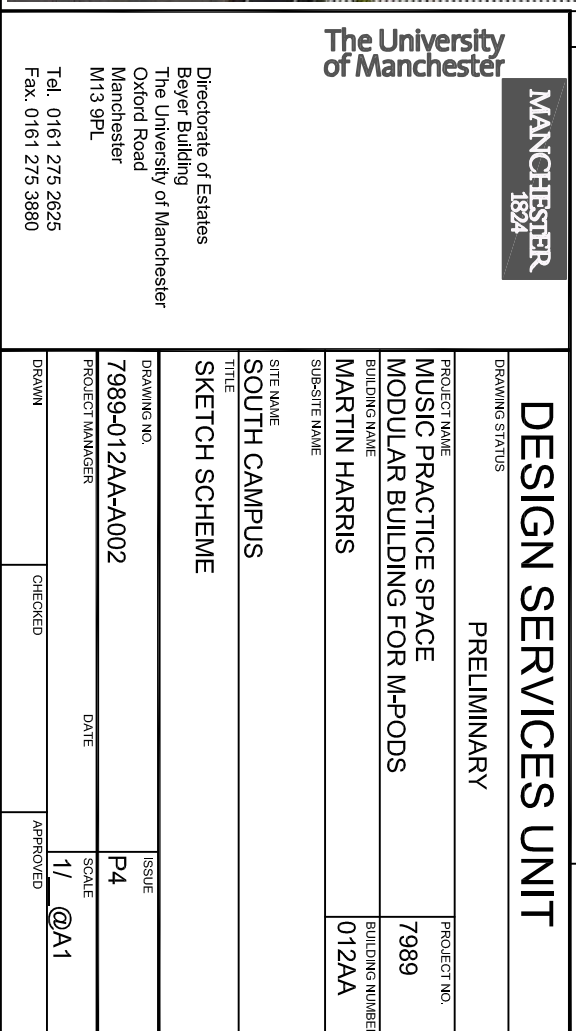
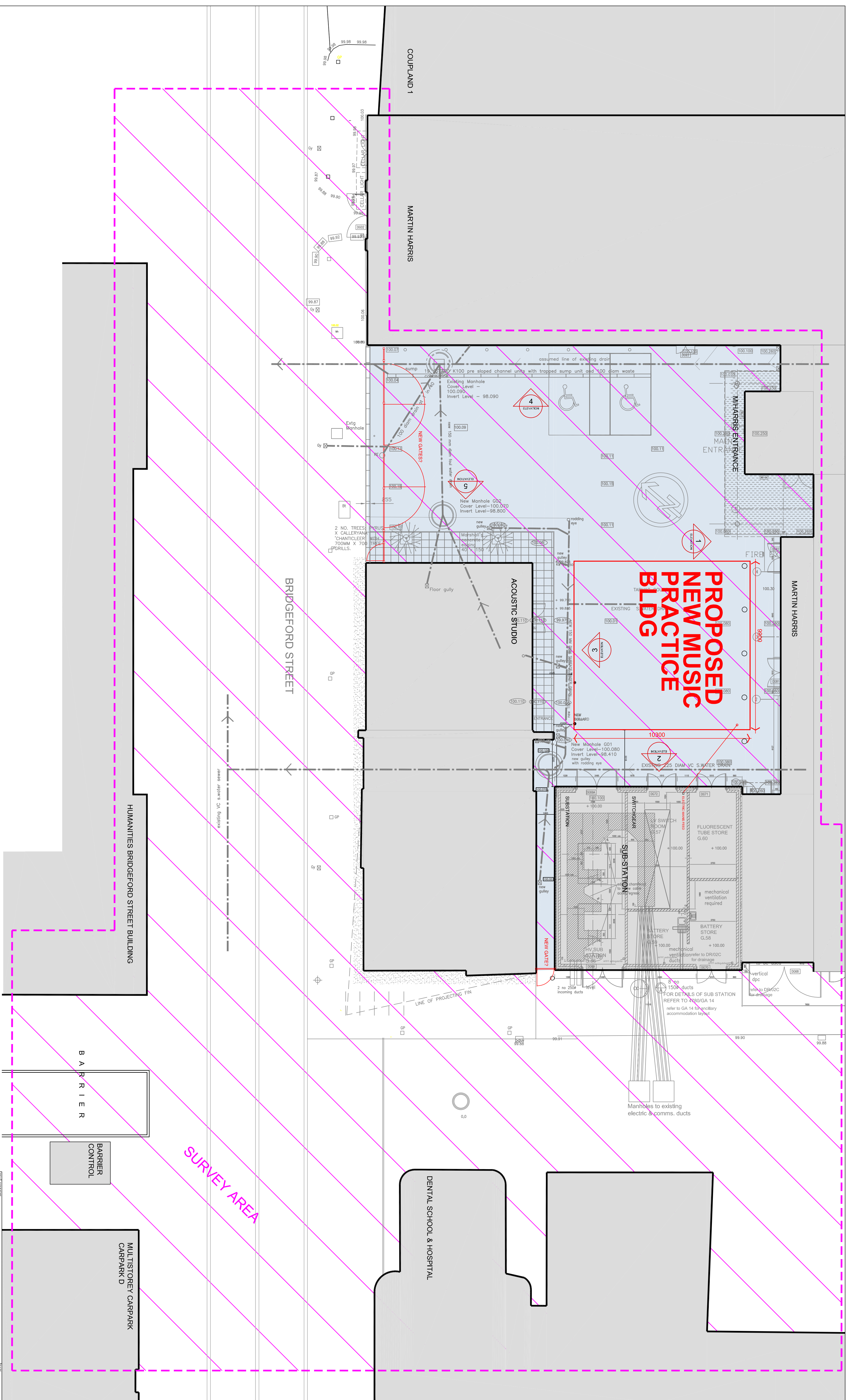






Appendix B – Ground Investigation



Phase 1 Preliminary Risk Assessment New Music Block, Martin Harris Centre for Music and Drama, University of Manchester

Prepared for University of Manchester

April 2021

10/2084/001 Rev. 00

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Document Origin

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Executive Summary

Client	The University of Manchester
Location	Martin Harris Centre for Music and Drama, The University of Manchester, Bridgeford Street, Manchester M13 9PL
Description	The site is located in a courtyard in the north of the Music and Drama Centre and is currently occupied by an area of hardstanding off Bridgeford Street. The site forms part of the University of Manchester campus and is surrounded by buildings associated with the University.
Development	It is proposed to develop the site with a two-storey music block within an existing courtyard of the Martin Harris Centre of Music and Drama.
Site History	The site comprised vacant land to the rear of residential dwellings in Manchester until the 1940's when the site became part of a depot. This was later removed and replaced with a dental hospital until the 2000's when the site was incorporated into the Drama and Music Centre. Surrounding land saw extensive residential development in the 1800's and early 1900's, with buildings associated with University of Manchester developed around the site throughout the 1900's. Industrial works were also developed around the site including a stone yard, depot, engineering works and other unidentified industrial type buildings.
Geology	British Geological Survey mapping indicates the site to be underlain Devensian Till, overlying the Chester Formation. Given the historical development of the site, Made Ground may also be present overlying natural soils.
Radon	The radon guidance on protective measures for new dwellings indicates that the site is in a 'low' probability radon area where less than 1% of homes are estimated to be at or above the Action Level. Radon gas protection measures are therefore not required in the construction of new dwellings or extensions.
Mining & Ground Stability	The site is located within a Coal Mining Reporting Area. However, a review of the Coal Authority online interactive map viewer indicates that there are no mine entries, abandoned mines or coal outcrops within 500m of the site. No BGS recorded mineral sites are indicated to be present within 500m of the site. Corn Brook, approximately 90m to the north of the site, was shown to have been infilled in the late 1800's. However, given its age and distance from the site, this is not considered to represent a significant risk to the proposed development.
Flood Risk	According to the Flood Map for Planning, available on the gov.uk website, the site is located within Flood Zone 3, whereby there is greater than 1% (1 in 100) chance of flooding from rivers or the sea occurring each year. The Flood Risk Extent map on the gov.uk website indicates that the site is within the extent of flooding in case of reservoir failure (Audenshaw reservoirs no.1, 2 and 3). If one is not already available, it is recommended that a Flood Risk Assessment is undertaken for the proposed development.

**Environmental
Setting**

The site is underlain by an Undifferentiated Secondary Aquifer and Principal Aquifer, relating to the Devensian Till and Chester Formation, respectively. The site is also located within Zone III (Total Catchment) of a SPZ. However, this is considered likely to be associated with the deeper Chester Formation Principal Aquifer, which is afforded a degree of protection by the overlying Devensian Till. Furthermore, the nearest groundwater abstraction is in excess of 500m from the site. On this basis, the site is not considered to represent a significant risk to groundwater resource receptors.

The nearest surface water feature is the River Medlock located 790m to the north. Given its distance, this watercourse is not considered to be at significant risk from potential contaminants of concern beneath the site.

UXO

Zetica Bomb Risk Mapping indicates the site to be in a moderate bombing density area during the Second World War. Therefore, further assessment of the risk posed by UXO is considered to be required.

**Conclusions /
Recommendations**

A number of potential pollutant linkages have been identified, which may be active following the proposed redevelopment of the site. On the basis of the assessment above, the following additional works are recommended:

- Flood Risk Assessment should be completed for the site.
- A Detailed UXO Desk Study should be undertaken to clarify the potential risk posed by buried ordnance beneath the site.
- Carry out an intrusive site investigation to confirm ground conditions at the site.
- Installation of wells in boreholes to allow the assessment of potential risk to future site users posed by ground gases.
- Soil samples should be recovered from selected exploratory holes and tested for potential contaminants of concern. This should include pH, metals, asbestos screening, speciated PAH and speciated TPH.
- In-situ testing and geotechnical soil sampling should be carried out during intrusive investigation to provide adequate recommendations for foundation design.

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Appendix III	Zetica Bomb Risk Mapping
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Appendix V	EA Groundwater Vulnerability & Flood Risk Maps
Appendix VI	Environmental Datasheets

1.0 Introduction

1.1 Background

Clancy Consulting Limited has been instructed by University of Manchester to carry out a Phase 1 Preliminary Risk Assessment for a site located in a courtyard in the north of the Music and Drama Centre at the University of Manchester.

It is proposed to develop the site with a two-storey music block within an existing courtyard of the Martin Harris Centre of Music and Drama.

A proposed development plan is included in Appendix I.

1.2 Objectives

The objectives of this investigation are summarised below:

- Provide a review of the site's land use history by reference to ordnance survey maps of the area.
- Assess the environmental setting, geology, hydrology, hydrogeology, mining and subsidence history of the site and surrounding area.
- Consider the potential risk to end users of the site from unexploded ordnance (UXO).
- Consider the potential risk to end users of the site from hazardous ground gas.
- Consider potential geotechnical constraints for the proposed development.
- Develop a preliminary risk assessment and a detailed 'conceptual site model' with regard to potential contamination sources, pathways and receptors.
- Provide recommendations regarding the requirement for further investigations, if required, to satisfy the Local Planning Authority.

1.3 Limitations of the Study

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2.0 Desk Study

2.1 General

Background information was sought from the following sources:

- Ordnance Survey historical maps (selected copies included in Appendix II).
- Zetica Bomb Risk Mapping (Appendix III).
- British Geological Survey (BGS) sheets (Appendix IV).
- Environment Agency site sensitivity & flood risk maps (Appendix V).
- Environmental datasheets (Appendix VI).

2.2 Site Setting and Description

The site is located at the Martin Harris Centre for Music and Drama, The University of Manchester, Bridgeford Street, Manchester M13 9PL, approximately 1.70km to the south of Manchester city centre at Ordnance Survey (OS) Coordinates 384420, 396600. The site is located within a courtyard to the north of the Centre. A site location plan is included in Appendix I.

The site is accessed from Bridgeford Street to the north and is located within the main Manchester University campus.

2.3 Site History

In order to investigate the development history and previous land uses at the site and surrounding area, historical OS maps were examined. Copies of the maps are presented in Appendix II.

Table 1 below is not intended to provide a comprehensive review of all the changes which have occurred at the site and instead provides a summary of the most salient points relating to the development history of the site. The most significant historical land uses are highlighted in bold text for ease of reference.

Table 1 – Site History

Date(s)	Site	Surrounding Land
1843 to 1851	The site comprised an area of vacant land to the rear of residential buildings located off Eagle Street, Manchester.	The surrounding land comprised a predominantly residential area of Manchester. Corn Brook was located approximately 90m to the northwest of the site and a bowling green was situated approximately 100m to the northeast, beyond which a carriage manufacturer was located. An engineering works was present approximately 100m to the south. Approximately 150m to the east of the site a tramline was present, continuing down Coupland Street to the south of the site.
1891 to 1908	Residential buildings had been constructed along Chatham Street, which bound the site to the west.	In the place of the bowling green to the northeast, Corporation Stone Yard was located. Beyond this to the east, two timber yards were situated. Corn Brook was no longer indicated to be present and had likely been infilled or culverted . Approximately 100m north of the site, a church and two schools were shown to be present. Approximately 50m to the south, Manchester University Owens College building was located, with the Eagle brewery bounding it to the west. There was further residential development of Manchester to the north, east, south and west.
1932 to 1933	No significant changes.	The residential buildings located to the south and east of the site were no longer present, with industrial buildings located in their place, including a chimney approximately 30m to the

Date(s)	Site	Surrounding Land
		northeast. Approximately 100m northeast of the site, a dental hospital was situated. The carriage manufacturer works to the east was shown to have been replaced by a shopfitters works .
1948 to 1949	An industrial building was shown to have been constructed to the south and extending onto the southern side of the site. The rest of the site was covered by hardstanding to the north and the existing residential buildings to the west.	The dental hospital to the northeast was shown to have been relocated in the place of a block of residential buildings, situated off Bridge Street to the west. Eagle Brewery to south was no longer present. Buildings associated with the University were present in its place, including a tank . Where the school had been located to the north of the site, Eagle Works was located. Approximately 200m to the east the shopfitters works was no longer indicated to be present, with a wire works present in its place. Additional works including a clothing and joinery works were located to the south. The tramline leading from Oxford Road to the south of the site was no longer present.
1952 to 1961	No significant changes.	The clothing and joinery works to the east were no longer present, with a large building associated with the University shown in their place. The dental hospital to the west was shown to have expanded.
1961 to 1970	The industrial building on site was labelled as a depot .	The wire works to the east was shown to have become a laboratory .
1974 to 2000	The depot and residential buildings situated within the site boundary were shown to have been removed, with the area indicated to be part of the dental hospital . Along the southern site boundary an electrical substation was located.	The residential buildings, works, school and church to the north were shown to have been removed, with a car park and buildings associated with the University of Manchester present in their place. To the west, residential buildings were absent, with St Ignatius School and tennis courts located instead.
2003 to 2022	The site was shown in its current configuration within the Martin Harris Drama and Music Centre and comprised a courtyard covered by hardstanding to the north of the Centre.	The dental hospital was shown to have been replaced by the Drama and Music Centre. The car park to the north of the site was no longer present, with buildings associated with the University present in its place.

2.4 UXO Risk Assessment

Zetica Bomb Risk Mapping indicates the site to be in an area of moderate bombing density during the Second World War. Further assessment of the risk posed by UXO is therefore recommended.

Zetica bomb risk mapping for the site is included in Appendix III.

2.5 Geology

The 1:50,000 geological map for the area (Map Sheet No 85, Manchester) indicates that the superficial deposits underlying the site comprise Devensian Till. This is underlain by bedrock deposits of the Chester Formation.

Given the development history of the site, Made Ground may also be present overlying natural strata. No previous site investigation information has been reviewed in order to confirm this. However, a historical BGS borehole record located approximately 120m east of the site indicates the presence of Made Ground to a depth of approximately 1.20m bgl.

Copies of the geological plans are provided in Appendix IV.

2.6 Mining and Ground Stability

The site is located within a Coal Mining Reporting Area. However, a review of the Coal Authority online interactive map viewer indicates that there are no mine entries, abandoned mines or coal outcrops within 500m of the site.

The environmental database report indicates that the site represents a very low risk with regard to ground stability issues relating to ground compressible ground, ground dissolution, collapsible ground, landslides, shrinking/swelling clay and running sand.

No BGS recorded mineral sites are indicated to be present within 500m of the site.

2.7 Hydrogeology

The Devensian Till, indicated to be present beneath the site, is classified by the EA as an Undifferentiated Secondary Aquifer. These are layers that have varying permeability characteristics in different areas.

The Chester Formation, indicated to be present beneath the Devensian Till, is classified by the EA as a Principal Aquifer. These are rock layers that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and transmission and may support water supply and/or river base flow on a strategic scale.

According to EA data, the site is located within Zone III (Total Catchment) of a groundwater Source Protection Zone (SPZ). Information provided by the EA indicates that there are 15 records of licensed groundwater abstractions within 1km of the site. These are located at distances ranging from approximately 543m northwest to 877m southwest of the site, associated with general use and heat pumps for schools and colleges and general cooling and process water for breweries.

Groundwater quality beneath the site has not been classified under an EA Local River Basin Management Plan.

2.8 Hydrology

The River Medlock is present approximately 790m to the north of the site. The chemical quality of this surface water feature has been classified as 'fail' under the EA River Basin Management Plan for the area.

There are no records of licensed surface water abstractions indicated to be present within 1km of the site.

There are no records of discharge consents within 500m of the site.

There are no records of significant or major incidents to controlled waters recorded within 500m of the site.

2.9 Soil Geochemistry

According to the BGS National Geoscience Information Service, the following background soil concentrations can be expected within natural soils at the site:

- Arsenic – 35-45 mg/kg
- Cadmium - <1.8 mg/kg
- Chromium – 90-120 mg/kg
- Lead – 300-600 mg/kg
- Nickel – 30-45 mg/kg

The concentrations of lead indicated above are in excess of assessment criteria protective of residential site users.

It should be noted that the soil geochemistry has been estimated solely on the basis of published geology and not empirical data.

2.10 Flood Risk

According to the Flood Map for Planning, available on the gov.uk website, the site is located within Flood Zone 3, whereby there is greater than 1% (1 in 100) chance of flooding from rivers or the sea occurring each year.

The Flood Risk Extent map on the gov.uk website indicates that the site is within the extent of flooding in case of reservoir failure (Audenshaw reservoirs no.1, 2 and 3).

The environmental database indicates that there is a very low risk of surface water (pluvial) flooding to occur at the site.

The environmental database report indicates that there is limited potential for groundwater flooding to occur at the ground surface.

The site may be located within a critical drainage area. The appointed drainage engineer should consult with the Lead Local Flood Authority (LLFA) to confirm this.

If one is not already available, it is recommended that a Flood Risk Assessment is undertaken for the proposed development.

Copies of the site sensitivity and flood risk maps are included in Appendix V.

2.11 Radon Risk Potential

The radon guidance on protective measures for new dwellings indicates that the site is in a 'low' probability radon area where less than 1% of homes are estimated to be at or above the Action Level.

Radon gas protection measures are therefore not necessary in the construction of new dwellings or extensions.

2.12 Landfill Sites

No current or former landfill or waste management sites are indicated to be present within 500m of the site.

A potential area of infilled land associated with a former river or stream is located 93m to the northwest. Other areas of potentially infilled former ponds, rivers or streams are located between 205m northeast and 645m west of the site. However, given their age and distance from the site, these are not considered to represent a significant risk to the proposed development.

2.13 Industrial Land Uses

There is no active Local Authority Pollution Prevention and Control permits recorded within 500m of the site.

There is one registered radioactive substance license located 235m to the northeast of the site and registered to Victoria University of Manchester. The registration is for the keeping, use and disposal of radioactive materials, with authorisation first granted in 1991 and since listed as revoked or cancelled. Other authorised registrations are located 289m to the northeast associated with the University of Manchester and 445m to the east with Manchester Incubator Co Ltd for the keeping, use and disposal of radioactive materials.

There are 14 active Contemporary Trade Directory entries recorded within 500m of the site. These relate to a petrol filling station, laboratories, printers, temperature monitoring systems manufacturers, MOT testing centres, distribution services, medical equipment maintenance and repairs, coating specialists, dry cleaners and car dealers.

Full details of the waste management and industrial land uses are detailed in the environmental database presented in Appendix VI.

2.14 Sensitive Land Uses

Natural England data indicates that there are no ecologically sensitive sites indicated within 500m of the site that constitute environmental receptors as defined within Table 1 of the DEFRA Environmental Protection Act 1990: Part 2A - Contaminated Land Statutory Guidance (2012).

2.15 Potential Geotechnical Constraints

Made Ground beneath the site would not form a suitable bearing stratum for traditional foundations. The underlying Devensian Till would likely support strip or pad foundations for light to moderate loads if present at relatively shallow depth. If the thickness of Made Ground is significant or if underlying natural soils were of low strength, piled foundation terminating in the deeper Chester Formation would likely be required. A geotechnical site investigation would be required to confirm a suitable foundation solution for the proposed development.

3.0 Phase 1 Risk Assessment

3.1 General

The “suitable for use” approach is adopted for the assessment of contaminated land and remedial measures are only undertaken where unacceptable risk to human health or the environment can be proven when taking into account the proposed use of the site and environmental setting.

A risk assessment process should be carried out to determine potential hazards to human health and the environment and be based on the “source” “pathway” “receptor” principal. For a potential risk to be present there must be a viable pollutant linkage whereby a contamination source may impact upon a receptor. The absence of one or more of these key components (source, pathway or receptor) prohibits a viable pollution linkage being formed.

3.2 Preliminary Conceptual Site Model

In accordance with the ‘Land Contamination Risk Management’ (LCRM) guidance on the gov.uk website (updated October 2020) and BSI 10175 “Code of Practice for Investigation of Potentially Contaminated Land” (2011), a Preliminary Conceptual Site Model was developed to identify potential contamination sources, migration pathways and receptors within the study area.

3.3 Potential Contaminant Sources

The site has been developed since the 1940’s and therefore, Made Ground may be present on and adjacent to the site, which could represent a potential source of contaminants of concern.

Historical surrounding land use was mixed residential, commercial and industrial in nature. Current surrounding land use is predominantly educational in nature. Potential contaminants associated with commercial and industrial land uses include metals, asbestos, total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH).

Made Ground beneath the site and surrounding area (if present) may represent a potential source of ground gases. Given the age and distance to recorded areas of infilled land summarized in Section 2.12, these are not considered to pose a significant risk to the proposed development.

The following potential sources of contamination have been identified at the site:

- Potential Made Ground and contamination associated with historic construction and demolition at the site (residential buildings, depot, dental hospital).
- Migration of potential contamination associated with historic land uses around the site, including a former works, construction of residential properties and nearby industrial land uses.
- Potential generation of hazardous ground gases associated with deep Made Ground and putrescible materials present at the site.

3.4 Potential Pathways

The site is proposed to be developed with a new two-storey music block. The following potential pathways are considered applicable at the site:

- Inhalation (dust / vapors)
- Ingestion
- Vertical / lateral migration (of both contamination and potentially hazardous ground gases)

3.5 Potential Receptors

Potential human health receptors include future site users and neighboring educational site users, whilst the proposed new buildings at the site are also be considered as receptors.

The underlying Principal Aquifer is considered to be the main environmental receptor of concern.

Given the distance to the nearest surface watercourse (the River Medlock 790m north), this is not considered to be at significant risk from potential contaminants of concern beneath the site.

3.6 Preliminary Risk Assessment

A preliminary risk assessment can be carried out using guidance outlined in Section 6.3 of CIRIA Document C552 "Contaminated Land Risk Assessment – A Guide to Good Practice" (2001). For a risk to be present there must be a viable pollutant linkage whereby a contamination source can impact on a receptor via a pathway. To carry out the risk assessment an estimate must be made of the potential severity of the risk and the likelihood of the risk occurring. The following Tables set out the criteria for this principal.

Table 2 - Severity of Risk

Severity	Description
Severe	Acute risk to human health likely to result in 'significant harm' i.e. very high concentrations of contamination or ground gases. Catastrophic damage to building i.e. by explosion from high gassing sites or VOC concentrations. Major pollution of controlled waters i.e. surface watercourses and Principal aquifers, source protection zones. Short term damage to ecosystems.
Medium	Long term risk to human health likely to result in 'significant harm' i.e. elevated concentrations of contaminants or ground gases. Pollution of sensitive controlled watercourses i.e. Principal or Secondary Aquifers. Significant effects on sensitive ecosystems or species.
Mild	Pollution of non-sensitive waters i.e. smaller surface watercourses or unproductive strata. Significant damage to crops, buildings, structures or services i.e. by explosion from sites with medium gassing potential, elevated concentrations of contaminants.
Minor	Non-permanent human health effects i.e. requirement for protective equipment during site works to mitigate health effects. Damage to non-sensitive ecosystems or species. Minor damage to buildings, structures or services.

Table 3 - Probability of Risk Occurring

Probability	Description
High Likelihood	Pollutant linkage may be present that appears very likely in the short term and risk is almost certain to occur in long term or evidence of harm to receptor exists.
Likely	Pollutant linkage may be present and is likely that the risk will occur over the long term.
Low Likelihood	Pollutant linkage may be present and there is a possibility of the risk occurring although no certainty that it will do so.
Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur even in the long term are improbable.

Table 4 - Comparison of Risk & Probability

Probability	Severity			
	Severe	Medium	Mild	Minor
High Likelihood	Very High	High	Moderate	Moderate/Low
Likely	High	Moderate	Moderate/Low	Low
Low Likelihood	Moderate	Moderate/Low	Low	Very Low
Unlikely	Moderate/Low	Low	Very Low	Very Low

A summary of potential pollutant linkages and perceived risks for this site are outlined in the Table below:

Table 5 - Pollutant Linkages & Perceived Risk

Sources of Contamination	Pathways	Receptors	Severity	Probability	Risk	Justification	Further Action Required
On site: Made Ground and contamination associated with historical commercial and industrial land use.	Inhalation and dermal contact of soil	Future site users	Medium Long term risk to human health	Unlikely	Low	Contaminants of concern may be present beneath the site, associated with the Made Ground and former commercial and industrial land use. However, given the continued coverage of the site with hardstanding it is considered that no contaminant pathways will remain active following the redevelopment.	Site investigation to confirm the contamination status of shallow soils beneath the site.
		Construction workers during development	Minor Non-permanent human health effects i.e. requirement for protective equipment during site works to mitigate health effects	Low Likelihood	Very Low	If construction workers come into contact with potential contaminated soils during the construction phase, such contact would be short term, limiting potential exposure. Construction workers are expected to undertake good working practices including regular hand washing and other hygiene techniques which would reduce the likelihood of long-term exposure to any contamination.	
	Acidic ground conditions affecting future site buildings	Building infrastructure	Minor Minor damage to buildings	Low Likelihood	Very Low	Made Ground and natural soils beneath the site may contain elevated concentrations of sulphates and low pH. Chemical testing for water soluble sulphate and pH should be undertaken to inform concrete classification.	
	Vertical and lateral migration	Neighbouring commercial properties	Medium Long term risk to human health	Unlikely	Low	Neighbouring land use is predominantly educational in nature. It is considered unlikely that contamination would be present in sufficient concentrations beneath the site to adversely affect neighbouring site users.	
		Controlled waters	Mild Pollution of non-sensitive controlled water receptors	Low Likelihood	Low	The site is underlain by an Undifferentiated Secondary Aquifer and Principal Aquifer, relating to the Devensian Till and Chester Formation, respectively. The site is also located within Zone III (Total Catchment) of a SPZ. However, this is considered likely to be associated with the deeper Chester Formation Principal Aquifer, which is afforded a degree of protection by the overlying Devensian Till. Furthermore, the nearest groundwater abstraction is in excess of 500m from the site. On this basis, the site is not considered to represent a significant risk to groundwater resource receptors. The nearest surface water feature is the River Medlock located 790m to the north. Given its distance, this watercourse is not considered to be at significant risk from potential contaminants of concern beneath the site.	
Off site: Made Ground and industrial buildings	Lateral migration onto site with subsequent dermal contact of soils	Future site users	Medium Long term risk to human health	Unlikely	Low	Contamination may migrate onto site from off-site sources associated with historical commercial/industrial land use. However, given the continued coverage of the site with hardstanding it is considered that no contaminant pathways will remain active following the redevelopment.	
Potential hazardous ground gas and vapours from Made Ground	Migration of ground gas	Future site users	Severe Acute risk to human health (asphyxiation)	Low Likelihood	Moderate	Made Ground beneath the site may represent potentially significant sources of ground gas.	Monitoring wells should be installed as part of the site investigation and monitoring undertaken to assess the risk posed by ground gases.
		Building Infrastructure	Severe Significant damage to buildings (explosion)	Low Likelihood	Moderate		