10. GROUND CONDITIONS & CONTAMINATION

10.1 INTRODUCTION

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10.1.3 Chapter Purpose

This chapter of the Environmental Statement (ES) assesses the likely significant effects of the proposed development on the environment in terms of Ground Conditions and Contamination. The chapter and it's supporting appendices describe the planning policy context, the assessment methodology; the baseline conditions at the application site and surroundings; the likely significant effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; the likely residual effects after these measures have been employed; and the cumulative effects.

10.1.4 Chapter Updates for Revised 2020 Submission

This Ground Conditions and Contamination ES Chapter has been reviewed against the following aspects and for each it has been confirmed that there are limited amendments required to the content of the chapter:

- Proposed development design changes: are of no specific relevance to this assessment;
- Baseline data validity: there are no relevant changes to the baseline data;
- Legislation/policy revisions: there have been no related updates to legislation/policy that have affected either the methodology or findings of this assessment. However, this update has included further detail and description in relation to the legislation and policy relevant to this topic area;
- Additional cumulative schemes: the additional cumulative schemes have been reviewed and are considered not to have cumulative interactions with the proposed development due to their distance/form of development as described subsequently – therefore, they have not been further assessed within this chapter.

Some statutory consultee comments were received from Liverpool City Council (LCC), Environment Agency (EA) and other statutory consultees in relation to this topic that required a response. As such this chapter revision includes further detail throughout from previously submitted ES.

As a consequence of the above factors, and in line with the methodology set out Chapter 2, a level 2 update has been undertaken. For completeness, additional detail has been provided in Sections 10.2 to 10.7, including more detailed explanation of the mitigation measures, however it is considered that the conclusions on previously reported residual effects remain valid.

10.1.5 Appendices

- Appendix 10.1 – Desk Study Report – BMD01-BHE-ZA-LXX-RP-CG-0001
- Appendix 10.2 – Geoenvironmental Interpretative Report – BMD01-BHE-XX-XX-RP-YG-0003

10.1.6 Figures

- N/A

10.2 METHODOLOGY

10.2.1 Guidance

The framework for the assessment of potential land contamination adopted in this assessment is based on current guidance documents regarding the implementation of these regimes and the assessment of potentially contaminated land, with particular reference to:

- Model Procedures for the management of land contamination – contaminated land report (CLR11) [1];
- Land Contamination: risk management (replacement of CLR11, currently in draft) [2];
- Managing and reducing land contamination: guiding principles [3]; and
- BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites – Code of Practice [4].

10.2.2 Legislation and Policy

Land contamination is regulated under several regimes including: environmental protection, pollution prevention and control, waste management, planning and development control, and, health and safety legislation. The primary regulatory regimes under which contaminated land is managed in the UK are the National Planning Policy Framework (NPPF) [5] and Part 2A of the Environmental Protection Act 1990 (as amended) [6].

Section 38(6) of the Planning and Compulsory Purchase Act 2004 [7] and Section 70(2) of the Town & Country Planning Act 1990 [8] requires that planning applications should be determined in accordance with the statutory development, unless material considerations indicate otherwise.

The statutory development plan for the City of Liverpool currently comprises:

- Liverpool Unitary Development Plan (UDP) (adopted 2002) [9]; and
- Merseyside and Halton Joint Waste Local Plan (adopted July 2013) [10].

The following policies and guidance are material considerations which also inform the assessment:

- Liverpool Local Plan (Submission Draft, May 2018) [11];
- NPPF (March 2012, updated in 2019) [5]; and
- Planning advice note for developers on developing contaminated land [12].

The key policies within the adopted UDP are as follows:

- Policy EP1 (Vacant, Derelict and Neglected Land): promotes and encourages the reclamation of derelict land and the restoration of neglected land and encourages the development of these for other appropriate uses. In determining priorities for derelict land, particular attention will be given to: the contribution the reclamation of the site would make to achieving the aims of urban regeneration and to aiding the implementation of policies in this Plan; the need to facilitate inward investment opportunities and create jobs, the degree of contamination, dereliction or danger posed by the site; and the need to integrate with, and support, other regeneration initiatives and agencies in order to maximise the benefits of reclamation.
- Policy EP2 (Contaminated Land): before determining any application for planning consent on land which the City Council considers is seriously contaminated, the Council will require the applicant to: submit details of a site survey identifying the type, degree and extent of any contamination; and submit details to the City Council of specific remedial measures required to deal satisfactorily with any hazard, together with the proposed timescale for the implementation of the measures. Planning permission will only be granted prior to a full site investigation where the Council considers that any known or suspected contamination is unlikely to adversely affect the proposed redevelopment. This permission may be subject to conditions requiring a site investigation together with the remediation of any contamination.
- Policy EP3 (Landfill Gas): planning permission will not be granted for development on former landfill sites, or within 250m of current or former landfill sites, unless the applicant can clearly demonstrate that there is no risk from the generation or migration of landfill gas, or that satisfactory measures can be taken to counter any possible hazard.
- Policy EP12 (Protection of Water Resources): planning permission will not be granted for development which, in the opinion of the City Council following consultation with the Environment Agency (EA), would adversely affect the quality or supply of surface water or groundwater as a result of: the nature of the surface or waste water discharge; unsatisfactory arrangements for the disposal of foul sewage, trade effluent of surface water; the disturbance of contaminated land; or the spillage or leakage of stored oil or chemicals.

The Liverpool Local Plan is presently awaiting formal public examination and when ultimately adopted will replace the UDP. The relevant policy for ground conditions is:

- Policy STP2, part a (Sustainable Growth Principles and Managing Environmental Impacts): as a priority, new development should be located on previously developed land and/or re-use an existing building; seek to use secondary materials such as recycled aggregates;

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and where appropriate aim to secure the remediation of contaminated sites.

Paragraph 170 of the NPPF details that planning decisions should contribute to and enhance the natural and local environment by, amongst others:

- Clause E – prevent new development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil pollution or land instability; and
- Clause F – remediate degraded, derelict, contaminated and unstable land where appropriate.

Paragraph 178 thereafter details that in relation to ground conditions and pollution, planning decisions should ensure that:

- A. – a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation).
- B. – after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- C. – adequate site investigation information, prepared by a competent person, is available to inform these assessments.

Paragraph 179 of the NPPF ultimately draws the policy together detailing that where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

The 'Planning advice note for developers on developing contaminated land' was produced by Liverpool City Council (LCC) Environmental Protection Unit (EPU). It comprises general advice to developers and requirements for planning application submissions on potentially-contaminated land.

10.2.3 Consultees & Scoping

In addition to the scoping consultation, during the pre-application stage, Peel Ports were consulted in regard to ground conditions at the application site on two occasions: 16th May 2019 and 7th October 2019.

The scoping consultation and initial planning application consultation is discussed in the following sub-sections.

10.2.3.1 Scoping Consultation

Table 10.1
Summary of consultee responses to Scoping Report

CONSULTEE	CONSULTEE RESPONSE	COMMENTARY
EA	The EA consider the historic industrial land uses at and around the application site are likely to have led to elevated concentrations of contamination which could pose an unacceptable risk to the adjacent River Mersey and the underlying Principal Aquifer.	Two phases of ground investigation have been undertaken and risk to River Mersey and Principal Aquifer assessed in a Geoenvironmental Interpretative Report. (Appendix 10.2). Ground Investigation results are summarised in Section 10.3 – Baseline Conditions and considered throughout the assessment presented in this ES chapter.
EA	Any proposal to develop the application site will need to be accompanied by an assessment of the impacts of development upon the hydrogeology of the area. This will need to address both existing contamination which may be present and the impacts that the future ongoing operation of the site will have on the groundwater environment.	Considered in Section 11.3 – Existing Baseline, 11.5 – Assessment Pre-Mitigation and 11.7 – Assessment Post-Mitigation.
Marine Management Organisation (MMO)	Mitigation measures and methodologies for reducing sediment disturbance and contamination issues should be provided in detail in the ES.	Construction Strategy described in Chapter 4 Construction Strategy & CEMP (Construction Environmental Management Plan). Mitigation measures are listed in Section 11.6.
MMO	Details of dredge and disposal methodologies should be included within the ES and potential contaminant issues should be addressed.	Construction Strategy described in Chapter 4 Construction Strategy & CEMP. In the proposed strategy, Dock Deposits are to remain in-situ.
MMO	The scoping report for the proposed development states that environmentally harmful contaminants, such as Tributyltin (TBT), are likely to be present in the dock sediments, and that there is potential for these contaminants to be released into the Mersey estuary and wider marine environment during silt removal and disposal. The potential effects of these contaminants on fish species and benthic organisms should be assessed in the ES.	Construction Strategy described in Chapter 4 Construction Strategy & CEMP. In the proposed strategy, following raking to identify obstructions contained within BMD, Dock Deposits are to remain in-situ.
Merseyside Environmental Advisory Service (MEAS)	MEAS state that the applicant should prepare a Construction Environmental Management Plan (CEMP) document to manage and mitigate the main environmental effects during the construction phase of the proposed development. The CEMP should include details of ecological mitigation, construction and demolition waste management, pollution prevention and soil resource management.	Recommended that a CEMP is prepared in Section 11.6 - Mitigation & Enhancement Measures. Overall Construction Strategy is described in Chapter 4 Construction Strategy & CEMP.
Liverpool City Council (LCC)	LCC stated that any proposal to develop the application site will need to be accompanied by an assessment of the impacts of development upon the hydrogeology of the area. This will need to address both existing contamination which may be present and the impacts that the future ongoing operation of the site will have on the groundwater environment.	An assessment of potential hydrogeological impacts during both construction and operation is made within this chapter. This is based on data obtained over two phases of ground investigation, presented in a Geoenvironmental Interpretative Report. (Appendix 10.2).

10.2.3.2 Planning Application Consultation

Subsequent to the planning application (ref. 20F/0001) being submitted to Liverpool City Council (LCC) in December 2019, the following consultation responses have been received:

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Table 10.2
Summary of consultee responses to planning application

CONSULTEE	CONSULTEE RESPONSE	COMMENTARY
EA	The EA expressed no objection in principle to the planning application. The EA recommended four planning conditions related to ground conditions and contamination. These related to production of a Remediation Strategy, Foundation Works Risk Assessment, Verification Report and a requirement to undertaken further assessment of deposits at the base of BMD.	These comments have no impact on the assessment presented in the ES Chapter. The recommended planning conditions are consistent with the mitigation / enhancement measures presented here and will be adhered to.
MEAS	MEAS stated that analysis of the sediment chemistry recorded a range of contaminants which are largely typical of the docklands location. Due to the proposed infill methodology, which involves leaving the existing dock sediment in-situ and covering with membrane, MEAS did not have any significant concerns regarding the spread of contaminated sediments into neighbouring docks or the adjacent SPA.	The infill methodology no longer includes covering dock sediments with a membrane, however supplementary mitigation measures are proposed. An assessment of dock sediment disturbance with regards to infilling without the membrane is addressed in the technical appendix 'Bramley-Moore Dock – Dock Deposit Disturbance' The assessment presented in the ES Chapter remains valid.
LCC	LCC have not provided formal comment but stated in email correspondence that the approach outlined in the Environmental Statement and as part of the overall Geoenvironmental Interpretative Report (Appendix 10.2) is considered suitable for the purposes of assessing risk to human health.	The assessment presented in the ES Chapter remains valid.
Centre for Environment, Fisheries and Aquaculture Science (CEFAS)	CEFAS requested physical sediment data concerning the infill material should be provided	The physical sediment data has been included in Appendix B alongside the chemical data within the technical appendix 'Bramley-Moore Dock – Dock Deposit Disturbance'

10.2.4 Consideration of Climate Change

Climate change is unlikely to affect the presence or occurrence of contamination within the proposed development. The source, pathway and receptor assessment (see Assessment of Baseline Conditions & Receptor Sensitivity) includes a consideration of the potential for rising flood levels.

10.2.5 Consideration of Human Health

A risk-based approach is used for the assessment of contamination. This requires identification of a contaminant source, a receptor and a realistic pathway via which the contaminant may reach the receptor. The key receptors considered in this assessment include people i.e. human health (amongst others), specifically construction workers, neighbours and site users.

The data obtained from two phases of ground investigation have been assessed by Generic Quantitative Risk Assessment (GQRA) within the Geoenvironmental Interpretative Report (Appendix 10.2). Within this, the risk to human health has been assessed by comparing the soil test results with available Soil Guideline Values (SGVs), Category 4 Screening Values (C4SLs), Buro Happold-derived and other industry Generic Assessment Criteria (GAC). Human health effects are divided into chronic and acute:

- Chronic: soil results have been assessed using GACs, C4SLs and SGVs for the Contaminated Land Exposure Assessment (CLEA) residential without plant uptake and commercial land use scenarios. These criteria were used to understand the liability and risk associated with future use of the site. The residential without plant uptake scenario has been applied to give context to the data whereas the commercial industrial scenario is the most appropriate land use scenario.
- Acute: There are no guidance values for assessing acute risk to human health from soil contamination. Because such risks are associated with short term exposure, consideration is required of maximum concentrations (not the average concentration which is relevant to chronic / long term risk). Comparison of maximum concentrations has been made with the various commercial land use GACs and other screening values which provides a conservative benchmark for such short-term risks.

10.2.6 Consideration of Risk of Major Accidents and/or Disasters

The major accidents and disasters identified to be of relevance to the application site and proposed development have been reviewed and are not identified to be of relevance to this technical topic.

10.2.7 Alternatives

A comprehensive alternative sites assessment has been undertaken and is addressed within Chapter 5 Alternatives and Design Evolution. An alternative future baseline scenario has been included within the assessment for comparison purposes as stated in Chapter 2 EIA Methodology.

10.2.8 Assessment of Baseline Conditions & Receptor Sensitivity

A conceptual model of the application site that describes its environmental features together with the expected interaction of potential contamination sources with the environment has been developed by undertaking a Source–Pathway–Receptor analysis in accordance with relevant good practice guidance.

These terms are defined here:

- Sources: potential or known sources of potential contamination associated with historic or recent/current land uses (e.g. disposal of wastes, spills and leaks);
- Pathways: mechanisms/systems through which exposure of a receptor to a contaminant could occur e.g. direct contact with contaminated soils, migration through air, over land or via permeable ground; and
- Receptors: receptors of varying sensitivity that could be adversely affected by contact (direct or indirect) with a contaminant e.g. residents, workers or visitors on the site, groundwater and surface water bodies, and ecological resources (flora and fauna).

The baseline data was sourced from a Desk Study (Appendix 10.1) of extensive data on the geological and geoenvironmental conditions obtained from a database search, together with published information and existing borehole logs published by the British Geological Survey.

10.2.8.1 Surveys

The baseline data identified in the Desk Study has been further refined by two phases of ground investigation undertaken during 2017 and 2018, the data from which are assessed together in a Geoenvironmental Interpretative Report (Appendix 10.2). The baseline conditions have been assessed for the application site and for a distance of up to 250m beyond the site boundary. This 250m "halo" around the application site is considered a suitable radius that takes into account the potential for contamination migration onto or off of the application site and the likely active pathways given the site geology; hydrogeology; ground elevations; and previous site uses. Table 10.3 sets out the scale of sensitivity that has been applied to receptors identified and considered within this assessment.

Table 10.3
Scale of receptor sensitivity used in the assessment

SENSITIVITY	DESCRIPTION
High	People (on site or on neighbouring properties) occupying land in residential use with gardens, or using allotments, children's play areas etc. Construction workers engaged in extensive earthworks.

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SENSITIVITY	DESCRIPTION
	Principal aquifer of regional importance used for potable water supply. Highly ecologically sensitive watercourse or water bodies. Nationally or internationally designated ecological sites. Buildings of high historic or local importance.
Medium	People (on site or on neighbouring properties) occupying land in residential use without gardens, or using public areas of soft landscaping/open spaces. Construction workers engaged in moderate earthworks. Secondary aquifer, local watercourse or non-designated water bodies not used for large scale human consumption which can be used for industrial purposes; may be important for local recreational purposes. Locally designated ecological sites. Buildings, including services and foundations.
Low	People (on site or on neighbouring properties) occupying or using commercial or industrial buildings, car parking, hard landscaping. Construction workers on site but with minimal disturbance to the ground. Non-potable water resources, water body of low recreational qualities. Sites of low ecological value and flora and fauna occupying non-designated open areas. Infrastructure (e.g. roads, highways and railways).
Negligible	Land with no access to people and no neighbouring properties. Construction workers on site, but with no disturbance to the ground on site. Non-aquifer, no nearby watercourses or water bodies within 1km. No sites of significant ecological value and no built development within 1km.

10.2.9 Assessment of Magnitude

The assessment was undertaken based on the description of development contained in Chapter 3 Application Site and Proposed Development, and, Chapter 4 Construction Strategy of this volume of the ES. Table 10.4 indicates the scale of impact magnitude that has been used in undertaking the assessment.

Table 10.4
Scale of magnitude for receptor impacts used in the assessment

MAGNITUDE	DESCRIPTION
Large	Short term (acute) or long term (chronic) adverse effects on human health, broadly equivalent to "significant harm" as defined by the Environmental Protection Act 1990. Persistent and extensive pollution of water resource or ecosystem equivalent to Category 1 pollution incident (major pollution release) as defined by the Environment Agency. [13] Catastrophic damage to crops/building/infrastructure.
Medium	Short term (acute) or long term (chronic) adverse effects on human health but not equivalent to "significant harm" as defined by the Environmental Protection Act 1990. Non-persistent pollution of water resource or ecosystem equivalent to Category 2 pollution incident (moderate pollution release) as defined by the Environment Agency [13]. Significant damage to crops/buildings/infrastructure (on or off site). Contamination of off-site soils.
Small	Easily preventable, non-permanent health effects on humans. Minor, low-level, localised, temporary pollution of water resources or ecosystem. Easily repairable damage to crops/buildings/infrastructure. Easily preventable, permanent health effects on humans. Localised damage to buildings/infrastructure (on or off site).
Negligible	No discernible negative effects.

10.2.10 Assessment of Significance

The assessment of significance within this chapter is based on the matrix presented in Table 10.5.

Table 10.5
Significance Matrix

MAGNITUDE OF EFFECT	SENSITIVITY OF RECEPTOR			
	High	**Medium**	**Low**	**Negligible**
Large	Major Significance	Major Significance	Moderate / Minor	Negligible Significance
Medium	Major Significance	Moderate Significance	Minor Significance	Negligible Significance
Small	Moderate / Minor	Minor Significance	Minor Significance	Negligible Significance
Negligible	Negligible Significance	Negligible Significance	Negligible Significance	Negligible Significance

10.2.11 Relevant Associated Development

There is no relevant associated development that impacts on the ground conditions assessment.

10.2.12 Assumptions/Limitations

In undertaking the Ground Conditions and Contamination assessment of the application site and wider surrounding area, there are a number of limitations and constraints affecting the outputs from this work. These are as follows:

- Beneficial or adverse effects to the relevant receptors during construction and when the application site is operational are identified and assessed. Beneficial (or positive) effects are associated with the mitigation of risks associated with contamination (e.g. as a result of the breaking of a pollutant linkage). The adverse (or negative) effects are temporary during the construction phase and relate to the increased potential for contaminant exposure (e.g. from the generation of contaminated dusts), and are long-term from the use of the application site during the operational phase (e.g. associated with any residual contamination).
- The significance of an effect also reflects the timescales involved, i.e. short-term (0-5 years), medium-term (5-10 years duration) or long term (in excess of 10 years duration), the extent of the area affected and the nature of the effect (i.e. its permanency). The significance of a potential effect is derived by considering both sensitivity of the receptor and the magnitude of change.
- Effects that are generated as a result of the enabling and construction works (i.e. those that last for this set period of time) are classed as 'temporary'. By adopting the construction methodology and programme described in Chapter 4 Construction Strategy & CEMP, all of these effects would classified as 'short term'. Effects that result from the completed and operational proposed development are classed as 'permanent' or 'long-term' effects.
- The scope and design of the ground investigations that have informed the baseline presented here reflect the known history of site use, with the results of the Phase 1 ground investigation informing the design of the Phase 2 investigation. On this basis the spacing of the exploratory holes, and, the sampling and analysis plan for this investigation is considered to have provided a reasonable level of certainty about the ground conditions. However, it is important to recognise that contamination can be both widespread and relatively localised, depending upon its source etc. No investigation, however comprehensive can be expected to determine absolutely the nature and extent of all the contamination which could be present on any site. There will always be an element of uncertainty about the ground conditions, including contamination. This potential for currently undetected contamination to be present must therefore be taken into account in consideration for all future activities.
- Dock Deposits contained within Bramley-Moore Dock (BMD) have been identified as a potential source of ground gas once the dock is filled. It is impossible to monitor ground gas generation from these deposits prior to dock infilling, and as such, no ground gas monitoring of these deposits has been undertaken to date The potential risk to future site users and buildings from Dock Deposits has therefore not been quantitatively assessed. Note that ground gas monitoring of on-shore strata (i.e. on the dock wharves) has been undertaken - the data are described in Section 11.3.
- The following assumptions have been made in regard to the future baseline with respect to ground conditions and contamination:

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- During the construction and operational phase of the Liverpool Waters Permission (Ref. 10O/2424), it is assumed that the on-site conditions as part of the Future Baseline will remain similar to the current Baseline Conditions in terms of the key receptors.
- Surrounding development as part of the Liverpool Waters Permission will be constructed using good practice, defined in a CEMP, as required by Condition 39 of that permission to prevent contamination to neighbouring sites.

- The existing and future baseline conditions with respect to both marine and terrestrial flora and fauna, along with potential significant impacts associated with bringing forward the proposed development and Liverpool Waters development, are considered in detail in Chapter 10 Ecology. This chapter briefly considers the potential impact of root uptake of phytotoxic metals by introduced flora only.

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10.3 BASELINE CONDITIONS

10.3.1 Existing Baseline

KEY RECEPTORS	DESCRIPTION	SENSITIVITY	FURTHER INFORMATION
Current Site Users	Site is of commercial / industrial use and is occupied by Svitzer (operation of tug boat services) and Cataclean. No disturbance to the ground within the application site is being undertaken. No / very limited potential for exposure to contaminants via direct or indirect ingestion, inhalation, and / or dermal contact. All concentrations of all inorganic determinands in on-shore soil samples were below commercial screening thresholds. Five samples (11%) exceeded the residential without plant uptake threshold for lead. Chrysotile asbestos was also detected in one sample (2%). Localised elevated concentrations of organic determinands were recorded on BMD wharves. Polycyclic Aromatic Hydrocarbons (PAHs) in excess of commercial screening thresholds and / or speciated TPH in excess of residential without plant uptake thresholds recorded at four locations but free phase contamination not identified. A strong hydrocarbon odour was noted during excavation in area of historical tar works (northern wharf) but no evidence of free-phase contamination. In this area, isolated exceedances of residential without plant uptake screening thresholds were recorded for TPH and some PAHs. Concentrations of Volatile Organic Compounds (VOCs) and Semi-volatile Organic Compounds (SVOCs) were low or below laboratory limits of detection.	Low	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
Site Neighbours	Surrounding site uses within 250m are predominantly commercial / industrial. No disturbance to the ground within the application site is being undertaken. No / very limited potential for exposure to contaminants via windblown dusts or vapours All concentrations of all inorganic determinands in on-shore soil samples were below commercial screening thresholds. Five samples (11%) exceeded the residential without plant uptake threshold for lead. Chrysotile asbestos was also detected in one sample (2%). Localised elevated concentrations of organic determinands were recorded on BMD wharves. PAHs in excess of commercial screening thresholds and / or speciated TPH in excess of residential without plant uptake thresholds recorded at four locations but free phase contamination not identified. A strong hydrocarbon odour was noted during excavation in area of historical tar works (northern wharf) but no evidence of free-phase contamination. In this area, isolated exceedances of residential without plant uptake screening thresholds were recorded for TPH and some PAHs. Concentrations of VOCs and SVOCs were low or below laboratory limits of detection.	Low	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
Principal Aquifer	Chester Formation is a Principal Aquifer. Presence of hardstanding limits infiltration. Two phases of ground investigation have proven presence of a limited thickness of low permeability strata to protect underlying Principal Aquifer. Limited potential for downwards migration of dissolved or mobile phase contamination. There are no groundwater or potable water abstraction licenses within 2km of the site. Groundwater samples showed marginal exceedances of relevant screening thresholds for cyanide, mercury, arsenic, boron, copper and zinc at some locations. Exceedances of screening thresholds for some organic determinands (PAHs, TPH) were principally recorded at two locations. An oil sheen and 0.5cm of Light Non-aqueous Phase Liquid Hydrocarbons (LNAPL) were recorded over the two monitoring rounds corresponding with the location of the former tar works.	High	Chapter 3 Environmental Setting, Appendix 10.1 Chapter 2 Site Setting, Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
River Mersey	River Mersey present adjacent to western site boundary. Potential for migration of contamination via surface water run-off or migration of contaminated groundwater via shallow permeable strata to the adjacent river. Near-surface groundwater in Made Ground is above River Mersey level. Due to variable quality / permeability of the River Mersey wall, a seepage regime may exist between near surface groundwater and River Mersey. Mersey Narrows & North Wirral Ramsar Site, Special Protection Areas (SPA) and Site of Special Scientific Interest (SSI) present within ~1km. Liverpool Bay SPA immediately adjacent to application site. Groundwater samples showed marginal exceedances of relevant screening thresholds for cyanide, mercury, arsenic, boron, copper and zinc at some locations. Exceedances of screening thresholds for some organic determinands (PAHs, TPH) were principally recorded at two locations. An oil sheen and 0.5cm of LNAPL were recorded over the two monitoring rounds corresponding with the location of the former tar works.	Medium	Chapter 3 Environmental Setting, Appendix 10.1 Chapter 2 Site Setting, Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
Port of Liverpool Dock System	Dock System within 250m radius is utilised for industrial / commercial use. Potential for migration of contamination via surface water run-off or migration of contaminated groundwater via shallow permeable strata to the Port of Liverpool Dock System. Near-surface groundwater in Made Ground is above BMD level Due to variable quality / permeability of the BMD walls, a seepage regime exists between near surface groundwater and BMD. Sediments (Dock Deposits) are contained within BMD and wider Port of Liverpool Dock System. Potential for disturbance of Dock Deposits and release of particulate / dissolved contamination. Groundwater samples showed marginal exceedances of relevant screening thresholds for cyanide, mercury, arsenic, boron, copper and zinc at some locations. Exceedances of screening thresholds for some organic determinands (PAHs, TPH) were principally recorded at two locations. An oil sheen and 0.5cm of LNAPL were recorded over the two monitoring rounds corresponding with the location of the former tar works. Leachate data from Dock Deposits showed exceedances of relevant screening criteria for arsenic, boron, lead, zinc, six PAHs and Total Petroleum Hydrocarbons (TPH) total. Exceedances generally were not significant. The Centre for Environment, Fisheries and Aquaculture Science (Cefas) Action Level 1 threshold for TBT was exceeded in one sample (11% of dataset); all concentrations were below the Cefas Action Level 2 threshold.	Low	Chapter 2 The Site & Chapter 3 Environmental Setting, Appendix 10.1 Chapter 2 Site Setting, Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
Existing Built Infrastructure	Potential for aggressive attack on below ground site drainage system, foundations, water supply pipework. No impact known to have occurred.	Low	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.

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KEY RECEPTORS	DESCRIPTION	SENSITIVITY	FURTHER INFORMATION
Existing Building Structures	Existing buildings include Hydraulic Engine House (Grade II listed). A two-storey brick structure sits at the western end of the north wharf and a shed structure sits on the southern wharf. Ground gas monitoring was undertaken over eight to nine monitoring rounds at five locations on the dock wharves. No methane was recorded over the monitoring period. The worst-case scenario of carbon dioxide (4.8% v/v) and flow rate (0.4 l/hr) produced a Gas Screening Value (GSV) of 0.0192, indicative of Characteristic Situation 1 (CS1). No monitoring of ground gas generation from the deposits contained within BMD has been undertaken. Potential for the migration of hazardous ground gas / vapour and for its accumulation to hazardous concentrations in any enclosed spaces.	High	Chapter 9 Ground Gas Assessment & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.
Terrestrial Flora within Application Site	Currently limited vegetation of low value. Potential for plant uptake of phytotoxic metals in Made Ground. Samples of Made Ground recorded occasional concentrations of phytotoxic metals above phytotoxicity threhsolds for copper (25% of samples) and zinc (12.5% of samples). All concentrations were below the threshold for nickel.	Low	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2.

10.3.2 Future Baseline

KEY RECEPTORS	DESCRIPTION	SENSITIVITY	FURTHER INFORMATION
Site Neighbours	During construction, as development works progress on a phased basis, people occupying neighbouring land (commercial and residential uses) could be exposed to contamination due to ground disturbance leading to the creation of soil dusts and release of soil gases or vapours. In view of the fact that site remediation is an inherent feature of the scheme, it is considered that exposure to ground contamination by people occupying neighbouring land (predominantly industrial and commercial uses) during operation is unlikely to occur.	Medium	Section 9.5, Liverpool Waters Environmental Statement
Construction / Maintenance Workers	Construction workers involved in the below ground works may be exposed to contaminants via direct or indirect ingestion, inhalation and/or dermal contact. If working in confined spaces, workers could be exposed to flammable of asphyxiating gases. Site occupancy during the construction phase is assumed to be low, and will comply with all relevant health and safety legislation which requires the adoption of suitable working procedures to control risks associated with potential ground contamination.	High	Section 9.5, Liverpool Waters Environmental Statement
Future Site Users	In view of the fact that site remediation is an inherent feature of the scheme, it is considered that exposure to ground contamination by future site users is unlikely to occur. Future Baseline development envisages mixed commercial / residential use with areas of open-space soft-landscaping.	Medium	Section 9.5, Liverpool Waters Environmental Statement
Principal Aquifer	Earthworks and construction could increase the potential for contaminant migration to the Principal Aquifer due to removal of hardstanding cover causing an increase in soil leachate, or due to leaching from soil stockpiles. Furthermore, it is possible that multi-storey buildings will require piled foundations bearing into the Principal Aquifer. These may act as preferential pathways through the soil that increase the potential for migration of contaminants. It is considered unlikely that the operational phase of the scheme would result in new, discernible impacts to the Principal Aquifer.	High	Section 9.5, Liverpool Waters Environmental Statement
Port of Liverpool Dock System	During construction (earthworks), there is potential for increased infiltration and promotion of leaching, lateral and vertical migration of contamination via permeable strata. There is also potential for accidental spillages of or leaching from temporary soil stockpiles to the Port of Liverpool Dock System. Port of Liverpool Dock System utilised primarily for commercial use with limited recreational value. Potential for removal of Dock Deposits and infilling / narrowing of Docks to result in suspension of solids and leaching of contaminants from the sediment.	Low	Section 8.5 Liverpool Waters Environmental Statement
Port of Liverpool Dock System	During operation, discharge of surface water from the site to the docks is proposed. Potential for vertical and lateral migration of free phase and dissolved phase contaminants in affected groundwater via preferential geological pathways to impact the Port of Liverpool Dock System. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges. Port of Liverpool Dock System (existing dock waterbodies within Liverpool Waters scheme) proposed to be utilised for recreational use as part of the Future Baseline development.	Medium	Section 8.5 Liverpool Waters Environmental Statement
River Mersey	During earthworks, there is potential for increased infiltration and promotion of leaching, lateral and vertical migration of contamination via permeable strata. There is also potential for accidental spillages of or leaching from temporary soil stockpiles to the River Mersey. During operation, discharge of surface water from the site to the River Mersey is possible. Potential for vertical and lateral migration of free phase and dissolved phase contaminants in affected groundwater via preferential geological pathways to impact the River Mersey. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges.	Medium	Section 8.5 Liverpool Waters Environmental Statement
Future Building Structures	During operation, there is potential for the migration of hazardous ground gas / vapour and for its accumulation to hazardous concentrations in any enclosed spaces. Current risk assessment indicates that gas protection measures will be required to prevent impacts to new buildings. However, additional investigation works will be undertaken on a cell basis based on detailed design to verify this.	High	Section 9.5 and Section 9.6, Liverpool Waters Environmental Statement

GROUND CONDITIONS & CONTAMINATION

10.4 POTENTIAL SIGNIFICANT IMPACTS

PHASE	RECEPTOR	DESCRIPTION	ADVERSE/BENEFICIAL
Construction	Construction / Maintenance Workers	Potential for construction workers involved in any earthworks and below ground construction activities on the dock wharves to come into contact with soil or contaminated materials. There is therefore a potential human uptake (via direct or indirect ingestion of soils, inhalation of dusts and vapours / gases and dermal contact) of contaminants.	Adverse
Construction	Construction / Maintenance Workers	Potential for workers engaged with clearance / raking of BMD during enabling works to come into contact with Dock Deposits during stockpiling etc. There is therefore a potential for human uptake (via direct or indirect ingestion of soils, inhalation of dusts and vapours / gases and dermal contact) of contaminants.	Adverse
Construction	Site Neighbours	Ground disturbance during the enabling and construction works has the potential to create new pathways for contaminants to migrate to adjacent land via air (e.g. as wind-borne dusts, vapours or odour). There is therefore the potential for human uptake via inhalation of contaminated dusts, although contaminant concentrations will reduce during migration and exposure is likely to be relatively short term.	Adverse
Construction	Principal Aquifer	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Principal Aquifer. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.).	Adverse
Construction	River Mersey	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the River Mersey. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.).	Adverse
Construction	Port of Liverpool Dock System	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Port of Liverpool Dock System.	Adverse
Construction	Port of Liverpool Dock System	During raking of BMD, Dock Deposits will be disturbed with potential for mobilisation of contamination with impact to water quality of Port of Liverpool Dock System.	Adverse
Operation	Future Site Users	In the absence of mitigation, there is potential for ground gas (no ground gas monitoring undertaken of Dock Deposits) or vapour migration into confined spaces which could result in the build-up to hazardous concentrations within the site.	Adverse
Operation	Future Site Users	Potential for future site users to come into contact with soils in landscaped areas with exposure to contaminants via direct or indirect ingestion, inhalation and/or dermal contact.	Adverse
Operation	Principal Aquifer	Migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) to the Principal Aquifer	Adverse
Operation	River Mersey	Migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata to the River Mersey.	Adverse
Operation	Port of Liverpool Dock System	Migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata to the Port of Liverpool Dock System.	Adverse
Operation	Terrestrial Flora Application Site	Loss of introduced vegetation due to plant uptake of phytotoxic metals in Made Ground.	Adverse
Operation	Built Environment	In the absence of any mitigation (remediation), there is a potential for contamination and / or the natural strata to affect the long-term integrity of below ground concrete (sulphate attack) and / or for any residual contamination to permeate any in ground plastic water supply pipework.	Adverse
Operation	Building Structures	Potential for the migration of hazardous ground gas / vapour and for its accumulation to hazardous concentrations in any enclosed spaces.	Adverse

10.5 ASSESSMENT OF PROPOSED DEVELOPMENT PRE-MITIGATION

10.5.1 Proposed Development Scenario

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Construction	Construction / Maintenance Workers	There is a potential for construction workers involved in any earthworks (on the dock wharves) to come into contact with soil or contaminated materials. Effects are generally likely to be short term and therefore the main contaminants of concern are those of potentially acute hazards (i.e. asbestos, carcinogens). Asbestos was detected in one sample of on-shore Made Ground (2% of samples). All concentrations of inorganic determinands on BDM wharves were below commercial screening thresholds. Concentrations of organic determinands exceeding commercial screening thresholds were recorded locally. Construction workers are high sensitivity receptors and the magnitude of the effects is large.	Large	Major Adverse	Yes	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Construction	Construction / Maintenance Workers	There is a potential for construction workers engaged in clearance / raking of BMD to come into contact with contaminated soils e.g. in the event of stockpiling. Effects are generally likely to be short term and therefore the main contaminants of concern are those of potentially acute hazards (i.e. asbestos, carcinogens). Asbestos was detected in one sample of Dock Deposits (7%). All concentrations of organic and inorganic determiands were below commercial screening thresholds. Construction workers are high sensitivity receptors and the magnitude of the effects is large.	Large	Major Adverse	Yes	Chapter 7 Analytical Results for Soil – Offshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2

GROUND CONDITIONS & CONTAMINATION

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Construction	Site Neighbours	Ground disturbance during the enabling and construction works has the potential to create new pathways for contaminants to migrate to adjacent land via air (e.g. as wind-borne dusts). There is therefore the potential for human uptake via inhalation of contaminated dusts, although contaminant concentrations will reduce during migration and exposure is likely to be relatively short term. Asbestos was detected in one sample of on-shore Made Ground (2% of samples) and one sample of Dock Deposits (7%). All concentrations of inorganic determinands were below commercial screening thresholds in on and off-shore samples. Concentrations of organic determinands exceeding commercial screening thresholds were recorded locally on the dock wharves. Site neighbours are low sensitivity receptors and the magnitude of the effect is large.	Large	Moderate / Minor Adverse	Yes	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Construction	Principal Aquifer	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Principal Aquifer. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.). Cohesive Tidal Flat Deposits and Glacial Till offer limited protection to the underlying Principal Aquifer. Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works. Principal Aquifer is a high sensitivity receptor and the magnitude of the effect is medium.	Medium	Major Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Construction	River Mersey	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the River Mersey. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.). Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works. The River Mersey walls are of variable condition and are not impermeable. The River Mersey is a medium sensitivity receptor and the magnitude of the effect is medium.	Medium	Moderate Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Construction	Port of Liverpool Dock System	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Port of Liverpool Dock System. Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works The BMD walls are in variable condition and are not impermeable. The Port of Liverpool Dock System is a low sensitivity receptor and the magnitude of the effect is medium.	Medium	Minor Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Construction	Port of Liverpool Dock System	During raking of BMD, Dock Deposits will be disturbed with potential for mobilisation of contamination with impact to water quality of Port of Liverpool Dock System. Leachate analysis was conducted on fifteen samples of Dock Deposits. Exceedances of relevant screening criteria for arsenic, boron, lead, zinc, six PAHs and TPH total were recorded. Exceedances generally were not significant. The Cefas Action Level 1 threshold for TBT was exceeded in one sample (11% of dataset); all concentrations were below the Cefas Action Level 2 threshold. The Port of Liverpool Dock System is a low sensitivity receptor and the magnitude of the effect is medium.	Medium	Minor Adverse	Yes	Chapter 7 Analytical Results for Soil – Offshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Future Site Users	There is potential for ground gas or vapour migration into confined spaced which could result in the build-up to hazardous concentrations within enclosed spaces on the site. No methane was detected over ground gas monitoring period on the dock wharves. Worst-case scenario of carbon dioxide (4.8% v/v) and flow rate (0.4 l/hr) produced a GSV of 0.0192, indicative of CS1. Exceedances of commercial screening criteria for some organic determinands with potential for vapour generation recorded in a limited number of locations on dock wharves. No monitoring of ground gas generation from the deposits contained within BMD has been undertaken. Future site users are a low sensitivity receptor and the magnitude of the effect is large	Large	Moderate / Minor Adverse	Yes	Chapter 9 Ground Gas Assessment & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Future Site Users	Potential for future site users to come into contact with soils in landscaped areas with exposure to contaminants via direct or indirect ingestion, inhalation and/or dermal contact. Majority of Proposed Development covered by hardstanding. All concentrations of all inorganic determinands in on-shore soil samples were below commercial screening thresholds. Chrysotile asbestos was also detected in one sample (2%). Localised elevated concentrations of organic determinands were recorded on BMD wharves. PAHs in excess of commercial screening thresholds and / or speciated TPH in excess of residential without plant uptake thresholds recorded at four locations but free phase contamination not identified. Future site users are a low sensitivity receptor and the magnitude of the effect is small.	Small	Minor Adverse	Yes	Chapter 6 Analytical Results for Soil – Offshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2

GROUND CONDITIONS & CONTAMINATION

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Operation	Principal Aquifer	Potential for migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) to the Principal Aquifer. Buildings and hardstanding will cover the majority of the site, therefore reduced infiltration compared to construction phase. The rising of site levels and presence of a suitable surface water drainage system will reduce infiltration. Cohesive Tidal Flat Deposits and Glacial Till offer limited protection to the underlying Principal Aquifer. Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works. Principal Aquifer is a high sensitivity receptor and the magnitude of the effect is small.	Small	Moderate / Minor Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	River Mersey	Potential for migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata. Buildings and hardstanding will cover the majority of the site, therefore reduced infiltration compared to construction phase. The rising of site levels and presence of a suitable surface water drainage system will reduce infiltration. Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works. The River Mersey walls are of variable condition and are not impermeable. The River Mersey is a moderate sensitivity receptor and the magnitude of the effect is small.	Small	Minor Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Port of Liverpool Dock System	Potential for migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata. Buildings and hardstanding will cover the majority of the site, therefore reduced infiltration compared to construction phase. The rising of site levels and presence of a suitable surface water drainage system will reduce infiltration. Groundwater monitoring generally showed marginal impact by some inorganic determinands. Exceedances of screening thresholds for some organic determinands recorded at two main locations. 0.5cm of LNAPL and an oil sheen recorded at location of former tar works. The BMD walls are of variable condition and are not impermeable. The Port of Liverpool Dock System is a low sensitivity receptor and the magnitude of the effect is small.	Small	Minor Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Terrestrial Flora within Application Site	Potential for root uptake of phytotoxic metals by introduced flora. Samples of Made Ground recorded occasional concentrations of phytotoxic metals above phytotoxicity threhsolds for copper (25% of samples) and zinc (12.5% of samples). All concentrations were below the threshold for nickel. Terrestrial flora are a low sensitivity receptor and the magnitude of the effect is small.	Small	Minor Adverse	Yes	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Built Environment	There is a potential for contamination and / or the natural strata to affect the long-term integrity of below ground concrete (sulphate attack) and / or for any residual contamination to permeate any in ground plastic water supply pipework. The sensitivity of the receptor is low and the magnitude of the effect is small.	Small	Minor Adverse	Yes	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2
Operation	Building Structures	Potential for the migration of hazardous ground gas and for its accumulation to explosive concentrations in any enclosed spaces. No methane was detected over ground gas monitoring period on the dock wharves. Worst-case scenario of carbon dioxide (4.8% v/v) and flow rate (0.4 l/hr) produced a GSV of 0.0192, indicative of CS1. No monitoring of ground gas generation from the deposits contained within BMD has been undertaken. Building structures are a high sensitivity receptor and the magnitude of the effect is large.	Large	Major Adverse	Yes	Chapter 9 Ground Gas Assessment & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2

10.5.2 Proposed Development + Liverpool Waters Scenario

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Construction	Site Neighbours	Ground disturbance during the enabling and construction works has the potential to create new pathways for contaminants to migrate to adjacent land via air (e.g. as wind-borne dusts). There is therefore the potential for human uptake via inhalation of contaminated dusts, although contaminant concentrations will reduce during migration and exposure is likely to be relatively short term. Due to phasing of development, the potential exposure of site neighbours is not anticipated to be significantly affected by construction of both the proposed development and Liverpool Waters development. With the development of the Liverpool Waters scenario in the surrounding area, site neighbours are medium sensitivity receptors and the magnitude of the effect is large.	Large	Major Adverse	Yes	Chapter 6 Analytical Results for Soil – Onshore & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 9.5, Liverpool Waters Environmental Statement

GROUND CONDITIONS & CONTAMINATION

PHASE	RECEPTOR(S) AFFECTED	IMPACT	MAGNITUDE PRE-MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION PROPOSED?	FURTHER INFORMATION
Construction	Principal Aquifer	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Principal Aquifer. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.). Cohesive Tidal Flat Deposits and Glacial Till offer limited protection to the underlying Principal Aquifer. The Principal Aquifer is a high sensitivity receptor. Due to the increased scale and timeframe in bringing forward the proposed development and Liverpool Waters scenario, the magnitude of the effect is large.	Large	Major Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 9.5, Liverpool Waters Environmental Statement.
Construction	River Mersey	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the River Mersey. Contamination could also migrate vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.). The River Mersey walls are of variable condition and are not impermeable. The River Mersey is a medium sensitivity receptor. Due to the increased scale and timeframe in bringing forward the proposed development and Liverpool Waters scenario, the magnitude of the effect is large.	Large	Major Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 8.5 Liverpool Waters Environmental Statement
Construction	Port of Liverpool Dock System	During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Port of Liverpool Dock System. During enabling and construction works, the removal of hardstanding and general earthworks give rise to a potential for increased rainwater infiltration with consequent mobilisation of contamination and its migration vertically and laterally to affect the Port of Liverpool Dock System. The Port of Liverpool Dock System is a low sensitivity receptor. Due to the increased scale and timeframe in bringing forward the proposed development and Liverpool Waters scenario, the magnitude of the effect is large	Large	Moderate / Minor Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 8.5 Liverpool Waters Environmental Statement
Operation	River Mersey	In the proposed development there is potential for migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata. Buildings and hardstanding will cover the majority of the site, therefore reduced infiltration compared to construction phase. The rising of site levels and presence of a suitable surface water drainage system will reduce infiltration. The River Mersey walls are of variable condition and are not impermeable. During operation of the Liverpool Waters development, discharge of surface water to the River Mersey is possible. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges. The River Mersey is a moderate sensitivity receptor and the magnitude of the effect is medium.	Medium	Moderate Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 8.5 Liverpool Waters Environmental Statement
Operation	Port of Liverpool Dock System	Potential for migration of contamination vertically along newly created preferential pathways (such as piled foundations, drainage trenches etc.) and laterally following permeable strata. Buildings and hardstanding will cover the majority of the site, therefore reduced infiltration compared to construction phase. The rising of site levels and presence of a suitable surface water drainage system will reduce infiltration. During operation of the Liverpool Waters development, discharge of surface water to the Port of Liverpool Dock System is proposed. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges. The Port of Liverpool Dock System is proposed to be utilised for recreational use as part of the Liverpool Waters scenario, and therefore is a medium sensitivity receptor. The magnitude of the effect is medium.	Medium	Moderate Adverse	Yes	Chapter 8 Analytical Results for Groundwater & Chapter 10 Geoenvironmental Risk Assessment, Appendix 10.2. Section 8.5 Liverpool Waters Environmental Statement

GROUND CONDITIONS & CONTAMINATION

10.6 MITIGATION & ENHANCEMENT MEASURES

PHASE	POSSIBLE EFFECT BEING MITIGATED	MITIGATION MEASURE	HOW SECURED / TRIGGER	MAGNITUDE POST-MITIGATION	ADVERSE/BENEFICIAL	FURTHER INFORMATION
Construction	Construction workers and site neighbours coming into contact with soil or contaminated materials (e.g. during earthworks, raking of BMD) with potential for human uptake.	Implementation of appropriate health, safety and hygiene regime (to include PPE and welfare provisions) and good construction practice.	Remediation Strategy and Construction Environmental Management Plan (CEMP) secured by planning condition, implemented by contactor, recorded in Verification Report.	Negligible	Adverse	Chapter 4 Construction Strategy & CEMP. Chapter 12 Outline Remedial Methodology, Appendix 10.2
Construction	Construction workers and site neighbours coming into contact with soil or contaminated materials with potential for human uptake.	Implementation of good construction practice and dust suppression measures (e.g. dampening, wheel washing, site vehicle speed and route control, control of drop height spoil loading etc.)	Remediation Strategy and CEMP secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Adverse	Chapter 4 Construction Strategy & CEMP. Chapter 12 Outline Remedial Methodology, Appendix 10.2
Construction	Infiltration and promotion of leaching of contamination to groundwater (Principal Aquifer)	Carry out a Foundation Works Risk Assessment (FWRA). Remove any gross contamination. Implement measures to minimise infiltration. Avoid stockpiling contaminated soil. Any stockpiled material will be covered/ placed on an impermeable surface. Control of shallow groundwater during excavation.	Remediation Strategy and CEMP to accord with FWRA, secured through planning condition implemented by contractor, recorded in Verification Report.	Negligible	Adverse	Chapter 4 Construction Strategy & CEMP. Chapter 12 Outline Remedial Methodology, Appendix 10.2
Construction	Infiltration and promotion of leaching of contamination to surface water (River Mersey, Port of Liverpool Dock System)	Remove gross contamination. Implement measures to minimise infiltration. Avoid stockpiling contaminated soil. Any stockpiled material will be covered/ placed on an impermeable surface. Control of shallow groundwater during excavation.	Remediation Strategy and CEMP secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Adverse	Chapter 4 Construction Strategy & CEMP. Chapter 12 Outline Remedial Methodology, Appendix 10.2
Construction	Disturbance of Dock Deposits during raking with potential impact to water quality (Port of Liverpool Dock System) and marine flora and fauna.	Methodology for identification of obstructions / artefacts in Dock Deposits (i.e. raking) will be agreed with the MMO. A separate assessment of risk to water quality or marine flora and fauna will be undertaken as necessary.	Methodology agreed with relevant parties (Natural England, MMO, MEAS)	Negligible	Adverse	Chapter 4 Construction Strategy & CEMP.
Operation	Vapour / gas migration to enclosed spaces with potential to affect future site users.	Undertake ground gas monitoring of Dock Deposits to define the nature of the ground gas regime, design for any protection measures and inform health and safety for works in confined spaces. Control of entry into any enclosed below ground spaces. Removal of areas of contamination with potential to generate vapours.	Remediation Strategy secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Beneficial	Chapter 12 Outline Remedial Methodology, Appendix 10.2
Operation	Future site users coming into contact with soil or contamination materials with potential for human uptake.	All soft landscaping to be isolated from underlying Made Ground using marker layer, with any planting in suitable imported soils.	Remediation Strategy secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Beneficial	Chapter 12 Outline Remedial Methodology, Appendix 10.2
Operation	Infiltration and promotion of leaching of contamination to groundwater (Principal Aquifer)	Carry out a Foundation Works Risk Assessment. Remove any gross contamination. Implement measures to minimise infiltration (including raising of site levels).	Remediation Strategy and CEMP secured by planning condition, implemented by contractor, recorded in Verification Report	Negligible	Beneficial	Chapter 4 Construction Strategy & CEMP.

GROUND CONDITIONS & CONTAMINATION

PHASE	POSSIBLE EFFECT BEING MITIGATED	MITIGATION MEASURE	HOW SECURED / TRIGGER	MAGNITUDE POST-MITIGATION	ADVERSE/BENEFICIAL	FURTHER INFORMATION
Operation	Infiltration and promotion of leaching of contamination to surface waters (River Mersey, Port of Liverpool Dock System)	Remove gross contamination (the likely source of any leachate). Implement measures to minimise infiltration (including raising of site levels).	Remediation Strategy and CEMP secured by planning condition, implemented by contractor, recorded in Verification Report	Negligible	Beneficial	Chapter 4 Construction Strategy & CEMP.
Operation	Loss of flora and fauna due to root uptake of phytotoxic metals in Made Ground.	All soft landscaping to be isolated from underlying Made Ground using marker layer, with any planting in suitable imported soils.	Remediation Strategy and CEMP secured by planning condition, implemented by contractor, recorded in Verification Report	Negligible	Beneficial	Chapter 12 Outline Remedial Methodology, Appendix 10.2
Operation	Direct contact (below ground concrete and water supply pipework)	Appropriate selection of concrete class and materials for water supply pipework (with agreement from water supply company).	Remediation Strategy secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Beneficial	Chapter 12 Outline Remedial Methodology, Appendix 10.2
Operation	Gas migration to enclosed spaces with potential to accumulate to explosive concentrations.	Undertake ground gas monitoring of Dock Deposits to define the nature of the ground gas regime and design for any protection measures. Control of entry into any enclosed below ground spaces.	Remediation Strategy secured by planning condition, implemented by contractor, recorded in Verification Report.	Negligible	Beneficial	Chapter 12 Outline Remedial Methodology, Appendix 10.2

10.7 ASSESSMENT POST-MITIGATION

10.7.1 Proposed Development Scenario

PHASE	RECEPTOR	RESIDUAL IMPACT	RESIDUAL EFFECT					
			SIGNIFICANCE	ADV/BEN	ST/MT/LT	D/IND	P/T	R/IRR
Construction	Construction / Maintenance Workers	There is a potential for construction workers involved in any earthworks (on the dock wharves) to come into contact with soil or contaminated materials by ingestion, inhalation and/or dermal contact with contaminated soils.These have the potential to cause short term (acute) or long term (chronic) adverse effects on human health. Implementation of appropriate health, safety and hygiene regime (to include PPE and welfare provisions) shall mitigate this effect.	Negligible	Adverse	Short-term	Direct	Temporary	Irreversible
Construction	Construction / Maintenance Workers	There is a potential for construction workers engaged in clearance / raking of BMD to come into contact with contaminated soils e.g. in the event of stockpiling. Exposure by ingestion, inhalation and/or dermal contact with contaminated soils. These have the potential to cause short term (acute) or long term (chronic) adverse effects on human health. Implementation of appropriate health, safety and hygiene regime (to include PPE and welfare provisions) shall mitigate this effect.	Negligible	Adverse	Short-term	Direct	Temporary	Irreversible
Construction	Site Neighbours	Ground disturbance during the enabling and construction works has the potential to create new pathways for contaminants to migrate to adjacent land via air (e.g. as wind-borne dusts) with the potential to cause short term (acute) or long term (chronic) adverse effects on human health. Implementation of good construction practice and dust suppression measures shall mitigate this effect.	Negligible	Adverse	Short-term	Indirect	Temporary	Irreversible
Construction	Principal Aquifer	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Principal Aquifer. Implementation of a FWRA, removal of gross contamination and adoption of a measures defined in a CEMP shall mitigate this effect.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible
Construction	River Mersey	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the River Mersey. Removal of gross contamination and adoption of measured defined in a CEMP shall mitigate this.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible
Construction	Port of Liverpool Dock System	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Port of Liverpool Dock System. Removal of gross contamination and adoption of measured defined in a CEMP shall mitigate this.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible
Construction	Port of Liverpool Dock System	During raking of BMD, Dock Deposits will be disturbed with potential for mobilisation of contamination with impact to water quality of Port of Liverpool Dock System. Adopting a methodology agreed with the MMO and undertaking a separate assessment of risk to water quality as necessary shall mitigate this effect.	Negligible	Adverse	Short-term	Direct	Temporary	Reversible

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PHASE	RECEPTOR	RESIDUAL IMPACT	RESIDUAL EFFECT					
			SIGNIFICANCE	ADV/BEN	ST/MT/LT	D/IND	P/T	R/IRR
Operation	Future Site Users	Vapour / gas migration to enclosed spaces with potential to accumulate to concentrations with toxic / hazardous affect future site users. Undertaking ground gas monitoring of Dock Deposits to define the nature of the ground gas regime with design of any suitable protection measures, along with removal of areas of contamination with potential to generate vapours shall mitigate this.	Negligible	Beneficial	Long-term	Indirect	Permanent	Irreversible
Operation	Future Site Users	Future site users coming into contact with soil or contamination materials with potential for human uptake via ingestion, inhalation and / or dermal contact with contaminated soils. All soft landscaping to be isolated from underlying Made Ground using marker layer, with any planting in suitable imported soils, shall mitigate this effect.	Negligible	Beneficial	Long-term	Direct	Permanent	Irreversible
Operation	Principal Aquifer	Potential for infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Principal Aquifer. Implementation of a FWRA, removal of gross contamination, appropriate site drainage and measures to reduce infiltration (including raising of site levels) shall mitigate this.	Negligible	Beneficial	Long-term	Indirect	Temporary	Reversible
Operation	River Mersey	Potential for infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the River Mersey. Removal of gross contamination, appropriate site drainage and measures to reduce infiltration (including raising of site levels) shall mitigate this.	Negligible	Beneficial	Long-term	Indirect	Temporary	Reversible
Operation	Port of Liverpool Dock System	Potential for infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Port of Liverpool Dock System. Removal of gross contamination, appropriate site drainage and measures to reduce infiltration (including raising of site levels) shall mitigate this.	Negligible	Beneficial	Long-term	Indirect	Temporary	Reversible
Operation	Terrestrial Flora within Application Site	Potential for loss of flora due to root uptake of phytotoxic metals. All soft landscaping to be isolated from underlying Made Ground using marker layer, with any planting in suitable imported soils, shall mitigate this effect.	Negligible	Beneficial	Long-term	Direct	Permanent	Irreversible
Operation	Built Environment	Sulphate attack on concrete building foundations and permeation of water supply pipework both via direct contact with contaminated soils. Potential to damage building fabric and structure. Appropriate design of below ground concrete and water supply pipework shall mitigate this effect.	Negligible	Beneficial	Long-term	Direct	Permanent	Irreversible
Operation	Building Structures	Potential for the migration of hazardous ground gas and for its accumulation to explosive concentrations in any enclosed spaces. Undertaking ground gas monitoring of Dock Deposits to define the nature of the ground gas regime and design for any protection measures, along with control of entry into any enclosed below ground spaces shall mitigate this.	Negligible	Beneficial	Long-term	Indirect	Permanent	Irreversible

Key: ADV/BEN = Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible

10.7.2 Proposed Development + Liverpool Waters Scenario

PHASE	RECEPTOR	RESIDUAL IMPACT	RESIDUAL EFFECT					
			SIGNIFICANCE	ADV/BEN	ST/MT/LT	D/IND	P/T	R/IRR
Construction	Site Neighbours	Ground disturbance during the enabling and construction works has the potential to create new pathways for contaminants to migrate to adjacent land via air (e.g. as wind-borne dusts) with the potential to cause short term (acute) or long term (chronic) adverse effects on human health. Due to phasing of development, the potential exposure of site neighbours is not anticipated to be significantly affected by the brining forward of both the proposed development and Liverpool Waters development. With the development of the Liverpool Waters scenario in the surrounding area, site neighbours to the proposed development are medium sensitivity. Implementation of good construction practice and dust suppression measures shall mitigate this effect.	Negligible	Adverse	Short-term	Indirect	Temporary	Irreversible
Construction	Principal Aquifer	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Principal Aquifer. Greater potential for migration of contamination to the Principal Aquifer in the Proposed Development + Liverpool Waters Scenario due to increased scale and programme of construction. Implementation of a FWRA, removal of gross contamination and adoption of a measures defined in a CEMP shall mitigate this effect.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible

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PHASE	RECEPTOR	RESIDUAL IMPACT	RESIDUAL EFFECT					
			SIGNIFICANCE	ADV/BEN	ST/MT/LT	D/IND	P/T	R/IRR
Construction	River Mersey	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the River Mersey. Greater potential for migration of contamination to the Principal Aquifer in the Proposed Development + Liverpool Waters Scenario due to increased scale and programme of construction. Removal of gross contamination and adoption of measured defined in a CEMP shall mitigate this.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible
Construction	Port of Liverpool Dock System	Potential for increased infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Port of Liverpool Dock System. Greater potential for migration of contamination to the Port of Liverpool Dock System in the Proposed Development + Liverpool Waters Scenario due to increased scale and programme of construction. Removal of gross contamination and adoption of measured defined in a CEMP shall mitigate this.	Negligible	Adverse	Short-term	Indirect	Temporary	Reversible
Operation	River Mersey	Potential for infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the River Mersey. Removal of gross contamination, appropriate site drainage and measures to reduce infiltration (including raising of site levels) shall mitigate this. During operation of the Liverpool Waters development, discharge of surface water to the River Mersey is possible. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges.	Minor	Adverse	Short-term	Indirect	Temporary	Reversible
Operation	Port of Liverpool Dock System	Potential for infiltration and promotion of leaching. Migration of contamination via preferential pathways and/or permeable strata have the potential to cause pollution to the Port of Liverpool Dock System. Removal of gross contamination, appropriate site drainage and measures to reduce infiltration (including raising of site levels) shall mitigate this. During operation of the Liverpool Waters development, discharge of surface water to the Port of Liverpool Dock System is proposed. Predicted to be chronic (low) levels of diffuse contaminants present in surface water discharges. The Port of Liverpool Dock System is proposed to be utilised for recreational use as part of the Liverpool Waters scenario, and therefore is a medium sensitivity receptor.	Minor	Adverse	Short-term	Indirect	Temporary	Reversible

Key: ADV/BEN = Adverse/Beneficial; ST/MT/LT = Short-term/Medium-term/Long-term; D/IND = Direct/Indirect; P/T = Permanent/Temporary; R/IRR = Reversible/Irreversible

10.8 GROUND CONDITIONS & CONTAMINATION: INTER-DEVELOPMENT CUMULATIVE SCHEME EFFECTS

The Liverpool Waters development is assessed cumulatively throughout this assessment. No other cumulative schemes are considered to be of relevance.

10.9 GLOSSARY & ABBREVIATIONS

TERM/ABBREVIATION	DESCRIPTION
BMD	Bramley-Moore Dock
LCC	Liverpool City Council
NPPF	National Planning Policy Framework
ES	Environmental Statement
GQRA	Generic Quantitative Risk Assessment
SGV	Soil Guideline Value
C4SL	Category 4 Screening Level
GAC	Generic Assessment Criteria
CLEA	Contaminated Land Exposure Assessment
PAH	Polycyclic Aromatic Hydrocarbon
LNAPL	Light Non-Aqueous Phase Liquid
TPH	Total Petroleum Hydrocarbons
GSV	Gas Screening Value

GROUND CONDITIONS & CONTAMINATION

TERM/ABBREVIATION	DESCRIPTION
CS1	Characteristic Situation 1
CLR11	Model Procedures for the management of land contamination – contaminated land report
UDP	Unitary Development Plan
EPU	Environmental Protection Unit
EA	Environment Agency
MMO	Marine Management Organisation
TBT	Tributyltin
CEMP	Construction Environmental Management Plan
MEAS	Merseyside Envrionmental Advisory Service
VOCs	Volatile Organic Compounds
SVOCs	Semi-volatile Organic Compounds
SPA	Special Protection Areas
Cefas	Centre for Environment, Fisheries and Aquaculture Science
SSSI	Site of Special Scientific Interest
FWRA	Foundation Works Risk Assessment

10.10 NON-TECHNICAL SUMMARY

The likely environmental effects of the proposed development, and cumulative effects of the proposed development and Liverpool Waters scenario, have been assessed with respect to ground conditions and contamination. Consideration has been given to the conceptual site model (including geology, hydrogeology and hydrology) and geoenvironmental conditions (soil and groundwater contamination, and ground gas) related to the historic and current use of the application site and environs. The assessment has considered the potential for mobilisation and migration of existing contamination in soil or groundwater, pollution of groundwater or surface waters from construction activities, health effects to people (construction workers, site users and site neighbours), potential effects to introduced plants, and possible effects to buildings and built Infrastructure.

During construction, there is potential for people to be exposed to contamination via direct contact with contaminated Made Ground (construction workers) and by inhalation of contaminated dusts and ground gas / vapours (construction workers and site neighbours). During earthworks on BMD wharves, there is potential for contamination to be mobilised and to migrate to affect groundwater (Principal Aquifer) or surface waters (River Mersey, Port of Liverpool Dock System). There is also potential to impact the Port of Liverpool Dock System by disturbing deposits contained within BMD. The potential ground related risks during construction have been assessed as minor to minor adverse significance. These risks are capable of mitigation by appropriate design and implementing a Remediation Strategy, Construction Environmental Management Plan and Foundation Works Risk Assessment. These will include a suitably robust set of precautionary measures to ensure good construction practice and the adoption of a health and safety regime that would protect both constructions workers and site neighbours. The earthworks and foundation solutions will be designed and constructed to mitigate the potential risk to groundwater and surface waters.

In operation, the proposed development will be complete. Any contamination in the Made Ground or near-surface groundwater will be been excavated, removed or capped during the construction of the development. All the potential risks associated with ground conditions and contamination will be mitigated during the construction phase by the implementation of the approved Remediation Strategy. The evidence for the successful completion of these works will be presented in a Verification Report. In bringing forward the proposed development and Liverpool Waters scenario, a residual minor adverse risk was identified to surface waters due to the potential for release of low levels of contaminants to these water bodies through surface water infiltration and drainage. No other cumulative schemes of relevance have been identified.

10.11 BIBLIOGRAPHY

[1] Environment Agency, "Model Procedures for the management of land contamination - contaminated land report (CLR11)," 2004.

[2] Environment Agency, "Land Contamination: risk management (replacement of CLR11, currently in draft)," 2019.

[3] Environment Agency, "Managing and reducing land contamination: guiding principles.," 2010.

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[4] British Standards Institute, "BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites - Code of Practice," 2017.

[5] MHCLG, "National Planning Policy Framework," 2019.

[6] HM Government, "Part 2A of the Environmental Protection Act 1990 (as amended)," 1990.

[7] HM Government, "Planning and Compulsory Purchase Act," 2004.

[8] HM Government, "Town and Country Planning Act," 1990.

[9] Liverpool City Council, "Saved Liverpool Unitary Development Plan: A Plan for Liverpool," 2002.

[10] Waste Planning Merseyside, "Joint Waste Local Plan for Merseyside and Halton," 2013.

[11] Liverpool City Council, "Liverpool Local Plan," 2018.

[12] Liverpool City Council, "Planning advice note for developers on developing contaminated land".

[13] Environment Agency, "Incidents and their classification: the Common Incident Classification Scheme (CICS). Ref: 04_01," 23 September 2016. [Online]. Available: https://www.ofwat.gov.uk/wp-content/uploads/2017/12/20171129-Incidents-and-their-classification-the-Common-Incident-Classification-Scheme-CICS-23.09.16.pdf.