POWERFUEL

Portland energy recovery facility

Environmental statement
Technical appendices

1

Ground conditions and water quality

POWERFUEL

Portland energy recovery facility

Environmental statement
Technical appendix I;

Ground conditions and water quality

(part 1 of 2)

I.1

Ground conditions technical assessment

Portland Powerfuel Ltd

Portland Energy Recovery Facility

Environmental Statement Ground Conditions Technical Assessment

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Appendices

Appendix A

Arup (2020) Geoenvironmental & Geotechnical Desk Study

1 Introduction

1.1 Scope and purpose of report

This report considers the potential environmental impacts and likely significant effects of Portland Energy Recovery Facility, the Proposed Development, with respect to ground conditions, focusing on ground contamination.

The scope of this assessment has been defined by Terence O'Rourke Ltd in the document EIA methodology briefing note (ground conditions and water quality) dated 18 March 2020 following the EIA scoping process undertaken with Dorset Council and other consultees.

Adverse environmental effects associated with ground contamination principally concern:

- pollution of groundwater;
- pollution of surface waters;
- human health and safety, on and off-site;
- ground conditions aggressive to construction materials, and
- plant growth restriction.

The assessment comprises the following:

- A baseline study of the history of the Site, its regulatory status, ground conditions, land and groundwater contamination prior to development;
- Identification and evaluation of impacts with respect to land contamination;
- Qualitative and quantitative assessment of significance and magnitude of land contamination on human health and controlled waters in accordance with current UK guidance;
- Assessment of impacts on land contamination during both the construction and operational phases;
- Recommendations for mitigation measures, including remediation that would reduce the potential effects of the development to acceptable levels.

The effects on the environment through the introduction of new pollutants to surface waters as a result of routine runoff or spillages of hazardous material is considered in Environmental Statement Water Quality Technical Appendix I2, which sets out the surface water position and identifies potential effects through the introduction of new pollutants.

1.2 Limitations

This report has been produced by Arup for use by Portland Powerfuel Ltd. It is not intended for and should not be relied upon by any third party except as provided for in Arup's agreement with Portland Powerfuel Ltd.

Arup has based this report on the sources detailed within the report text and believes them to be reliable, but cannot and does not guarantee the authenticity or reliability of third party information. Notwithstanding the efforts made by the professional team in undertaking this assessment, it is possible that ground conditions other than those indicated by this report may exist at the site.

This report has been prepared based on current legislation, statutory requirements, planning policy and industry good practice prevalent at the time of writing. Any subsequent changes or new guidance may require the findings, conclusions and recommendations made in this report to be reassessed in the light of the circumstances.

2 Legislation and policy

2.1 Legislation and statutory guidance

Part 2A of the Environmental Protection Act 1990 (as amended) (EPA 1990) establishes the legal framework for dealing with land contamination in England and is the primary UK legislation specifically relating to land contamination. It provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment.

Contaminated land is defined in the legislation as land which is in such condition by reason of substances in, on or under the land that:

- Significant harm is being caused, or there is a significant possibility of such harm being caused, or
- Significant pollution of controlled waters is being or is likely to be caused.

The potential for harm is based on the presence of three factors:

- Source: substances that are potential contaminants
- Pathways
- Receptors.

For the land to be determined as 'contaminated' in a regulatory sense, and thereby require remediation (or a change to a less sensitive use), all three elements (source-pathway-receptor) of a significant pollutant linkage must be present.

Government objectives with respect to land contamination policy and the Part 2A regime are set out in the Department for Environment, Food and Rural Affairs (Defra) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance 2012[1] as:

- to identify and remove unacceptable risks to human health and the environment;
- to seek to ensure that contaminated land is made suitable for its current use, and
- to ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.

2.2 National planning policy and guidance

National planning policy is set out in the National Planning Policy Framework 2019 (NPPF (19))[2]. The underlying principle of the NPPF (19) is a presumption in

[1] DEFRA (2012) Contaminated land statutory guidance: Available at https://www.gov.uk/government/publications/contaminated-land-statutory-guidance
[2] Ministry of Housing Communities & Local Government (2019) National Planning Policy Framework, revised February 2019. Available at:

favour of sustainable development. It requires that both geology and ground conditions are considered as a resource and that the effects that they may have, including as a result of contamination, are taken into account in the planning process. Key to this assessment are paragraphs 170, 178-9 and 183.

The National Planning Practice Guidance (PPG) for land affected by contamination has been produced by the Government to support the NPPF (19). Paragraph: 007, Reference ID: 33-007-20190722, Revision date: 22nd July 2019 of the PPG states that if contamination could be an issue: *"applicants should provide proportionate but sufficient Site investigation information (a risk assessment) prepared by a competent person to determine the existence or otherwise of contamination, its nature and extent, the risks it may pose and to whom/what (the 'receptors') so that these risks can be assessed and satisfactorily reduced to an acceptable level".*

Paragraph: 007, Reference ID: 33-007-20190722, Revision date: 22 July 2019 of the PPG goes on to state that the risk assessment should *"identify the potential sources, pathways and receptors ('pollutant/ contaminant linkages') and evaluate the risks. This information will enable the local planning authority to determine whether more detailed investigation is required, or whether any proposed remediation is satisfactory".*

2.3 Local planning policy

The site lies within the development boundary as allocated in the West Dorset, Weymouth and Portland Adopted Local Plan. The policy of relevance to this report is:

- ENV9 Pollution and Contaminated Land: Planning permission for development on or adjoining land that is suspected to be contaminated will not be granted unless it can be demonstrated that there is no unacceptable risk to future occupiers of the development, neighbouring uses and the environment from the contamination.

The site is also within the boundary as allocated in the Bournemouth, Christchurch, Poole and Dorset Adopted Waste Plan. The policy of relevance to this report is:

- Policy 16, Natural Resources: Proposals for waste management facilities will be permitted where all of the following criteria are met:
  a) it can be demonstrated that the quality and quantity of water resources would not be adversely impacted and/or would be adequately mitigated;
  b) ground conditions are shown to be suitable;
  c) site soils would be adequately protected, reused and/or improved as required; and
  d) there would not be a loss of the best and most versatile agricultural land unless the environmental, social and/or economic benefits of the proposal

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

outweigh this loss and it can be demonstrated that the proposal has avoided the highest grades of land wherever possible.

2.4 Other relevant standards and guidance

Other guidance documents that have been used in the preparation of the assessments presented in this Technical paper are:

- Environment Agency, Land Contamination: risk management[3]
- Environment Agency (2009) Updated technical background to the CLEA model. Science Report SC050021
- Environment Agency (2006) Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination
- HSE (2012) The Control of Asbestos Regulations
- CIRIA (2014) Asbestos in soil and made ground: a guide to understanding and managing risks. Publication C733
- CIRIA (2007) Assessing risks posed by hazardous ground gases to buildings, C665
- British Standards Institute (2019) BS8485:2015+A1:2019: Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (+A1:2019)
- Building Research Establishment (2005) Special Digest 1: Concrete in aggressive ground, third edition
- Building Research Establishment (2004) Report 465: Cover systems for land regeneration: thickness of cover systems for contaminated land
- Building Research Establishment (2003) Report 456: Control of dust from construction and demolition activities
- Environment Agency (2002) National Groundwater and Contaminated Land Centre: Piling into contaminated Sites
- Environment Agency (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. NC/99/73

[3] Available at (accessed 24th April 2020): https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks

3 Methodology and approach

3.1 Consultation

A formal scoping report was issued to Dorset Council on 10 January 2020 and the council's scoping opinion was received on 25 February 2020. Scoping responses on ground conditions were received from Dorset Council's waste planning team and environmental health officer and the Environment Agency, details of which are provided in Table 1.

Table 1: Consultation summary

Consultee and date	Issue raised
Emma Macdonald Minerals and Waste Planning Dorset Council 24th February 2020	Dorset Council's Environmental Health Officer (EHO) has advised that the potential for human health effects from contact with ground gas post-construction should be considered.
EHO, Weymouth & Portland Borough Council 10th February 2020	Potential for human health effects from contact with ground gases post-construction must be considered due to the potential chronic effects for employees.
Environment Agency 10th February 2020	If historic land use of the site may have caused contamination then National Planning Policy Framework (NPPF) states that the planning system could contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to, or being put at risk from unacceptable levels of water pollution.

3.2 EIA methodology

3.2.1 Receptors

Table 2 sets out the sensitivities that have been assigned to typical land quality receptors and resources of relevance to the site and used in this assessment. The criteria used has been developed using industry guidance combined with professional experience.

Table 2: Receptor value and sensitivity

Designation	Receptors
High	**Human health:** Residential, schools and playing fields **Controlled waters:** Catchment or surface water bodies of high quality[4] and/or Principal aquifers with high to minor vulnerability. Likely to be groundwater protection zone SPZ1 (inner or outer source protection zone) with short travel times to sources or sensitive watercourses
Medium	**Human health:** Retail and business parks (public and work places), allotments and market gardens

[4] As defined in the Water Framework Directive (WFD)

Designation	Receptors
	Controlled waters: Catchment or surface water bodies of moderate quality, and/or Secondary A aquifers with moderate to low vulnerability. Likely to be SPZ2 and 3 for potable water supplies
Low	**Human health:** Public open space, commercial developments, construction workers with acute exposure **Controlled waters:** Surface water bodies of low quality. Secondary B and undifferentiated aquifers with low vulnerability. Likely to be SPZ3 (Total catchment source protection zone). Unproductive strata with no apparent abstraction use, including aquifers affected by saline intrusion **Property:** Infrastructure susceptible to potential gas accumulation, attack by aggressive contaminants or permeation
Negligible	**Human health:** Industrial development **Controlled waters:** Secondary B aquifer, undifferentiated aquifers, surface water bodies of poor quality

3.2.2 Magnitude of impacts

Impacts have been assessed during the construction and operational phase of the proposed development. Where possible, impacts have been assessed using site-specific data. Where no site-specific data is available, impacts have been assessed qualitatively. Table 3 provides examples of impacts which are of relevance to the ground conditions assessment, together with their classification.

Table 3: Classification of impacts

Magnitude	Definition	Receptors (example of impact)
Large	Severe or substantial alteration to a key receptor such that the post-development character/composition attributes will be fundamentally changed	**Human health:** Introduction/removal of contamination resulting in acute change in risk to health based on the potential effects on the critical human health receptor **Controlled waters:** Introduction/removal of pollution to a Principal aquifer within a SPZ (inner and outer) or potable supply characterised by a breach of drinking water standards (DWS)
Medium	Loss of alteration to one or more key receptors of the baseline conditions such that post development character/ compositions/ attributes of the baseline will be materially changed	**Human health:** Introduction of contamination resulting in chronic damage to health **Controlled waters:** Pollution of a Principal aquifer outside a SPZ characterised by a breach of DWS
Small	A small shift away from baseline conditions. Change arising from the loss/ alteration will be discernible/ detectable, but not material. The underlying character/ composition/ attributes of the baseline condition will be similar to the pre-development circumstances/ situation	**Human health:** Introduction of contamination resulting in minimal short-term effects to health **Controlled waters:** Low levels of pollution to a principal aquifer outside a SPZ, or pollution of a Secondary A/B aquifer

Magnitude	Definition	Receptors (example of impact)
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a "no change" situation	**Human health:** No appreciable impact on health **Controlled waters:** No appreciable impact on pollution or water quality

3.2.3 Significance of effects

The matrix for the determination of the significance of effects is presented in Table 4. The effects significance is derived from the sensitivity of the receptors and the magnitude of the impact as defined above.

By establishing these factors, the matrix will aid in the determination of the overall significance of effects. Only effects which are moderate or above will be considered significant in terms of this ES.

Table 4: Matrix defining the relative significance of effects

Magnitude of impact	Sensitivity/ importance of receptor			
	High	Medium	Low	Negligible
Large	Very substantial	Substantial	Moderate	Slight
Medium	Substantial	Moderate	Slight	Negligible
Small	Moderate	Slight	Negligible	Negligible
Negligible	Slight	Negligible	Negligible	Negligible

4 Baseline conditions

4.1 Sources of information and data

The ground conditions have been established through desk study and documented in the Arup (2020) Geoenvironmental and geotechnical desk study report included in Appendix A.

4.2 Site history

A detailed description of the site history is provided in the Arup desk study report (Appendix A).

Portland harbour was constructed between 1837 and 1890 to provide a harbour Refuge and coaling stations for the steam navy. Portland and its harbour were designated as HM Naval Base Portland in 1923. The naval base was closed in 1995/96 and Portland Port Ltd began the transformation of the harbour into a commercial port.

The main development site has a long history of development associated with the port activities. The last vacated buildings in the north of the site were demolished in 2014 and 2017.

4.3 Published geology

The geology across the Site has been inferred from recent British Geological Survey mapping. Geological maps are provided in the Groundsure report included in the Arup desk study (Appendix A).

4.3.1 Superficial geology

The Artificial and Made Ground map provided in the Groundsure indicates the presence of made ground within the north and centre of the site.

Natural superficial deposits comprise Landslip deposits of unknown/unclassified rock type in the southwest corner of the site. Tidal Flat Deposits, comprising sand, silt and sand are present along the shoreline to the east of the site.

4.3.2 Bedrock

The bedrock beneath the site comprises the Kimmeridge Clay Formation which comprises a succession of thinly laminated mudstones and clays.

4.4 Hydrogeology

The underlying Kimmeridge Clay bedrock is classified by the Environment Agency (EA) as an unproductive aquifer.

The superficial deposits (tidal flat deposits) immediately east of the site are classified as Secondary Undifferentiated aquifers.

The site is not located within an EA designated groundwater source protection zone (SPZ). There are no groundwater abstractions reported within 1km of the site.

Available monitoring data indicates the groundwater beneath the site has a natural gradient towards the coast and discharges into the sea. Groundwater quality beneath the site is indicative of the presence of saline and brackish water.

4.5 Hydrology

There are no surface water features on site. However, the site is located in close proximity to the coastline of Balaclava Bay.

There are no surface water abstractions within 1km of the site.

4.6 Mining and mineral extraction

The site is not located in an area that may have been affected by coal mining activities. The Isle of Portland has a history of quarrying for Portland Stone from the early 1600s to the present day. The main quarry sites are located in the centre and south of the island. There are no quarries within close proximity to the site.

4.7 Protected areas/designations

The cliffs immediately to the west of the main development site are designated as part of the Isle of Portland Site of Special Scientific Interest (SSSI) and Isle of Portland to Studland Cliffs Special Area of Conservation (SAC). The SSSI is designated due to its geological interest, and rich assemblage of plants and animals associated with limestone grassland, scrub and coastal habitats. The condition of this SSSI unit is recorded as ‘unfavourable (declining)’.

4.8 Ground conditions

An intrusive ground investigation was undertaken across the main development area in 2009 by RPS. The results of the ground investigation are summarised in the Arup desk study (Appendix A) and have been used to develop an understanding of the ground conditions at the site.

The ground conditions beneath the site are summarised in Table 5.

Table 5: Summary of general ground conditions encountered within the site

Description	Depth to base (mbgl)	Thickness (m)	Comments
Made Ground	5.1 to 8	5.1 to 8	Grey brown gravels, gravelly sands, firm to stiff occasionally green gravelly clays and clays. Frequent gravels of limestone and other stone. Clays generally

Description	Depth to base (mbgl)	Thickness (m)	Comments
			encountered below unconsolidated materials
Superficial Deposits (northeast of site only)	12	7	Grey brown sand and gravels of subrounded to angular chert
Weathered Kimmeridge Clay	7.8 to 9	1 to 2.7	Firm to stiff grey clays
Kimmeridge Clay	Unproven (>21m)	-	Mudstones and stiff clays

Groundwater was encountered between depths of 7.18 m and 7.88m bgl within the Kimmeridge Clay and at a depth of approximately 7.7m bgl in the superficial deposits in the northeast of the site.

4.9 Contamination sources

4.9.1 Soil contamination

The main potential source of contamination within the site is the made ground associated with the port development, which contains a range of materials and potential contaminants. In addition, historical uses of the site and the surrounding area may also be potential sources of contamination.

The 2009 RPS ground investigation included chemical analysis of soil for contaminants which would be expected to be present based on the land-use history. The resulting soil data were reviewed and the contaminant concentrations in soils assessed with respect to their potential impact on the health of future site users.

The assessment of soil contamination was carried out by RPS in line with UK good practice guidance, using Generic Assessment Criteria (GAC) appropriate for the proposed land use as commercial/industrial development.

The assessment of soil data within the main development site (summarised in the desk study in Appendix A) concluded that the infill contained concentrations of polycyclic aromatic hydrocarbons (PAH) exceeding the GAC for commercial development within a localised area of made ground.

4.9.2 Groundwater contamination

The main potential source of groundwater contamination within the site is the made ground associated with the port development and contamination associated with historical releases and spills. Chemical analysis data for soil and groundwater samples collected during the RPS 2009 ground investigation were reviewed and the contaminant concentrations assessed with respect to their potential impact on the quality of groundwater within the bedrock and the adjacent coastal waters.

The impact of groundwater contamination on the health of future site users during operation has not been assessed, as the groundwater will not be used as a water supply to proposed development within the site.

The assessment of groundwater contamination was carried out in line with current UK good practice guidance, using published water quality guideline values appropriate for the coastal water, principally saltwater environmental quality standards (SEQS).

The groundwater generic quantitative risk assessment identified that contaminants including arsenic, chromium, copper and nickel within groundwater were occasionally elevated when compared to the EQS for saltwater. When compared to UK drinking water standards concentrations of PAH and total petroleum hydrocarbons (TPH) were elevated.

4.9.3 Ground gas contamination

The 2009 ground investigation identified no potential ground gas sources. Standpipes installed in 2009 ground investigation were monitored for the presence of grounds gases such as methane and carbon dioxide. Minimal concentrations of carbon dioxide were detected and there was no methane, carbon monoxide or hydrogen sulphide detected.

4.9.4 Unexploded ordnance (UXO)

A UXO desk study and risk assessment report is included in the desk study in Appendix A.

The report concluded that the site has a moderate risk of unexploded bombs (UXB) being present. It was estimated that average bomb penetration depths on the site would range from 2.5m to 6.0m depending on the weight of the bomb.

4.10 Potential receptors to contamination

The following potential receptors have been identified within or of relevance to the proposed scheme:

- Human receptors:
  - construction workers involved with the development;
  - users of nearby sites;
  - future users.
- Controlled waters receptors:
  - the sea;
  - groundwater within the Tidal Flat Deposits Secondary aquifer.

4.11 Potential contamination pathways

During the construction the following pathways may link sources of contamination at the site to identified receptors:

Human health pathways

- inhalation of soil and dust generated as a result of the disturbance of ground within the Site (on- and off-site);
- inhalation of vapours, odours and gases from the ground (on- and off-site);
- ingestion of soil, soil-derived dust and groundwater;
- dermal contact with soils and groundwater; and
- explosion of UXO as a result of below ground activities (excavations, piling).

Controlled waters pathways

- runoff from stockpiles and lateral flow into the sea;
- runoff from stockpiles and infiltration into groundwater;
- leaching and infiltration into groundwater from exposed soil during earthworks and excavation;
- vertical migration of contaminants into groundwater during piling activities;
- lateral flow of contaminated groundwater into the sea;
- leaks and spills from the temporary storage of fuels during construction which may enter groundwater via vertical flow.

During the opening and operational phase of the proposed scheme, the following pathways may link sources of contamination on the site to receptors:

Human health pathways

- migration of gases and vapours into confined spaces, and accumulation to explosive or toxic concentrations.

4.12 Baseline conceptual model

The baseline conceptual model (CM) is summarised in Table 6.

Table 6: Summary of baseline conceptual model for the site

Sources	→	Pathways	→	Receptors
Contaminated made ground	→	Ingestion of soils, fibres or dust	✗	Maintenance workers Site operatives The site is currently vacant
	→	Ingestion of dissolved contamination in groundwater/leachate	✗	
	→	Dermal contact with soils	✗	
	→	Inhalation of dust and fibres, including spores	✗	
Contaminated groundwater	→	Leaching of contaminated fill in unsaturated zone and vertical infiltration	→	Groundwater
	→	Leaching and vertical migration	→	Deep groundwater in mudstone

Sources	→	Pathways	→	Receptors
	→	Lateral migration of dissolved phase contamination	→	Sea Groundwater in Tidal Flat Deposits
Ground gases	→	Inhalation following ingress into enclosed spaces such as chambers, manholes	✗	Maintenance workers Site operatives The site is currently vacant

4.13 Future baseline

The evolution of the Site's condition has been considered if the development does not come forward. The Site is no longer actively used, meaning that future inputs of contamination into the ground or groundwater are likely to be negligible.

It is therefore considered that, if the Proposed Development did not come forward, the future baseline contamination status of the site would not change. The Proposed Development will benefit the condition of the Site compared to baseline, as it will cause remediation to be carried out which has an overall benefit to land quality.

4.14 Construction phase conceptual model

A conceptual model has been developed for the construction phase of the proposed Scheme and is presented in Table7. This presents the potential sources, receptors and pathways during the construction phase of the proposed Scheme.

Table 7: Conceptual model for the construction phase

Possible source		Pathway		Receptor
Contaminated made ground	→	Inhalation of soil, fibres and soil dust Inhalation of vapours and odour	→	Construction workers Users of adjacent sites
		Ingestion of soil and dust	→	Construction workers
		Dermal contact with soil		
		Runoff from stockpiles*	→	Sea
		Leaching of exposed soils	→	Groundwater
		Vertical migration during piling	→	Groundwater
Contaminated groundwater	→	Inhalation of vapours	✗	Construction workers Groundwater not considered as a potential vapour source
		Dermal contact with groundwater	→	
		Ingestion of groundwater	→	
		Lateral migration of groundwater	→	Sea Groundwater in Tidal Flat Deposits

Possible source		Pathway		Receptor
Ground gases (*e.g.* methane, carbon dioxide, hydrogen sulphide)	→	Inhalation of gases in confined spaces Accumulation of gases to explosive concentrations in confined spaces	→	Construction workers Users of adjacent port developments
Pollutants resulting from construction (such as fuels)	→	Leakage into soil and groundwater*	→	Groundwater
		Direct runoff*	→	Sea
UXO	→	Explosion during excavation or piling activities	→	Construction workers Users of adjacent port developments
*these pollutant linkages are assessed in the water quality assessment				

4.15 Operational phase conceptual model

A conceptual model has been developed for the operational phase of the proposed scheme and is presented in Table 8.

Table 8: Conceptual model for the operational phase

Possible Source		Pathway		Receptor	Comment
Contaminated made ground	→	Inhalation of soil and soil dust Inhalation of vapours	✗	Future users	Pathway removed during construction as a result of the Scheme Design
		Ingestion of soil and soil-derived dust	✗		
		Dermal contact with soil and soil dust	✗		
		Leaching of exposed soils	✗	Groundwater	Pathway removed/reduced during construction as a result of the Scheme Design
Contaminated groundwater	→	Inhalation of vapours	✗	Future users	No pathway - groundwater will not be exposed at surface in proposed development Groundwater not considered as a potential vapour source
		Dermal contact with groundwater	✗		
		Ingestion of groundwater	✗		
		Lateral migration of groundwater	✗	Sea Groundwater in Tidal Flat Deposits	Source of any contamination will be depleted as a result of construction and scheme design

Possible Source		Pathway		Receptor	Comment
Ground gases (*e.g.* methane, carbon dioxide, hydrogen sulphide)	→	Inhalation of gases in confined spaces Accumulation of gases to explosive concentrations in confined spaces	→	Future site users	Pathway controlled by measures in Scheme Design

5 Potential environmental effects

An EIA has been carried out which considered the potential impacts of the proposed development on the surrounding environment without mitigation, except those control measures which are inherent in the development proposals, which are presented in Table 9.

Table 9: Example control measures during construction

Potential exposure pathway	Example control measures during construction
H&S management during construction	
Inhalation of soil-derived dust (which may contain contaminants such as metals, asbestos fibres, PAH) by construction workers and adjacent site users.	Dust generated from areas of contaminated soils during dry weather is a potential means for migration of contaminants to both site workers and adjacent site users. Dust suppression measures are presented in the draft CEMP. Use of appropriate site controls, abatement measures and monitoring will mitigate against potential risks.
Generation of airborne asbestos fibres from asbestos-containing soils and asbestos-containing materials (ACMs) presenting a risk via inhalation to construction workers and adjacent site users.	ACMs may be present in site soils. It is likely that the greatest potential risks will be during excavation and processing of the infill materials, when they are disturbed and may allow fibres to be released into ambient air. Therefore, works will need to be carried out by a suitably qualified experienced contractor and employ methods to control risks to on-site workers and adjacent site users.
Exposure of construction workers to infill and groundwater (which may contain contaminants such as asbestos, metals, PAH) via dermal contact, ingestion, and inhalation of vapours.	Contractors working on the Site will require appropriate Health and Safety briefings on the types of contaminants known to exist on-site and the possibility of unexpected contamination. Procedures should be in place in the event that unexpected contamination is encountered. Contractors should be provided with personal protective equipment (PPE) appropriate for the contamination expected.
Environmental protection during construction	
Exposure of soils during removal of existing hardstanding and increased potential for leaching and infiltration into groundwater	Sequencing of the earthworks to minimise the amount of soil exposed at any one time.

Further ground investigation at the site is proposed ahead of the construction works to provide further information on the ground contamination conditions at the site. This data will be used to inform refinement of risk assessments and if necessary produce a remediation strategy which will be implemented during the construction works.

5.1 Environmental impacts and significance of effects

5.1.1 Construction phase

Human health

A plausible pollutant linkage has been identified relating to construction workers and adjacent site users as a result of the excavation of potentially contaminated materials, which may generate contaminated dust and vapour, or result in exposure to contamination, via dermal contact and ingestion. The concentrations of contaminant measures in soil and groundwater were typically below values which might be regarded as posing an acute risk to construction workers.

During site development excavations appropriately trained staff must observe excavated material to identify suspected asbestos and measures must be implemented to manage suspect material.

The magnitude of these impacts would be large in the absence of mitigation and the effect would be moderate and significant. However, with the implementation of the inherent mitigation measures outlined in Table 9 and implemented by the CEMP, the magnitude of the impact during construction is assessed to be negligible. The effect via these pathways is assessed to be negligible for construction workers and adjacent site users and therefore not significant.

Ground gases may pose a risk to construction workers and adjacent site users in enclosed or confined spaces. It is possible that disturbance of the ground during construction and activities such as compaction may result in a temporary worsening of ground gas risks compared to baseline. On the basis of current assessments (see Appendix A) the magnitude of impact is assessed to be small for construction workers and negligible for users of adjacent developments. The effect is assessed to be negligible to construction workers and users of adjacent developments and therefore not significant.

Unexploded ordnance may pose an explosion risk to construction workers and adjacent site users if encountered during excavation works or piling activities during construction. On the basis of the current assessments (see Appendix A) the magnitude of impact is assessed to be medium for construction workers and users of adjacent developments. The effect is assessed to be substantial and therefore significant.

Controlled waters

A potential pollutant linkage has been identified during construction as a result of the exposure of contaminated soils, when existing hardstanding is removed, which could result in a temporary increase in infiltration of rainwater and consequently an increase in the leaching of contaminants into groundwater or allow direct run-off of contaminants into groundwater where it is encountered during deep excavation. The value of the receptors, in this case the groundwater, is considered to be low, as the water body would not be used for water supply and has elevated salinity. The magnitude of these impacts would be medium and the effect would be slight and not significant. However, with the implementation of the inherent

mitigation measures outline in Table 9 and implemented by the CEMP, and scheme design which will reduce infiltration in shallow soils, the magnitude of impact during construction is assessed to be negligible and the effect would be negligible and not significant.

During piling activities, a potential pollutant linkage has been identified where piling could drive contaminants down into groundwater from the overlying made ground. As discussed above, the value of the groundwater body is low, and therefore the magnitude of impact without mitigation would be medium. The effect is therefore slight and not significant. Selection of an appropriate piling method will minimise the potential for cross contamination during piling.

Any additional contamination that leaches into the groundwater during construction has the potential to migrate laterally into the sea, where it could impact on the water quality. The sensitivity of these receptors is high. The magnitude of these impact would be small and the effect would be moderate and significant. However, based on the inherent control measures implemented by the CEMP, the magnitude of impact during construction would be negligible and the effect would be slight and not significant.

Potential pollutant linkages have been identified during construction as a result of contaminated runoff from stockpiles, which could enter the sea. There is also the potential for leakage of contaminants used during construction such as fuels. These impacts are considered in the water quality assessment.

Construction impacts summary

The ground conditions impacts assessed for the construction phase are summarised in Table 10 below.

A significant impact has been identified in relation to the risk of encountering UXO during excavation and piling activities.

No other significant impacts have been identified as a result of the construction phase, due to the implementation of control measures as detailed in the Outline CEMP.

Additional mitigation measures will be required during construction for the UXO risk. No other mitigation measures in addition to those identified in the Outline CEMP and those inherent in the scheme design are required during construction.

Table 10: Summary of construction phase impacts

Possible source	Pathway	Receptor	Receptor sensitivity	Magnitude of impact	Significance of effect
Contaminated made ground	Inhalation of soil, dust and vapour	Construction workers	Low	Small	Negligible
		Users of adjacent sites,	Low	Small	Negligible
	Ingestion of soil, dust and groundwater	Construction workers	Low	Small	Negligible
	Dermal contact with soil and groundwater	Construction workers	Low	Small	Negligible
	Leaching of exposed soils	Groundwater	Low	Small	Negligible
	Vertical migration during piling	Groundwater	Low	Medium	Slight
Contaminated groundwater	Lateral migration	Sea	High	Negligible	Slight
Ground gases (*e.g.* methane, carbon dioxide, hydrogen sulphide)	Inhalation of gases in confined spaces	Construction workers	Low	Small	Negligible
	Accumulation of gases to explosive concentrations in confined spaces	Users of adjacent residential developments	Low	Negligible	Negligible
Unexploded ordnance	Explosion during excavation or piling activities	Construction workers	High	Medium	Substantial
		Users of adjacent residential developments	High	Medium	Substantial

5.1.2 Operational phase

Human health

The proposed scheme comprises hardstanding cover, except for small areas of soft landscaping.

The conceptual model for operation in Section 4.15 identified that many of the plausible pollutant linkages that are present at baseline will be broken during operation, as a result of the implementation of the measures inherent in the scheme design.

The ground gases methane, carbon dioxide, hydrogen sulphide and carbon monoxide pose a potential risk to existing adjacent site users and workers in the proposed development. No significant ground gases have been identified at the site to date, however further assessment of ground gas risk will be undertaken following additional ground investigation ahead of the development. On the basis of current assessments, the magnitude of impact is assessed to be small for users of the proposed development. The effect during operation without mitigation is assessed to be negligible which is not considered significant.

Risks posed by ground gases will be controlled by the implementation of appropriate ground gas protection measures into the scheme which will be defined within the remediation strategy. The effect during operation is therefore assessed to be negligible which is not considered significant.

In areas of soft landscaping site-won soils must be validated to demonstrate they are suitable to remain at surface or a clean cover layer must be placed over site won soils.

Operational phase impacts summary

The ground condition impacts assessed for the operational phase are summarised in Table 11 below.

No significant effects have been identified on the health of future site users as a result of reduced exposure to ground gases generated by made ground material.

No mitigation measures in addition to those identified in current best practice and those inherent in the scheme design are therefore required during operation.

Table 11: Summary of opening and operational phase impacts

Possible source	**Pathway**	**Receptor**	**Receptor sensitivity**	**Magnitude of impact**	**Significance of effect**
Ground gases (*e.g.* methane, carbon dioxide, hydrogen sulphide)	Inhalation of gases in confined spaces Accumulation of gases to explosive concentrations in confined spaces	Site users	Low	Small	Negligible

5.2 Mitigation

5.2.1 Construction phase

The construction phase assessment took into account the control measures, which reduced the significance of many of the identified environmental impacts to negligible or minor.

To protect receptors during construction, the control measures will be outlined in an outline Construction and Environmental Management Plan (CEMP), provided in technical appendix C, for the Proposed Development that will be adopted by the construction contractor.

In areas of the Site which have been subject to historical development, the Site preparation work will include the systematic excavation of the made ground to remove obstructions such as old foundations and known contamination sources.

Material will be replaced to achieve the required development levels and in accordance with an agreed geotechnical and chemical specification. As part of a future remediation implementation plan, materials re-use criteria will be developed to be protective of controlled waters and human health based on the Proposed Development an agreed with the Dorset Council and the EA. Only soils that have been validated as meeting the required re-use criteria will be used in the earthworks.

During piling activities an appropriate piling method will be selected which will reduce the risk of cross contamination from made ground into the underlying groundwater.

A potential risk of encountering UXO during construction has been identified. A UXO desk study and risk assessment for the site has been completed by Zetica (see Appendix A) which identified a medium risk of encountering UXO. Mitigation measures employed during construction works should include:

- supervision of all excavations by an Explosive Ordnance Clearance (EOC) Engineer who will assess any suspect items encountered; and
- intrusive magnetometer survey to clear pile positions of potential UXB at each proposed pile location.

With these measures being adopted, the magnitude of impacts during construction would be negligible to slight.

5.2.2 Operational phase

A plausible pollutant linkage has been identified between sources of ground gas and new buildings constructed within the Site. A preliminary gas risk assessment has concluded the site is at low risk from ground gases, however further ground investigation and risk assessment will be undertaken prior to development to assess the ground gas risk. A scheme of ground gas protection will be incorporated into the remediation implementation plan and new buildings will

incorporate measures to prevent ingress of gases into confined spaces where necessary. The design will follow UK good practice guidance (BS8485:2015).

The possible effects associated with ground gases are considered to be negligible following implementation of the mitigation measures outlined above.

5.3 Residual effects

The summary of the assessment and the residual effects for the construction phase and operational phase are displayed in Table 12, including embedded mitigation within the outline CEMP and the scheme design.

Table 12: Summary of effects

Potential impact	Environmental effect without mitigation	Mitigation	Effect after mitigation (residual effect)
Construction Phase			
Contaminated infill – inhalation of soil, dust and vapour to construction workers	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Contaminated infill – inhalation of soil, dust and vapour to users of adjacent sites	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Contaminated infill – ingestion of soil, dust and groundwater by construction workers	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Contaminated infill – dermal contact with soil and groundwater by construction workers	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Contaminated infill – leaching of exposed soils to groundwater	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Contaminated infill – vertical migration to groundwater during piling activities	Slight	Selection of appropriate piling method	Negligible
Contaminated groundwater – lateral migration into Sea affecting water quality	Slight	Measures to be set out in CEMP and remediation strategy	Negligible
Ground gases – inhalation of gases in confined spaces or explosion risk to construction workers	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Ground gases – inhalation of gases in confined spaces or explosion risk to users of adjacent sites	Negligible	Measures to be set out in CEMP and remediation strategy	Negligible
Unexploded ordnance – explosion risk to construction workers and users of adjacent sites	Substantial	EOC engineer supervision of all excavations. Intrusive magnetometer survey at the proposed location of each pile	Slight

Potential impact	Environmental effect without mitigation	Mitigation	Effect after mitigation (residual effect)
Operational Phase			
Ground gases – inhalation in confined spaces/explosion hazard to future site users	Negligible	Further risk assessment and incorporation of appropriate gas protection measures into new buildings	Negligible

5.4 Cumulative effects

This assessment of cumulative impacts has been based on the understanding that the construction of the proposed scheme is delivered in line the measures contained in the Outline Construction Environmental Management Plan (CEMP). It further assumes that the developments identified to be included in the cumulative effects assessment through the scoping process will be delivered in accordance with the same environmental standards and require the appropriate level of mitigation at construction and operation to meet regulatory requirements. Therefore, it is predicted that the cumulative impacts are no greater than those from the proposed scheme in isolation.

6 Summary

This document provides an overview of the legislation and policy relevant to ground conditions and details the baseline conditions at the site.

The scope of this assessment covers ground conditions impacts as a result of construction and operational activities.

With the implementation of the recommended mitigation measures, no significant adverse residual effects have been identified during the construction and remediation phase of the proposed scheme.

No adverse residual effects have been identified during the operational phase of the proposed scheme.

Appendix A

Arup (2020) Geoenvironmental & Geotechnical Desk Study

Powerfuel Portland Ltd

Portland Energy Recovery Facility

Geoenvironmental and Geotechnical Desk Study

GEO-REP001

Rev A | 23 June 2020

Job number 267701-20

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1 Introduction

1.1 Context

This geotechnical and geoenvironmental desk study has been prepared by Ove Arup and Partners Ltd (Arup) on behalf of Powerfuel Portland Ltd (Powerfuel) to support a planning application for an Energy Recovery Facility (ERF) on a site located within Portland Port on the Isle of Portland, Dorset.

1.2 Proposed development

The proposed development will comprise an ERF with an annual throughput of 183,000 tonnes of waste in the form of refuse-derived fuel (RDF) and the capacity to export 15.2 MWe of electricity to the grid. It will be a mass burn facility, using boiler and moving grate technology with a high efficiency steam boiler and high efficiency turbine.

The RDF will be stored in a bunker, envisaged to be approximately 40m long, 20m wide and 8m deep. The proposed building will enclose the RDF bale storage area in the fuel hall and waste bunker, tipping hall, cranes, conveyors, feed hopper, furnace boiler, condenser units and turbine/generator.

Cables for the grid connection will be provided to the substation off Lerret Road and also to the berths at Queens Pier and Coaling Pier within the existing road network. The development includes only shallow service routes outside of the main development site. As the service routes are shallow linear excavations within the existing road network, the focus of this report is on the main development site.

Proposed scheme drawings are provided in Appendix A.

1.3 Scope of report

The objectives of this desk study are to:

- collate and review available information on ground conditions at the site;
- identify and assess geotechnical and geoenvironmental constraints that may affect the proposed development;
- to provide an outline scope of intrusive ground investigation to address uncertainties; and,
- to provide sufficient geoenvironmental information to accompany the planning application to enable conditional planning approval.

1.4 Sources of information

The following sources of information have been reviewed as part of this desk study:

- Groundsure reports including historical mapping and environmental data (provided in Appendix B);
- Published geological information (BGS);
- Historical ground investigation data provided by the client team; and
- UXO desk study and risk assessment report obtained by the client team for the proposed development (Appendix D)

Details of the information sources used are indicated in subsequent sections and are provided in the references section.

Supporting information has been included in the appendices where appropriate.

A site walkover could not be completed by the geoenvironmental and geotechnical team due to COVID-19 restrictions, however detailed descriptions and photographs have been provided by the project team.

1.5 Report structure

This report has the following structure:

- Section 2 introduces the site, site history and ground conditions;
- Section 3 details ground conditions from available historical information of the site;
- Section 4 presents the geotechnical constraints associated with the site;
- Section 5 provides a preliminary conceptual model for the site and outlines the proposed development; and
- Section 6 presents the conclusions and recommendations for ground investigation.

1.6 Limitations

This report has been produced by Arup for use by Portland Powerfuel Ltd. It is not intended for and should not be relied upon by any third party except as provided for in Arup's agreement with Portland Powerfuel Ltd.

Arup has based this report on the sources detailed within the report text and believes them to be reliable, but cannot and does not guarantee the authenticity or reliability of third party information. Notwithstanding the efforts made by the professional team in undertaking this assessment, it is possible that ground conditions other than those indicated by this report may exist at the site.

This report has been prepared based on current legislation, statutory requirements, planning policy and industry good practice prevalent at the time of writing. Any

subsequent changes or new guidance may require the findings, conclusions and recommendations made in this report to be reassessed in the light of the circumstances.

2 Site setting

2.1 Site location and extent

The site is located at NGR 369640, 74180 in the northeast of the Isle of Portland, a peninsula island on the Dorset coast, within Portland Port approximately 600m east of the villages of Fortuneswell and Castletown. The site location is shown on Figure 1.

The planning application area is shown on Figure 2. The planning application area covers 6.29 hectares and comprises two elements:

- Main development site - 2.14 hectares for the main ERF development; and
- Cable routes – cable routes within the existing road network to connect the ERF to the electricity substation off Lerret Road and to the berths at Queens Pier and Coaling Pier

As the cable routes are shallow linear excavations within the existing road network, the focus of this report is on the main development site.

The main development site is bounded to the east by overland fuel pipelines which supply marine fuel from Portland Bunkers fuel storage area in the nearby cliffs. Beyond the pipelines is the shingle shoreline of Balaclava Bay, which extends south from the Portland Harbour breakwaters. To the southwest is Incline Road, a private road actively used by port traffic, and a former railway embankment. To the south west of the railway embankment is a steeply rising cliff supporting grassland, scrub and woodland habitat. Existing operational port development lies to the north and northwest of the site.

As the site lies within the port, it is not publicly accessible. Vehicular access is from the west through the main Portland harbour complex.

2.2 Site description

The main development site (Figure 3) is roughly triangular in shape and is currently vacant. All previous buildings have been demolished. The groundcover is predominantly hardstanding (concrete/tarmac) associated with former roads/buildings and there are some areas of rough gravel cover.

A weighbridge is present in the western corner of the site, it is understood that the weighbridge will be retained within the proposed development. An electricity substation is located outside the site, adjacent to the northern site boundary.

The northern boundary of the site is formed by a retaining structure increasing in height to the east. Towards the east the retaining wall has arched structures behind which voids may remain.

Selected photographs of the site are presented in Appendix C.

2.3 Topography

The site is relatively flat with an elevation of approximately 7 m above Ordnance Datum (AOD).

The topography to the immediate south and west becomes steeper where the cliff rises inland to approximately 125 mAOD.

2.4 Site history

The history of the development site has been determined from historical maps and aerial photographs provided in the Groundsure report (included in Appendix B) and is summarised in Table 1.

Table 1: Site history

Map Year	Within main development site boundary	Adjacent to site
OS 1864 (1:2,500)	Several railway lines run across the site, servicing a number of buildings in the north and west of the site and a gas works to the south. One building in the east is labelled as 'Breakwater Works'. Within the northeast corner of the site is shingle beach	The main gasworks buildings are located outside the site, adjacent to the southern site boundary. Two gasometers are located approximately 15m to the south. The railway lines extend to the south and north of the site. A Coal Depot is located on the harbour side 100m to the north. A reservoir and evidence of ground excavation is located 100m to the southeast and a reservoir is present on the top of the cliff approximately 100m to the southwest. Shingle beach is located to the east of the site.
OS 1901 (1:10,560)	The gas works has been removed and a new building occupies the south of the site which is the 'Admiralty Slaughter House'. The buildings in the northwest of the site are occupied by the Royal Naval Hospital and there is a boat house in the east of the site. The area of shingle beach in the northeast of the site appears to have been infilled and now forms part of the port side	A railway bounds the west of the site. Portland Port to the north of the site is more built up, including several buildings, jetties and cranes. The reservoirs southwest of the site are shown as disused, a spring is marked at their location. A cemetery is located 250m southwest of the site on the top of the cliff. The Balaclava Coastguard Station is present 100m to the south of the site and the reservoir in this area appears to be no longer in use.
OS 1903 (1:2,500)	A timber yard occupies the northeast of the site.	The railway embankment along the western site boundary has been constructed and includes two viaducts adjacent to the south of the site

Map Year	Within main development site boundary	Adjacent to site
OS 1927 (1:10,560)	The railways line on site have been removed. Several buildings have been demolished including the slaughterhouse and hospital. The timber yard is no longer marked.	Rail lines within the port areas to the north and south no longer present.
OS 1929 (1:2,500)	No significant change.	The rail line on the embankment to the west is labelled as the Easton & Church Hope railway.
OS 1938 (1:10,560)	There are two new buildings in the south and north of the site.	No significant change.
OS 1959-1960 (1:2,500)	No information provided	Tanks present to the immediate west of the railway embankment.
OS 1960 (1:2,500)	No information provided	No significant change.
OS 1963 (1:10,560)	The site is occupied by several large buildings which cover a significant proportion of the site area and is labelled as a Dockyard.	Increased development to the north and southeast of the site along the port. HM Prison Training Centre built on the cliff top 500m to the southwest.
OS 1973 (1:2,500)	Canteen Road and Balaclava Road marked in east of the site and Incline Road in the west of the site.	Two outfalls are noted on the eastern boundary of the site leading to Balaclava Bay. Old Depot Road labelled to the north. Buildings 100m to southeast labelled as HM Underwater Detection Establishment
OD 1973-1976 (1:2,500)	No significant change	No significant change
OS 1976-1978 (1:10,000)	No significant change.	No significant change.
OS 1994 (1:2,500)	No significant change.	The railway to the west has been dismantled.
Groundsure Aerial Image, July 1999	Building in northwest of the site has been demolished, demolition rubble appears to remain stockpiled across building footprint area	No significant change
OS 2001 (1:10,000)	The buildings in the west of the site have been demolished.	No significant change
OS 2003 (1:2,500)	No significant change.	An electricity substation is located adjacent to the northern site boundary.
Groundsure Aerial Image, October 2005	West of site divided into four open storage areas. There appears to be some stockpiled materials (possible sand or soil) within one of the storage areas.	Pipeline along the eastern site boundary has been constructed. Some demolition/reconfiguration of buildings to the north

Map Year	Within main development site boundary	Adjacent to site
Groundsure Aerial Image, September 2009	Buildings in the south of the site have been demolished. Demolition rubble appears to be stockpiled in the area of the former building footprint. Stockpiled materials in the storage areas to the west no longer present, this area appears to be occupied by vehicles and other mechanical equipment.	No significant change
OS 2010 (1:10,000)	No significant change	Two buildings <100m north of the site have been demolished.
Groundsure Aerial Image, May 2014	Storage areas and equipment to the west removed and buildings in the northeast corner have been demolished	No significant change
Groundsure Aerial Image, June 2017	One building remains within the north of the site. All other buildings demolished, some stockpiles of rubble remain	No significant change
OS 2020 (1:10,000)	All buildings on site demolished	No significant change.

The wider Portland Harbour was constructed between 1837 and 1890 to provide a harbour and coaling station for the steam navy [1]. Portland and its harbour were designated as HM Naval Base Portland in 1923. The main development site is likely to comprise reclaimed land.

During this time, the buildings located within the main development site comprised a weapons research establishment building in the south east, with the other buildings used for mechanical repair facilities for military vehicles. The naval base was closed in 1995/96 and Portland Port Ltd began the transformation of the harbour into a commercial port [1].

Following privatisation, the buildings on site were progressively demolished to create cargo storage space. The last vacated buildings in the north of the site, used by UMC, Portland Shellfish and Permavent, were demolished in 2014 and 2017. It is understood that at least one of the former buildings in the northeast of the site had a basement. In 2016/17, the main road was realigned along the base of the cliff along the western site boundary creating the current vacant site. The last of the stockpiled demolition rubble was cleared from the site in 2018.

To summarise, the review of site history has identified over 150 years of port and industrial uses at the site. Made ground has been placed across the site to create a development platform in several phases. No particular potential sources of contamination such as fuel tanks have been identified within the site boundary however spills and contaminant releases may have occurred across the site. Historical mapping from the 1970s shows two drainage outfalls were present on the eastern site boundary which discharged to Balaclava Bay. Demolition of twentieth century buildings may have resulted in asbestos presence in fill

materials. Beyond the site boundary, similar port uses are recorded, with the exception of a gasworks to the southwest of the site which was present in the late 1800s.

2.5 Geology

The geology of the site has been determined from British Geological Survey (BGS) 1:50,000 scale mapping [5] and additional geological maps provided in the Groundsure report (Appendix B).

2.5.1 Superficial deposits

The Artificial and Made Ground map provided in the Groundsure report (Appendix B) indicates the presence of made ground within the north and centre of the site. While not recorded on the maps, made ground associated with the historical development of the site is expected to be present across the entire site area.

Natural superficial deposits comprise Landslide Deposits of unknown/unclassified rock type in the southwest corner of the site. Tidal Flat Deposits, comprising sand, silt and sand are present along the shoreline to the east of the site. Based on historical maps described in Section 2.3 it is anticipated that Tidal Flat Deposits may be present beneath the northeast corner of the site.

2.5.2 Bedrock

The bedrock beneath the site is the Kimmeridge Clay Formation which comprises a succession of thinly laminated mudstones and clays.

2.5.3 BGS borehole data

One borehole record (SY67SE240) situated in the south west of the site is available from the BGS Geoindex. The borehole record indicates that made ground fill comprising topsoil, gravel, ashes and cinder was encountered to a depth of 1.9m. This was underlain by the Kimmeridge Clay bedrock, described as a stiff to very stiff, very closely fissured silty clay and was proven to a depth of 5.5mbgl.

Another borehole record adjacent to the sites north west corner (SY67SE145/A-F) encountered made ground comprising a silty clay with sandstone/limestone gravels to a depth of 4.75m. This was underlain by layers of siltstone and mudstone proven to a depth of 9.6m.

2.5.4 Landslide

The site is located on flat ground at the base of a hillside which is up to around 125m in height. The approximate overall angle of the slope of the hillside is around 1v:3h, however it comprises an upper steep escarpment of sandstone/limestone over a shallower slope of landslide deposits over Kimmeridge Clay, with a gradient of around 1v:2.5h towards the base. The

landslide deposits are mapped to extend into the southern tip of the site. Historical BGS boreholes on the slope indicate the thickness of the landslide deposits to be up to at least 5m thick, but the morphology of the previous slope movements is uncertain.

2.6 Radon risk

The site is located within an area where the Health Protection Agency has defined less than 1% of properties are above the Radon Action Level. No radon protection measures are necessary for new properties on site as described in BR211 by the Building Research Establishment.

2.7 Mining and quarrying

The site is not located in an area that may have been affected by coal mining activities.

The Isle of Portland has a history of quarrying for Portland Stone from the early 1600s to the present day. The main quarry sites are located in the centre and south of the island [2]. There are no quarries within close proximity to the main development site.

It is understood that there are bunkers within the cliffs to the west of the site which are currently used for fuel storage and supply marine fuel to the port via the overland pipeline which runs adjacent to the sites eastern boundary.

2.8 Hydrogeology

The underlying Kimmeridge Clay bedrock is classified by the Environment Agency (EA) as an unproductive aquifer.

The site is not located within an EA designated groundwater source protection zone (SPZ). There are no groundwater abstractions reported within 1km of the site.

The superficial deposits (tidal flat deposits) are classified as Secondary Undifferentiated aquifers.

Due to the proximity to the coast the local groundwater regime is likely to have a tidal influence and likely elevated salinity. Groundwater beneath the site is therefore of limited value as a potential resource.

2.9 Hydrology

There are no surface water features on site. However, the site is located in close proximity to the coastline of Balaclava Bay. Historical maps show two outfalls on the Balaclava Bay shore northeast and southeast of the site that suggest culverts may extend across the site.

The site is defined as a European Union Water Framework Directive (WFD) coastal catchment. To the east of the site, surface water is classified as

Dorset/Hampshire coastal water. The EA's most recent assessment (2016[1]) classified Dorset/Hampshire coastal water as a moderate water body, with a good chemical rating and moderate ecological rating. 40m north of the site, surface water is defined as Portland Harbour coastal water. The EA's recent assessment (2016[2]) classified Portland Harbour coastal water as a moderate water body, with a good chemical rating and moderate ecological rating.

There are no surface water abstractions within 1km of the site.

2.10 UXO

A UXO desk study and risk assessment report for the main development site was produced by Zetica and is included in Appendix D.

The report identified a high localised bombing density in the vicinity of the site during WWII and it was concluded that the site has a moderate risk of unexploded bombs (UXB). Zetica estimate that the average bomb penetratiojn depths on the site would range from 2.5m to 6.0m depending on the weight of the bomb.

The report recommends that mitigation measures should be employed during any ground investigations, excavations or piling works and include the following:

- Excavations – Explosive Ordnance Clearance (EOC) engineer supervision to ensure safety and minimise delays.
- Boreholes/Piling – Deep UXB detection to clear borehole and pile locations of potential UXB. An intrusive magnetometer survey should be undertaken until either the maximum bomb penetration or maximum drilling/piling depth is reached

2.11 Discharge consents, pollution incidents and landfill

There are nine discharge consents recorded within 500m of the site, however there are none within the site boundary. 25m south of the site is a non-water company sewerage discharge from the HM Naval Base at Osprey Quay into the English Channel and is dated 1995 and may still be active, however the Naval Base is no longer in operation. Approximately 50m north of the site is a discharge consent related to fish farming from the Native Marine Centre at Portland Port. This is dated 2012 and appears to still be active.

There are no recorded relevant pollution incidents.

There are no registered or historical landfill sites recorded within 500m of the site and no relevant permitted waste activities.

[1] https://environment.data.gov.uk/catchment-planning/WaterBody/GB620705550000
[2] https://environment.data.gov.uk/catchment-planning/WaterBody/GB680805270000

2.12 Environmental designations

The cliffs to the west of the site are designated as the Isle of Portland Site of Special Scientific Interest (SSSI) and Isle of Portland to Studland Cliffs Special Area of Conservation (SAC). The SSSI is designated due to its geological interest, and rich assemblage of plants and animals associated with limestone grassland, scrub and coastal habitats[3]. The condition of this SSSI unit is recorded as 'unfavourable (declining)'.

[3] https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1000128.pdf

3 Previous ground investigation

3.1 Introduction

An intrusive ground investigation was carried out on the main development site by RPS Planning and Development Chepstow (RPS) in 2009 [3] to inform a previous planning application for a power plant development.

The objectives of the investigation were to provide an assessment of the ground conditions and determine the extent of any contamination in soil and groundwater beneath the site and to provide a baseline geotechnical assessment. The historical exploratory locations are shown on Figure 4, the spacing of locations across the site is approximately 30m to 60m.

At the time of the investigation some of the buildings in the north of the site were still present (site canteen and workshops) and large areas of demolition rubble were also present across the site from former site buildings which limited access to some areas of the site. The scope of works comprised the following:

- 4 rotary boreholes to between 13m and 21m bgl;
- 11 window sample holes to a maximum depth of 7m bgl;
- 2 hand dug pits to 0.9m and 1.3m bgl;
- 14 dynamic probes to a maximum depth of 8.7m bgl using Super Heavy Dynamic Probing techniques;
- In situ SPT testing;
- Groundwater and gas monitoring; and
- Samples for geoenvironmental and geotechnical laboratory testing.

3.2 Ground conditions recorded

3.2.1 Made ground

The RPS investigation recorded made ground deposits across the entire site to a depth of up to 8m bgl. The total thickness of made ground was proven in the four rotary boreholes to be between 5.1m and 8m.

The deposits recorded as made ground by RPS comprised a mixture of firm, locally firm to stiff clays, gravelly clays, silty sands, sands and gravels. In general limestone gravels and cobbles were encountered within the gravelly clays. Occasional bricks and concrete were encountered in soils beneath the northeast of the site. There is limited anthropogenic materials within the made ground recorded by RPS, it may be that this material largely comprises reworked natural materials used to form the original port development in the 1800s.

3.2.2 Superficial deposits

Superficial deposits were recorded in borehole RT2 in the northeast corner of the site. These comprised grey and brown sands and gravels at a depth of 5m bgl to approximately 12m bgl and were considered likely to be Tidal Flat deposits by RPS. Superficial deposits were not encountered elsewhere on site.

3.2.3 Kimmeridge Clay

A weathered zone of Kimmeridge Clay was identified in two boreholes in the north of the site as a thin layer of firm to stiff grey clay containing limestone gravels resting above the Kimmeridge Clay bedrock at 8m to 9m bgl (RT1) and 5.1m to 7.8m bgl (RT3).

The top of the Kimmeridge Clay bedrock was identified as depths from 7.8m to 12m bgl and was proven to a maximum depth of 21m bgl. The strata encountered largely comprised mudstones with occasional bands of stiff clay. The Kimmeridge Clay contained many sub-horizontal slightly undulating bedding fractures with occasional subvertical fractures, which were typically slightly open to open, with occasional clay or silt infill.

3.2.4 Summary

The geological sequence recorded by RPS [3] is summarised in Table 2.

Table 2: Geological sequence recorded by RPS 2009 investigation

Description	Depth to base (mbgl)	Thickness (m)	Comments
Made Ground	5.1 to 8	5.1 to 8	Grey brown gravels, gravelly sands, firm to stiff occasionally green gravelly clays and clays. Frequent gravels of limestone and other stone. Clays generally encountered below unconsolidated materials
Superficial Deposits (northeast of site only)	12	7	Grey brown sand and gravels of subrounded to angular chert
Weathered Kimmeridge Clay	7.8 to 9	1 to 2.7	Firm to stiff grey clays
Kimmeridge Clay	Unproven (>21m)	-	Mudstones and stiff clays

3.3 Visual and olfactory evidence of contamination

The RPS investigation recorded evidence of hydrocarbon contamination in three locations in the northeast of the site. The contamination was identified beneath concrete slabs in the vicinity of one of the buildings present on site at the time.

The contamination comprised a hydrocarbon odour within the top 1m of made ground in boreholes WS13 and WS14.

Within the natural superficial deposits in RT2 from 5m to 12m depth, dark brown staining was evident within the soils and oil droplets were recorded within groundwater encountered at a depth of between 7m and 8m bgl.

3.4 Groundwater

Groundwater level monitoring was undertaken on two occasions by RPS. Groundwater was encountered between depths of 7.18 m and 7.88m bgl within the Kimmeridge Clay and at a depth of approximately 7.7m bgl in the superficial deposits in the northeast of the site.

The groundwater beneath the site forms a natural gradient towards the coast and discharge into the sea. RPS conducted testing for chloride, sodium and electrical conductivity which indicated the presence of saline and brackish water beneath the site, suggesting the presence of a saline/freshwater interface.

Localised perched groundwater was recorded within two wells installed within the made ground at a depth between 2.57m (WS11) and 3.4m bgl (WS7).

3.5 RPS contamination risk assessment

The RPS risk assessment [3] compared results of the soil chemical analysis to human health generic risk assessment criteria (GAC) for a commercial/industrial land use. No exceedances of the GAC were recorded except for benzo(a)pyrene in one sample obtained from the made ground in WS14 in the northeast of the site as a depth of 0.1-0.4m.

No asbestos testing was undertaken by RPS on the soil samples obtained as part of the ground investigation, however an asbestos screening assessment of the stockpiles of demolition rubble which were present on site at the time of the investigation was completed [4]. The assessment did not identify any asbestos fibres or asbestos containing materials (ACMs) within the demolition rubble.

Ground gas monitoring indicated limited potential risk from ground gas due to low ground gas concentrations (methane and carbon dioxide) and limited gas flow.

RPS compared the groundwater chemical analysis to published Water Quality Standards. The results indicated there were occasional elevated concentrations of arsenic, chromium, copper and nickel within the groundwater when compared to the Environmental Quality Standard (EQS) for Saltwater. Concentrations of total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) were elevated when compared to UK drinking water standards.

The RPS risk assessment concluded that the measured concentrations of soil and groundwater contamination recorded on site posed a moderate risk to human health during construction works and low risk for a commercial/industrial site end use and a low risk to controlled waters receptors.

4 Geotechnical risks

4.1 Proposed development

The proposed ERF building height varies from approximately 18m in the area of the tipping hall and bunker to 45m in the area of the furnace and boiler. The proposed ground level for the development is similar to existing at approximately 6-7m AOD. A waste bunker for storage of RDF will be extend to a depth of approximately 5m bgl (approximately 2m AOD) beneath the centre of the building.

Proposed site layout plans are provided in Appendix A.

4.2 Existing structures

There are currently no above-ground structures on the site. A retaining wall supports the northern boundary of the site. A development access road for the ERF is proposed along the top of this retaining wall. The condition of the retaining wall should be investigated and assessed for the proposed development.

The demolition of the former buildings on the site is understood to have been to ground level only. The former building ground floor slabs and below ground structures are expected to be present beneath the site. Some of these structures could be substantial concrete obstructions. Voids relating to former building basements may also be present, it is understood that at least one former building in the northeast of the site had a basement area.

The extent of former building footprints on the site is shown on Figure 5.

4.3 Piling and concrete classification

The made ground thickness beneath the site is up to approximately 8m. Due to the thickness of made ground and the expected magnitude of loading for the proposed structure, the use of piles will be the preferred foundation option. The piles should be extended into the underlying Kimmeridge Clay bedrock.

The choice of pile installation method and plant selection will need to consider the presence of obstructions within the made ground. Removal of obstructions in the made ground prior to piling may be required. The potential presence of UXO on site (Section 2.11) will also have to be considered during foundation construction.

Given the expected thickness of made ground, the use of suspended ground floor slabs or ground improvement should be assumed.

Sulphate resistant concrete may be required to prevent aggressive conditions affecting the performance of concrete foundations. Sulphate data obtained during the 2009 RPS investigation [3] suggests the designated sulphate class is DS-4 and the Aggressive Chemical Environment for Concrete (ACEC) site classification is AC-4 in accordance with the recommendations of BRE Special Digest 1.

4.4 Earthworks

Bulk earthworks may be required to clear the site of below-ground obstructions (floor slabs, concrete foundations) to prevent refusal during piling. Assuming they are chemically suitable, the site-won materials will require processing, such as crushing and screening, to provide material suitable as an engineering fill. After screening, the coarse fraction could be suitable as a piling platform, or general fill across the site, however this will need to be assessed with further ground investigation testing and risk assessment.

The depth of the RDF bunker excavation may extend up to 8m bgl which is anticipated to be towards the base of the made ground and geological boundary with the top of the Kimmeridge Clay. Based on the historical information available it is anticipated the base of the excavation will be below groundwater level and groundwater control such as pumping and dewatering will be required during construction.

As excavated soils could be considered to be regulated waste a Materials Management Plan or waste exemption may be required in accordance with the CL:AIRE Definition of Waste Code of Practice that would allow excavated materials to be reused within the development.

4.5 Slope stability

4.5.1 Hillside to west

As described in Section 2.5.4, the hillside above the site is mapped as comprising landslide deposits, and these deposits are mapped as extending into the southern part of the site.

It is noted that Incline Road has been recently diverted to run along the toe of the hillside.

The proposed development will not result in any general reduction in ground level on the site, and hence the overall stability of the adjacent hillside should be unaffected by the works. However, locally, for example for the bunker excavations, slope stability will need to be considered in the design of temporary support.

Long term stability of the hillside, which could potentially affect the completed development, has not been considered in detail. However, it is noted that the former railway that ran along the side of the site at the toe of hillside, was in place for over 100 years and does not appear to have been affected by large-scale slope movements.

4.5.2 Slope to east

A slope is present on the east edge of the site leading down to the beach. This slope is partially protected by rock armour and retaining walls. The coastal vulnerability of the east edge of the site should be assessed for hazards relating to

erosion and storm surge as part of the flood risk assessment, which is being prepared by AWP and will be submitted with the planning application.

5 Geoenvironmental assessment

Current UK guidance recommends a phased risk-based approach to the assessment of contaminated sites, based on the development and updating of a conceptual model.

The conceptual model and potential pollutant linkages identified at the site are described in the following section. A preliminary risk assessment has been carried out to assess the likelihood that each potential linkage exists and whether any further assessment is required. The risk assessment has been undertaken in accordance with the Environment Agency guidance LCRM[4].

5.1 Preliminary conceptual model

5.1.1 Potential sources

The site area has a history of industrial and commercial use. The historical activity on site and adjacent areas will contribute to the potential sources of contamination that may be present on site. A summary of the potential contaminants that could be associated with the historical activity on site is presented in Table 4.

Table 3 Potential contaminants and sources

Potential source	Potential contaminants	Comments
Made ground beneath site from previous port uses including warehouses, vehicle repair, gas works, hospital, timber yard, food production, canteen and infilling of land along seawall	Asbestos Extremes of pH Heavy metals Petroleum hydrocarbons Polycyclic aromatic hydrocarbons (PAHs) Volatile and semi-volatile organic compounds (VOCs and SVOCs) Ground gases (methane, carbon dioxide)	Previous ground investigations identified the presence of variable made ground beneath the site. Localised elevated concentrations of hydrocarbons have been recorded in soils beneath the northeast corner of the site. Ground investigation has not been undertaken beneath the footprint of a number of the former buildings on site. Limited ground gas monitoring completed in 2009 identified low concentrations of ground gas and low to negligible flows.
Groundwater beneath site areas	Extremes of pH Heavy metals Petroleum hydrocarbons Polycyclic aromatic hydrocarbons (PAHs) Polychlorinated biphenyls (PCBs) Volatile and semi-volatile organic compounds (VOCs and SVOCs)	Previous ground investigation identified marginal exceedances of inorganic and organic contaminants in the saline groundwater. Localised hydrocarbon contamination was recorded beneath the northeast corner of the site

[4] Environment Agency Land Contamination: Risk Management
https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks

Potential source	Potential contaminants	Comments
Deep geology	Radon	The site is in a radon affected area where <1% of properties are above the Action Level. Based on data provided in the Groundsure report radon protection measures are not required for new buildings on the site.

5.1.2 Potential pathways

Potential pathways that may be present during redevelopment and operation include:

- Human health – ingestion of soils or dust;
- Human health – inhalation of dust, vapour or ground gas;
- Human health – dermal contact with soils, surface water and groundwater;
- Controlled waters – leaching of contaminants from soils into groundwater;
- Controlled waters – migration of dissolved phase contamination within groundwater;
- Controlled waters – transport of non-aqueous phase contaminants;
- Ground gas – ingress of ground gas and/or vapours into buildings.
- Buried services and structures – direct contact with soils and/or groundwater

5.1.3 Receptors

Receptors both during construction and after completion of the development include:

- Construction workers and site neighbours during development;
- Visitors, site workers and maintenance workers of the proposed commercial development;
- Coastal waters (Balaclava Bay and Portland Harbour);
- Groundwater within the Tidal Flat Deposits (secondary aquifer).

5.2 Contamination assessment

5.2.1 Soil human health risks

The proposed development at the site will comprise a ERF facility with associated road access and car parking. Small areas of soft landscaping are proposed which will require import of subsoil/topsoil.

The proposed site use means there is limited potential that future site users will come into contact with soils on site due to the mainly hardstanding and building end use. Soft landscaped areas may require a clean cover layer over site won soils. Risks to future site users are considered to be low.

The biggest risk from interaction with soil on site arises during the construction works. There is a possibility that, if contaminated, the made ground may pose a risk to human health for the construction workforce via potential exposure pathways including dermal contact, dust/fibre inhalation and ingestion pathways outdoors, and inhalation of gases. There is also a possible risk to site neighbours during construction via dust/fibre inhalation exposure pathways.

5.2.2 Controlled waters risks

Leachable contamination present in the made ground, non-aqueous phase liquid contaminants and historical groundwater contamination may pose a risk to controlled waters.

The coastal waters of Balaclava Bay and Portland Harbour are adjacent to the site and are considered to be at risk from contaminants arising from the site.

The site is located over the Kimmeridge Clay which is classified as unproductive strata and therefore is not considered to be a sensitive groundwater receptor. The tidal flat deposits beneath the northeast corner of the site are a Secondary aquifer, however they are of limited extent and no resource value and are unlikely to be considered a significant receptor.

Groundwater beneath the site is expected to have a natural gradient towards the coast and discharge into the sea. Groundwater testing by RPS in 2009 indicated saline/brackish groundwater quality and occasional elevated concentrations of metals.

Localised hydrocarbon contamination was encountered within groundwater beneath the northeast corner of the site, associated with contamination within the overlying soils. The hydrocarbon contamination does not appear to be widespread across the site, and concentrations are not highly elevated.

5.2.3 Ground gas risks

Made ground may be a potential source of ground gases, which could pose a risk to future site users through accumulation in confined spaces. Deep geology beneath the site may also be a potential source of radon.

The site is in a radon affected area where <1% of properties are above the Action Level. Based on data provided in the Groundsure report radon protection measures are not required for new buildings on the site.

During the previous ground investigation on site no evidence of highly degradable or gas generating materials were recorded and concentrations of total organic carbon (TOC) were typically low (<1%) within the made ground indicating that there was no significant source of gas.

Limited ground gas monitoring of the made ground and tidal flat deposits was undertaken by RPS in 2009 which recorded low concentrations of carbon dioxide, low/non-detectable concentrations of methane and low flow rates. While the gas monitoring was limited, it is considered that the conditions recorded are likely to be a fair representation of the gas regime on the site. It is therefore considered that risks from ground gas are low.

5.3 Conceptual model

The conceptual model, which illustrates the potential pollutant linkages that may be present for the proposed development is summarised in Table 4.

Table 4: Conceptual model

Source	→	Pathways	→	Receptors	Further works recommended
Contaminants in made ground soils	→	Ingestion of soils, fibres or dust	→	Site workers during construction Maintenance workers	Ground investigation required to assess ground conditions and target areas of site beneath the footprint of former buildings which have not been investigated to assess potential risks to human health. Appropriate site management protocols and PPE to be adopted during future construction and maintenance works.
		Dermal contact with soils	→	Site workers during construction Maintenance workers	
		Inhalation of dust and fibres	→	Site workers and neighbours during construction Maintenance workers	
		Inhalation of vapour	→	Site workers and neighbours during construction Maintenance workers Future site users	
Dissolved phase contamination in groundwater	→	Dermal contact with groundwater	→	Site workers during construction Maintenance workers	Ground investigation required to assess ground conditions and target areas of site beneath the footprint of former buildings which have not been investigated. Groundwater monitoring of installed wells
		Vertical migration of dissolved phase contamination	→	Secondary aquifer	
		Lateral migration of dissolved phase contamination	→	Coastal water	
Ground gas	→	Inhalation following ingress into buildings and enclosed spaces	→	Future site users Site workers during construction (in confined spaces)	No significant ground gas sources identified. If during the ground investigation soils beneath the site are found to have a high TOC content and/or highly degradable materials, then gas monitoring should be undertaken.

6 Conclusions and recommendations

6.1 Conclusions

6.1.1 Development constraints

Potential constraints to the proposed development are highlighted on Figure 5. The risks of each constraint and potential mitigation measures are summarised in Table 5.

Table 5: Potential constraints for ERF development

Constraint	Risk to development	Mitigation measures
Presence of contamination that requires remediation or other mitigation	Risk of delay and cost escalation to development programme	Ground investigation and further risk assessment to assess mitigation required, and consideration in development design.
Moderate UXO risk	Risk of delay and cost escalation to development programme if UXO encountered	EOC engineer supervision during all ground investigation, excavation and piling activities
Former building substructures remain in situ	Voids, obstruction during foundation construction	Intrusive ground investigation to increase confidence in presence of substructures. Bulk earthworks to excavate and remove obstructions and replace with engineered fill

6.1.2 Geotechnical risks

The most significant geotechnical risks relate to the historical port activities and thickness of made ground. Significant thicknesses of made ground will be present on site that is likely to be highly variable in nature, including obstructions associated with basements and foundations.

Previous ground investigation on the site recorded up to 8m of made ground which is not suitable as a founding stratum. Piled foundations are likely to be required for all the buildings across the site. Concrete design must take account of potentially aggressive chemical conditions.

There are limited rotary boreholes which investigate the mudstone bedrock. Further boreholes are recommended to obtain information on the Kimmeridge Clay for the design of heavily-loaded piles. Additional investigation to confirm ground conditions in the location of the proposed RDF bunker is also recommended.

The assessment of the risk of future instability of the hillside to the west of the site is outside the scope of this report. However, it is considered that the proposed development should not significantly affect this risk, as any excavations that may

remove toe weight will be of relatively local extent and will be supported in the temporary and permanent conditions.

6.1.3 Geoenvironmental risks

The site has had a long history of harbourside and industrial uses and site levels have been raised with up to 8m thickness of made ground.

Previous ground investigation data identified the presence of localised hydrocarbon contamination within the soils and groundwater beneath the site. No asbestos testing of soils beneath the site was undertaken as part of the previous investigation.

No significant source of ground gas has been identified and ground gas monitoring undertaken on site recorded low ground gas concentrations and flows.

However the existing ground investigation and contamination testing on site is widely-spaced, with limited coverage beneath the former building footprints. The exploratory hole spacing is not compliant with British Standard BS10175:2011 Investigation of potentially contaminated sites [6].

Made ground beneath the site may contain a range of contaminants including asbestos, heavy metals, hydrocarbons, PAHs, VOCs and SVOCs. Contamination may also be present in groundwater due to leaching of made ground and contaminant releases.

Further ground investigation across the site is recommended to fully assess the potential for contamination which could impact the proposed redevelopment of the site. This data will be required to:

- inform the management of excavated soils (reuse or offsite disposal) during construction. Reuse of material on site is usually the most cost-effective approach to material management;
- ensure risks to construction workers/future users, controlled waters and buildings/new structures are assessed and mitigated; and
- to satisfy the environmental regulators and facilitate discharge of any relevant planning conditions.

6.2 Ground investigation recommendations

It is recommended that additional ground investigation incorporates the following works to address the data gaps identified above:

- 10 to 15 trial pits to characterise made ground and the presence of substructures in situ across the site.
- 15 to 20 boreholes to prove depth and nature of mudstone and assess the presence of groundwater. Piles for the main building structures will be rock-socketed and may be extend to around 20m to 25mbgl. Boreholes should therefore extend to depths of around 25m to 30m.

- Cone penetration testing in conjunction with the boreholes to characterise the made ground and superficial soils to provide data for bunker retaining wall design.
- EOC engineer supervision will be required during the ground investigation to mitigate potential UXO risks.
- Soil samples should be obtained from all investigation locations for geotechnical/geoenvironmental laboratory testing.
- In situ rising head tests in selected boreholes to understand permeability in the location of the proposed RDF pit excavation.
- Geoenvironmental laboratory testing will be dependent on ground conditions encountered but as a minimum testing for the following contaminants is anticipated: asbestos, heavy metals, inorganics (including TOC, pH and sulphate), hydrocarbons, PAHs, VOCs, SVOCS.
- Piezometers installed at excavation level in the location of the proposed RDF pit to provide groundwater level information.
- Groundwater and gas monitoring standpipe installations screened within the superficial deposits and bedrock should be installed. A minimum of three wells should be installed within the site.
- A period of groundwater level monitoring and sampling/chemical testing should be undertaken to inform the assessment of risk to controlled waters (minimum of two rounds).
- A period of ground gas monitoring should also be allowed for within the ground investigation scope to inform the assessment of gas risk associated with the made ground (minimum of six rounds). This will only be required if ground conditions identify soils which could pose an increased ground gas risk (i.e. high TOC content and/or highly degradable materials)

References

[1] Terence O'Rourke (2020) Portland Energy Recovery Facility (ERF) EIA Scoping Report, Powerfuel Portland, January 2020

[2] Powerfuel Research Document (2019) Portland Port Ground Conditions

[3] RPS (2009) Port of Portland Phase 2 Site Investigation Report. Prepared for W4B Renewable Energy Ltd, May 2009

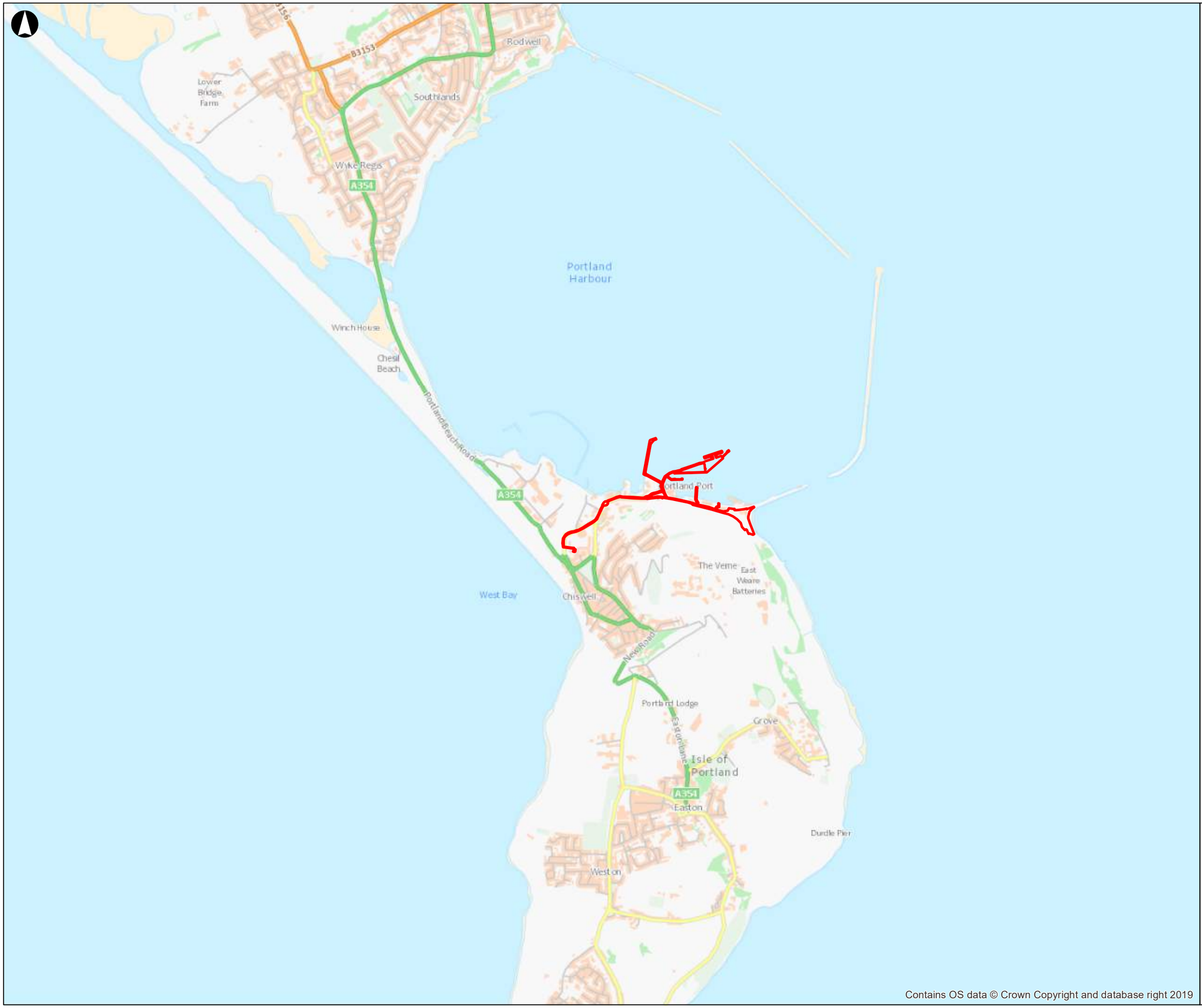
[4] RPS (2009) Port of Portland, Castletown, Isle of Portland, Initial Asbestos Screening Assessment Report. Prepared for W4B Renewable Energy Ltd, May 2009

[5] British Geological Survey, 2000. 1:50,000 geological map series, Sheet 341 and part of 342, West Fleet and Weymouth, Solid and Drift

[6] British Standard BS 10175:2011+A2:2017 Investigation of potentially contaminated sites – code of practice

Figures

A3



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F1	2020-06-22	JW	JL	RK

ARUP

9th Floor, 3 St Paul's Place,
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Sheffield, S1 2JE
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www.arup.com

Client
Powerfuel Portland Ltd

Project Title
Portland Energy Recovery Facility

Drawing Title
Site Location

Scale at A3
1:30,000

Role

Suitability
For Issue

Arup Job No
267701-20

Rev
F1

Name
Figure 1

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A3

Planning Application Area

Main Development Site Area

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Coordinate System: British National Grid

Metres

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Rev	Date	By	Chkd	Appd
F1	2020-06-22	JW	JL	RK

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Client

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Project Title

Portland Energy Recovery Facility

Drawing Title

Site Boundaries

Scale at A3

1:6,000

Role

Suitability

Preliminary

Arup Job No	Rev
267701-20	**F1**

Name

Figure 2

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A3

Main Development Site Area
Above Ground Pipeline

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Coordinate System: British National Grid

Metres
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Rev	Date	By	Chkd	Appd
F1	2020-06-22	JW	JL	RK

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Portland Energy Recovery Facility

Drawing Title
Site Layout

Scale at A3
1:1,500
Role

Suitability
Preliminary

Arup Job No
267701-20

Rev
F1

Name
Figure 3

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A3

Main Development Site Area

RPS GI, 2009

- Rotary Boreholes
- Window Samples
- Dynamic Probes
- Hand Pits

22/06/2020 16:18:27

Coordinate System: British National Grid

Metres

0 12.5 25 50

Rev	Date	By	Chkd	Appd
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Drawing Title
Historical Ground Investigation

Scale at A3
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Role

Suitability
Preliminary

Arup Job No
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Rev
P0

Name
Figure 4

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A3

22/06/2020 16:32:37

- Above Ground Pipeline
- Main Development Site Area
- Outfalls shown on historical maps (1973)
- Area of hydrocarbon contamination (RPS, 2009)
- Former Building Locations
- Retaining Structures

Coordinate System: British National Grid

Metres

0 12.5 25 50

Rev	Date	By	Chkd	Appd
F1	2020-06-22	JW	JL	RK

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Client
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Project Title
Portland Energy Recovery Facility

Drawing Title
Site Constraints

Scale at A3
1:1,000

Role

Suitability
For Issue

Arup Job No
267701-20

Rev
F1

Name
Figure 5

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Appendix A

Proposed scheme drawings

Portland ERF

Powerfuel Portland Ltd

0 10 20 30 40 50 M

Scale to be used for planning purposes only

Proposed Site Plan

262701B - TOR - XX-XX-DR-A-P004 -

Scale 1:500 @ A1 / 1:1000 @ A3 PLANNING

Aug 2020

N

TERENCE O'ROURKE

Portland ERF

Powerfuel Portland Ltd

0 10 20 30 40 50 M

Scale to be used for planning purposes only

Proposed Aerial Roof Plan

262701B - TOR - XX-XX-DR-A-P005

Scale 1:500 @ A1 / 1:1000 @ A3 PLANNING

Aug 2020

N

TERENCE O'ROURKE

Location plan key
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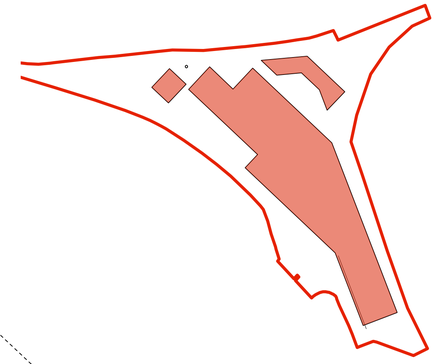

01 Proposed Ground Floor Plan
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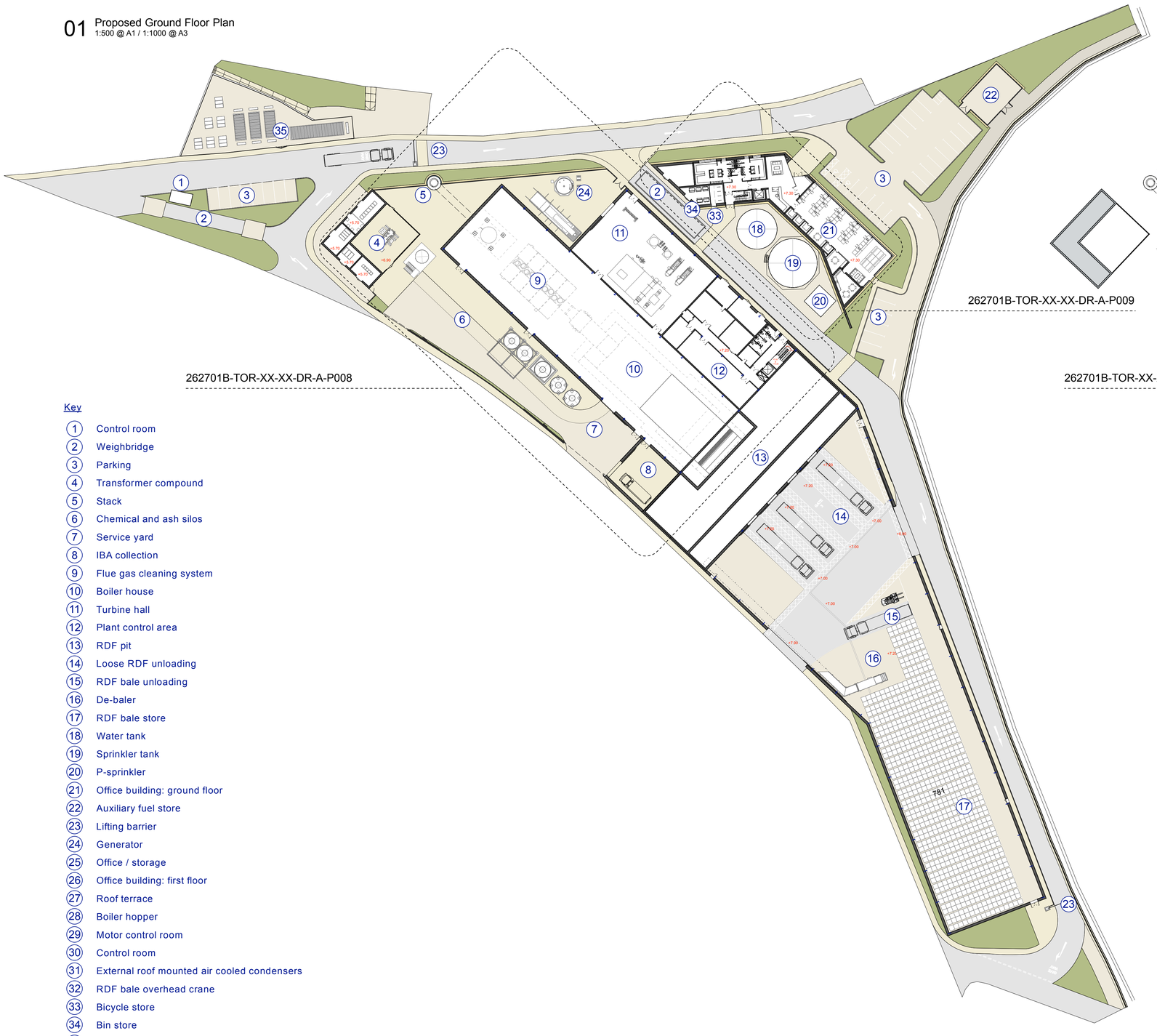

02 Proposed First Floor Plan
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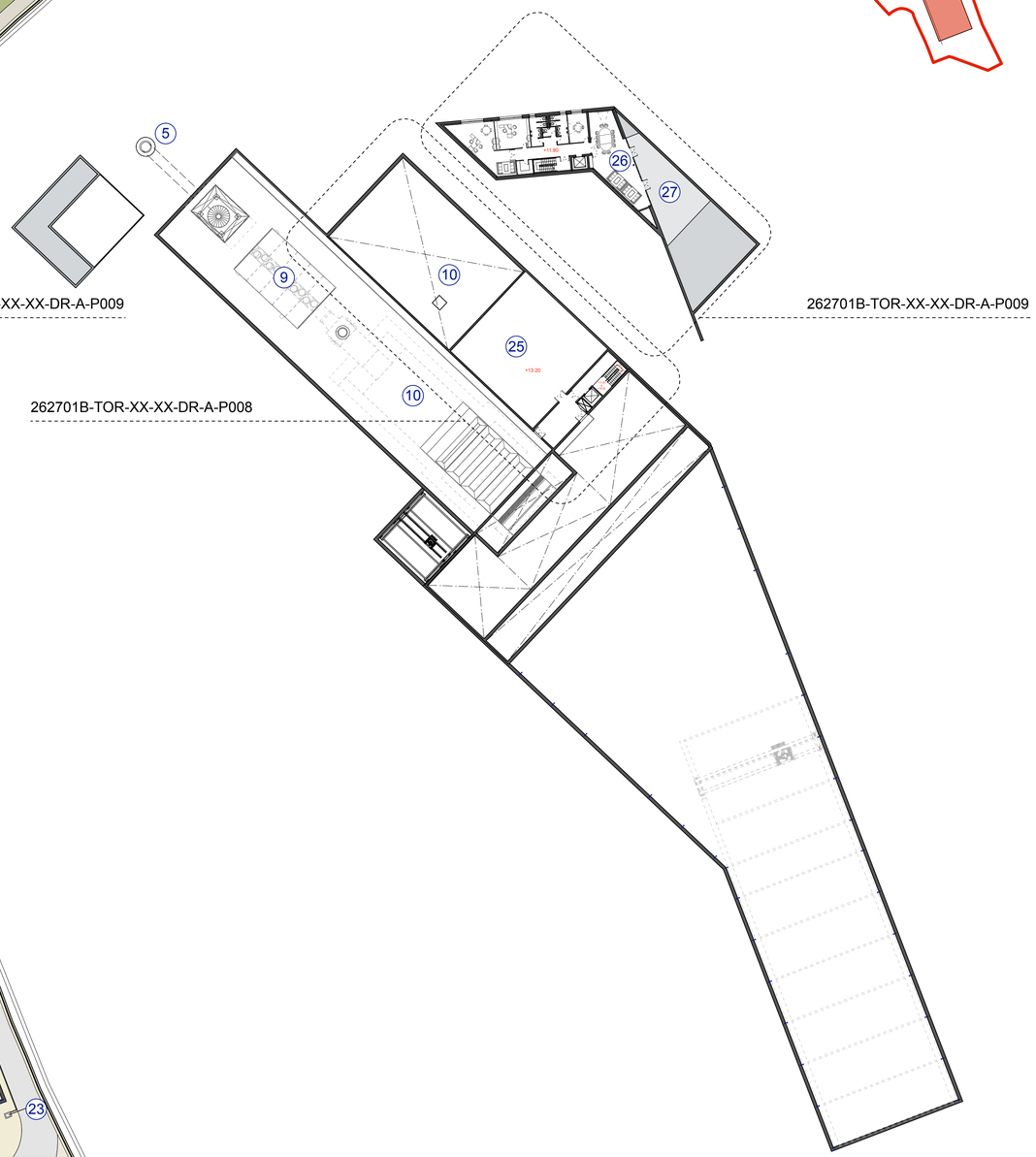

Key

1. Control room
2. Weighbridge
3. Parking
4. Transformer compound
5. Stack
6. Chemical and ash silos
7. Service yard
8. IBA collection
9. Flue gas cleaning system
10. Boiler house
11. Turbine hall
12. Plant control area
13. RDF pit
14. Loose RDF unloading
15. RDF bale unloading
16. De-baler
17. RDF bale store
18. Water tank
19. Sprinkler tank
20. P-sprinkler
21. Office building: ground floor
22. Auxiliary fuel store
23. Lifting barrier
24. Generator
25. Office / storage
26. Office building: first floor
27. Roof terrace
28. Boiler hopper
29. Motor control room
30. Control room
31. External roof mounted air cooled condensers
32. RDF bale overhead crane
33. Bicycle store
34. Bin store
35. Shore Power main switchgear

Portland ERF
Powerfuel Portland Ltd

0 10 20 30 40 50 M
Scale to be used for planning purposes only

Proposed Floor Plans
262701B - TOR - XX-XX-DR-A-P006 -
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Aug 2020

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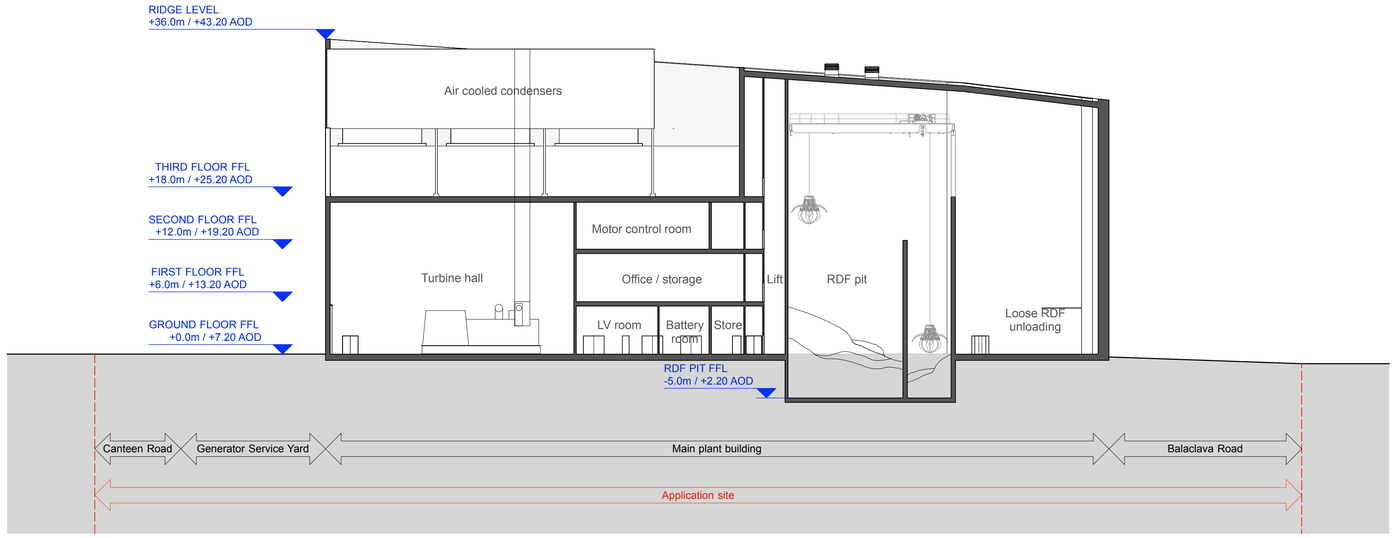

01 Section 01 (Long section through turbine hall and RDF pit)
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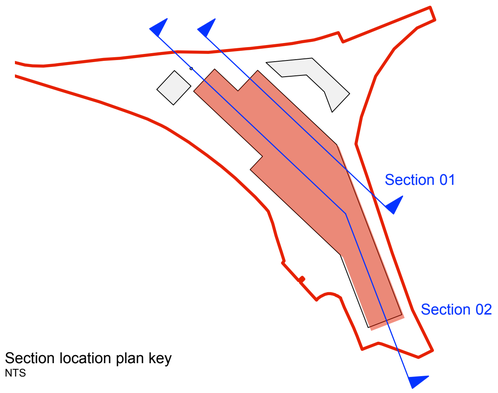

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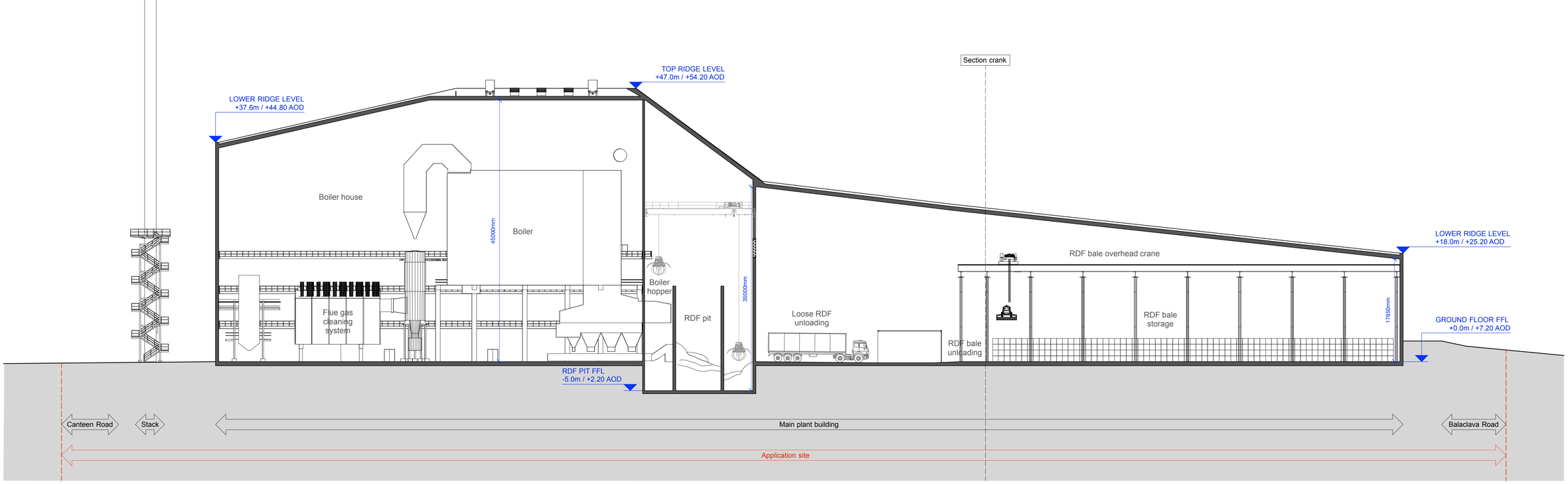

02 Section 02 (Long section through boiler house, RDF pit and RDF store)
1:350 @ A1 / 1:700 @ A3

Portland ERF

Powerfuel Portland Ltd

0 10 20 30 M

Scale to be used for planning purposes only

Proposed Sections_Sheet 1
Long sections through Main Plant Building
262701B - TOR - XX-XX-DR-A-P014 -
Scale 1:350 @ A1 / 1:700 @ A3 PLANNING
Aug 2020

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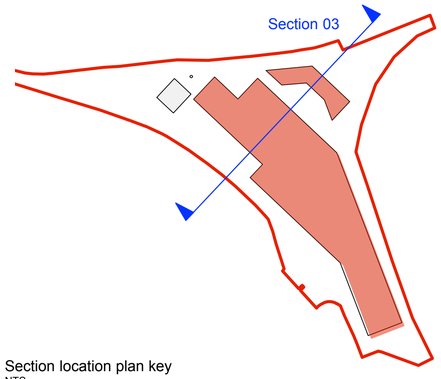

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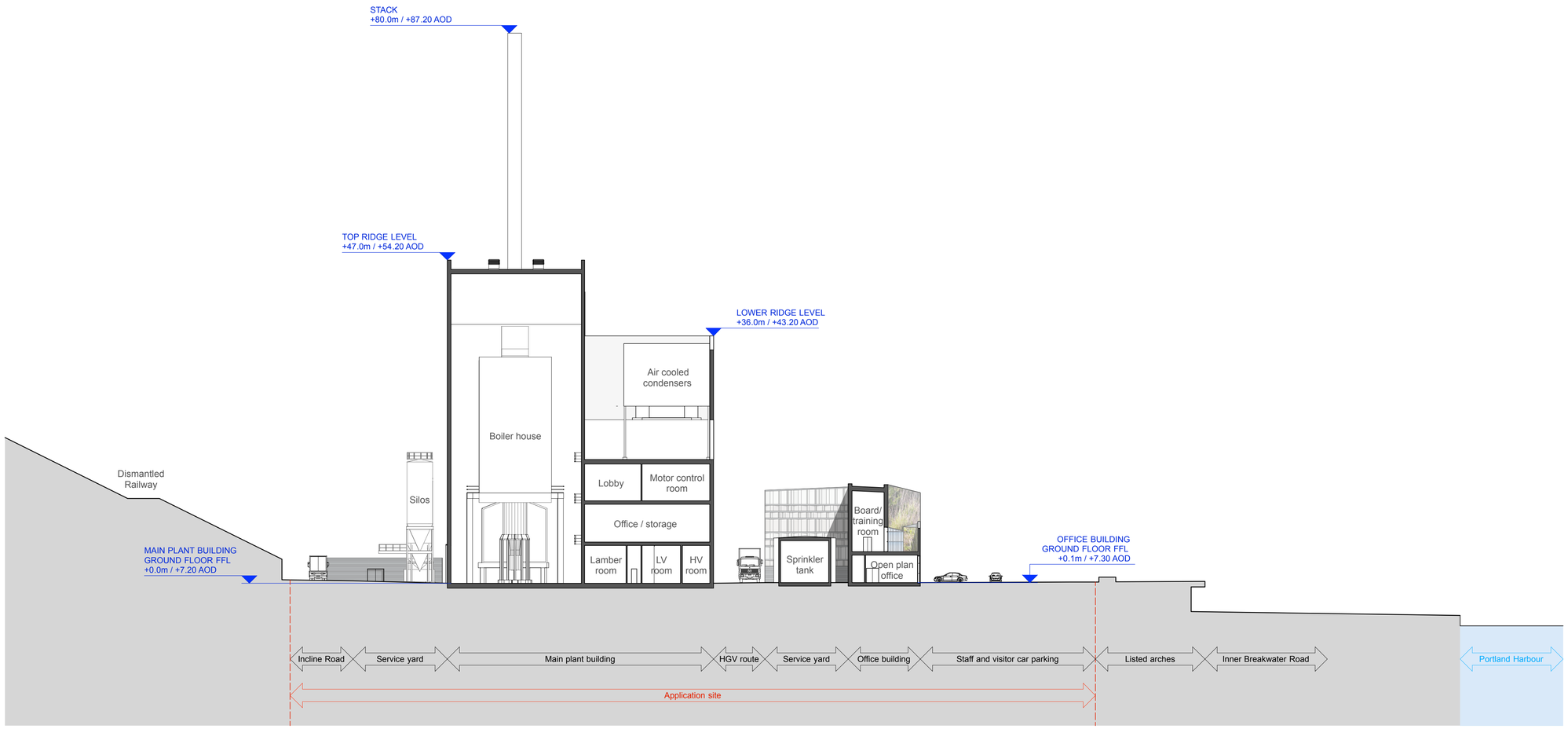
NTS



03 Section 03 (Cross section through Main Plant and Office Building)
1:250 @ A1 / 1:500 @ A3

Portland ERF
Powerfuel Portland Ltd

0 10 20 30 M
Scale to be used for planning purposes only

Proposed Sections_Sheet 2
Long section through Boiler House & RDF
262701B - TOR - XX-XX-DR-A-P015 -
Scale 1:250 @ A1 / 1:500 @ A3 PLANNING
Aug 2020

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TERENCE O'ROURKE

LANDSCAPE STRATEGY

The landscape strategy is primarily ecology-driven, providing a range of habitats to mitigate and enhance for identified plant and animal species. New planting will be primarily local native plants, but the proposals will include a very limited area of ornamental planting, appropriate in a maritime location, to provide year-round interest and biodiversity value. For additional detail on mitigation measures, refer to the GCO ecology report May 2020. The proposals include:

- Shingle/sand and boulder areas providing habitat for the black redstart and invertebrates, planted with native maritime plants
- Open mosaic, replicating existing areas of open mosaic removed
- Gabions on the road side of swales filled with portland stone and planting substrate to provide additional black redstart and invertebrate habitat
- Distinctive marine-themed planting at reception

Other biodiversity measures

- 5 bat boxes e.g. Schwegler 2FN located in dark parts of the building
- 5 hedgehog hibernation boxes located in the quieter fringes of the site
- 5 nest boxes for black redstart and at least 25 other nestboxes in suitable locations on and adjacent to the site, utilising existing structures and new buildings/structures. Including for grey wagtail, pied wagtail, common and widespread passerines such as blue tit, and swift.
- 10 solitary insect boxes

Key

1. Main reception/entrance with distinctive maritime-themed planting including some non-native ornamental species
2. Boulder/shingle areas around north-east and south east sides of the office building with predominantly native planting pockets to replicate shingle shore habitat
3. Potential location of portland stone rough-hewn feature development sign at entrance
4. Swales with combination of stone-filled gabion sides and mosaic slopes
5. Shingle/boulder native planting in area of weighbridge with additional ornamental planting to provide attractive arrival area
6. Replicate mosaic areas adjacent to car park, north east of LPG store and at southern exit
7. Potential gabion mattress cladding on LPG store to provide habitat area

Application Boundary

Portland ERF
Powerfuel

0 10 20 30 40 50 M
Scale to be used for planning purposes only

Proposed Landscape strategy
262701B - TOR - XX-XX-DR-L-P016 -
Scale 1:500 @ A1 PLANNING
August 2020