

Bellrock Crescent, Glasgow
Proposed Residential Development
Stage 1, Development Appraisal

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EXECUTIVE SUMMARY

Site Walkover

The site is currently unoccupied by any structures with the ground coverage comprising tarmac and overgrown soft landscaping. The general topography of the site slopes from the north down towards the south and has been platformed to create level building areas to accommodate the previous development.

Site History

The documentary evidence indicates that prior to the construction of the former school circa 1955, the site was largely unoccupied, with the exception of a well and small structure in the northern area. Limited industrial activities have historically been present within the area immediately surrounding the site, with the surrounding area largely containing residential properties.

Anticipated Ground Conditions

Geological map and BGS report evidence indicates that the site is underlain by glacial till deposits, of a cohesive nature. The thickness of the deposits is shown as being less than 1m in the northern area increasing to 5m across the southern area. The documentary evidence also suggests the presence of a mantle of made ground across the site, up to 1.5m in thickness. The underlying bedrock of the Middle Coal Measures and the igneous teschenite dolerite intrusion is not expected to be at risk of mineral instability from shallow mineworkings.

Environmental Considerations

The site has assigned the site a low to medium risk rating, based on the fact that made ground is documented to be present, which represents a possible source of contamination, and that the enduse of the site is of a relatively sensitive nature. In addition, any made ground present may contain sources of soil gas, such as buried timbers. The potential risk to groundwater and the wider environment is considered to be generally low, based on the expected presence of low permeability glacial till.

Geotechnical Considerations

The documented glacial till would be anticipated to constitute a suitable bearing stratum for light to moderate weight structures. However, consideration should be given to the potential for made ground to be present, where the glacial till could be present outwith the realms of conventional foundation techniques, resulting in the requirement for localised areas where trench-fill techniques.

Shallow bedrock is documented in the northern and central area of the site. Although the bedrock is considered to represent a suitable bearing stratum for the proposed structures, the presence of shallow bedrock could represent a constraint to development if any significant re-profiling of the site is proposed.

Recommendations

It is recommended that an intrusive investigation should be undertaken. The following issues have been highlighted as requiring clarification:

- Presence, nature and thickness of any made ground;
- Engineering properties of the natural glacial deposits;
- The depth to bedrock, particularly in the central and northern of the site; and
- Presence, nature, distribution and mobility of any contaminants.

1.0 INTRODUCTION

1.1 Terms of Reference

It is proposed to re-develop the former Bellrock Primary School for residential purposes. To assist with the proposals, a Stage 1, Desk Study was undertaken to provide an indication of the ground conditions across the site.

1.2 Objectives and Scope of Works

At the first stage in the appraisal process, a Stage 1, desk study is undertaken to enable a Conceptual Model of the site to be developed, through an assessment of the following:

- Historic development of the site and surrounding area;
- Expected ground conditions, including the nature and thickness of geological deposits;
- Environmental conditions, including industrial consents and potentially contaminative landuse, on and in the vicinity of the site;
- Hydrogeology and hydrology;
- Mining conditions; and
- Location of utilities.

The following tasks were undertaken to achieve the objectives listed above:

- Site walkover;
- Review of available historical maps;
- Review of geological maps;
- Consultation with the Scottish Environment Protection Agency (SEPA);
- Consultation with Scottish Natural Heritage (SNH).

1.3 Study Limitations

In reviewing this report, a number of study limitations should be borne in mind. These are presented at the rear of the report, immediately following the text.

1.4 Report Layout

Following this introduction, the remainder of the report is set out as follows:

- Section 2 – Site location and description;
- Section 3 – Historical & industrial development of the site;
- Section 4 – Expected ground conditions; including the anticipated nature and thickness of geological deposits, mining conditions, hydrology and hydrogeology;
- Section 5 – Utility information;
- Section 6 – Assessment of environmental conditions and development of Conceptual Site Model;
- Section 7 – Geotechnical issues;
- Section 8 – Intrusive investigation considerations;
- Section 9 – Conclusions and recommendations

Selected information collected during this study is presented in the Figures and Appendices that follow the text.

2.0 SITE LOCATION & DESCRIPTION

The site is located off Bellrock Crescent, Cranhill to the east of Glasgow city centre. The approximate National Grid Reference for the site is NT 640 659. Figure 1 shows the general location, while Figure 2 shows the site in more detail.

The site is currently unoccupied by any structures with the ground coverage comprising a combination of tarmac and overgrown soft landscaping. The general topography of the site, as well as the surrounding area, slopes from the north down towards the south. It appears as though the site has been platformed to create level building areas, presumably to accommodate the previous development. A result of these earthworks an embankment runs east/west along the central area of the site, with access gained between the two levels by concrete stairs. A further embankment is present along the northern most boundary of the site.

The site is bound to the east and west by residential properties, with Gartcraig Road forming the northern boundary and Bellrock Crescent marking the southern boundary.

The majority of the surrounding area is of a residential nature, with the exception of a large depot to the north of the site. The M8 motorway is located approximately 90m to the north of the site.

Photographs taken during the recent site visit are included as Appendix A to this report.

3.0 HISTORICAL & INDUSTRIAL DEVELOPMENT OF THE SITE

3.1 Historical Development

The historical development of the site was evaluated following inspection of available maps at the National Library of Scotland in Edinburgh. The following maps were examined during the course of this study.

Table 1: Historical Maps Viewed

Map	Scale	Date
County Series: Lanarkshire Sheet VII.5 Lanarkshire Sheet VII.9	1:2500	1861, 1898, 1912 & 1933
National Grid: NS6365NE NS6465NW NS6466SW	1:1250	1955, 1967, 1979, 1982, 1992, 2009

Copies of these maps are contained within the Envirocheck® Report, which is included as Appendix B. The historical development of both the site and surrounding area are summarised in the following table.

Table 2: Summary of Historical Landuse

Map Edition	On site	Off Site
1861	<ul style="list-style-type: none">• Site unoccupied by any structures, unnamed roadway forms N boundary	<ul style="list-style-type: none">• Monkland Canal located 60m NE, with Gartcraig Bridge crossing the canal at this locale• Gartcraig Farm present 20m NW, with several farm buildings and an unlabelled circular structure• Vast majority of surrounding area openland
1898	<ul style="list-style-type: none">• Small unnamed structure present in NW of site, possibly a farm building, with a 'well' shown in central-northern area• Pathway shown to extend from farm running NW/SE across site	<ul style="list-style-type: none">• Gartcraig Fire Clay Works present 60m N, with the building 160m N• Also associated with fire clay works contains several tanks and railway sidings• Gartcraig Bridge now labelled Jessie's Bridge• Area labelled 'Her Majesty's Prison (Barlinnie)' present 380m NW• Several areas marked 'old quarry' shown NW, W & SW - closest 270m NW
1912	<ul style="list-style-type: none">• Well in N of site no longer present• No other significant changes shown	<ul style="list-style-type: none">• No major changes are shown to have occurred in the surrounding area

Table 2: Summary of Historical Landuse (Cont.)

Map Edition	On site	Off Site
1933	<ul style="list-style-type: none"> • No changes shown to have occurred • Unnamed road labelled as Gartcraig Road 	<ul style="list-style-type: none"> • Fire clay works no longer shown, with area marked Gartcraig Playing Field • Quarry shown 420m NW, directly N of Barlinnie Prison • Large-scale residential developments have occurred west of site, closest area 170m W
1955	<ul style="list-style-type: none"> • A structure labelled 'Bellrock Crescent Primary R.C. School' present in central area • Structure in northern area still present 	<ul style="list-style-type: none"> • Large residential development has occurred in surrounding, site bound to W & E by residential properties • Quarry to N of Barlinnie no longer shown
1967	<ul style="list-style-type: none"> • Building in N of site no longer shown, with 'Playing Fields' now indicated • Embankment shown to immediate S of playing fields • School now labelled 'Bellrock Primary School' 	<ul style="list-style-type: none"> • Gartcraig Farm no longer shown • Monkland Canal labelled as 'disused'
1979	<ul style="list-style-type: none"> • No significant changes have occurred 	<ul style="list-style-type: none"> • Monkland Canal shown to have been infilled - M8 Motorway shown in its place • Embankment associated with this present to immediate NE • Large bus depot present approximately 10m N, contains large structure 60m N and tanks 40m N
1982	<ul style="list-style-type: none"> • Rectangular building present in N, in area previously labelled 'Playing Fields' • 'football pitch' located NW of site, extending off site 	<ul style="list-style-type: none"> • No significant changes have occurred
1992	<ul style="list-style-type: none"> • Site shown to be unchanged from previous map edition 	<ul style="list-style-type: none"> • No major changes shown to have occurred
2009	<ul style="list-style-type: none"> • School no longer shown, with site shown to be unoccupied 	<ul style="list-style-type: none"> • No significant changes have occurred

3.2 Industrial Development

An Envirocheck® Report was obtained for the site by another party and was made available to provide details any industrial land uses and consents within a 1.0km radius of the site. This indicated that various industrial landuses and consents are present within the surrounding area; however, the vast majority of these are located greater than a distance of 250m from the site. Within 250m, one potentially contaminative landuse has been identified, which relates to 'Excel Printing' 99m to the west. Also identified within 250m was a landfill site 172m to the north and a waste treatment/disposal site 29m to the northwest relating to the bus depot.

The Envirocheck® Report is included as Appendix B.

3.3 Environmentally Sensitive Features

Scotland's Nature Map, present on the Scottish Natural Heritage (SNH) website, was consulted to search and view information relating to any sensitive features, such as SSSI's and National Scenic Areas.

The map however does not show any such features on, or within the close proximity to this site.

4.0 EXPECTED GROUND CONDITIONS

4.1 Geology

Reference was made to the relevant maps published by the British Geological Survey (BGS), Sheets NT 66 NW, scale, 1:10,560. These indicated that the following ground conditions prevail.

Superficial Deposits

The geological map evidence indicates that the entire site and the majority of the surrounding area is underlain by glacial till, which is documented to be of a cohesive nature. Across the central and northern sections of the site bedrock is shown to be 'at or close to the surface' with the superficial deposits likely to be less than 1m thick. The superficial deposits are shown to increase to in the region of 5m in the southern region of the site.

The geological map indicates that made ground is not documented to be present on site, with the closest such area 30m to the northeast associated with the embankment adjacent to the motorway. Made ground is also documented along the course of the former Monkland Canal (now the M8 motorway). Although made ground is not shown to be present on the site, it is considered likely that made ground will be present relating to the construction and demolition of the farm buildings and school structures that previously occupied the site. In addition, there is the potential for made ground to be present associated with the platforming of the site, particularly along the embankment in the central area of the site. There is however no evidence to indicate that any made ground present will be of a significant thickness.

A British Geological Survey (BGS) 'Georeport' commissioned was made available to provide further details on the likely ground conditions. The report has confirmed the findings of the geological map evidence, in that the natural superficial deposits comprise of cohesive glacial till that is relatively thin in the northern and central areas (0.50m-1.5m), increasing in thickness to the south (4-6m). This report indicates that former boreholes and trial pits undertaken on the site encountered made ground at depths up to 1.50m.

Solid Geology

The documentary map evidence indicates that the vast majority of the site is underlain by the Middle Coal Measures of Upper Carboniferous age. This group of strata is shown to comprise of cyclic sequences of sandstone, siltstones, and mudstones with several coal seams. The strata are shown to dip to the southeast at angles between 5-10°.

The southern section of the site is documented to be underlain by a Teschenite dolerite igneous intrusion. This intrusion is also present approximately 80m to the north of the site.

No coal seams are shown to outcrop on the site; closest seams shown are the Virgin Coal (0.68m thick) and Splint Coal (0.76m thick) present 270m and 310m southeast, respectively. Although not shown on the geological map, due to the presence of the igneous intrusion, there is the potential for various other coals to be present in the surrounding area. Details on the anticipated outcrop positions from the site and if applicable depth to the seam are summarised in the table below:

Table 3: Summary of Conjectured Coal Seam Position

Name of Coal Seam (thickness / m)	Anticipated Position	Expected depth below site (m)
Kiltongue Coal (0.60)	246m NW	23.18
Airdrie Virgin Coal (0.50)	32m SE	N/A
Airdrie Blackband Coal (0.60)	147m SE	N/A
Virgin Coal (0.70)	270m SE	N/A
Splint Coal (0.70)	310m SE	N/A

As the above table shows, the only seam shown to underlie the site at shallow depth is the Kiltongue Coal, at approximately 23-24m below rockhead.

The Blackhill Fault is shown approximately 310m to the north of the site, trending east/west with the downthrow of the strata to the south. An unnamed northwest/southeast trending fault extends from the Blackhill Fault, cutting through the strata approximately 210m north of the site with the associated downthrow to the northeast.

Based on recent borehole and trial pit records, the BGS report states that the igneous intrusion was found to underlie the vast majority of the site, possibly all of the site. The report also indicates that the intrusion is up to 25m in thickness. The report indicates that the unnamed fault is in fact named the Easterhouse Fault, with the associated downthrow being 20-40m.

4.2 Mining

As discussed above, the geological map evidence indicates that the central and northern section of the site is underlain by the Middle Coal Measures, with a dolerite intrusion underlying the southern section. However, the BGS report indicates that recent intrusive investigations have encountered the igneous intrusion across the vast majority of the site.

The Environmental Geological Maps (EGMs) have indicated that the site is not located within an area of recorded mineworkings within 30m of rockhead, with the closest area shown to be approximately 310m to the southeast. These recorded workings are shown to be within the Virgin Coal. Further recorded mineworkings are shown 710m southwest of the site, within both the Virgin Coal and the Splint Coal. Within this area, numerous mine entries and boreholes are shown encountering mineral extraction within 30m of rockhead.

A Coal Authority Report was also made available to provide further information with regard to the potential for mineworkings to be present below the site. This report is summarised below and a copy of this report provided as Appendix C.

According to the Coal Authority report, the site is not located within a likely zone of influence from former underground mineworkings. In addition, the report states that the Coal Authority holds no records of any mine entries on, or within 20m of the site.

Based on all the available information, it is considered unlikely that the site is underlain by historical shallow mineworkings; as such, the site has been assigned a low risk from a mineral instability viewpoint.

4.3 Hydrology

Watercourses

The closest watercourse to the site is the Light Burn, which is located approximately 580m to the southeast, flowing to the southwest. This watercourse appears to have been largely culverted. The Monkland Canal was historically present to the north of the site, by approximately 60m, although this is understood to have been infilled and replaced by the M8 motorway.

Water Quality

SEPA has recently implemented a new monitoring scheme and classification methodology to meet the requirements of the Water Framework Directive. 2007 was the baseline year for the classification of Scotland's Water Environment, using the new classification scheme. SEPA uses these results, alongside other information, to set the objectives for improving the environment. The quality ratings range from Good to Bad, or from Good Ecological Potential (EP), to Bad EP, for those watercourses not yet monitored. No monitoring information was available for the Light Burn, with the closest monitored watercourse being the Molendinar Burn approximately 1800m to the northwest. This was assigned as having Bad EP.

4.4 Hydrogeology

Superficial Deposits

The superficial deposits are shown to comprise of cohesive glacial till, which would be expected to be of low permeability, and thus unlikely of supporting a shallow groundwater table. This is consistent with the documentary evidence from the SEPA 'River Basin Management Plans' Interactive Map, which does not classify the superficial deposits as a body of groundwater. A groundwater body is defined as '*an aquifer that must be capable of supplying 10m³ or 50 people of water per day (on a continuous basis)*'.

Made ground is expected to be present relating to the construction and demolition of the former structures on the site; this was confirmed by the BGS 'Georeport' that revealed previous intrusive investigations encountering made ground to a depth of 1.5m. Made ground would be expected to be of a relatively high permeability, thus allowing the flow of fluids.

There is the potential for 'trapped water' to be present at the interface of any made ground and the underlying glacial till, although any water present is considered to have limited horizontal flow.

Solid Geology

According to the SEPA 'River Basin Management Plans' interactive map shows the bedrock aquifer to belong to the Clydebank and Kirkintilloch aquifer. The quantitative class for this aquifer was good; however, the groundwater chemistry was classed as being poor.

4.5 Flooding

The Indicative Flood Map of Scotland present on the SEPA website, was consulted to assess the possible risk of flooding at the site. This flood map highlights the areas at risk of flooding, by rivers or sea, during a theoretical 1:200 year flood event.

The Indicative Flood Map of Scotland shows that the site is outwith the area of flooding and as such the site has been assigned a low risk rating in terms of being affected by flooding.

5.0 UTILITY INFORMATION

5.1 General

Utility information was made available for this site from the following utility providers:

- Scottish Power;
- Scottish Water;
- Scottish Gas Network;
- BT; and
- Virgin Media.

It should be noted that public utility plans, by definition, do not tend to show plant extending into private sites. Therefore, whilst plant may not be shown within a site, it does not necessarily imply that utilities are not present in that area.

5.2 Location Of Plant

Gas

The Scottish Gas Plan indicates that no plant is present within the site boundaries. A low-pressure gas main is shown to follow the course Bellrock Crescent to the immediate south of the site.

Water

The Scottish Water drawing does not indicate the presence of any plant on the site, with a 125mm MDPE distribution main shown to the south of the site, running east/west along Bellrock Crescent.

Wastewater

The wastewater plan also shows no plant to be present within the site, with a 4inch Asbestos Concrete combined sewer running along the centre of Bellrock Crescent.

Power

The Scottish Power plan shows underground to be present on the site. This is shown to enter the southern section of the site, running along the eastern boundary before entering into the existing school structure. Further underground cables are shown to enter into the central western section of the site, before running east into a former building on the site.

BT

The BT plan indicates underground plant to run north/south along the eastern boundary of the site; however, this plant is not shown to extend into the site.

Virgin Media

A response from Virgin Media indicates that the site or the surrounding area does not contain any Virgin Media plant.

6.0 CONCEPTUAL SITE MODEL & ENVIRONMENTAL ASSESSMENT

6.1 General

This section is concerned with an assessment of the environmental conditions at the site, and development of a Conceptual Site Model, based on the available documentary information.

UK legislation has changed recently with the implementation of Part II A of the Environmental Protection Act. This legislation provides a definition of contaminated land as "Land posing significant risk where:

1. Significant harm is being caused, or there is a significant possibility of such harm being caused to the health of living organisms or other interference with the ecological systems of which they form a part (in the case of man this includes harm to property); or
2. Pollution of controlled waters is being or is likely to be caused."

The legislation was amended with the introduction of the Contaminated Land (Scotland) Regulations, 2005. The amended regulations removed the reference to 'Controlled Waters' and substituted the term 'Water Environment'. The regulations also introduced various tests of significance of pollution to the Water Environment.

It is current good practice to adopt the principals of risk assessment. Thus, the potential or actual presence of measurable levels of contaminants across a site does not automatically imply that a problem exists, since the potential for harm to occur requires the following:

- Source of contamination; contaminants
- Target (receptor) which may be harmed; and
- Pathway linking sources to targets.

Using the above methodology, only if all three elements (source, pathway and receptor) are identified, is a potential risk deemed to exist.

6.2 Conceptual Site Model

The Conceptual Site Model illustrates potential sources of contamination, migration pathways and likely receptors on and in the vicinity of the site, taking into account both the existing and the proposed residential site use.

The model has been derived from the documentary information collated during the stage 1 study. The individual elements of the conceptual model are presented in the following section, whilst Figure 3 provides a summary of the model, based on the proposed end use.

6.3 Potential Sources of Contamination

The site previously contained a farmhouse in the northwestern section, with a well, prior to the development of the previous school, which has since been demolished. It is therefore considered that made ground will be present, relating the construction/demolition of the previous school buildings. In addition, made ground is also locally anticipated with respect to the apparent platforming of the site. The surrounding area has historically contained various industrial activities that may have impacted on the regional environment. As such, the following issues are noted with respect to this site.

On-Site Sources of Contamination

Made Ground

Made ground is expected to be present on the site relating to the construction and subsequent demolition of the former farmhouse and school on the site. This was confirmed in the BGS 'Georeport' that revealed former investigations within the site having encountered made ground to a depth of 1.50m. The historical map evidence indicates the presence of a well in the northern section of the site, which the Envirocheck® Report indicates as an area of potentially infilled land; as such, it is considered that the made ground may be locally thicker in these areas. The source and nature of any made ground is unknown and is therefore considered to represent a potential source of contamination.

With regards to the above, the following issues are noted:

- Made ground may comprise deposits of heavy metals, organic or inorganic contamination including asbestos;
- Asbestos may be present within any demolition rubble;
- Abandoned underground mineworkings (at depth) could potentially be generating toxic and/or combustible gases; and
- Buried organic materials such as timber may biodegrade to produce potentially toxic and/or combustible gases.

Off-Site Sources of Contamination

Clay, Brick & Tile Works

Gartcraig Fire Clay Works was historically present to the north of the site, possibly containing a spoil heap. Based on the processes involved in this industrial activity, it is considered that there is the potential for this to have impacted on the environment, as such, the following issues are noted:

- Any spillage of fuel or lubricating oils from storage areas to production areas, is a possible source of contaminants;
- Any waste material disposed on site may contain various inorganic and organic contaminants;
- Asbestos was commonly used as insulation for industrial pipework;
- In the area of the former kilns potential for fuel ash to be present relating to these features.

Railway Land

The historical maps indicated the presence of historical railway sidings in the area of Gartcraig Fire Clay works, with the Envirocheck® Report indicating the presence of mineral railway lines. Potential hazards arise from the material used in the construction and maintenance of rolling stock. Hazards are greatest in depots, sidings and engineering works, rather than main track work. Hazards are likely to arise from spillages, accidents and a variety of processes, such as painting, maintenance and engineering shops. In this respect, the following issues were noted:

- Construction may have utilised waste ash and clinker from local industrial sources. This material will be contaminated with a wide range of toxic metals;
- Lead paint may have been used to prevent corrosion of iron and steel;
- Creosote (a coal tar derivative) used as a preservative on railway sleepers;

- Diesel and oil spillages may have occurred (risk heightened at depots);
- Pesticides used to control vegetation and storage areas may have become contaminated due to spillages; and
- Asbestos widely used for insulation in locomotives and carriages.

Above Ground Storage Tanks

The historical map evidence indicates the presence of above ground storage tanks in the area of the fire clay works to the north. It is not known what these tanks were used to store; however, there is the potential they could have stored fuel oils or heating oils, which may have leaked, as such, the following issues are therefore noted:

- Residues from tanks may contain alkyl lead (organometal compounds);
- Oily residues may contain Poly Aromatic Hydrocarbons (PAHs);
- Buried oily residues may anaerobically degrade to release methane and carbon dioxide, and;
- Organic solvents may release toxic and flammable vapours;

The tanks could have suffered leakages and/or spillages overtime and any ground contaminated with fuels, oils or solvents may be potentially combustible. Any made ground containing PAHs may be combustible.

Mineral Extraction

The geological map evidence shows the surrounding area to have contained various coal pits and collieries, particularly to the southeast of the site. The hazards posed by mineral extraction depend on the minerals involved, namely coal, and may be due to the minerals themselves, wastes from mining activities or wastes from mineral processing. A variety of mainly solid waste may be present such as mining spoil, ore residues and dust, slag heaps, contaminated groundwater in mineshafts and acid-mine runoff.

Infilled Quarries/Landfill Site

Numerous quarries were present to the west of the site, which are considered to have been infilled. Such features are commonly infilled with waste. There is no record of these quarries having been licenced/registered refuse tips however, this does not preclude the use of these features being used for uncontrolled waste disposal purposes. The Envirocheck® Report also disclosed the presence of a landfill site 172m to the north and a waste treatment/disposal site 29m to the northwest relating to the bus depot; these are considered to represent potential sources of contamination.

6.4 Potential Receptors

Environmental receptors that could feasibly be adversely affected by potential sources of contamination identified, are as follows; taking into account both the existing use of the site and the future end use, in this case a residential end use has been assumed.

- Current and future site users;
- Site operatives, particularly when undertaking ground works;
- Contractors involved in excavation works;
- Shallow groundwater;
- Deep groundwater; and
- Existing and future buildings and services.

6.5 Potential Pathways

The following potential pathways could bring receptors into contact with the potential sources of contamination:

- Direct dermal contact with contaminated soil or groundwater;
- Ingestion and / or inhalation of contaminated soil or fugitive dust;
- Ingestion of contaminated fruit and vegetables;
- Plant root up-take;
- Leaching of contaminants from soil to groundwater;
- Migration of mobile contaminants in groundwater;
- Migration of mobile contaminants via service trenches.

6.6 Risk Assessment

The following table contains an assessment of the potential for complete pollutant linkages to exist at the site, based on the potential sources, pathways and receptors identified in the previous sections and assign each a risk rating.

Each issue is assigned a risk rating from low, through medium to high. The risk classifications are defined as follows:

- Low Risk - Little chance that the issue is occurring/will occur is posing/will pose a liability or cost for the site owner.
- Medium Risk - It is possible that the issue could arise and could pose a liability or cost for the site owner. Additional information is required.
- High Risk - It is considered likely that the issue is occurring or will occur, with potential liability or cost for the site owner.

The assessment is based on the proposed end use of the site being for the redevelopment of the existing school buildings, a residential enduse has been assumed.

Table 4: Risk Matrix.

Potential Source	Potential Pathway	Potential Receptor	Likelihood of complete linkage being realised
Toxic metalliferous/inorganic and organic contaminants associated with made ground relating to previous structures that have been constructed/demolished, together with localised platformed areas.	Direct dermal contact; ingestion and inhalation of contaminated soil and dust; ingestion of contaminated fruit and vegetables	Existing site users, future residential site users	Medium. The historical evidence indicates the potential for made ground to be present, which may represent a possible source of contamination. The proposed development is likely to contain private garden areas, across which the risk will be greatest.
		Users of surrounding sites	Low. Minor risk of exposure to soil during construction. Risks should be controlled by good working practices (i.e. keeping excavations and spoil heaps damped down during prolonged periods of dry weather and securing the construction site). Majority of surrounding area comprises of sensitive (residential) development.
	Vertical / lateral infiltration or leaching from soil	Groundwater (surface water)	Low. The made ground is considered to represent a source of contamination, and may permit the flow of any mobile contaminants present. Consideration was given to the likelihood of the superficial deposits containing a shallow groundwater table and the distance to the receptor (the Light Burn).
		Groundwater (future resource)	Low to Medium. The natural superficial deposits comprise of glacial till that is not defined as supporting a body of groundwater, as such, the potential future extraction is from the bedrock aquifer. Risk will be reduced in the southern area where a substantial thickness of glacial till is documented; however, risks increase in the north and central area where the till is likely to be relatively thin.

Table 4: Risk Matrix (continued)

Potential Source	Potential Pathway	Potential Receptor	Likelihood of complete linkage being realised
Toxic metalliferous/inorganic and organic contaminants associated with made ground relating to various structures that have been constructed and demolished, together with localised platformed areas.	Direct contact or leaching from soil	Built Environment	Low. Structures and utilities could be in contact with aggressive contaminants. Any such risks can be mitigated in design.
Soil gases produced from made ground.	Migration into buildings via cracks and service entries	Existing site users, future residential site users, built environment	Low to Medium. Made ground may contain potential sources of gas generating material, such as buried timbers. Any risks identified to future site users can be mitigated in design.
Phytotoxic contaminants within made ground.	Plant Root Uptake	Vegetation in soft landscaped areas	Medium. The proposed development is likely to contain areas of private soft landscaping. The made ground represents a potential source of these contaminants; however, any risk can be mitigated using capping layers, if necessary.
Organic and inorganic contaminants potentially migrating onto site from historically proximal industries.	Vertical / lateral infiltration or leaching from soil	Site occupants, construction and maintenance workers, groundwater	Low to Medium. Potential sources of contamination have been identified in the surrounding area; however, given the presence of glacial till across the area the migration of any contamination is likely to be restricted.

6.7 Summary of Environmental Assessment

The Conceptual Site Model is based on the available documentary information and as the above table shows, it is generally considered that there is limited potential for widespread contamination to be present, due to the history of development that has occurred. There is the potential for made ground to be present relating to the apparent platforms that were created for the construction of the previous school structures. In addition, rubble may also be present with respect to the demolition of these former structures; the presence of made ground was confirmed by the BGS 'Georeport'. Therefore, there is the potential for localised issues to exist.

Taking into consideration the sensitive nature of the proposed enduse of the site, as well as the contamination potential, the site was assigned an overall low to medium risk rating.

With regard to any complete pollutant linkages, these are most likely to be encountered across areas of proposed soft landscaping (garden areas), where site users may be directly exposed to any contaminants present. In areas of hardstanding, the risk will be reduced due to this acting as a barrier between any contaminants present and the site users.

The potential risk to surface water features is considered to be low due to the presence of low permeability glacial till and the distance to the nearest surface water receptor. The superficial deposits are not considered to represent a source for future groundwater extraction, thus it was considered necessary to assess the risk to the bedrock aquifer. This was assigned a low to medium risk, with the risk greatest in the north where shallow bedrock is documented.

It is ultimately recommended that intrusive investigation be undertaken to confirm the risk rating, and presence or otherwise of any contamination at this site.

7.0 GEOTECHNICAL ISSUES

It is proposed to redevelop the site of the former Bellrock Primary School for residential development. At this stage, the layout and nature of the residential structures have not been finalised; as such the geotechnical issues are discussed in general terms.

The geological map evidence does not indicate the presence of made ground on the site; however, documentary evidence from the BGS report indicates that recent intrusive investigations undertaken on the site have encountered made ground persisting to a depth of 1.50m. This made ground is most likely to relate to the creation of platforms for the former school buildings that previously occupied the site. Made ground, at least in its untreated state, does not represent a suitable bearing stratum for foundations; as such, it is considered that all future foundations will require to be transferred through this material.

The natural superficial deposits are documented to comprise of cohesive glacial till. Such deposits are typically over consolidated clays leading to high bearing capacities and low settlement potential; therefore, these deposits are likely to provide a suitable bearing stratum for light to moderately loaded structures. Given the documentary evidence, it is considered likely that the glacial till will be present within the realms of conventional foundation methods, although local requirements for trench-fill techniques may be necessary where the made ground is found to be of increased thickness.

The documentary evidence indicates the presence of shallow bedrock in the northern and central area of the site. Although the bedrock is considered to represent a suitable bearing stratum, the presence of shallow bedrock could represent a constraint to development if any significant re-profiling of the site is proposed. In addition, the shallow bedrock could be problematic for deep utility runs, such as future sewers.

The glacial till is expected to be of a cohesive nature and is therefore likely to be of low permeability and as a result is unlikely to lend itself to the infiltration of surface water.

Based on the documentary, it is considered that the site is at low risk of being underlain by former shallow mineworkings.

The site slopes from the north down towards the south, and appears to have been platformed to accommodate the former development. Dependent on the layout of the proposed development, it is considered likely that some form of earthworks will be required. Given the potential for shallow bedrock, it may be prudent to make an allowance for rock excavation.

Ultimately, it is recommended that some intrusive investigation be undertaken to confirm the presence, nature and thickness of made ground, the nature and engineering properties of the natural glacial deposits and the depth to rockhead in the central and northern sections of the site.

8.0 INTRUSIVE INVESTIGATION CONSIDERATIONS

8.1 General Investigation Objectives

The overall investigation strategy is to confirm or otherwise, the various hypotheses developed in the Conceptual Site Model. The following issues have been highlighted as requiring clarification:

- Presence, nature and thickness of any made ground;
- Engineering properties of the natural glacial deposits;
- The depth to bedrock, particularly in the central and northern of the site; and
- Presence, nature, distribution and mobility of any contaminants;

The site is currently unoccupied by any structures, as such, it is considered that no access constraints should be encountered and that standard investigation equipment may be utilised. In this respect, the following scope of works is proposed at this site:

- Drilling of a number of soil boreholes to an anticipated depth of 5.0m;
- A series of trial pits undertaken to an average depth of 3.50m;
- In-situ sampling and testing;
- Installation of gas / groundwater monitoring standpipes in the boreholes;
- Undertaking a programme of geotechnical and analytical laboratory testing.

8.2 Sampling Strategy

Geotechnical Sampling Strategy

It is understood that the finalised design of the proposed development has not been completed. In this respect, a general investigation into the geotechnical conditions of the site will be necessary to confirm the presence, nature and thickness of made ground, the nature and engineering properties of the natural glacial deposits and the depth to rockhead in the central and northern sections of the site.

A comprehensive sampling strategy will be necessary to identify the soil profile. Disturbed samples should be obtained within each strata encountered. Standard Penetration Tests (SPTs) should also be undertaken within each strata and U100s collected as appropriate, for classification, environmental testing and descriptive purposes.

Environmental Sampling Strategy

Based on the historical map evidence, there is the potential for made ground to be present on the site, relating to the platforming of the site and subsequent demolition of the various structures. This made ground may potentially be of increased thickness in the area of the existing embankment and former well. A BGS report has confirmed the presence of made ground on the site, proven to a maximum depth of 1.50m. Any made ground is of an unknown source and therefore considered to represent a potential source of contamination.

Based on the documentary evidence, it is considered that no area of the site is at greater risk than any other of contamination being present, with the exception of the existing embankment and former well; as such, a non-targeted investigation strategy is considered appropriate for this site, albeit with the embankment and former well specifically targeted.

To assess matters with respect to groundwater, standpipes should be installed and samples collected and analysed if groundwater is present. The standpipes should also be dual purpose, being fitted with gas-monitoring facilities.

In order to confirm the Conceptual Site Model, the philosophy of the sampling strategy should be to obtain representative samples across the soil profile through the made ground and into the natural deposits to obtain a three-dimensional assessment of the ground conditions.

In this respect, disturbed soil samples should be obtained from each stratum at regular intervals both above and below the groundwater table (if encountered).

8.3 Laboratory Testing

Analytical Testing Strategy

In deriving the most appropriate analytical laboratory testing schedule, consideration was given to the Conceptual Site Model. Thus, the history of land use was used to provide an indication of the likely contaminants that are associated with the former land uses, whilst cognisance was also taken of the ground conditions, which were expected to comprise made ground with glacial till underlying.

The following table gives an indication of the contaminants, which are proposed to be included in the testing schedule for this site.

Table 5: Analytical Testing Rationale

Analyte	Medium	Justification
<u>Metals and inorganics</u> Arsenic Cadmium Chromium (total) Lead Mercury Selenium Boron Copper Nickel Zinc pH Cyanide Sulphide Water Soluble Sulphate	Soil, leachate and groundwater	A general screen for contaminants typically associated with brownfield sites, given documented presence of made ground considered to relate to site platforming and previous demolitions
Asbestos screen	Soil	Given the anticipated presence of made ground from historical demolitions
<u>Organics</u> Polycyclic aromatic Hydrocarbons (PAHs) Total Petroleum Hydrocarbons (TPHs) Phenols	Soil, leachate and groundwater	General screen for organic contaminants potentially associated with brownfield sites Made ground may contain such contaminants

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

It is proposed to develop the former Bellrock Primary School site for residential development. In this respect, an indication is sought of the expected ground conditions across the site.

A Stage 1 Desk Study was undertaken to formulate a Conceptual Model of the site. This is based on the historical development of the site; expected ground conditions; hydrology; hydrogeology; mining and environmental conditions.

The site is currently unoccupied by any structures with the ground coverage comprising tarmac and overgrown soft landscaping. The general topography of the site and surrounding area slopes from the north down towards the south. It appears as though the site has been platformed to create level building areas to accommodate the previous development, resulting in an embankment being present along the central area of the site.

The documentary evidence indicates that prior to the construction of the former school circa 1955, the site was largely unoccupied, with the exception of a well and small structure in the northern area. Limited industrial activities have historically been present within the area immediately surrounding the site, with the surrounding area largely containing residential properties.

Geological map and BGS report evidence indicates that the site is underlain by glacial till deposits, of a cohesive nature. The thickness of the deposits is shown as being less than 1m in the northern area increasing to 5m across the southern area. The documentary evidence also suggests the presence of a mantle of made ground across the site, up to 1.5m in thickness. The underlying bedrock of the Middle Coal Measures and the igneous teschenite dolerite intrusion is not expected to be at risk of mineral instability from shallow mineworkings.

A Qualitative Environmental Risk Assessment has been undertaken based on the historical landuse and expected ground conditions on and in the vicinity of the site. This has assigned the site a low to medium risk rating, based on the fact that made ground is documented to be present, which represents a possible source of contamination, and that the enduse of the site is of a relatively sensitive nature. In addition, any made ground present may contain sources of soil gas, such as buried timbers. The potential risk to groundwater and the wider environment is considered to be generally low, based on the expected presence of low permeability glacial till.

Given that proposals have not yet been finalised as to the design of the structures within the site, a general view was adopted with respect to geotechnical issues. The documented glacial till would be anticipated to constitute a suitable bearing stratum for light to moderate weight structures. However, consideration should be given to the potential for made ground to be present, where the glacial till could be present outwith the realms of conventional foundation techniques, resulting in the requirement for localised areas where trench-fill techniques being required.

The documentary evidence indicates the presence of shallow bedrock in the northern and central area of the site. Although the bedrock is considered to represent a suitable bearing stratum for the proposed structures, the presence of shallow bedrock could represent a constraint to development if any significant re-profiling of the site is proposed. The shallow bedrock could be problematic for deep utility runs, it may therefore be prudent to make an allowance for rock excavation.

9.2 Recommendations

Given the conclusions reached above, it is recommended that a Stage 2, intrusive investigation is undertaken, the objective of which should be to verify the ground conditions across the site and to clarify the nature of any risk. In this respect, it is considered that an assessment is required of the following:

- Presence, nature and thickness of any made ground;
- Engineering properties of the natural glacial deposits;
- The depth to bedrock, particularly in the central and northern of the site; and
- Presence, nature, distribution and mobility of any contaminants;

The site is currently unoccupied by any structures, as such, it is considered that no access constraints should be encountered and that standard investigation equipment may be utilised. In this respect, the following scope of works is proposed at this site:

- Drilling of a number of soil boreholes to an anticipated depth of 5.0m;
- A series of trial pits undertaken to an average depth of 3.50m;
- In-situ sampling and testing;
- Installation of gas / groundwater monitoring standpipes in the boreholes;
- Undertaking a programme of geotechnical and analytical laboratory testing.

STUDY LIMITATIONS

1. The study conducted and this report has been prepared for the sole use and reliance of the client and their advisors. The report shall not be relied upon, or transferred to any other parties without written authorisation. If any unauthorised third party comes into possession of this report, they rely upon it at their own risk and the authors owe them no duty of care and skill;
2. The opinions and advice set out in this report relates specifically to the current site and proposed development as detailed herein. They should not be transferred to other sites or to alternative schemes without prior consultation;
3. The findings and opinions conveyed herein are based on information obtained from external sources as detailed in the report and which Woolgar Hunter believes are reliable. Nevertheless, the reliability of such information cannot be guaranteed;
4. This report has been prepared in the light of legislation and best practices, current and applicable at the time of writing;
5. We do not provide legal advice and the advice of lawyers may also be required, and;
6. This report does not include comment in relation to archaeology, flora and fauna. Separate advice may be required in respect of this matter.

Figures

Appendix A

Photographs

Appendix B

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