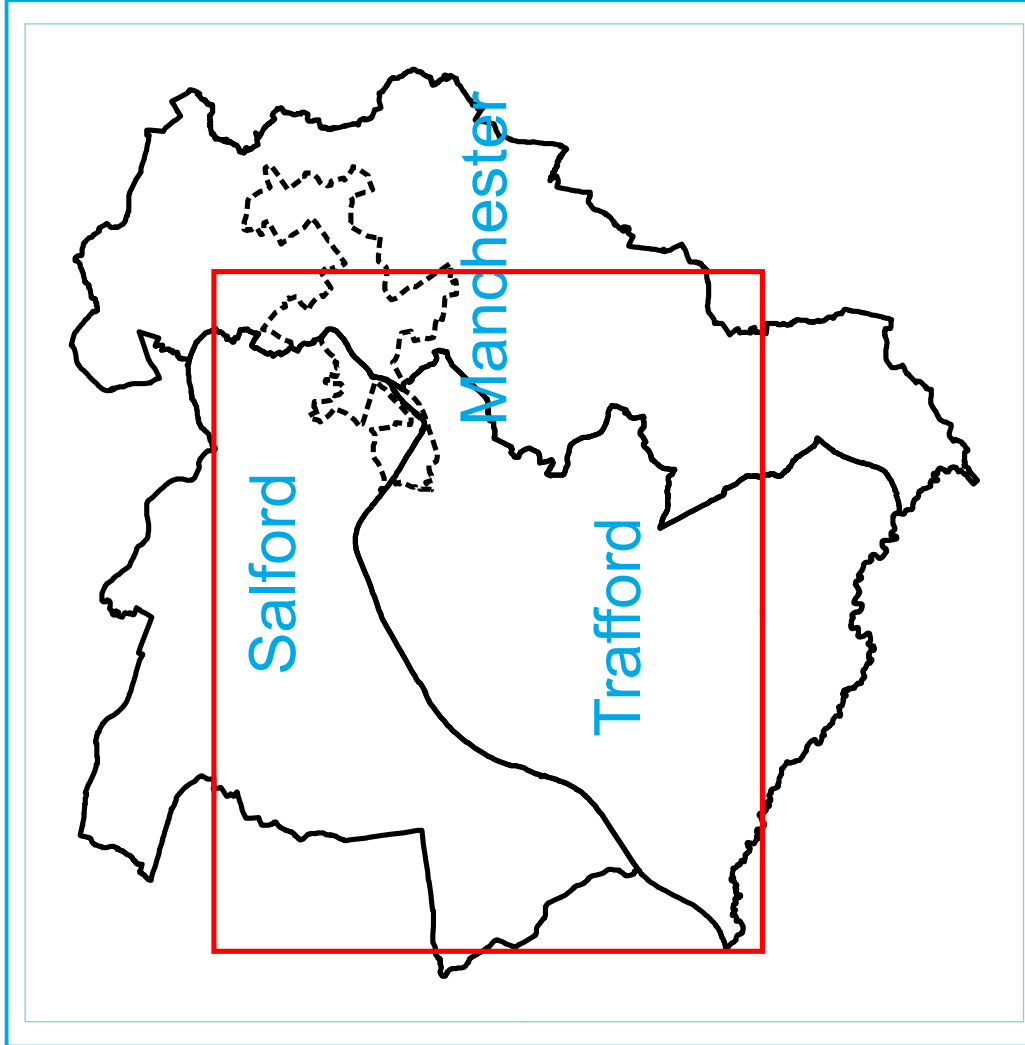
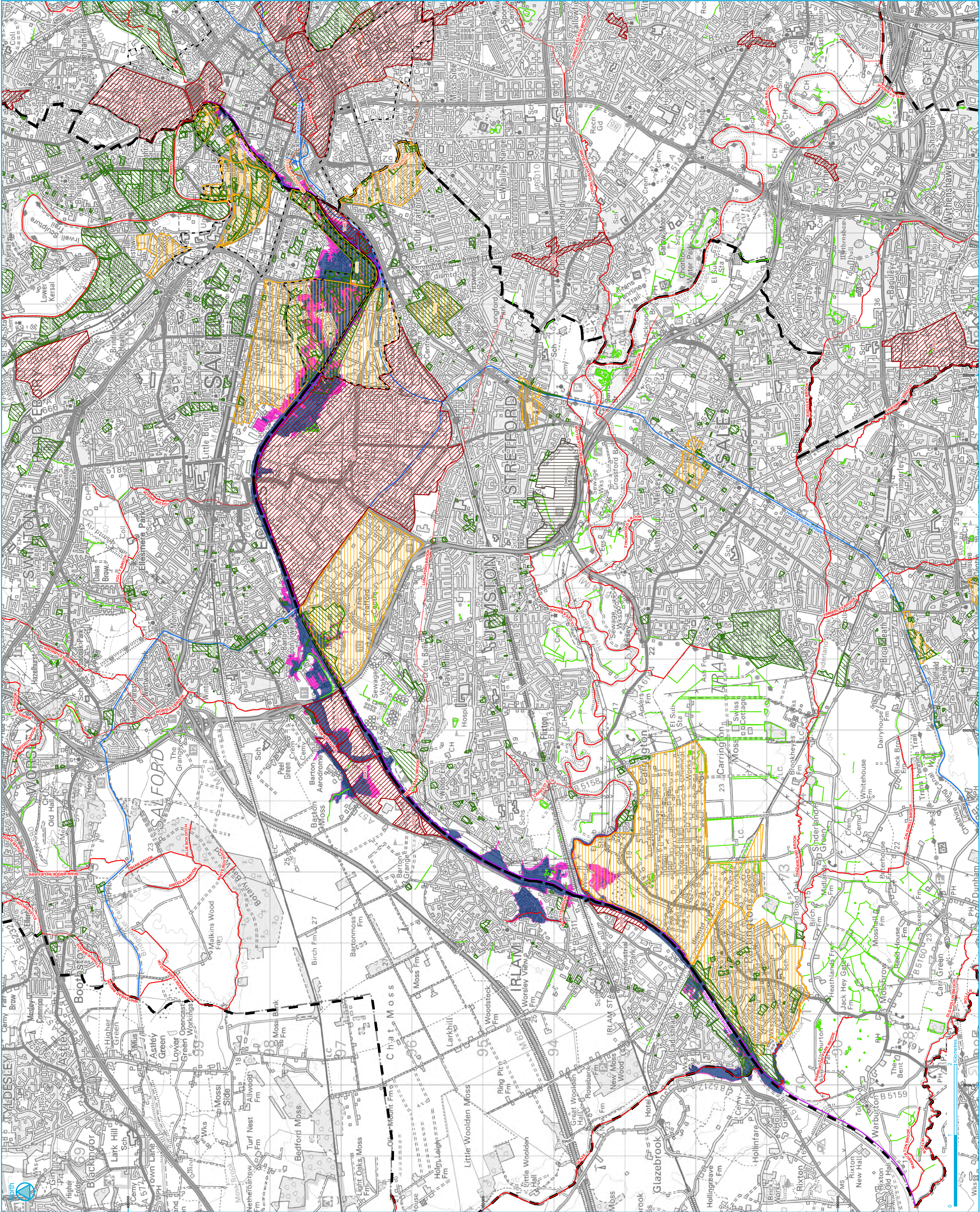




- Council Boundary
- Urban Design Thresholds For Resistance & Resilience
 - Ashton, Bridgewater and Rochdale Canals
 - Manchester Ship Canal / Grey Inwell
 - Other Waterbodies
 - Main Rivers (V8.0)
- Potential Development Sites / Locations
 - <0.6 m
 - >0.6 m
- Digitised River Lines
 - Employment
 - Housing
 - Mixed Use
 - Other
- Regional Centre Boundary

The map has been produced in accordance with PP25: Development and Flood Risk and its Practice Guide.

Areas at risk from the Manchester Ship Canal and Grey Inwell are currently subject to a wide variation in model results resulting from model uncertainties. Hence urban design response needs to adopt a mix of non-structural resilience measures and/or floor level raising to account for the high degree of uncertainty associated with a residual risk.

The Main River information shown in the SFRA is provided by the Environment Agency, the centreline data may deviate from that shown on basemapping due to inherent differences in data resolution. Further information on Main Rivers is provided on the Environment Agency's website. The map shows the potential flood risk, scenario of the operation of the Manchester Ship Canal. The map should be used in conjunction with the advice given in Chapter 6 of the Level 2 SFRA.

This map shows typical urban design approaches that would be applicable to areas of residual flood risk. The design thresholds used to identify where resistance and resilience are potentially applicable are based on flood depths expected in a 1 in 100 yr event with an allowance for the potential for increased flood risk, scenario of the operation of the Manchester Ship Canal. The map should be used in conjunction with the advice given in Chapter 6 of the Level 2 SFRA.

The River Inwell between Victoria Station and Pomona Island is not shown as a Main River on the Environment Agency's Flood Map, though Flood Zones related to the river are. The same approach has been taken in this SFRA.

www.jbaconsulting.co.uk
t 0161 275 1000
e info@jbaconsulting.co.uk

Bentley House
Salford Street
Warrington
WA1 1NN
United Kingdom

Other offices at Aldershot, Oxford, Newcastle, Newcastle upon Tyne, Newport, Northampton, Salisbury, Slough, Telford & Walsingham

Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA				Urban Design Zoning for the Manchester Ship Canal and Grey Inwell	
Drawn by:	J Cheatham	Date:	06/03/2011	The City of Manchester, Salford City and Trafford Councils have given permission for a Ordnance Survey map to be used in the preparation of this Mapping Statement. Once a Ordnance Survey map has been used, the user must acknowledge the source of the map and the permission granted by Ordnance Survey. The user must also acknowledge the permission granted by the Ordnance Survey to use the map for the purpose of the project. The user must also acknowledge the permission granted by the Ordnance Survey to use the map for the purpose of the project. The user must also acknowledge the permission granted by the Ordnance Survey to use the map for the purpose of the project. The user must also acknowledge the permission granted by the Ordnance Survey to use the map for the purpose of the project. The user must also acknowledge the permission granted by the Ordnance Survey to use the map for the purpose of the project. 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APPENDIX I: EXISTING DRAINAGE SITUATION

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- GENERAL NOTES:
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
 - DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
 - ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
 - FOR GENERAL NOTES REFER TO DRAWING.
 - ALL LEVELS IN mAOD UNLESS SPECIFIED OTHERWISE.
 - EXISTING UTILITIES INFORMATION TO BE SUPPLIED BY OTHERS.
 - THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE ACCURACY OF THE TOPOGRAPHICAL SURVEY AND UNDERTAKING ADDITIONAL SURVEYS FOR VALIDATION PURPOSES.
 - ALL WORKS TO BE AGREED AND APPROVED BY THE LOCAL AUTHORITY PRIOR TO COMMENCING ON SITE.

KEY

- SITE BOUNDARY
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED FILTER DRAIN
- EXISTING COMBINED DRAINAGE
- EXISTING COMBINED MANHOLE
- SURFACE WATER MH
- VORTEX FLOW CONTROL MH
- PROPOSED TYPE 3 PAVEMENT
- STONE DEPTH 150mm

P02	AMENDED TO SUIT NEW LAYOUT	11.01.18	AMG	RMZ
P01	ISSUED FOR PLANNING	28.11.17	AMG	e
Rev:	Description:	Date:	By:	Check:



Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
0161 275 0000
manchester@curtins.com
www.curtins.com

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PRELIMINARY

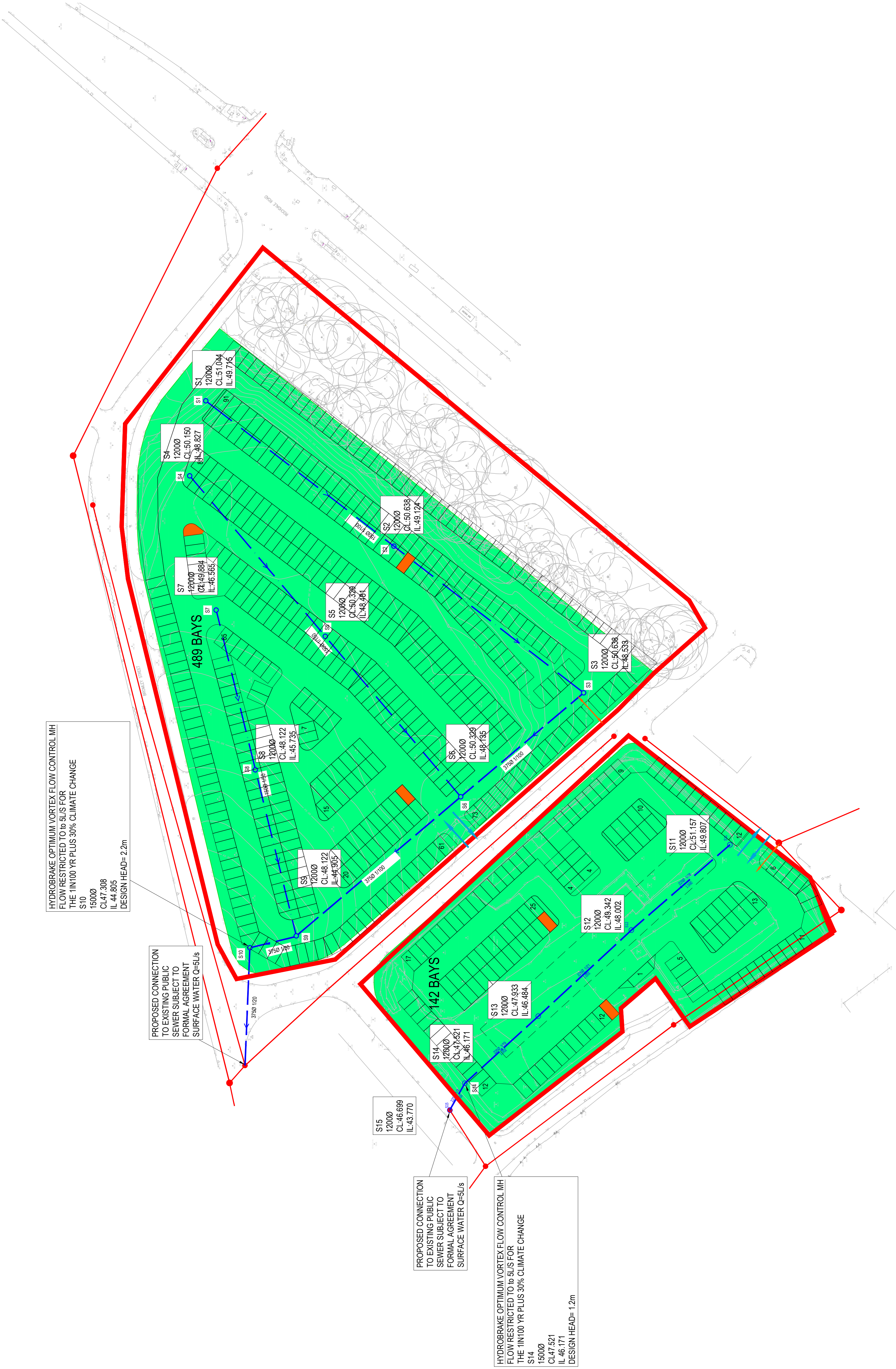
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Project: PEARY STREET CAR PARK, MANCHESTER

Dwg Title: DRAINAGE STRATEGY GENERAL ARRANGEMENT

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	28.11.17	AMG	AMG	RM
Scale:	1:500			
Project No:	Originator:	Zone:	Level:	Type: Discipline: Category: Number:

065819 - CUR - 00 - XX - DR - D - 72001 -P02



Peary Street (Temporary Car Park), Manchester

Flood Risk Assessment and Detailed Drainage Strategy

Curtins Ref: 065619-CUR-00-XX-RP-D-500

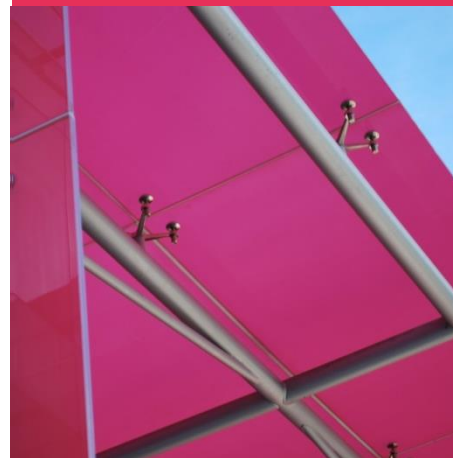
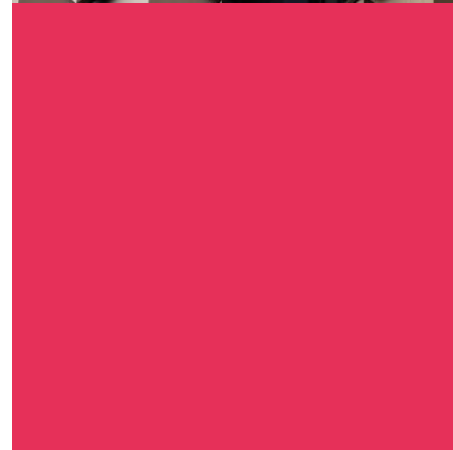
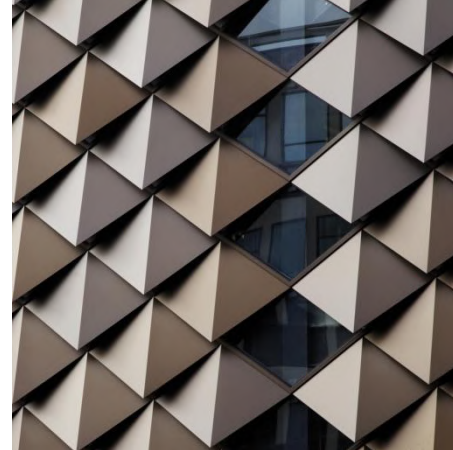
Revision: V03

Issue Date: 11 January 2018

Client Name: Far East Consortium International

Client Address: That Space, 31-33 Princess Street Manchester, M2 4EW.

Site Address: Peary Street, Manchester, (M4 4JA Nearest Post Code)



Curtins
Merchant Exchange
17-19 Whitworth Street West
Manchester, M1 5WG
Tel: 0161 236 2394
www.curtins.com

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Control Sheet

Rev	Description	Issued by	Checked	Date
V01	First Issue	AMG	RM	29/11/2017
V02	Amended to reflect How comments	AMG	RM	11/12/2017
V03	Updated to incorporation layout change	AMG	RM	11/01/2018

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Author	Signature	Date
Andrea McGee Technician		11 January 2018

Reviewed	Signature	Date
Richard Manock BEng(Hons) MCIHT Associate		11 January 2018

Authorised	Signature	Date
Andy Day BEng(Hons) Technical Director		11 January 2018

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Appendix A

Proposed Site Plan

Appendix B

UU Public Sewer Records

UU PDE Responses

Appendix C

Topographic Survey

Appendix D

BGS Infiltration SuDS GeoReport

Appendix E

Drainage Calculations

Detailed Drainage Strategy

1.0 Introduction

1.1 Project Background

- 1.1.1 Curtins was appointed by HOW Planning LLP on behalf of Far East Consortium (FEC) to provide a Flood Risk Assessment and Detailed Drainage Strategy to obtain temporary consent for a proposed 631 space surface level car park on a site of Rochdale Road, adjacent to Peary Street, Manchester. The nearest postcode to the site is M4 4JA, and the site is centred around National Grid Ref: 384847,399316.
- 1.1.2 The report provides summary information on the nature of flood risk at the site and follows Government guidance with regards to development and flood risk.
- 1.1.3 The report is based on currently available information and preliminary discussions.
- 1.1.4 Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.
- 1.1.5 Where the proposed works to which this report refers are undertaken more than twelve months following the issue of this report, Curtins shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins.

1.2 Scope of Assessment

- 1.2.1 The assessment is to be undertaken in accordance with the standing advice and requirements of the Environment Agency (EA) for Flood Risk Assessments as outlined in the Communities and Local Governments Planning Policy Guidance to the National Planning Policy Framework (NPPF).
- 1.2.2 The total site area is approximately 2 hectares in total and is located within the northern fringe of Manchester City Centre. The development areas are north-east and south west of the Peary Street. Following scrutiny of the UK Governments Long Term Flood risk information it has been identified that the existing site lies within an area which is classified as Flood Zone 1, indicating low probability of fluvial or tidal flooding. Following scrutiny of surface water flood maps and risk of flooding from reservoir maps, it has been identified that the site does not lie within an area which is at risk of flooding from reservoirs, however the site does appear to have localised areas of low surface water flooding. The larger parcel of the site (east of Peary Street) there is a localised risk of surface water flooding in the north-east corner of the site as well as adjacent to Rochdale road. The smaller parcel of the site (west of Peary Street) there is a low risk of surface water flooding to the south of the site. Therefore, it is

assumed that a full Flood Risk Assessment would be required to support a planning application, however based on the proposals and temporary nature, a reduced scope Flood Risk Assessment and Drainage Strategy should be completed as part of the application.

1.2.3 In April 2015, the Government made changes to the National Planning Policy Framework which made Sustainable Urban Drainage Systems (SuDS) a material consideration in the determination of planning applications for 'major' developments.

1.2.4 A Drainage Strategy will therefore be required to support the Planning Application as the site is considered to be 'major' development by the Town and Country Planning Order 2015.

1.2.5 The assessment will:

- Investigate all potential risks of flooding to the site,
- Consider the impact the development may have elsewhere with regards to flooding;
- Consider proposals to mitigate any potential risk of flooding determined to be present; and
- Consider design proposals for foul and storm water drainage of the site.

1.2.6 The Assessment reviews the following information:

- UK Government Flood Map for Planning.
- UK Government Long Term Flood Risk Assessment for Locations in England.
- Manchester City Council Preliminary Flood Risk Assessment, Published May 2011.
- Strategic Flood Risk Assessment for Greater Manchester. Published in August 2008.
- United Utilities Public Sewer Records, dated August 2017.
- Topographical Survey by Chris Partington Land Surveyors, dated October 2017.
- British Geological Survey (BGS) Infiltration SuDS GeoReport dated August 2017.

1.3 Proposed Development

1.3.1 The proposal is to obtain temporary consent for a 631-space surface level car park on a site off Rochdale Road, Adjacent to Peary Street, Manchester.

1.3.2 The proposed commercial car park plans are enclosed in *Appendix A*.

2.0 Existing Site Details

2.1 History and Current Use

- 2.1.1 The site is located off Peary Street on the north-east edge of Manchester City Centre, of Rochdale Road, nearest postcode is M4 4JA.
- 2.1.2 The larger site (east of Peary Street) is bounded by, Bromley Street and northern railway to the north and east and Rochdale Road (A664) to the south. A police station was once located here but has now been demolished and the site lies vacant. The site has a single access point on Peary street along the western boundary. There are a number of other potential access point along the north-eastern boundary, along Bromley street however the entire perimeter of the site is secured with fencing present. The smaller site (west of Peary Street) is bounded by St George Street to the south, Brook Street to the north west and Bromley street to the north. This site is currently being occupied by MTP and has a single access point along St Georges Road, this parcel of the site is also secured with a high bordered fence.
- 2.1.3 The wider area consists of mixed commercial / industrial and car parking to the east of the site. To the north of the site adjacent to Bromley street are rail tracks. There are car parking/ commercial units to the south of the site while to the west of the site there is a bordered up industrial site. (see Figure 1).



Figure 1: Aerial Photograph (©Google 2017)

2.2 Existing Watercourses

- 2.2.1 No above ground watercourses have been identified within the proposed site or in the immediate vicinity of the site.
- 2.2.2 The River Irk is approximately 175m north of the site.
- 2.2.3 The Rochdale Canal tow path is situated approximately 650m south of the proposed site. Keepers Quay and New Islington Marina converge with the Rochdale canal tow path in this area.
- 2.2.4 A canal basin is located approximately 665m south west of the site.
- 2.2.5 The river Irwell is located approximately 1.05km west of the site.

2.3 Existing Drainage

- 2.3.1 The public sewer records have been obtained for the development site and are enclosed in *Appendix B*. The records indicate that there are no public sewers recorded within the development site.
- 2.3.2 The public sewer records indicate that the following public sewers are located within the vicinity of the site:
 - There is a 225mm combined sewer located approximately 4m to the west of the proposed site and within the Peary Street, reference MH number 8201. It flows in a northwest direction to MH 7301, from here it increases to a 375mm combined sewer and continues to flow in a north-west direction until it converges with MH 7302.
 - From the north-east corner of the site there is MH 8402, from here a 300mm combined sewer flows in from east to west direction to MH 8403 and continues via a 375mm pipe to join MH 7302.
 - Located at the northeast portion of the site is MH9302 a 375 x 500 combined sewer flow in a north-east to south-west direction.
 - Along the north border of Bromley street there is a combined sewer from MH 9301 to MH 804 from a north east to north west. It continues from MH 8401 to MH6302.
 - The head of the system is located to the south of the proposed site boundary of the smaller parcel of the site. It flows southwest to MH 7201 via a 500 x 750 combined public sewer. From here is the sewer flows north along Billbrook Street to the west of the site to MH 7305.
 - MH7305 is located on Burstock Street, North of the site boundary of the smaller parcel of the site, it flows south to MH 7306.
 - There are further combined sewers located in the wider vicinity of the site.
- 2.3.3 Previously the site housed Collyhurst Police Station (now demolished) which included a 6 storey police station and adjacent multi-storey car park, and therefore historical drainage may still be present within the site. The topographical survey has identified several inspection chambers, gullies, stop valves within

the public footway around the perimeter of the pipe. However, a CCTV survey has not been carried out and there are no records of existing private drainage within the site. There is a drain approximately 5.5m long located along the proposed boundary towards the north east of the site of Bromley Street. Levels of this vary between 79.70mAOD to 79.51mAOD.

- 2.3.4 It is recommended that a GPR and CCTV drainage survey is carried out in order to determine the size, location, routes, depth, condition and outfalls of any existing drainage within the site.

2.4 Topography

- 2.4.1 A topographical survey has been carried out for the site, and is enclosed in *Appendix C*.
- 2.4.2 The site gradually falls from a south east to north west, with levels varying between approximately 51.4mAOD in the south-east corner to 46.9mAOD in the north-west corner. The smaller parcel of the site also falls gradually from a south east to a north-west direction with levels varying from approximately 51.99mAOD to 45.42mAOD.
- 2.4.3 The site generally falls from south to north in direction. The centre of the site is relatively flat before falling north-west towards Bromley street.
- 2.4.4 The topographical survey indicates there are trees on a slight embankment along the edge of the site boundary along Rochdale road.

2.5 Geology

- 2.5.1 The British Geological Survey Infiltration SuDS GeoReport is included in *Appendix D*, and identifies the following geological succession underlying the site:
- Superficial deposits – permeability is spatially variable, but likely to permit moderate infiltration.
 - Bedrock – Till, Devensian, Chester Formation (Sandstone, Pebbly (Gravelly)) Manchester Marls Formation. Permeability is likely to permit poor to moderate infiltration.
- 2.5.2 There is no Made Ground recorded on the site in the BGS maps.
- 2.5.3 Ground water is likely to be more than 5m below the ground surface through the year.
- 2.5.4 The site is not located within a Source Protection Zone.

3.0 Development and Flood Risk

3.1 National Planning Policy Framework (NPPF) and Planning Practice Guidance

- 3.1.1 In March 2012, the Department of Communities and Local Government published the National Planning Policy Framework document (NPPF) and the Planning Practice Guidance was published in March 2014 which provides guidance on how flood risk should be assessed during the planning and development process.

Table 1: (Extract from Planning Practice Guidance) Flood Zone Classifications

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's [Flood Map for Planning \(Rivers and Sea\)](#), available on the Environment Agency's web site, as indicated in the table below.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Table 2: (Extract from Planning Practice Guidance) Flood Risk Vulnerability Classification

Essential Infrastructure • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable • Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable • Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non-residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less Vulnerable

- Police, ambulance and fire stations which are **not** required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Water-Compatible Development

- Flood control infrastructure.
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 3: (Extract from Planning Practice Guidance) Flood Risk Vulnerability and Flood Zone Compatibility

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

Key:

✓ Development is appropriate

x Development should not be permitted.

Notes to table 3:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, 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.

3.2 Site Specific NPPF Flood Risk Categorisation

3.2.1 To assess the NPPF flood risk classification for the site, the first step was to inspect the UK Government web based 'Flood Map for Planning' which is used to inform planning of a site's Flood Zone(s) and the probability of flooding from rivers or sea (not taking into account the presence of flood defences). However, the web based 'Long Term Flood Risk Assessment for Locations in England' should also be used to identify the flood risks from rivers and seas, surface water and reservoirs.

3.2.2 From the Flood Map for Planning map:

- Where a site is located in a clear (unshaded) area, it is deemed to be classified as Flood Zone 1 (low probability) and is defined as land having a less than 1 in 1,000 (0.1%) annual probability of river or sea flooding.
- Where a site is located in a light blue shaded area, it is classified as Flood Zone 2 (medium probability) and is defined as land having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability of river flooding; or land having between a 1 in 200 (0.5%) and 1 in 1,000 (0.1%) annual probability of sea flooding.
- Where a site is located in a dark blue shaded area, it is generally classified as Flood Zone 3. Flood Zone 3 is further divided into the following zones:
 - Flood Zone 3a (high probability) and is defined as land having a 1 in 100 (1%) or greater annual probability of river flooding; or land having a 1 in 200 (0.5%) or greater annual probability of sea flooding.
 - Flood Zone 3b (the Functional Flood Plain) which comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Flood Zone 3b is not separately distinguishable from Zone 3a on the flood map).

3.2.3 The Flood Map for Planning is shown below in Figure 2, and it can be seen that the pre-development site and the surrounding area is located in an area classified as Flood Zone 1 (low probability of flooding from rivers or sea).

Figure 2: Flood Map for Planning (© Crown Copyright)



3.3 Site Specific Flood Zone Compatibility

- 3.3.1 The proposals for the development site will fall under the category of a temporary surface level car park.
- 3.3.2 The site is located within Flood Zone 1, for which all development is deemed to be appropriate, and neither the sequential nor the exception test is required (refer to Table 3 for the Flood Zone compatibility table taken from NPPF technical guidance).

4.0 Hydrological Assessment

4.1 Sources of Flood Risk

- 4.1.1 This study summarises the risk from different types of flooding to the development and the risk of flooding from the development, taking into consideration climate change, as well as how flood risks should be managed. The approach to assessing flood risk at the development site was informed by the requirements of NPPF in conjunction with the client and Environment Agency requirements.

4.2 Fluvial Flooding (Rivers and Streams)

- 4.2.1 Flooding to the site from rivers and seas is indicated below in Figure 3, taken from the UK Government's Long-Term Flood Risk Information.

Figure 3: Long Term Flood Risk Assessment Map – Flood Risk from Rivers or Sea (© Crown Copyright)



- 4.2.2 The detailed flood risk information taken from the UK Government Long Term Flood Risk Assessment website indicates that the area within the existing site is at 'Very Low' residual risk from fluvial flooding. Since the site is not shown to be in an area which benefits from flood defences, the fluvial flooding risk is directly linked to the Flood Zone 1 extents.

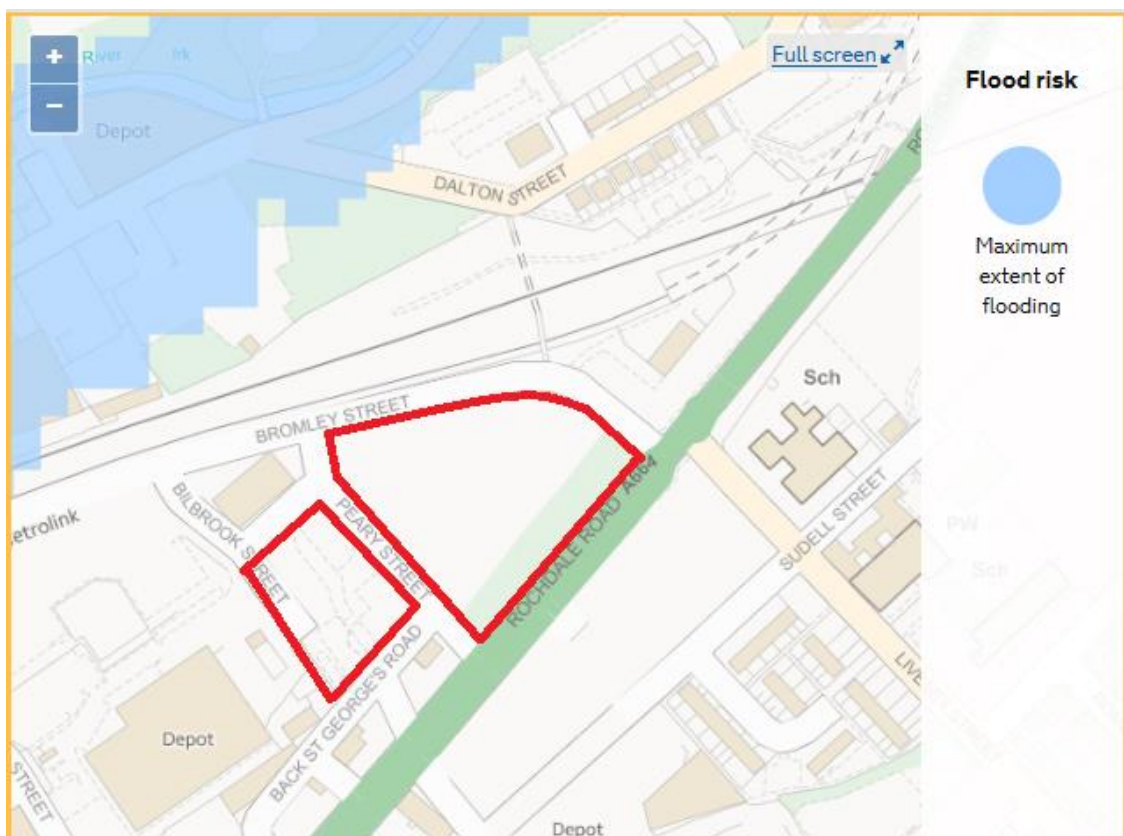
4.3 Tidal Flooding (Coastal or Estuarine)

- 4.3.1 There is currently no flood risk identified on the Environment Agency flood maps for the site and it is therefore regarded to be at low risk from tidal flooding.

4.4 Reservoir Flooding

- 4.4.1 Reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly and essential safety work is carried out.
- 4.4.2 The Long-Term Flood Risk Assessment (Flood Risk from Reservoirs) map (see *Figure 4*) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a worst-case scenario, it is very low risk that a reservoir flood would be this large.

Figure 4: Risk of Flooding from Reservoirs – Extent of Flooding (© Crown Copyright)



- 4.4.3 It can be seen that the site does not lie within the extents of flooding due to a reservoir breach.

- 4.4.4 The reservoir which could affect the area shown is:

- Heaton Park (grid reference SD82639 04954)

- 4.4.5 The reservoir is owned and operated by United Utilities plc. The Lead Local Flood Authority for the reservoir location is Bury Metropolitan Borough Council.
- 4.4.6 Manchester City Council would be responsible for coordinating emergency plans for the area which may be affected by reservoir flooding and ensuring communities are well prepared. Following the declaration of a major incident, Manchester City Council would offer support to the emergency services.
- 4.4.7 Since the likelihood of a reservoir breach ever occurring is extremely unlikely, providing that the reservoir asset owners conduct appropriate maintenance and regular inspections, the site is considered to be at low risk of flooding from reservoirs.
- 4.4.8 However, in considering the residual risk to the site, building occupiers in an area at risk of flooding from reservoirs should have an emergency procedure in place for the unlikely event of reservoir failure. This would include considering safe routes for occupants to a safe haven, and be ready to follow the advice of emergency services.

4.5 Canal Flooding

- 4.5.1 The Rochdale Canal Towpath link is situated approximately 650m south of the site, adjacent to the New Islington Marina and Keepers quay, providing access to the Ashton Canal Tow Path, approximately 1.1km south of the proposed site. Both are at a lower elevation than the development site.
- 4.5.2 Since canals are a controlled water body, the residual risk of canal flooding is usually associated with lower probability events such as overtopping and/or the breaching of embankments.
- 4.5.3 The Manchester City Council SFRA identifies that there are few recorded instances of flooding from the canal networks as they tend to be heavily regulated and controlled.
- 4.5.4 Given the above information, it is considered that there is very low risk of canal flooding to the site.

4.6 Groundwater Flooding

- 4.6.1 The Manchester City Council SFRA 'Areas Susceptible to Groundwater Flooding' map shows that the development is not in an area susceptible to groundwater flooding.
- 4.6.2 The BGS Infiltration SuDS GeoReport, enclosed in *Appendix D*, identifies that groundwater is likely to be more than 5m below the ground surface throughout the year.
- 4.6.3 The proposed development does not include a basement, and the proposed finished levels around the boundary of the site are to tie in with existing ground levels.
- 4.6.4 It is assumed based on the information available that there is no significant risk of groundwater flooding to the site and the risk is considered low.

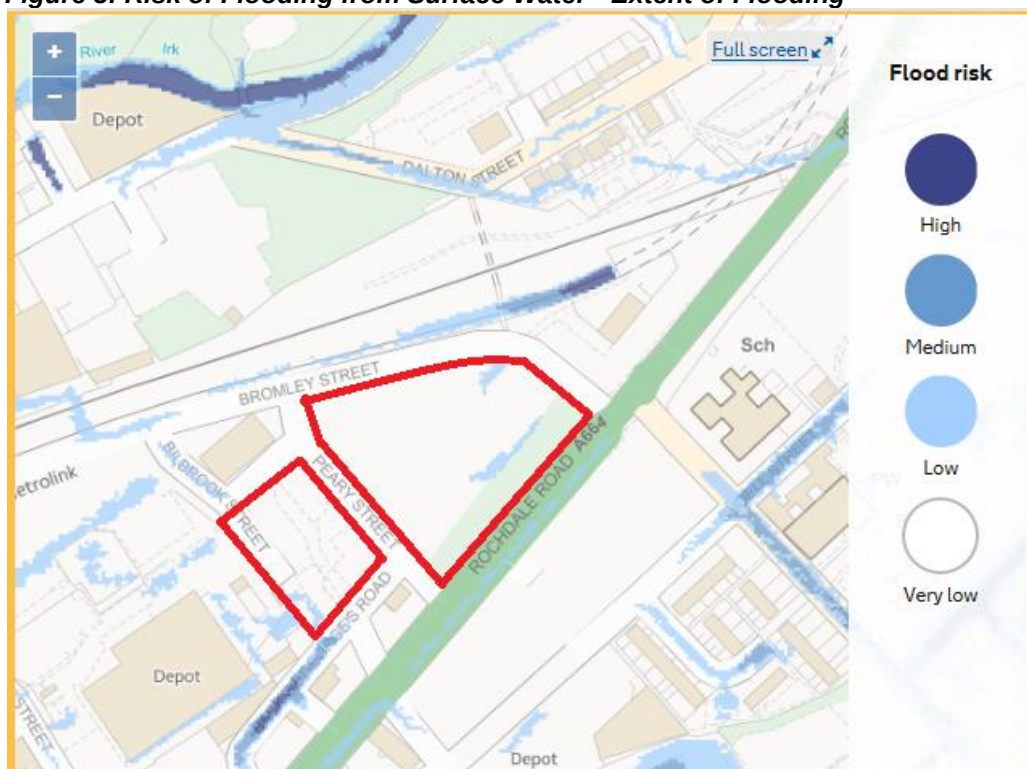
4.7 Public Sewers or Highway Drainage Flooding (Infrastructure Failure)

- 4.7.1 There are no public sewers or highway drainage recorded within the site.
- 4.7.2 A Pre-Development enquiry has been submitted to United Utilities and their response is included in *Appendix B*. UU have clarified that they do not accept temporary connection to the public sewerage network. However, if there is evidence exhausting the drainage hierarchy has been provided then UU will not object to connection to public combined sewerage network, with a maximum pass forward flow rate of 10l/s.
- 4.7.3 The PDE response from UU also notes that as the site will be commercial it will be subject to site area charging.
- 4.7.4 While UU may agree discharge points and rates in principle, formal application for sewer connections may be required.
- 4.7.5 There is a 225mm public combined sewer within approximately 4m of the site boundary, to the north-west of the site.
- 4.7.6 There is a 225mm combined sewer located approximately 4m to the west of the proposed site and within the Peary Street, reference MH number 8201. It flows in a northwest direction to MH 7301, from here it increases to a 375mm combined sewer and continues to flow in a north-west direction until it converges with MH 7302.
- 4.7.7 From the north-east corner of the site there is MH 8402, from here a 300mm combined sewer flows in from east to west direction to MH 8403 and continues via a 375mm pipe to join MH 7302.
- 4.7.8 Located at the northeast portion of the site is MH9302 a 375 x 500 combined sewer flow in a north-east to south-west direction.
- 4.7.9 Along the north border of Bromley street there is a combined sewer from MH 9301 to MH 804 from a north east to north west. It continues from MH 8401 to MH6302.
- 4.7.10 The head of the system is located to the south of the proposed site boundary of the smaller parcel of the site. It flows southwest to MH 7201 via a 500 x 750 combined public sewer. From here is the sewer flows north along Billbrook Street to the west of the site to MH 7305.
- 4.7.11 MH7305 is located on Burstock Street, North of the site boundary of the smaller parcel of the site, it flows south to MH 7306.
- 4.7.12 There are further combined sewers located in the wider vicinity of the site
- 4.7.13 Providing United Utilities and Manchester City Council maintain their drainage assets in the vicinity of the site, the risk of flooding to the proposed redevelopment site from public sewers or highway drainage is considered as low.

4.8 Surface Water Flooding to the site

- 4.8.1 Surface water flooding can be caused when rainwater during extreme rainfall events does not drain away through the normal drainage system or soak into the ground with flooding occurring, principally from manholes and gullies. Surcharging sewers can result in overland flows which if originating at a higher elevation than a development site can potentially pose a flood risk.
- 4.8.2 The extent of flooding to the site from surface water is indicated in Figure 5 and it can be seen that the majority of the site is located in an area classified as being at 'Very Low' risk of flooding from surface water. However, there is an area at low risk of surface water flooding in the northern corner of the site as well as alongside the boundary near to the edge of Rochdale road (A664). To the north of the site along Bromley Street, and a separate area at low to high risk of surface water flooding adjacent to the north-east corner of the site within vicinity of the railway tracks.

Figure 5: Risk of Flooding from Surface Water - Extent of Flooding



- 4.8.3 Considering the above information, the risk of surface water flooding to the site is considered very low. However, in order that the risk remains very low, the following mitigation measures are proposed:

- Existing footway levels along the outside perimeter of the site are determined by the highway authority. It is recommended that these levels, along the site boundary, should be maintained in order that surface water from outside of the site boundary shall fall away from the site and

into the highway gullies. It is assumed that the highway drainage will be subject to the local highway authority regular drainage maintenance schedule.

- The existing topographical levels of the adjacent car park (to the southern boundary of the site along Rochdale road) are approximately 3.2m higher than the existing levels to the north of the development site near to the location of surface water flood risk. Since the maximum depth of flooding at this point is below 300mm, it is recommended that the existing ground levels adjacent to the south-east boundary of the site are maintained in order to prevent surface water from the neighbouring land from entering the site.

4.8.4 Providing the above measures are implemented the flooding risk to the development site from surface water is therefore considered low post development.

4.9 Surface Water Flooding from the site

4.9.1 Developers are responsible for ensuring that new development does not increase the flood risk elsewhere. This is so as not to cause damage to buildings, essential services or adjoining developments and services.

4.9.2 The proposed surface water drainage network shall be designed to not flood for the critical 1 in 30-year storm event and flood water generated up to the critical 1 in 100-year plus climate change storm event shall be constrained within areas on site so as not to cause damage to buildings, essential services or adjoining developments and services.

4.9.3 The development has the potential to increase flood risk where additional run-off from proposed roads and paved areas are discharged freely into the downstream drainage network. It is therefore encouraged to propose permeable areas, landscaping areas and incorporate sustainable drainage features utilising infiltration or attenuation where possible.

4.9.4 A detailed assessment of the proposed surface flows is carried out within the drainage strategy within section 5 of this report.

4.10 Historical Flooding

4.10.1 Historical flood events are noted within the SFRA, and there has been previous flooding in the Manchester area. Historic flooding does not necessarily indicate that flooding will be a future risk.

4.10.2 Although the PFRA provides an overview of historical flood events taken from the Manchester Salford Trafford SFRA the PFRA states there is insufficient data to confirm the occurrence of an event with significant harmful consequences.

4.11 Summary of Flood Risk

- 4.11.1 From the evidence collated and subsequent negotiations the main types of flooding that may apply to the proposed development site is surface water flooding from the site.

5.0 Drainage Strategy

5.1 Existing Drainage

- 5.1.1 The public sewer records have been obtained for the development site. The records indicate that there are no public sewers recorded within the site therefore sewer diversion works are not required.
- 5.1.2 There is a 225mm combined sewer with the head of the system located within approximately 4m to the west of the proposed site and within Peary Street, MH number 8201. It flows in a north-west direction to MH 7301, from here it increases to a 375mm combined sewer and continues to flow in a north-west direction until it converges with MH 7302.
- 5.1.3 From the north-east corner of the site there is MH 8402, from here a 300mm combined sewer flows in an east to west direction to MH 8403 and continues via a 375mm pipe to join MH 7302.
- 5.1.4 Located at the northeast corner of the site is MH9302 a 375 x 500 combined sewer flow in a north to east to southwest direction.
- 5.1.5 Along the north border of Bromley street there is a combined sewer from MH 9301 to MH 804 in a north east to north west. It continues from MH 8401 to MH7304.
- 5.1.6 It is recommended that a GPR and CCTV drainage survey is carried out in order to determine the size, location, routes, depth, condition and outfalls of any existing drainage within the site.

5.2 Proposed Foul Water Drainage

- 5.2.1 Due to the anticipated nature of the proposed site a foul water system network is not required in this instance.
- 5.2.2 A pre-development enquiry has been issued to United Utilities, and they have carried out an assessment of the PDE issued to them. They have clarified that UU will not accept temporary connections to the public sewerage system network, however if evidence was provided exhausting the drainage hierarchy then UU will not object to connecting to the public combined sewerage network, with a maximum pass forward flow rate of 10l/s. A direct connection to the public sewer will be subject to a Section 106 Agreement with United Utilities.
- 5.2.3 The proposed drainage strategy is enclosed in *Appendix E*.

5.3 Proposed Surface Water Drainage

- 5.3.1 Any new development site drainage should be designed in accordance with current best practice to provide adequate capacity not to flood for the critical 1 in 30-year storm event and flood water generated from up to the critical 1 in 100-year plus climate change storm event shall be constrained within the

areas on site so not to cause damage to buildings, essential services or adjoining developments & services.

- 5.3.2 In February 2016, the Environment Agency released updated climate change allowances for peak rainfall intensities which should be applied to new developments. Table 4 demonstrates the climate change allowances with central and upper end allowances being considered.
- 5.3.3 Based on the nature of the development, a lifespan in excess of 60 years is anticipated. Therefore, the potential climate change allowance for 2070-2115 ranges between 20% for the central allowance and 40% for the upper end allowance. As such, the design will take into account the average allowance of 30%, although up to 40% for climate change on peak rainfall intensity will be considered in calculations.

Table 4: (Extract Environment Agency Guidance) Peak Rainfall Intensity Allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

- 5.3.4 For the surface water drainage of the proposed site, in following the standard hierarchy of drainage solutions, consideration should firstly be given to the discharge of surface water runoff by sustainable methods such as infiltration.

Infiltration

- 5.3.5 The British Geological Survey (BGS) infiltration report confirms that there is no recorded made ground on site. There are superficial deposits identified for the site, including Till and Devensian. The Bedrock formation is recorded as Chester Formation (Sandstone, Pebbly (Gravelly)), Manchester Marls Formation with permeability anticipated to be low to high. Since the superficial deposit thickness is likely to be more than 3m, the underlying bedrock (and superficial deposits where present) permeability is likely to determine the permeability of the ground.
- 5.3.6 Superficial deposits present at the site are described as being 'spatially variable' in their ability to permit infiltration and further site-specific infiltration testing should be undertaken at detailed design in order to determine the potential of an infiltration solution.
- 5.3.7 The site is not located within a Source Protection Zone; the groundwater is likely to be more than 5m below the surface throughout the year.

- 5.3.8 Given the information available above, it is considered that the ground conditions across site may be suitable for some degree of diffuse infiltration.

Watercourse

- 5.3.9 The nearest watercourse is the River Irk located approximately 175m north of the site.
- 5.3.10 The Rochdale Canal tow path is situated approximately 650m south of the proposed site. Keepers Quay and New Islington Marina converge with the Rochdale canal tow path in this area.
- 5.3.11 A canal basin is located approximately 665m south west of the site.

Surface Water Sewer

- 5.3.12 There are no surface water sewers within the proximity of the site.

Combined / Foul water sewer

- 5.3.13 The nearest combined public sewer is located approximately 4m west of the proposed site boundary, flowing northwest along Peary Street. Another combined sewer is located approximately 10m north of the proposed site boundary, and there are further combined sewers within the vicinity of the site.
- 5.3.14 The discharge options are summarised below in Table 5.

Table 5: Summary of Surface Water Disposal

Surface Water Disposal	Potential	Description
Infiltration	✓	Infiltration may be moderate to high across the site and groundwater likely to be more than 5 metres below ground, however site-specific testing would be necessary in order to prove that infiltration will work.
Watercourse	✗	Disposal of surface water to an ordinary watercourse is considered not a viable solution as there are no watercourses within reasonable distance to the site.
Surface Water Sewer	✗	There is no surface water sewer connection within proximity of the site.
Combined Water Sewer	✓	There are combined public sewers within the vicinity of both respective boundaries of the site. Although there is potential to connect to these, there are potential options higher up the drainage hierarchy and therefore disposal of surface water to a combined sewer is not recommended.

- 5.3.15 Disposal of surface water into the combined sewer within Peary Street for the eastern plot is proposed, with a new connection required to connect to MH 7302 on Bromley Street. It is proposed to dispose surface water from the western plot of the site to manhole 7305 on Burstock Street.

- 5.3.16 The site is approximately 2.1 Ha in total. Although the site is considered to be brownfield, no positive drainage from the site has been proven and it is likely that surface water runoff currently spills onto the public highway. Therefore, in order to calculate the existing runoff rates the site shall be treated as greenfield.
- 5.3.17 There are two methods for calculating the Greenfield run-off rate; the IH124 method and the ICP method. The IH124 method calculates the peak Greenfield run-off flow rates by correlation of the Soil Index Value, the Average Annual Rainfall and the Site Area (SOIL, SAAR and AREA). The IH124 Method should be used for sites in excess of 50 hectares and the resulting discharge is linearly interpolated for the required area. The ICP method uses the IH124 method and automatically interpolates the discharge for sites less than 50 hectares and therefore this is the method that has been used.
- 5.3.18 The proposed development is split into two separate car park areas; a small western parcel and larger eastern plot. Greenfield run-off rates for the two plots are illustrated in Figures 6 and 7 below.

Figure 6: Greenfield Run-off rate for the smaller western parcel of the site.

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<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>100</td><td>Soil</td><td>0.450</td></tr><tr><td>Area (ha)</td><td>0.551</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>888</td><td>Region Number</td><td>Region 10</td></tr></table> Results 1/s <table><tr><td>QBAR Rural</td><td>3.2</td></tr><tr><td>QBAR Urban</td><td>3.2</td></tr><tr><td>Q100 years</td><td>6.7</td></tr><tr><td>Q1 year</td><td>2.8</td></tr><tr><td>Q30 years</td><td>5.4</td></tr><tr><td>Q100 years</td><td>6.7</td></tr></table>			Return Period (years)	100	Soil	0.450	Area (ha)	0.551	Urban	0.000	SAAR (mm)	888	Region Number	Region 10	QBAR Rural	3.2	QBAR Urban	3.2	Q100 years	6.7	Q1 year	2.8	Q30 years	5.4	Q100 years	6.7
Return Period (years)	100	Soil	0.450																							
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Q30 years	5.4																									
Q100 years	6.7																									

Figure 7: Greenfield Run-off rate for the larger eastern parcel of the site.

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Results1/s QBAR Rural8.7 QBAR Urban8.7 Q100 years18.1 Q1 year7.6 Q30 years14.8 Q100 years18.1		

- 5.3.19

The above give a combined QBAR run-off rate of 11.9 l/s. However, the drainage design will restrict the post-development flows to a maximum 10 l/s, in accordance with UU's requirements (correspondence enclosed in *Appendix B*).
- 5.3.20

Whilst the BGS data indicates that diffuse infiltration may be possible for the site, the following storage estimates to contain the 1 in 100 plus 30% climate change events have assumed that no infiltration will be possible to obtain worst case estimates. Both plots have been restricted to 5 l/s.
- 5.3.21

Approximate storage estimates for the two plots, using the above parameters, are indicated in Figures 8 and 9 on the following pages.

Figure 8: Quick Storage Estimate for the smaller western parcel of the site.

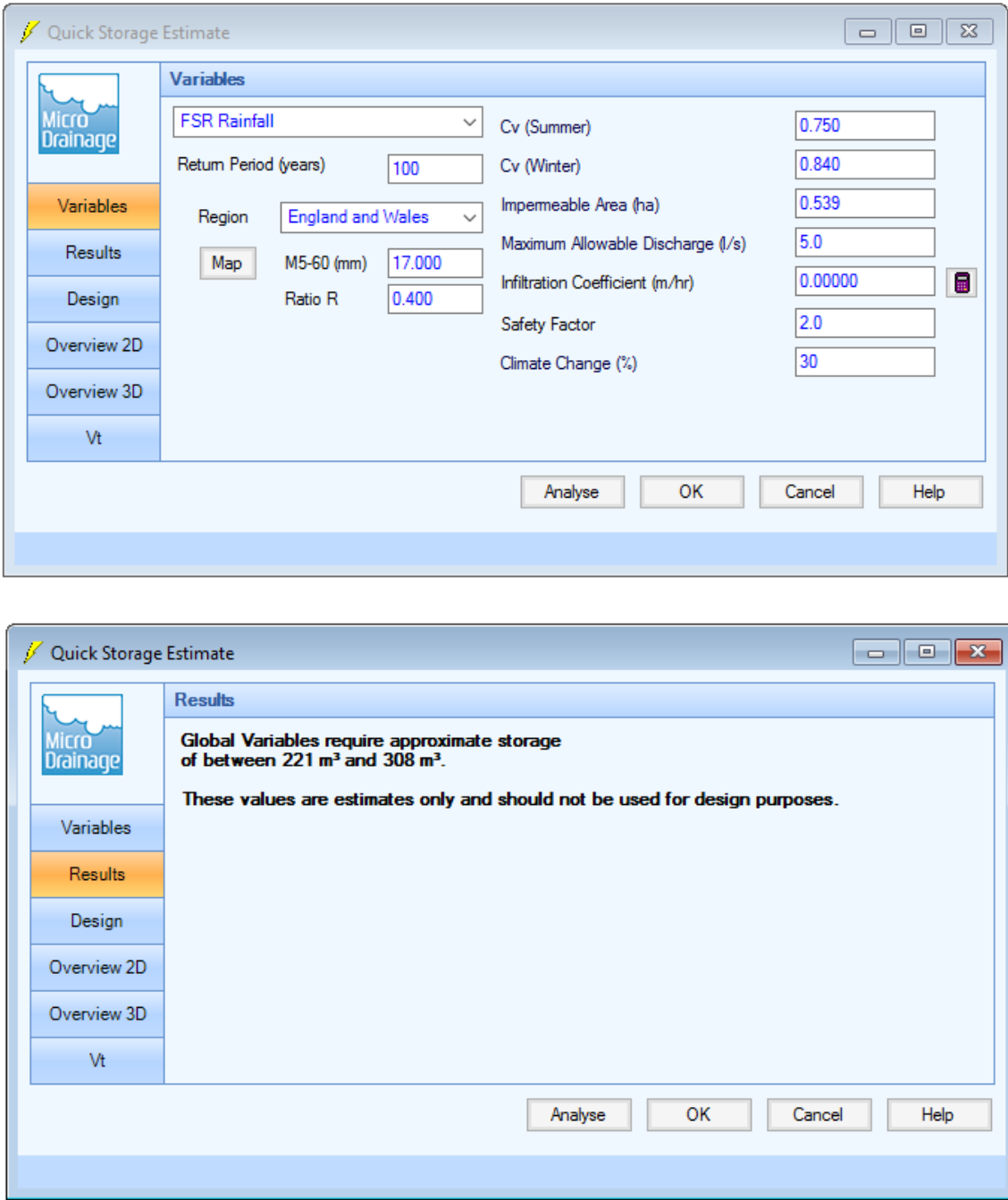
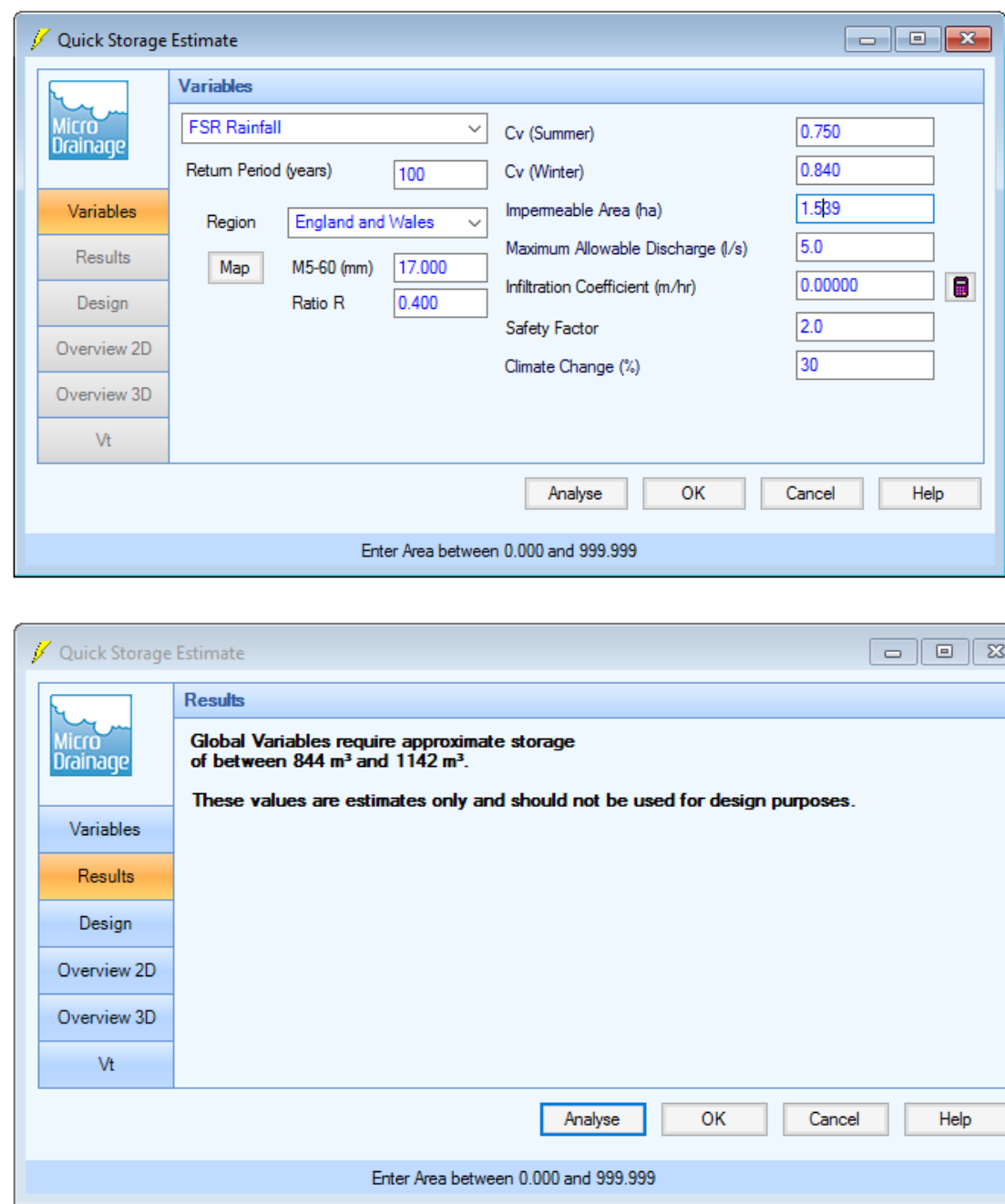


Figure 9: Quick Storage Estimate for the larger eastern parcel of the site.



The figure shows two screenshots of the 'Quick Storage Estimate' software interface. The top screenshot displays the 'Variables' tab with the following settings:

Variable	Value
FSR Rainfall	0.750
Return Period (years)	100
Region	England and Wales
Impervious Area (ha)	1.539
Maximum Allowable Discharge (l/s)	5.0
Infiltration Coefficient (m/hr)	0.00000
Safety Factor	2.0
Climate Change (%)	30
M5-60 (mm)	17.000
Ratio R	0.400

The bottom screenshot displays the 'Results' tab with the following text:

Global Variables require approximate storage of between 844 m³ and 1142 m³.

These values are estimates only and should not be used for design purposes.

5.3.22 The proposed construction build-up of the car park is a 450mm layer of compacted DfT Type 3 permeable sub-base material with a minimum void ratio of 30%. Baffles within the car park build-up and perforated pipe filter trenches below the car park formation will then attenuate and channel filtered run-off towards the discharge point(s).

5.3.23 The available storage within the stone voids of the car park build up for the two plots are:

- Western Plot = $5,510 \times 0.45 \times 0.3 = 740 \text{ m}^3$ (i.e. $> 308 \text{ m}^3$)
- Eastern Plot = $15,390 \times 0.45 \times 0.3 = 2,070 \text{ m}^3$ (i.e. $> 1,142 \text{ m}^3$)

5.3.24 No additional attenuation is required to store volumes up to the 100 year +30% climate change with a restriction of 10 l/s, as the volumes generated can be accommodated in the pipework and stone voids of the private drainage network within the site prior to discharge to the public sewer.

5.3.25 The proposed drainage strategy and associated calculations is enclosed in *Appendix E*.

5.3.26 The final design of the drainage networks shall be in accordance with the legislation set by the Environment Agency, Manchester City Council and United Utilities.

5.4 Maintenance

5.4.1 A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.

5.4.2 It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event. Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.

5.4.3 A management company may be required for maintenance of attenuation facilities.

Appendix A

Proposed Site Plan

Appendix B

UU Public Sewer Records

UU PDE Responses



**Curtins Consulting Engineers
1st Floor Merchant Exchange
17-19 Whitworth Street West
Bishopsgate
Manchester
M1 5WG**

FAO: Andrea McGee

Dear Sirs

Location: TEMPARY SUPPLY PEARY STREET MANCHESTER M4 4JA

I acknowledge with thanks your request dated 16/08/17 for information on the location of our services.

Please find enclosed plans showing the approximate position of our apparatus known to be in the vicinity of this site.

The enclosed plans are being provided to you subject to the United Utilities terms and conditions for both the wastewater and water distribution plans which are shown attached.

If you are planning works anywhere in the North West, please read our access statement before you start work to check how it will affect our network.

<http://www.unitedutilities.com/work-near-asset.aspx>.

I trust the above meets with you requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please telephone us on 0370 7510101.

Yours Faithfully,

Karen McCormack
Property Searches Manager

United Utilites Water Limited

Property Searches
Ground Floor Grasmere House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP

Telephone 0370 751 0101

Property.searches@uuplc.co.uk

Your Ref: 65619 PEARY STREET

Our Ref: 1318875

Date: 17/8/2017

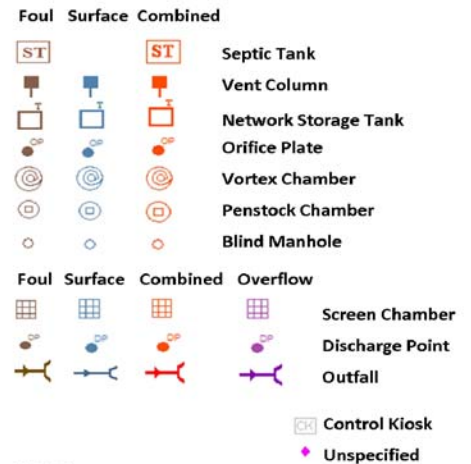
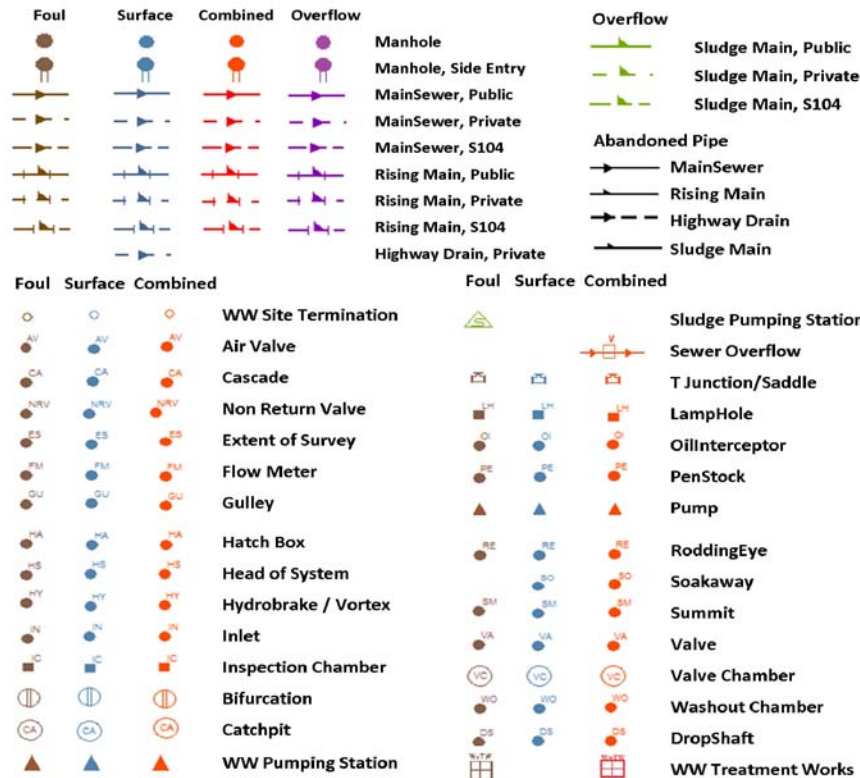
TERMS AND CONDITIONS - WASTERWATER & WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self-construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

1. This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
2. This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
3. In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only and given in accordance with the best information available. The nature of the relevant system and/or its actual position may be different from that shown on the plan and UUWL is not liable for any damage caused by incorrect information provided save as stated in section 199 of the Water Industry Act 1991. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
4. The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
5. The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
6. This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
7. No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
8. If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
9. This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

WASTE WATER SYMBOLOGY



Legend	
MANHOLE FUNCTION	SEWER SHAPE
FO Foul	CI Circular
SW Surface Water	EO Egg
CO Combined	OV Oval
OV Overflow	FT Flat Top
	RE Rectangular
	SQ Square
	TR Trapezoidal
	AR Arch
	BA Barrel
	HO HorseShoe
	UN Unspecified
SEWER MATERIAL	
AC Asbestos Cement	DI Ductile Iron
BR Brick	VC Vitrified Clay
CO Concrete	PP Polypropylene
CSB Concrete Segment	PF Pitched Fibre
CSU Concrete Segment	MA Masonry, Coursed
CC Concrete Box Culverted	MA Masonry, Random
PSC Plastic / Steel	RP Reinforced Plastic
GR Glass Reinforced	CI Cast Iron
GRP Glass Reinforced	SI Spun Iron
PVC Polyvinyl Chloride	ST Steel
PE Polyethylene	U Unspecified

CLEAN WATER SYMBOLOGY

PIPE WORK



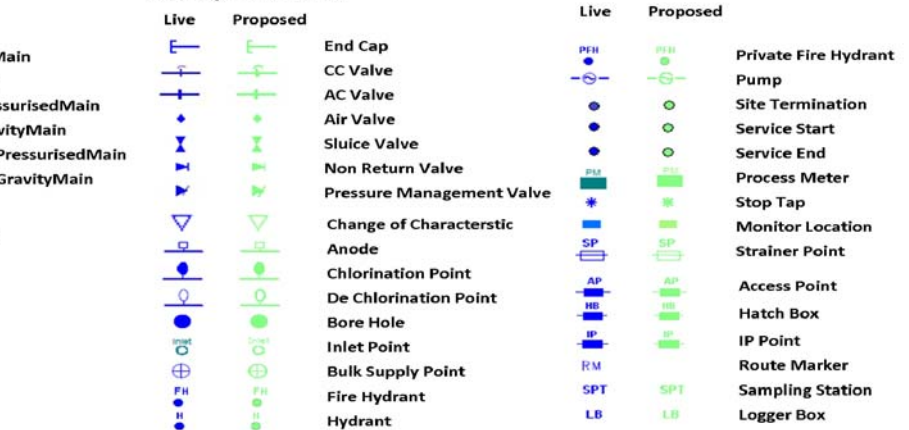
ABANDONED PIPE



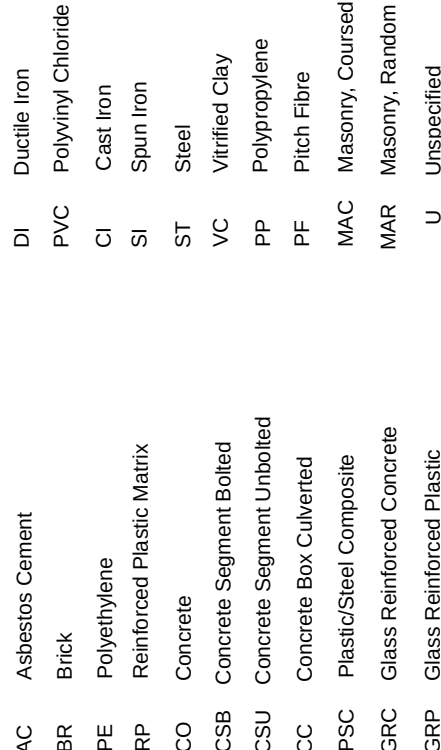
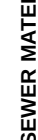
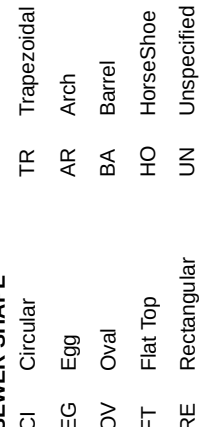
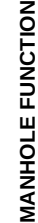
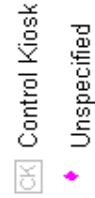
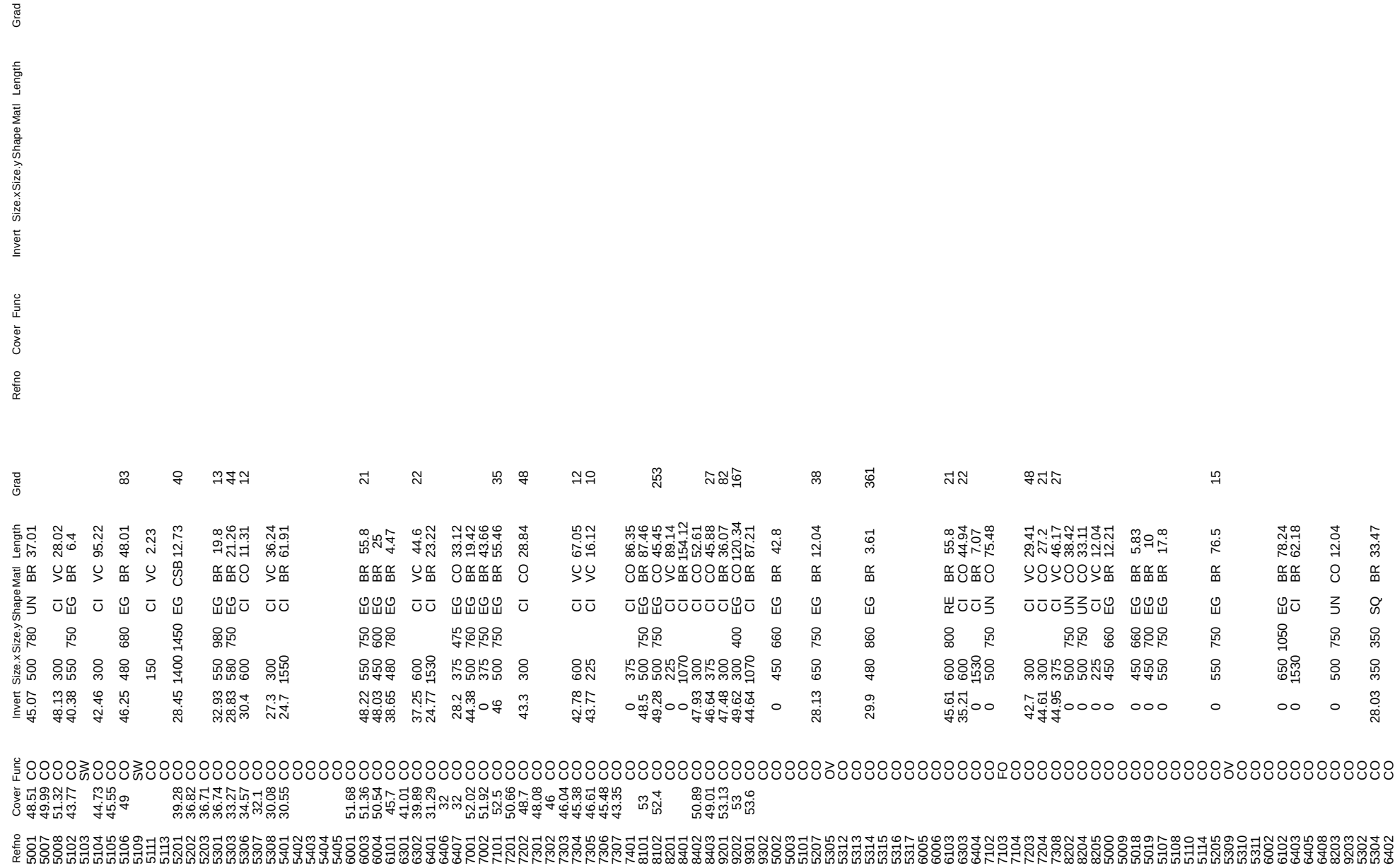
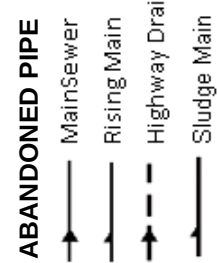
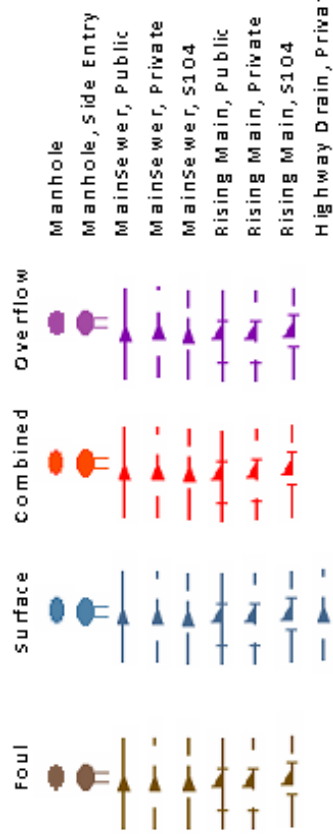
PROPERTY TYPES



NODES/FURNITURES



Legend	
MATERIAL TYPES	LINING TYPES
AC ASBESTOS CEMENT	CL CEMENT LINING
CI CAST IRON	TB TAR OR BITUMEN
CU COPPER	ERL EPOXY RESIN
CO CONCRETE	
DI DUCTILE IRON	INSERTION TYPES
GI GALVANISED IRON	DD DIE DRAWN
GR GREY IRON	DR DIRECTIONAL DRILLING
OT OTHERS	MO MOLING
PB LEAD	PI PIPELINE
PV UPVC	SL SLIP LINED
SI SPUN IRON	
ST STEEL	
UN UNKNOWN	
PE POLYETHYLENE	



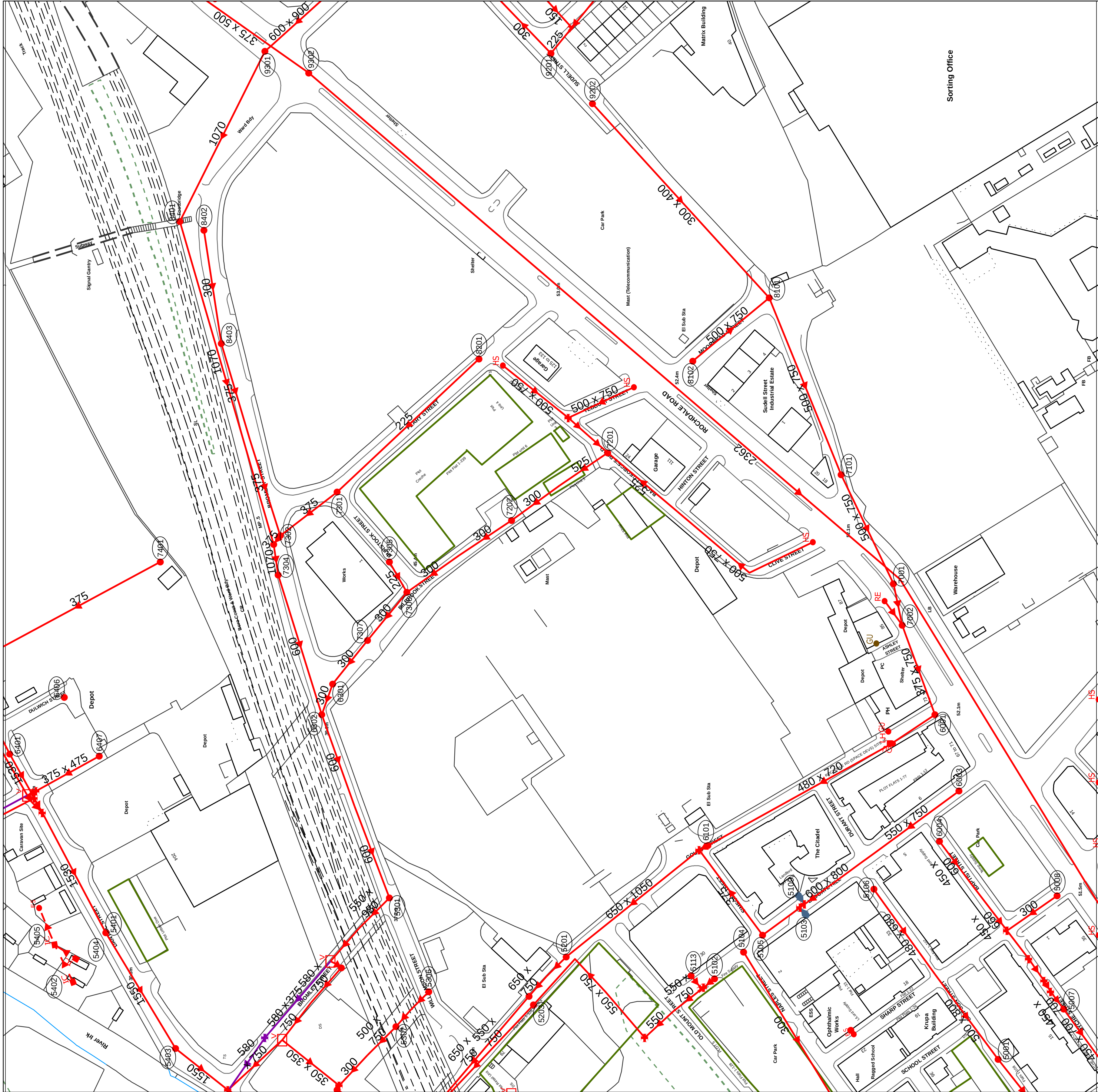
The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown. Crown copyright and database rights (2016) Ordnance Survey 100022432.

OS Sheet No: SJ8499SE
Scale: 1:1250 Date: 17/08/2017

103 Nodes
Sheet 1 of 1



SEWER RECORDS



OS Sheet No: SJ8499SE

Scale: 1:1250 Date: 17/08/2017

Printed By: Property Searches

Andrea McGee

From: Harrison, William <William.Harrison1@uuplc.co.uk>
Sent: 05 September 2017 12:09
To: Andrea McGee
Cc: Wastewater Developer Services
Subject: PDE UU Ref: 4200018231 Peary Street, Manchester

Good Afternoon Andrea,

We have carried out an assessment of your application which is based on the information provided; this pre development advice will be valid for 12 months.

Just to clarify, United Utilities do not accept temporary connections to the public sewerage network. Having said that if you provide evidence of exhausting the drainage hierarchy then United Utilities won't object to you connecting to the public combined sewerage network, with a maximum pass forward flow rate of 10l/s.

It's also worth noting that this site, as it will be commercial, will be subject to site area charging, more details of which can be found below.

<https://www.unitedutilities.com/services/wholesale-services/site-area/>

Although we may discuss and agree discharge points & rates in principle, please be aware that you will have to apply for a formal sewer connection. This is so that we can assess the method of construction, Health & Safety requirements and to ultimately inspect the connection when it is made. Details of the application process and the form itself can be obtained from our website by following the link below:

<http://www.unitedutilities.com/connecting-public-sewer.aspx>

Please be aware that on site drainage must be designed in accordance with Building Regulations, National Planning Policy, and local flood authority guidelines, we would recommend that you speak and make suitable agreements with the relevant statutory bodies.

Kind Regards

Will Harrison BSc (Hons)

Assistant Developer Engineer
Developer Services & Planning
Operational Services
United Utilities
T : 01925 679319
E : Wastewaterdeveloperservices@uuplc.co.uk

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United Utilities Water Ltd. - Developer Services and Planning

Warrington North Wastewater Treatment Works

Garnard Street Off Old Liverpool Road

From: Andrea McGee [<mailto:Andrea.McGee@curtins.com>]
Sent: 31 August 2017 09:14
To: Wastewater Developer Services <WastewaterDeveloperServices@uuplc.co.uk>
Subject: UU PDE- Peary Street, Manchester

Dear Sir/Madam,

Please find attached predevelopment enquiry for the above site.

I attach the site location plan with indicative redline boundary. The nearest post code is M4 4JA and grid reference of the site is:384847,399316.

It is proposed to obtain temporary consent for a surface level car park on a site off Rochdale Road, adjacent to Peary Street, Manchester.

Please see the attached site location plan, the development areas are north-east and south-west of Peary Street.

As the proposals are for a temporary car park, we are currently reviewing whether a formal drainage network will be necessary or whether a rough permeable finish will be beneficial. It is possible that a either option may require some form of outfall.

The nearest watercourse is the River Irk which is located approximately 175m north of the site, therefore it is unfeasible to discharge to here.

There are various public sewers surrounding the site, and it is assumed that based on the brownfield status of the site that the existing connections to the surrounding public network are likely, however exact connection points are unknown.

The site appears to have been developed historically, however, the larger part of the site (east of Peary Street) appears to be within an area of existing foliage, with some encroachment of 'rough ground' being used as an informal car park. The smaller part of the site (west of Peary Street) appears to be used as a form of industrial storage area. Where any existing connections are available, we would propose to reuse this- where an outfall is required. However this would be subject to location and invert level.

Foul drainage is not necessary.

Andrea McGee
Technician
T. 0161 236 2394
andrea.mcgee@curtins.com

Merchant Exchange
17-19 Whitworth Street West
Manchester M1 5WG

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EMGateway3.uuplc.co.uk made the following annotations

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Appendix C

Topographic Survey

Appendix D

BGS Infiltration SuDS GeoReport



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

GeoReports

**Andrea McGee
Curtins Consulting Ltd
Merchant Exchange
17-19 Whitworth Street West
Manchester
Lancashire
M1 5WG**

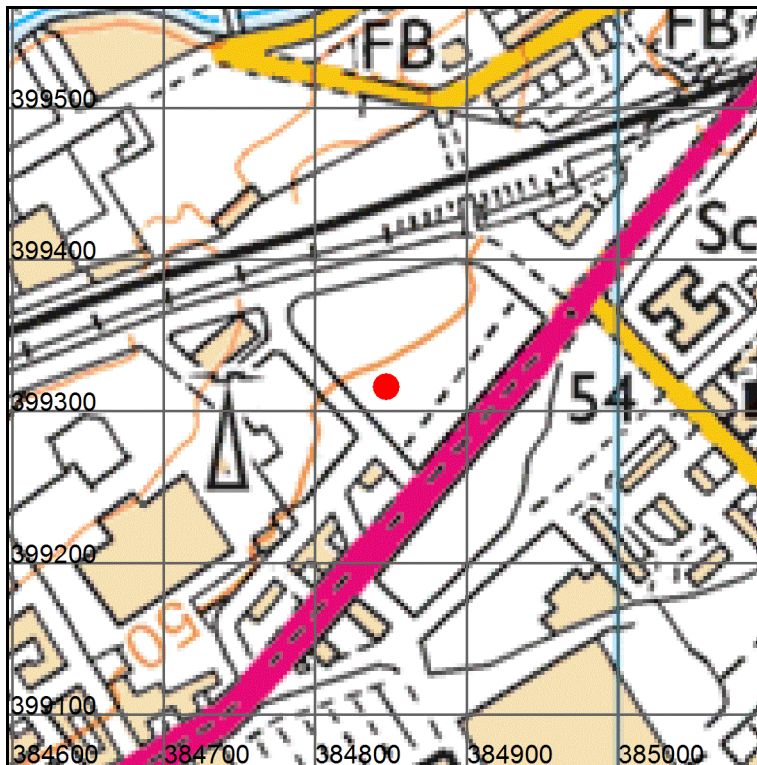
Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: GR_216654/1

Client reference: 065619 -Peary Street

Search location



Point centred at:
384847,399316

Search location indicated in
red

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Scale: 1:5 000 (1cm = 50 m)



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OS Street View: Scale: 1:5 000 (1cm = 50 m)

Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- o **source control:** systems that control the rate of runoff
- o **pre-treatment:** systems that remove sediments and pollutants
- o **retention:** systems that delay the discharge of water by providing surface storage
- o **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- o **Part 1. Summary data.**

Comprises three maps that summarise the data contained within Part 2.

- o **Part 2. Detailed data.**

Comprises a further 24 maps in four thematic sections:

- o **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
- o **Drainage potential.** Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
- o **Ground stability.** Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
- o **Groundwater protection.** Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

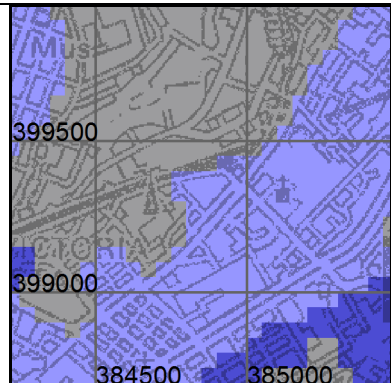
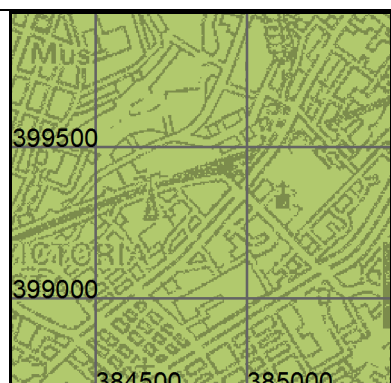
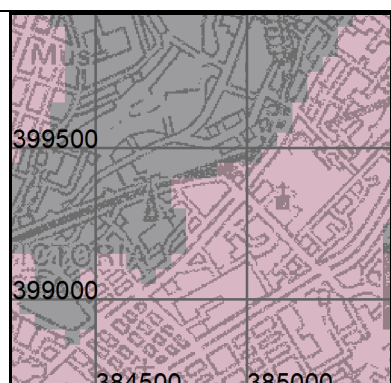


This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed*' national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed*', available from <http://nora.nerc.ac.uk/16618/>.

PART 1: SUMMARY DATA

This section provides a summary of the data on the following pages.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Highly compatible for infiltration SuDS. The subsurface is likely to be suitable for free-draining infiltration SuDS.
	 Probably compatible for infiltration SuDS. The subsurface is probably suitable although the design may be influenced by the ground conditions.
	 Opportunities for bespoke infiltration SuDS. The subsurface is potentially suitable although the design will be influenced by the ground conditions.
	 Very significant constraints are indicated. There is a very significant potential for one or more hazards associated with infiltration.
Is ground instability likely to be a problem?	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is very unlikely to result in ground instability.
	 Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability
	 Ground instability problems are probably present. Increased infiltration may result in ground instability.
	 There is a very significant potential for one or more geohazards associated with infiltration.
Is the groundwater susceptible to deterioration in quality?	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 The groundwater is not expected to be especially vulnerable to contamination.
	 The groundwater may be vulnerable to contamination.
	 The groundwater is likely to be vulnerable to contaminants.
	 Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

PART 2: DETAILED DATA

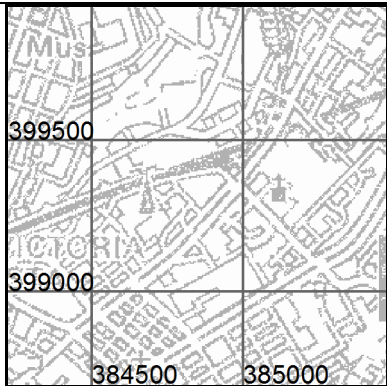
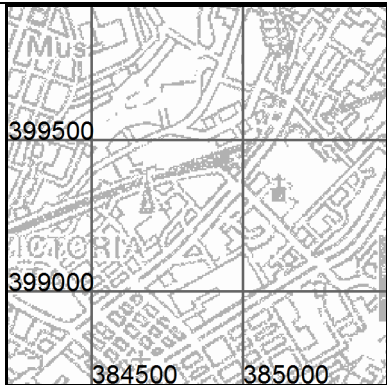
This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

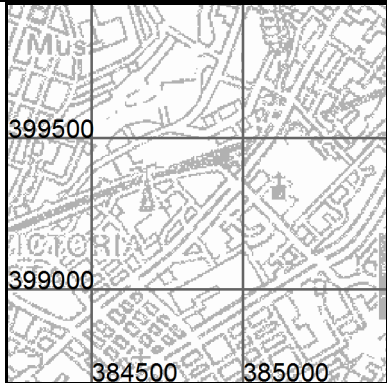
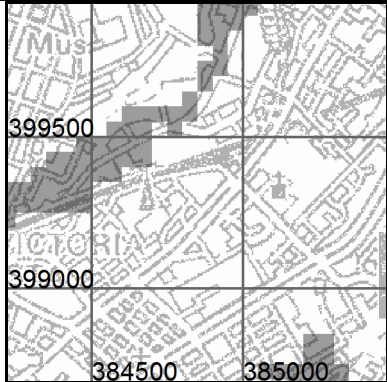
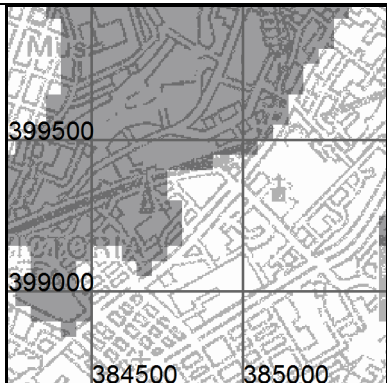
Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	☒ Very significant soluble rock hazard. Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant. ☐ Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.
Landslide hazard	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	☒ Very significant landslide hazard. Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant. ☐ Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

Shallow mining hazard	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	☒ Very significant mining hazard. Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant. ☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.
Persistent shallow groundwater	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	☒ Very high likelihood of persistent or seasonally shallow groundwater. Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant. ☐ See Part 2 for the likely depth to water table.
Made ground	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	☒ Made ground present. Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant. ☐ None recorded

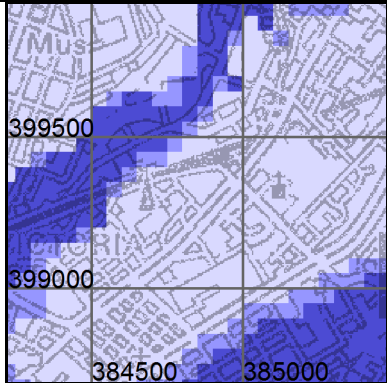
Section 2. Drainage potential

The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

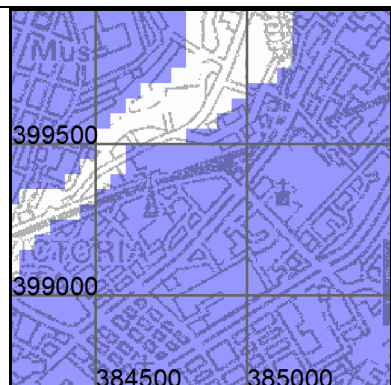
- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Groundwater is likely to be more than 5 m below the ground surface throughout the year.
	 Groundwater is likely to be between 3 and 5 m below the ground surface for at least part of the year.
	 Groundwater is likely to be less than 3 m below the ground surface for at least part of the year.

Superficial deposit permeability



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Licence number 100021290 EUL

 Superficial deposits are likely to be **free-draining**.

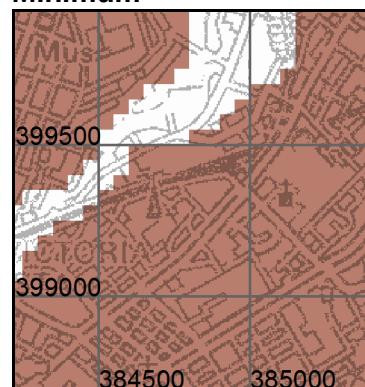
 The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.

 Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

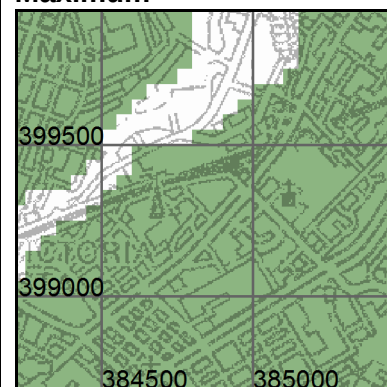
-  Very Low
-  Low
-  Moderate
-  High
-  Very High

Minimum



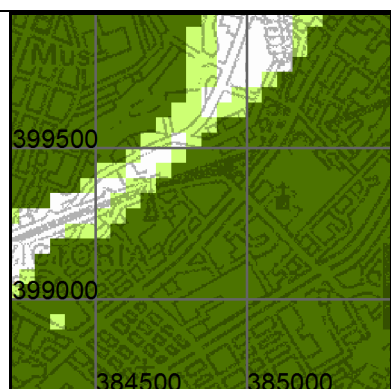
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Maximum



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Superficial deposit thickness

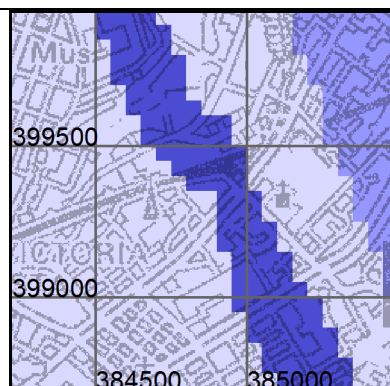


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 The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).

 The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

Bedrock permeability



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Bedrock deposits are likely to be **free-draining**.



The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.



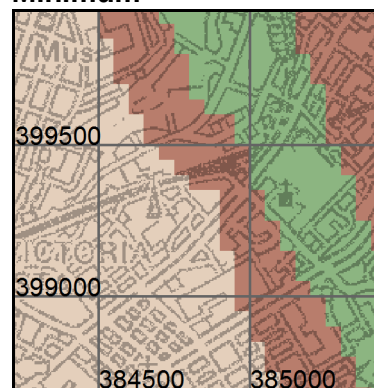
Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

Key

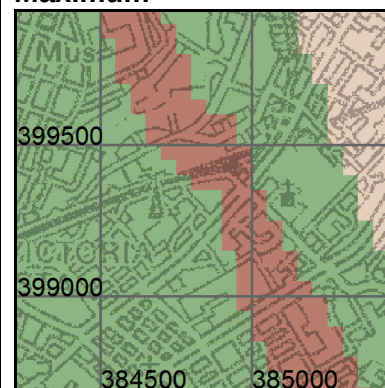
-  Very Low
-  Low
-  Moderate
-  High
-  Very High

Minimum



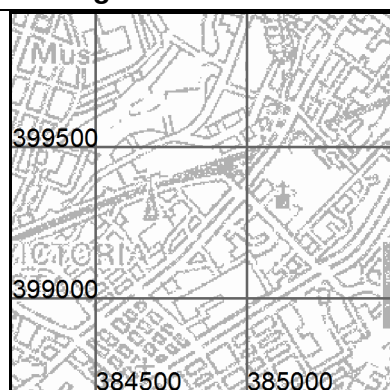
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Maximum



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Geological indicators of flooding



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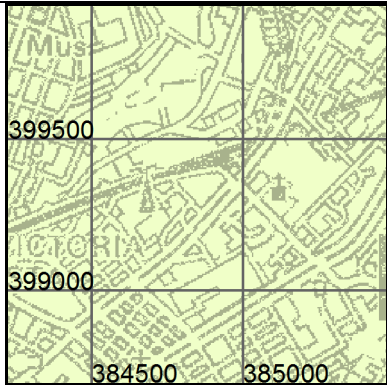
Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

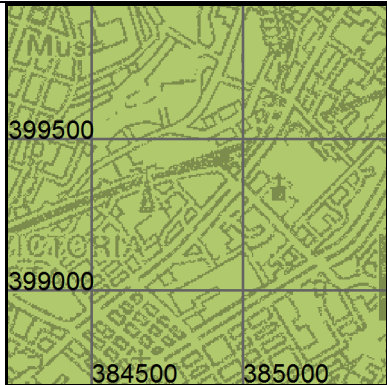
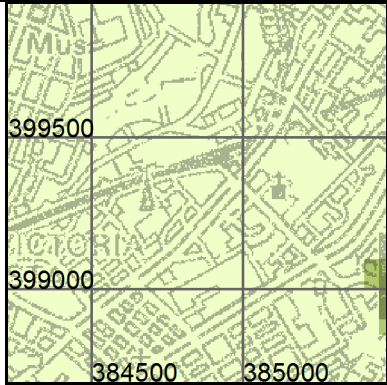
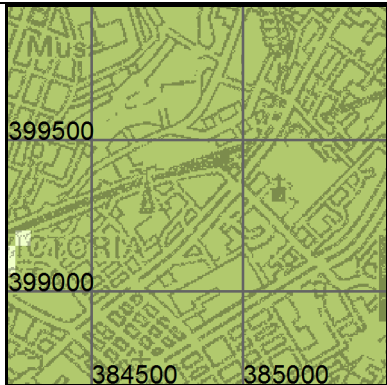
Section 3. Ground stability

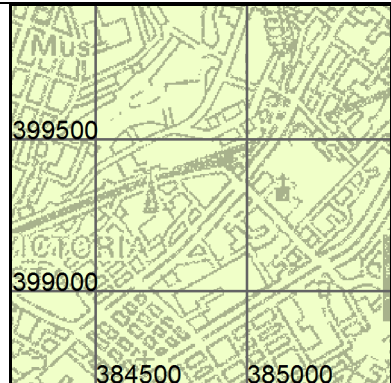
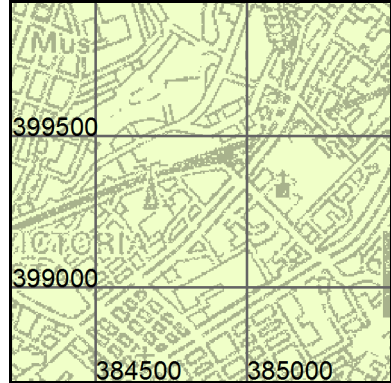
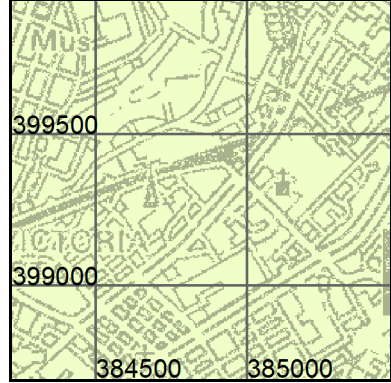
The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to result in subsidence.
	 Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
	 Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
	 Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

Landslides	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to lead to slope instability.
	 Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
	 Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
	 Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.
Shallow mining	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to lead to subsidence.
	 Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
	 Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
	 Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.
Running sand	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to cause ground collapse associated with running sands.
	 Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
	 Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

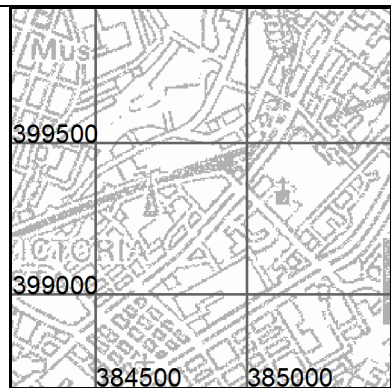
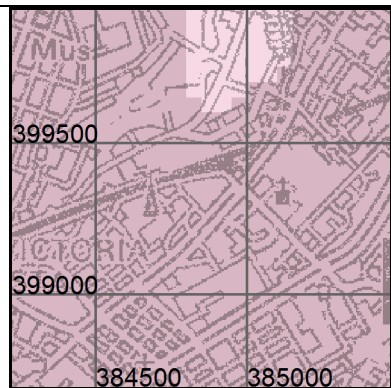
Swelling clays	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to cause shrink-swell ground movement.
	 Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
	 Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.
Compressible ground	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to lead to ground compression.
	 Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.
Collapsible ground	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Increased infiltration is unlikely to result in subsidence.
	 Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
	 Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

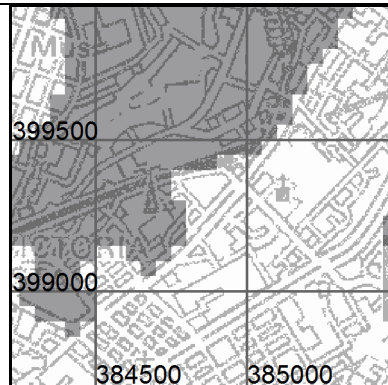
- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

For more information read 'Explanation of terms' at the end of this report.

Groundwater source protection zones	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2017.	 Groundwater is not within a source protection zone.
	 Source protection zone IV
	 Source protection zone III
	 Source protection zone II
	 Source protection zone I.
Predominant flow mechanism	
 © Crown Copyright and/or database right 2017. All rights reserved. Licence number 100021290 EUL	 Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
	 Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.



Made ground



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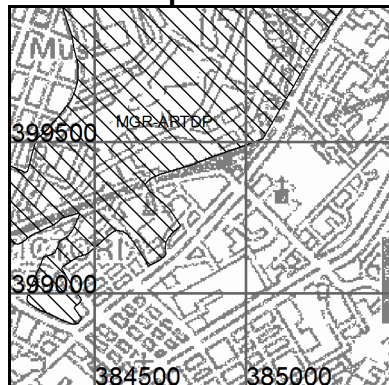


Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

Section 5. Geological Maps

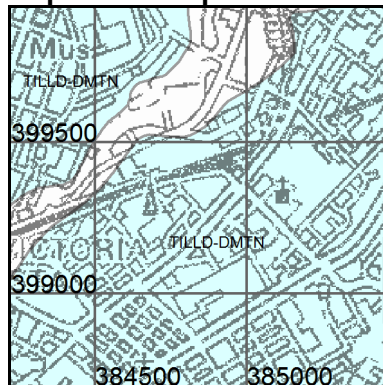
The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



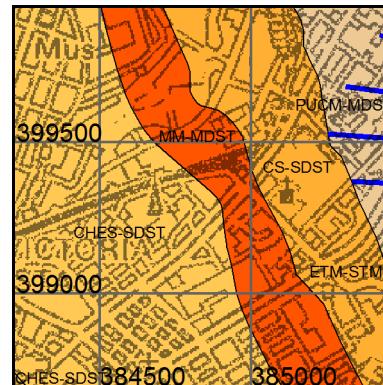
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Superficial deposits



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Bedrock



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Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:

Map colour	Computer Code	Rock name	Rock type
	MGR-ARTDP	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	TILLD-DMTN	TILL, DEVANSIAN	DIAMICTON



Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	CHES-SDST	CHESTER FORMATION	SANDSTONE
	MM-MDST	MANCHESTER MARLS FORMATION	MUDSTONE
	CS-SDST	COLLYHURST SANDSTONE FORMATION	SANDSTONE
	PUCM-MDSS	PENNINE UPPER COAL MEASURES FORMATION	MUDSTONE, SILTSTONE AND SANDSTONE
	ETM-STMD	ETRURIA FORMATION	SANDSTONE AND MUDSTONE



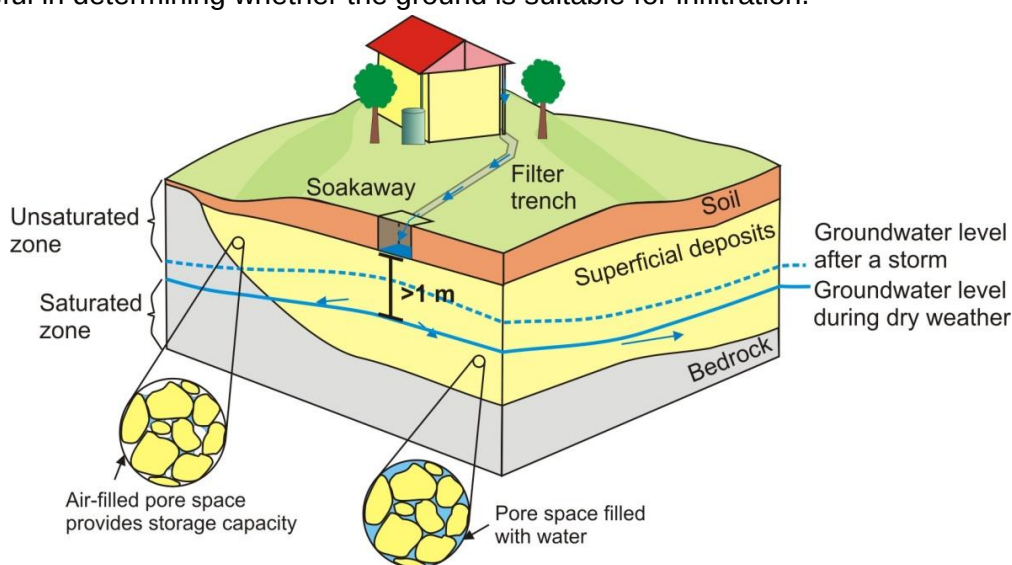
Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
 - o previous land use,
 - o potential for, or presence of contaminated land
 - o presence of perched water tables
 - o shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
 - o made ground, where not recorded
 - o proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
 - o zones around private water supply boreholes that are susceptible to groundwater contamination.
- This report is supplied in accordance with the GeoReports Terms & Conditions available separately, and the copyright restrictions described at the end of this report

Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

Compressible ground

Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits

Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand

Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)

Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.



For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk. For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)



Contact Details

Keyworth Office

British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Fax: 0115 9363276
Email: enquiries@bgs.ac.uk

Wallingford Office

British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Tel: 01491 838800
Fax: 01491 692345
Email: hydroenq@bgs.ac.uk

Edinburgh Office

British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk



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- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
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- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
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- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be quite historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

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Appendix E

Drainage Calculations

Detailed Drainage Strategy