Portland Powerfuel Ltd

Portland Energy Recovery Facility

Environmental Statement Ground Conditions Technical Assessment

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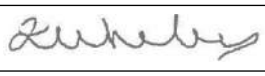
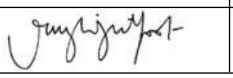
		Signature			
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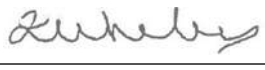
		Signature			
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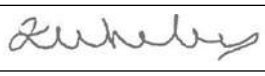
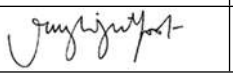
		Signature			
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Appendices

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.