

4 GROUND QUALITY

4.1 INTRODUCTION

The existing soil, geological and hydrogeological conditions, together with the influences of historic industrial activities on a site can impose constraints on a proposed development. Construction works which disturb contaminated land, in the absence of mitigation measures, present a risk of remobilising contaminants and causing additional contamination to water and to the air. In addition, exposure to contaminated material can potentially present a risk to those in its immediate vicinity.

4.2 LEGISLATION AND POLICY CONTEXT

Contamination of land, or the possibility of it, is a material planning consideration for development, and developers need to undertake work to establish the extent and nature of contamination, and define appropriate remediation works. The planning authority will require sufficient assessment in advance of the grant of the HEO to ensure that it is feasible to use the site in the manner proposed. More detailed assessment, and the remediation work itself may be controlled through conditions attached to the order, or by separate legal agreements. The draft planning technical advice note 'The development on Land Affected by Contamination' identifies that the same basic principles upon which Part IIA of the Environmental Protection Act (EPA) are based will also apply in the context of planning control, including the approach to risk assessment, intervention and remediation, therefore all receptors (humans, controlled waters, ecology, crops/livestock and buildings) should be considered if there is the potential for them to be adversely affected by exposure to contamination.

For sites where existing impact poses an unacceptable risk to the current site users or the wider environment, then Part IIA is likely to be applicable. Specifically, under Part IIA, contaminated land is defined as:

“any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of the substances in, on, or under the land, that:

- a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
- b) pollution of controlled waters is being or is likely to be caused.”*

Under Part IIA, receptors which may be considered are limited to those set out in Table A of the Statutory Guidance, specifically humans, the water environment, designated ecological systems, property (domestic and commercial crops, livestock, wild animals subject to shooting and fishing rights), and property in the form of buildings.

The baseline conditions on the site were assessed through desk study and intrusive investigation. The impacts that the proposed development may have on the ground quality during construction and operation were then assessed.

4.3.1 *Defining the Baseline Conditions*

Ground Quality

In order to assess the potential impacts of the development on the soil, geology and hydrogeology of the area, a baseline assessment was undertaken. This involved reviewing available information on the soils, geology and hydrogeology from a desktop study followed by two onshore intrusive site investigations to confirm soil and geological compositions and to determine contamination and its volume, groundwater presence, quality and flow direction.

The first intrusive investigation was undertaken on the site in November and December 2007 and included the drilling of nine boreholes to a maximum depth of 21 metres below ground level (mbgl) and excavating eleven trial pits to a maximum depth of 4.5 mbgl. Seven of the boreholes were installed with groundwater monitoring wells. The report on this intrusive investigation, *Stena Port (Old House Point) Phase II Site Investigation Report, February 2008, ERM*, is attached as *Annex E1*.

The second site intrusive investigation, undertaken in a discrete area of the site identified as a suspected asbestos landfill, was carried out in May 2008 and included drilling six boreholes to a maximum depth of 15 mbgl. Three of the boreholes were installed with groundwater monitoring wells. The report on this intrusive investigation, *Stena Port (Old House Point) Phase II Site Investigation (Suspected Asbestos Landfill Assessment), June 2008, ERM* is attached as *Annex E2*.

Contamination

In order to identify and broadly categorise areas of potentially contaminated land within the vicinity of the site, a desk study review of information on the current and historical land uses was undertaken. Information obtained during the desk study is included in the intrusive investigations attached as *Annex E1* and *Annex E2*.

The desk study investigation was based on a detailed assessment of historic maps of the site and surrounding area and the review of previous investigations undertaken on the site to identify activities that may have resulted in land contamination.

The areas identified as potentially contaminated were then assessed as part of the intrusive investigations. As part of this intrusive investigation soil and

groundwater samples were submitted to an accredited laboratory for environmental analysis. The results of this environmental assessment were then quantitatively assessed to look at the potential impacts of the contamination detected on human health, the water environment and future infrastructure.

Waste

Waste produced during the development will fall into the three main types generally associated with construction projects:

- spoil generated by on shore excavation (with the potential for contaminated spoil arising);
- other solid wastes (eg general refuse) arising during construction and operation; and
- liquid wastes, runoff and drainage during construction and operation.

Where spoil is not contaminated, it is envisaged that the approach will be to reuse spoil on site as part of the development.

The requirement for a Waste Management Plan in order to deal with these waste streams is acknowledged and will be developed as part of the Code of Construction Practice (CoCP).

4.3.2 *Assessment Criteria*

The assessment of the significance of the site on ground quality, contamination and waste is based on the criteria reported in *Table 4.1* below.

Table 4.1 *Assessment Criteria*

Significance		Definition
<i>Major Adverse Impact</i>	Ground Quality	The presence of a designated geological site within the site.
		Ongoing exploitation of a mineral resource within the site.
		Impacts to a major utilised aquifer.
<i>Moderate Adverse Impact</i>	Contamination	The known presence of large areas of contaminated land whose removal would require extensive mitigation measures to protect human health and the environment. The significant potential for construction and/or operation to lead to harm to the environment or human health.
	Waste	The removal of large volumes of material to a hazardous landfill or the removal of a considerable volume of material to another (non hazardous) landfill.
	Ground Quality	No designated geological site within the site. The planned exploitation of a mineral resource within the site. Impacts to a minor utilised aquifer.

Significance	Definition
	Contamination The known presence of any areas of contaminated land whose removal would require extensive mitigation measures to protect human health and the environment. The potential for construction and/or operation to lead to harm to the environment or human health.
	Waste The removal of considerable volumes of materials to landfill.
Minor Adverse Impact	Ground Quality No designated geological site within the site. The presence of a mineral resource within the site. Impacts to any groundwater body.
	Contamination The potential for areas of contaminated land whose removal may require mitigation measures to protect human health and the environment. The limited potential for construction and/or operation to lead to harm to the environment or human health.
	Waste The removal of low volumes of materials to landfill.
Negligible Impact	Ground Quality No designated geological site within the site. No mineral reserves within site.
	Contamination No potentially contaminated land identified within site. No potential for construction and/or operation to lead to minor harm to the environment or human health.
	Waste No removal of materials to landfill.

4.4

BASELINE CONDITIONS

In order to assess the potential impacts of the site on the geology, and hydrogeology of the area a baseline assessment was undertaken. This involved reviewing available information on the geology and hydrogeology, assessing the geological conditions and, therefore, the groundwater vulnerability and sensitivities of the area. The characteristics of a groundwater body are highly dependent on the geology that it flows through, as geology influences the nature of the body, its flow rate, quality and potential yield. Any contamination of the surrounding geology has the potential to leach into the groundwater, and depending on the size and connectivity of the body, may then migrate to impact a wider area.

4.4.1

Soil, Geology and Hydrogeology

Sources of Information

General information regarding the geology and hydrogeology of the area has been derived from the following maps and documents.

- British Geological Survey (BGS) Stranraer map (Sheet 3 Drift Geology, 1:50,000 Series, 1978);

- BGS Rhins of Galloway map, (Sheet 1&3, Solid 1:50,000 Series1992);
- Stena Port (Old House Point) Phase II Site Investigation Report, February 2008, ERM; and
- Stena Port (Old House Point) Phase II Site Investigation of the Suspected Landfill Area, June 2008, ERM.

Site Soils and Geology

The BGS map shows that the site is underlain by varying thicknesses of made ground. During the initial ERM intrusive investigation made ground was not encountered across the whole of the site but was present in only two of the twenty investigatory locations. During the second investigation within the suspected asbestos area made ground was encountered from surface level to a maximum of 0.5 metres below ground level (mbgl) and consisted of a hardcore capping layer overlying sandy clays.

According to the BGS the drift geology across the site comprises an unknown thickness of raised beach deposits, which encompasses mainly sands and gravels. This was in accordance with the intrusive investigations where drift deposits were encountered ranging from surface level to 28 mbgl. The drift deposits generally comprised of sandy gravels, and angular and sub-angular cobbles within a coarse sandy matrix. In some areas of the site a layer of sandy clay with cobbles and boulders was encountered underlying this horizon.

According to the BGS, the solid geology across the site comprises the Kirkcolm Formation. The Kirkcolm Formation is Ordovician bedrock comprising blue-grey to reddish-brown greywacke and siltstone of marine origin. The Loch Ryan Fault lies immediately parallel to the Old House Point shoreline.

The initial intrusive investigation encountered bedrock at between 5.5 mbgl and 19.5 mbgl. Bedrock was not encountered in all locations. Where the bedrock was encountered it comprised grey fine grained sandstone.

There are no designated geological sites within the area of the proposed scheme.

Site Hydrogeology

Information on hydrogeology was obtained from the BGS Hydrogeological Map of Scotland (1:625,000, 1988) and the intrusive investigations.

During the intrusive investigations groundwater elevations were recorded in the installed monitoring wells. The groundwater elevations indicate that groundwater is present within the drift deposits. The groundwater elevations did not indicate a consistent shallow groundwater table across the site but it can be assumed that shallow groundwater flow will be to the west towards

Loch Ryan. The shallow groundwater is considered to be in hydraulic connectivity with Loch Ryan.

The groundwater conductivity levels measured during the initial intrusive investigation indicated that the groundwater conductivity decreases the further the monitoring wells are from Loch Ryan. This indicates that there is a mixing zone (which is likely to be tidally influenced) on the site between the shallow groundwater and the saline water from Loch Ryan.

The bedrock is classified as impermeable rock with groundwater only present at shallow depths in surface cracks and joints.

During the desk study it was identified that there are no groundwater abstractions within a 1 km radius of the site. The licensing of groundwater abstractions in Scotland is currently being regulated but no database exists of all existing abstractions.

4.4.2 *Potentially Contaminated Land*

Historical and Current Potentially Contaminating Land Uses

The following potential sources of contamination were identified during the desk study.

Current On-Site

- None.

Historical On-Site

- Suspected asbestos landfill in south of site; and
- Historical use of the site (the military railway, the port, the concrete production, ship breaking yard and the transportation of ammunition across the site post World War Two).

Current Off-Site (<1000 m)

- None.

Historical Off-Site (<1000 m)

- Railway line for ammunition transportation;
- Registered waste transfer site; and
- Registered landfill site.

The potential for these sources to have impacted the site was assessed by the intrusive investigations undertaken on the site.

Conceptual Site Model

In order to assess the potential impacts associated with the identified potential sources, a conceptual site model was developed during the development of the scope of works for the intrusive investigations.

The preliminary Conceptual Site Model (CSM) is summarised in *Table 4.2*. This details the most likely plausible pollutant linkages which have been identified at the site for the proposed development. *Table 4.2* summarises the results of a relative risk screening and prioritisation exercise which has sought to identify the relative significance of identified pollutant linkages in terms of the severity of the impact and/or likelihood of occurrence across the entire site.

Table 4.2 Preliminary Identified Pollutant Linkages

	Primary Source	Secondary source	Hazard	Transport Mechanism	Pathway	Medium of Exposure	Receptor	Relative Risk Screening and Prioritisation
1	Historical site activities	Contaminated soils	Human health effect	Direct contact	Ingestion of near surface soils	Soil	Humans (on-site)	Medium
2	Historical site activities	Contaminated soils	Human health effect	Direct contact	Dermal contact with near surface soils	Soil	Humans (on-site)	Medium
3	Historical site activities	Subsurface vapours & gasses	Human health effect	Emissions at surface	Inhalation of vapours	Air	Humans (on-site)	Low
4	Historical site activities	Subsurface vapours & gasses	Human health effect	Accumulation within buildings	Inhalation of vapours	Air	Humans (on-site)	Low
6	Historical site activities	Contaminated soils (including potential asbestos fibre contamination)	Human health effect	Windblown dusts/ transport through air	Inhalation of particles	Air	Humans (on-site)	High
7	Historical site activities	Mobile soil contaminants	Deleterious effect on groundwater quality.	Migration of contaminated shallow groundwater	Dissolution in groundwater	Water	Water environment (shallow groundwater)	High
8	Historical site activities	Mobile soil contaminants	Deleterious effect on surface water quality	Percolation of mobile contaminants	Dissolution in surface water	Water	Water environment (Loch Ryan)	High
9	Historical site activities	Contaminated shallow groundwater	Deleterious effect on surface water quality	Migration of contaminated shallow groundwater	Dissolution in surface water	Water	Water environment (Loch Ryan)	High
10	Historical site activities	Subsurface vapours & gasses	Substantial damage to buildings	Accumulation and ignition within buildings	Migration in soils & into buildings	Air	Proposed commercial structures (on-site)	Low
11	Historical site activities	Contaminated soils/mobile soil contaminants	Chemical attack services inc. water supply pipes	Direct contact	Direct contact & migration in soils	Soil/Water	Proposed commercial structures (on-site)	Low
12	Historical site activities	Contaminated soils/mobile soil contaminants	Chemical attack on building materials	Migration of contaminated groundwater	Direct contact & migration in soils	Soil/Water	Proposed commercial structures (on-	Low

Primary Source	Secondary source	Hazard	Transport Mechanism	Pathway	Medium of Exposure	Receptor	Relative Risk Screening and Prioritisation
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site)

Relative Risk Screening and Prioritisation for further Investigation & or Assessment

High Higher probability of occurrence and identification of primary sources of contamination with respect to most sensitive receptors.

Medium Pollutant linkage generally dependent on the presence of other primary pollutant linkages and/or where pollutant linkage generally associated with less sensitive receptors.

Low Lower probability of occurrence such as based on requirement for significant migration pathway or where pollutant linkage requires the presence of source contaminants at concentration likely to be much higher than other identified pollutant linkages.

Soil and Groundwater Environmental Analysis

During the intrusive investigations samples of soil and groundwater were collected and analysed for the following potential contaminants:

- total petroleum hydrocarbons (TPH);
- volatile organic compounds (VOC);
- polyaromatic hydrocarbons (PAH);
- phenols;
- polychlorinated biphenyls (PCB);
- metals (arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc);
- tributyl tin (TBT);
- cyanide;
- sulphate;
- asbestos identification; and
- pH.

Data Assessment

The risks to human health, the water environment and the built environment were carried forward from the conceptual site model to quantitative risk assessments for both intrusive investigations.

The assessment addressed the potential risks to human health, the water environment and the built environment and is consistent with the UK framework on contaminated land, which will be reflected in the planning procedure for the development of the site.

The data assessment identified the following potential risks:

- Human Health: arising from exceedances of the assessment criteria for polychlorinated biphenyls;
- Water Environment: no risk to Loch Ryan from shallow groundwater quality was identified; and
- Built Environment: arising from exceedances of the assessment criteria for the protection of water supply pipes.

Conclusions of Intrusive Investigation

Following the assessment of the risks associated with the site conditions the following conclusions have been drawn:

- No specific measures are required to address risks associated with human health for the proposed development in terms of chemical contamination, although the use of appropriate personal protective equipment (PPE) is required for construction and service workers;
- Although the investigation on the suspected asbestos landfill did not detect the presence of any asbestos on this area of the site it is considered

that there is a high likelihood that asbestos is present in this area of the site, expected to be found in discrete pockets. Therefore specific measures will be required to be adopted when excavation in this area is undertaken. This will include measures to inhibit the mobilisation of asbestos fibres into the air, air monitoring during any works and the use of appropriate PPE by construction workers. There is also a requirements for the remainder of the site to be cleared of surficial asbestos

- The site does not represent a significant risk to the water environment (Loch Ryan); and
- Upgrading of water pipe supply materials may be required in line with the WRAS guidance.

4.5 CONSTRUCTION IMPACTS, MITIGATION AND RESIDUAL IMPACTS

4.5.1 Predicted Impacts

Ground Quality

During construction there will be the potential for impacts to groundwater wherever dewatering activities are carried out during excavation. Dewatering activities during the development are expected to be limited as the elevations of the site are presently below the proposed elevations of the development and therefore upfill will be required. Areas of the site are still likely to be excavated during construction activities for underground structures such as foundations. If dewatering is conducted it will be undertaken in accordance with SEPA guidance, consultation, and relevant consents issued under the *Controlled Activities (Scotland) Regulations 2005 (CARs)*, see *Chapter 6, Hydrology*.

Contamination

In areas of known contamination and/or if unexpected contamination is encountered during construction, the necessary mitigation measures to reduce risks to human health and the environment will be adopted. These measures will include an increase in the amount of PPE worn by earthworks personnel and other mitigation measures, particularly if asbestos contamination is encountered.

Measures will be put in place to prevent any contaminated material impacting on groundwater or surface waters. This will include strict segregation of contaminated material into areas where contaminants cannot leach into water bodies/courses.

The identified presence of contamination will require mitigation in terms of the materials used during construction. For example the local ground conditions will be a material consideration for the specification of materials used for water supply pipes.

Measures and procedures to enable the correct handling and treatment of contaminated areas will be developed and integrated within the CoCP as the document evolves.

Waste

Earthworks will be undertaken during the construction of the site. Where spoil arising from earthworks is not contaminated the spoil will be reused on site as part of the development

Other solid wastes and liquid wastes will not impact on the site as they will be handled in a controlled manner with the necessary mitigation measures in place.

4.5.2 Mitigation Measures

The following mitigation will be implemented to minimise the adverse environmental impacts predicted during construction.

Ground Quality

Mitigation measures will be taken to limit potential impacts to ground quality.

Contamination

- In areas of known contamination and/or if unexpected contamination is encountered during construction then an assessment of the risks posed by the contaminants to the development and the environment will be undertaken as per appropriate guidelines ⁽¹⁾. This assessment will include further development of the conceptual site model identifying the source, pathways and receptors for each contaminated area encountered. The assessment will determine the levels of contamination which would lead to a potential risk to the identified receptors for the given end use of that area of the site and determine the amount of clean up required. The requirements for the construction workforce to have suitably experienced staff to undertake investigation of contamination will be set out in the CoCP.
- Steps will be taken to minimise the exposure of construction workers and site neighbours to contaminants if encountered. The exposure of construction workers will be limited by varying working practice or use of personnel protective equipment. Steps will also be taken to ensure contaminated material is removed promptly from site to limit the creation of contaminated run off from any stock piles of contamination. The exposure to site neighbours will be reduced by dust reduction measures. Mitigation measures will be developed within the CoCP.

(1) Planning Advice Note 33: Development of Contaminated Land, Scottish Executive.

- Where piling is undertaken during construction the appropriate guidance will be adhered to ⁽¹⁾.
- Any potential actions or discharges with the potential to contaminate or otherwise affect groundwaters or surface waters will be conducted in accordance with SEPA guidance, consultation and any consents issued under the CARs.
- The local ground conditions will be a material consideration for the specification of materials used for water supply pipes.

Waste

- During construction, measures will be undertaken to minimise waste by working with suppliers to ensure effective waste management, waste streaming, reduce packaging and maximise recycling. The waste that is produced will be handled, stored and transported correctly, dependent on any hazards associated with it. This will include measures to protect construction workers, transport workers and the general public along disposal routes.
- A Waste Management Plan (WMP) will be progressed as a requirement of the CoCP to reduce the impact of waste and to ensure it is handled in line with appropriate guidelines such as *Environmental Protection Act 1990*, *Duty of Care Regulations 1991*, *Special Waste Regulations (Scotland), 1996*, *Duty of Care Code* and in accordance with the general principles in terms of waste management in the Local Plans. The WMP will include details on how the waste streams produced during construction will be handled, stored and transported, records on waste (which will be taken and maintained) and the responsibilities of all parties in respect of wastes.

4.5.3 Residual Impacts

Ground Quality

The main residual impacts on ground quality during construction will be the upfill and the potential excavation operations in the drift deposits. There will be localised minor impacts on shallow groundwater flow patterns.

Due to the permeable nature of the drift deposits and the fact shallow groundwater is in hydraulic connectivity with Loch Ryan, it is considered to be vulnerable to contamination through spills during construction and operation.

The overall significance of the impacts on ground quality is considered to be of minor significance.

(1) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, National Groundwater and Contaminated Land Centre Report NC/99/77.

Contamination

Based on the soil and groundwater quality data gathered during the two intrusive investigations there are no specific remedial measures required to address risks to human health for the proposed development, although the use of appropriate PPE will be required for construction and service workers, particularly during development in the suspected asbestos area of the site.

The identified contamination on the site does not pose a significant risk to the water environment.

The local ground conditions will be a material consideration for the specification of materials used for water supply pipes.

The overall significance of the adverse impacts of contamination is considered to be of minor significance.

Waste

With implementation of the waste management plan, the impacts associated with the removal and disposal of spoil are considered to be minor. This impact category has been applied to reflect that whilst the site may require the excavation and removal of material, the area is not especially sensitive or of major geological importance.

The construction of the port will produce construction associated waste and a waste management plan will act to minimise this volume. The impact of the removal and disposal of other construction and operation solids and liquid waste is therefore considered of minor significance.

4.6 OPERATIONAL IMPACTS, MITIGATION AND RESIDUAL IMPACTS

4.6.1 Predicted Impacts

Ground Quality

The operation of the site will have no direct impact on the geology of the site. There are no designated geological sites within or close to the development area.

A permanent change to the geology in the area of the site will be an increase of thickness to the made ground on the site due to upfilling during development.

It is likely that shallow groundwater flow patterns will be permanently affected by the development. Drainage may also potentially acting as a conduit for flow, but groundwater paths are expected to adapt and stabilise.

Contamination

The operation of the development has the potential to cause impacts if spills of hazardous chemicals occur during operation.

Any contaminated land issues on the site will be addressed during the construction phase.

Waste

Solid and liquid wastes will be produced during operation and could impact the site if handled incorrectly.

4.6.2 Mitigation Measures

Contamination

- Preventative measures and emergency response / spill procedures will be developed by the operator of the site.

Waste

- A waste management plan will be created and adopted by the operator of the site to prevent significant impacts occurring.

4.6.3 Residual Impacts

Ground Quality

The effects of the change in groundwater flow patterns are likely to be localised and of minor significance.

Contamination

The impact of potential contamination during the operation of the site is considered to be of minor significance.

Waste

- The impact of waste during the operation of the site is considered to be of minor significance.