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Project:	Phase 1 Flood Risk Assessment (FRA)
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Document Issue Record

Project: Phase 1 Flood Risk Assessment

Prepared for: Tang & Associates Ltd

Reference: 3112

Site Location: 10-16 Harris Street, Manchester, M8 8EG

Proposed Development: Refurbishment and subdivision of the two block at the 10-16 Harris Street site in order to create 14 units of wholesale cash and carry units. As part of the proposed development, elevation alterations will be required on all four elevations to create the new shopfronts and add window openings.

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1. Summary

1.1 Ambiental Technical Solutions Limited has been appointed by Tang and Associates Ltd to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) to assist with the development at 10-16 Harris Street, Manchester, M8 8EG.

1.2 The proposed development is for the refurbishment and subdivision of the two blocks at 10-16 Harris Street site in order to create 14 units of wholesale cash and carry units. As part of the proposed development, elevation alterations will be required on all four elevations to create the new shopfronts and add window openings.

1.3 According to the NPPF and the Environment Agency (EA) standing advice on development and flood risk, as well as the low detail, national-scale flood mapping created on behalf of the EA the site is located in Flood Zone 3 (High Risk; 1 in 100 or greater annual probability of flooding from fluvial flooding (>1%). Under the NPPF guidance, the existing site consists of industrial units and associated hardstanding, as such the existing and proposed developments are classified as “Less Vulnerable”.

1.4 The nearest watercourse to the site is the River Irwell, located approximately 260m to the south of the site. The River Irwell has been classified as an EA main river.

1.5 The Manchester City, Salford City and Trafford Councils SFRA has shown the site to be located within the ‘Conurbation Core’ Critical Drainage Area.

1.6 Site topographic levels for the site range between approximately 26.87mAOD and 27.44mAOD, as shown in Figure 2 (Source: 2m LiDAR). Comparison of topographic site levels with modelled flood levels for the defended 1 in 100 year flood event (26.64mAOD) confirms that the site is located on land topographically higher than the modelled flood event. Modelled flood levels for the defended 1 in 1000 year flood event (29.82mAOD) confirms that the site resides within this flood extent with possible maximum flood depths of 2.95m in the worst case scenario.

1.7 The EA have calculated the climate change flood level, analysis of the 1:100 year (+35% increase in flow) shows a possible flood level of 27.38mAOD. Comparison with minimum site topographic level (26.86mOAD to 27.44mAOD) shows the site to be partially inundated by this flood event, with possible maximum flood depths of 0.51m in the worst case scenario.

1.8 As such and given that:

- the proposed development is for the internal reconfiguration of the existing industrial units;
- no increase in built footprint, no increase to flood risk elsewhere post development;
- the existing and proposed development are classified as ‘Less Vulnerable’;
- the existing site is located on land topographically higher than the 1:100 year flood event, and;
- it is recommended that the site owner(s) signs up to the EA Flood Warning Service to provide a betterment to the site, if they have not done so already.

following the guidelines contained within NPPF, the proposed development type is considered to **be suitable** assuming appropriate mitigation (including adequate warning and evacuation procedures) can be maintained for its lifetime.

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Development Description	Existing	Proposed
Development Type:	Industrial Units	Reconfiguration of existing industrial units
(Number of Bedrooms):	N/A[2]	N/A[2]
EA Vulnerability Classification:	Less Vulnerable	No Change
Ground Floor Level:	Ground flood levels vary between approx. 26.87mAOD and 27.44mAOD (Source: 2m LiDAR)	No Change
Level of Sleeping Accommodation:	N/A[2]	N/A[2]
Impermeable Surface Area:	Existing site considered 100% impermeable	No Change
Surface Water Drainage:	N/A[2]	Discharge via existing drainage infrastructure
Site Size:	N/A[1]	
Risk to Development	**Summary**	**Comment**
EA Flood Zone:	Flood Zone 3	
Flood Source:	Fluvial	River Irwell (EA Main River)
Defended 1 in 100yr flood Level	26.64mAOD	Lower Irwell ISIS-TUFLOW model (May 2015) Node: 2
Defended 1 in 1000yr flood level:	29.82mAOD	
Defended 1 in 100 + CC (+35%) year flood level:	27.38mAOD	
Recorded Flood Events in Area:	Yes	1866, 1946 and 2015
Recorded Flood Events at Site:	Yes	1866, 1946 and 2015
SFRA Available:	Yes	Manchester City, Salford City and Trafford Councils Level 2 SFRA (March 2011)
Management Measures	**Summary**	**Comment**
Ground floor level above extreme flood levels:	N/A[1]	
Safe Access/Egress Route:	Yes	EA Flood Warning Service and Evacuation Plan
Flood Resilient Design:	N/A[1]	
Site Drainage Plan:	N/A[2]	Utilise existing drainage infrastructure
Flood Warning & Evacuation Plan:	Yes	Sign up to EA Flood Warning Service to provide betterment
OFFSITE IMPACTS	**SUMMARY**	**COMMENT**
Displacement of floodwater:	No	Change of use
Increase in surface run-off generation:	None	No increase in impermeable surfaces/built footprint
Impact on hydraulic performance of channels:	None	Does not affect channel

Table 1: Summary of flood risks, impacts and proposed flood mitigation measures.

N/A[1] not required for this assessment; *N/A[2]* data not available.

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2. Development Description and Site Area

Proposed Development and Location

2.1 The site is located at 10-16 Harris Street, Manchester, M8 8EG (Figure 1 and 2).

2.1 The existing site consists of industrial units and associated hardstanding. It is understood that the proposed development is for the refurbishment and subdivision of the two block at the 10-16 Harris Street site in order to create 14 units of wholesale cash and carry units. As part of the proposed development, elevation alterations will be required on all four elevations to create the new shopfronts and add window openings.

2.2 The nearest watercourse to the site is the River Irwell, located approximately 260m to the south of the site. The River Irwell has been classified as an EA main river.

2.3 Analysis of topographic levels (source: topographic survey) show the site to be relatively flat, with topographic levels varying between 26.87mAOD and 27.44mAOD.



Figure 1: Wider Location Map. The site area outlined in red (Source: Google Earth)

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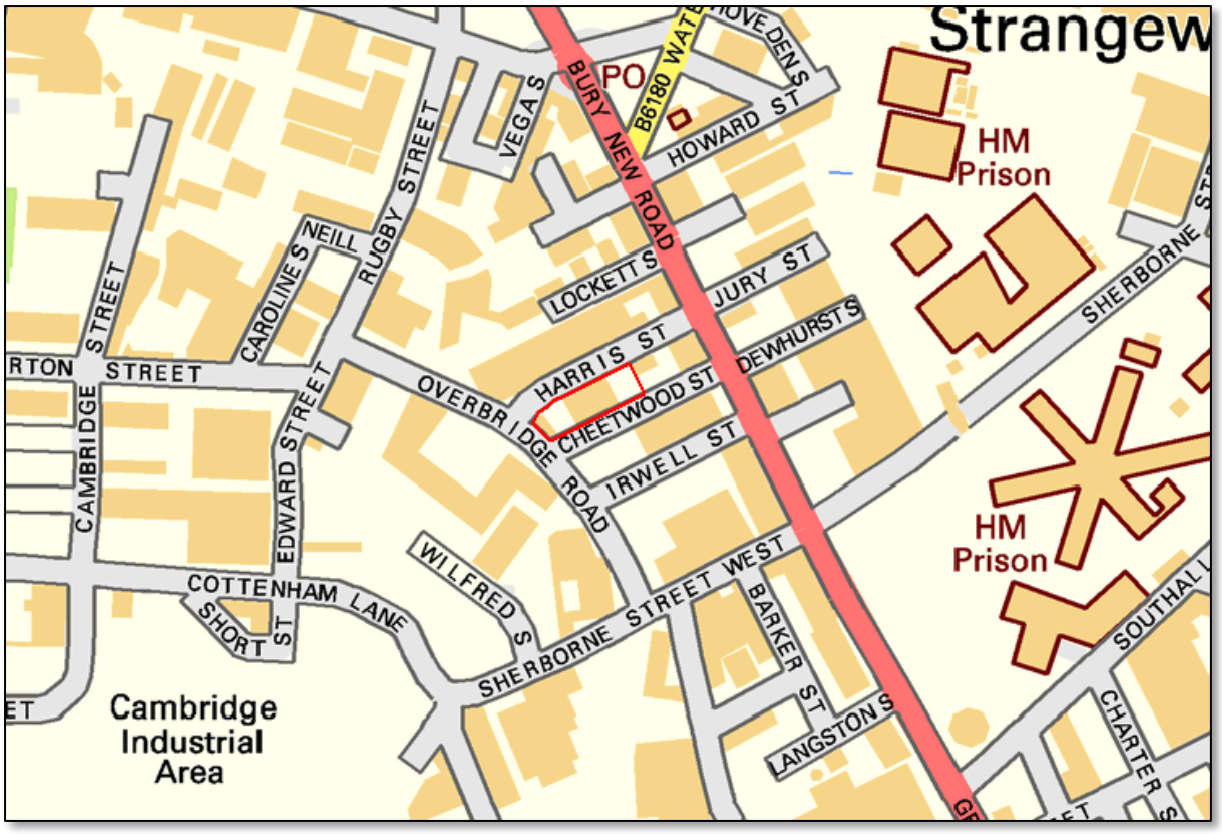


Figure 2: Site location, approximate site boundary outlined in red (Source: OS)

Vulnerability classification

2.1 According to the NPPF and the Environment Agency (EA) standing advice on development and flood risk, as well as the low detail, national-scale flood mapping created on behalf of the EA the site is located in Flood Zone 3 (High Risk; 1 in 100 or greater annual probability of flooding from fluvial flooding (>1%).

2.2 Under the NPPF guidance, the existing site consists of industrial units and associated hardstanding, as such the existing and proposed developments are classified as "Less Vulnerable".

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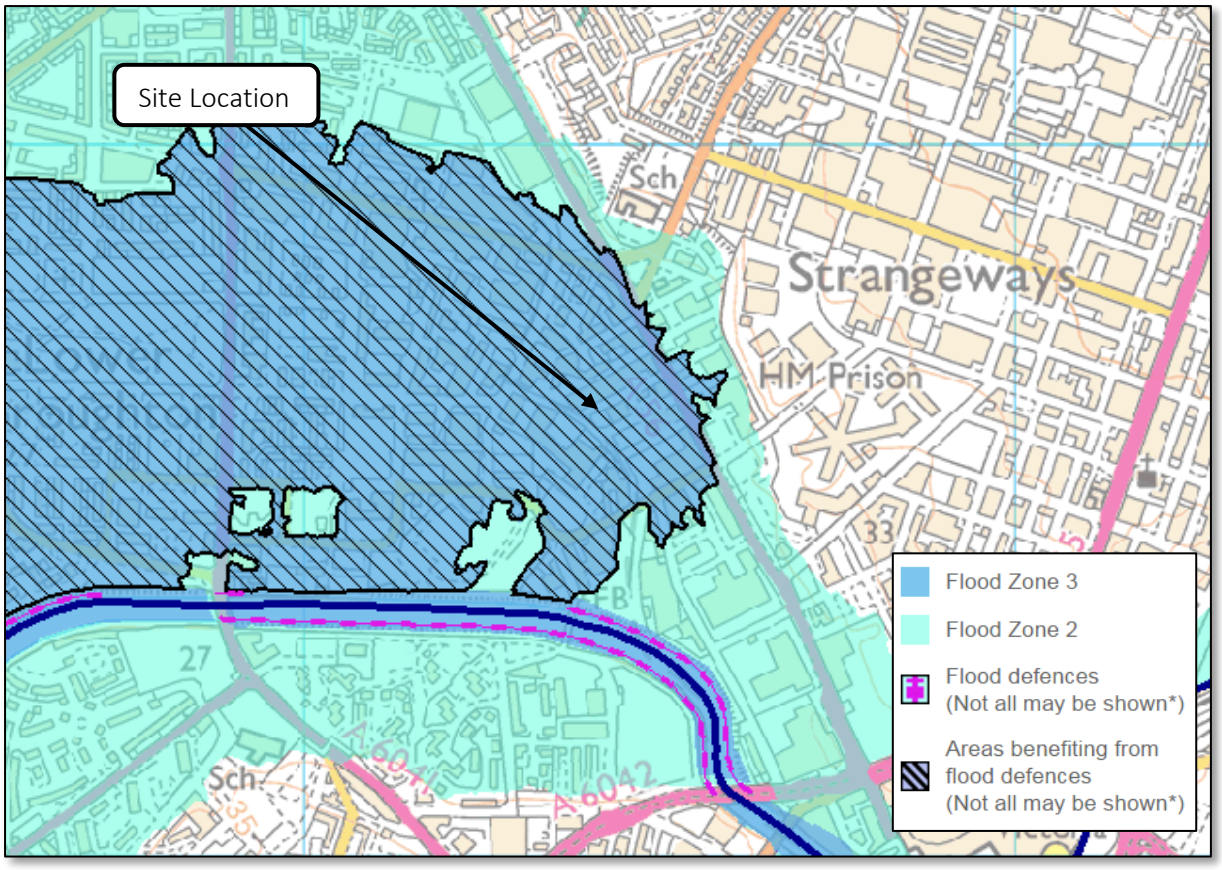


Figure 3: EA Flood Zone Map – including EA Main Rivers (Source: EA)

Geology

2.3 The site's bedrock geology has been identified by the British Geological Survey's public mapping model as the Chester Pebble Beds Formation consisting of Sandstone. Superficial deposits at the site have been identified as Alluvium – clay, silt, sand and gravel.

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3. Sequential Test/Exception Test

3.1 Under the NPPF, all new planning applications must undergo a *Sequential Test*. This test must be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals, mobile homes etc.) outside of the floodplain.

3.2 The test refers to the EA Flood Zones described in Table 5. For reference, the NPPF *Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table* is reproduced below:

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

Table 2: The Sequential Test: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF. Shaded cells denote the proposed re-development. Please note: ✓ means development is appropriate; × means the development should not be permitted.

3.3 Using the principles of the Sequential Test outlined above, the proposed development is 'Less Vulnerable' and is located within Flood Zone 3. As such, under the NPPF, this development type does not require the implementation of the Exception Test nor a Sequential Test. For reference purposes, this development is for a change of use, and under NPPF guidelines the development is exempt from the Sequential Test:

"The Sequential Test does not need to be applied for individual developments on sites which have been allocated in development plans through the Sequential Test, or for applications for minor development or ***change of use*** *(except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site)."*

3.4 The proposed development site is also located within a Strategic Development site (M0004), as defined by the Level 2 SFRA. The planning conclusion for this area states that development should be acceptable on flood risk grounds. Residual risk from these sources needs to be taken into account when planning developments, including the careful consideration of urban design at Strangeways.

3.5 The planning application submitted by Tang and Associates Ltd is required to be accompanied by a FRA which shows that the development can be achieved in a sustainable manner, with an overall reduction of flood risk to the site and surrounding area.

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4. Site Flood Hazards

Sources of Flooding

4.1 As outlined in Figure 3, the site is located in Flood Zone 3 (High risk of flooding). Under the NPPF, the proposed development is considered to be 'Less Vulnerable'. Communication with the Environment Agency (EA) has identified the following potential sources of flooding to the site:

Source	Description
Fluvial	River Irwell (EA Main River)
Surface	On Site
Groundwater	In area
Sewer	N/A

Table 3: Summary of flood sources.

Mechanisms and History of Flooding

4.2 According to the low detail, national-scale flood mapping created on behalf of the EA, the site and proposed development are located within Flood Zone 3. Areas of the development located within Flood Zone 3 have a 1 in 100 year or greater probability of river flooding in any year (>1%). Figure 3 outlines only the potential floodplain; and the mitigating effects of flood defences currently in place are not considered, however the site has been shown to benefit from the presence of defences.

River (Fluvial)

4.3 The EA Flood Map for Planning (Figures 3) confirms the site and proposed development are located within Flood Zone 3 (High Risk).

4.4 The nearest watercourse to the site is the River Irwell, located approximately 260m to the south of the site. The River Irwell has been classified as an EA main river.

4.5 Existing topographic levels for the site range between approximately 26.87mAOD and 27.44mAOD (Source: 2m LiDAR).

4.6 The EA has provided in-channel flood levels for the undefended and defended 1 in 100 year and 1 in 1000 year flood events. Flood levels for the 1 in 100 year plus climate change event (35% and 70% increase in flow) have also been provided.

4.7 Figure 5 shows the four in channel nodes provided by the EA. Node 2 is the closest upstream node and therefore is the most representative of the potential flood risk at the site.

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Corresponding flood levels for all four nodes are shown in Table 4. The site has been shown to benefit from the presence of defences, as such defended levels have been used in the analysis.

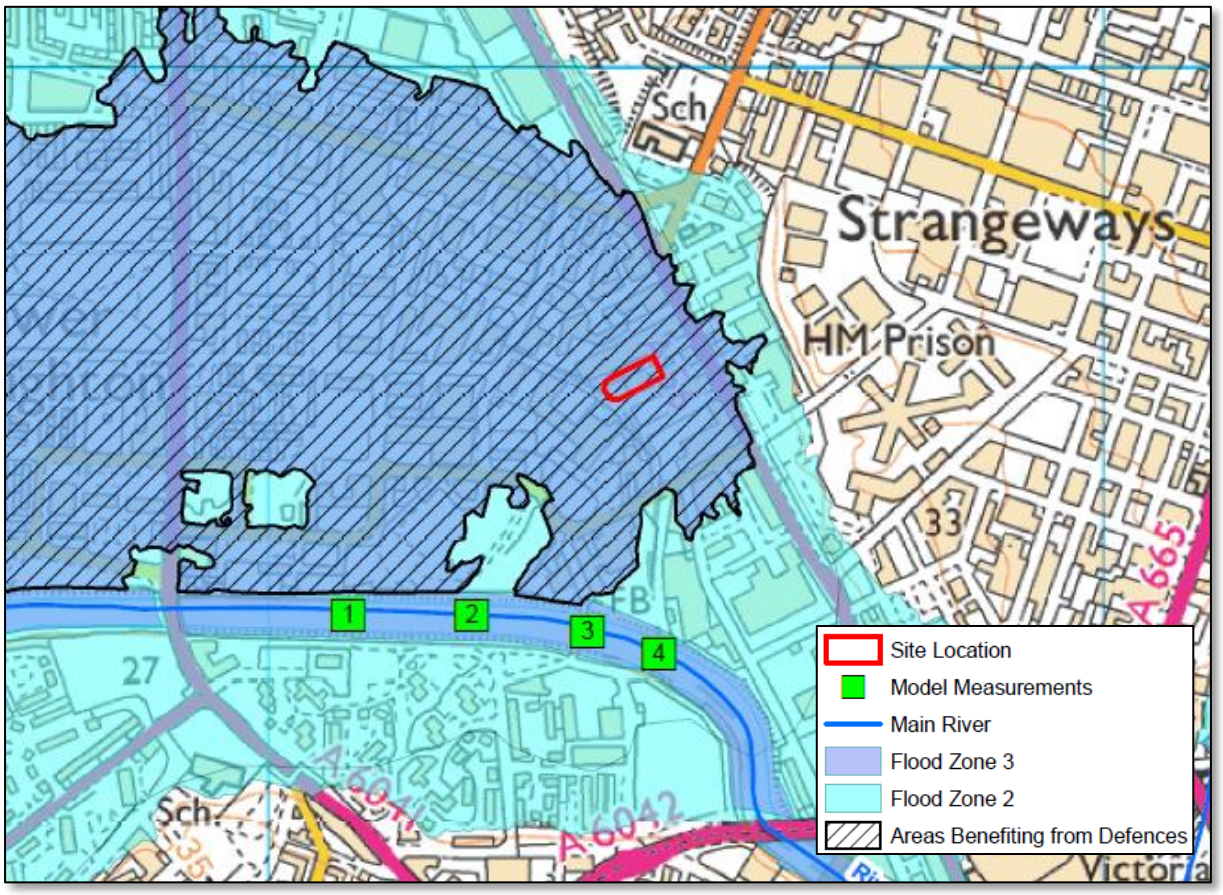


Figure 4: EA In-channel Node Map (Source: EA)

Modelled Flood Level for Flood Plain Nodes Annual Exceedance Probability (mAOD)				
Node	1% AEP (1:00yr)	0.1% AEP (1:1000yr)	1% AEP + CC (1:100yr) + 35%	1% AEP (1:100yr) + 70%
1	26.69	29.85	27.47	28.91
2	26.64	29.82	27.38	28.86
3	26.59	29.75	27.30	28.77
4	26.46	29.68	27.16	28.67

Table 4: Flood Levels based on EA In-channel Nodes 2, 3 and 4 (Source: EA)

4.8 Site topographic levels for the site range between approximately 26.87mAOD and 27.44mAOD, as shown in Figure 2 (Source: 2m LiDAR). Comparison of topographic site levels with modelled flood levels for the defended 1 in 100 year flood event (26.64mAOD) confirms that the site is located on land topographically higher than the modelled flood event.

4.9 Comparison of topographic site levels with modelled flood levels for the defended 1 in 1000 year flood event (29.82mAOD) confirms that the site resides within this flood extent with possible maximum flood depths of 2.95m in the worst case scenario.

4.10 The EA have also provided flood depths for the 1:100 year + CC (35% and 70% increase in flow). Comparison of topographic site levels with modelled flood levels for the defended 1 in 100 year (+35% increase in flow) flood event (27.38mAOD) confirms that the site resides within this flood

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extent with flood depths of 0.51m in the worst case scenario. Comparison of the 1:100 year + CC (70% increase in flow) flood event (28.86mAOD) with topographic site levels shows the site could experience maximum flood depths of 1.99m.

4.11 The EA has confirmed that the site and surrounding area benefits from the presence of defences, with the defences in the area having been shown to have a designed level of protection of 75 years. The defences closest to the proposed development site (Asset ID: 181081) have an upstream actual crest level of 27.10mAOD and a downstream actual crest level of 27.07mAOD. The condition of these defences are between 2 and 3 (Good to Fair).

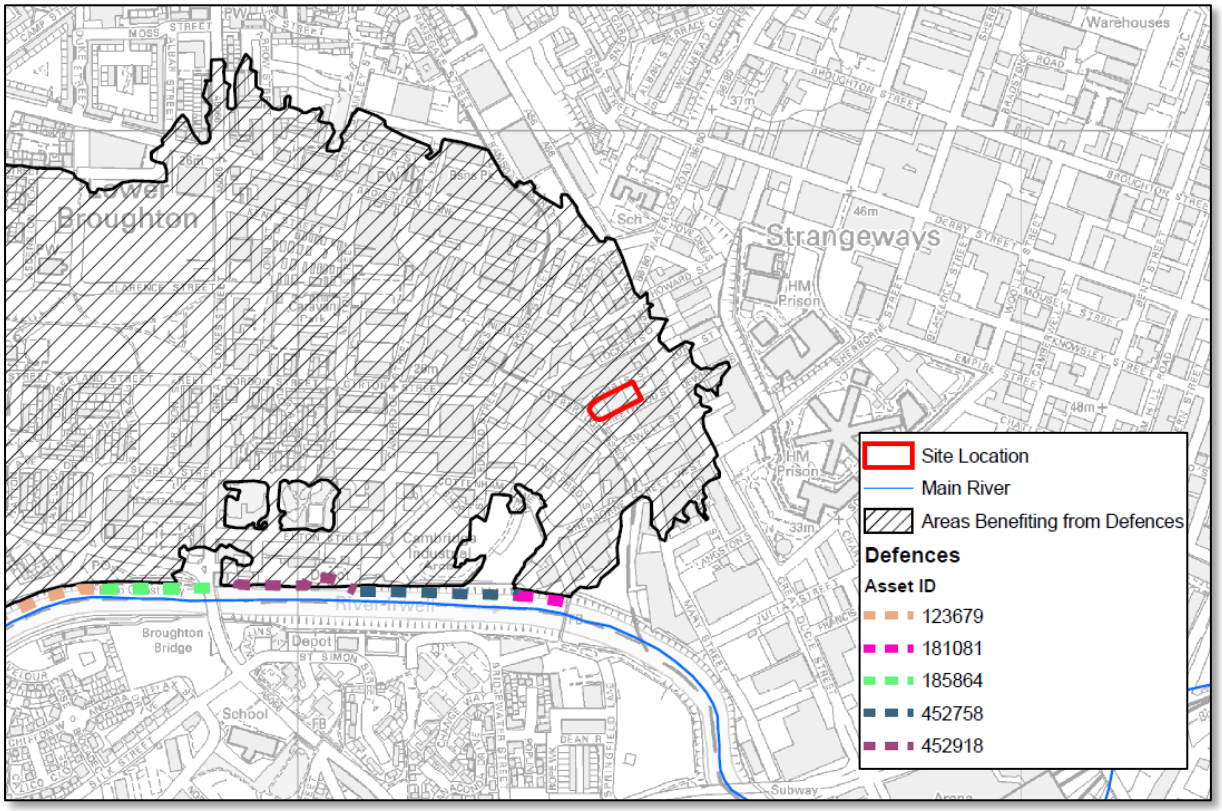


Figure 5: Flood Defence Asset ID (Source: EA)

4.12 Communication has been sought with Manchester City Council Flood Risk Management Team in regards to overtopping and breach modelling for this part of the River Irwell. They have stated that 'Breach and overtopping of defences modelling was only undertaken for the Lower Irwell and the Ship Canal as part of the SFRA. As previously mentioned if any defence modelling has been undertaken this will be held by the Environment Agency'.

4.13 The SFRA modelling identifies that for the Manchester Strategic Employment Site M0004 – Strangeways the 1 in 100 year flood event will remain in bank. Taking climate change into account, the defences will overtop in Lower Broughton, with flooding affecting the west of the site between Rugby Street and Irwell Street to a maximum depth of 1m in places. There is significant residual risk to the site in the 1 in 1000 year and 1 in 100 year plus climate change flood events. Flooding is predicted to affect around a quarter of the area in the west, bordering the prison and encroaching on the brewery. The majority of flooding is shown to be in excess of 2m in these events, resulting in hazards of 'danger for all'.

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4.14 The EA have stated that flooding has previously affected the site and surrounding area. Flooding affected the site in December 2015, January/February 1866 and September 1946, the source of flooding was the main river caused by channel capacity being exceeded.

4.15 As such, given the site benefits from the presence of defences, the risk of fluvial flooding to the site is considered to be low to moderate.

Surface Water (Pluvial)

4.16 The site is shown to be located within the 'Conurbation Core' Critical Drainage Area (Figure 6).

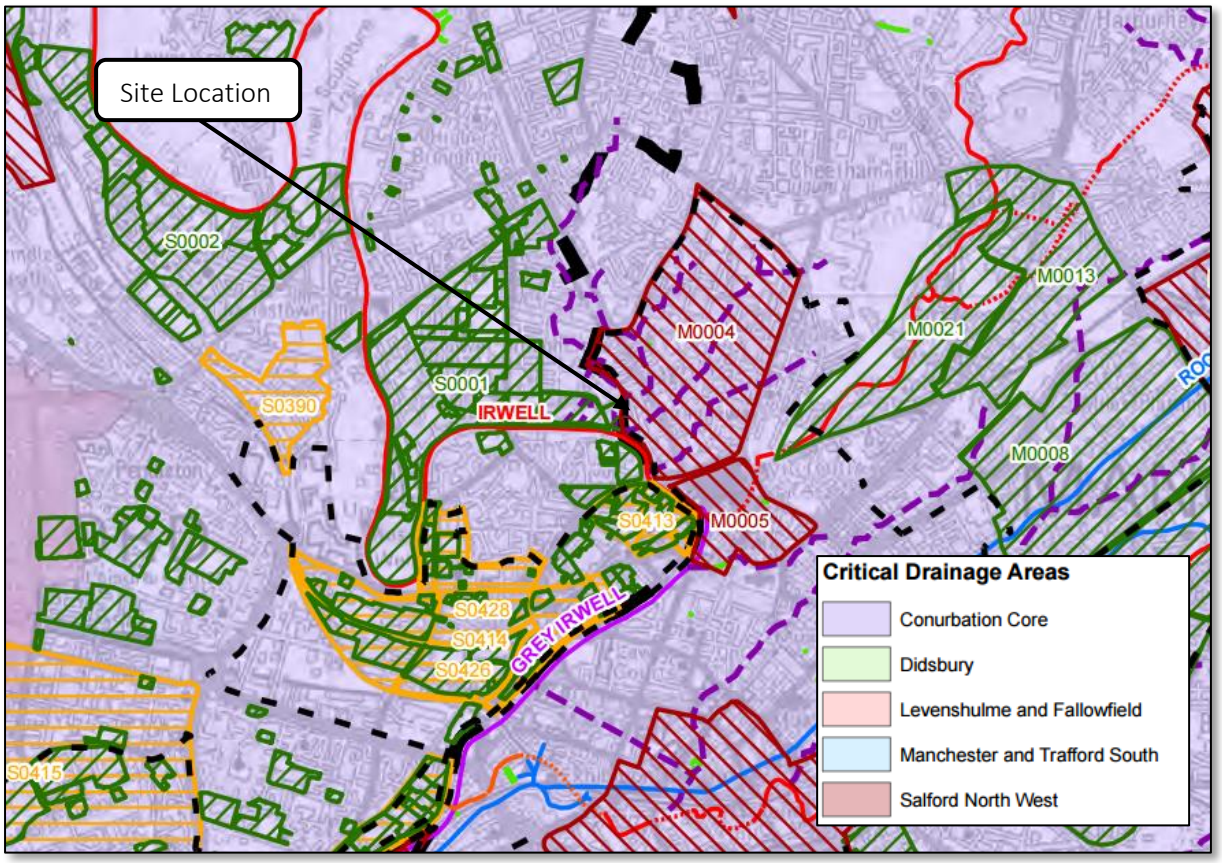


Figure 6: SFRA (2011) Critical Drainage Area Location Map (Source: SFRA)

4.17 The EA Risk of Surface Water Map has shown the site to be located in areas with 'Low', 'Medium' and 'High' risk of surface water flooding. The majority of the site is shown to be at 'Low' and 'Medium' risk. Areas identified to be at 'Low' risk of flooding have between 0.1% and 1% chance of flooding annually, areas at 'Medium' risk of flooding have between 1% and 3.3% chance of flooding annually and areas at 'High' risk of flooding have a greater than 3.3% chance of flooding annually (Figure 7).

4.18 The EA Surface Water Depth - High Chance of Occurring Map (Figure 8) has shown the site to be partially affected by flood depths during this event. However, the site would experience flood depths of between greater than 300mm (Figure 8).

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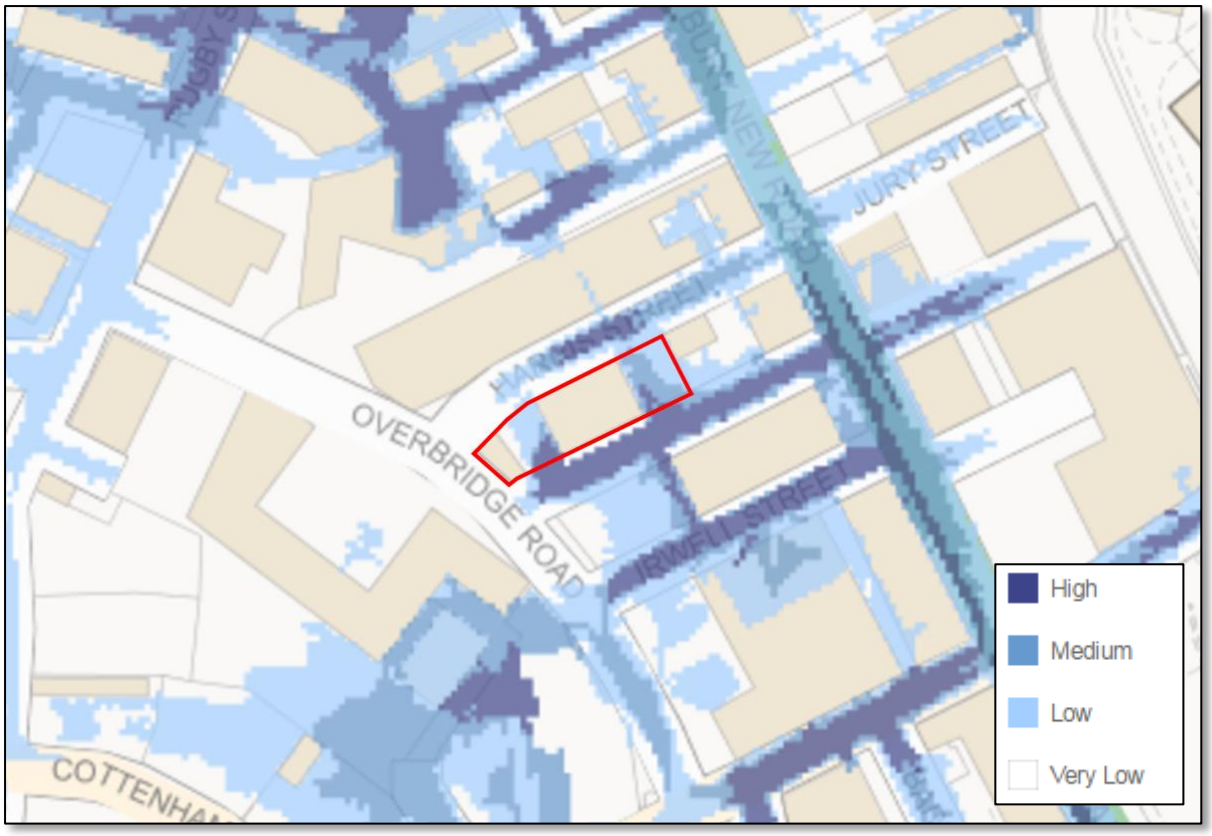


Figure 7: EA Surface Flood Risk Map. (Source: EA)

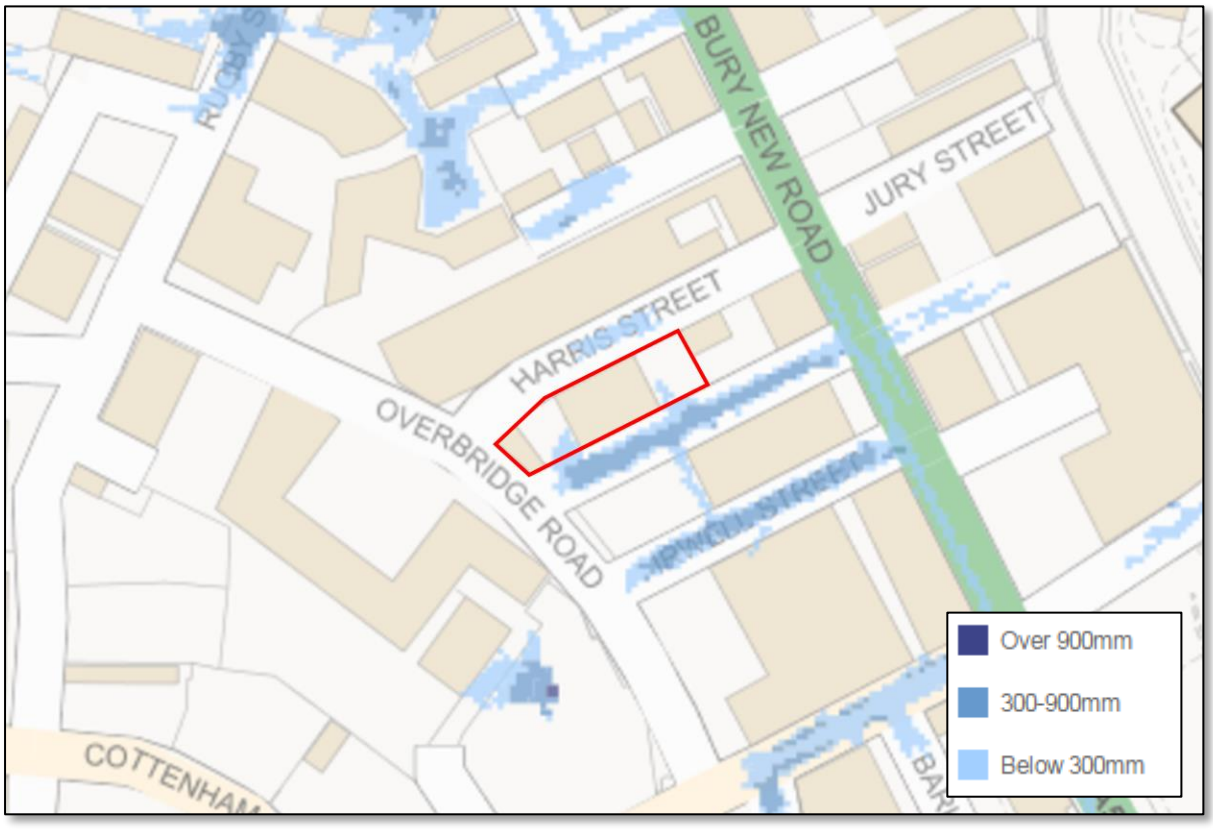


Figure 8: EA High Chance of Occurring Map. (Source: EA)

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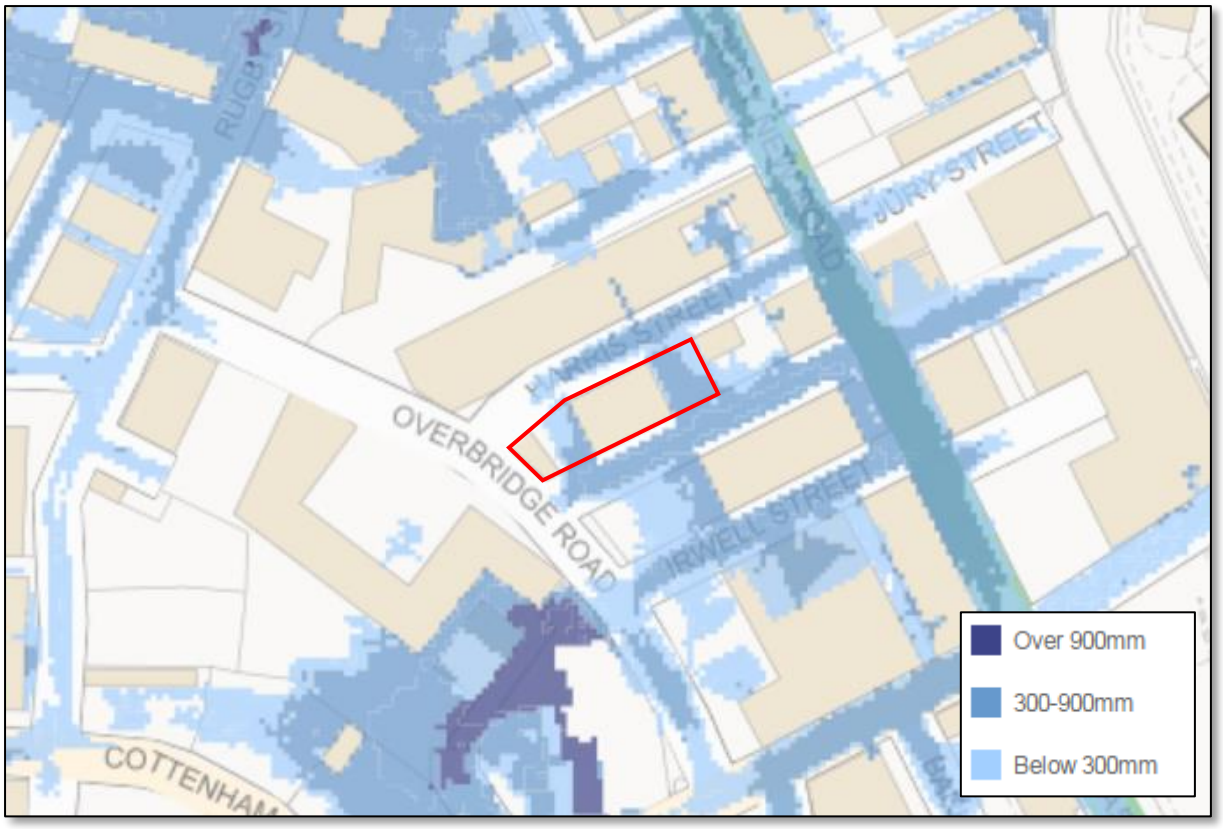


Figure 9: EA Low Chance of Occurring Map. (Source: EA)

4.19 The EA Surface Water Depth - Low Chance of Occurring Map (Figure 8) has shown the site to be affected by flood depths during this event. The site could experience flood depths of between 300mm and 900mm (Figure 9).

4.20 As such the risk from surface water flooding can be considered to be **moderate.**

Groundwater

4.21 The EA has confirmed that the site is not located within a groundwater protection zone. However the site is located within a groundwater vulnerability zone classified as a major aquifer with high vulnerability.

4.22 The Manchester, Salford and Trafford SFRA (2011) has not provided records to show the site has experienced groundwater flooding previously.

4.23 As such, the risk of flooding from this source can be considered to be **relatively low.**

Sewer

4.24 No records have been provided to state that the site has experienced sewer flooding previously.

4.25 As such, the risk from this source is considered to be **relatively low**.

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Surface Water Drainage Strategy

4.26 The proposed development is for the subdivision of the existing industrial units to create 14 cash and carry units. There will be no increase in impermeable surfaces, nor increase in built footprint as a result of the development.

4.27 As such, it is proposed to discharge surface water via the existing drainage infrastructure associated with the existing site.

Records of Historical Flooding

4.28 The EA have stated that flooding has previously affected the site and surrounding area. Flooding affected the site in December 2015 (BOX_D_15), January/February 1866 (FEB01569C) and September 1946 (FEB01568C), the source of flooding was the main river caused by channel capacity being exceeded (Figure 10).

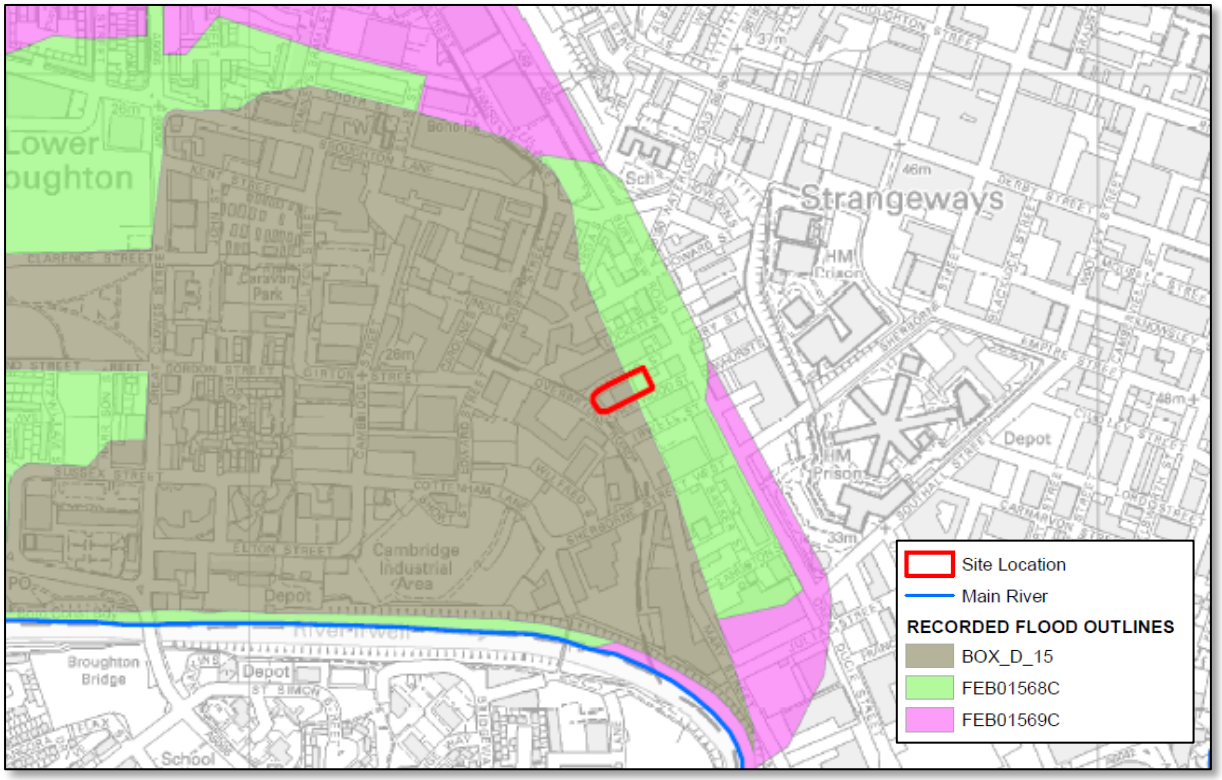


Figure 10: Historic Flood Events Map (Source: EA)

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5. Probability of Flooding

5.1 The site and proposed development is located within Flood Zone 3 (High Risk of Flooding). As such, the site has a chance of fluvial flooding of 1 in 100 or greater (>1%) in any year.

Zone	Description
1	Low Probability. This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
2	Medium Probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
3a	High Probability. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
3b	The Functional Floodplain. This zone comprises land where water has to flow or be stored in times of flood. SFRA's should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the EA, including water conveyance routes).

Table 5: Definition of the NPPF Flood Zones. Shaded cells denote the proposed development. (Source: EA)

Climate Change on Site

5.2 Climate change is likely to increase the flow in rivers, raise sea levels and increase storm intensity. The range of allowances in Table 6 is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.

- Central allowance is based on the 50th percentile,
- higher central is based on the 70th percentile,
- upper end is based on the 90th percentile.

5.3 So, if the central allowance is 30%, scientific evidence suggests that it is just as likely that the increase in peak river flow will be more than 30% as less than 30%.

5.4 At the higher central allowance 70% of the possible scenarios fall below this value. So, if the higher allowance is 40%, then current scientific evidence suggests that there is a 70% chance that peak flows will increase by less than this value, but there remains a 30% chance that peak flows will increase by more (Source: EA).

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5.5 The risk of flooding to the site would therefore be expected to increase following the effects of climate change. The likely increases in peak rainfall intensity would also lead to an increased risk of surface water flooding. The increase in river flows for the North West has been outlined within Table 6 below.

River basin district	Allowance category	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)
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%

Table 6: Peak river flow allowances by river basin district (Source EA)

Flood Zone	Essential Infrastructure	Highly Vulnerable	More vulnerable	Less Vulnerable	Water Compatible
2	Higher Central and Upper End	Higher Central and Upper End	Central and Higher Central	Central	None of the allowances
3a	Upper End	Development should not be permitted	Higher Central and Upper End	Central and Higher	Central
3b	Upper End	Development should not be permitted	Development should not be permitted	Development should not be permitted	Central

Table 7: Allowance and Flood Zone Table (Source EA)

5.6 The proposed development is considered "Less Vulnerable" under the NPPF. Less vulnerable developments in Flood Zone 3 must use the central and higher central climate change allowances for their river basin district (Table 7). The allowances for the North West basin are provided in Table 7. To provide a worst case scenario, the higher central climate change allowance has been used in the analysis.

5.7 The EA have calculated the climate change flood level, analysis of the 1:100 year (+35% increase in flow) shows a possible flood level of 27.38mAOD. Comparison with minimum site topographic level (26.86mOAD to 27.44mAOD) shows the site to be partially inundated by this flood event, with possible maximum flood depths of 0.51m in the worst case scenario.

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6. Flood Risk Management Measures

6.1 The existing site and proposed development is located within Flood Zone 3 (High risk of flooding). The proposed development is for the internal reconfigurations of the existing units to create 14 cash and carry units and will be classified as 'Less Vulnerable'. As such, it is recommended that the development adopt the following mitigation measures:

- all plumbing insulation to be of closed-cell design;
- sign up to the EA Flood Warning Service;
- non-return valves to be fitted on sewers to prevent back-flow;
- wiring and power outlets raised above floor level (where possible),
- subscribe to the EA Flood Warning Service and ensuring that this service is made available to all site users, and;
- site to be vacated and closed on receipt of a severe flood warning and to remain so whilst flood warnings are in place for the area.

Flood Warning and Evacuation

6.2 The site is and proposed development are located in Flood Zone 3 (High Risk of flooding).

6.3 The site is located within the EA Flood Warning Service Area (Figure 11). To provide betterment to the site, it is recommended that the site owner(s) sign up to this service if they have not done so already.

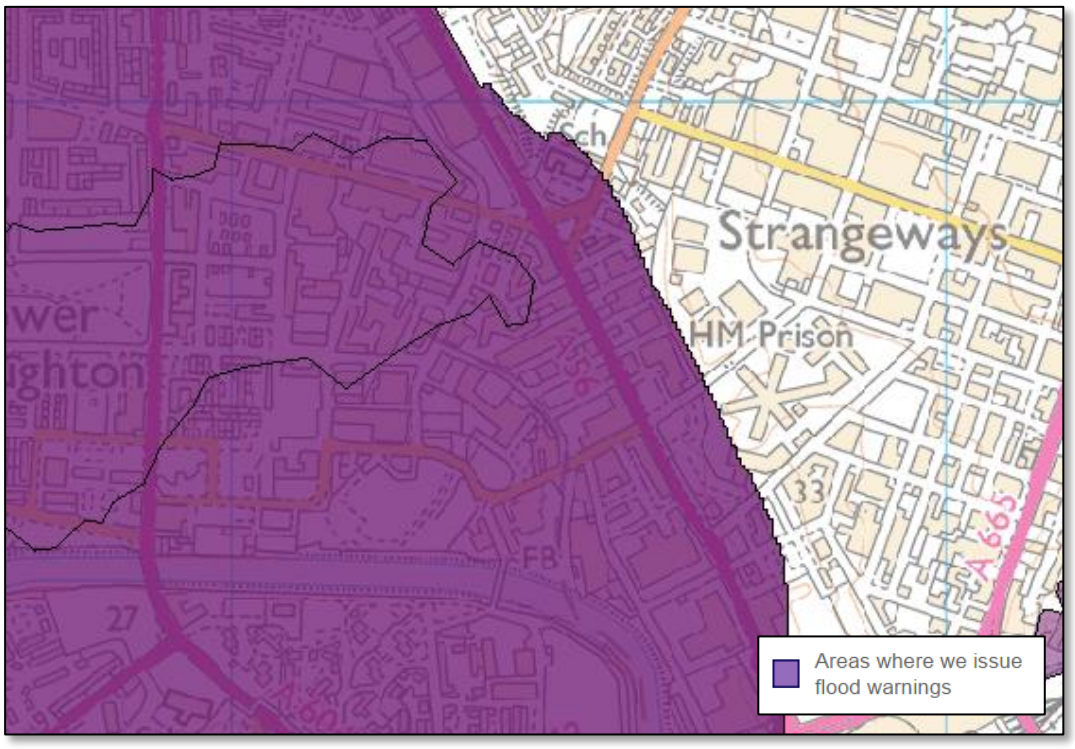


Figure 11: EA Flood Warning Service Location Map (Source: EA)

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6.4 The EA operate a 5 day county-wide forecast in relation to flood risk. It is recommended that this service is regularly checked to ensure occupants/residents are aware of any possible risks: https://flood-warning-information.service.gov.uk/5-day-flood-risk.

6.5 The EA operate a Flood Information service which identifies whether any flood warnings or alerts have been issued for a specific postcode or place in England or Wales: https://flood-warning-information.service.gov.uk/.

6.6 The EA also operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. It is important to note that the EA's flood warnings are only in relation to fluvial and tidal flooding, and do not cover other sources of flooding such as surface water or groundwater flooding.

6.7 The site owner(s) and management will be required to register for this service (https://www.gov.uk/sign-up-for-flood-warnings). It is advised that all residents and site users also register for this service, as management may not be on site at the time of a flood event. It is the responsibility of the site owner to make this service available to all site users.

6.8 The site owner(s), site management and residents will be required to register for this service. It is the site owner and site management's responsibility to make this service available and known to all site users.

- On receipt of a FLOOD ALERT, the site users should:
  - Monitor the situation via local media;
  - Make themselves aware of forecast local weather conditions;
  - Alert others resident in the property of the situation;
  - Prepare to evacuate if necessary.
- On receipt of a FLOOD WARNING, the site users should:
  - Follow advice to "go in, stay in, and tune in";
  - Be prepared to follow instruction form the Emergency Services.
- On receipt of a SEVERE FLOOD WARNING, the site users should:
  - Follow advice to "go in, stay in, and tune in";
  - Remain attentive to local media forecasts and news bulletins;
  - Do not evacuate unless instructed to do so by the Emergency Services;
  - Only when instructed to evacuate by the Emergency Services, leave the property and follow the agreed evacuation route – detailed previously.

6.9 Upon receipt of a severe flood warning, the site should be evacuated. All site users should be advised not to return the site until the site is deemed to be safe for return by the Emergency Services.

6.10 Site owners will be responsible for informing occupants of the risk posed by flooding.

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6.11 Further information can be found on www.environment-agency.gov.uk/floodline. Floodline Warnings Direct is a free service operated by the EA that provides flood warnings direct to occupants by telephone, mobile phone, fax or pager.

7. Off Site Impacts

Impact to Flood Risk Elsewhere

7.1 The proposed development is for the subdivision of the existing industrial units to create 14 cash and carry units. There will be no increase in the building footprint on site, and therefore no loss in floodplain storage.

Generation of Runoff

7.2 There will be no increase in impermeable surfaces or increase in built footprint as a result of the development.

7.3 As such, it is proposed to discharge surface water via the existing drainage infrastructure associated with the existing site.

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8. Conclusion

8.1 Ambiental Technical Solutions Limited has been appointed by Tang and Associates Ltd to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) to assist with the development at 10-16 Harris Street, Manchester, M8 8EG.

8.2 The proposed development is for the refurbishment and subdivision of the two block at the 10-16 Harris Street site in order to create 14 units of wholesale cash and carry units. As part of the proposed development, elevation alterations will be required on all four elevations to create the new shopfronts and add window openings.

8.3 According to the NPPF and the Environment Agency (EA) standing advice on development and flood risk, as well as the low detail, national-scale flood mapping created on behalf of the EA the site is located in Flood Zone 3 (High Risk; 1 in 100 or greater annual probability of flooding from fluvial flooding (>1%). Under the NPPF guidance, the existing site consists of industrial units and associated hardstanding, as such the existing and proposed developments are classified as “Less Vulnerable”.

8.4 The nearest watercourse to the site is the River Irwell, located approximately 260m to the south of the site. The River Irwell has been classified as an EA main river.

8.5 The Manchester City, Salford City and Trafford Councils SFRA has shown the site to be located within the ‘Conurbation Core’ Critical Drainage Area.

8.6 Site topographic levels for the site range between approximately 26.87mAOD and 27.44mAOD, as shown in Figure 2 (Source: 2m LiDAR). Comparison of topographic site levels with modelled flood levels for the defended 1 in 100 year flood event (26.64mAOD) confirms that the site is located on land topographically higher than the modelled flood event. Modelled flood levels for the defended 1 in 1000 year flood event (29.82mAOD) confirms that the site resides within this flood extent with possible maximum flood depths of 2.95m in the worst case scenario.

8.7 The EA have calculated the climate change flood level, analysis of the 1:100 year (+35% increase in flow) shows a possible flood level of 27.38mAOD. Comparison with minimum site topographic level (26.86mOAD to 27.44mAOD) shows the site to be partially inundated by this flood event, with possible maximum flood depths of 0.51m in the worst case scenario.

8.8 As such and given that:

- the proposed development is for the internal reconfiguration of the existing industrial units;
- the existing and proposed development are classified as ‘Less Vulnerable’;
- no increase in built footprint, no increase to flood risk elsewhere post development;
- the existing site is located on land topographically higher than the 1:100 year flood event, and;
- it is recommended that the site owner(s) signs up to the EA Flood Warning Service to provide a betterment to the site, if they have not done so already.

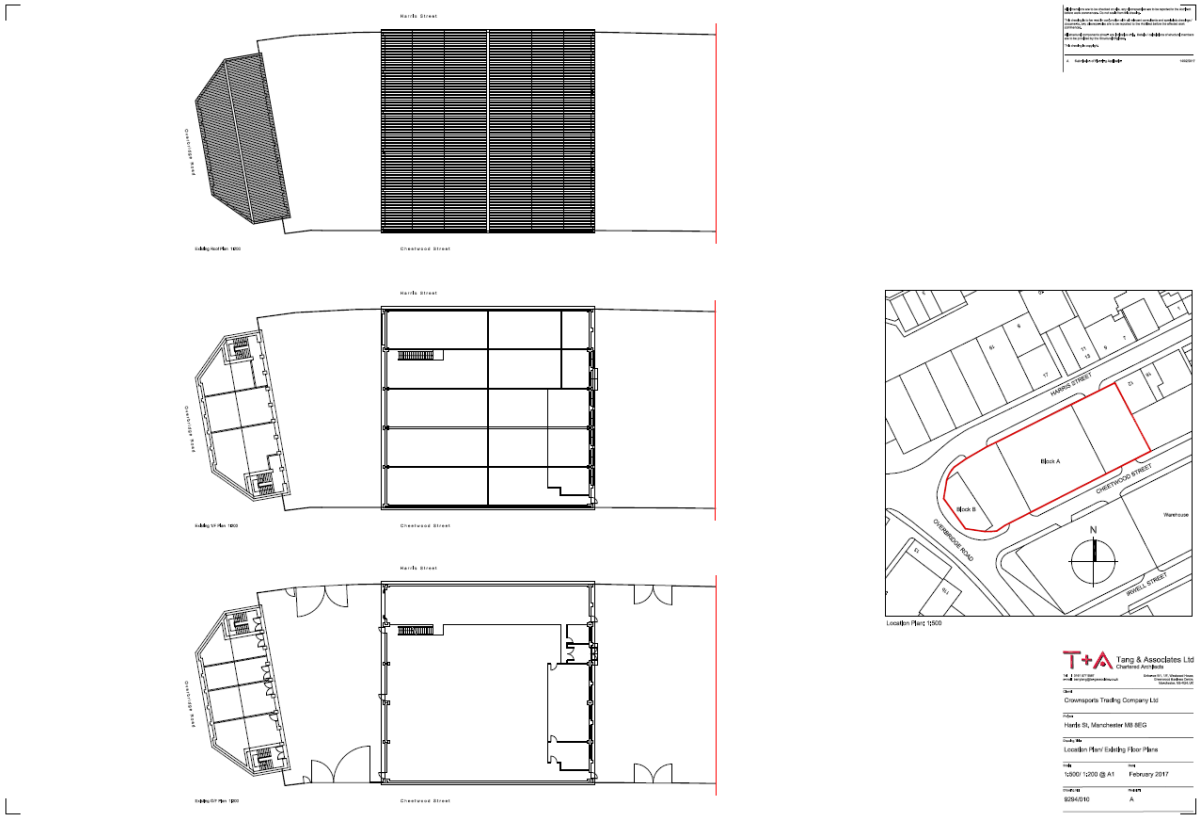
Following the guidelines contained within NPPF, the proposed development type is considered to **be suitable** assuming appropriate mitigation (including adequate warning and evacuation procedures) can be maintained for its lifetime.

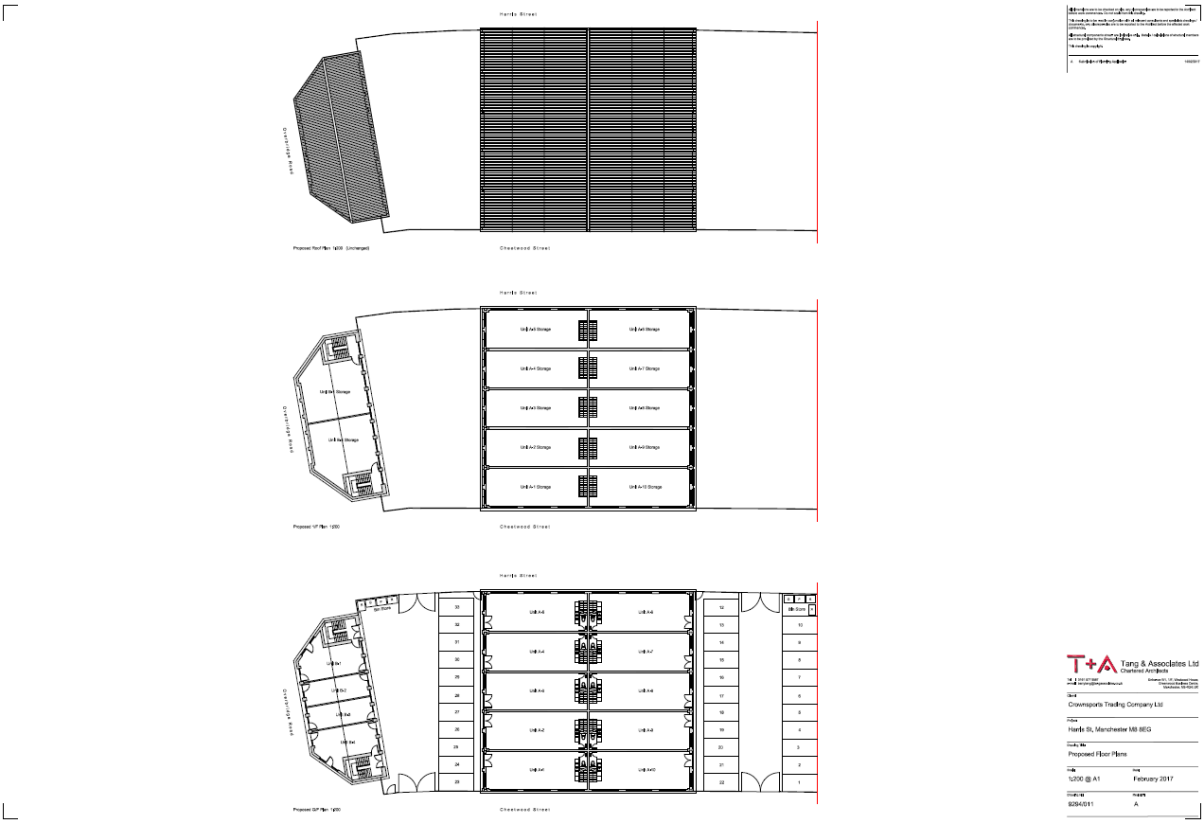
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Appendix A – Supporting Information

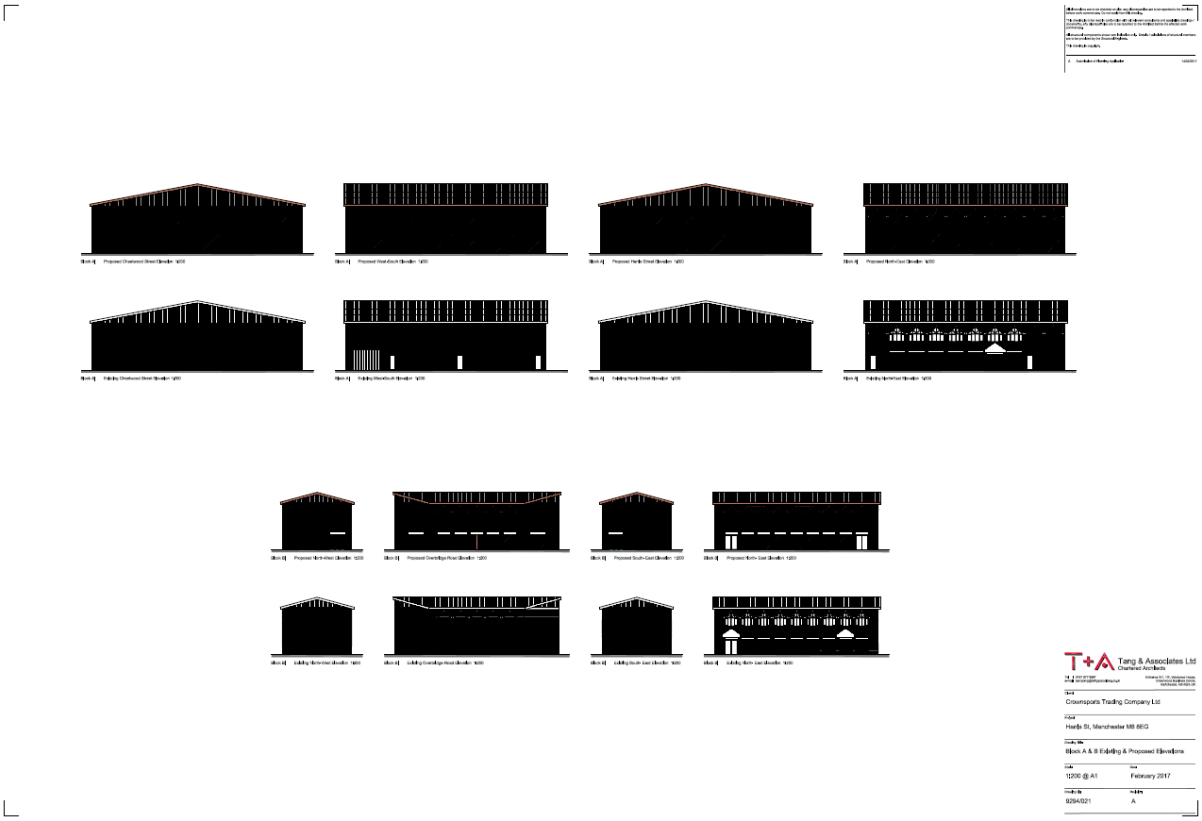
- Existing Site
- Proposed Site
- Existing/Proposed Elevations

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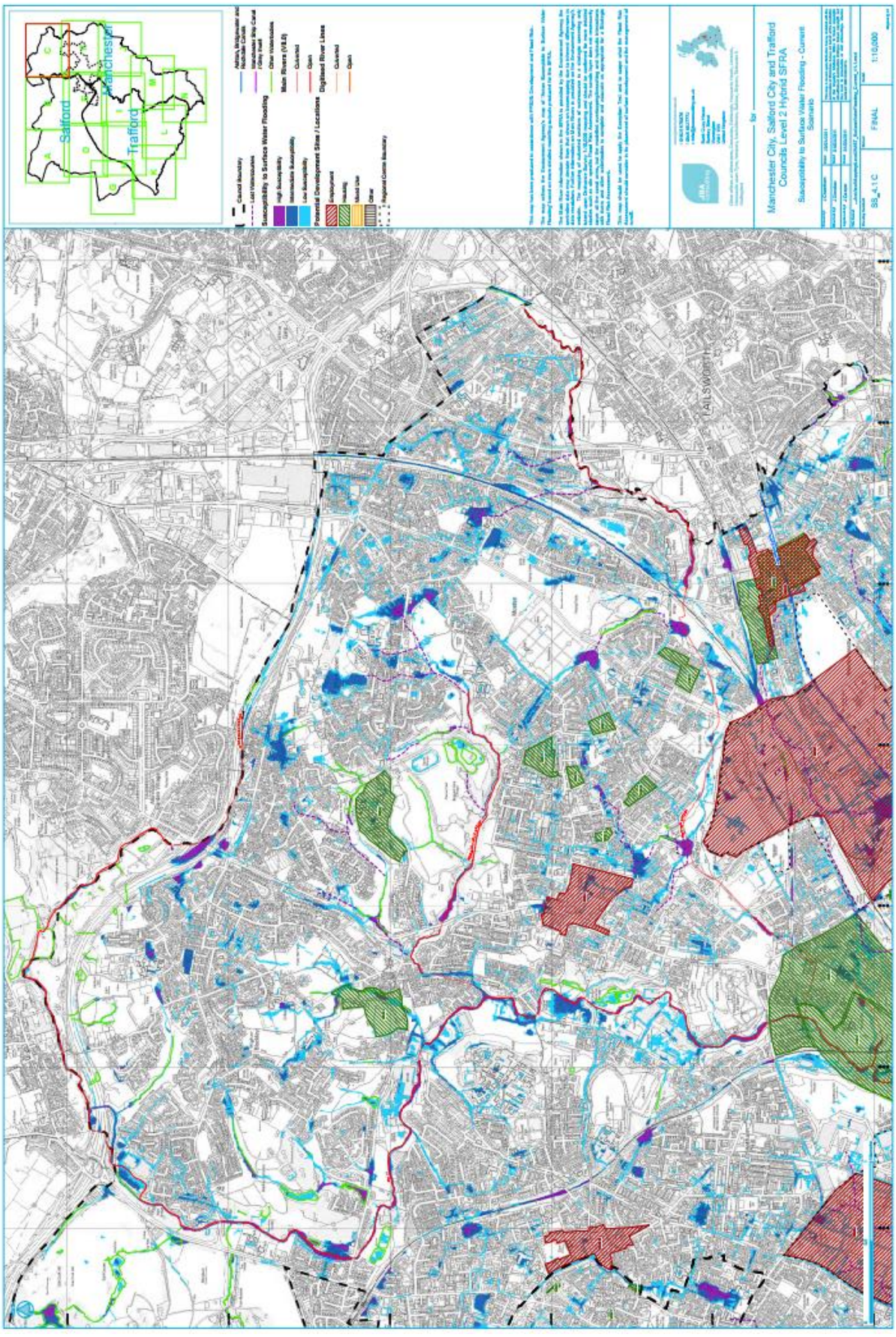


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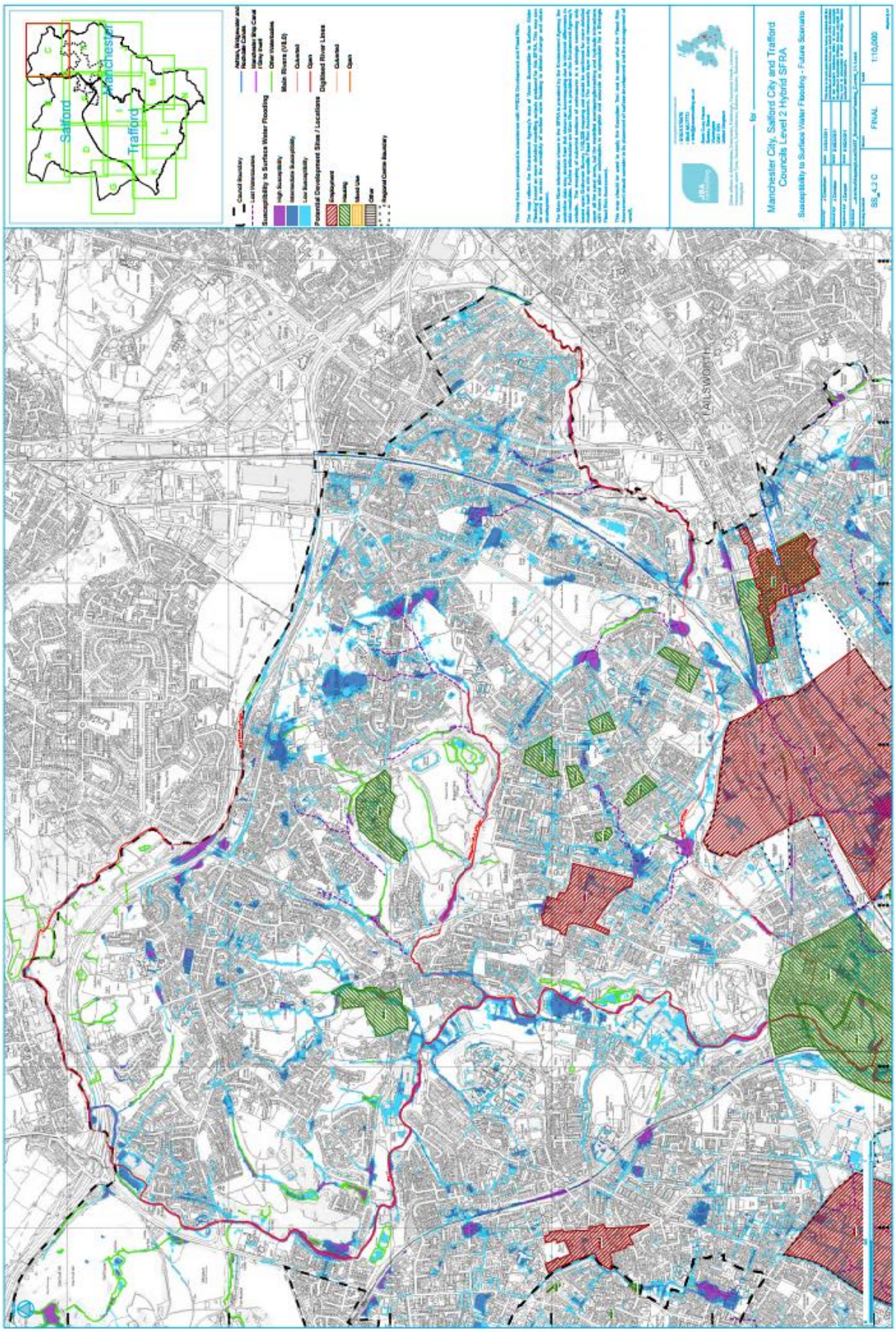
Appendix B – Supporting Information

- SFRA Susceptibility to Surface Water Flooding Map Current Scenario
- SFRA Susceptibility to Surface Water Flooding Map Future Scenario
- SFRA Surface Water Flooding Risk Assessment Current Scenario
- SFRA Surface Water Flooding Risk Assessment Future Scenario

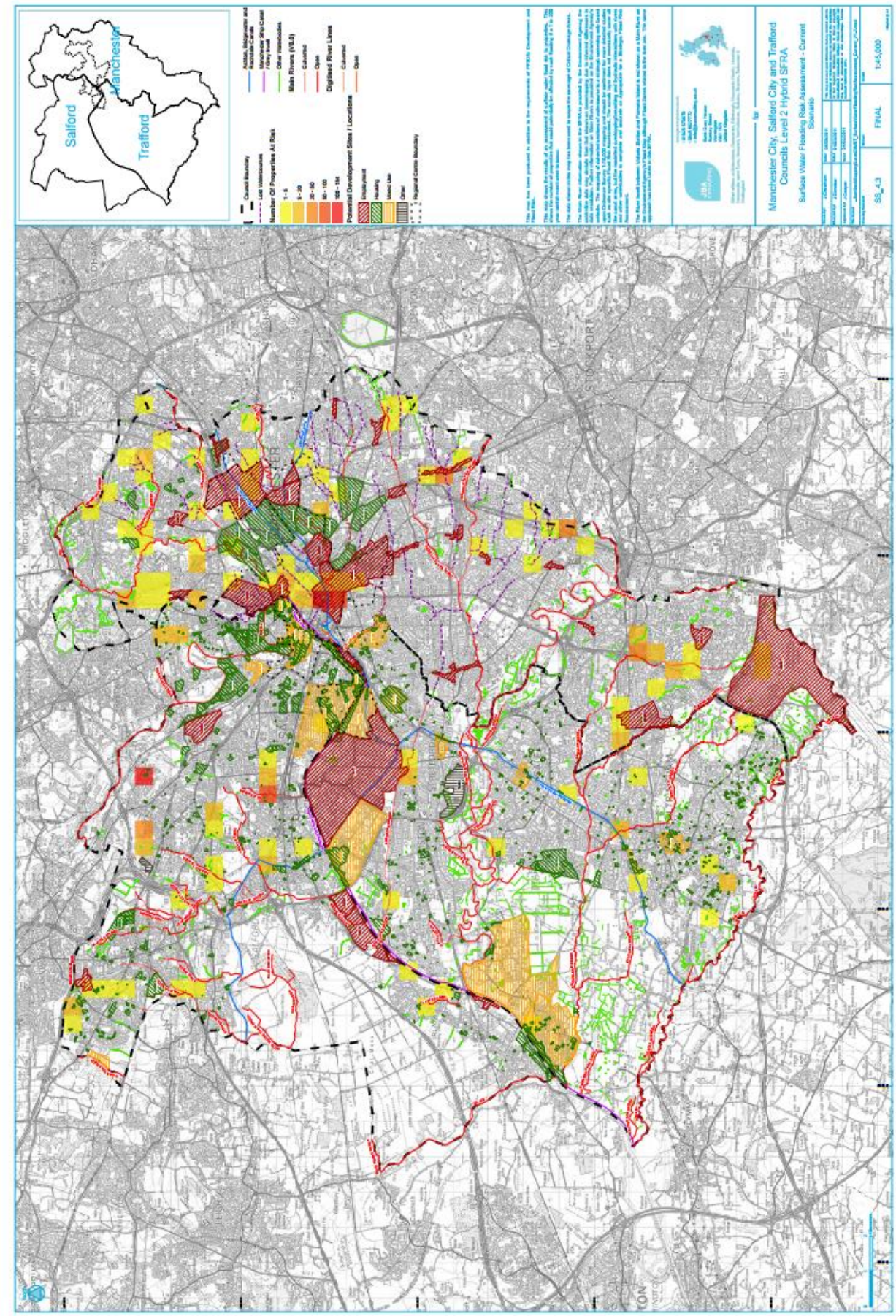
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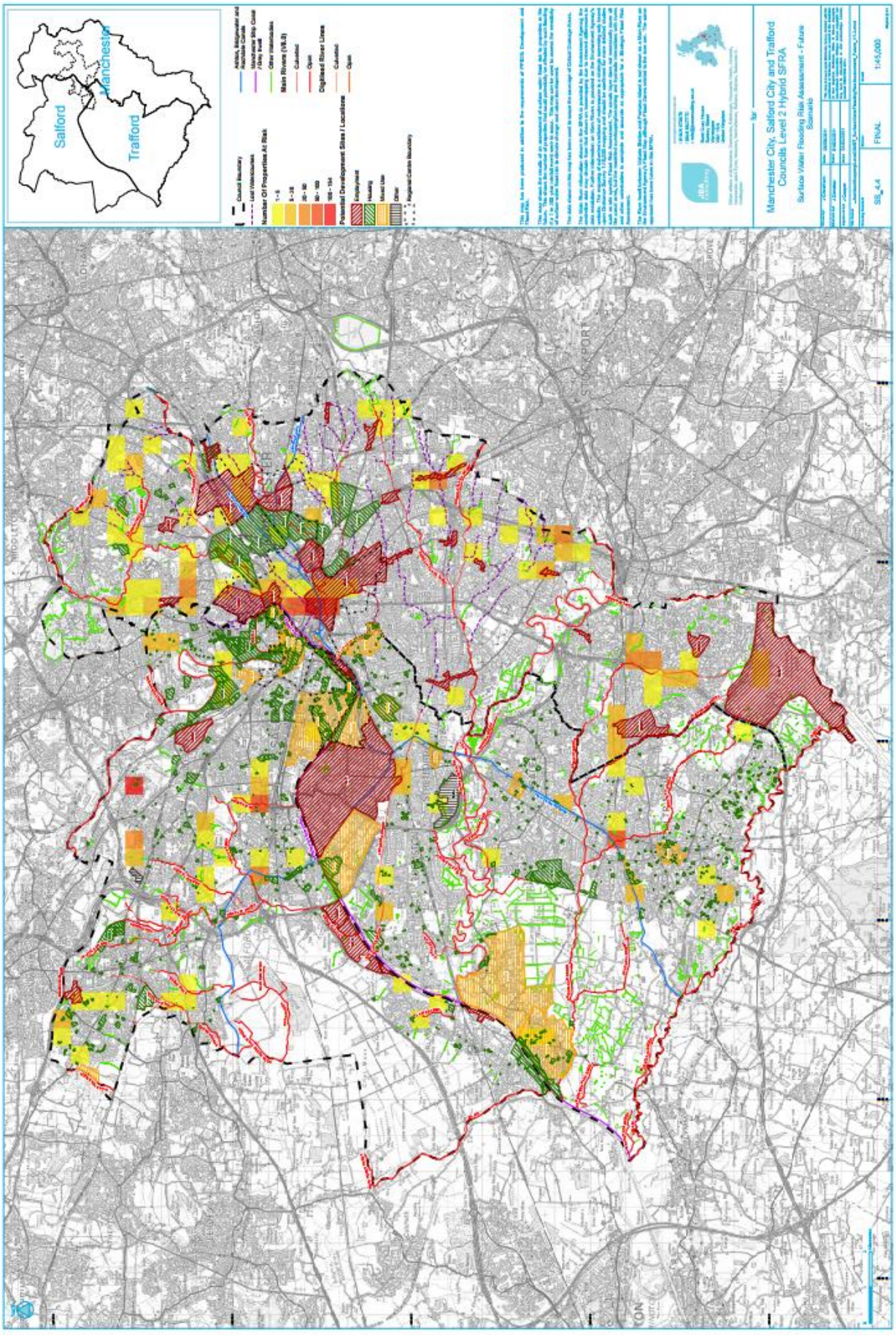
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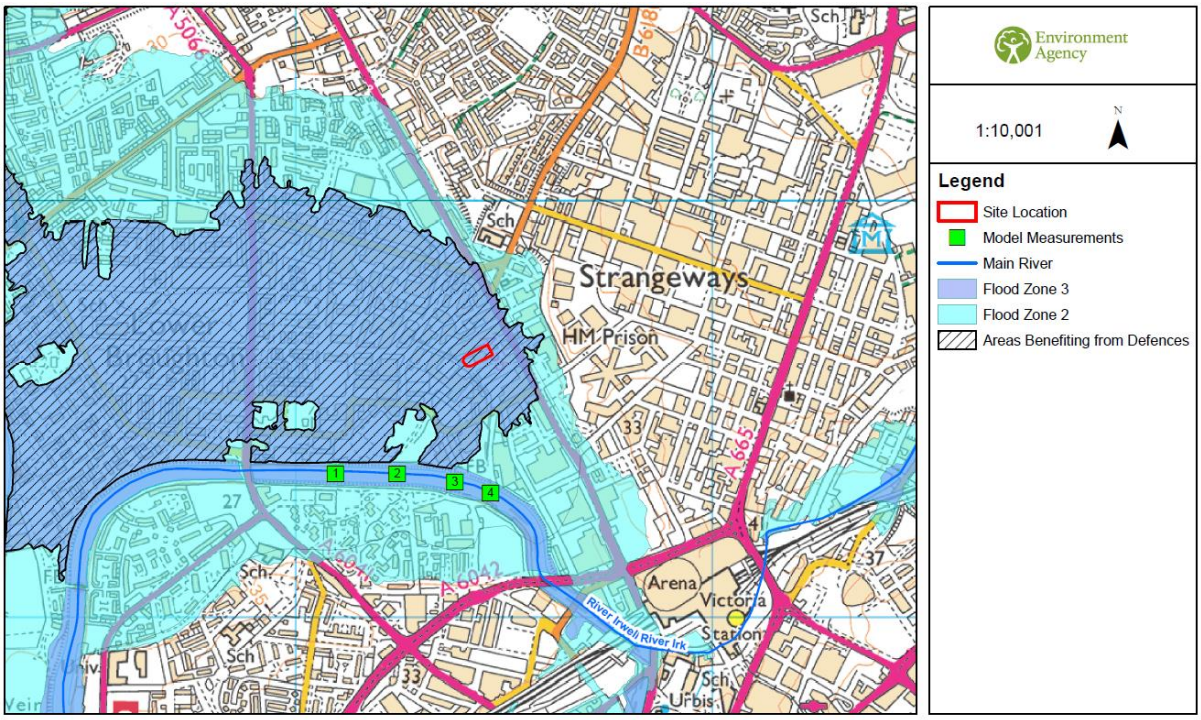
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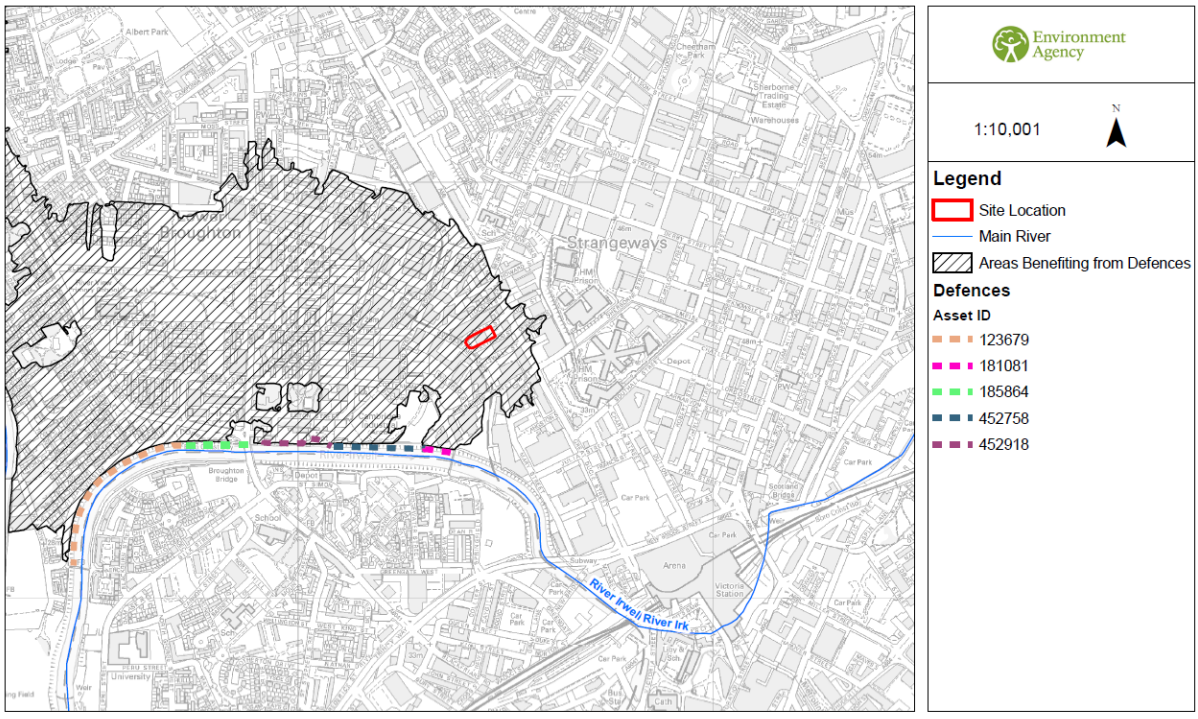
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Appendix C – Environment Agency Product 4 Data Set

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					Undefended				Defended			
Map Reference	Model Node Reference	Easting	Northing	Data	1 % AEP (1 in 100 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow	1 % AEP (1 in 100 year)	0.1 % AEP (1 in 1000 year)	1 % AEP (1 in 100 year) + 35% increase in flow	1 % AEP (1 in 100 year) + 70% increase in flow
1	UndefendedRW1_3949	383096	399344	Modelled Water Level (m aodN)	26.50	30.00	28.23	29.73	26.69	29.85	27.47	28.91
				Modelled Flow (cumecs)	432.97	449.78	487.52	480.00	457.41	462.93	499.05	490.12
2	UndefendedRW1_3798	383244	399343	Modelled Water Level (m aodN)	26.45	29.97	28.13	29.70	26.64	29.82	27.38	28.86
				Modelled Flow (cumecs)	433.08	469.51	515.74	498.09	457.52	472.34	523.18	509.05
3	UndefendedRW1_3665	383383	399324	Modelled Water Level (m aodN)	26.39	29.92	28.03	29.64	26.59	29.75	27.30	28.77
				Modelled Flow (cumecs)	433.20	524.77	559.39	529.12	457.63	533.08	542.78	559.94
4	UndefendedRW1_3571	383469	399298	Modelled Water Level (m aodN)	26.26	29.86	27.88	29.57	26.46	29.68	27.16	28.67
				Modelled Flow (cumecs)	433.29	553.26	582.10	548.18	457.70	554.73	543.45	581.37

Model data taken from Salford 2012 Study**

Notes:

AEP - Annual Exceedence Probability

m aodN - metres above ordnance datum Newlyn

cumecs - cubic metres per second

*Climate Change Scenario - 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. **Note that these levels have not yet been subject to detailed review and therefore should be treated as draft.**

The Salford_2012 Climate Change outputs provided have been taken from the updated JBA Lower Irwell ISIS-TUFLOW model from May 2016. No other measurements or outlines have been delivered for this model yet.

Defences

Date built	Asset ID	Design Standard of Protection	Overall Condition Grade*	Upstream Actual Crest Level (m aodN)	Downstream Actual Crest Level (m aodN)
01/01/2003	185864	75	3	28.33	27.6
N/A	452918	N/A	2	N/A	N/A
N/A	452758	75	3	N/A	N/A
N/A	181081	75	2	27.1	27.07
01/01/2003	123679	75	3	27.77	27.48

Recorded Flood Events

Flood Event Code	Start Date	End Date	Source of Flooding	Cause of Flooding
BOX_D_15	26/12/2015	26/12/2015	Main River	Channel capacity exceeded
FEB01569C	11/01/1866	11/02/1866	Main River	Channel capacity exceeded
FEB01568C	20/09/1946	21/09/1946	Main River	Channel capacity exceeded

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Environment Agency

Visual Condition Grading of FCRM Assets

The Environment Agency has a risk-based programme for the regular inspection of flood defence assets. We record the results of these inspections in our Asset Information Management System (AIMS).

Inspecting and checking individual flood defence assets helps us understand their likely performance, which is essential for effective flood risk management. We need to understand the asset's failure mechanisms, exposure to loading, construction materials, present condition and likely future deterioration.

The condition grading and descriptions given below are the standards adopted by the Environment Agency. The five condition grades range from 'very good' to 'very poor', and the descriptions reflect condition according to flood defence performance.

Rating System:

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance
2	Good	Minor defects that will not reduce the overall performance of the asset
3	Fair	Defects that could reduce performance of the asset
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation needed
5	Very Poor	Severe defects resulting in complete performance failure

We inspect and assign a condition grade to each element of the asset, and calculate the overall grade from these values.

The table on the following pages outlines some of the key features our inspectors look for when assessing the assets.

Issued by: Environment Agency Flood & Coastal Risk Management, Horizon House, Deanery Road, Bristol, BS1 5AH. February 2013.

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Appendix D – Information Relating To JFLOW

JFLOW and flood outlines (Source: EA)

Flood Zones have been produced using JFLOW, a nationally consistent model. JFLOW has been used to produce the 1% (1 in 100 year) and 0.1% (1 in 1000 year) flood outlines.

The flood outlines have been developed by applying flow and tide models to a 3D ground level map of England and Wales, known as a Digital Terrain Model (DTM). This is created by flying an aircraft over the whole of the country using radar to record and create a contoured model of the land. This DTM is used as the basis of a grid of cells which is used to estimate the extent of flooding in a flood of a given return period or probability.

The size of the flood event (1 in 100 or 1 in 100 year) is determined by the inflows to the JFLOW model, which are calculated using statistical techniques from the Flood Estimation Handbook. The technique used is based upon catchment descriptors and data transfer, the details of these can be found in the Flood Estimation Handbook volume 3. The Flood Estimation Handbook provides a consistent technique for estimating inflows to the national model and its methods are widely accepted.

The methodology is a raster-based approach, driven by an underlying Digital Elevation Model (DEM).

- Each cell has a ground level and water depth
- Water can move to any of surrounding 8 cells where the water level is lower
- Water will pond in low spots until the water level is high enough to spill
- The velocity of movement depends on water surface slope and surface roughness

The above points describe the basic principles of the model. The two underlying principles are:

- Mass conservation within each cell
- Calculation of the fluxes between the cells

Each grid cell is treated as a small storage area. Mass conservation is applied to each grid cell. The flux between cells is calculated using a form of the generalised weir equation.

Efficient coding is achieved by keeping a list of all currently wet cells and a list of newly wet cells. This avoids having to search through each cell in the ground grid.

For whole catchment modelling, the hydrographs used as inflow boundary conditions represent the whole hydrograph at that inflow location and a simple conceptual method has been derived to account for the amount of flow within the channel banks. A simple solution was therefore sought which would approximately account for the proportion of flow contained within the channel without requiring further information about the channel.

The simple conceptual method used involves two assumptions:

1. That bankfull flow (Q_b) is equal to QMED as calculated by the Flood Estimation Handbook (FEH) methods. QMED has a return period of 2 years. This assumption derives from the

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concept of dominant discharge in fluvial geomorphology (Wolman and Leopold, 1957; Wolman and Miller, 1960) where the cross-section shape is assumed to be formed by a discharge with a recurrence interval of 1-2years.

2. That the additional channel flow (Q_c) scales with both Q_b and depth above bankfull (d).

The basis of the current model is that each grid cell acts as a small flood cell and the links to each of the surrounding cells are automatically calculated. It is therefore capable of simulating the inundation extent at a level of detail equal to the underlying DEM. It is fundamentally volume conservative and so, in a given time period, will simulate the peak water levels across the floodplain depending on the volume of water that has entered the floodplain. This approach is a half-way house between the common 1D hydrodynamic models and a 2D hydrodynamic model.

Limitations

JFLOW was used to produce flood maps for the whole of England and Wales for all catchments greater than 3 sq-km in a consistent manner. The method is therefore very generalised and therefore cannot take account of information that may be very significant locally. This might include:

1. Effects of bridges and other structures including flood defences are not taken into account.
2. Errors in the DTM, caused by trees and buildings for example.
3. The effect of reservoirs and urban drainage and other man made influences on the flow regime can only be taken into account in a very general sense in JFLOW.
4. The channel is assumed to be able to take the 2 year flow. This may not be true especially in those modified by man.
5. Hydraulic roughness is assumed to be the same everywhere in JFLOW, but of course it is not.

For these and many other reasons, the flood outlines produced by JFLOW can only be taken as a rough guide, showing where more detailed flood risk assessments are essential. Flood risk assessments should also be undertaken near small watercourses whose catchments are too small to have been included in the JFLOW modelling.

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