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RIGIFA, THURSO
PRELIMINARY RISK ASSESSMENT

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Client Name: Field
Client Address: Fora Montacute Yards
186 Shoreditch High Street
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Site Address: Rigifa,
Thurso
KW14 8XH

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Reviewed	Signature	Date
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EXECUTIVE SUMMARY

Curtins were instructed by Field to undertake a Phase 1 Preliminary Risk Assessment of a site located in Rigifa, Thurso. The Proposed Development for the Site is a battery energy storage system (BESS).

A review of relevant geological maps, historical maps and publicly available resources show the Site has undergone minimal development since 1877. The Site has previously been used for agricultural purposes and, at the time of writing, was in use as an agricultural field.

From our preliminary assessment we have considered there to be a moderate to low risk to future site users and adjacent surface water bodies posed by any potential contaminants in the near surface superficial deposits. As such, further work including an intrusive site investigation is required pre-construction to characterise site soils, assess extents of contamination, assess gas risk to future site users and allow for a geotechnical assessment of the Site.

CONTENTS

1 INTRODUCTION

1.1 Project Background

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

The Proposed Development principally comprises a battery energy storage system (BESS) with a capacity of up to 200 megawatts (MW) which will charge and discharge electricity from the adjacent planned and consented Gills Bay substation. It includes:

- Battery storage units arranged into rows;
- Medium-voltage (MV) skids and ancillary low-voltage (LV) equipment;
- High-voltage (HV) grid transformers;
- Air insulated switchgear;
- A substation building comprising welfare facilities, a switch room and control room;
- An interface substation and underground 132 kV grid connection cable; and
- Site-wide supporting infrastructure including cabling, access tracks, fencing, attenuation basins, and landscaping measures.

Whilst the exact specifications are subject to detailed design, the principal components described form the basis of the planning application to allow environmental assessments and mitigation to be appropriately scoped.

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 BESS 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;

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 Development;

f) The location of any above-surface features that may affect the Proposed Development, and

g) Recommendations for intrusive investigations, as appropriate.

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.

Table 2.1 – Site Details

Site Address	Rigifa, Thurso, KW14 8XH
NGR	329401, 971053
Area of Site	10.93 ha
Current Site use and Description	The site is currently vacant, utilised for farming.

Figure 2.1 Site Location Plan (Site boundary shown in red).

2.2 Surrounding Area Details

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

Table 2.2 Surrounding Land uses

Surrounding Area	N	Woodland and agricultural fields
	E	Agricultural fields
	S	Agricultural fields
	W	Agricultural fields

2.3 Site Walkover

A Site walkover was undertaken by a Curtins Engineer on the 22nd January 2024. The walkover was undertaken to ascertain current Site conditions. The weather was very windy followed by clear skies after a period of heavy rain.

The Site is a large agricultural field located along a gravel farm track. A storage area is utilised in the north end of the Site consisting of silage and tires. A windfarm was noted 2.2 km to the west. The Site peaks in the centre of the Site before dropping in altitude to the north and to the south. Discussions with locals indicate anecdotal evidence that there is the potential for shallow rockhead on the Site. A small woodland is located north of the Site across a gravel farm track.

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.

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

Date	Description	Potential Sources of Contamination
1877	The Site is shown as a farmer's field. The wider area is shown as various farmer's fields, small holdings and pockets of woodland. A sheepfold is located in the southwest of the Site.	Potential contamination associated with the sheepfold.
1907	No changes are shown to the Site. Three quarries are identified within 250 m of the Site boundary; approximately 10 m from the southern-most corner and between 60 m and 75 m from the western boundary.	Potential for the uncontrolled deposition of made ground from historical quarry associated with potential backfilled materials adjacent to the Site, in particular, potential for ground gas generation.
1960	No changes shown on the Site and the immediate surrounding area.	None noted.
1968 - 1976	The sheepfold is noted as a sheep dip. The three quarries are no longer identified as "quarries" on the map extract. Instead, the extents of excavation are shown for the two quarries to the west, with the southern quarry now shown as a pond.	Sheep dip features can typically be associated with contaminants such as heavy metals and organochlorines. Potential for the uncontrolled deposition of made ground from historical quarry associated with potential backfilled materials adjacent to the Site, in particular, potential for ground gas generation.
2001 – 2023	Sheep dip is no longer shown on the Site. No further significant changes to the Site are shown up to the present day.	None noted.

Potential sources of onsite contamination are further discussed in Section 5.0.

4 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

4.1 Geology and Hydrogeology

A study of the British Geological Survey (BGS) 1:50,000 mapping records (Bedrock and Superficial Editions) for Wick (Sheet 116) (Ref.2) indicates the following geological and hydrogeological succession underlying the site.

Table 4.1 – Geological/Hydrogeological Succession

Geology	Associated Hydrogeological Classification
Tilll, Devensian - Diamicton	SEPA mapping does not provide information on superficial aquifers.
Spital Flagstone Formation – Siltstone, Mudstone and Sandstone	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.

There are no relevant (within 500 m 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 clay and where present is likely to be perched within sandy bands.

A former well was noted on the 1906 map extract, located adjacent to an existing property approximately 300 m south-west of the site. It is unknown if this well remains active.

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 ‘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

There are no recorded operational or historic landfills recorded within 1 km of the site.

4.1.4 Ground Gas

The BGS Radon Mapping (Ref.5) confirms the site is situated in radon area where >5-10% of homes are at or above the radon action level. On this basis, basic radon protection measures are recommended in the construction of any enclosed spaces.

Where a new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

The presence of nearby former quarries could be considered representative of potential ground gas generating sources depending on the extent and nature of any backfill materials. Further intrusive investigation is recommended in this regard.

4.2 Hydrology

The nearest named surface water feature is the Burn of Horsegrow located ~100 m to the north west of the Site, however, the aerial photographs indicate a network of small drainage burns to the north of the Site. There is no classification for the burn provided by SEPA.

A former well was noted on the 1906 map extract, located adjacent to an existing property approximately 300m south-west of the site. It is unknown if this well remains active.

No pollution incidents have been registered within 300 m 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 which is summarised within 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 4.1.3.
- The risk presented by Unexploded Ordnance is discussed and assessed in Section 4.3.

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 and 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.

Qualitative Risk Assessment → Generic Quantitative Risk Assessment → Detailed Quantitative Risk Assessment or; Remedial Action

- 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*	
Made Ground and contamination associated with the Sheep Dip. **Fuel Spills from farming equipment during farming activities on the Site.**	**Direct contact, ingestion,** *inhalation (dust and vapours).*	***Site end-user***	**Medium** *Acute health risk*	**Low** *Due to the nature of the Site having undergone minimal development over time the presence of made ground is considered Low, however, there is potential for contaminants associated with the sheep dip.*	***Moderate/ Low***	**Generic Quantitative Risk Assessment** recommended as part of the ground investigation to confirm risk assessment
	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 superficial deposits are likely cohesive in nature, as such are likely to reduce likelihood of vertical migration.*	**Water Environment (groundwater)** *Unclassified Aquifer.* *No potable abstraction points located within the vicinity of the site.* *The site is not within a source protection zone.*	**Mild** *Pollution of non-sensitive water resources*	**Low** *There is potential for the leaching of contamination form made ground arising from the site, however there is also a lack of potable abstractions within the area.*	***Low***	**No action required**
	Horizontal migration over and through the superficial deposits *(soils).*	**Water Environment (surface water)** *Burn of Horsegrow*	**Medium** *Pollution of sensitive water resources*	**Unlikely** *Unlikely considering the distance to the receptor.*	***Moderate/ Low***	**Generic Quantitative Risk Assessment** recommended as part of the ground investigation to confirm risk assessment.
Production of ground generating gases from: • *Made ground from infilled quarries to the south and west of the Site.*	**Vertical and horizontal migration** *through existing service corridors and the underlying superficial deposits.*	*Site end-user*	**Medium** *Human health risk*	**Likely** *With reference to BS8576:2013 (Ref.10), these sources are considered to have a moderate gassing potential.*	***Moderate***	**Ground Gas Monitoring** Risk is considered Moderate due to proximity of western quarries, cohesive nature of on-site deposits and lack of infill of quarry adjacent to the Site. Ground Gas Monitoring should mitigate any residual risk to future Site users.

6 CONCLUSION AND RECOMMENDATIONS

The qualitative risk assessment (QRA) determined a varied level of 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.

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 works taking place.

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 reporting 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 organochlorines (sheep dip).

Potential contaminants associated with the airborne dust/particulates/ vapours 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 Proposed 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. arboricultural and ecological surveys, should be confirmed through advice from a suitably qualified and experienced professional.

7 REFERENCES

1. Landmark (2019) Envirocheck Report (report no. 333608385_1_1).
2. British Geological Society (BGS) Solid and Drift Editions (1985) 1:50,000 mapping, Sheet No. 116 (Wick).
3. BGS Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html (accessed January 2024).
4. Coal Authority Interactive Map Viewer, http://mapapps2.bgs.ac.uk/coalauthority/home.html (accessed January 2024).
5. UK Maps of Radon, http://www.ukradon.org/information/ukmaps (accessed January 2024).
6. CIRIA (2009) Unexploded Ordnance: A Guide for the Construction Industry (report no. C681).
7. Zetica Risk Maps, https://zeticauxo.com/downloads-and-resources/risk-maps/ (January 2024).
8. Health and Safety Executive (2015) Construction (Design and Management) Regulations.
9. British Standards Institution BSI (2013) Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (report no. BS8576)
10. Rigifa BESS – Archaeological Written Scheme of Investigation for Engineering-led Ground Investigations, HaskoningDHV UK Ltd, 2024 – PC3506-RHD-07-XX-ME-Z-0003.

8 APPENDICES

8.1 Appendix A – Drawings

8.2 Appendix B – Third Party Information

8.3 Appendix C – Qualitative Risk Assessment Rationale

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of an event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment, the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

In accordance with DoE guidance, the following categorisation of consequence has been developed:

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in “significant harm” as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into the water environment. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

In accordance with DoE guidance, the following categorisation of probability has been developed:

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of risk has been developed:

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe*, and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Very Low Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.