
8.0 Revised Conceptual Site Model

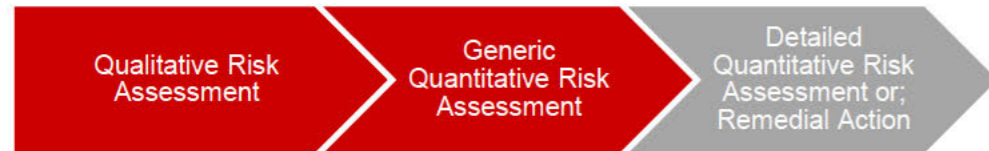
The Preliminary Conceptual Site Model (PCSM) presented in *Section 4.0* of this report has been revised following the GQRA in *Section 7.0* above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM follows the framework outlined within CIRIA C552 (CIRIA, 2001) which is summarised within *Appendix G*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (CITB, 2015) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk. It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model. Reference should be given to the environmental testing results discussed within *Section 7.0* and presented within *Appendix C*.



- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Generic Qualitative Risk Assessment			Action
Identified Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating	
On-site sources of potential contamination: Made ground is the primary source of contamination on site. Contaminants expected within the made ground include: Asbestos, hydrocarbons and heavy metals. On-site historic industrial processes which may give rise to gross contamination.	Direct contact, ingestion and inhalation (soil, dust and vapours)	Future site users Staff and visitors	Medium Chronic health risk	Unlikely Elevated concentrations of Cyanide were encountered in one exploratory hole at the site, with respect to the selected screening thresholds. The chosen commercial end-use and sandy loam GACs are broad and likely to be over-conservative in this case. Considering the site conditions and development proposals, the concentration of cyanide identified is considered to present a low risk to future site occupiers.	Low	No further action required.
	Vertical migration of contaminants	May occur due to processes including; capillary action, burrowing animals inducing soil mixing and downwards migration into the natural deposits through infiltration.	Controlled waters (Groundwater and Surface Water) Secondary A aquifer in the bedrock No local sensitive surface waters	Medium Pollution of lower sensitivity water resources	Unlikely The underlying aquifer is noted to be sensitive, however the absence of any substantial contamination in the made ground, being the only identified on-site source of contamination, identifies that a source, pathway, receptor linkage is not present at the site.	Low
On-site and off-site sources of potential contamination: Ground gases from made ground and coal mining legacy.	Horizontal migration through the shallow soils and air (dust/particulates) Followed by... Direct contact, ingestion, inhalation (dust)	End users of site Staff and visitors.	Medium Chronic health risk	Unlikely Previous investigations on site classified the future development sections as a Characteristic Situation 1, with no further ground gas protection measures required. No further ground gas sources were identified during the Curtins site investigation.	Low	No further action required.
Off-site sources of potential contamination: Made ground is considered the primary source of contamination, due to previous phases of development and historic industrial land uses in the surrounding area.	Horizontal migration through the shallow soils and air (dust/particulates) Followed by direct contact, ingestion and inhalation (dust and vapours)	Future site users Visitors and staff	Medium Chronic health risk	Unlikely There is a low potential for mobile phase contamination to migrate onto the subject site, due to the cohesive condition of the ground. Overall the potential off-site sources of contamination in the close surrounding area are considered no greater than the subject site.	Low	No further action required.

9.0 Geotechnical Conclusions and Recommendations

The recommendations provided within this section are based on a review of the historical and recent records of ground conditions encountered across the site, considering the geotechnical and geo-environmental limitations and hazards identified.

In addition, the recommendations presented here have considered the proposed cut and fill model, as presented in Appendix A.

9.1 Foundation Recommendations

The ground conditions present at the site are noted to be highly variable. In particular the depth of made ground. The presence of soft natural soils and made ground also presents a geohazard for shallow foundations. Due to highly variable nature of the ground conditions encountered, it is anticipated that variable founding solutions may be required.

The intention of substantial cut and fill indicates the risk for intolerable ground movements. It is anticipated that intolerable ground movements may be locally present associated with poor ground conditions. In addition, however, the opportunity to found on soils with suitable structural properties may present as a result of cut activities. As such the ground conditions at each development plot should be considered individually and further assessment of suitable founding solutions is undertaken.

It is advised that where poor ground conditions are present locally, options such as;

- Piled foundation;
- Ground improvement (Stone Columns, soil modification, surcharge).
- Excavation & re-compaction.

are considered. These solutions are proposed to reduce associated risks with intolerable ground movements and to improve the ground bearing capacities.

Optioneering of a suitable foundation solution (outside the scope of this report) should be furthered by production of a detailed specification for each plot, and in consideration of the wider site. For shallow foundation solutions, the ground should be engineered in a manner to allow sufficient bearing capacity to be achieved whilst ensuring settlement remains within tolerable levels.

The presence and removal of underground obstructions needs to be considered.

The presence of an unrecorded 'landfill' will need to be considered within foundation design, with potential for further investigation and assessment.

Due to presence of made ground, it is advised that suspended slabs are adopted unless engineering of the made ground is completed to a suitable specification. All areas of soft/loose compressible material and made ground from sub-grade should be removed and replaced with suitably compacted granular deposits, in accordance with Series 600 Specification for Highways Works (SHW).

In accordance to BS8004:2015, foundations, pile caps and slabs are to be taken to a minimum 450mm depth, to avoid Heave/Frost (NHBC Guidance Chapter 4.2).

9.2 Excavations

It is anticipated that excavations will be required during the construction phase. These are likely to be for achieving required founding levels or localised services and dig & replacement works.

Due to the presence of a variable thickness of made ground, stability of unsupported excavations <1.2m bgl is considered a hazard.

It is anticipated that any deep excavation which may be required will necessitate suitable stabilisation methods. However, some localised excavations e.g. for services (shallower than 1.0m) may be able to achieve stability, utilising appropriate batters, to be decided by the temporary works designer.

Groundwater present at relatively shallow depths must be taken into consideration, for the purposes of design of the temporary excavation works. De-watering may pose a risk and may be required dependant on depths of excavation.

The presence of underground obstructions should be considered likely.

Advice from a temporary works designer and a de-watering specialist must be sought prior to commencement of the works. A de-watering Strategy may be required.

9.3 Re-use of Site Soils

It is assumed that re-use of soils will be considered as a part of the development works.

The re-use of site soils is considered viable due to the presence of contamination levels below screening values.

In addition to quality, the re-use of site-won soils is governed by the following principles:

- The geotechnical suitability of the material needs to be confirmed;
- The re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits;
- The volume of the material being re-used needs to be confirmed and traceable
- Regulatory approval from the relevant authorities should be sought.

These principles are outlined within the CL:AIRE Code of Practice (v2) (Contaminated Land: Applications In Real Environments (CL:AIRE), 2011) and if and where the re-use of site-won soils is proposed as part of the development works, it is recommended that a Materials Management Plan is produced in line with the Code of Practice to detail and document the process.

9.4 Waste Classification of Soils

It is the responsibility of the contractor and/or their appointed groundworks contractor to confirm waste classifications of soils requiring disposal off site.

Where any site soils are to be disposed of off-site guidance on the disposal of contaminated soils is provided within the following documents published by the Environment Agency.

- a) Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Environment Agency, May 2015).

Guidance states that the principal contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the relevant environmental chemistry analyses results to classify any surplus material identified for off-site disposal. However, it should be noted that this information is for guidance only, based on soils selected for sampling. All material identified for disposal should be tested and assessed in accordance with WM3 to enable classification prior to and during the works.

An initial assessment for the waste classification of the made ground encountered on site has been carried out through a comparison of the soil testing results using the Waste Soils Characterisation Assessment Tool, Cat-Waste^{Soil}, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous waste.

The initial CAT Waste assessment has identified that the made ground soils tested are classified as non-hazardous waste for off-site disposal. As such, the waste code for these soils is 17-05-04, mirror non-hazardous.

Following the CATWaste assessment, consideration of landfill acceptance is also given. The waste code of non-hazardous identifies that the material may potentially be accepted at a non-hazardous or inert landfill dependant on the results of Waste Acceptance Criteria tests. A total of three WAC tests have been completed. The results of the WAC testing indicate that the made ground soils would be accepted as a non-hazardous waste, but unlikely to be accepted as inert waste due to exceedances in antimony, total PAH and loss on ignition.

As discussed, preliminary waste classification and discussion of landfill acceptance is undertaken to offer indicative advice only with respect to disposal requirements. Furthermore, landfill operators are

not obligated to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. It is noted that it is the responsibility of the contractor to ascertain and apportion the soils at the site for disposal.

9.5 Geotechnical Risk Assessment

The risk rating is derived from Risk Rating = Risk Likelihood x Risk Severity. Where risk likelihood and risk severity are defined as:

RISK LIKELIHOOD	RISK SEVERITY
1. LOW (unlikely)	1. LOW
2. MEDIUM (Possible)	2. MEDIUM
3. HIGH (Probable)	3. HIGH

The result is a risk that can be described as MINIMAL (0-3), RESIDUAL (4) or SIGNIFICANT (6-9) as per the risk matrix in **Table 9.5**.

Table 9.5; Risk Matrix.

		Severity		
		1	2	3
Likelihood	1	• Minimal	• Minimal	• Minimal
	2	• Minimal	• Residual	• High
	3	• Minimal	• High	• High

Ref No.	Hazard/Activity	Risk/Potential Outcome	Design Measures to Remove/Reduce the Risk	Risk Likelihood	Risk Severity	Risk	Residual Risk
1	Unsuitable ground conditions	Intolerable ground movements for ground bearing slabs	Suitable foundation design – likely to be variable across the site on a unit by unit basis. Detailed Review of the provided ground information within this report by the designer and the contractors. Designer and the contractor must satisfy themselves with the ground conditions across the site.	2	1		Where soft/loose compressible material is encountered, it must be removed and replaced with suitably compacted granular material in accordance with Series 600 SHW.
2	Fluctuating shallow Groundwater	Flooding in excavations	Dewatering is advised, however due to presence of adjacent structures, it may be complex.	2	2		Dewatering strategy undertaken by a dewatering specialist
3	Structural loading, earthworks & compressible soils	Excessive settlement	Design of appropriate ground improvement of foundation option to limit settlement to tolerable levels	3	3		

Ref No.	Hazard/Activity	Risk/Potential Outcome	Design Measures to Remove/Reduce the Risk	Risk Likelihood	Risk Severity	Risk	Residual Risk
4	Area of unrecorded historical landfill	Lower bearing capacity, settlement	Further investigation and or consideration of foundations in this area	3	3		Further consideration / investigation
5	Aggressive ground/groundwater conditions	Degradation on the buried concrete	Adoption of suitable concrete design based on the assessment undertaken to BRE Digest 1. DS-2, AC-2.	1	1		N/A
6	Unforeseen ground conditions	Unexpected ground conditions encountered during construction	N/A	2 Former WWTW & previously unidentified potential landfill area	2		N/A
7	~Mine Shafts	Collapse / settlement / impact on works	Treat & cap mine shaft	3	3		

9.6 Recommendations

The following recommendation are made for future works;

- Geotechnical optioneering to consider the most efficient foundation solution for each plot;
- Earthworks strategy, site wide and tailored to each plot;
- Mine shaft treatment strategy and mine shaft cap design;

10.0 Geo-Environmental Conclusions and Recommendations

A revised tabulated Conceptual Site Model has been derived following the findings of the Generic Quantitative Risk Assessment and is presented in Section 8.0.

10.1 Conclusions

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against a '*Commercial*' threshold.

With respect to the proposed end-uses of the site, the risk to human health is considered **low**.

This investigation confirms the CS1 ground gas classification.

The BGS Radon Mapping confirms that the site is situated in a lower probability radon area where 1 - 3% of homes are above the radon action level. On this basis radon protection measures are not considered necessary for the proposed development on the site.

10.2 Recommendations

The following further works are recommended;

- Remediation strategy / development statement for imported soils & unexpected contamination.

11.0 Bibliography

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Appendix A – Drawings

- Curtins Drawing Ref. 065646-CUR-00-XX-DR-GE-001-V01 Exploratory Hole Location Plan.
- Curtins cut & fill model.

