

Appendix D

Existing Pre-Development Drained Areas



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EXISTING PUBLIC SURFACE WATER NETWORK

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EXISTING PUBLIC FOUL WATER NETWORK

PRE-DEVELOPMENT SOFT LANDSCAPING (1.67ha)

PRE-DEVELOPMENT HARD-STANDING (3.63ha)

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS.

2. THIS DRAWING IS BASED ON:

2.1. TOPOGRAPHICAL SURVEY DWG FILE REF. 200510-001 TO 004 DATED JULY 2020 BY SURVEY OPERATIONS

2.2. FULL UTILITIES SURVEY DWG FILE REF. 0620-ARC-13319 DATED 06/07/2020 BY SITE VISION SURVEYS

2.3. LANDSCAPE LAYOUT DWG FILE REF. "041220_Hyde_SitePlan_Option A_Landscape_Resigned plaza and updated car park" RECEIVED ON 16/12/2020 BY SPACE ARCHITECTS

2.4. UNITED UTILITIES RECORD MAP, UI REF. UUPS-ORD-175605 DATED 22/07/2020 (pdf)

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BDP.

HYDE ROAD SECONDARY SCHOOL

P3001502

COMMERCIAL IN CONFIDENCE

EXISTING
PRE-DEVELOPMENT
DRAINED AREAS

1:500 @ A0

DEC 2020

HRS-BDP-ZZ-00-DR-C-50_10-0001

P01

Appendix E

Phase I Geo-Environmental Desk Study Extract

Phase 2 Intrusive Ground Investigation and Assessment Extract

PHASE I GEO-ENVIRONMENTAL DESK STUDY

LAND OFF HYDE ROAD

Manchester City Council

Report: 10041634-ARC-XX-XX-RP-ZZ-0002-01-P1DS

JUNE 2020

Tameside, Trafford and Wigan)”, brick clay is the term used to describe ‘clay and shale’ used in the manufacture of structural clay products. In Greater Manchester, brick clay has been produced for local consumption from small brick pits via the extraction of a variety of clays including boulder clay. Today, one active clay quarry remains in Manchester, at Harwood, working the Pennine Lower Coal Measures (PLCM). The report states that the PLCM are the principal brick clay resource in North West England, therefore it is unlikely that the Glacial Till beneath the site would be used as a source for brick clay in the future.

Sandstone bedrock comprising the Triassic Chester Pebble Beds Formation of the Sherwood Sandstone Group is present beneath the superficial Glacial Till. The BGS report states that the Sherwood Sandstone is rarely worked due to difficulties in removing overburden in the form of Glacial Till and extra treatment required which can make the resource uneconomic compared to more easily worked glacial sands.

In view of the above, it is considered that the Glacial Till clay has no potential value as a mineral resource for construction related use and extraction of the underlying sandstone would not be viable due to the anticipated thickness of clay overburden above and the limited size of the development site.

Additionally, it is considered unlikely that excavations for the development of residential housing or a high school building on the site would extend below the superficial clay strata underlying the site, however onsite ground conditions need to be confirmed through a Phase 2 intrusive ground investigation.

3.2 Hydrogeology and Groundwater Vulnerability

3.2.1 Regional Hydrogeology

The historical borehole logs available for the surrounding area record water strikes at depths of between 24.0 to 28.0m bgl, and resting groundwater levels between 18.5 to 22.0m bgl. The regional water table appears to lie within the upper sandstone strata. Groundwater flow direction is unclear at this stage.

3.2.2 Aquifer Classification

The Groundsure report indicates that the Superficial geology is classified as a Secondary Undifferentiated Aquifer. Generally, these layers have been previously designated as minor and non-aquifers due to variable characteristics of the rock type.

The bedrock geology is classified as a Principal Aquifer. Principal aquifers have high intergranular and/or fracture permeability, providing a high level of water storage and may support water supply/river base flow on a strategic scale.

3.2.3 Groundwater Vulnerability

An assessment of the vulnerability of the groundwater beneath the site to a pollutant discharged at ground level is presented in the Groundsure report.

Groundwater vulnerability at the site has been assessed as Low, which is described as areas providing greatest protection from pollution, likely characterised by the presence of low permeability superficial deposits.

3.2.4 Groundwater Abstraction

The Groundsure report found no current records relating to licensed groundwater abstractions within 1km of the site. There are six records of historical groundwater abstractions, the nearest located 163m east for groundwater from the Permo-Triassic sandstone for dust suppression at Belle Vue.

3.2.5 Groundwater Protection Zones

The site does not lie within 500m of a groundwater Source Protection Zone (SPZ).

3.3 Hydrology

3.3.1 Surface Water Features

The Groundsure report indicates that the nearest surface water body is Platt Brook located 366m south.

3.3.2 Flooding Risk

The Groundsure report indicates that the site is in Flood Zone 1 and is not at risk of flooding from rivers and sea. Localised areas of the site, around the northern perimeter of the cinema building and the access road along the west of the site, are indicated to have a low to high risk of surface water flooding. The site is generally indicated to be at moderate to high risk of groundwater flooding. However, there are no records of historical flood events from rivers, the sea, groundwater or surface water.

3.3.3 Discharge Consents

The Groundsure report includes three records of licensed discharges to controlled waters within 500m of the site. The nearest is a revoked license relating to sewer storm overflow approximately 376m south of the site.

3.3.4 Pollution Incidents

The Groundsure report includes records of four substantiated pollution incidents since 2006 within 500m of the site. None of these had an impact on water, however an incident 323m northeast in 2008 involving vehicles and vehicle parts is stated to have had a significant impact to land.

3.4 Landfills and Waste Management Activities

The Groundsure report did not identify any active or recent landfill sites or BGS/LA recorded historical landfills within 500m of the site.

One EA record of an historical landfill was identified 238m southeast of site. This relates to Mount Road Plant site accepting household waste.

Fourteen historical waste sites are recorded within 500m of the site. The nearest is located 287m southeast relating to a refuse destructor in 1934.

One EA licensed waste site is recorded within 500m of the site. This record relates to King Autos located 412m south, dealing with vehicle depollution.

Fifteen waste exemption records are recorded within 500m of the site. The nearest is located 410m east at Victoria Works, for storage of non-agricultural waste in a secure place.

3.5 Current Industrial Land-Use

The Groundsure report indicates there are 17 potentially contaminative industrial sites within 250m of the study site. Identified on site are two electrical sub stations. Offsite records relate to further electrical features, tanks, containers, storage and warehouses.

The nearest open petrol filling station is 419m east of the site and is operated by Texaco. A closed petrol station is also recorded 229m northwest of the site.

The site is not designated as Contaminated Land under Part 2a of the Environmental Protection Act 1990.

Five records of licensed pollutant release (Part A(2)/B) have been found within 500m of the site. The nearest is 232m northwest of the site relating to Belle Vue Filling Station permitted for unloading petrol into storage at service stations.

3.6 Environmental Designations

The Groundsure report did not identify any of the following statutory protected sites within 2km of the site: Site of Special Scientific Interest (SSSI), Conserved Wetland Site (Ramsar Sites), National Nature Reserve (NNR), Special Area of Conservation (SAC), Special Protection Area (SPA), RAMSAR, Local Nature Reserve (LNR), Designated Ancient Woodland, Biosphere Reserves, Forest Parks, Marine Conservation Zones, Green Belt, Proposed Ramsar Sites, Possible Special Areas of Conservation (pSAC), Potential Special Protection Areas (pSPA) or Nitrate Sensitive Areas/Vulnerable Zones.

3.7 Invasive Plants & Species

A specific ecological walkover has not been completed by Arcadis, and therefore no detail can be given regarding the presence or absence of invasive plants / protected species.

4 SITE HISTORY

4.1 Site History

Based on historical maps provided by Groundsure (presented in Appendix H) the site history is summarised below.

Map Dates	Comments
1849	The majority of the site was originally part of Belle Vue Gardens. Several ponds are shown to the southwest of the site.
1893 - 1961	The site was developed as Belle Vue Zoological Gardens with buildings present across the northern half, a lake in the south-eastern parcel and a pond and landscaping to the south. A railway siding appears to enter and terminate in the north-western corner of the site. The buildings to the north may have been associated with the neighbouring brewery. A tank is labelled within the southern boating lake on the 1933 map edition. Additional small ponds are shown to the south of the site from 1950 and a scenic railway is shown to the northwest from this date. A miniature railway and chimney are depicted on the 1960 map though the centre of the site.
1968 - 1984	Northern part of the site remains unchanged with similar building layout. Boating lake to the east of the site appears to have been infilled. Lake to the south potentially also infilled. The site is called Belle Vue Leisure Park by 1984.
1985 - 1989	Site has been cleared with two roads appearing to enter the site from neighbouring highways to the west of site.
1991 - 2001	Site has undergone major redevelopment into current layout with main cinema building to the north of the central parcel, car parking to the south and east and access road on site.
2003	Majority of the site remains unchanged. Northwest corner has seen small development of two buildings.
2019 (Aerial Photograph)	Large central building (Cinema) remains with car parking to the south. Buildings in northwest corner demolished between 2015 and 2019.

4.2 Potentially Contaminative History of the Surrounding Area

Based on historical maps provided by Groundsure (presented as Appendix H) the pertinent history of the area surrounding the site is summarised below.

Location	Map dates	Land Use
~450m south	1849 - 1923	Print and bleach works. Relabelled dye works and chemical works from 1892.
Adjacent northwest	1892 - 1933	Railway line from Longsight station approximately 700m southwest.
~20m west (potentially extending onsite)	1892 - 1923	Brewery.
~300m east	1892 - Present	Railway line.
~200m northwest	1892 - 1981	Iron works. Labelled engineering works and iron works from 1923 map.

Phase 1 Geo-Environmental Desk Study
Land off Hyde Road

Adjacent north and south	1893 - 1933	Tramlines shown within Hyde Road and Kirkmanshulme Lane.
~300m south	1905 – 1923	Tarpaulin works.
~340m northeast	1905	Brick Works
~350m southeast	1905 – 1968	Sewage works. Later just labelled refuse destructor.
~35m west	1908	Gas works. Tanks shown between 1893 and 1922, however only labelled gas works on 1908 map.
~190m east	1915 - 1938	Corporation Yard
~150m west	1934 - 1985	Speedway stadium and exhibition hall.
~350m northeast	1934 - 1985	Motor works.
~250m west	1991 – Present	Car auction.

4.3 History Summary

The site was originally part of Belle Vue Gardens, later becoming the Belle Vue Zoological Gardens. Several ponds and boating lake features were subsequently infilled and by 1991 the site was redeveloped to the current layout principally comprising a cinema building and associate car parking. The recent buildings located on the northwest parcel have since been demolished.

Surrounding land has comprised a mix of industrial, commercial leisure and residential uses. Nearby breweries, tanks, engineering and other works were present locally from the late 1800's, however heavy industry has since faded from the area.

5 Hydrogeology - Superficial aquifer



- Site Outline
- Search buffers in metres (m)
- Principal
 - Secondary A
 - Secondary B
 - Secondary Undifferentiated
 - Unproductive
 - Unknown

5.1 Superficial aquifer

Records within 500m

1

Aquifer status of groundwater held within superficial geology.

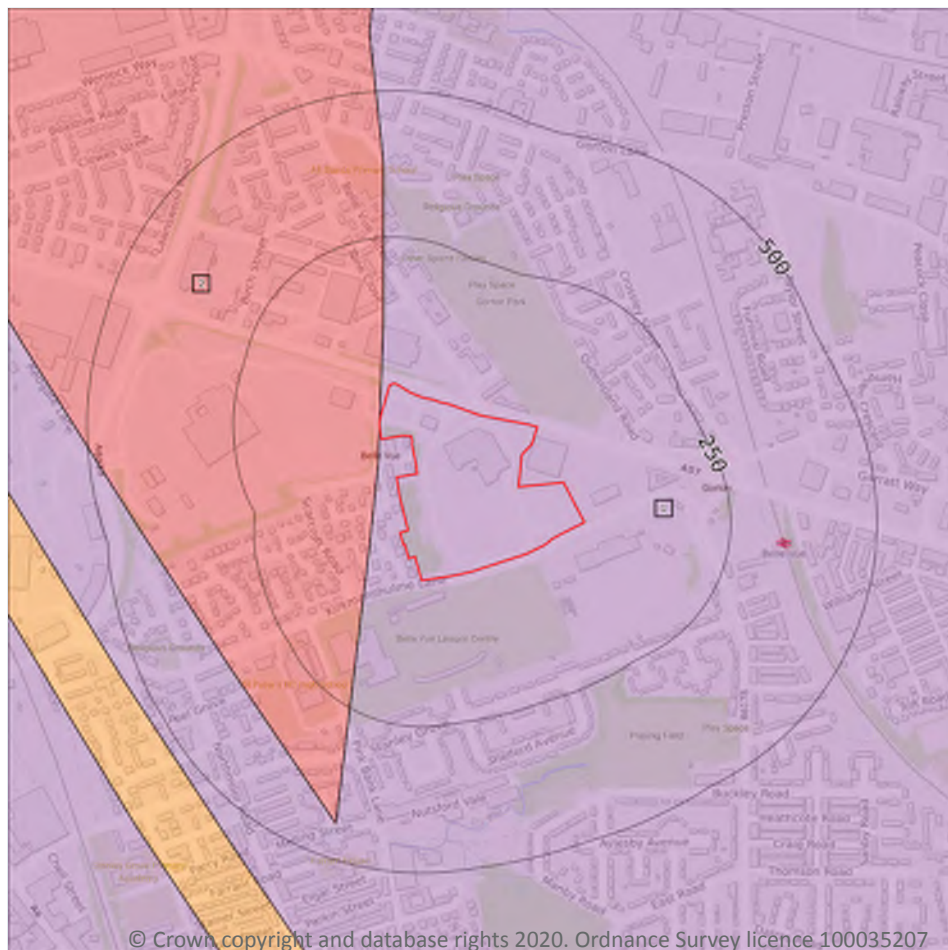
Features are displayed on the Hydrogeology map on **page 52**

ID	Location	Designation	Description
1	On site	Secondary Undifferentiated	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type

This data is sourced from the British Geological Survey, the Environment Agency and Natural Resources Wales.



Bedrock aquifer



- Site Outline
- Search buffers in metres (m)
- Principal
 - Secondary A
 - Secondary B
 - Secondary Undifferentiated
 - Unproductive

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5.2 Bedrock aquifer

Records within 500m

2

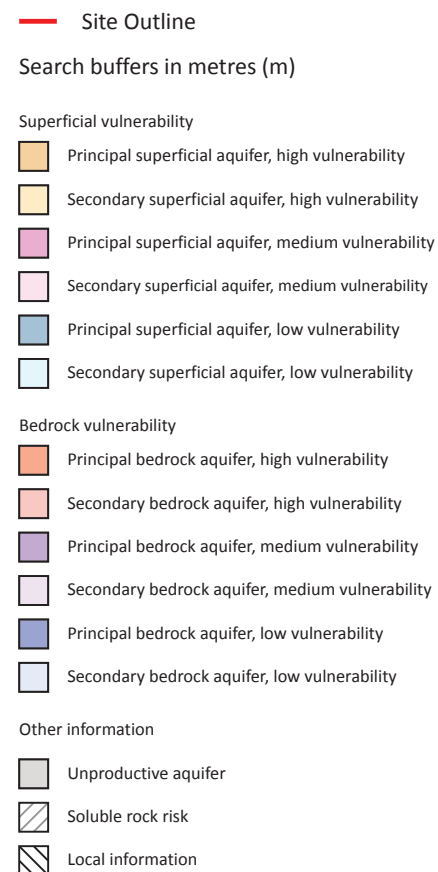
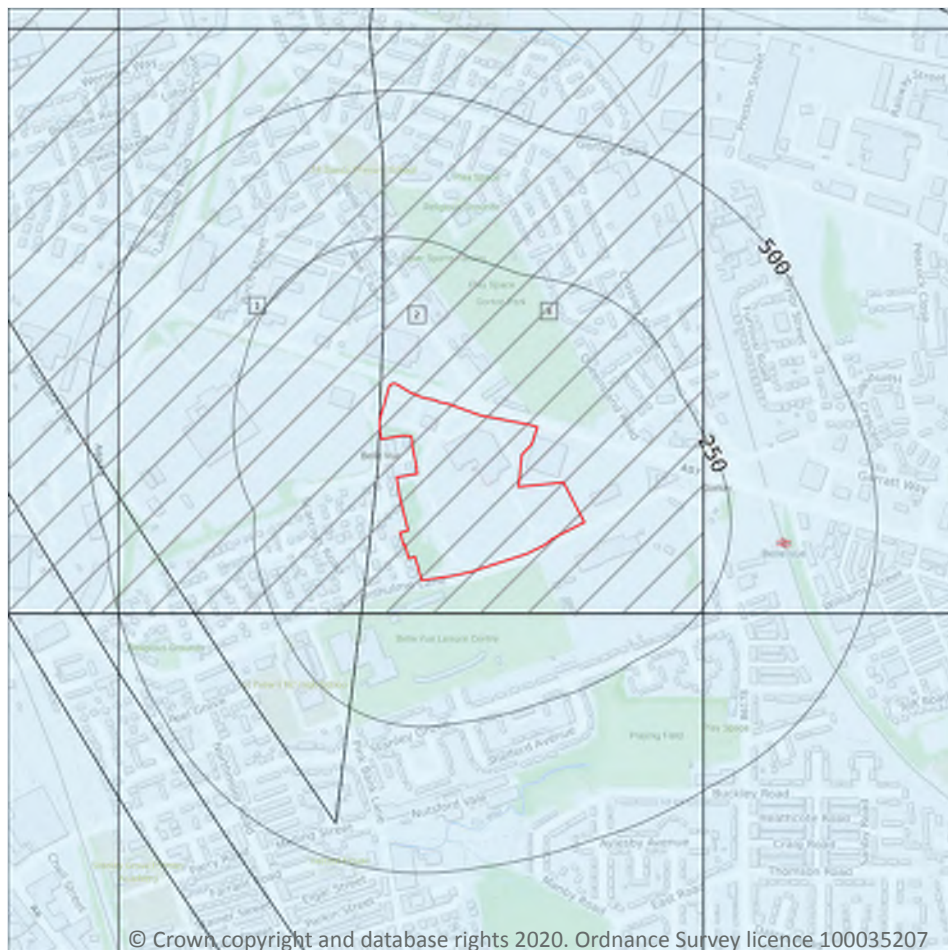
Aquifer status of groundwater held within bedrock geology.

Features are displayed on the Bedrock aquifer map on **page 53**

ID	Location	Designation	Description
1	On site	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers
2	On site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers



Groundwater vulnerability



5.3 Groundwater vulnerability

Records within 50m

2

An assessment of the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a one kilometre square grid. Groundwater vulnerability is described as High, Medium or Low as follows:

- High - Areas able to easily transmit pollution to groundwater. They are likely to be characterised by high leaching soils and the absence of low permeability superficial deposits.
- Medium - Intermediate between high and low vulnerability.
- Low - Areas that provide the greatest protection from pollution. They are likely to be characterised by low leaching soils and/or the presence of superficial deposits characterised by a low permeability.

Features are displayed on the Groundwater vulnerability map on **page 55**

Abstractions and Source Protection Zones



- Site Outline
- Search buffers in metres (m)**
- Source Protection Zone 1
Inner catchment
- Source Protection Zone 2
Outer catchment
- Source Protection Zone 3
Total catchment
- Source Protection Zone 4
Zone of Special Interest
- Source Protection Zone 1c
Inner catchment - confined aquifer
- Source Protection Zone 2c
Outer catchment - confined aquifer
- Source Protection Zone 3c
Total catchment - confined aquifer
- Drinking water abstraction licences
Point features
- Drinking water abstraction licences
Polygon features
- Drinking water abstraction licences
Linear features
- Groundwater abstraction licence (point)
- Groundwater abstraction licence (area)
- Groundwater abstraction licence (linear)
- Surface Water Abstractions (point)
- Surface Water Abstractions (area)
- Surface Water Abstractions (linear)

5.6 Groundwater abstractions

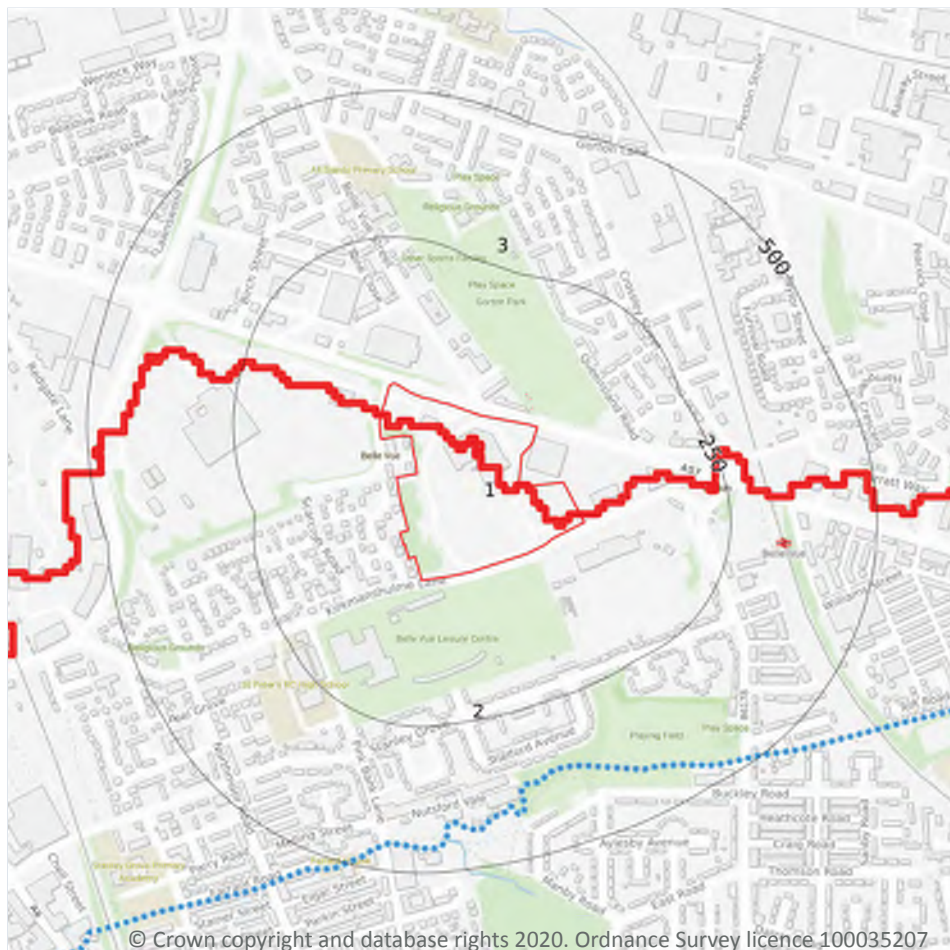
Records within 2000m

26

Licensed groundwater abstractions for sites extracting more than 20 cubic metres of water a day and includes active and historical records. The data may be for a single abstraction point, between two points (line data) or a larger area.

Features are displayed on the Abstractions and Source Protection Zones map on **page 57**

6 Hydrology



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- Site Outline
- Search buffers in metres (m)
- Water Network (OS MasterMap)
- Surface water features (wider than 5m)
- Surface water features (narrower than 5m)
- ⋯ WFD River, canal and surface water transfer water bodies
- WFD Lake water bodies
- WFD Transitional and coastal water bodies
- WFD Surface water body catchments boundaries
- WFD Groundwater body boundaries

6.1 Water Network (OS MasterMap)

Records within 250m

0

Detailed water network of Great Britain showing the flow and precise central course of every river, stream, lake and canal.

This data is sourced from the Ordnance Survey.

6.2 Surface water features

Records within 250m

0

Covering rivers, streams and lakes (some overlap with OS MasterMap Water Network data in previous section) but additionally covers smaller features such as ponds. Rivers and streams narrower than 5m are represented as a single line. Lakes, ponds and rivers or streams wider than 5m are represented as polygons.



7 River and coastal flooding

7.1 Risk of Flooding from Rivers and Sea (RoFRaS)

Records within 50m

0

The chance of flooding from rivers and/or the sea in any given year, based on cells of 50m. Each cell is allocated one of four flood risk categories, taking into account flood defences and their condition; Very low (less than 1 in 1000 chance in any given year), Low (less than 1 in 100 but greater than or equal to 1 in 1000 chance), Medium (less than 1 in 30 but greater than or equal to 1 in 100 chance) or High (greater than or equal to 1 in 30 chance).

This data is sourced from the Environment Agency and Natural Resources Wales.

7.2 Historical Flood Events

Records within 250m

0

Records of historic flooding from rivers, the sea, groundwater and surface water. Records began in 1946 when predecessor bodies started collecting detailed information about flooding incidents, although limited details may be included on flooding incidents prior to this date. Takes into account the presence of defences, structures, and other infrastructure where they existed at the time of flooding, and includes flood extents that may have been affected by overtopping, breaches or blockages.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.3 Flood Defences

Records within 250m

0

Records of flood defences owned, managed or inspected by the Environment Agency and Natural Resources Wales. Flood defences can be structures, buildings or parts of buildings. Typically these are earth banks, stone and concrete walls, or sheet-piling that is used to prevent or control the extent of flooding.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.4 Areas Benefiting from Flood Defences

Records within 250m

0

Areas that would benefit from the presence of flood defences in a 1 in 100 (1%) chance of flooding each year from rivers or 1 in 200 (0.5%) chance of flooding each year from the sea.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.5 Flood Storage Areas

Records within 250m

0

Areas that act as a balancing reservoir, storage basin or balancing pond to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel or to delay the timing of a flood peak so that its volume is discharged over a longer period.

This data is sourced from the Environment Agency and Natural Resources Wales.



River and coastal flooding - Flood Zones

7.6 Flood Zone 2

Records within 50m	0
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Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land between Flood Zone 3 (see next section) and the extent of the flooding from rivers or the sea with a 1 in 1000 (0.1%) chance of flooding each year.

This data is sourced from the Environment Agency and Natural Resources Wales.

7.7 Flood Zone 3

Records within 50m	0
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Areas of land at risk of flooding, when the presence of flood defences are ignored. Covering land with a 1 in 100 (1%) or greater chance of flooding each year from rivers or a 1 in 200 (0.5%) or greater chance of flooding each year from the sea.

This data is sourced from the Environment Agency and Natural Resources Wales.



8 Surface water flooding



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— Site Outline

Search buffers in metres (m)

1 in 1000 return period

- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 250 return period

- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 100 return period

- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

1 in 30 return period

- Depth between 0.1m - 0.3m
- Depth between 0.3m - 1.0m
- Depth greater than 1.0m

8.1 Surface water flooding

Highest risk on site

1 in 30 year, 0.3m - 1.0m

Highest risk within 50m

1 in 30 year, 0.3m - 1.0m

Ambiental Risk Analytics surface water (pluvial) FloodMap identifies areas likely to flood as a result of extreme rainfall events, i.e. land naturally vulnerable to surface water ponding or flooding. This data set was produced by simulating 1 in 30 year, 1 in 100 year, 1 in 250 year and 1 in 1,000 year rainfall events. Modern urban drainage systems are typically built to cope with rainfall events between 1 in 20 and 1 in 30 years, though some older ones may flood in a 1 in 5 year rainfall event.

Features are displayed on the Surface water flooding map on **page 72**

The data shown on the map and in the table above shows the highest likelihood of flood events happening at the site. Lower likelihood events may have greater flood depths and hence a greater potential impact on a site.

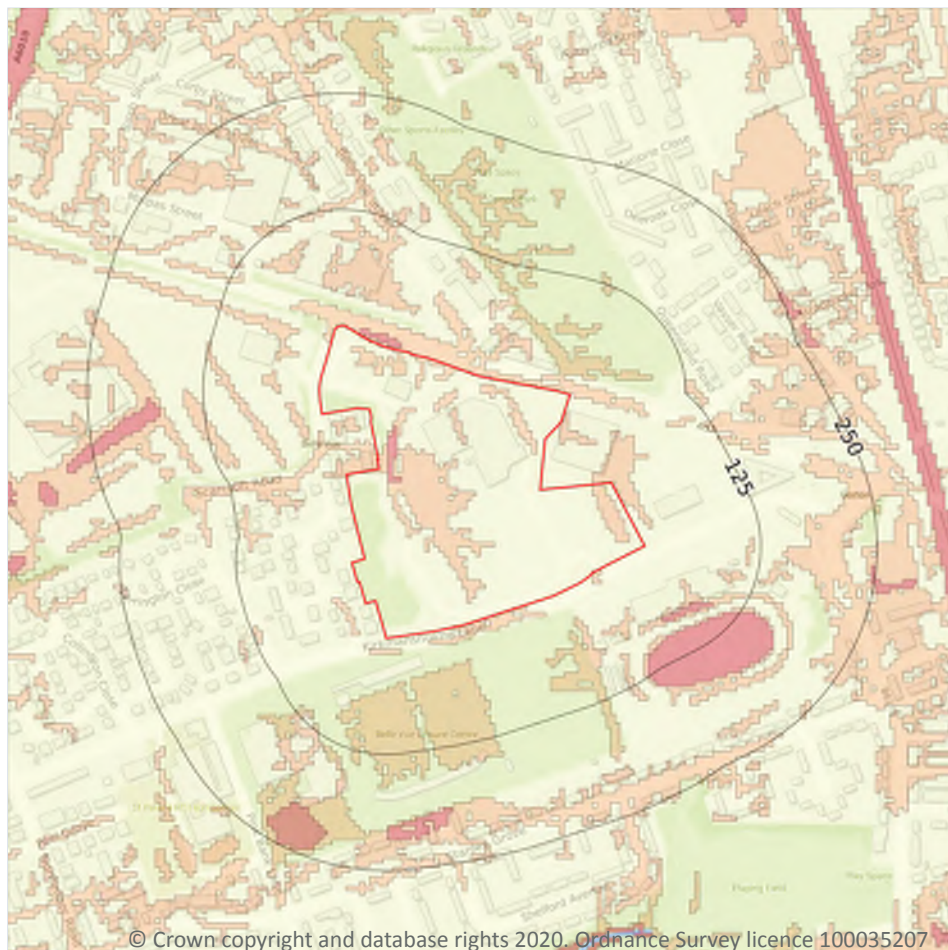
The table below shows the maximum flood depths for a range of return periods for the site.

Return period	Maximum modelled depth
1 in 1000 year	Between 0.3m and 1.0m
1 in 250 year	Between 0.3m and 1.0m
1 in 100 year	Between 0.3m and 1.0m
1 in 30 year	Between 0.3m and 1.0m

This data is sourced from Ambiental Risk Analytics.



9 Groundwater flooding



— Site Outline
Search buffers in metres (m)

- High
- Moderate - High
- Moderate
- Low
- Negligible

9.1 Groundwater flooding

Highest risk on site

High

Highest risk within 50m

High

Groundwater flooding is caused by unusually high groundwater levels. It occurs when the water table rises above the ground surface or within underground structures such as basements or cellars. Groundwater flooding tends to exhibit a longer duration than surface water flooding, possibly lasting for weeks or months, and as a result it can cause significant damage to property. This risk assessment is based on a 1 in 100 year return period and a 5m Digital Terrain Model (DTM).

Features are displayed on the Groundwater flooding map on **page 74**

This data is sourced from Ambiantal Risk Analytics.

PHASE 2 INTRUSIVE GROUND INVESTIGATION & ASSESSMENT

LAND OFF HYDE ROAD

Manchester City Council

Ref: 10041634-ARC-XX-XX-RP-ZZ-0005-01-P2GIA

AUGUST 2020

4 Ground Conditions

The key findings of the ground investigation are summarised below and include descriptions of the interpreted geological and hydrogeological conditions, as well as in-field observations of any contamination observed.

4.1 General Stratigraphy

A detailed description of the ground conditions encountered at the site during the intrusive investigation is included on the borehole logs, presented as Appendix C and summarised below. All geotechnical and chemical laboratory reports are presented in Appendix E and F respectively.

Interpreted soil type / geological unit	Minimum depth (m bgl)	Maximum depth (m bgl)	Description
Made Ground	0.0 (All)	3.3 (WS110)	Generally bituminous hardstanding underlain by sandy gravel of type 1 material, over predominantly granular Made Ground comprising slightly clayey slightly sandy fine to coarse gravel with fragments of brick, sandstone, limestone, concrete and occasional wood and clinker. Made Ground is occasionally recorded as slightly clayey slightly gravelly fine to coarse sand. Granular Made Ground is frequently underlain by cohesive strata comprising sandy gravelly clay with many cobbles of brick and concrete and occasionally soft to firm dark grey sandy gravelly clay with an organic odour.
Glacial Till	0.6 (CP107)	15.0 (All cable percussion boreholes except CP102)	Firm to very stiff brown and grey sandy gravelly clay, with a layer of fine to medium sand generally recorded at depths between 6 to 11m bgl in boreholes located to the east of the site.
Sandstone (Chester Pebble Beds Formation) – CP102 only	12.9 (CP102)	13.2 (CP102) Base not proven	Orangish brown fine to medium SANDSTONE recovered as angular coarse gravel.

4.2 Made Ground

Category	Data	Information
General	Distribution	Encountered in all of the exploratory holes formed at the site from ground level to depths of between 0.60 and 3.30m bgl. Made Ground appears to be thicker across the north-western and south-eastern parcels where it was generally recorded to a depth of between 2.2 to 2.5m bgl. Across the central site area, Made Ground was generally recorded to a depth of between 0.6 and 1.4m bgl.
	In-situ - SPTs	SPT N-values between 3 and 23 were recorded indicating variable material.

Category	Data	Information			
Geotechnical Testing	Natural Moisture Content (4 samples, 0.50 – 1.65m bgl)	Natural Moisture Content: 18 - 52%.			
	Atterberg Limits (4 samples, 0.5 – 1.65m bgl)	Liquid Limit: 42 - 69% Plastic Limit: 17 - 49% Plasticity Index: 20 - 29% Fraction <0.425mm: 39 - 100% Modified Plasticity Index: 11 - 29% - Cohesive Made Ground is of intermediate to high plasticity / low to medium shrink/swell potential.			
	Particle Size Distribution (7 samples, 0.1 – 1.0m bgl)	Total percentage of soil fractions: Cobbles: 0 - 52% Gravel 20 - 82% Sand: 12 - 33% Silt/Clay: 4 - 20% - Generally, slightly clayey/silty sandy fine to coarse GRAVEL (with cobbles)			
	One Dimensional Consolidation Test	Location	Depth (m)	M _v (MPa ⁻¹ or m ² /MN)	Description
		CP104	1.2-1.65	0.401	High Compressibility
		M _v calculated for pressure range equivalent to sample overburden pressure plus 100kPa.			
Soil Quality Observations	Obstructions	WS103, WS105, WS105A, WS106, WS106A, WS112, WS114 and WS115 all encountered buried concrete slabs within the hand-pits. WS107 and WS109 refused at 1.3m bgl on cobbles and boulders within Made Ground.			
	Visual / Olfactory Evidence of Contamination	Organic odours were frequently noted within the Made Ground between depths of 0.60 m bgl to 2.30m bgl. Clinker, slag and ashy material was recorded within shallow Made Ground at various locations across the site. Hydrocarbon odours were recorded as below: - CP103, 0.8 – 1.3m bgl: Slight hydrocarbon odour - CP106, 0.5 – 1.0m bgl: Slight hydrocarbon odour - WS106, 0.4 – 0.8m bgl: Hydrocarbon odour			
	NAPL	None.			
	PID Screening	Max 7.2ppm (WS106A at 0.5m bgl).			

Category	Data	Information
	Asbestos	No Asbestos containing materials observed.

4.3 Glacial Till

Category	Data	Information
General	Distribution	Glacial Till was encountered in all exploratory holes, beneath Made Ground deposits and overlying the bedrock.
Geotechnical Testing	In-situ - SPTs	SPT N-values between 6 and >50 (refusal) were recorded, however were generally greater than 15. The N-value of 6 was recorded in soils described as stiff clay and coincided with a shallow water strike indicating a degree of softening. N-values were generally found to increase with depth and indicate firm to very stiff soils.
	Natural Moisture Content (17 samples, 1.20 – 13.95m bgl)	Natural Moisture Content: 9 – 32%
	Atterberg Limits (17 samples, 1.2 – 13.95m bgl)	Liquid Limit: 36 – 49% Plastic Limit: 12 – 30% Plasticity Index: 12 – 31% Fraction <0.425mm: 54 – 100% Modified Plasticity Index: 12 – 29% - Intermediate to high plasticity / low to medium shrink/swell potential.
	Particle Size Distribution (3 samples, 5.6 – 8.5m bgl)	Total percentage of soil fractions: Cobbles: 0% Gravel 0 - 1% Sand: 73 - 97% Silt/Clay: 3 - 26% Generally, slightly clayey/silty fine to coarse SAND or slightly gravelly clayey/silty fine to coarse SAND.
	Undrained Shear Strength in Triaxial Compression	Depth (m)
		Cell Pressure (kPa)
		Cohesion (kPa)
		Mode of Failure
		2.00 – 2.45
		40
		101
		Compound
		3.00 – 3.45
		60
		266
		Plastic
		4.00 – 4.45
		80
		277
		Compound
		5.00 – 5.45
		100
		81
		Plastic
		7.50 – 7.95
		100
		55
		Plastic

Category	Data	Information			
		7.50 – 7.95	150	101	Plastic
		9.00 – 9.45	180	42	Compound
		13.50 – 13.95	270	49	Plastic
Soil Quality Observations	Obstructions	Refusals during drilling (refused on stiffness of clay N >50): WS108, WS111, WS113, WS116 all refused at depths below 3.00m bgl			
	Visual / Olfactory Evidence of Contamination	None.			
	NAPL	None.			
	PID Screening	Max 5.5ppm (CP106 at 1.2m bgl).			
	Asbestos	No Asbestos containing materials observed.			

4.4 Bedrock

Category	Data	Information
General	Distribution	Bedrock was only observed in CP102 at 12.90m bgl, where it was taken down to 13.20m bgl following 1 hour of chiselling. The bedrock was recorded as orangish brown fine to medium sandstone of the Chester Pebble Bed Formation and was recovered as angular coarse gravel.
Geotechnical Testing	In-situ - SPTs	SPT N-values >50 (refusal) were recorded.
Soil Quality Observations	Obstructions	Borehole CP102 terminated upon 1 hour of chiselling in the bedrock.
	Visual / Olfactory Evidence of Contamination	None.

4.5 Hydrogeology

Subject	Information
Groundwater Levels	During drilling, groundwater strikes were encountered as below: CP101: 1.70m bgl (rising to 1.50m bgl) – within shallow Made Ground CP102: 8.50 bgl - within dense sand strata CP103: 7.50m bgl – within dense sand strata CP103: 13.30m bgl – slight seepage within stiff clay strata CP104: 0.50m bgl (rising to 0.30m bgl) – within shallow Made Ground CP104: 8.00m bgl (rising to 7.60m bgl) – within dense sand strata

Phase 2 Intrusive Ground Investigation & Assessment
Renfrew Road, Paisley

	CP106: 3.00m bgl (rising to 2.00m bgl) – within stiff clay above a layer of sand WS107: 0.30 m bgl – within shallow Made Ground WS108: 0.5m bgl (rising to 0.2m bgl) – within shallow Made Ground WS111: 1.00m – within stiff clay, just below granular Made Ground
	During subsequent monitoring, resting groundwater levels were recorded within the newly installed groundwater monitoring well infrastructure as follows: CP101 11.39 – 11.48m bgl CP102 7.38 - 7.40m bgl CP104 5.72 – 5.75m bgl CP107 8.50 - 8.55m bgl WS102 1.77 - 1.83m bgl WS104 1.48 – 1.50m bgl WS107 0.45 – 0.49m bgl WS108 0.55 – 0.62m bgl WS110 1.20 – 1.26m bgl WS111 0.70 – 0.81m bgl WS113 0.88 - 0.95m bgl WS116 Dry Shallow groundwater recorded within the windowless sample boreholes is considered to represent a perched waterbody within the Made Ground deposits. Within the deeper cable percussion boreholes groundwater was encountered in a saturated layer of sand within the Glacial Till deposits recorded in boreholes to the east of the site. Elsewhere, the true groundwater table was not intercepted during drilling, but resting levels were recorded within CP101 at a depth of roughly 11.5m bgl.
Groundwater Flow Direction	Based on the measured depth to groundwater from surface level a groundwater flow direction broadly towards the north west can be inferred.
Visual / Olfactory Evidence of Contamination	No visual/olfactory evidence of contamination was noted during groundwater monitoring or sampling.
NAPL	No NAPL was recorded during groundwater monitoring or sampling.

5 Geotechnical Appraisal

5.1 Proposed Development

A feasibility layout plan, presented in Appendix B, illustrates the preferred layout for the central school development. It is understood that all discussions to date have led to a preference for the school to be located at the northern Hyde Road end of the site. The feasibility plan shows a three-storey main school building roughly within the footprint of the existing cinema building, with car parking to the north east and playing fields and sports pitches to the south. The appraisal below and recommendations provided are based on this feasibility plan and the current proposed location for the main school building.

It is understood that the north-west and south-east parcels of land are being considered for residential redevelopment, however, preliminary layout plans have not been made available to Arcadis for these areas.

We have assumed that the development levels will mimic existing levels and therefore significant re-profiling of the site will not be undertaken.

5.2 Ground Conditions

Ground conditions across the site were found to comprise a sequence of Made Ground, underlain by predominantly cohesive Glacial Till deposits, in turn underlain by sandstone bedrock of the Chester Pebble Bed Formation, however this was only exposed in CP102 at 12.90m bgl.

Made Ground was encountered in all of the exploratory holes to a maximum depth of 3.30m bgl. Bituminous hardstanding was generally recorded over sandy gravel of type 1 material to depths of between 0.1 and 1.4m bgl. In the majority of exploratory locations this was underlain by predominantly granular Made Ground comprising slightly clayey slightly sandy fine to coarse gravel. Granular Made Ground was frequently underlain by cohesive strata comprising sandy gravelly clay with many cobbles of brick and concrete.

Made Ground appears to be thicker across the north-western and south-eastern parcels where it was generally recorded to a depth of between 2.2 to 2.5m bgl. Across the central site area, Made Ground was generally recorded to a depth of between 0.6 and 1.4m bgl.

The underlying Glacial Till deposits were generally found to comprise firm to very stiff sandy gravelly clay. SPT N-values were recorded between 6 and >50 (refusal), however were generally recorded greater than 15, with values increasing with depth. Several cobbles were also noted within the Glacial Till.

Bedrock geology was observed only in CP102 at 12.90m bgl, indicating the bedrock is shallower in the east of the site. The bedrock comprised orangish brown fine to medium sandstone recovered as angular coarse gravel and was taken to 13.20m bgl after 1 hour of chiselling.

5.3 Site Preparation

At present the majority of the site comprises car parking with the main cinema building in the north. The intrusive ground investigation encountered numerous obstructions at shallow depth, including buried concrete slabs in multiple locations.

General turnover of the uppermost Made Ground will therefore be required locally (i.e. beneath the footprints of new buildings and along service routes) to allow the breaking out and removal of former sub-structures including brick and concrete foundations. Concrete and masonry should be crushed to a suitable grading (e.g. 6F2) for re-use in the development (e.g. working platforms, road capping, temporary haulage roads etc.).

Where structures are particularly deep (e.g. old piles), total removal will not be practical or economical and therefore the positions of such obstructions should be accurately recorded to allow new foundations to be designed around them accordingly.

Furthermore, the remaining structures located across the site will require full above and below ground demolition prior to re-development.

Excavations formed as a result of the demolition activities will require adequate backfilling to a specification suitable to the proposed use of the area in question. Sorting and screening to remove deleterious materials and crushing of oversized items (concrete blocks, blocks of masonry, etc.) should be undertaken where necessary in order to facilitate and improve the compaction of site-won fill materials during placement. This

process may generate a fraction which will not be suitable for re-use (including potentially deleterious materials such as timber) and as such these are likely to require offsite disposal.

Granular materials should be used preferentially in areas beneath proposed structures. The use of cohesive materials should therefore be considered more appropriate as general fill (in landscape areas for example) where settlements are less critical.

5.4 Foundations and Floor Slabs

In their untreated state, the Made Ground deposits are considered unsuitable for the direct support of conventional shallow-spread strip foundations as their potentially variable relative density could give rise to unacceptable magnitudes of total and differential settlements on loading.

In the area currently proposed for the main school structure (north of the central site area) ground conditions comprise Made Ground to depths of between 0.6 and 1.4m bgl, underlain by firm to stiff glacial clay. Preliminary calculations indicate that an allowable net bearing capacity of around 130kN/m² is likely to be feasible for pad foundations up to 1m² at a depth of around 1.5m. For greater loads, a piled foundation solution would be required to transfer loads through to the competent Glacial Till at depth. These options are considered typical foundation solutions for a new school building. At present, however, the existing cinema building is located roughly within the footprint of the proposed school building. Therefore, supplementary investigation will be required post demolition to obtain development-specific geotechnical design parameters for the school building.

Based on the ground conditions encountered and the plasticity of the predominantly cohesive Made Ground, suspended floor slabs would be required for the school building if shallow foundations are adopted and for piled foundation solutions to eliminate differential settlement between the piled super structure and the floor slab.

Within the north-western and south-eastern parcels, Made Ground was recorded to greater depths, generally between 2.2 and 2.5m bgl. Therefore, traditional shallow spread foundations are unlikely to be feasible/economical for the residential development proposed in these areas. Deep, trench fill foundations are also not likely to be feasible as the sides of excavations through the Made Ground may become unstable resulting in oversize foundations and excessive volumes of concrete. The most economical foundation solution will likely comprise ground improvement by vibro-treatment methods (such as vibro stone columns) to improve and unify the shallow soils. Treatment would be required to extend the full thickness of the Made Ground and within the underlying Glacial Till, to depths of around 3m bgl. Following vibro-treatment, suitably reinforced spread foundations based upon a net allowable bearing pressure of about 125kPa could be formed on the treated ground at depths of around 1m bgl.

If ground improvement by vibro treatment is to be considered further, consultation with a reputable ground-improvement specialist is recommended. Ideally the specialist will have local knowledge and have experience of working on similar developments with similar ground conditions.

Due consideration should also be given to the following limitations:

- NHBC standards require that vibro-treatment beneath structures extends through the full thickness of Made Ground to the underlying (competent) Glacial deposits.
- Consideration should be given to the impact during construction, in terms of noise/vibration etc. upon nearby structures, services and developments.
- There are distance limitations of vibro-treatment adjacent to existing structures/services; these are understood to be in the order of 2-6m and therefore consideration should be given to buildings on the adjacent land.

A mini pile foundation solution may be an appropriate alternative solution for low-rise residential structures, with piles extending through the Made Ground to the stiff Glacial Till at depths of around 3 to 4m bgl. However, whether or not this would be more cost effective than the ground improvement solution will depend upon a number of factors including the design costs, mobilisation costs, length of the piles, etc.

Detailed pile designs (in terms of pile type, depths, and method of installation) would be dependent upon the required working loads and should be undertaken in conjunction with a reputable, specialist, piling contractor; ideally with local experience.

For the residential parcels, floor slabs will be subjected to relatively light loads and therefore ground-bearing floor slabs may be feasible if ground improvement is undertaken (subject to appropriate preparation and treatment of the subgrade formation and where necessary the allowance for capping in addition to Type 1 sub-base). However, the type of floor slab construction is also dependent on the foundation design, the combination of which will also need to take into consideration any requirement for ground gas mitigation and therefore suspended floor slabs are likely to be more appropriate.

5.5 Pavement Design

In consideration of the ground conditions encountered, it is likely that the pavement subgrade exposed at formation levels will comprise predominantly granular Made Ground deposits.

For preliminary design purposes, based upon the available soil descriptions, it is recommended that new road pavement and road construction design be based upon (an estimated) CBR value of about 5%. However, the design value will need to be reviewed and confirmed by suitable in-situ testing at formation levels following any earthwork operations and prior to pavement construction.

The formation at all levels will require proof-rolling prior to pavement construction, and any soft zones thus revealed excavated out, with the resulting excavation in-filled with appropriately graded engineered granular fill.

5.6 Concrete Classification

Design/mix of buried concrete should be undertaken in accordance with BRE Special Digest 1 (2005).

A summary of the soil and groundwater chemical results pertinent to concrete classification is presented in the following table.

Matrix	Test	Range of Values
Soil	pH	6.7 – 11.6
	Water Soluble Sulphate 2:1 Extract (mg/l)	16.9 – 235
Groundwater	pH	7.13 – 7.46
	Sulphate (mg/l)	35.3 – 60.3

A review of the available soil and groundwater chemical results indicates that sulphate and pH results fall within “Design Sulphate Class” DS-1, and the “Aggressive Chemical Environment for Concrete” (ACEC) class for the site is considered to be AC-1. Design/mix of buried concrete should be undertaken in accordance with these classifications.

5.7 Excavations & Groundwater

Excavations at the site should be feasible using an appropriate scale of hydraulic plant. All excavations at the site will require adequate lateral support, or battering back to a safe angle, to ensure their stability.

Based on the available data, it is considered likely that perched groundwater will be encountered in shallow excavations (i.e. <2.0mbgl) at the site, especially during periods of wet weather and in this scenario appropriate groundwater control/dewatering provisions should be employed to keep such excavations dry.

5.8 Infiltration Drainage

Given the presence of site wide cohesive Glacial Till deposits underlying the Made Ground, infiltration drainage via soakaways are unlikely to be feasible due to the anticipated low infiltration rate of the underlying soils.

6 Contamination Assessment

6.1 Generic Quantitative Risk Assessment

In order to assess the potential significance of the CoC in relation to the potentially active source-pathway-receptor linkages identified, the measured concentrations of CoC in soil and groundwater have been compared to applicable Arcadis GAC derived based on a residential end-use of the site. This is a conservative scenario when considering the school development.

Concentrations of CoC have been compared to GAC protective of potential future onsite residents and site users, and GAC derived for the protection of neighbouring residents.

Desk study information and the results of the intrusive investigation indicates that the Site is underlain by Glacial Till deposits, which are classified as a secondary undifferentiated aquifer with local or limited potential. The superficial deposits are underlain by the Chester Pebble Beds Formation which is classified as a principal aquifer. Based on this, concentrations of CoC measured in soil and groundwater have been compared to GAC protective of the underlying aquifers.

Surface water features are not considered a potential receptor as the nearest is Platt Brook, located approximately 365m away from the site.

The GAC have been derived by Arcadis, in line with guidance provided by the Environment Agency (EA). The derivation of the Arcadis GAC, to which the concentrations of potential contaminants have been compared, is presented as Appendix G and the results of the soil and groundwater generic quantitative risk assessment are presented in the tables in Appendix H. These are summarised in the following sections.

6.2 Summary of Laboratory Results

6.2.1 Soil

A total of 36 soil samples were scheduled for chemical laboratory analysis.

Concentrations of various TPH fractions were measured above the laboratory Method Detection Limit (MDL) in the majority of soil samples analysed. Sum TPH was measured at concentrations greater than 1,000mg/kg in the soil samples from CP103 at 1.0m bgl (2,820mg/kg), CP106 at 0.6m bgl (3,670mg/kg) and WS106 at 0.4 – 0.5m bgl (2,430mg/kg).

Concentrations of Benzene, Toluene, Ethylbenzene and Xylene were all found to be below the laboratory MDL. The sum of BTEX for all soil samples was below the laboratory MDL. The measured concentrations of MTBE were below the laboratory MDL for all soil samples.

Various PAH fractions were measured above the MDL in the majority of soil samples analysed. The highest detected Total PAH concentration was recorded as 67.1mg/kg in the soil sample from WS101 at 2.2 – 2.3m bgl.

Concentrations of various metals were measured above the MDL in all of the soil samples analysed.

Several soil samples were analysed for SVOCs and VOCs, with the majority of compounds analysed measuring below the laboratory MDL or at very low levels.

The soil samples analysed for polychlorinated biphenyls (PCBs) were found to be below the laboratory MDL.

A total of 25 soil samples were scheduled for asbestos screening and 6 positive identifications were made in the laboratory. Amosite asbestos fibres were found to be present within the soil sample from WS103 0.7 – 0.8m bgl and CP107 0.3m bgl, and amosite containing debris was found within CP101 0.5 – 0.6m bgl. Chrysotile fibres were also identified within the soil sample from WS109 0.5 – 0.6m bgl and WS116 0.2 – 0.3m bgl. Subsequent quantification analysis found these to be at concentrations <0.001%.

The soil sample obtained from WS107 1.1 – 1.2m bgl was found to contain chrysotile and crocidolite containing debris and fibre bundles. Quantification analysis on this sample found the asbestos concentration to be 0.0442%.

6.2.2 Groundwater

A total of 3 groundwater samples were scheduled for chemical laboratory analysis. These were obtained from the deeper monitoring wells installed within CP101, CP102 and CP104. CP107 was found to be dry during the groundwater sampling visit.

Concentrations of TPH were recorded below the laboratory MDL in the groundwater samples obtained in CP102 and CP104. Sum TPH was measured at a concentration of 1200 µg/L in CP101, comprising principally heavy-end aliphatic fractions >C21.

Concentrations of BTEX and MTBE were measured below the laboratory MDL in all groundwater samples.

Concentrations of PAHs were generally measured at low levels. The highest total detected PAH was recorded from the groundwater sample from CP101 (23.6µg/l).

Metals were recorded at generally low levels above the laboratory MDL in all three samples.

6.3 Risk Estimation

The results of the soil and groundwater generic quantitative risk assessment are presented in the tables in Appendix H, and are summarised below:

6.3.1 Soil

Receptor	Soil samples with measured contaminant concentrations in excess of the GAC	GAC (mg/kg)	No. exceeding	Exceedance concentration range (mg/kg)
Human Health (neighbouring residents)	None	-	-	-
Human Health (future site users and residents)	Chromium: CP102 (MG), WS102 (Natural), WS104 (MG), WS108 (Natural)	21	4	29.8 – 91.9
	Lead: CP101, CP102, CP104, WS101, WS102, WS104, WS109, WS110, WS112, WS116 (All MG)	200	10	225 - 2070
	Mercury: CP101, WS101, WS104, WS109, WS110, WS112, WS116 (All MG)	0.0302	7	0.188 - 0.865
	Chrysene: CP103 (MG)	22.5	1	34.3
	Benzo(a)anthracene: CP103 (MG)	6.59	1	37
	Benzo(b)fluoranthene: CP103, CP107, WS115 (All MG)	3.48	3	3.61 – 16.9
	Benzo(a)pyrene: CP103 (MG)	5	1	28.9
	Dibenz(a,h)anthracene: CP101, CP103, CP106, CP107, WS115 (All MG)	0.274	5	0.283 – 1.68
	>C10-C12 Aliphatics: WS102, WS106 (All MG)	8.97	2	13.5 – 49.2
	>C12-C16 Aliphatics: WS106 (MG)	40.7	1	383

Water Resources – Aquifers	>EC12-EC16 Aromatics: CP103, WS102 (All MG)	78	2	95.4 - 272
	>EC21-EC35 Aromatics: CP103 (MG)	1720	1	1810
	Naphthalene: CP101 (MG), CP102 (MG), CP103 (Natural), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS108 (Natural), WS109 (MG), WS110 (Natural), WS112 (MG), WS113 (MG), WS115 (MG), WS116 (MG)	0.015	21	0.0159 – 2.24
	Benzo(b)fluoranthene: CP101 (MG), CP102 (MG), CP103 (Natural), CP104 (MG), CP106 (MG), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS108 (Natural), WS109 (MG), WS110 (Natural), WS112 (MG), WS113 (MG), WS115 (MG), WS116 (MG)	0.26	24	0.0742 – 16.9
	Benzo(k)fluoranthene: CP101 (MG), CP102 (MG), CP103 (Natural), CP104 (MG), CP106 (MG), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS109 (MG), WS110 (Natural), WS112 (MG), WS113 (MG), WS115 (MG), WS116 (MG)	0.037	22	0.0633 – 21.8
	Benzo(a)pyrene: CP101 (MG), CP102 (MG), CP103 (Natural), CP104 (MG), CP106 (MG), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS108 (Natural), WS109 (MG), WS110 (Natural), WS112 (MG), WS113 (MG), WS115 (MG), WS116 (MG)	0.013	24	0.0776 – 28.9
	Benzo(g,h,i)perylene: CP101 (MG), CP102 (MG), CP103 (MG), CP106 (MG), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS109 (MG), WS110 (Natural), WS112 (MG), WS115 (MG), WS116 (MG)	0.105	19	0.331 – 12.4
	Indeno(1,2,3-cd)pyrene: CP101 (MG), CP102 (MG), CP103 (Natural), CP104 (MG), CP106 (MG), CP107 (MG), WS101 (Natural), WS102 (MG), WS103 (MG), WS104 (MG), WS107 (MG), WS108 (Natural), WS109 (MG), WS110 (Natural), WS112 (MG), WS113 (MG), WS115 (MG), WS116 (MG)	0.022	24	0.0395 – 15

* MG / Natural – Soil samples obtained from shallow Made Ground or underlying natural strata

6.3.2 Groundwater

Receptor	Groundwater samples with measured contaminant concentrations in excess of the GAC	GAC (µg/l)	No. exceeding	Exceedance concentration range (µg/l)
Human Health (future site users and residents, and neighbouring residents)	None	-	-	-
Water Resources - Aquifers	Benzo(b)fluoranthene: CP101	0.025	1	3.35
	Benzo(k)fluoranthene: CP101	0.025	1	1.22
	Benzo(a)pyrene: CP101	0.01	1	2.69
	Benzo(g,h,i)perylene: CP101	0.025	1	2.36
	Indeno(1,2,3-cd)pyrene: CP101	0.025	1	1.96
	TPH C5-C35 Aliphatics/Aromatics: CP101	10	1	1200

6.4 Risk Evaluation

6.4.1 Human Health

Several of the CoC concentrations in the soil samples analysed exceed the GAC derived for the protection of onsite human health receptors. Elevated contaminants within site soils include metals, several PAH compounds and TPH. Asbestos was also identified in the shallow Made Ground, however for most of the positive identifications these were quantified to trace levels <0.001%. A single soil sample from WS107 1.1 – 1.2m bgl was found to contain chrysotile and crocidolite containing debris and fibre bundles above the quantification MDL with a concentration of 0.0442%.

The driving exposure pathway for the majority of these contaminants (with the exception of volatile hydrocarbons) comprise direct exposure pathways including soil ingestion/inhalation and dermal contact, or in the case of asbestos, the inhalation of airborne fibres. Therefore, in areas with buildings/external hardstanding or similar, no such potential pollution would exist, and hence no specific remedial measures would be required. However, in the areas of soft landscaping and private gardens the potential contamination linkage will need to be broken by capping with a suitable thickness of uncontaminated cover soils. For private gardens within the proposed residential development this should comprise a 600mm cover system of clean soils with an intervening no dig layer. A reduced thickness of capping soils (~300mm) may be acceptable for the landscaped areas within the proposed school development. We are not aware of any specific design at this stage for the construction of the playing fields, or whether the Sports England specification will be adopted, however a suitable breakage layer will be required to remove the direct contact pathway between the Made Ground soils and the site users.

Within the central site area, CP103 at 1m bgl recorded hydrocarbon fractions C12-16 (95.4mg/kg) and C21-35 (1,810mg/kg) marginally above their respective GACs of 78 and 1720mg/kg. The GACs for these hydrocarbon bands are driven by the theoretical saturation limits of the compounds in soil as they partition into water. The concentrations recorded within the shallow soil sample from CP103 appear to be above the soil saturation limit which should be indicative of free product. However, free product was not encountered and a maximum PID reading of 3.8ppm was recorded at 1m bgl. In this instance the heavy end hydrocarbons recorded are likely to be a result of ashy Made Ground rather than free product, and this is supported by the

relatively high level of PAHs measured within this sample. Therefore, these concentrations only exceed the GACs since they are limited by the soil saturation limit and are not considered to represent a significant risk to human health.

However, within the residential parcels, lighter potentially volatile hydrocarbons were measured in the soil samples from WS101 at 2.2 to 2.3m bgl, WS102 at 2.2 to 2.3m bgl and WS106 at 0.4 to 0.5m bgl. The samples from WS102 and WS106 in particular exceed the GAC for the hydrocarbon fraction C10-12 (8.97mg/kg) with concentrations of 13.5 and 49.2mg/kg respectively. Light-end hydrocarbons could potentially present a risk through the inhalation of volatile vapour.

An early allowance could be made for the inclusion of hydrocarbon resistant membranes for plots across the proposed residential development. These would also meet the specification for the ground gas protection measures required within these areas of the site as detailed in Section 7.

Alternatively, an allowance could be made for further investigation across the two residential parcels to provide a better understanding of the distribution and extent of lighter end hydrocarbons within site soils in these areas. Vapour monitoring/sampling and risk assessment could then be undertaken to determine whether residual contamination in the shallow soils poses a significant risk to human health via inhalation pathways.

6.4.2 Water Environment

Contaminant concentrations in exceedance of GACs protective of groundwater were measured in several soil and groundwater samples.

Within the soil samples, several PAHs were measured at concentrations exceeding their respective GACs. However, given that PAHs are generally of limited solubility and therefore do not readily dissolve in water, it is unlikely that PAH compounds will be mobilised by leaching into the underlying aquifer. This is generally supported by the results of the groundwater samples, where PAHs were only measured above the GACs in CP101 where a grab sample had to be taken due to the depth to water which exceeded the capability of the peristaltic pump. The groundwater samples obtained by micro-purging techniques from CP102 and CP104 recorded PAHs either below the laboratory method limit of detection (MDL) or at very low levels below the GACs.

Elevated TPH, comprising predominantly heavy end fraction >C21 and likely to include the low-level PAH compounds detected, was also recorded in the groundwater sample obtained from CP101. No visual or olfactory evidence of hydrocarbon contamination was noted within this borehole in the field, and significant hydrocarbon concentrations were not recorded in the shallow soil sample obtained from this location. The groundwater sample was noted to be highly sedimented and hence the detected hydrocarbon concentrations are likely due to entrained sediment and solid particle interference skewing the results, and not associated with elevated dissolved phase hydrocarbons in this area.

Given the distance to the nearest surface watercourse (Platt Brook located 366m to the south), the presence of a significant thickness of cohesive clays underlying the entirety of the site, the depth to the true groundwater table (indicated to be >11.5m bgl) and the generally low contaminant concentrations recorded within the groundwater samples, the risk to controlled waters is considered to be low and unlikely to warrant further consideration.

6.5 Conclusion

General site-wide, low level contamination was identified in Made Ground soils comprising elevated metals and PAHs. Asbestos was also identified in the shallow Made Ground, however for most of the positive identifications these were quantified to trace levels <0.001%.

In the northwest and south-eastern parcels, where residential development is proposed, the potential contamination linkage will need to be broken in private gardens by capping with a suitable thickness (600mm) of uncontaminated cover soils with an intervening demarcation layer. A reduced thickness of capping soils (~300mm) may be acceptable for the landscaped areas within the proposed school development.

Asbestos was quantified above 0.001% in one soil sample within the south-eastern parcel and as such there is a possibility for small quantities of asbestos containing material to be present within the site soils. It is therefore recommended that all site enabling and construction works are undertaken according to an asbestos management plan to ensure safe working.

Within the two proposed residential parcels, lighter potentially volatile hydrocarbons were also measured in several shallow soil samples, which could potentially present a risk through the inhalation of volatile vapour.

An early allowance could be made for the inclusion of hydrocarbon resistant membranes for plots across the proposed residential development. These would also meet the specification for the ground gas protection measures required across the site as detailed in Section 7.

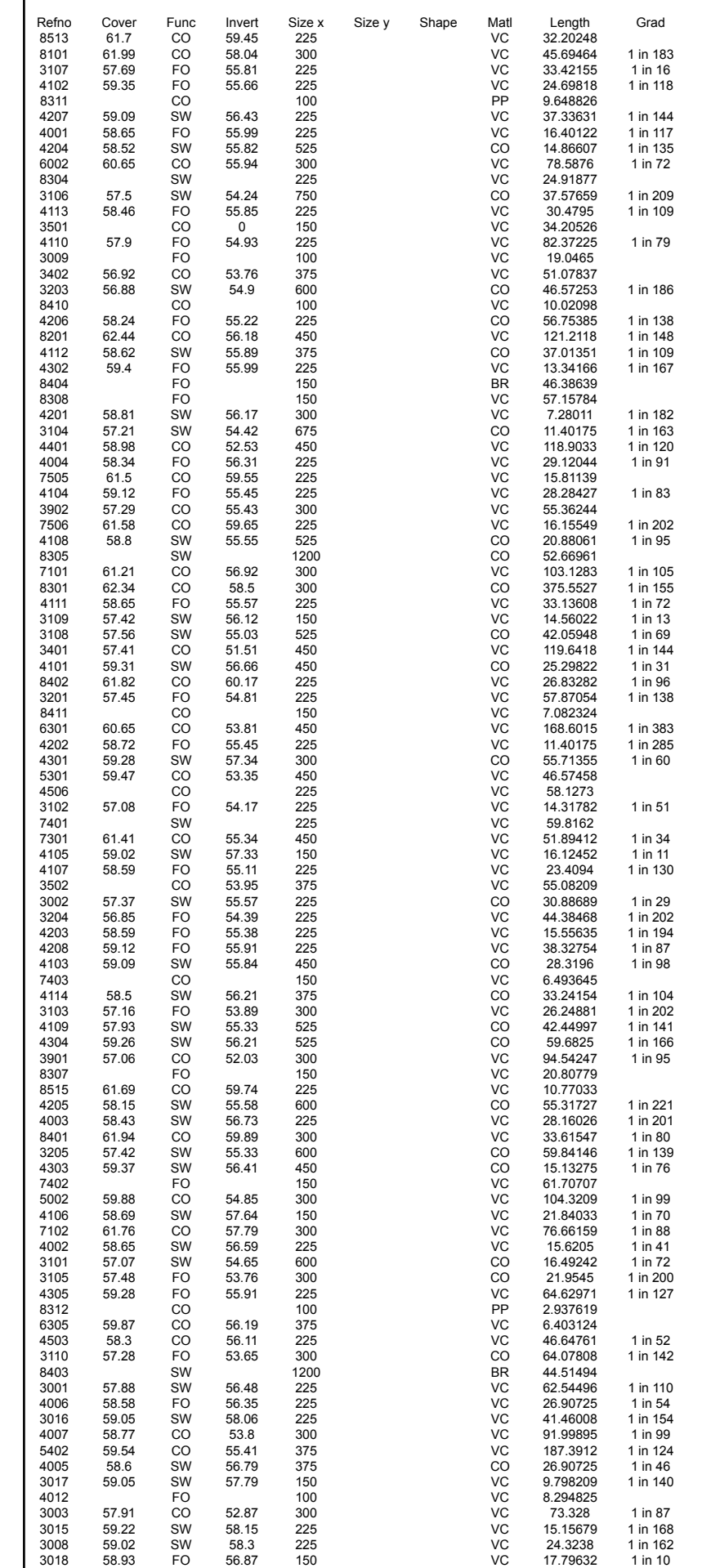
Alternatively, further investigation could be undertaken across these parcels to provide a better understanding of the distribution and extent of lighter end hydrocarbons. Vapour monitoring/sampling and risk assessment could then be undertaken to determine whether residual contamination in the shallow soils poses a significant risk to human health via inhalation pathways.

The risk to controlled waters is not indicated to be significant based on the measured soil and groundwater concentrations and the sensitivity of the site with regards to controlled water resources, and therefore no further work is likely to be warranted in this respect.

Planning Permission conditions for the site will likely include a requirement for an agreed Remediation Strategy, outlining the above required remedial measures.

Appendix F

United Utilities Record

[illegible]

All point assets follow the standard colour convention:

red	- combined	blue	- surface water
brown	- foul	purple	- overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate
- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Wt Treatment Works
- W Pumping Station
- Septic Tank
- Control Kiosk
- Change of Characteristic

FO Foul
SW Surface Water
CO Combined
OV Overflow

CI	Circular	TR	Trapezoidal
EG	Egg	AR	Arch
OV	Oval	BA	Barrel
FT	Flat Top	HO	HorseShoe
RE	Rectangular	UN	Unspecified
SQ	Square		

AC	Asbestos Cement
BR	Brick
PE	Polyethylene
RP	Reinforced Plastic Matrix
CO	Concrete
CSB	Concrete Segment Bolted
CSU	Concrete Segment Unbolted
CC	Concrete Box Culverted
PSC	Plastic / Steel Composite
GRC	Glass Reinforced Plastic
DI	Ductile Iron
PVC	Polyvinyl Chloride
CI	Cast Iron
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
PP	Polypropylene
PF	Fibre Fibre
MACH	Masonry, Coursed
MAR	Masonry, Random
U	Unspecified

390 HYDE ROAD,
MANCHESTER,
M12 4BD

Sheet: 1 of 1

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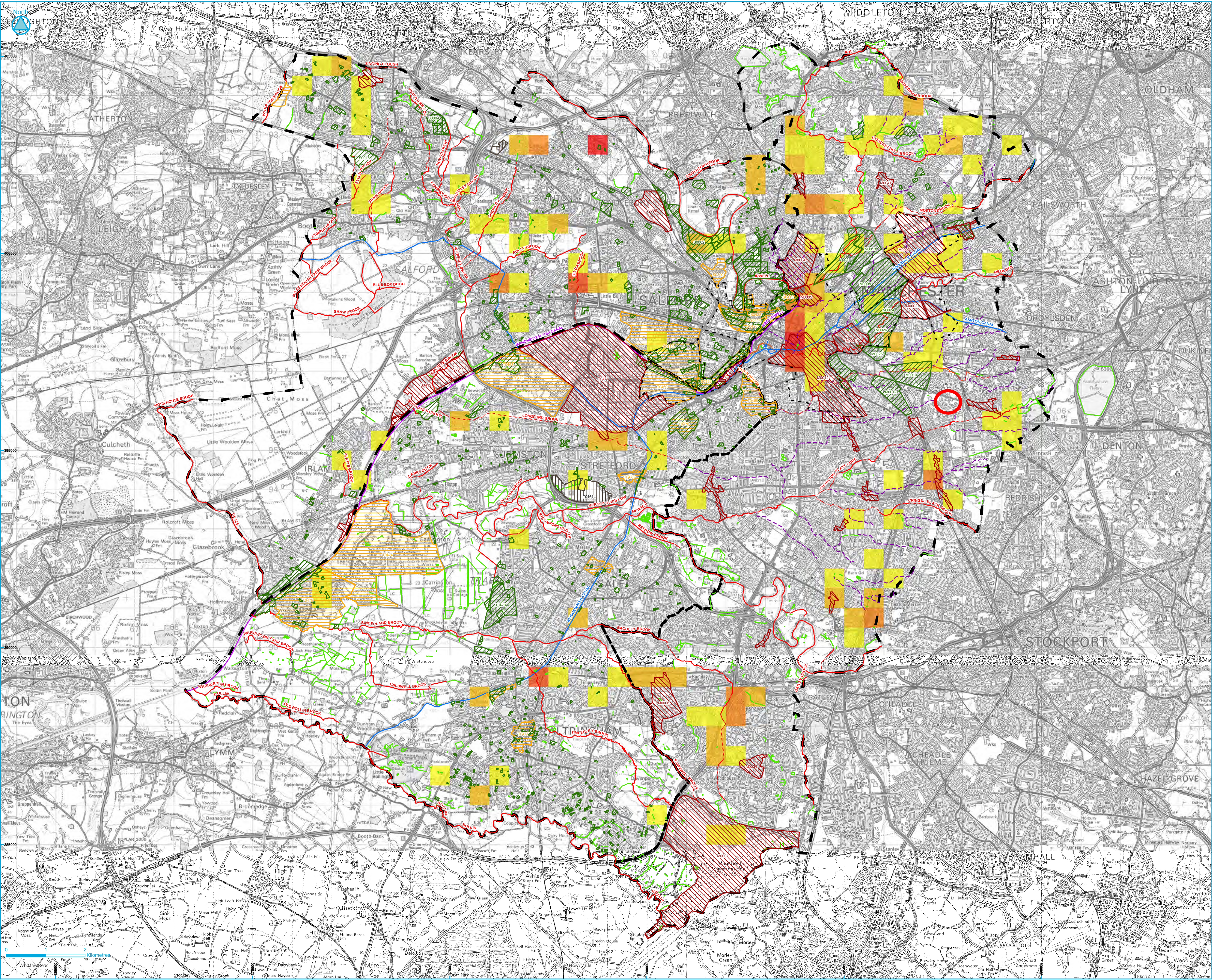
United Utilities
helping life flow smoothly

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

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Appendix G

Manchester City Council Flood Maps



- Council Boundary
- Lost Watercourses
- Number Of Properties At Risk**
 - 1 - 5
 - 5 - 20
 - 20 - 50
 - 50 - 100
 - 100 - 154
- Potential Development Sites / Locations**
 - Employment
 - Housing
 - Mixed Use
 - Other
 - Regional Centre Boundary
- Main Rivers (V8.0)**
 - Ashton, Bridgewater and Rochdale Canals
 - Manchester Ship Canal / Grey Inwell
 - Other Waterbodies
- Digitised River Lines**
 - Culverted
 - Open

This map has been produced in addition to the requirements of PPS25: Development and Flood Risk.

This map shows the results of an assessment of surface water flood risk to properties in the future. This shows the number of properties that could potentially be affected by such flooding if a 1 in 200 year rainfall event were to occur. This map can be used to assess the sensitivity of surface water flood risk to climate change and urban development.

The data shown in this map has been used to scope the coverage of Critical Drainage Areas.

The Main River information shown in the SFRA is provided by the Environment Agency; the centreline data may deviate from that shown on basemapping due to inherent differences in data resolution. Further information on Main Rivers is provided on the Environment Agency's website. The mapping of culverted sections of watercourse is a strategic screening only based upon Ordnance Survey 1:10,000 mapping and should be confirmed for more detailed studies such as site specific Flood Risk Assessment. The canals layer does not necessarily cover all the canal arms, but the modelled overtopping/breaching and hydraulic interactions with rivers and other waterbodies is complete and accurate as appropriate for a Strategic Flood Risk Assessment.

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

Other offices at Altrincham, Doncaster, Edinburgh, Haywards Heath, Limerick, Newcastle upon Tyne, Newport, Northallerton, Salford, Skipton, Tadcaster & Wellingford

Manchester City, Salford City and Trafford Councils Level 2 Hybrid SFRA

Surface Water Flooding Risk Assessment - Future Scenario

Drawn by: J Cheetham	Date: 08/03/2011	This map is based upon Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Licence number: 100016688 2011
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