SEVERN ROAD RESOURCE RECOVERY CENTRE

CHAPTER 10 LAND QUALITY

Viridor

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solutions for today's environment

CONTENTS

INTRODUCTION

10.1 This section presents information concerning ground conditions and land quality at the application site and identifies the potential impacts associated with the proposed Resource Recovery Centre (RRC) development.

10.2 The proposed development aims to utilise a brownfield site. Therefore, land quality has been established in accordance with CLR 11 'Model Procedures for the Management of Land Contamination'. The procedures followed take account of the proposal to construct commercial buildings and re-introduce humans to this disused site. Various risk assessments consider the potential for existing ground conditions to damage new buildings, harm site users and pollute the wider environment. Mitigation measures are proposed where the potential for damage, harm or pollution is considered significant.

10.3 The land quality assessment is augmented with a discussion of the potential physical and chemical impacts of the proposed development on soils and near surface geological deposits via erosion, disaggregation, compaction and pollution. Appropriate mitigation measures are identified where predicted impacts during construction and operation are significant.

INFORMATION SOURCES

10.4 The baseline conditions laid out below are drawn from widely available published materials, previous technical reports and a recent site investigation. Previous technical reports are referenced within **Appendices 10/1, 10/2** and **10/3.**

BASELINE CONDITIONS

Geology

10.5 Geological Map Sheet No. 264 (Bristol) and site investigations reported in **Appendices 10/1, 10/2** and **10/3** have confirmed the geology that the proposed development is underlain by Made Ground over Estuarine Alluvium (Tidal Flat Deposits), comprising of organic rich clay and silt, which is underlain by Triassic Mercia Mudstone Group. The generalised ground conditions are summarised in Table 10-1 below.

Table 10 - 1
Generalised Ground Conditions

Depth	Description of Ground Conditions
G.L to 2.0m	MADE GROUND – Comprising gravelly clay, clayey gravel, cobbles and boulders and sandy clay
G.L to 16.5m	ESTUARINE ALLUVIUM (Tidal Flat Deposits) - Brown mottled grey firm silty and sandy clay, becoming grey mottled black silty clay with more sand and thin peat bands with depth
10.5m to 45m	MERCIA MUDSTONE – Grey blue mottled red brown sandy mudstone

Ground Gas

10.6 The site investigations reported in **Appendices 10/2** and **10/3** have recorded the presence of hazardous ground gases as a consequence of natural organic material present within the Estuarine Alluvium.

10.7 Results of gas monitoring visits carried out as part of the 2009 investigation are presented in Appendix C of Appendix 10/3. SLR completed six rounds of monitoring with elevated methane concentrations recorded above 1% within five boreholes, with a maximum recorded value of 42.8% in BHR04. Elevated carbon dioxide levels were proven to exceed 5% at six borehole locations, with a maximum recorded value of 5.6% by volume in BH4.

Land Quality

10.8 The land quality baseline has been established by the site investigations reported in **Appendices 10/1, 10/2** and **10/3.**

10.9 It has been established that this brownfield site is capped with a veneer of made ground (<2m) comprising light gravelly or sandy clay with occasional boulders and cobbles.

10.10 Representative samples of the made ground and natural soils were collected. A total of 42 soil samples were submitted to a laboratory for chemical analysis. Samples were analysed for a wide range of contaminants and a summary of the results is presented in Appendix 10/2 and 10/3

POTENTIAL IMPACTS AND THEIR SIGNIFICANCE

10.11 The following sections explore the potential impacts generated by redevelopment this brownfield site, and via reference to risk assessments, establish whether or not those impacts are significant. Significant impacts are judged to warrant mitigation.

10.12 Sections 10.13 to 10.20 examine the impact of the land upon the development, whilst Sections 10.21 to 10.25 predict the impacts of the development upon the land. This approach ensures that all potential impacts involved in the creation of this development are considered. The results of this assessment are summarised in Table 10-2.

Impacts of the land upon the development

10.13 The Preliminary Land Quality Risk Assessment report (**Appendix 10/1**) indicated that the proposed development site had the potential to be contaminated from its historic use as a Carbon Black works and could be affected by contaminants migrating from the adjacent landfilled ground. It was determined that the risks of impacting new buildings and human health required assessment, the risk assessments undertaken are summarised below.

Damage to Buildings / Structures from Aggressive Ground

10.14 The assessment examined the potential impacts upon proposed buildings or structures from contaminants within the ground. The Alluvium and Mercia Mudstone Group soils beneath the site were tested for the presence of aggressive compounds using the suite suggested by the BRE in Special Digest 1: Concrete in Aggressive Ground. Given the soluble sulphate and pH results, groundwater pH and mobility the guidance document suggests a Design Sulphate Class DS-2 with an Aggressive Chemical Environment for Concrete (ACEC) classification of AC-2.

10.15 Given the above, it is apparent that the mildly aggressive ground conditions may significantly impact the proposed structures if unmitigated.

Damage to Buildings / Structures from Hazardous Gases

10.16 This assessment considered impacts to proposed buildings or structures from the potential for ground gas to become concentrated, to hazardous levels, beneath the proposed structure/building.

10.17 Given that methane and carbon dioxide concentrations occasionally exceed the guidance criteria in Part 2C of the Building Regulations it is clear that gas concentrations may significantly impact the proposed structures if unmitigated.

Harm to Human Health from Soil Based Contaminants

10.18 The risks to humans working on or visiting the site are driven by the potential for exposure to soil-based contaminants. **Appendix 10/1** presents detailed information with respect to contaminant levels. Maximum recorded concentrations of the contaminants of concern were used to derive representative concentrations for consideration. Those concentrations were compared to generic assessment criteria.

10.19 The representative concentrations were considerably lower than the screening criteria indicating an absence of health risk from these contaminants. No significant impacts are predicted.

Health Risks from Exposure to Ground Gases

10.20 The risks to humans working on or visiting the site are driven by the possibility of harmful gases/vapours intrusion into (proposed) buildings. Several organisations publish guidance with respect to ground gases, and it is clear that gas concentrations may significantly impact humans if unmitigated.

Impacts of the development upon the land

10.21 This development impact assessment discusses the potential impacts of the proposed development on soils and near surface geological deposits via erosion, disaggregation, compaction and pollution. The assessment considers impacts during construction and operation of the proposed facility.

10.22 During the construction phase it is envisaged that the main impact will be removal and redistribution of in-situ geological deposits during excavation of the bunker adjacent to the tipping hall in the central area of the site, and creation of the various development plateaux. Such mass movement of soil has an impact on vegetation and can result in increased erosion via wind and water. Stockpiles and any unvegetated slopes, which may be part of the permanent works, are particularly prone to erosion. The adverse effects leading from soil erosion are nutrient loss and loss of fine soil particles, both of which can affect local watercourses (increasing turbidity and siltation and raising nutrient concentrations)[1].

10.23 Disagreggation is a term describing the mixing of soils when disturbed by excavation. This impact changes the physical and chemical composition of the soil, which can later cause problems when re-establishing vegetation or when contaminants from one soil are released into others. Again this impact would generally occur during the construction stages.

10.24 Large earthworks projects, such as this, also tend to cause compaction of soil; again this occurs predominantly during the construction phase. The consequence of vehicle movements compacting soil is to reduce the ability of

[1] The potential impacts on surface water and groundwater quality are presented in **Table 9-9**

plants to form roots and reduction of the capacity for water infiltration. Hardening of the soil surface can lead to increased runoff, erosion and surface water ponding.

10.25 Contamination of the soil can lead to pollution of controlled waters. Introduction of construction plant and material and later introduction of waste management processes has the potential, if poorly controlled, to contaminate soils by the uncontrolled release of solid and liquid compounds associated with vehicles (e.g. oils, fuels, de-icing salts, etc) and hazardous materials handled, used and created by the proposed waste management process.

10.26 The matrix presented in Table 10-2 has been used to determine the significance of the effects predicted above. The assessment of adverse impacts indicates low to medium significant impacts in both the construction and operational stages of the development without mitigation measures. The most serious, medium significant impacts, would arise should soils be contaminated during construction by mishandling of hazardous construction materials, construction wastes or fuels or mishandling of waste, fuels, bottom ash, alkaline reagents, fly ash or other hazardous materials during operation of the facility.

10.27 Previous site uses indicate the potential for contaminated soils to be present which may be disturbed during the demolition of the redundant plant and preparatory earthworks leading to the mobilisation of pollutants and soils. Recent Site Investigations shows areas of contamination therefore the probability of the impact is 'high' and the magnitude of any impact is rated as 'Moderate' giving an overall impact significance of High'. Mitigation is therefore required.

Table 10 - 2
Summary of Unmitigated Potential Impacts, Soils & Near Surface Geological Deposits

Potential Impact	Spatial and Temporary impact	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required
Soils & Near Surface Geological Deposits					
Adverse - Contamination of soils during construction by mishandling of hazardous construction materials (e.g. cement), construction wastes and other hazardous materials associated with construction, including fuels and existing contaminated soils	Local, Short Term	High	Moderate	High	Yes

Potential Impact	Spatial and Temporary impact	Probability of Occurrence	Magnitude of Impact	Significance of Impact	Mitigation Required
Adverse - Erosion of slopes and unvegetated areas during construction.	Local, Short Term	Medium	Moderate	Medium	Yes
Adverse - Compaction of haul roads and land to be built upon during construction.	Local, Short Term	Medium	Mild	Low	Yes
Adverse - Disaggregation of soils during construction.	Local, Short term	Low	Mild	Low	Yes
Adverse - Erosion of slopes and unvegetated areas during operation of the facility.	Local, Medium to Long Term	Low	Mild	Low	Yes
Adverse - Contamination of soils during operation of the facility by mishandling of waste, fuels, bottom ash, alkaline reagents, fly ash, and other hazardous materials associated with the facility.	Local, Medium to Long Term	Medium	Moderate	Medium	Yes

MITIGATION MEASURES

10.28 One of the main aims of the ES is to develop mitigation measures to avoid, offset or reduce the significant adverse effects of a project. These measures can relate to any of the three key phases of the project: design, construction or operation.

Mitigation of the impacts of the land upon the development

10.29 The generic quantitative land quality assessments performed concluded that several of the potential pollutant linkages identified would produce unacceptable impacts / risks and require mitigation by the inclusion of protective features within the design of the facility, and mitigation measures during construction.

10.30 To combat the mildly aggressive ground conditions design engineers responsible for the foundations of the new buildings should specify sulphate

resistant concrete, and new water supply pipes should be protected to the approval of the local water authority.

10.31 With respect to ground gas, guidance given in Wilson and Card (1999) suggests that the site fits "Characteristic Situation 4"[2] and that the proposed commercial buildings should include a reinforced concrete cast in situ slab, that all joints and penetrations should be sealed, and that a gas resistant membrane and passively vented under floor sub-space should be included[3]. The measures deemed necessary to protect new buildings would also be appropriate for the protection of health.

10.32 All groundwork's should be undertaken in line with current health and safety guidance including the Health and Safety Executive's: Protection of Workers and the General Public During the Development of Contaminated Land. TSO, London (1991).

10.33 Mitigation of shallow oil impacts beneath former production plant areas by excavation and offsite disposal to landfill or onsite exsitu soil treatment.

10.34 Implementation of the mitigation measures described would lead to a 'low' residual significance rating.

Mitigation of the impacts of the development upon the land

10.35 The development impact assessment predicted low to highly significant impacts upon the ground during both the construction and operational stages of the development if mitigation measures were not employed.

10.36 Typical mitigation measures are presented in Table 10-3. The measures either reduce the likelihood of an event occurring, or reduce the magnitude of the consequences if the event does occur. Briefly the mitigations measures include:

- Institute procedures for the storage and handling of:
  - all hazardous materials;
  - construction wastes; and
  - fuels.

- Ensure that:
  - spill response kits are provided;
  - as little vegetation as possible is removed;
  - no large areas of bare soil are exposed to the wind;
  - long-term stockpiles are grassed or covered to prevent erosion;
  - soil is excavated in order of horizons and each soil-type is kept in separate piles;
  - water is directed away from slopes using a surface water drainage system;
  - siltation traps are installed in local watercourses;

[2] Further borehole flow rate monitoring could reduce this classification to perhaps a Characteristic Situation 2/3.
[3] Basement structures should be tanked to prevent water ingress and will therefore be gas resistant.

- wide tyres/tracks are fitted to construction plant;
- the site road network is limited to a few main tracks; and that
- compacted areas are tilled once activities have ceased.

- Production of a materials management plan to control the movement and placement of site derived soils during redevelopment.

10.37 The mitigation measures above are echoed in **Chapter 9** which considers the potential for pollution of controlled waters.

ASSESSMENT OF RESIDUAL IMPACTS

10.38 It is considered that the residual impacts associated with the development on the soils and geological regime is low or near zero after the incorporation of mitigation measures detailed above. A summary of these residual impacts is provided in Table 10-3.

Table 10 - 3

Summary of Residual Impacts

Potential Impact	Significance of Impact	Mitigation Measures	Probablility of Occurence	Magnitude of Effect when Mitigated	Residual Significance of Impact
Soils & Near Surface Geological Deposits					
Adverse - Contamination of soils during construction by mishandling of hazardous construction materials (e.g. cement), construction wastes and other hazardous materials associated with construction, including fuels and existing contaminated soils	High	- Instigate procedures for the storage and handling of all hazardous materials. - Institute procedures for the storage and handling of construction wastes e.g. from impermeable surfaces across areas where waste will be stockpiled. - Institute procedures and facilities for the re-fueling of vehicles and storage of fuels and make spill response kits available - Identify and excavate / treat areas of shallow oils impact prior to site construction / post demolition	Low	Mild	Low

		works			
Adverse - Erosion of slopes and unvegetated areas during construction.	Medium	- Removal of as little vegetation as possible and re-establishment of vegetation on bare areas as soon as possible. - Create shallow gradients and avoid steep slopes. - Direct water away from slopes using a surface water drainage system. - Avoid creating large areas of bare soil exposed to the wind and use wind breaks. - Install siltation traps in local watercourses.	Low	Mild	Low
Adverse - Compaction of haul roads and land to be built upon during construction.	Low	- Use wide tyres/tracks on construction plant. - Limit the site road network to a few main tracks. - Till compacted areas once activities have ceased.	Low	Mild	Low
Adverse - Disaggregation of soils during construction.	Low	- Excavate soil in order of horizons and keep each horizon in separate piles. - If piles are to be stored for any length of time they may need to be grassed over or covered to prevent erosion. - Ensure that Made Ground materials are not mixed with natural soils or imported fills - Soil reuse / replacement to follow procedures set out in Materials Management Plan	Low	Mild	Low
Adverse - Erosion of slopes and	Low	- Maintain vegetation across	Low	Mild	Low

unvegetated areas during operation of the facility.		unsurfaced areas. - Direct water away from slopes using a surface water drainage system. - Install siltation traps in local watercourses.			
Adverse - Contamination of soils during operation of the facility by mishandling of waste, fuels, bottom ash, alkaline reagents, fly ash, and other hazardous materials associated with the facility.	Medium	- Institute procedures for the storage and handling of all hazardous materials including waste, fuels, bottom ash, alkaline reagents and fly ash. - Institute procedures and facilities for the re-fuelling of vehicles and storage of fuels and make spill response kits available.	Low	Mild	Low

CONCLUSIONS

10.39 It is concluded that its previous use, residual made ground and the neighbouring landfill have reduced the quality of the land to some degree. That said, the human health assessment performed to date demonstrates that soils on this site should not pose an unacceptable risk to the heath of future site workers and visitors. Whilst no remediation works are required on that account, mitigation measures are required to protect new structures against mildly aggressive ground conditions and to protect the buildings and their users from hazardous concentrations of ground gases.

10.40 The land quality assessment is augmented with assessment of the potential physical and chemical impacts of the proposed development on soils and near surface geological deposits via erosion, disaggregation, compaction and contamination. The development impact assessment indicated low to highly significant impacts in both the construction and operational stages of the development. The medium level of impact derived for the potential to contaminate the ground requires mitigation measures, any measures adopted would also serve to mitigate against the effects predicted in **Chapter 9** which considers pollution of controlled waters.

10.41 Sections 10.29 to 10.34 list the protective features which should be incorporated within the design and construction of the facility and Sections 10.35 to 10.37 summarise the mitigation measures which should be implemented to reduce the risk of the development having an unacceptable impact on the soil environment.

10.42 Given that a commitment has been made by the Applicant to implement all protective features and mitigation measures, the residual significance of the impacts to soil can be classified as Low.

10.43 The effect of the proposed development on the local geology, ground conditions and land quality is considered to be negligible.