SA	60 Winter	100	+20%	30/15 Summer				77.186
S2.000	S1	60 Winter	100	+20%	101/60 Winter				77.295
S2.001	S2	15 Winter	100	+20%	101/15 Summer				77.226
S2.002	S3	15 Winter	100	+20%	1/60 Winter				77.202
S1.001	S4	60 Winter	100	+20%	1/60 Summer	101/60 Winter			77.189
S1.002	S5	15 Winter	100	+20%					76.486
S3.000	S6	60 Winter	100	+20%	30/30 Winter				77.270
S3.001	S7	60 Winter	100	+20%	30/30 Winter				77.521
S1.003	S8	15 Winter	100	+20%	101/15 Summer				76.350

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SA	0.136	0.000	0.65		70.5	SURCHARGED	
S2.000	S1	-0.125	0.000	0.41		16.2	OK	
S2.001	S2	-0.015	0.000	0.32		12.6	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.002	S3	0.184	0.000	0.75		26.2	SURCHARGED	
S1.001	S4	0.239	0.000	0.58		74.1	FLOOD RISK	2
S1.002	S5	-0.117	0.000	0.77		93.7	OK	
S3.000	S6	0.220	0.000	0.29		22.5	SURCHARGED	
S3.001	S7	0.765	0.000	0.23		20.8	FLOOD RISK	
S1.003	S8	0.000	0.000	1.02		104.9	OK	

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.359
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 1, 30, 100, 101
Climate Change (%) 20, 20, 20, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SA	60 Winter	101	+40%	30/15 Summer				77.586
S2.000	S1	60 Winter	101	+40%	101/60 Winter				77.515
S2.001	S2	60 Winter	101	+40%	101/15 Summer				77.481
S2.002	S3	60 Winter	101	+40%	1/60 Winter				77.446
S1.001	S4	60 Winter	101	+40%	1/60 Summer	101/60 Winter			77.432
S1.002	S5	15 Winter	101	+40%					76.510
S3.000	S6	60 Winter	101	+40%	30/30 Winter				77.307
S3.001	S7	60 Winter	101	+40%	30/30 Winter				77.521
S1.003	S8	15 Winter	101	+40%	101/15 Summer				76.361

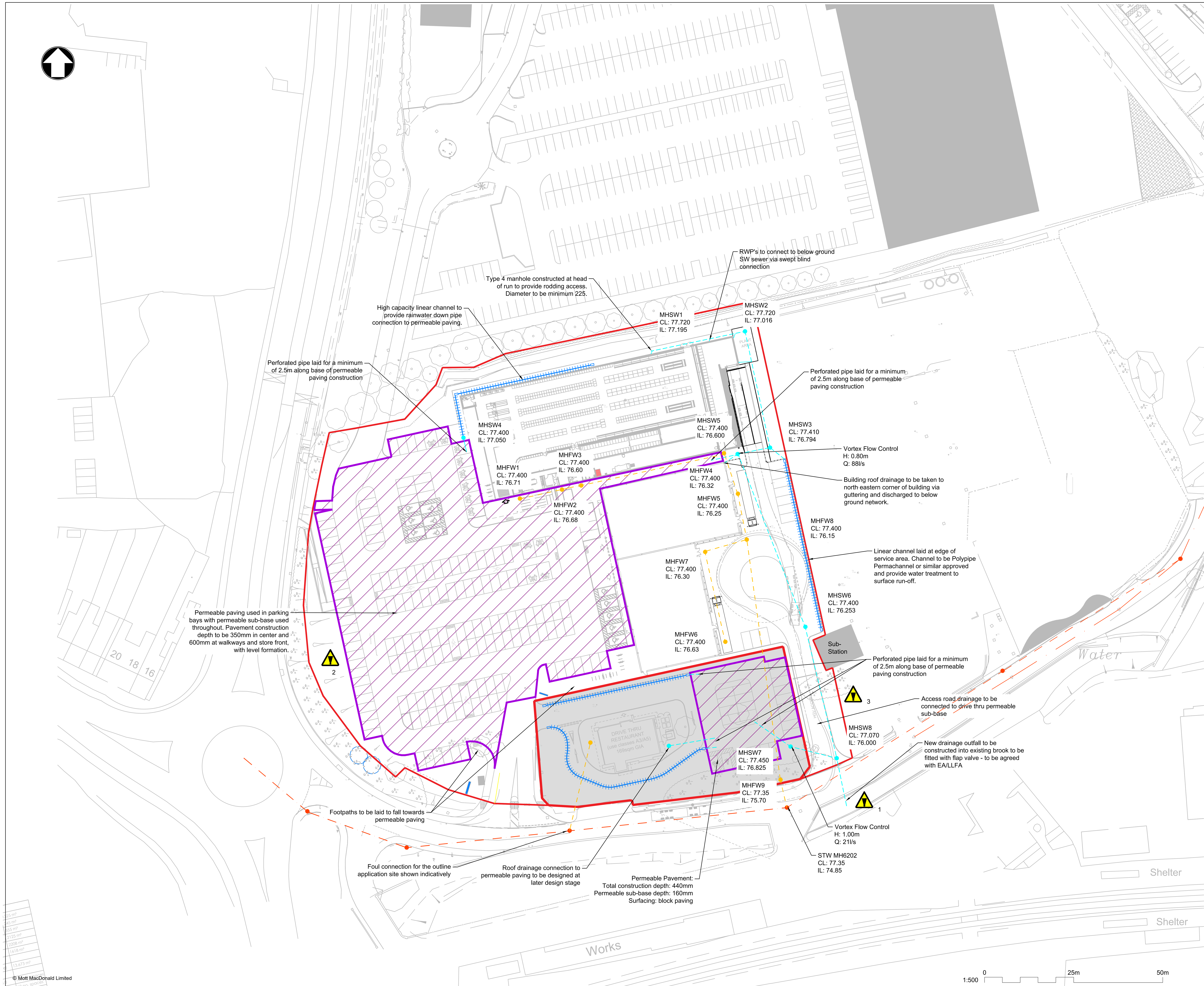
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SA	0.536	0.000	1.29		139.5	FLOOD RISK	
S2.000	S1	0.095	0.000	0.48		18.9	FLOOD RISK	
S2.001	S2	0.240	0.000	0.47		18.8	FLOOD RISK	

101 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.002	S3	0.428	0.000	0.70		24.3	FLOOD RISK	
S1.001	S4	0.482	31.840	0.70		88.4	FLOOD	2
S1.002	S5	-0.093	0.000	0.82		99.8	OK	
S3.000	S6	0.257	0.000	0.30		22.7	SURCHARGED	
S3.001	S7	0.765	0.000	0.23		20.7	FLOOD RISK	
S1.003	S8	0.011	0.000	1.13		116.6	SURCHARGED	

F. Indicative Surface Water Drainage Masterplan

F.1 MML drawing ref 392669-MMD-00-XX-DR-D-0001



P:\Sheffield\392669 - Brookside, Uttoxeter\5.0 MM Drawings\Drainage\392669-MMD-00-XX-DR-D-0001.dwg Jun 14, 2018 - 4:57PM PRE27448

Notes

1. Do not scale from this drawing.
2. All levels are in meters above Ordnance Datum (mAOD) unless otherwise specified.
3. All dimensions are in metres unless specified otherwise.
4. Main car park permeable paving to have minimum level of 77.400mAOD and maximum level of 77.650mAOD. Sub-base base to be laid at constant formation level of 77.050mAOD throughout with constant surfacing build up, permeable sub-base thickness to be increased to account for difference.
5. Permeable paving systems to be lined with welded impermeable tanking membrane, with suitable specification for use in on-site ground conditions.#
6. Foul drainage system to discharge via gravity to adopted assets, subject to S106 agreement with Severn Trent Water.
7. Adopted drainage assets taken from STW sewer records and shown here indicatively only.

Key to symbols

- Existing Foul Sewer
- Linear Channel with Sump Unit
- Proposed Surface Water Sewer
- Proposed Foul Drainage
- Proposed Permeable Paving

Reference drawings

15541a_OGL_REV0 - Site Topographical Survey
A-PL-003 - Proposed Site Plan
A-PL-010 - Proposed Site Sections

Residual Health & Safety Risk Assessment

1. Working near live carriageway
2. Risk of dust and noise to public
3. Open excavations

Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	20/03/2018	M Smith	For Information	AJP	HL

Status Stamp

NOT FOR CONSTRUCTION

MOTT MACDONALD
Mott MacDonald House
8-10 Sydenham Road
Croydon
CR0 2EE
United Kingdom
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Client

Hadfield Cawkwell Davidson
Broomgrove Lodge
Sheffield
S10 2LZ

Title

LiDL Uttoxeter
Indicative Surface Water Drainage
General Arrangement

Designed	M Smith	MCS	Eng check	A Precious	AJP
Drawn	M Smith	MCS	Coordination		---
Dwg check	A Precious	AJP	Approved		

MMD Project Number	Scale at A1	Security
392669	As Shown	STD

Suitability Description	Suit. Code
Suitable for Stage Approval	S4

Drawing Number	Revision
392669-MMD-00-XX-DR-D-0001	P01