

KNOCKNAGAEI, INVERNESS

PRELIMINARY RISK ASSESSMENT

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Site Address: Knocknagael,
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EXECUTIVE SUMMARY

Curtins were instructed by Field Energy to under a Phase 1 Preliminary Risk Assessment of a site located in Knocknagael, Inverness. The proposed redevelopment for the Site is a battery storage facility for renewable energy storage.

A review of relevant geological maps, historical maps and publicly available resources show the Site has undergone minimal development since 1874. The Site has previously been used for agricultural purposes and, at the time of writing, was in use as an agricultural field. The construction of historical farm buildings and a historical infilled pond in the centre of the Site may have generated and resulted in (potentially) contaminated made ground deposits and ground gas respectively.

As the Site is proposed for extensive redevelopment for a battery storage facility there is a moderate to low risk to future site users and a low risk to adjacent surface water bodies posed by any potential contaminants in the near surface superficial deposits. To assist in the design of the proposed development and satisfy local planning authority conditions an intrusive site investigation is required to characterise site soils, assess potential extents of contamination, assess potential ground gas risk to future site users and allow for a geotechnical assessment of the Site.

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1 INTRODUCTION

1.1 Project Background

In January 2024 Curtins were instructed by Field Energy to undertake a Phase 1 Preliminary Risk Assessment of a site located in Knocknagael near Inverness.

1.2 Scope of Services

The Preliminary Risk Assessment (PRA) is intended to provide an overview of the geo-environmental and geotechnical setting of the site. It is understood the site is to be developed into a battery storage facility with associated access and drainage infrastructure.

Through this overview, the PRA aims to develop both a working conceptual and ground model for the site, as well as present an initial assessment of any risks that could be presented to the development including its intended end users and the wider environment.

Specifically, the PRA provides an initial assessment of the site regarding:

- a) Potential contamination of the site strata by historical and/ or current use;
- b) The potential impact on the wider environment by historical and/ or current use of the site of interest;
- c) The potential impact from surrounding land uses and other environmental factors;
- d) Potential problems associated with geological features such as faulting, mineral extraction, mining and land instability;
- e) The location of any sub-surface structures that may affect the proposed redevelopment;
- f) The location of any above-surface features that may affect the proposed redevelopment, and
- g) Recommendations for intrusive investigations.

A Site walkover was undertaken in addition to desk-based searches. Consideration of detailed flood risk, ecology and archaeological issues are outside the scope of this report.

2 SITE DETAILS

2.1 Site Location and Current Details

Site use, location and description are shown below in Table 2.1 and Figure 2.1 obtained from desk-based sources.

Site Address	Knocknagael, Inverness IV2 6DL
NGR	264900, 839000
Area of Site	16.24 ha
Current Site use and Description	The site is currently vacant and is utilised for farming.

Table 2.1 – Site Details

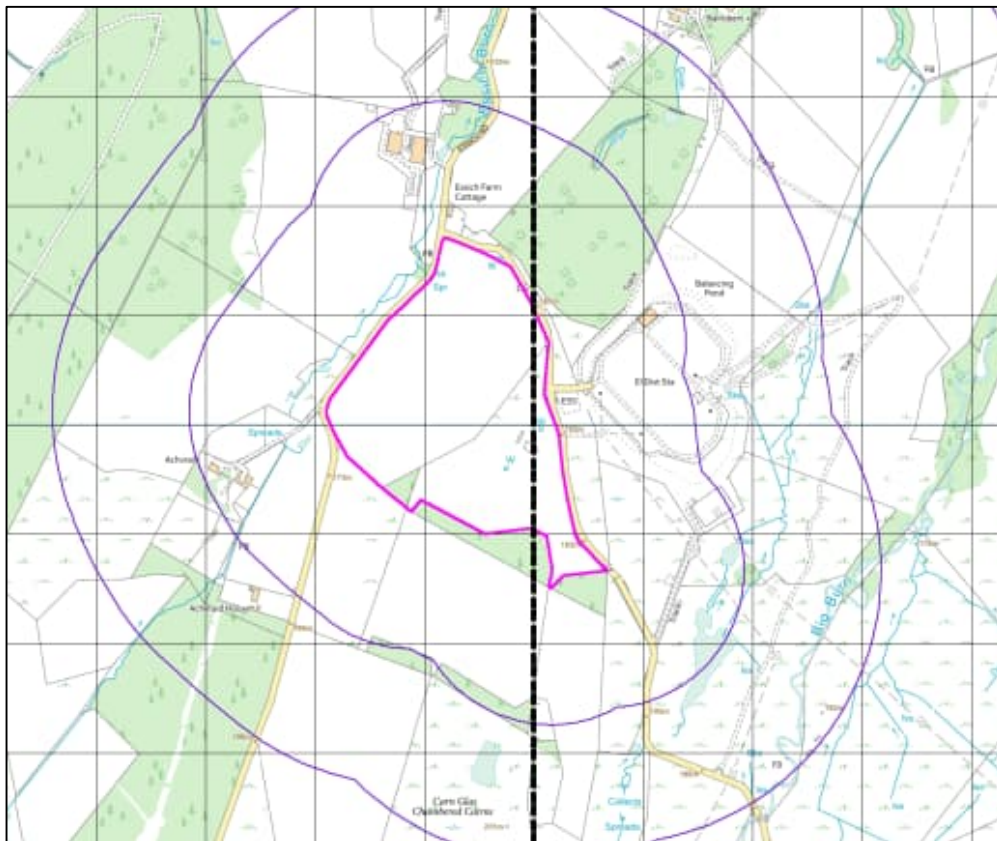


Figure 2-1 Site Location Plan (Site boundary shown in pink and 250m buffer in blue).

2.2 Surrounding Area Details

The following information was established through undertaking an environmental database search (Envirocheck report (Ref.1) included in Appendix A).

Surrounding Area	N	Road and agricultural land. Scrubland and trees to the north-east of the Site.
	E	Road and then electrical substation
	S	Woodland with agricultural land beyond.
	W	Agricultural land

Table 2.2 Surrounding Land uses

2.3 Site Walkover

A Site walkover was undertaken by a Curtins Engineer on the 23rd January 2024. The walkover was undertaken to ascertain current Site conditions. The weather was very windy but clear skies after a period of heavy rain.

The Site is a large agricultural field located adjacent to a road. The field slopes steeply from south to north towards Inverness and is bound by roads on the east and north. A post and wire fence with a metal access gate divides the Site, running approximately west to east. The south of the Site is bound by woodland. An area of archaeological significance is located in the centre of the Site as described in Document Archaeological Desk-Based Assessment, *Knocknagael Site, Essich, Inverness, Royal Haskoning DHV UK Ltd (2023) – (Report no. PC3506-RHD-03-XX-RP-Z-0002 (Ref. 10))*. Evidence of above ground structures such as hut circles was noted.

A number of trees in the centre of the Site were shown to have tree protection order numbers.

Out with the Site boundary, an electrical substation is located approximately 20m east of the Site.

There were no visual or olfactory indications of contaminated land issues on the Site.

3 SITE HISTORY

3.1 Historical Maps Review

A review of the available historical mapping and other information for the site, as presented within the Envirocheck Report (Ref.1), has been undertaken and is presented in *Table 3.0* below.

Date	Description	Potential Sources of Contamination
1874	Site is shown as a farmer's field and the surrounding land use across the Site is shown as farmers' fields. A small building is shown on the centre of the Site with a well adjacent to the south-west. The surrounding area is shown as farmland and woodland. A large pond is shown approximately 50m downslope to the west of the Site.	Uncontrolled deposition of made ground from construction of building on the site, in particular, potential for ground gas generation.
1874 - 1904	An additional well is shown to the north-east of the building in the centre of the Site. A shape is shown on the map north of the building that represent a pond. A pond is shown approximately 30 m to the south-east of the Site.	Organic-rich soils associated with the pond feature could represent a potential ground gas source.
1904 - 1964	The potential pond* area in the centre of the Site is no longer shown.	Contaminated materials used to infill pond may have the potential to generate ground gas and represent a potential risk to future site users.
1964 - 2005	Pond to the south-east of the Site is no longer shown.	Contaminated materials used to infill pond may have the potential to generate ground gas and represent a potential risk to future site users.
2005 - 2023	Electrical Substation shown on the 2023 mapping approximately 20m east of the Site. The well(s) are not longer noted and it is unclear if these have been backfilled.	None noted – The sub-station was assessed as having been constructed after 2005, therefore the risk of encountering chemical contaminants associated with older facilities was considered low (ie. PCBs) Contaminated materials used to infill well(s) may have the potential to generate ground gas and represent a potential risk to future site users.

Table - 3.0 Previous Site and Surrounding Land Use and Potential Sources of Contamination

*The identified former pond feature is located within an area of archaeological interest and has therefore been excluded from the Phase 2 intrusive investigations.

It should be noted that whilst there is a gap in mapping from 1904-1964 and then from 1964 -2005, considering the limited development on the Site and no particular features noted during the Site walkover, out with the archaeological features, it is considered unlikely that the Site was developed in any significant way to generate potential sources of contamination beyond those noted in the maps made available. Potential sources of on-site contamination are further discussed in Section 5.0.

4 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

4.1 Geology and Hydrogeology

A study of the Envirocheck records, British Geological Survey (BGS) 1:50,000 mapping records (Bedrock and Superficial Editions) for Inverness (Sheet 83) (Ref.2) indicated the following geological and hydrogeological succession underlying the site.

Geology	Associated Hydrogeological Classification
Hummock Glacial Deposits – Diamicton, Sand and Gravel.	SEPA mapping does not provide information on superficial aquifers.
Inshes Flagstone Formation – Red, green and grey flaggy sandstones	Middle Old Red Sandstone – Moderately productive aquifer. Sandstones, in places flaggy, with siltstones, mudstones and conglomerates and interbedded lavas, locally yields small amount of groundwater.

Table 4.1 – Geological/Hydrogeological Succession

There are no relevant (within 500m of the Site boundary) borehole records available for the Site.

Groundwater within the superficial deposits is likely to be limited due to the cohesive nature of the soils (clay) and, where present, is likely to be perched within sandy bands.

The Envirocheck report noted no groundwater abstractions to be located within 1km of the site. However, the historical map review indicated the presence of two former wells on the Site. Whilst no evidence of these features were noted during the Site walkover, the presence of the wells on the Site can not be ruled out. At the time of writing the landowner has been contacted for more information but no response has been received.

4.1.1 Mining

The site is not within a coal mining reporting area according to the Coal Authority Interactive Mapping (Ref.4).

4.1.2 Ground Stability

The Envirocheck Report confirms that there is a ‘no hazard’ to ‘low risk’ from the following ground stability hazards onsite; collapsible ground, compressible ground, ground dissolution, landslide ground, running sands and shrinking or swelling clay.

4.1.3 Landfill

The Envirocheck Report confirms there are no recorded operational or historic landfills recorded within 1km of the site. It is noted that the Site is within the Highland Council local authority landfill coverage and the Envirocheck Report did not receive information pertaining to landfill activities on the Site. A search of the Highland Council’s landfill and contaminated land registers was undertaken in addition to a search of SEPA’s landfill register. No landfill records were noted during both searches.

4.1.4 Ground Gas

The BGS Radon Mapping (Ref.5) confirms the site is situated in a radon area where less than 1% of homes are at or above the radon action level. On this basis, basic radon protection measures are not considered to be required in the construction of any enclosed spaces.

As per the historical map review, a pond and two wells on the Site, if infilled, could contain materials that generate ground gas.

4.2 Hydrology

The nearest surface water feature is the Essich Burn located ~50m to the north-west of the Site. There is no classification for the burn provided by SEPA.

No surface water abstractions are noted within 500m of the site.

No pollution incidents have been registered within 300m of the site.

4.3 Unexploded Ordnance

Military activities including those conducted as part of both the First and Second World Wars have resulted in a legacy of unexploded ordnance (UXO) being present within the shallow soils of the UK.

UXO result from various sources including both allied (military training) and German (bombing raids) with a guide figure of approximately 10% of all munitions failing to function as designed.

The likelihood of UXO being encountered on a development site is influenced by several factors including; the proximity to strategic targets, the nature of the development works being undertaken and evidence of local damage in the post-war periods amongst others. To determine the likelihood of UXO being present on a site, a step-wise risk assessment process is followed. This process is outlined within CIRIA C681 Unexploded Ordnance: A Guide for the Construction Industry (Ref.6) with the following commentary considered to represent a Preliminary Risk Assessment intended to guide if and where there is a requirement for a Detailed Risk Assessment.

4.4 Preliminary UXO Assessment

Risk mapping (Ref.7) for UXO's has placed the site in a Low risk area. Low risk areas are those with a bombing density of up to 10 bombs per 1000 acres. These areas are considered to have a low UXO risk.

The Envirocheck Report historical mapping (Ref.1) does not indicate any ruins, or buildings that disappeared during WWII, on or surrounding the site.

Based on the forgoing commentary, the likelihood of encountering UXO on site as part of the ground investigation or development works is Low.

If unexploded ordnance is discovered, stop immediately, prevent access to the area, and inform the police. If the site boundary or location changes then the UXO risk should be reassessed

5 CONCEPTUAL SITE MODEL & QUALITATIVE RISK ASSESSMENT

5.1 Conceptual Site Model

The conceptual site model (CSM) and Qualitative Risk Assessment (QRA) are presented in the table within this section.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified for the site. The QRA details the associated level of risk relating to these potential pollutant linkages.

The CSM and QRA concern risk to human health and water environment with additional, more specific risk assessment protocols contained within the main body of this reporting, as detailed in Section 5.2 below.

The QRA follows the framework outlined within CIRIA C552 as detailed in Appendix C.

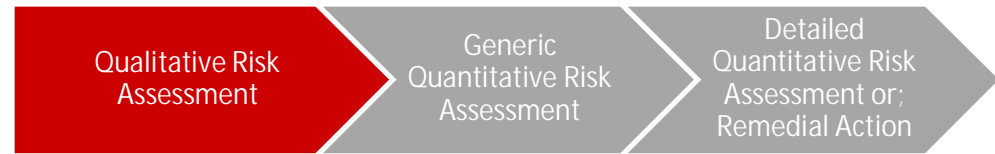
The 'risk rating' within the QRA refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation

5.2 Additional Risk Assessments

The following risk assessments, listed below, are not included within the main CSM and QRA but nonetheless can be of critical importance to the onward development of the site.

- The risk presented by Mining is discussed and assessed in Section 4.1.1.
- The risk presented by Radon is discussed and assessed in Section 4.1.4.
- The risk presented by Unexploded Ordnance is discussed and assessed in Section 4.4.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref.8) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate/manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements.



- The table below represents the first stage in the land quality risk assessment process: The Qualitative Risk Assessment.
- For a development site to be deemed 'suitable for use', the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish, if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions
Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating	
<p>Made Ground and contamination associated with:</p> <ul style="list-style-type: none"> • Buildings on Site • Infilled pond <p>Localised Fuel Spills from farming equipment during farming activities on the Site.</p>	<p>Direct contact, ingestion, inhalation (dust and vapours).</p>	<p>Site end-user</p>	<p>Medium Acute health risk</p>	<p>Unlikely Due to the nature of the Site having undergone minimal development over time the presence of made ground is considered unlikely</p>	<p>Moderate/Low</p>	<p>Generic Quantitative Risk Assessment recommended as part of the ground investigation to confirm risk assessment</p>
	<p>Vertical migration through the superficial deposits (soils) May occur due to physical processes including; capillary action and downwards into the natural deposits through infiltration, however, on Site deposits are likely to be cohesive in nature, reducing the potential for vertical migration.</p>	<p>Water Environment (groundwater) Unclassified Aquifer. No active/in use potable abstraction points located within the vicinity of the site, although former wells were noted on historical map extracts.</p>	<p>Mild Pollution of sensitive water resources</p>	<p>Low There is potential for the leaching of contamination from made ground arising from the site, however the superficial deposits on Site are likely to be cohesive reducing the risk of vertical migration. Wells are assumed to no longer be in use.</p>	<p>Low</p>	
	<p>Horizontal migration over and through the superficial deposits (soils).</p>	<p>Water Environment (surface water) Burn of Arrachnaras</p>	<p>Mild Pollution of sensitive water resources</p>	<p>Unlikely Unlikely considering the distance to the receptor and cohesive nature of superficial deposits.</p>	<p>Low</p>	
<p>Production of ground generating gases from:</p> <ul style="list-style-type: none"> • Made ground from infilled pond and wells in the centre of the Site and to the south-east of the Site. 	<p>Vertical and horizontal migration through existing service corridors and the underlying superficial deposits.</p>	<p>Site end-user</p>	<p>Medium Human health risk</p>	<p>Low With reference to BS8576:2013 (Ref.9), these sources are considered to have a moderate gassing potential.</p>	<p>Moderate</p>	<p>Ground Gas Monitoring Risk is considered Moderate due to unknown provenance of materials used to infill former ponds and close proximity to the development. However, as the superficial deposits are likely to be cohesive in nature, there is unlikely to be an active pathway on the Site for ground gas to migrate.</p>

6 CONCLUSION AND RECOMMENDATIONS

The qualitative risk assessment (QRA) determined a varied level moderate to low risk associated with the proposed development.

The QRA concluded by recommending that generic quantitative risk assessments (GQRA) were conducted to confirm the assessment of risk ascribed to each of the respective potential pollutant linkages (PPLs). It is recommended that the GQRA is conducted as part of a ground investigation in support of the engineering design of the proposed development, as well as satisfying requirements of anticipated planning conditions.

In summary, the following recommendations are made:

- Undertake an intrusive ground investigation;
- Undertake a GQRA as part of the ground investigation; and
- Undertake ground gas monitoring.

It is further recommended that this work is completed in advance of any development works taking place. A Drawing showing a proposed ground investigation is located in Appendix B.

6.1 Contaminants of Concern

Potential contaminants of concern associated with the sources identified within the Conceptual Site Model in Section 5.0 of this report include, but are not limited to: broad range aliphatic and aromatic hydrocarbons present within any fuel oils from farming activities (localised spills); polycyclic aromatic hydrocarbons (PAHs); inorganic compounds including heavy metals and asbestos.

Potential contaminants associated with the airborne dust/particulates include, but are not limited to: polycyclic aromatic hydrocarbons and inorganic compounds including toxic metals that are also accounted for by potential on-site contaminants of concern.

6.2 Geotechnical Considerations

A review of the geological mapping and Envirocheck report in Section 4.0 has determined that, whilst there are no geological features that pose significant risk to the Site development a ground investigation should be undertaken to characterise ground conditions on-site.

Therefore, an allowance should be made for in situ testing of soils and retrieval of soil samples for laboratory testing to develop recommendations for suitable foundation solutions and consideration of other geotechnical aspects, for example:

- The presence of soft/ unsuitable soils, including organic-rich materials and/ or peat,
- The presence of shallow bedrock,
- The presence of shallow groundwater which may impact on the cutting of foundations and other excavations during development,
- The stability of excavation side walls during development works, including services/ utilities and foundations,
- The potential re-use of site-won materials within earthworks (where appropriate), and
- The potential requirement for slope stability assessments (where appropriate).

6.3 Additional Considerations

The requirement for additional surveys, e.g. arboriculture, ecological and archaeological surveys should be confirmed through advice from a suitably qualified and experienced professional.

7 REFERENCES

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6. CIRIA (2009) Unexploded Ordnance: A Guide for the Construction Industry (report no. C681).
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10. Archaeological Desk-Based Assessment, Knocknagael Site, Essich, Inverness, Royal Haskoning DHV UK Ltd (2023) – (Report no. PC3506-RHD-03-XX-RP-Z-0002)