



RENAISSANCE, DEANSGATE

FLOOD RISK ASSESSMENT

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Report Title: Renaissance, Deansgate
Flood Risk Assessment

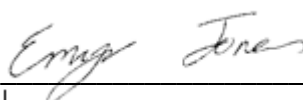
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Limitations

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CONTENTS

Contents.....	4
List of Tables	5
List of Figures.....	5
List of Appendices.....	5
SECTION 1 SITE INVESTIGATION	6
INTRODUCTION	6
EXISTING SITE DESCRIPTION	6
PROPOSED SITE LAYOUT	8
SECTION 2 POTENTIAL SOURCES OF FLOODING	11
FLUVIAL/TIDAL FLOOD RISK.....	11
CANAL FLOOD RISK.....	14
GROUNDWATER FLOOD RISK.....	15
ARTIFICIAL WATERBODIES.....	15
PLUVIAL RUNOFF.....	15
CRITICAL DRAINAGE AREA	17
FLOOD RISK OVERVIEW	18
SECTION 3 FLOOD RISK ANALYSIS	19
FLUVIAL/TIDAL FLOODING	19
ARTIFICIAL WATERBODIES.....	23
CRITICAL DRAINAGE AREAS	24
SECTION 4 FLOOD ZONE REQUIREMENTS.....	25
SECTION 5 EXISTING DRAINAGE INFORMATION	29
PUBLIC SEWERS	29
PRIVATE DRAINAGE.....	30
SECTION 6 SUSTAINABLE DRAINAGE STRATEGY	31
EXISTING SURFACE WATER RUNOFF RATE	31
PROPOSED RUNOFF DESTINATION.....	33
SUSTAINABLE DRAINAGE TECHNIQUES.....	34
CLIMATE CHANGE ALLOWANCE	35
SECTION 7 PRELIMINARY DRAINAGE STRATEGY.....	36
SURFACE WATER STRATEGY.....	36
FOUL WATER STRATEGY	36
SECTION 8 FUTURE DRAINAGE MAINTENANCE	38
SECTION 9 CONCLUSION	40

LIST OF TABLES

TABLE 2.1 POTENTIAL SOURCES OF FLOODING OVERVIEW	18
TABLE 3.1 ESTIMATED EA FLOOD LEVELS	20
TABLE 3.2 MINIMUM FINISHED FLOOR LEVELS – CAR PARK	22
TABLE 3.3 MINIMUM FINISHED FLOOR LEVELS – CAR PARK	23
TABLE 4.1 FLOOD RISK CLASSIFICATION (NPPF)	25
TABLE 4.2 EXISTING ONSITE FLOOD VOLUMES	26
TABLE 4.3 EXISTING ONSITE FLOOD VOLUMES	27
TABLE 4.3 ONSITE FLOOD STORAGE DIFFERENCE	27
TABLE 6.1 SITE PLAN	31
TABLE 6.2 WALLINGFORD PROCEDURE VOLUME 3 VARIABLES	32
TABLE 6.3 PEAK GREENFIELD RUNOFF RATES	32
TABLE 6.4 SOIL CLASSIFICATION	33
TABLE 6.5 SUDS TECHNIQUES	34
TABLE 6.6 RECOMMEND CLIMATE CHANGE GUIDANCE (EA)	35
TABLE 8.1 SUDS MAINTENANCE MANAGEMENT	39

LIST OF FIGURES

FIGURE 1.1 SITE LOCATION PLAN (GOOGLE MAPS)	7
FIGURE 1.2 PROPOSED DEVELOPMENT (JMA)	7
FIGURE 1.3 GROUND LEVEL -00 (JM ARCHITECTS)	8
FIGURE 1.4 BASEMENT LEVEL -01 (JM ARCHITECTS)	9
FIGURE 1.5 BASEMENT LEVEL -02 (JM ARCHITECTS)	9
FIGURE 1.6 LOWER LEVEL ELEVATIONS (JM ARCHITECTS)	10
FIGURE 2.1 FLOOD MAP FOR PLANNING (GOV.UK)	11
FIGURE 2.2 SFRA FLOOD MAP (SFRA FIGURE N.2)	12
FIGURE 2.3 FLOOD MAP (ENVIRONMENT AGENCY)	13
FIGURE 2.4 THE GREAT FOSSE (NORTH WEST GEOGRAPHY VOL 8 NO. 1 2008)	14
FIGURE 2.5 RESERVOIR FLOOD RISK MAP (GOV.UK)	16
FIGURE 2.6 PLUVIAL FLOOD RISK MAP (GOV.UK)	16
FIGURE 2.7 CRITICAL DRAINAGE AREAS (SFRA)	17
FIGURE 3.1 EA PRODUCT 4 MAP (EA DATA)	19
FIGURE 3.2 EXISTING SITE FROM BLACKFRIARS STREET (GOOGLE MAPS)	20
FIGURE 1.6 LOWER LEVEL ELEVATIONS (JM ARCHITECTS)	21
FIGURE 3.3 RERSERVOIR FLOOD RISK DEPTH (GOV.UK)	23
FIGURE 3.4 SFRA USER GUIDE (SFRA)	24
FIGURE 4.1 EXISTING FLOOD EXTENTS	26
FIGURE 4.2 PROPOSED FLOOD EXTENTS	27
FIGURE 5.1 SEWER RECORDS (SOUTHERN WATER)	29
FIGURE 6.1 PROPOSED DEVELOPMENT PLAN	31

LIST OF APPENDICES

APPENDIX A	ARCHITECT'S LAYOUT
APPENDIX B	ENVIRONMENT AGENCY DATA
APPENDIX C	FLOOD OVERLAY
APPENDIX D	UNITED UTILITIES SEWER RECORDS
APPENDIX E	PRELIMINARY DRAINAGE LAYOUT

SECTION I SITE INVESTIGATION

INTRODUCTION

- I.1. This report has been prepared by Shepherd Gilmour Infrastructure Ltd (SGi) on behalf of Deansgate SOF Alliance LeaseCo Limited, a joint venture between Property Alliance Group (PAG) and an affiliate of Starwood Capital (SCG), to support a full planning application for the residential element of its wider masterplan proposals for high quality mixed-use development at the Renaissance hotel complex.
- I.2. The Flood Risk Assessment has been prepared in accordance with the Flood Risk and Coastal Change Planning Practice Guidance (PPG) and the National Planning Policy Framework (NPPF). It contains information from sources such as the Environment Agency (EA), Local Sewerage Undertaker, District Council and Site Owner.

EXISTING SITE DESCRIPTION

- I.3. The application site extends to approximately 0.35 hectares and forms part of the wider Renaissance hotel complex, which is located at the northern end of Deansgate in Manchester City Centre. The wider site fronts onto Deansgate, Blackfriars Street, and Victoria Bridge Streets, and the River Irwell.
- I.4. The Renaissance complex currently comprises a vacant 15-storey, 203 bedroom hotel building, a multi-storey car park, a restaurant and a dilapidated former office building (Premier House) which has been vacant for a significant number of years.
- I.5. This particular application relates to the proposed development of a high-quality landmark residential building on the northernmost area of the Renaissance complex, following the consented partial demolition of Premier House which will clear the plot for development.
- I.6. The site can be found using the location data in **Figure I.1**.

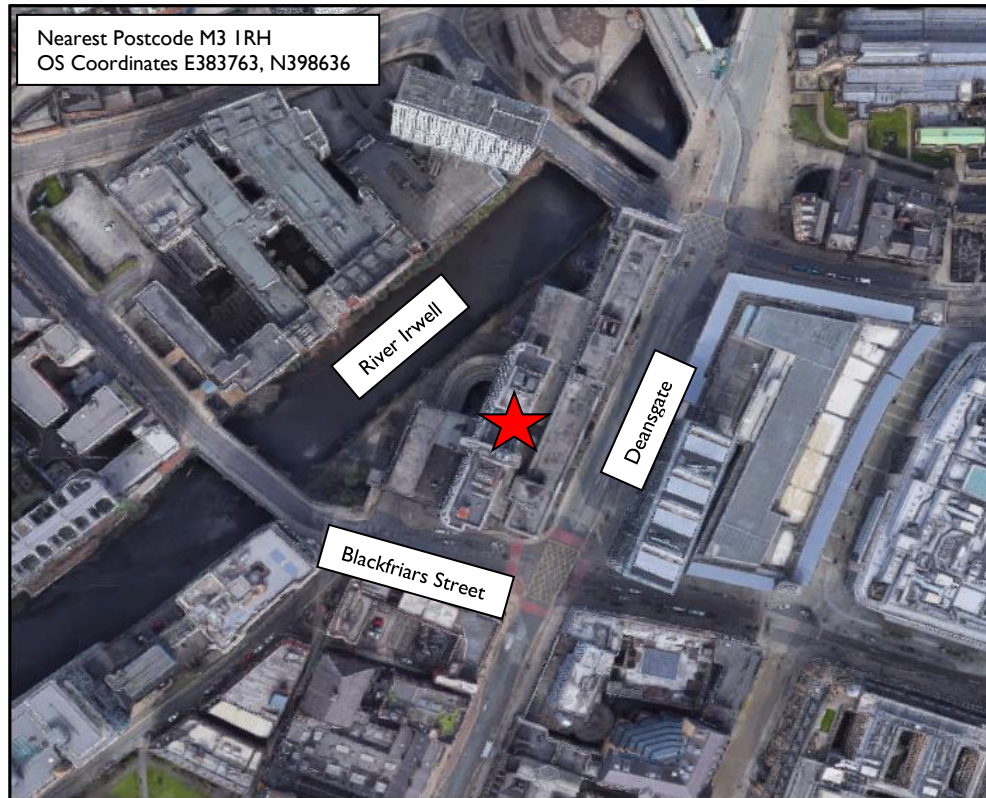


Figure 1.1 Site Location Plan (Google Maps)

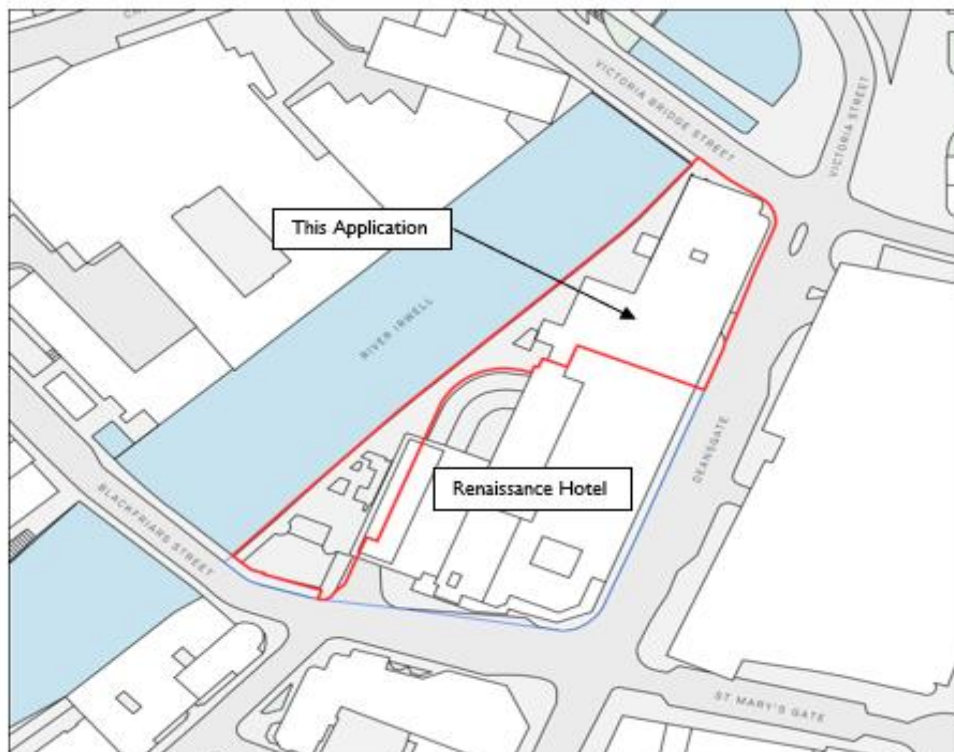


Figure 1.2 Proposed Development (JMA)

PROPOSED SITE LAYOUT

1.7. The proposals provide for a new, high quality residential development at ground + 26 storeys that will provide approximately 300 residential units with ground floor retail/leisure units, supported by high quality amenity space, including new riverside public realm with a new food and beverage offer, as well as riverside amenity space and communal and private roof terraces for new residents.

1.8. This report will mainly focus on the lower basement level known as Basement Level-02. But a copy of the following architect's plans has been included within **Appendix A**.

- *Ground Level-00*
- *Basement Level-01*
- *Basement Level-02*



Figure 1.3 Ground Level -00 (JM Architects)

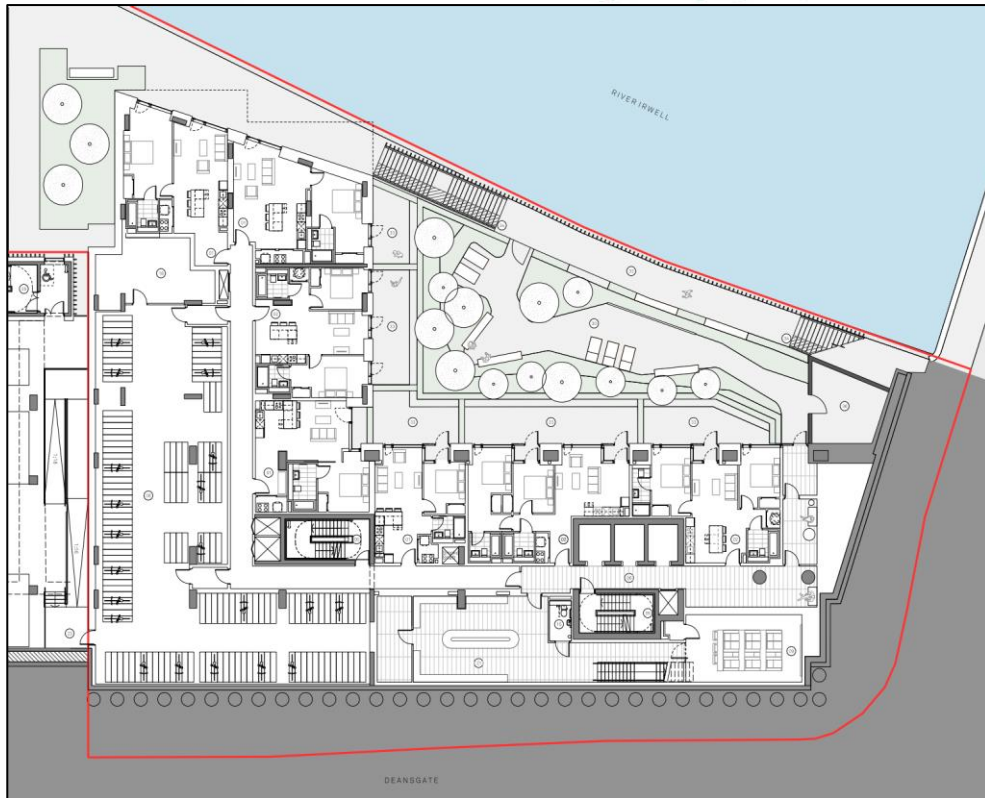


Figure I.4 Basement Level -01 (JM Architects)



Figure I.5 Basement Level -02 (JM Architects)



SECTION 2 POTENTIAL SOURCES OF FLOODING

2.1. There are several sources of flooding which could impact the proposed development site (PDS). These potential sources have been previously assessed, but we have reviewed each source again using the latest available information/data.

- Fluvial/Tidal,
- Ground Water,
- Artificial Waterbodies (canals, reservoirs etc) and,
- Pluvial.

2.2. The sources of flooding which are found to impact the PDS will be discussed in further detail in **Section 3 & 4**.

FLUVIAL/TIDAL FLOOD RISK

Gov.UK Website

2.3. The Gov.UK website provides a flood risk service which allows for a PDS to be quickly checked against fluvial/tidal flooding. An abstract has been shown in **Figure 2.1**.

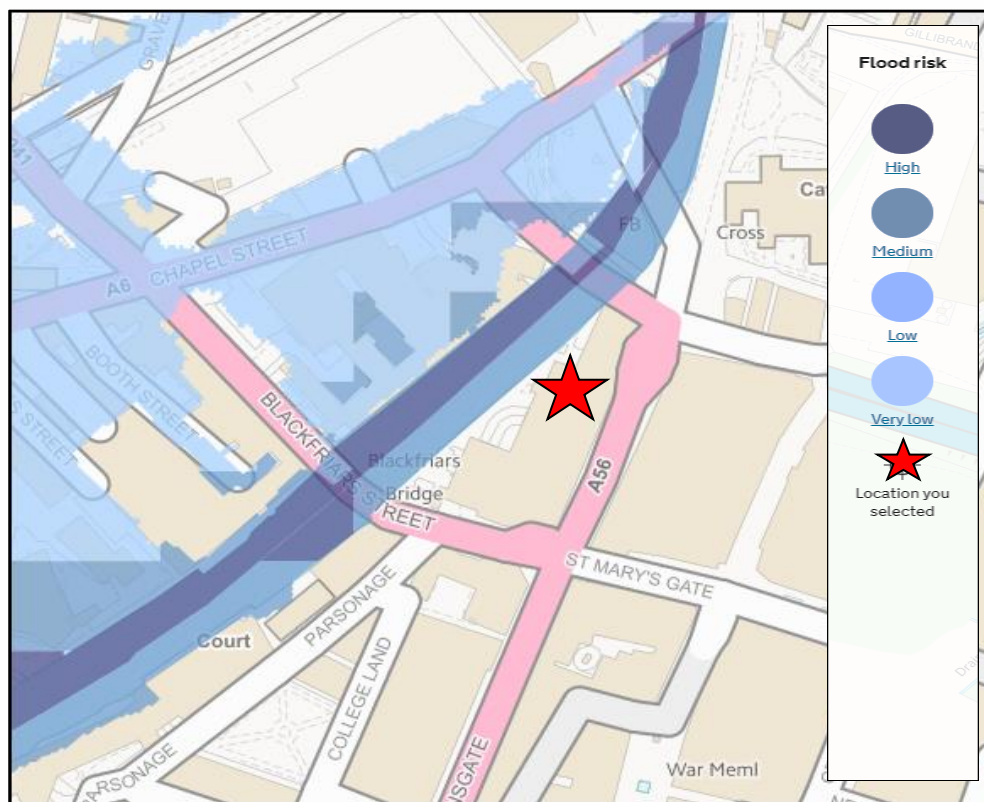


Figure 2.1 Flood Map for Planning (Gov.UK)

2.4. The Gov.UK flood maps indicate that the PDS is at outside any fluvial flood risk.

Strategic Flood Risk Assessment

2.5. The NPPF requires Local Planning Authorities to produce Strategic Flood Risk Assessments in support of their Local Plan. These form the basis for preparing appropriate policies for flood risk management within the area and provide the framework for assessing areas of developable land.

2.6. The PDS is within the SFRA for Manchester City, Salford City and Trafford Council and was produced by JBA Consulting in August March 2010. The SFRA flood data confirms that the PDS is located within Flood Zone 2 & 3.

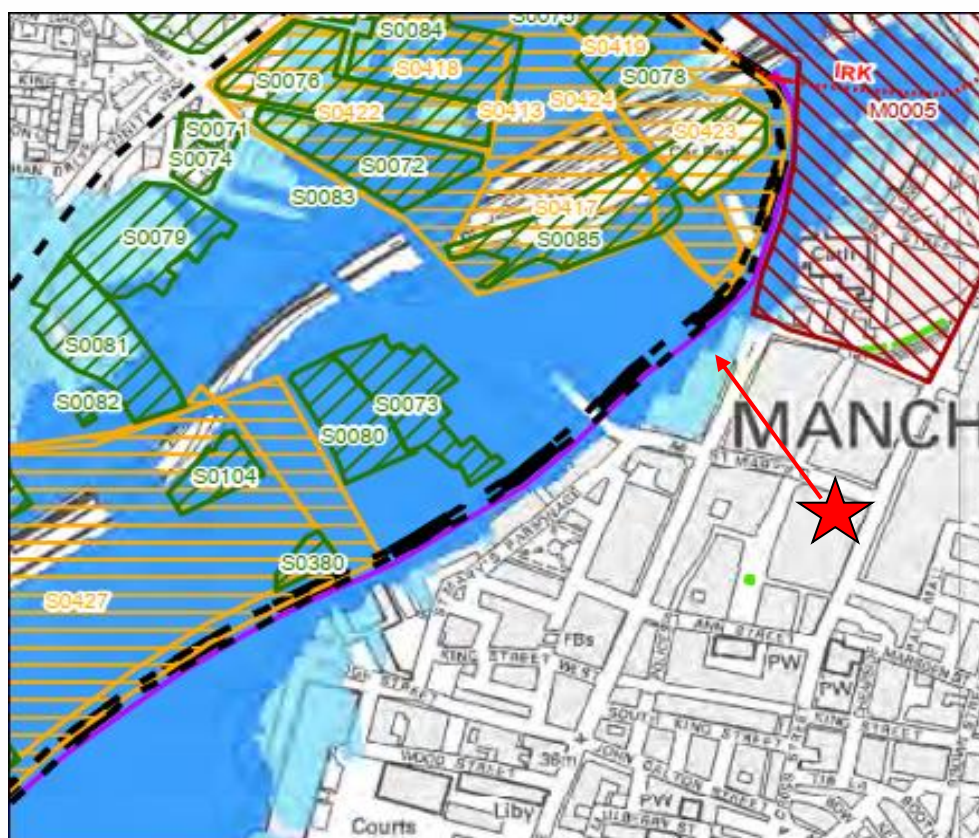


Figure 2.2 SFRA Flood Map (SFRA Figure N.2)

Environment Agency

2.7. According to the Environment Agency (EA) flood search the PDS is located within Flood Zones 1, 2 & 3. An abstract of this EA Flood Map has been shown below in **Figure 2.3**.

- Flood 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)

- Flood 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)

- **Flood Zone 3 – 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)

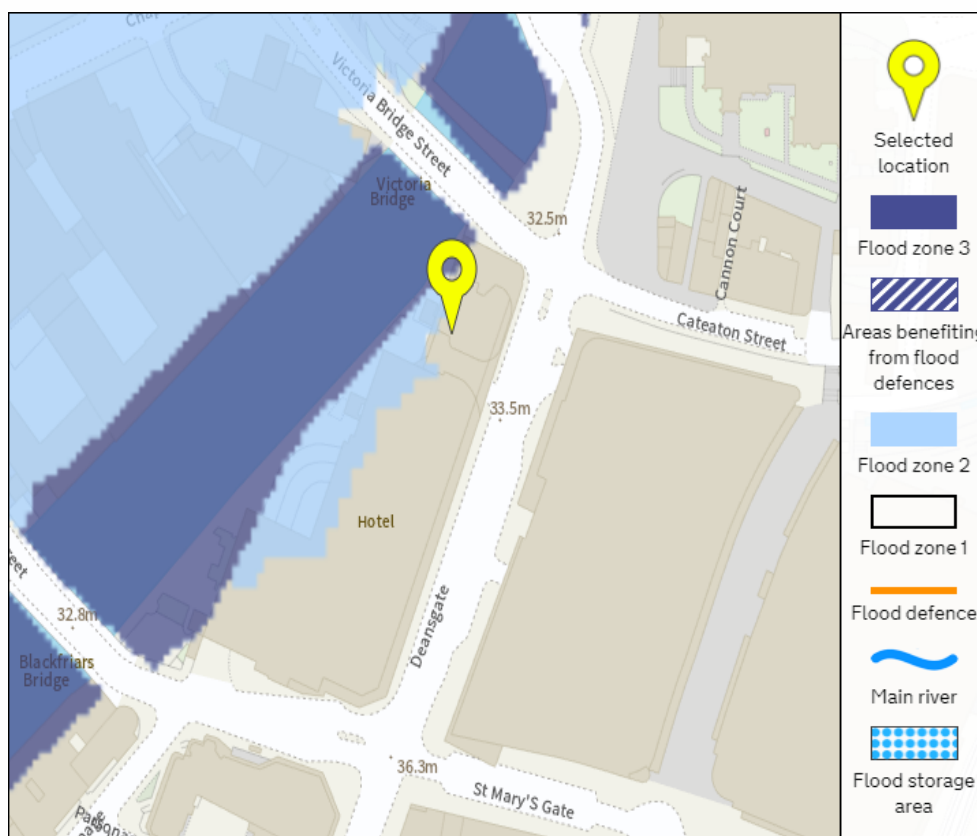


Figure 2.3 Flood Map (Environment Agency)

Ordinary Watercourse

2.8. Ordinary watercourses do not form part of a 'main river' and can consist of rivers, ditches, swales, drains etc. These watercourses are the responsibility of the riparian owner who must ensure that:

- *Flows can pass freely without obstruction, pollution, or diversion (affecting the rights of others).*
- *The banks and bed of the watercourse are maintained (including vegetation).*
- *Any approved onsite watercourse structures are maintained.*

- 2.9. Whilst there is no ordinary watercourse on the site. There is a culverted watercourse identified within Cateaton Street that may encroach into the development boundary (potentially the Hanging Ditch).

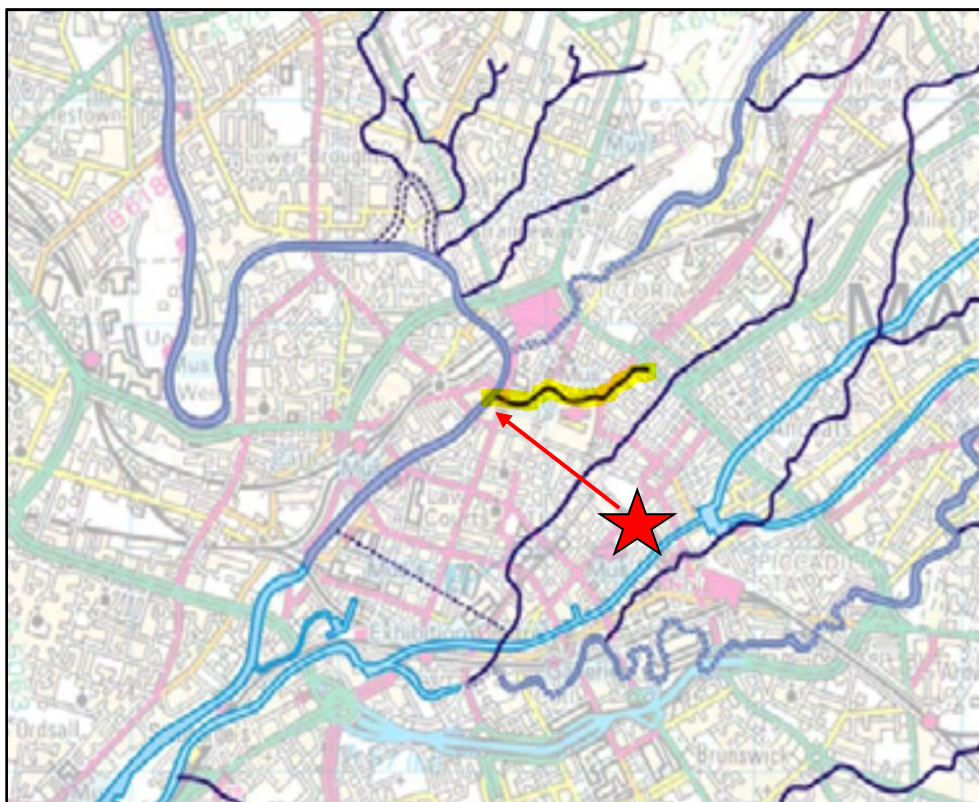


Figure 2.4 The Great Fosse (North West Geography Vol 8 No. 1 2008)

CANAL FLOOD RISK

- 2.10. Water levels within a canal structure are maintained and regulated sluice gates along the route of the canal. Whilst a breach or overtopping is unlikely occur, the potential risk should be assessed within the FRA.

Canal & River Trust

- 2.11. Many of canals in England and Wales are owned, maintained, and operated by the Canal & River Trust (CRT). The closest CRT canal to site is the Rochdale Canal and is approximately 1100m to the southeast.
- 2.12. Maps within the SFRA indicate that the PDS is located outside of any CRT Flood Risk.

Manchester Ship Canal

- 2.13. The Manchester Ship Canal (MSC) is the canalised segment of the River Irwell and starts at the convergence of the River Irwell and River Irk. The flood risk associated with the MSC is covered by the EA data and discussed in the fluvial/tidal section of this report.

GROUNDWATER FLOOD RISK

- 2.14. Unlike flooding from rivers and the sea, groundwater does not pose a significant risk to life. It is more associated with damage to the building, due to the flooding persisting over several weeks.
- 2.15. The SFRA indicates that the PDS is located outside of any current/historic groundwater levels. Any groundwater issues, however, will be confirmed during the Phase II site investigation and any potential issues will be mitigated during the detailed design.

ARTIFICIAL WATERBODIES

- 2.16. The reservoirs in the area are owned and operated by United Utilities and are covered by the Reservoirs Act 1975. Whilst the probability of a catastrophic dam failure occurring is relatively low the consequences of such an event are severe.
- 2.17. Reservoir flood plans are still required and are prepared by their owners. These documents are considered sensitive due to national security and only indicative plans are made available by the Environment Agency/Gov.UK.
- 2.18. The indicative reservoir flood plan (**Figure 2.5**) indicates that the PDS maybe affected by a potential breach, but the information is very limited.

PLUVIAL RUNOFF

- 2.19. Pluvial flooding is defined as 'flooding from rainfall generated overland flow before the runoff enters any watercourse or sewer.' It is usually associated with high-intensity rainfall events but can also occur during low-intensity events when the ground is saturated/frozen or has low permeability.
- 2.20. The maps provided within the SFRA and Gov.UK (**Figure 2.6**) indicate that the PDS is at very low to low risk of pluvial flooding.

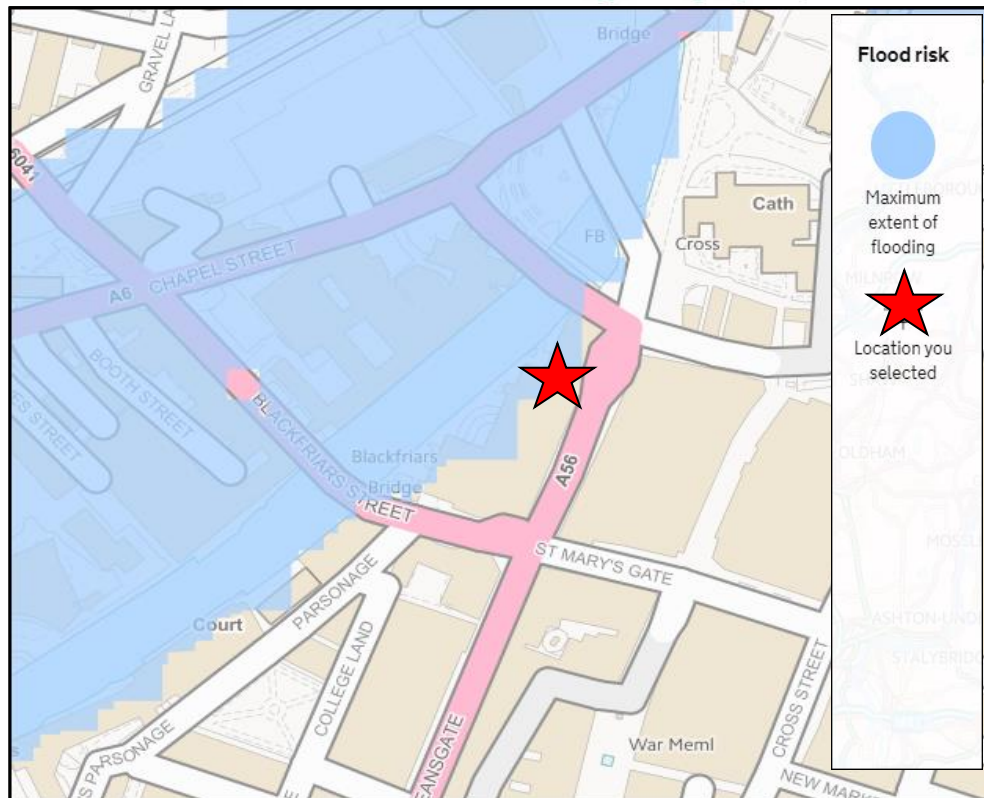


Figure 2.5 Reservoir Flood Risk Map (Gov.UK)

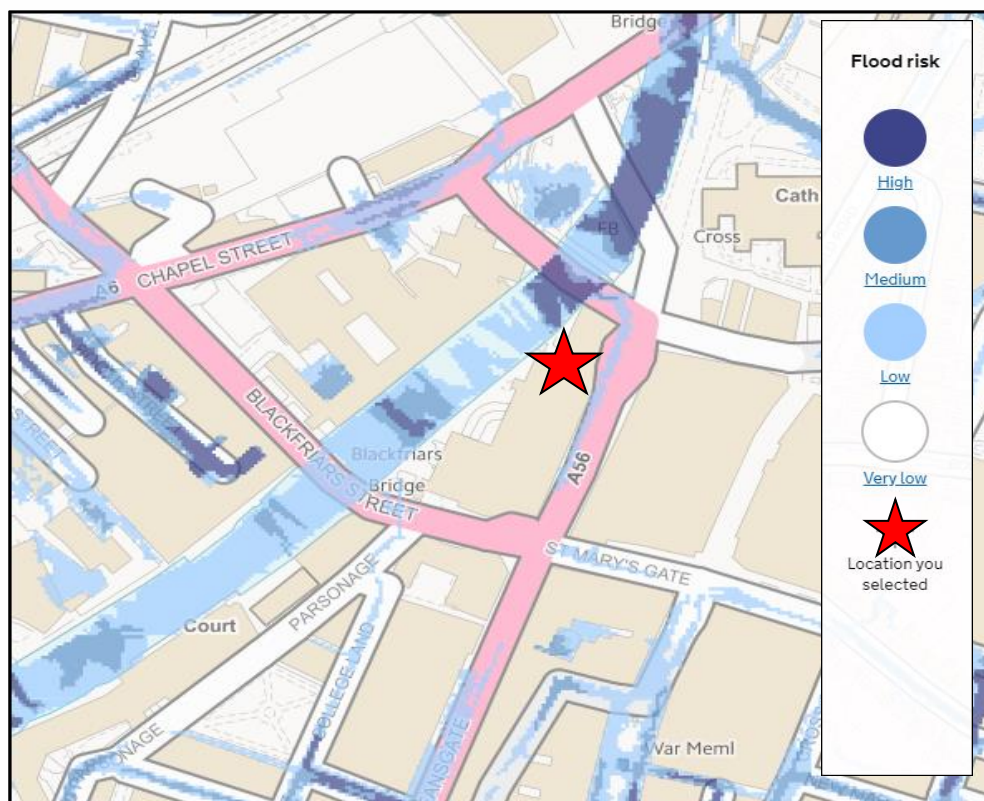


Figure 2.6 Pluvial Flood Risk Map (Gov UK)

CRITICAL DRAINAGE AREA

- 2.21. Critical Drainage Areas (CDA) are areas that are particularly sensitive to an increase in surface water runoff, either as direct overland flow or from the existing sewer network.
- 2.22. The SFRA confirms that the PDS is located within the Conurbation Core CDA. Surface water runoff from the PDS must therefore be restricted to the calculated greenfield rate and/or provide a betterment over the existing brownfield arrangement.

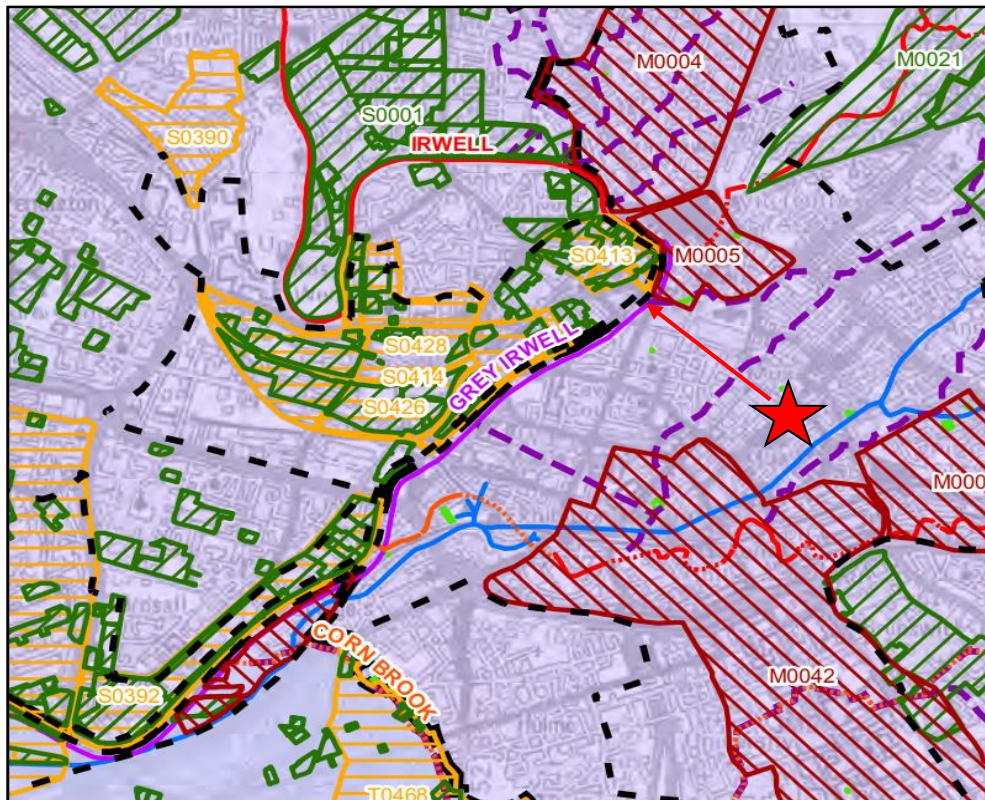


Figure 2.7 Critical Drainage Areas (SFRA)

FLOOD RISK OVERVIEW

2.23. The potential sources of flooding which could be experienced have been summarised in **Table 2.1**. Those posing the greatest flood risk to the site have been investigated further in **Section 3** to determine the potential mitigation measures.

Source of Flooding	Potential Flood Risk					Site Description
	High	Medium	Low	Very Low or Negligible	Information Not Available	
Fluvial/Tidal	X	X	X	X		The Environment Agency maps indicate that the PDS is in Flood Zone 1, 2 & 3. The SFRA map indicates that the site is within Flood Zone 2 & 3.
Canal				X		SFRA Maps indicate that the PDS is located outside of any CRT Flood Risk.
Ground Water				X		SFRA indicates that the PDS is at low risk. Ground water to be checked during the intrusive site investigation.
Artificial Waterbodies (Reservoir)		X	X			In the event of a potential breach, the PDS is located on the outer edge of the expected flood route.
Pluvial Runoff			X	X		The Gov.UK Maps identifies that the site is at low to very low risk of surface flooding.
Critical Drainage Areas			X			The SFRA confirms that the PDS is located within a CDA.

Table 2.1 Potential Sources of Flooding Overview

SECTION 3 FLOOD RISK ANALYSIS

FLUVIAL/TIDAL FLOODING

- 3.1. The SFRA fluvial flood maps indicated that the PDS was within Flood Zone 2 & 3 (**Figure 2.2**). These flood maps were produced in 2010 and may no longer be based on the most current information.
- 3.2. The online Environment Agency maps on the other hand indicates that the PDS is within Flood Zone 1, 2 & 3 (**Figure 2.3**). These maps are updated on a regular basis, and they are potentially more relevant in terms of flood risk.
- 3.3. However, for the avoidance of doubt, we have requested the Product 4 hydraulic data from the EA. This will allow the source of flooding to be investigated further detail.

Environment Agency Data (Product 4)

- 3.4. Product 4 data provides estimated flood levels at specific node points along a water course. Each node has a series of water levels that correspond to a return period and can be used/compared against the onsite topography to confirm its potential risk.
- 3.5. Extracts of this Product 4 data have been used in this report and copies of the original data have been included within **Appendix B**.



Figure 3.1 EA Product 4 Map (EA Data)

Node Point	Return Period/Probability Normal Operation				
	1 in 100	100 Plus 30%CC	100 Plus 35%CC	100 Plus 70%CC	1 in 1000
1	25.71m	26.32m	26.44m	27.80m	28.10m
2	25.40m	25.92m	26.03m	27.18m	27.45m
3	25.25m	25.77m	25.88m	27.08m	27.37m
4	25.19m	25.70m	25.81m	26.98m	27.27m

Table 3.1 Estimated EA Flood Levels

**Node 2 is considered the most relevant.*

Level Comparison

3.6. The topography of the existing site is complex, and the proposed development consist of a ground floor with two lower basement levels. These proposed floors are set at the following levels.

- Ground Floor Level = 32.535m AOD
- Basement Level-01 = 28.810m AOD
- Basement Level-02 = 25.260m AOD

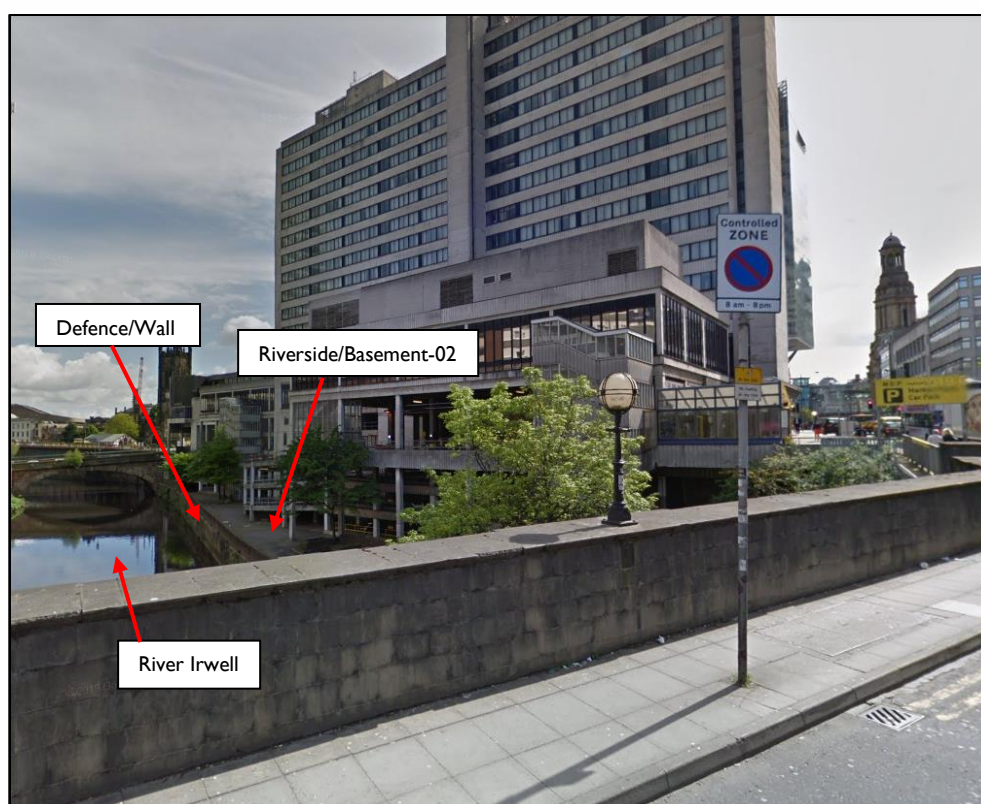


Figure 3.2 Existing Site From Blackfriars Street (Google Maps)

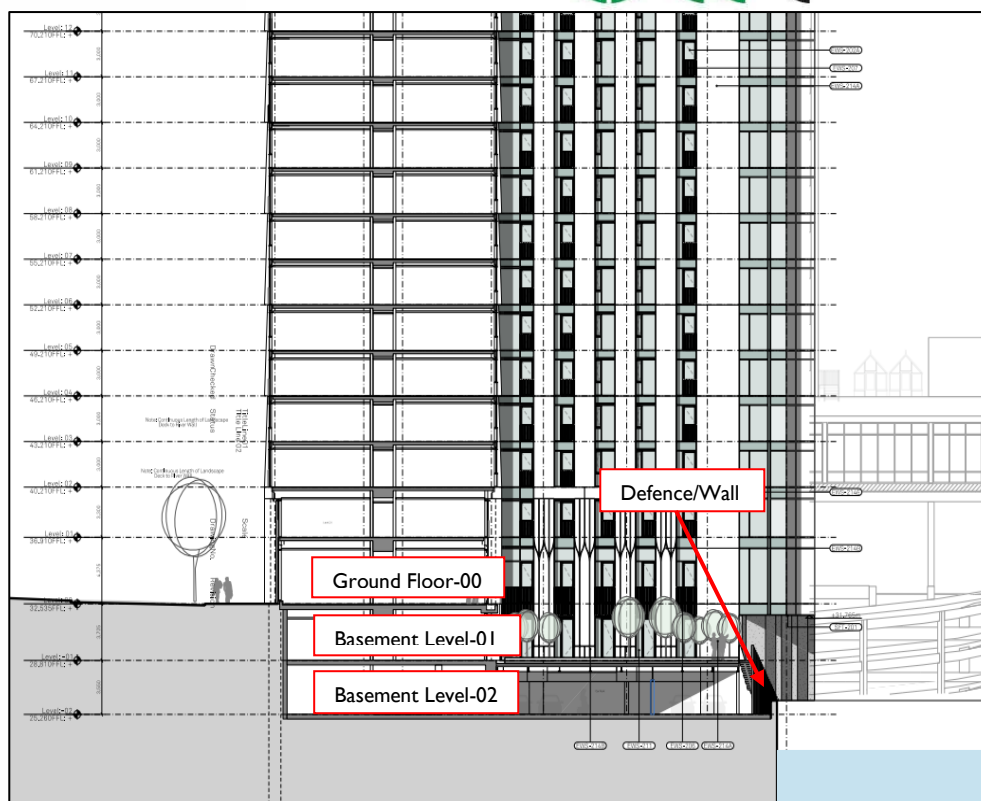


Figure 1.6 Lower Level Elevations (JM Architects)

- 3.7. Basement Level-02 has been currently set at 25.260m on the topographical survey and opens out onto the adjacent Riverside courtyard at 25.100m. Based on the estimated flood levels in **Table 3.1** (25.40m AOD), Basement Level-02 would become flooded during the 100-year event.
- 3.8. The existing wall along the riverside is shown to be at or above 26.28m AOD on the topographical survey. The wall in theory could provide some protection to the PDS during the 100-year event flood event. But the structural condition of the wall cannot be confirmed, so the “defence” has been ignored in this report.
- 3.9. The existing drainage system for the courtyard area would also pose a risk to the PDS. The drainage discharges to the River Irwell and would allow flood water to backflow up into the site during a flood event (flap valves are not evident).
- 3.10. Even if flap valves were installed on the existing outfall(s). It is unlikely that the site drainage from Basement Level-02 could generate the hydraulic head required to counter a submerged outfall.
- 3.11. Based on the above and the estimated flood levels we would deem the PDS to be within Flood Zone 3 i.e., high risk of fluvial flooding.

EA Climate Change Allowances

- 3.12. The proposals from the architect indicate that Basement Level-02 will primarily serve as an extended car park for the adjacent site. But also contains some facilities such as storage tanks, cleaners store and a staff breakroom.
- 3.13. The car park would be considered as a water compatible development type and in accordance with the EA guidance the Central Climate Change allowance (30%) should be used for the estimated flood level (25.92m).
- 3.14. The staff breakroom/storage rooms would be classed as less vulnerable development types. The EA guidelines recommend that the Higher Central Climate Change allowance (35%) should for less vulnerable development types in Flood Zone 3 (26.03m).

**River levels taken from Node position 2.*

Mitigation Measures I – Basement Level-02 Car Park

- 3.15. The finished floor level of the proposed development must be set at least 600mm above the estimated 100-year flood level with the appropriate climate change included. This will provide the recommended freeboard (EA guidance) to safeguard the development during this flood event.
- 3.16. The proposed finished floor level for water compatible developments should be set at or above the level noted in **Table 3.2**. This minimum level, however, is not suitable since the proposed car park is an extension of the existing one and a level difference of 1.26m is not compatible.

Development Type	Proposed Level	Estimated 100 year Plus CC	Freeboard Allowance	Minimum Finished Floor Level
Water compatible i.e., Car Park	25.260m	25.920m	+0.600m	26.520m

Table 3.2 Minimum Finished Floor Levels – Car Park

- 3.17. The basement car park must therefore be designed to flood during the 100-year event and be constructed with flood resilient techniques. Vehicle barriers/loops or equivalent will also need to be added around any openings to prevent buoyant vehicles being dragged downstream. The car park should also include appropriate flood warning signs.
- 3.18. The car park must also be closed/evacuated during flood warnings This will be address in more detail in Section 4.

Fluvial/Tidal Flood Risk = High fluvial flood risk remains in the Basement car park.

Mitigation Measures 2 – Basement Level-02 Less Vulnerable

- 3.19. The proposed finished floor level for less vulnerable development types should be set at or above the level noted in **Table 3.3**.

Development Type	Proposed Level	Estimated 100 year Plus CC	Freeboard Allowance	Minimum Finished Floor Level
Less Vulnerable i.e., Staff room & Storage	25.260m	26.030m	+0.600m	26.630m

Table 3.3 Minimum Finished Floor Levels – Car Park

- 3.20. To address this the Basement Level -02 will either need to be split level with ramps and steps between the car park and the less vulnerable zones. Or the Less vulnerable areas will need to be moved to the floor above.

Fluvial/Tidal Flood Risk = Low fluvial flood risk after mitigation measures.

ARTIFICIAL WATERBODIES

- 3.21. Flooding from reservoirs is considered extremely unlikely. However, Gov.UK Maps indicate that the PDS could be at risk of flooding should a breach occur (**Figure 2.5**). The Gov.UK maps also indicate that over 2m of flood water could potential be on the PDS during a breach (**Figure 3.3**).

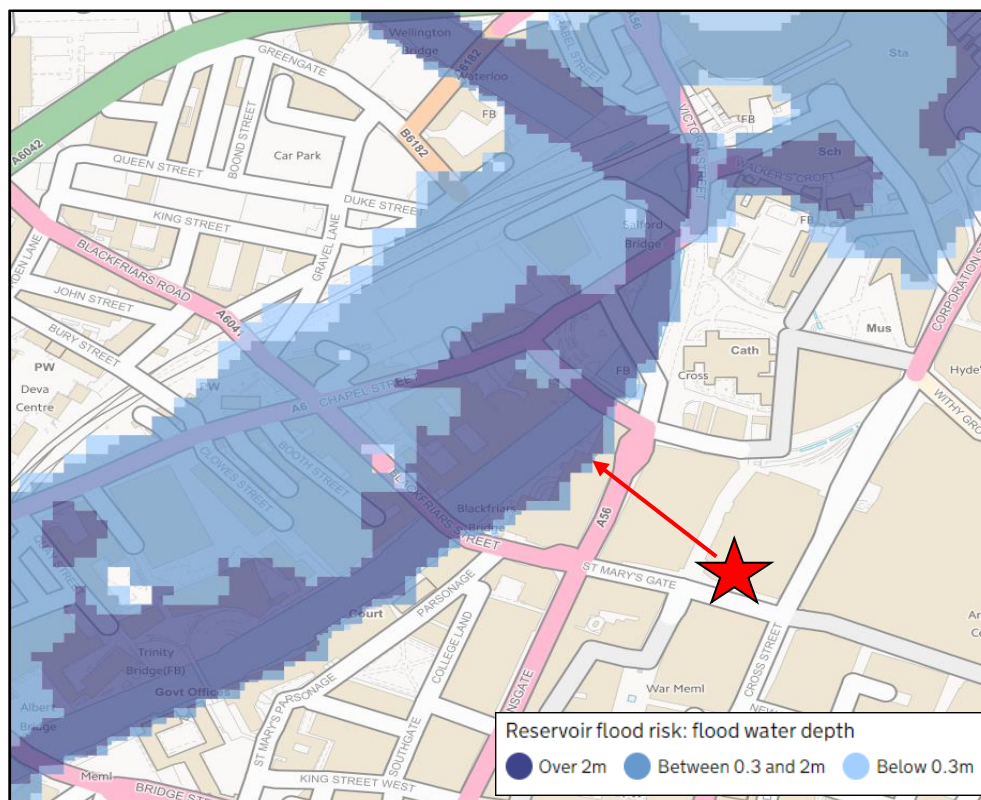


Figure 3.3 Reservoir Flood Risk Depth (Gov.UK)

Mitigation Measures

- 3.22. Whilst this depth of flood water onsite is significant, we would note that this is the “maximum extent” and will only occur if the reservoir completely failed and released all the water it held at once (when full).
- 3.23. This is a worst-case scenario for a highly unlikely event, and this flood data is intended more for emergency planning uses rather than large scale flood risk assessments.
- 3.24. Proposing any mitigation measure to defend against such an unlikely event would be impractical and cost prohibitive. A residual risk from this source will therefore remain.

Reservoir Flooding = Residual Risk remains

CRITICAL DRAINAGE AREAS

- 3.25. The PDS is located within the Conurbation Core CDA. Specific details relating to this CDA are limited and further information/discussion with United Utilities and the Lead Local Flood Authority should be undertaken.

Mitigation Measures

- 3.26. The proposed drainage system must also not contribute to any flood risk or overland flow risk elsewhere. Therefore, any runoff generated by the proposed development must provide betterment over the existing arrangement.
- 3.27. The Manchester, Salford and Trafford SFRA User Guide 2010 recommends the following surface water runoff reductions which the proposals must adhere to.

“Developments should aim for a minimum reduction in surface water runoff rates of 50% for Brownfield sites, with an aim of reducing runoff to Greenfield rates up to a 1 in 100 year storm event, considering climate change”

Figure 3.4 SFRA User Guide (SFRA)

Pluvial Flood Risk = Low risk after redevelopment

SECTION 4 FLOOD ZONE REQUIREMENTS

Development Flood Zone

4.1. Based on the information available, the PDS is located within Flood Zone 3.

- Flood Zone 3 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.

Proposed Development Type

4.2. In accordance with the National Planning Policy Framework Practice Guidance on flooding. The less vulnerable and water compatible development types proposed in Basement Level-02 are permitted within Flood Zones 3.

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	✓	✓	✓	✓	✓
2	✓	Exception Test Required	✓	✓	✓
3a	Exception Test Required	x	Exception Test Required	✓	✓
3b	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted

Table 4.1 Flood Risk Classification (NPPF)

Policy Aims

- 4.3. In this zone developers and Local Authorities should still seek opportunities to reduce the overall level of flood risk in the area through the layout design and form of development and the appropriate application of sustainable drainage techniques.
- 4.4. Relocate existing development to land in zones with a lower probability of flooding; and create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Finished Floor Level Restrictions

4.5. Refer to Section 3 for further information.

- Water Compatible i.e., The proposed car park extension is to be set at or around the existing car park levels **25.26m AOD**
- Less Vulnerable areas at Basement Level-02 are to be set at or above **26.63m AOD**

Flood Compensation Review

- 4.6. Developments within Flood Zone 3 must consider their impact on flood storage and ensure that the proposals do not exacerbate downstream flooding. An overlay of the flood extents has been included within **Appendix C** and the volumes noted below.
- 4.7. The EA usually excludes buildings from their flood modelling by creating glass walls around them i.e., making them watertight. Whilst this isn't a perfect solution it allows for simpler modelling/comparisons, so we have used this approach for the PDS.

Flood Compensation Comparison

- 4.8. The estimated flood levels within Section 3 indicate that areas adjacent to the river will experience flooding during the 100-year event. The affected areas have been highlighted in **Figure 4.1** and **4.2** and show that 1260m² of the site will be impacted prior to the development and 980m² afterwards.

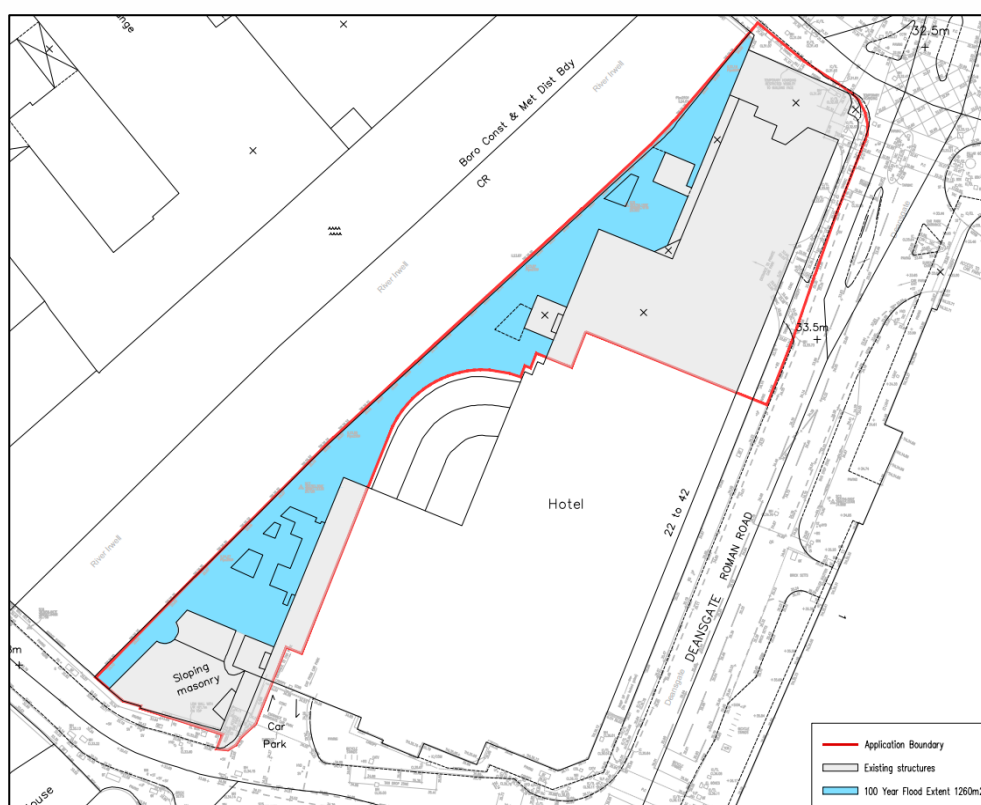


Figure 4.1 Existing Flood Extents

Return Period	Average Ground Level	Flood Level	Flood Area	Onsite Volume
100 Year	25.050m	25.400m	1260m	441m ³
100 Year Plus 30% Climate Change		25.920m		1096m ³
100 Year Plus 35% Climate Change		26.030m		1235m ³

Table 4.2 Existing Onsite Flood Volumes

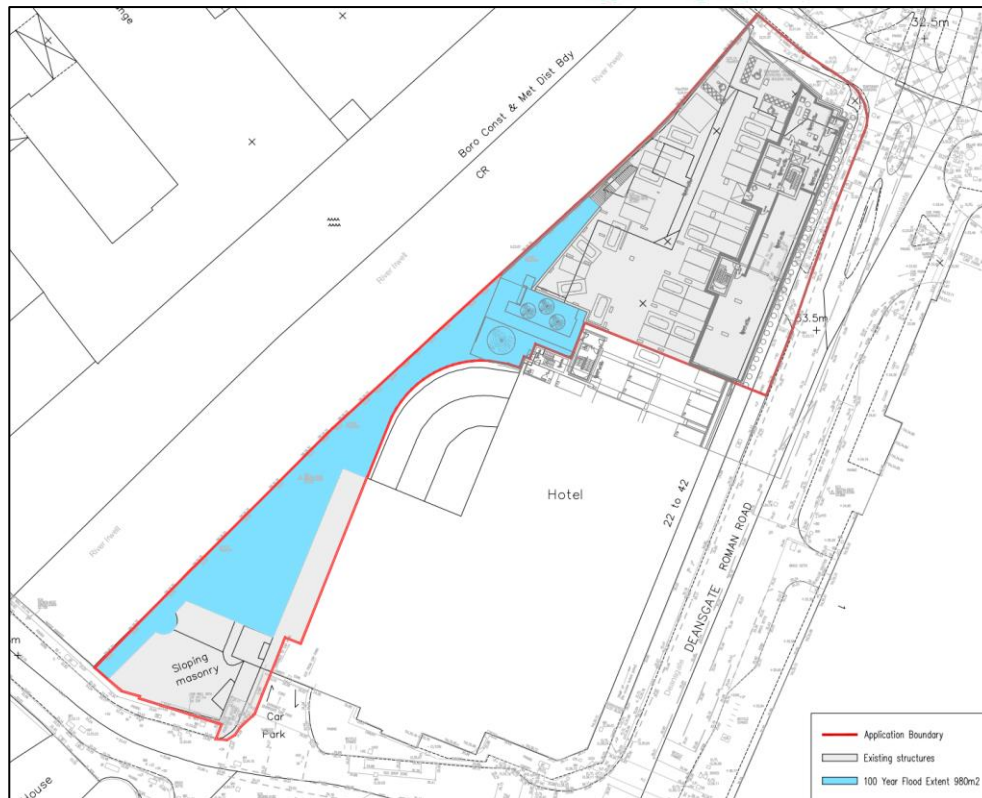


Figure 4.2 Proposed Flood Extents

Return Period	Average Ground Level	Flood Level	Flood Area	Onsite Volume
100 Year	25.050m	25.400m	980m	343m ³
100 Year Plus 30% Climate Change		25.920m		853m ³
100 Year Plus 35% Climate Change		26.030m		960m ³

Table 4.3 Existing Onsite Flood Volumes

Flood Compensation Volumes

- 4.9. The flood storage volumes in **Table 4.2** and **4.3** indicate that there could be up to 275m³ of flood storage lost post development. The flood storage loss, however, would actually be minimal due to the existing car park open structure. The open structure of the car park would permit any fluvial flooding to flow freely below the building.

Return Period	Existing Onsite Flood Volume	Proposed Onsite Flood Volume	Flood Difference
100 Year	441m ³	343m ³	-98m ³
100 Year Plus 30% Climate Change	1096m ³	853m ³	-243m ³
100 Year Plus 35% Climate Change	1235m ³	960m ³	-275m ³

Table 4.3 Onsite Flood Storage Difference

- 4.10. We would therefore consider that the fluvial flood risk downstream as a result of this development would remain unchanged.

Flood Resilient Construction

- 4.11. Flood resilient construction techniques should be used within the PDS up to the 1000-year event (27.45m AOD). This will enable to PDS to quickly and safely reopen in the event of an extreme flood.

Safe Access and Egress from the Site

- 4.12. During an extreme 1000-year flood event, Basement Level-02 could experience up to 2.2m of flooding. The building floors above are all higher than the extreme flood and and provide safe refuge. The building can also be safely accessed from Deansgate, Blackfriars, Victoria Bridge Street should the Basement Level-02 experience flooding.
- 4.13. An evacuation plan/strategy for Basement Level-02 must be developed during the detailed design stage and submitted for approval.

Flood Warning & Evacuation Plan

- 4.14. We would recommend that all businesses, residents, and site users within the PDS (regardless of which floor they are situated on) sign up to the EA Flood Warnings Direct Service. This will act as an early warning detection system for extreme weather conditions.

SECTION 5 EXISTING DRAINAGE INFORMATION

PUBLIC SEWERS

Foul Water Sewers

5.1. Public sewers within the Manchester area are owned and maintained by United Utilities (UU). A copy of their sewer records has been included within **Appendix D**.

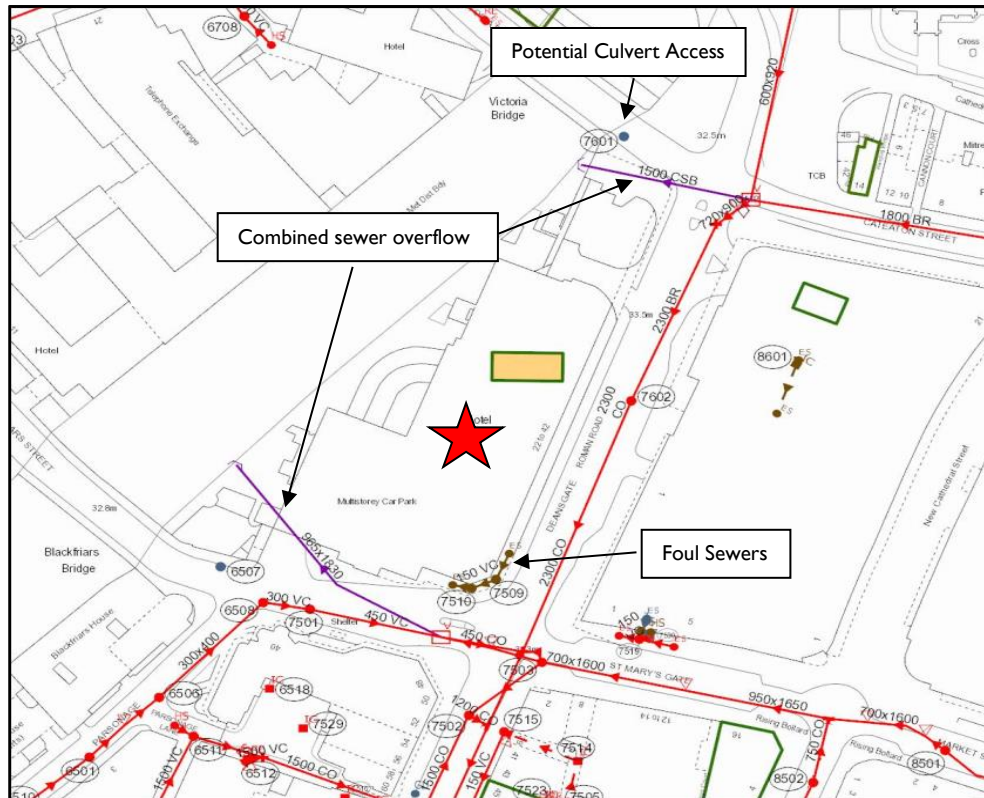


Figure 5.1 Sewer Records (Southern Water)

Surface Water Sewers

5.2. No surface water sewers in the vicinity of the PDS.

Foul Water Sewers

5.3. There is a small section of foul water drainage on the corner of Deansgate and Blackfriars Road. This drainage likely serves the adjacent units which are part of the PDS. The foul drainage more than likely discharges to the nearby combined system.

Combined Water Sewers

5.4. There are several combined water sewers next to the PDS and UU's records indicate.

- A 2300mm diameter sewer within Deansgate. No depth available.
- A 450mm diameter sewer within Blackfriars that is around 10m deep.

Sewer Overflows

- 5.5. There are two sewer overflows that pass thru the PDS to the River Irwell. Information is limited but the pipes have been identified in **Figure 5.1**.

Sewer Diversions

- 5.6. The existing sewer overflows might be affected by the development proposals. Further investigation will be needed during the next stage and any potential diversion/protection measures will need to be agreed with United Utilities.

PRIVATE DRAINAGE

Foul & Surface Water

- 5.7. No information is available at this stage. We envisage however, that the surface water runoff will discharges directly to the River Irwell and the foul effluent discharges to UU combined sewerage system.

SECTION 6 SUSTAINABLE DRAINAGE STRATEGY

- 6.1. The general requirement set out by the NSSDS 2011 and NSTSSD 2015 technical documents is that 'the development must not increase the risk of flooding elsewhere.' In practical terms this means that the proposed development runoff rate must provide a betterment or be equal to the calculated greenfield rate.

EXISTING SURFACE WATER RUNOFF RATE

Greenfield Runoff Rate

- 6.2. The Institute of Hydrology Report 124 Flood Estimation for Small Catchments has been used to calculate the mean annual flood flow from the catchment.

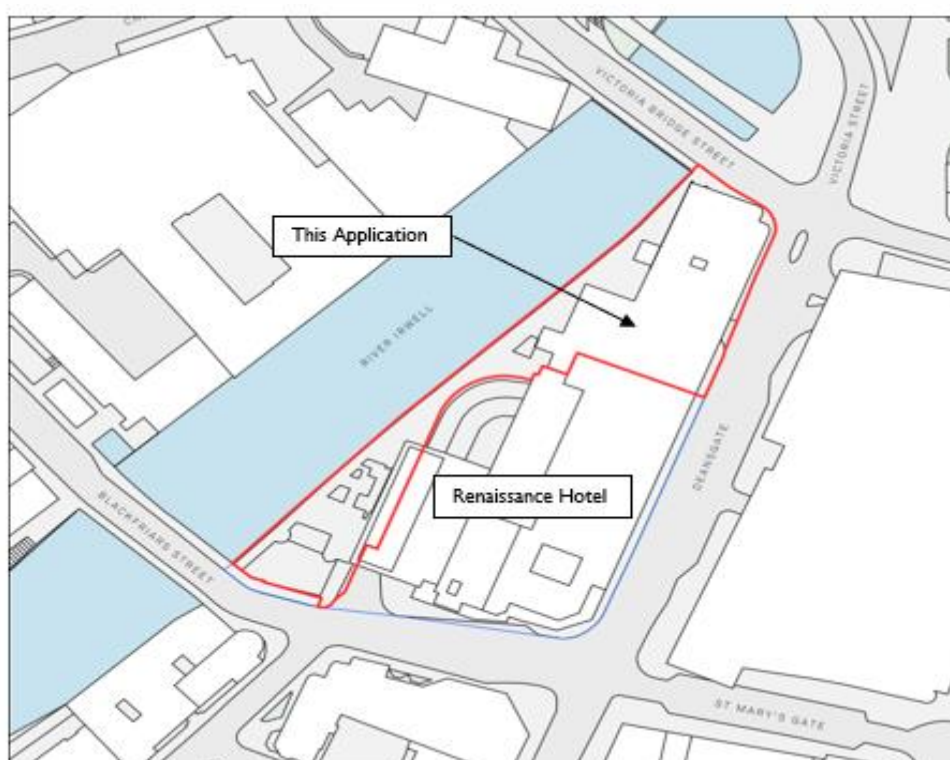


Figure 6.1 Proposed Development Plan

	m ²	ha
Planning Boundary	3500	0.3500

Table 6.1 Site Plan

Volume Wallingford Variables	Value
M5-60 minute rainfall depth	18mm
Ratio of M5-60 to M5-2 day rainfalls	0.34mm
Average Annual Rainfall (SAAR)	890mm
Winter Rain Acceptance Potential (SOIL)	Soil Type 4 (0.45)

Table 6.2 Wallingford Procedure Volume 3 Variables

$$QBAR_{rural} = 1.08 (AREA/100)^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

Where; $AREA = 50 \text{ ha (to be scaled to 0.350ha)}$

$SAAR = 890\text{mm}$

$SOIL = \text{Type 4 (0.45)}$

$$QBAR_{rural} = 1.08 (AREA/100)^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

$$= 1.08 (50/100)^{0.89} \times 890^{1.17} \times 0.45^{2.17}$$

$$= 290.91 \text{ (50-hectare site)}$$

Therefore $QBAR = (290.91 / 50) \times 0.35$

$$= \underline{\underline{2.04}}$$

Growth Curve Factor

6.3. Growth curve factors have been derived for each of the 10 hydrological regions of the UK. These are based on the work carried out by the Flood Studies research and assists in calculating multiple peak runoff rates for different events using the estimate QBAR value.

6.4. The Microdrainage calculations are shown below in **Table 6.3**.

Hydrological Region	10				
Estimated QBAR Value	2.04				
Growth Curve Year	1	2	5	30	100
Total Greenfield Peak Runoff (l/s)	1.8	1.9	2.4	3.5	4.2

Table 6.3 Peak Greenfield Runoff Rates

Proposed Development Runoff Rate

6.5. The proposed surface water discharge from the site must be limited to or better than the estimated flow rates shown in **Table 6.3**. The typical vortex flow control device, however, should have an orifice diameter of 75mm or greater in size to prevent blockages and maintenance issues in future.

- 6.6. A 75mm orifice is usually equivalent to a **5 l/s** discharge rate and we would therefore recommend, that all return periods are limited to this rate.

PROPOSED RUNOFF DESTINATION

Surface Water Hierarchy

- 6.7. Paragraph 080 of the Flood Risk and Coastal Change Guidance within the Planning Practice Guidance sets out the following hierarchy of surface water runoff destinations:

- i. Discharge into the ground (infiltration),
- ii. Discharge to a surface waterbody,
- iii. Discharge to a surface water sewer,
- iv. Discharge to a combined sewer.

Discharge into the ground

- 6.8. There are five bands of soil classes in England which roughly describe the infiltration potential of an area. It is derived from factors such as, soil permeability, topography, and the likelihood of impermeable layers.
- 6.9. The soil classification for the PDS is Type 4 and thus the use of infiltration to dispose of surface runoff onsite is unlikely to be practical. Infiltration tests should be carried out however in accordance with BRE365 at the detailed application stage to confirm the permeability of the ground.

Soil	WRAP	Runoff	Soil Value	Soil Characteristics
1	Very High	Very Low	0.15	Sandy, well drained
2	High	Low	0.30	Intermediate soils (sandy)
3	Moderate	Moderate	0.40	Intermediate soils (silty)
4	Low	High	0.45	Clayey, poorly drained
5	Very Low	Very High	0.50	Steep, rocky areas

Table 6.4 Soil Classification

Discharge to a surface water body

- 6.10. The River Irwell forms the western boundary of the site and likely to be the current outfall destination. The PDS should therefore continue to utilise this outfall but should be limited to 5 l/s.

Discharge to a surface water sewer

- 6.11. Not applicable for this site.

Discharge to a combined sewer

6.12. Not applicable for this site.

SUSTAINABLE DRAINAGE TECHNIQUES

6.13. There are various SuDS techniques that are suitable for low and high density developments. One or more of the techniques noted in **Table 6.5** could be used during the detailed design stage to treat/control the runoff.

SuDS Technique		Proposed Development Suitability
Porous pavements	Description	Pavements constructed with porous paving can provide runoff storage within the sub-base and runoff treatment.
	Suitability	Whilst the storage potential would be limited on this scheme it could provide some benefit to the overall scheme.
Filter drains	Description	Granular filled linear trenches with a perforated pipe installed at the base.
	Suitability	Filter drains could be used where necessary to control/prevent surface water runoff leaving the PDS.
Swales	Description	Relatively shallow naturally landscaped channels that convey and/or infiltrate the surface water runoff.
	Suitability	Not suitable for the PDS.
Retention Ponds	Description	Partially filled permanent water bodies that have been designed to provide temporary surface water storage during critical events.
	Suitability	Not suitable for the PDS.
Detention Basin	Description	Naturally vegetated depression. Designed to store surface water runoff on a temporary basis during critical events.
	Suitability	Not suitable for the PDS.
Soakaways	Description	Drainage structures designed to store and infiltrate runoff into the ground.
	Suitability	Not likely to be suitable.
Green Roofs	Description	Vegetated roof areas that reduce and runoff and increase times of concentration.
	Suitability	Shown illustratively on the concept drawings for the new build. Use is subject to detailed design.
Underground Storage	Description	Attenuation structures installed below ground to provide surface water storage.
	Suitability	Could be used in the courtyard subject to levels

Table 6.5 SuDS Techniques

CLIMATE CHANGE ALLOWANCE

- 6.14. An allowance for climate change should be included at the detailed application stage to help minimize vulnerability and provide resilience to flooding. According to the Flood Risk Assessments: Climate Change Allowances **both** the 'Upper End' and 'Central' allowances should be assessed.
- 6.15. The 'Central' allowance should be applied to the underground surface water drainage network/design to assess its ability to contain critical events. Whilst the 'Upper End' allowance should be applied to evaluate the potential implications and to ensure that the flooding is wholly contained onsite.
- 6.16. The following climate change allowances should be applied to the proposed rainfall intensities during the detailed application stage.

- *More Vulnerable Commercial Development +20% to +40% Allowance.*

Applies across all of England	Potential Change anticipated for the 2020's	Potential Change anticipated for the 2050's	Potential Change anticipated for the 2080's
Upper End	+10%	+20%	+40%
Central	+5%	+10%	+20%

Table 6.6 Recommend Climate Change Guidance (EA)

SECTION 7 PRELIMINARY DRAINAGE STRATEGY

- 7.1. A preliminary drainage strategy has been produced to identify any major issues that may affect the foul and surface water drainage for the proposed development. All recommendations are preliminary at this stage and should be developed/investigated further during the detailed application stage.
- 7.2. A preliminary drainage layout for the PDS, utilising SuDS where possible, is included in **Appendix E**.

SURFACE WATER STRATEGY

- 7.3. A new underground surface water network will collect runoff from this development and convey it to a new/existing outfall on the River Irwell. The surface water outfall will be restricted to 5 l/s, so a new underground storage tank will be required to store excess runoff.
- 7.4. The volume of this attenuation tank will be confirmed during the detailed design stage, but we would estimate that between 100m³ & 150m³ of storage will be required. This will safeguard the development for all storms up to and include the 100 year plus climate change.

River Irwell Outfalls

- 7.5. The existing surface water outfalls to the River Irwell should be fitted with non-return valves to protect the onsite networks. Any new outfalls will require an Environment Agency Permit which will be undertaken at the detailed design stage.

Proposed Peak Runoff Rates

- 7.6. The runoff rate will need to be agreed with Peel L&P Group to ensure the flows become part of the overall CWS drainage model.

Water Quality

- 7.7. The PDS is only allowed to discharge clean/treated runoff to the River Irwell. The treatment process (if required) will be confirmed during the detailed design stage.

FOUL WATER STRATEGY

- 7.8. The foul water effluent generated by the new residential building will be collected and conveyed by a new underground network to the combined water sewer within Deansgate. The connection point will be confirmed during the detailed design stage and may involve the reuse of a connection and/or a new connection.



Foul Water Flows

- 7.9. The proposed flow rate must be agreed with United Utilities during the detailed design stage. Any proposed drainage should also be designed in accordance with Building Regulations Document H1 and Sewers for Adoption 7th Edition.

SECTION 8 FUTURE DRAINAGE MAINTENANCE

General Drainage Maintenance

- 8.1. The end-users will be provided with as-built plans to ensure that the proposed developments private drainage undergoes a regular maintenance regime (either as required or every 2-5 years). This includes, jetting, vacuumation and a visual/CCTV survey to check the structural condition of pipes and manholes.

SuDS Maintenance (If Required)

- 8.2. The maintenance for the onsite SuDS elements will be split into the following sections and will be undertaken by an appointed Maintenance Company once the scheme/plot has been completed.
- *Regular (weeding/inspections/sweeping/litter removal/grass cutting),*
 - *Occasional (sediment removal/vacuum brushing) and*
 - *Remedial maintenance (repair and replacement).*
- 8.3. The Maintenance Company will be employed by the end user of the site and will be provided an Operation and Maintenance manual. This manual will outline the location(s) of any drainage infrastructure and detail the maintenance that is required. It will also include the associated cost, and how often each activity should be carried out.
- 8.4. Records must be kept by the Maintenance Company and the end user for any maintenance works undertaken and must be available for inspection when requested.

Site Specific SuDS elements

- 8.5. The design of the onsite surface water drainage networks will be carried out during the detailed design stage. But we envisage that the design will include the following SuDS elements.
- *Porous Paving,*
 - *Underground storage*
 - *Proprietary System; Petrol Interceptors, Downstream Defenders*
- 8.6. The maintenance required for each of the above SuDS elements is shown below in **Table 8.1.**

Operation and Maintenance Activity	Suds Component												
	Pond	Wetland	Detention Basin	Infiltration Basin	Soakaway	Infiltration Trench	Filter Drain	Cellular Storage	Permeable Pavement	Swales	Filter Strip	Green Roof	Proprietary Systems
Regular Maintenance – Monthly Basis													
Inspection	●	●	●	●	●	●	●	●	●	●	●	●	●
Litter and debris removal	●	●	●	●	○	●	●	○	●	●	●		○
Grass cutting	●	●	●	●	○	●	●	○	○	●	●		
Weed and invasive plant control	○	○	○	○		○	○		○		○	●	
Shrub management	○	○	○	○					○	○	○		
Shoreline vegetation management	●	●	○										
Aquatic vegetation management	●	●	○										
Occasional Maintenance – Annually or as required													
Sediment management	●	●	●	●	●	●	●	●	●	●	●		●
Vegetation replacement	○	○	○	○						○	○	●	
Vacuum sweeping and brushing									●				
Remedial Maintenance – As required													
Structure rehabilitation/repair	○	○	○	○	○	○	○	○	○	○	○	○	
Infiltration surface reconditioning				○	○	○	○		○	○	○		

● Will be required ○ May be required

Table 8.1 SuDS Maintenance Management

SECTION 9 CONCLUSION

- 9.1. A Flood Risk Assessment is required to satisfy all requirements of the National Planning Policy Framework (NPPF) and the Flood Risk and Coastal Change Planning Practice Guidance (PPG).
- 9.2. This FRA as far as reasonably practical; determines the potential flood risk associated with the site and has concluded the following:
- a) The PDS is within Flood Zone 3 (high probability of fluvial flooding) but fluvial flood risk will only impact Basement Level-02.
 - b) The proposed car park extension within the Basement Level-02 has been classed as water compatible. The car park will be set at or around the existing level of 25.260m and will experience flooding during the 100-year event. Vehicle barriers/loops will be required around all vehicular opening to prevent buoyant vehicles leaving the area.
 - c) The proposed Basement Level-02 car park must remain as an open structure to allow for the free flow of flood water during the 100-year event flood
 - d) The less vulnerable areas in Basement Level-02 i.e., staff welfare and storage area must be set at or above 26.630m. This will ensure that these areas are safeguarded against the 100 plus climate change flood event.
 - e) Flood resilient construction techniques must be used up to 27.45m AOD. This will ensure that the damage to the PDS is reduced and that the PDS can quickly reopen if a 1000-year event occurred.
 - f) There is a residual risk that the PDS could be affected in event of a catastrophic breach at the upstream reservoir.
 - g) The proposed onsite drainage system must not contribute to any offsite flood risk via overland flows. Any residual risk must be effectively managed onsite with the use of appropriate drainage and/or topographical level consideration.
 - h) The PDS should not commence until a detailed scheme for surface and foul water drainage has been submitted to and approved by the Local Planning Authority.
 - i) The PDS surface water network must include a “Central” climate change allowance of 20%. The proposed network must also be checked against the “Upper” climate



change allowance of 40% to ensure any surface flooding remains wholly within the development.

- j) Any existing drainage that will be reused onsite must be inspected via a CCTV survey and repaired/upgraded, as necessary. The extent of these works will be confirmed during the detailed design stage.
 - k) The PDS will only be allowed to discharge clean/treated surface water runoff to the River Irwell. Any requires surface water treatment will be specified during the detailed design stage.
 - l) The surface water runoff from the development must be restricted to 5 l/s.
 - m) The allowable foul water discharge rate must be approved by United Utilities via a S106 & S104 application.
- 9.3. SGi considers the proposed scheme to be acceptable in planning terms, with regards to flood risk and recommends that the Local Planning Authority accept this Flood Risk Assessment and Drainage Strategy in support of the Planning Application.



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APPENDIX A1



Notes:

Site Application Boundary

PLAN KEY:

- | | | | | | | | | | | | |
|------------------|----------------------|------------------|-----------------|--------------------------|---------------------|------------------|--------------------------|-------------------------|--------------------------------|---------------------------------|--------------------------|
| 01 One Bedroom | 04 Riverside Access | 07 Storage Tanks | 10 Reception | 13 Yoga Studio | 16 Secondary Access | 19 Parcel Store | 22 Service Yard Entrance | 25 Carpark Escape Stair | 28 Cleaners Storage | 31 Postal Lounge | 34 Communal Roof Terrace |
| 02 Two Bedroom | 05 Fire Escape Stair | 08 Cycle Store | 11 Refuse Store | 14 Substation Entrance | 17 Roof Garden | 20 Main Entrance | 23 Premier House | 26 Switch Room | 29 Staff Welfare | 32 Public Walkway/ Viewing Deck | 35 Residential Car Park |
| 03 Three Bedroom | 06 Lift Lobby | 09 Cinema Room | 12 Gym | 15 Accessible Stair Lift | 18 Comms Room | 21 Retail Unit | 24 Service Yard | 27 Substation | 30 Resident's Riverside Garden | 33 Private Terrace | 36 Garden store |

Project Name:
Renaissance

Drawn: FM
Checked: JC

Details:
22.10.21 Issued for Planning

Title:
Block 2 Residential Building
Proposed Ground Floor
GA Plan

Status:
Planning

Scale:
1:100 @A1

Project: 150
Drawing No: B2_02_2200

Jon Matthews Architects
4th Floor, Centurion House, 129 Deansgate, Manchester, M3 3WR

0161 974 3690

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01 One Bedroom	04 Riverside Access	07 Storage Tanks	10 Reception	13 Yoga Studio	16 Secondary Access	19 Parcel Store	22 Service Yard Entrance	25 Carpark Escape Stair	28 Cleaners Storage	31 Postal Lounge	34 Communal Roof Terrace
02 Two Bedroom	05 Fire Escape Stair	08 Cycle Store	11 Refuse Store	14 Substation Entrance	17 Roof Garden	20 Main Entrance	23 Existing River Wall	26 Switch Room	29 Staff Welfare	32 Public Walkway/ Viewing Deck	35 Residential Car Park
03 Three Bedroom	06 Lift Lobby	09 Cinema Room	12 Accessible Stair Lift	15 Accessible WC/ Shower	18 Comms Room	21 Retail Unit	24 Service Yard	27 Substation	30 Resident's Riverside Garden	33 Private Terrace	36 Garden store

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APPENDIX B1

				Normal Operation														Latchford 1 Gate Closed		Latchford 3 Gates Closed
Map Reference	Model Node Reference	Easting	Northing	Data	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + 30% increase in flow	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year)		
1	ea013_0251_IRW201_1941	383790	398725	Modelled Water Level (m aodN)	24.22	24.56	25.04	25.31	25.48	25.71	26.32	26.44	27.80	26.16	28.10	25.71	28.14	25.71		
				Modelled Flow (cumecs)	310.05	351.13	411.03	444.92	466.22	495.36	572.95	588.67	742.00	552.49	760.75	495.36	758.94	495.34		
2	ea013_0251_IRW201_1926	383761	398694	Modelled Water Level (m aodN)	24.08	24.40	24.82	25.06	25.21	25.40	25.92	26.03	27.18	25.79	27.45	25.40	27.49	25.40		
				Modelled Flow (cumecs)	310.05	351.13	411.03	444.92	466.22	495.36	572.95	588.67	742.00	552.49	760.75	495.36	758.94	495.34		
3	ea013_0251_IRW201_1769	383675	398614	Modelled Water Level (m aodN)	23.94	24.24	24.67	24.91	25.05	25.25	25.77	25.88	27.08	25.64	27.37	25.25	27.42	25.25		
				Modelled Flow (cumecs)	310.09	351.17	411.08	445.00	466.29	495.42	573.03	588.76	742.02	552.59	760.91	495.42	758.86	495.41		
4	ea013_0251_IRW201_1756	383633	398575	Modelled Water Level (m aodN)	23.89	24.19	24.61	24.84	24.99	25.19	25.70	25.81	26.98	25.58	27.27	25.19	27.32	25.19		
				Modelled Flow (cumecs)	310.09	351.17	411.08	445.00	466.29	495.42	573.03	588.76	742.02	552.59	760.91	495.42	758.86	495.41		

Model data taken from Manchester Ship Canal 2018

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

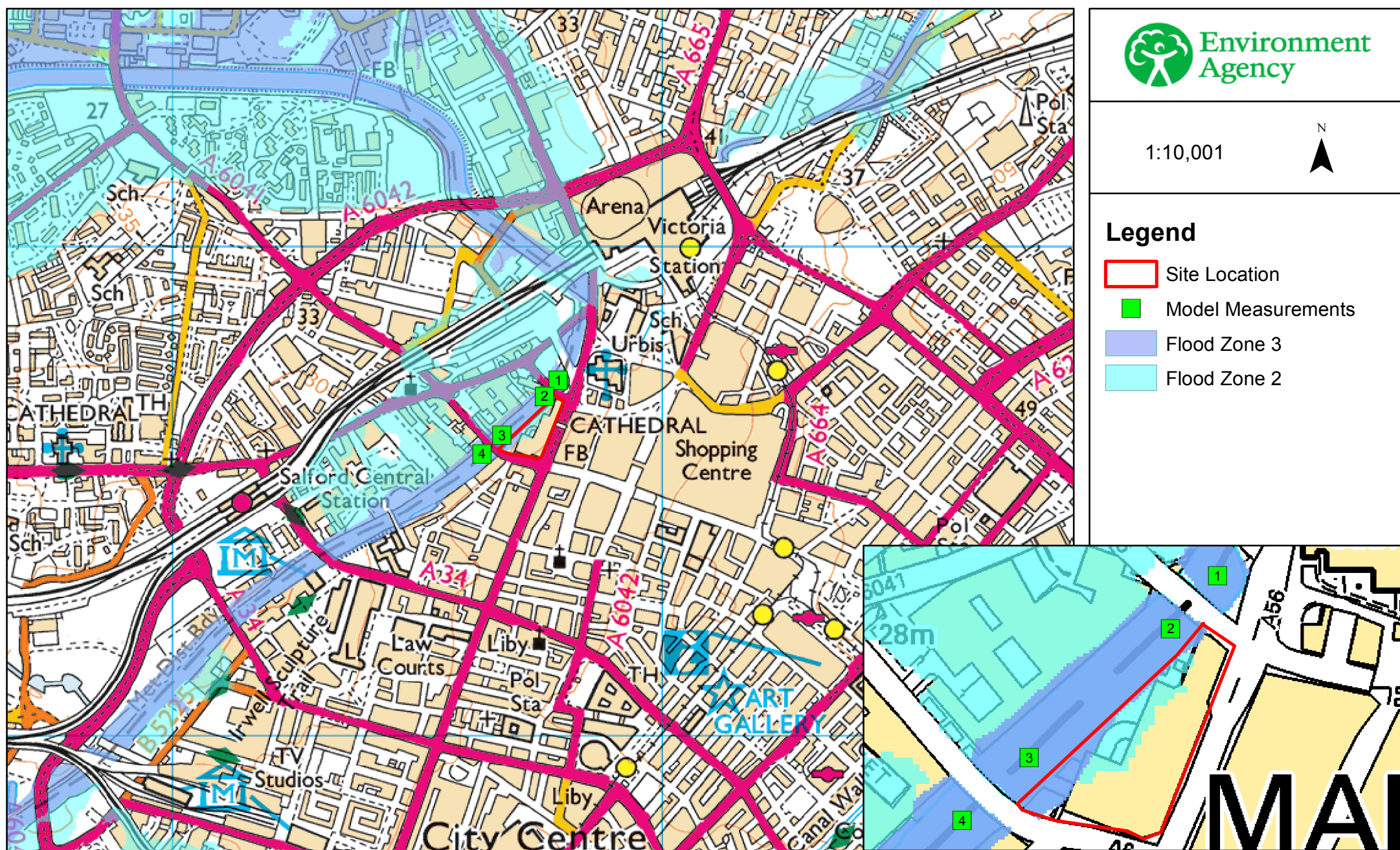
cumecs - cubic metres per second

Notes: 30%, 35% and 70% increases in flow calculated for the 2080's (2070 - 2115). Please see <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> for more information regarding the new climate change guidance. The location of the site and the type (vulnerability) of development determine the climate change allowances to consider in any flood risk assessment.

For the Manchester Ship Canal Model, we provide the following three scenarios:

1. Normal Operation: All sluice gates operate automatically to maintain a navigable ponded water level upstream of each set of sluice gates. During times of high flow the gates are opened automatically to allow excess water pass downstream. During extreme conditions the sluice gates can be manually overridden to extend the opening heights.
2. Latchford 1 Gate Closed Scenario: This scenario represents a single operational sluice gate at Latchford Locks fixed closed. Therefore, only operational movements from 2 active sluice gates.The model setup removes the gate from PID controller setup and an IED file is used to define the sluice gate as fixed in the closed position.
3. Latchford 3 Gates Closed Scenario: This scenario has been defined as the removal of operational rules at all three sluice gates at Latchford Locks, thus, all gates are fixed in the closed position resulting in no regulation of upstream water levels. The model setup removes each of the gates from PID controller setup and an IED file is used to define sluice gates fixed in the closed position.

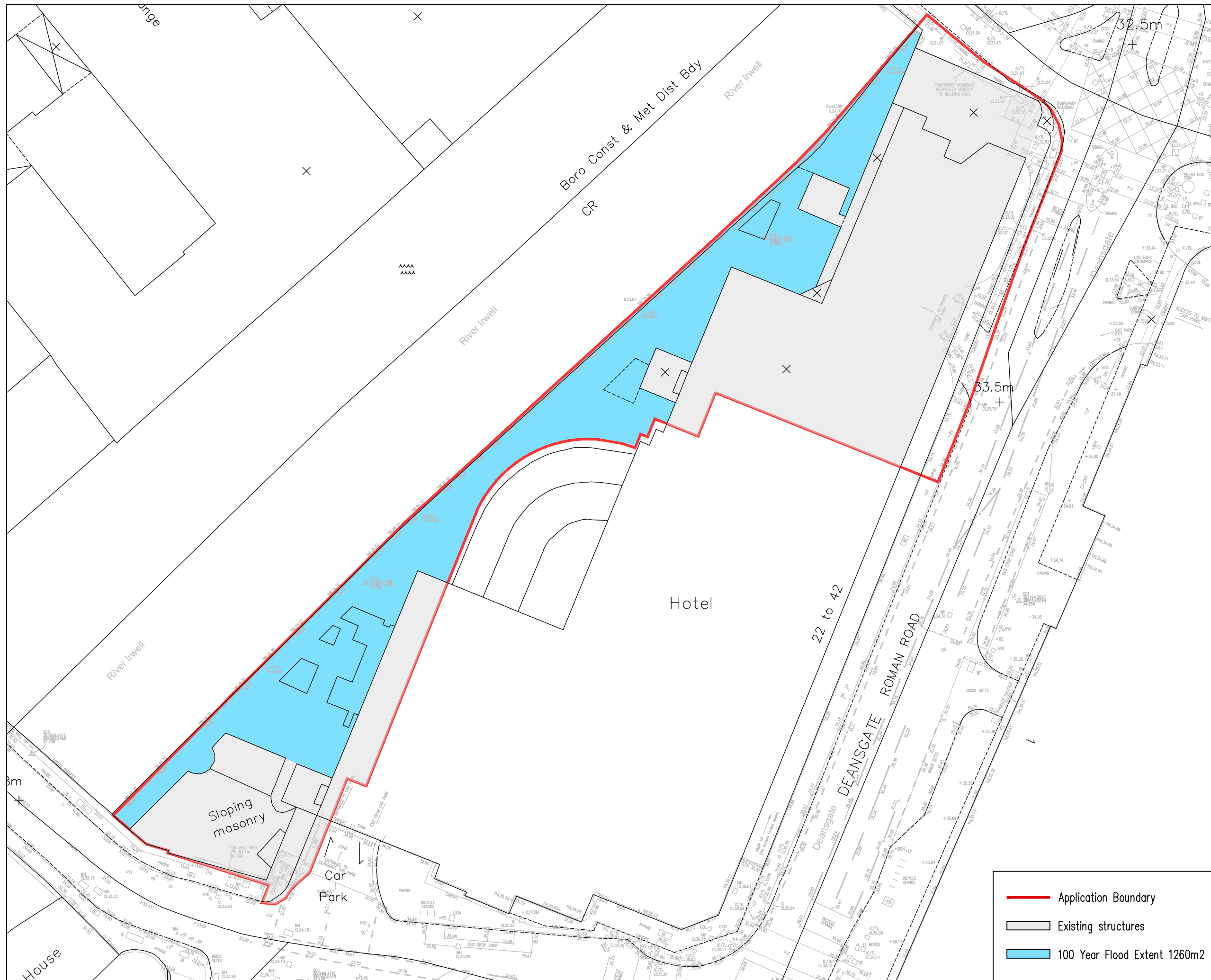
Detailed Flood Map centred on Blackfriars St, Manchester, M3 1AZ. Created on 14/07/2021 [GMMC224509AB]



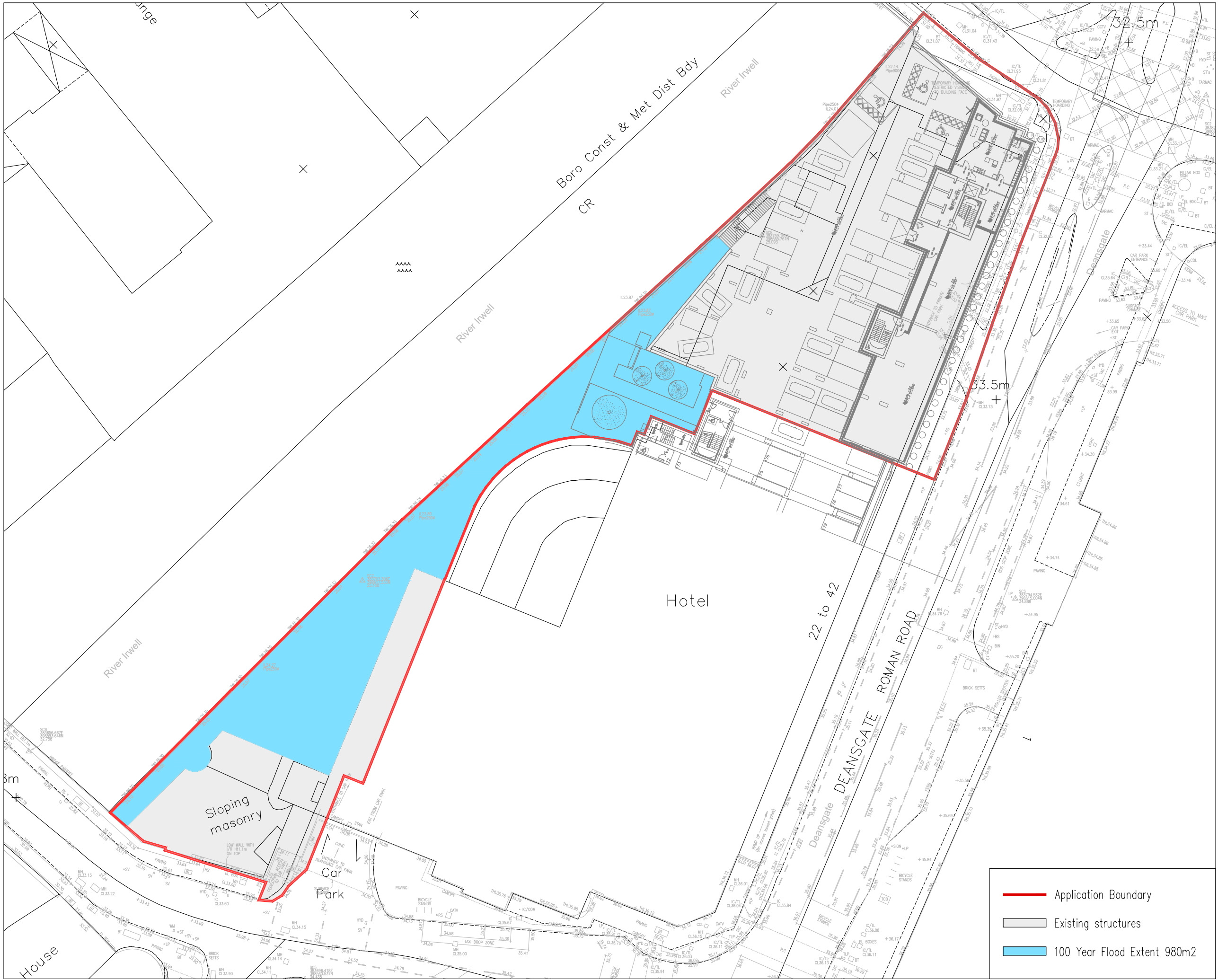


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Consulting Engineers

APPENDIX C1



Rev.	Description	Rev. by	Date
 Shepherd Gilmour Consulting Engineers 3rd Floor Phoenix House, 45 Cross Street, Manchester, M2 4JF T: 0161 837 1500 W: www.sginfrastructure.co.uk			
Client			
Property Alliance Group			
Architect			
Jon Matthews Architects			
Project			
Renaissance			
Title			
Existing Site 100 Year Flood Extents			
Date	20/04/2021	Drawn By	DOR
Size	A3	Checked By	
Scale	1/500	Approved By	
Dwg. No.			Rev
C1504-110			



- Application Boundary
- Existing structures
- 100 Year Flood Extent 980m2

Rev.	Description	Rev. by	Date
Shepherd Gilmour Consulting Engineers 3rd Floor Phoenix House, 45 Cross Street, Manchester, M2 4JF T: 0161 837 1500 W: www.sginfrastructure.co.uk			
Client Property Alliance Group			
Architect Jon Matthews Architects			
Project Renaissance			
Title Proposed Site 100 Year Flood Extents			
Date	20.04.2021	Drawn By	DOR
Size	A3	Checked By	
Scale	1/500	Approved By	
Dwg. No. C1504-111			Rev ■



Shepherd Gilmour
Consulting Engineers

APPENDIX D1

warren chan

40
peter street,
Manchester,
M2 5GP

FAO:

How to contact us:

**United Utilities Water Limited
Property Searches
Haweswater House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP**

Telephone: 0370 7510101

E-mail: propertysearches@uuplc.co.uk

**Your Ref: C1405
Our Ref: UUPS-ORD-250037
Date: 19/02/2021**

Dear Sirs

Location: FLAT 101 1 DEANSGATE, MANCHESTER, M3 1AZ

I acknowledge with thanks your request dated 11/02/2021 for information on the location of our services.

Please find enclosed plans showing the approximate position of United Utilities' 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 United Utilities' 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 your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please [contact us](#).

Yours Faithfully,



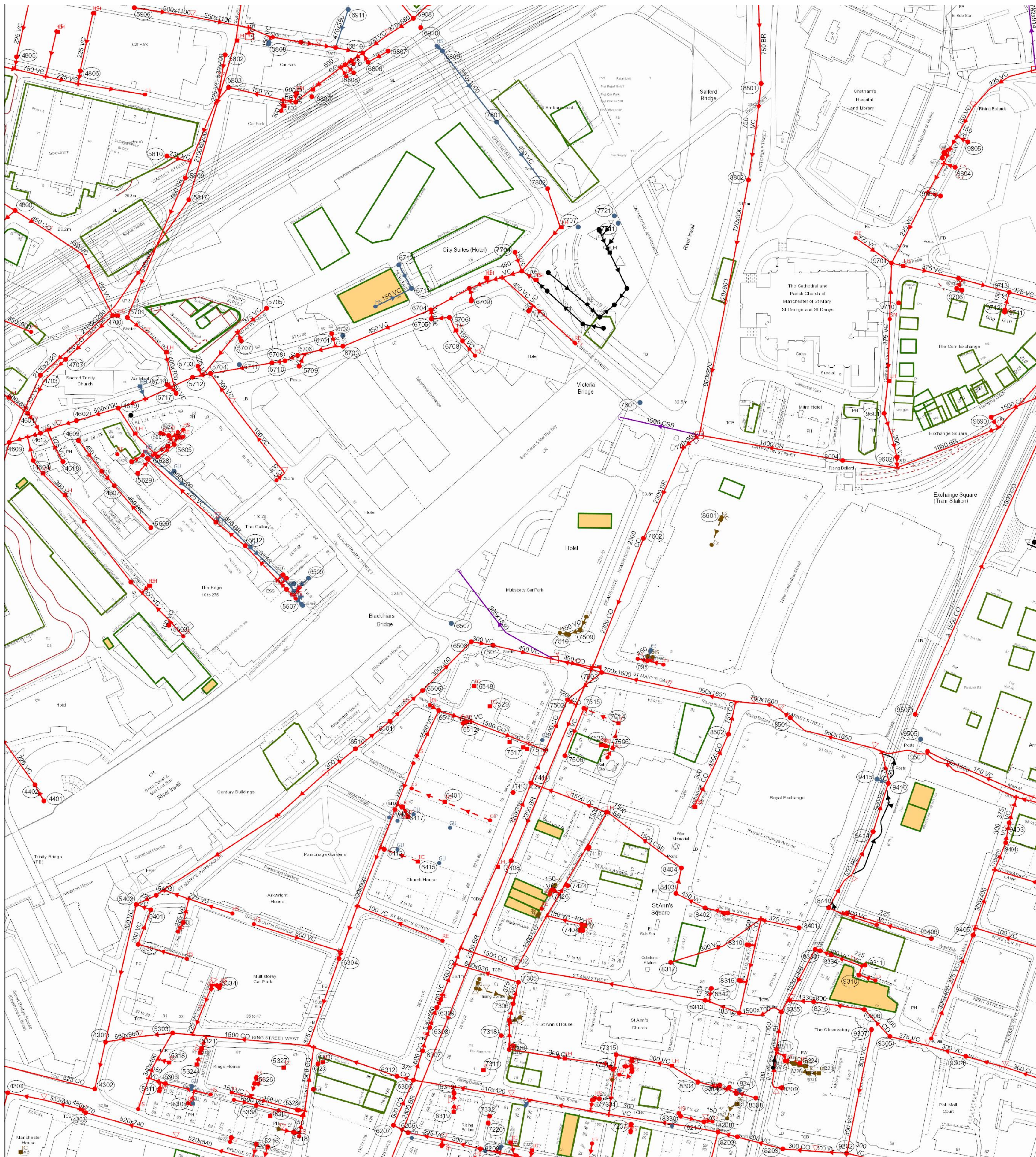
Karen McCormack
Property Searches Manager

TERMS AND CONDITIONS - WASTEWATER AND 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:

- 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.
- 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.
- In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.

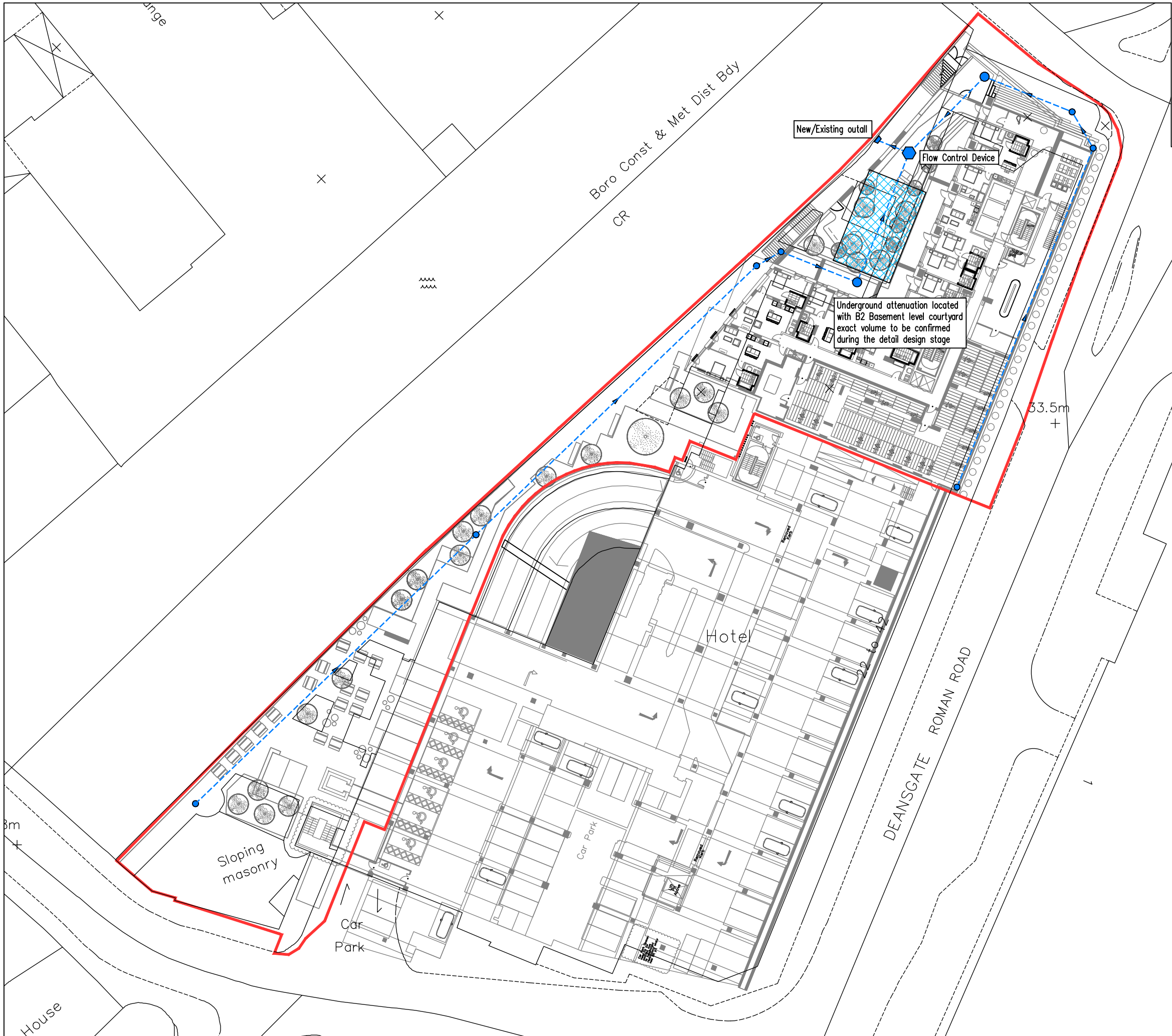


Refno	Cover	Func	Invert	Size x	Shape	Mat	Length	Grad
7334	8801	29.58	CO	22.78	750	VC	2.02999	
8306	8801	29.58	CO	22.78	750	VC	26.1725	
8802	8801	29.58	CO	22.78	750	VC	16.70305	1 in 186
6709	26.74	CO	30.65	150	BR	71.9991	1 in 4	
6911	26.74	CO	30.65	150	BR	22.1554		
8330	34.17	CO	31.1	100	VC	13.17195		
8628	29.27	CO	31.1	150	VC	6.334555		
5705	29.27	CO	24.17	375	BR	20.61553		
7704	26.7	CO	24.72	150	VC	32.5625		
6312	35.69	CO	30.65	1500	VC	11.04455		
7404	35.69	CO	30.65	150	VC	48.70318		
5709	27.23	CO	24.28	150	VC	19.70966		
9802	34.02	CO	31.52	150	VC	7.615773	1 in 19	
8309		VC		150	VC	2.230068		
7115		VC		150	VC	3.095886		
6206	35.66	CO	31.91	600	CO	26.14559		
7510		VC		600	CO	8.94272	1 in 25	
6801	29.48	CO	28.22	150	VC	4.836473		
8401	37.17	CO	28.79	375	VC	15.29706		
5609	29.61	CO	28.79	375	VC	40.28788	1 in 204	
4800	29.92	CO	26.98	450	BR	30.4705		
5402	33.55	CO	26.24	300	VC	22.4722		
7411	36.15	CO	25.52	1500	CO	17.87811	1 in 88	
7352	36.54	CO	0	1500	CO	19.69772		
7424		VC		150	VC	107.2179		
4800	29.92	CO	27.47	450	VC	6.83088	1 in 63	
8310		VC		150	VC	12.04159		
7326		VC		300	VC	4.474555		
6705	26.65	CO	22.54	300	VC	6.119659		
5328		VC		450	VC	2.87207		
4609	27.31	CO	32.62	400	VC	4.231385	1 in 58	
9601	35.16	CO	27.65	375	VC	11.07758		
8410	38.23	CO	28.36	300	VC	21.45093		
8334		VC		300	VC	4.231385	1 in 1	
7602		VC		2000	VC	18.14339	1 in 107	
5707	28.24	CO	0	375	VC	6.37287		
7305	36.55	CO	36.44	600	VC	76.32169		
5307	38.74	CO	36.62	300	VC	5.385165	1 in 61	
8806	28.38	CO	0	225	VC	36.40555		
9706	35.3	CO	0	150	VC	69.73816		
5222		VC		0	VC	5.83092		
4301	33.01	CO	27.17	150	VC	3.16278	1 in 167	
6703	26.85	CO	22.32	450	VC	2.498542	1 in 1279	
9713		VC		375	VC	26.65333		
8315		VC		375	VC	25.5875		
6307	35.8	CO	31.34	375	VC	45.97192		
6207	35.66	CO	31.53	600	VC	4.180113	1 in 67	
7410		VC		100	VC	30.93151		
8307		VC		150	VC	27.313		
5809	28.93	CO	23.64	600	VC	3.514048	1 in 258	
5806	28.87	CO	23.86	600	VC	41.23106		
5612	27.09	CO	22.75	225	VC	69.7764		
9603		VC		150	VC	20.61553		
9406	36.23	CO	37.53	225	VC	3.74308	1 in 117	
8304	37.03	CO	33.07	300	VC	48.69493		
4401		VC		225	VC	48.06997		
4601	27.55	CO	21.78	800	VC	10.20953	1 in 117	
6712	28.97	CO	25.98	150	VC	6.403124	1 in 0	
5206		VC		225	VC	14.74462	1 in 32	
4612		VC		375	VC	8.828272		
5808	30.45	SW	23.57	150	VC	7.28011		
8313	36.83	CO	31.59	1500	VC	4.123106		
5806	28.87	CO	23.86	600	VC	105.5462		
6306	35.83	CO	0	375	VC	7.071068	1 in 6252	
7408	36.08	CO	22.1	2300	VC	9.219544	1 in 885	
4700	28.07	CO	24.6	600	VC	17.69181	1 in 9	
6702	26.6	CO	24.15	150	VC	10.01802	1 in 284	
5701	28.18	CO	23.28	660	VC	14.21267	1 in 776	
7822	26.6	CO	27.12	450	VC	12.52996		
6808	28.46	CO	27.2	150	VC	54.32451		
8317	36.69	CO	28.18	300	VC	6.47294		
9406	39.21	CO	31.37	150	VC	56.17143	1 in 187	
5714		VC		150	VC	1.64278		
4618	27.59	CO	0	225	VC	20.51628		
5507	26.56	SW	25.18	150	VC	7.196777		
5505	26.81	CO	23.18	225	VC	8.65551	1 in 295	
5301	33.38	CO	32.3	300	VC	19.26955		
5806	31.54	CO	0	150	VC	46.4043	1 in 32	
7426		VC		150	VC	7.071068		
8209	36.74	CO	28.36	450	VC	32.3927	1 in 143	
8209	36.67	CO	33.53	300	VC	4.539997	1 in 28	
5817	28.86	CO	0	2100	VC	14.31782		
8402	36.68	CO	28.51	450	VC	25.91794	1 in 138	
6410		VC		300	VC	99.53259		
5601		VC		225	VC	17.8854		
6501	35.35	CO	28.37	300	VC	57.17316		
5704	27.78	CO	25.15	450	VC	5.747467	1 in 204	
5502	26.94	CO	22.94	300	VC	10.19094	1 in 66	
5507	26.56	SW	25.18	150	VC	86.17817		
6504	28.53	SW	26.18	150	VC	2.828427		
4302	32.79	CO	26.98	625	VC	4.101243	1 in 4	
7308	36.39	CO	30.99	375	VC	105.3946	1 in 254	
5706	27.27	CO	22.27	450	VC	16	1 in 67	
6809	27.61	SW	23.92	550	VC	7.071068	1 in 226	
7333		VC		150	VC	49.20366		
8210		VC		100	VC	1.585261		
7705	26.85	CO	22.52	450	VC	1.413899		
6506	34.94	CO	28.19	300	VC	11.59125	1 in 11	
6508	34.1	CO	24.8	300	VC	38.15377		
9415		VC		225	VC	12.16553	1 in 243	
9414	38.02	CO	32.15	500	VC	6.626892	1 in 35	
7503		VC		950	VC	27.83223	1 in 58	
4806		VC		225	VC	13.6147		
5509	26.85	CO	24.49	150	VC	7.071068		
8401	37.17	CO	28.79	375	VC	5.83092	1 in 49	
5303	33.64	CO	28.4	1500	VC	12.86265	1 in 44	
4707	27.81	CO	24.5	450	VC	18.10777		
6307	35.94	CO	30.93	600	VC	6.48281	1 in 56	
4608	27.21	CO	0	450	VC	7.28011		
7502	36.25	CO	28.01	1200	VC	10.62015		
9603		VC		300	VC	5.83092		
9310	27.25	CO	23.5	225	VC	11.46175	1 in 17	
6708	26.74	CO	26.2	150	VC	11.31291		
6510	26.72	CO	25.98	150	VC	14.82688	1 in 17	
6908	28.01	CO	24.37	370	VC	4.24264		
7306	36.62	CO	30.52	375	VC	16.64332	1 in 206	
9306	36.22	CO	31.24	600	VC	12.36932	1 in 189	
7307	36.48	CO	30.73	375	VC	28.3249	1 in 49	
4303	33.01	CO	25.94	490	VC	2.12544		
5706	27.2	CO	22.28	450	VC	1.414214		
9202	36.78	CO	34.41	300	VC	7.615773	1 in 46	
6812	30.12	CO	26.78	560	VC	17.34546	1 in 38	
7503		VC		1500	VC	BR 9.97503		
9701	34.81	CO	28.63	375	VC	24.07744		
6810	28.35	CO	24.35	300	VC	37.52708		
7503		VC		700	VC	7.539593		
9403	40.08	CO	28.5	150	VC	BR 6.954919		
5629		VC		225	VC	7.28011		
9405	40.4	CO	35.98	225	VC	14.39183		
7314	36.91	CO	32.86	225	VC	7.41562		
9803	34.6	CO	31.44	150	VC	2.230068		
8308	35.97	CO	30.65	530	VC	5		
6319		VC		225	VC	6.324555	1 in 79	
7315	36.56	CO	32.64	300	VC	7.28011		
8308	37.5	CO	33.58	300	VC	16.12452	1 in 70	
4604	28.84	CO	21.9	300	VC	16.76305		
5608	28.32	CO	24.31	225	VC	13.34166		
6710	27.35	CO	22.22	450	VC	2.230068	1 in 691	
5218		VC		150	VC	34.52535		
6704	26.69	CO	22.4	450	VC	5.699745	1 in 879	
7519		VC		300	VC	52.71165		
9304	41.84	CO	38.87	300	VC	5.32454		
4805	31.33	CO	30.04	225	VC	21.84033	1 in 8	
5803	29.88	CO	0	800	VC	7.071068		
9602		VC		225	VC	55.96387		
5216		VC		225	VC	9.2409		
5334		VC		225	VC	2.792821		
9409		VC		225	VC	2.734224		
5712	27.8	CO	22.18	400	VC	26.8394		
5608	28.32	CO	22.5	225	VC	51.66236		
9507		VC		1500	VC	179.9222		
9802	30.26	CO	24.08	530	VC	13.12296		
6701	26.97	CO	23.61	150	VC	7.28011		
9404	36.74	CO	28.24	1500	VC	61.40039		
4304	31.63	CO	25.29	510	VC	39.78766	1 in 59	
5306	33.95	CO	25.71	150	VC	5.48633		
4619		VC		500	VC	24.04183		
8208	37.6	CO	32.43	150	VC	10.17526		
9805	33.65	CO	30.78	150	VC	60.91338		
7509		VC		150	VC	6.708204		
4602		VC		500	VC	6.819644		
5403	33.63	CO	28.42	300	VC	10.44031	1 in 81	
8501	37.04	CO	26.34	850	VC	12.06395		
5703	27.72	CO	26.9	225	VC	6.403124		
5405	34.35	CO	0	225	VC	13.34166		
8502		VC		750	VC	18.43609		
9401	33.							



Shepherd Gilmour
Consulting Engineers

APPENDIX E1



Planning Boundary
Surface Water Drainage
Surface Water Attenuation

P2	Updated site layout shown in background	WC	21.10.2021
Rev.	Description	Rev. by	Date
 Shepherd Gilmour Consulting Engineers 3rd Floor Phoenix House, 45 Cross Street, Manchester, M2 4JF T: 0161 837 1500 W: www.sginfrastructure.co.uk			
Client Property Alliance Group			
Architect Jon Matthews Architects			
Project Renaissance			
Title Preliminary SW Drainage B2 Level Background			
Date	20.04.2021	Drawn By	DOR
Size	A3	Checked By	
Scale	1/200	Approved By	
Dwg. No. C1504-102			Rev P3