10 GROUND CONDITIONS AND CONTAMINATION

10.1 INTRODUCTION

This Chapter of the Environmental Statement (ES) evaluates the effects of the Retford Circular Economy Project (the Proposed Development) on Ground Conditions and Contamination. This assessment was undertaken by SLR Consulting Limited (SLR).

The assessment in this chapter includes the likely impact of the Proposed Development upon human health and water environment receptors within and surrounding the Proposed Development site from contamination.

This Chapter includes the following elements:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Development Design mitigation
- Assessment of likely Effects;
- Mitigation measures and Residual Effects;
- Cumulative Effect Assessment;
- Summary of likely Effects; and
- Statement of Significance.

This Chapter is supported by a Preliminary Land Quality Risk Assessment (PLQRA) which is provided in Volume 3 Appendix 10.1.

An Agricultural Land Classification (ALC) assessment has been undertaken. Whilst the ALC is informative of the quality of the existing land use from an agricultural perspective, it does not inform assessment of environmental risk as undertaken within this chapter. However, the ALC does provide context to inform the baseline quality of soils at the Site, particularly in the context of Site restoration, and therefore it is useful supporting document. The ALC is therefore provided in Volume 3 Appendix 10.2.

This chapter should also be read in conjunction with Volume 1 Chapter 9 - Hydrology, Hydrogeology and Flood Risk.

It should be noted that the ground conditions scope, as established via scoping opinion, within this Chapter is limited to contaminated land as opposed to assessment of geological resources, geotechnical or any other geo-engineering related discipline. Any such matters would be dealt with separately outside of the ES.

10.2 LEGISLATION, POLICY AND GUIDANCE

The following guidance, legislation and information sources have been considered in carrying out this assessment:

- Part 2A of the Environmental Protection Act (EPA) 1990[1];
- The Contaminated Land (England) (Amendment) Regulations 2012[2], Contaminated Land Statutory Guidance 2012 (Defra, 2012) Defra Circular 01/2006 (Defra 2006)[3];

[1] The Contaminated Land (England) (Amendment) Regulations 2012 [online] Available at: https://www.legislation.gov.uk/uksi/2012/263/made (Accessed 17/01/2023)
[2] Environmental Protection Act 1990 : Part 2A. Contaminated Land Statutory Guidance. Defra April 2012 [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735cont-land-guidance.pdf (Accessed 17/01/2023)
[3] Defra Circular 01/2006. Environmental Protection Act 1990: Part 2A. Contaminated Land. September 2006 [online] Available at:

- Water Resources Act 1991[4]
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017[5];
- Environment Agency - Land Contamination: Risk Management (LCRM) (2020)[6];
- Environment Agency - Protect Groundwater and Prevent Groundwater Pollution (EA, 2017);
- Environment Agency - Groundwater Protection Technical Guidance (EA, 2017).
- Safeguarding our Soils: A Strategy for England[7];
- The Construction Industry Research and Information Association (CIRIA) (2015), Environmental Good Practice on Site (C741)[8];
- CIRIA (2001), Control of Water Pollution from Construction Sites (C532)[9]; and

Relevant guidance provided by the Environment Agency (EA) include:

- Discharges to surface water and groundwater: environmental permits[10]; and
- Apply for a water abstraction and impoundment license[11].

10.2.1 Legislation

The EIA Regulations establish in broad terms what is to be considered when determining the effects of development proposals on ground conditions and contamination.

As detailed in Schedule 4, Paragraph 5 of the EIA Regulations description of the likely significant effects of the development on the environment resulting from or resulting in contamination, inter alia:

(a) the construction and existence of the development, including, where relevant, demolition works;
(b) the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources;
(c) the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;
(d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters);

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69309/pb12112-circular01-2006-060817.pdf (Accessed 17/01/2023)

[4] UK Government (1991) Water Resources Act [online] Available at: https://www.legislation.gov.uk/ukpga/1991/57/section/107 (Accessed 17/01/2023)

[5] UK Government (2017). The Water Environment (Water Framework Directive) (England and Wales) Regulations. [online] Available at: https://www.legislation.gov.uk/uksi/2017/407/part/1/made (Accessed 17/01/2023)

[6] Land Contamination: Risk Management (LCRM) (2020) [online] Available at: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm (Accessed 17/01/2023)

[7] Safeguarding our Soils: A Strategy for England. DEFRA (2009). [online] Available at: https://www.gov.uk/government/publications/safeguarding-our-soils-a-strategy-for-england (Accessed 10/11/2022).

[8] CIRIA (2015) Environmental Good Practice on Site [Online] Available at: https://www.ciria.org/Training/Training_courses/Environmental_good_practice_on_site.aspx (Accessed 10/11/2022)

[9] CIRIA (2001), Control of Water Pollution from Construction Sites (C532) [Online] Available at: https://www.ciria.org/ProductExcerpts/C532.aspx (Accessed 10/11/2022)

[10] UK Government (2021) Discharges to surface water and groundwater: environmental permits [online] Available at: https://www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits#apply-for-a-standard-rules-permit (Accessed 10/11/2022)

[11] UK Government (2021) Apply for a water abstraction or impoundment license [online] Available at: https://www.gov.uk/guidance/water-management-apply-for-a-water-abstraction-or-impoundment-licence#before-you-apply (Accessed 10/11/2022)

(e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources.

10.2.2 National Policy

The primary UK regulatory regimes under which potentially contaminated land is managed under the planning process are described in the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012 - revised 2021) and under Part 2A of the Environmental Protection Act 1990 (Department for Environment Food and Rural Affairs, 2012).

National Planning Policy Framework (NPPF)

The NPPF has a core aim to encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value. The NPPF says the planning system should contribute to and enhance the natural and local environment by:

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and,
- remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

Furthermore, the NPPF says that planning policies and decisions should also ensure that:

- 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);
- after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990; and
- adequate site investigation information, prepared by a competent person, is available to inform these assessments.

In addition, where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

It is clear that the national planning policy directs those involved in development to ensure sites are suitable for use and not be capable of being determined as contaminated land under Part 2A – which means that the category of land, following remediation (if required) also needs to be considered.

Statutory Contaminated Land Regime

Contaminated Land Statutory Guidance advocates a precautionary approach to dealing with contaminated land, with clear direction to avoid the "excessive cost burdens" of "wastefully expensive remediation". For clarity:

- Category 1: describes land which is clearly problematic from a contamination risk perspective;
- Categories 2 and 3: cover the less straightforward land where detailed consideration is needed before deciding whether it is Category 2 (contaminated land requiring remedial action) or Category 3 (not contaminated land) - wider socio-

economic factors come into play if health risks assessment fails to produce a decision; and
- Category 4: describes land that is clearly not contaminated land.

The Category 4 test is particularly important in defining when land is clearly not contaminated land in the legal sense, it would be exceptional for land exhibiting:

- normal background levels of contamination; or
- contaminant levels below published assessment criteria (including Category 4 Screening Criteria)

To be considered as contaminated land, Regulators can only require remediation to a point where land is no longer contaminated land in the legal sense (i.e. the boundary between Categories 2 and 3) and not require "unnecessary" clean up to attain Category 4 standards. Exceedance of published assessment criteria should simply trigger further risk assessment.

Other relevant National Land Quality Guidance

The assessment approach adopted in this chapter summarises the information provided to the consenting authority to allow it to determine whether the site is suitable for its proposed end use, taking into account remediation (or mitigation) measures that may be required.

There is no single guidance document that provides a methodology for assessing the environmental effects of developments on geology, soils and land quality receptors. However, there are a number of guidance documents that have been referred to in developing the bespoke EIA methodology used in this assessment, as explained below.

The Institute of Environmental Management and Assessment (IEMA) Guidance for Environmental Impact Assessment (IEMA, 2006) provides general advice on how to undertake an EIA and has been taken into account in this assessment.

EIA guidance has been published by the Highways Agency in the Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3, Part 11, Geology and Soils (Highways Agency, 1993) for assessing the geology and soils effects of highways schemes. That guidance is not, however, particularly prescriptive on how a practitioner should determine the magnitude of impacts/change and the significance of effects. A later DMRB document: Volume 11 Environmental Assessment, Section 2, Part 5, HA205/08 Assessment and Management of Environmental Effects Highways Agency (Highways Agency, 2008), does provide a commonly used framework for assessing effects using a matrix approach.

In terms of assessing risk from contaminated land, especially Made Ground, the overarching guidance document is the Environment Agency's Land Contamination Risk Management (LCRM) published in October 2020. This provides a useful risk-based evidence approach for determining whether effects are significant or not. However, it is important to note that there is no commonly accepted guidance within LCRM on how practitioners should utilise the risk assessment approach in EIA. SLR has, therefore, applied a logical approach and defined the significance of contaminated land risk after developing a Conceptual Site Model (CSM) as prescribed in LCRM.

10.2.3 Local Policy

Nottinghamshire County Council (NCC)

There are no specific policy requirements when dealing with contaminated land under Nottinghamshire County Council's 'The Nottinghamshire Plan 2021-2031' or the Environmental Policy under Ambition 9 'Protecting the environment and reducing our carbon footprint.'

Contaminated land will be dealt with under the planning regime and legislative requirements under Part 2A of the Environmental Protection Act (1990).

Bassetlaw District Council (BDC)

Bassetlaw District Council (BDC) has a Contaminated Land Inspection Strategy that details the local policy approach to dealing with contaminated land.

The Inspection Strategy is presented in the context of Bassetlaw's Strategic Plan. Six of the priority policy areas are particularly relevant to contaminated land, as follows:

- **Enterprising Communities - Regenerate Key Areas of Bassetlaw**

By encouraging brownfield re-development through voluntary remediation and providing specialist advice to potential developers, contaminated land can be safely recycled to the benefit of the local community.

- **Sustainable Communities - Conserve and Expand Areas of Open Green Space**

The identification and safe re-use of contaminated land is an important part in the sustainable development of Bassetlaw's area. The contaminated land inspection strategy will make an increasingly significant contribution to sustainable development within Bassetlaw.

- **Supporting Children and Young People - Ensure the Safety of Children and Young People and Reduce the Risks to Children and Young People.**

Much land contamination has been present for long periods of time. Limited controls were placed on land which poses significant risks. The strategy will ensure that the risks from such land is identified and reduced or removed.

Similarly, Bassetlaw's Core Strategy sets out 10 strategic objectives, four of which the Contaminated Land Inspection Strategy will assist in the achievement of. These are:

- SO3 To prioritise the community regeneration opportunities available in Harworth, Bircotes, Misterton and Carlton-in-Lindrick / Langold by developing brownfield sites in these settlements in advance of greenfield allocations.
- S05 To ensure the continued viability of Bassetlaw's rural settlements through the protection and enhancement in the levels, of local services and facilities and support for enterprises requiring a rural location.
- S08 To protect Bassetlaw's natural environment by maintaining, conserving and enhancing its characteristic landscapes, biodiversity, habitats and species and seeking quantitative and qualitative growth in the green infrastructure network across and beyond the District.
- S09 To protect and enhance Bassetlaw's heritage assets, identify those of local significance, advance characterisation and understanding of heritage asset significance, reduce the number of heritage assets at risk and ensure that development is managed in a way that sustains or enhances the significance of heritage assets and their setting.

These various strategies as well as providing support to Bassetlaw's Strategic Plan show that the identification and safe re-use of contaminated land plays a key part in the sustainable development of Bassetlaw and its surrounding area.

10.2.4 Guidance

The main framework document that sets out procedures for the conduct of technical processes or activities which may be relevant or partially relevant to Part 2A includes The Environment Agency / Department of Environment guidance, Land Contamination: Risk Management (LCRM) (2020) and this document recommends a phased or tiered approach to risk assessment.

Other statutory and non-statutory guidance documents and research publications are available which can be used for assessing risks to human health and controlled waters from the development of contaminated land. DEFRA and the Environment Agency developed the Contaminated Land Exposure Model (CLEA) in 2002 intended to be used as the common basis for contamination assessments in the United Kingdom.

An assessment of the risks posed by soil and groundwater contamination to controlled waters is presented in the Environment Agency's Research and Development Publication, "Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination" and Research and Development Publication 95 - "Guidance on the Assessment and Monitoring of Natural Attenuation of Contaminants in Groundwater".

The following documents have been considered for the assessment of potential effects of the Proposed Development on ground conditions and contamination:

- Land Contamination: Risk Management (LCRM) (EA, 2020);
- Protect Groundwater and Prevent Groundwater Pollution (EA, 2017)12;
- Groundwater Protection Technical Guidance (EA, 2017);
- BS 5930:2015+A1:2020 "Code of practice for ground investigations" (BSI, 2015);
- BS 10175:2011+A2:2017 "Investigation of potentially contaminated sites – code of practice" (BSI, 2011);
- Guidance for the Safe Development of Housing on Land Affected by Contamination R&D Publication 66 (NHBC/Environment Agency/CIEH, 2008)
- Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2 (EA, 2009);
- CIEH/LQM, Generic Assessment Criteria for Human Health Risk Assessment, Nathanail et al, 2nd Edition, Land Quality Press (2009)
- Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (EA, 2006);
- Guidance on the Assessment and Monitoring of Natural Attenuation of Contaminants in Groundwater (EA, R&D95);
- Construction Industry Research and Information Association (CIRIA) Guidance C532, 'Control of Water Pollution from Construction Sites' (CIRIA, 2001);
- Guidance C665, 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' (CIRIA, 2007);
- Guidance C682 The VOCs handbook: investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination London (CIRIA, 2009);
- BS 8485: 2015+A1:2019 Code of practice for the characterization and remediation from ground gas in affected developments (BSI, 2015); and
- A Guide to Developing Land Within Nottinghamshire. Guidance for landowners and Developers. Nottinghamshire Land Quality Group (2013)

[12] Pollution Prevention Guidelines (PPGs) and Guidance for Pollution Prevention (GPPs). Pollution Prevention Guidelines (PPGs) and the replacement series Guidance for Pollution Prevention (GPPs) give advice on statutory responsibilities and good environmental practice https://www.gov.uk/guidance/pollution-prevention-for-businesses

10.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

10.3.1 Scoping Responses and Consultations

Consultation for this Chapter was undertaken with the organisations shown in Table 10.1

Table 10.1 Scoping and Consultation Response

Consultee	Type and Date	Summary of Consultation Response	Response to Consultee
Nottinghamshire County Council (contaminated land)	EIA Scoping Opinion 2nd November 2022	A geo-environmental desk-based assessment is required with a conceptual site model to show contamination sources, pathways and receptors- human and ecological. The means to prevent pathways and remove any contamination if it is encountered should be developed. The assessment work should help understand the residual risk to the environment from undertaking the proposed extraction works, taking into account particular sensitivities – notably the adjacent SSSI. Information on soil resource impacts to be provided and suitability for re-use in site restoration.	Preliminary Land Quality Risk Assessment (PLQRA) has been undertaken. An Agricultural Land Classification (ALC) has been undertaken.
Environment Agency	EIA Scoping Opinion 7th October 2022	From a controlled waters protection perspective we are satisfied with the scope of the proposed Environmental Impact Assessment. We have already held discussions with the applicant regarding their plans and they appear to have incorporated our comments made during these discussions. We would like to reiterate that the applicant must ensure they are compliant with water abstraction licensing requirements for any dewatering that is proposed. From a waste regulation perspective the conclusions made regarding waste are acceptable.	Controlled waters assessments and abstraction licensing have been undertaken under consultation with the EA and permit requirements. The Applicant is twin tracking these with the planning application process. A Site Waste Management Plan (SWMP) would detail how waste streams are to be managed. This is included within Appendix 5.2 OCEMP.

10.3.2 Scope of Assessment

Before the assessment of environmental impacts can be carried out certain basic information about the Proposed Development needs to be established. Some of this information is of particular relevance in the consideration of indirect and cumulative impacts and interactions. This Chapter identifies the type and detail of information about the Proposed Development that should be/has been obtained, where possible and practical, to enable the assessment to reflect the potential impacts on Land Quality more

fully. The assessment of Land Quality also includes the impacts to human health, the water environment (groundwater, surface water quality), property and infrastructure.

It is essential to consider the nature of the Proposed Development as this influences the type of impacts that are likely to/could occur. It is important to determine its key physical characteristics as these influence indirect and cumulative impacts and impact interactions. The phasing, scale and layout of the Proposed Development as well as operational activities, mitigation measures and environmental controls all need to be considered in terms of determining the extent of any impact.

One key aspect of the assessment of impact relates to the baseline condition and/or quality of the land prior to any of the Proposed Development taking place. This is because land that is due to be developed, especially if it has a historic use where previous activity has taken place, is not necessarily uncontaminated in terms of its existing condition.

In such circumstances it is likely that development would/may have a material improvement of the land quality through mitigation activities associated with the remediation of the historic contamination such that the land is suitable for the intended use.

Accordingly, there is a standard approach to assess whether the land to be developed and the associated soil, hydrogeological (groundwater quality) and hydrological (surface water quality) quality, has been impacted from historic activities. The defining assessment of land contamination/quality is undertaken in accordance with the Environment Agency Guidance Land Contamination: Risk Management (LCRM).

LCRM is intended to assist all those involved in dealing with land contamination, including landowners, developers, professional advisors, regulatory bodies and financial providers. The technical approach presented in LCRM is designed to be applicable to a range of non-regulatory and regulatory contexts that includes:

- development or redevelopment of land under the planning regime;
- regulatory intervention under Part 2A of the Environment Protection Act 1990;
- voluntary investigation and remediation; and
- managing potential liabilities of those responsible for individual sites or a portfolio of sites.

LCRM is split into stages: risk assessment, options appraisal and remediation and verification, which can be sub-divided as shown in Table 10.2.

Table 10.2 LCRM Stages of Contaminated Land Assessment

Stages within LCRM for Contaminated Land Assessment				
Stage 1 **Risk Assessment**	>	**Stage 2** **Options Appraisal**	>	**Stage 3** **Remediation and Verification**
• Tier 1 - Preliminary risk assessment • Tier 2 - Generic quantitative risk assessment • Tier 3 - Detailed quantitative risk assessment		• Identification of feasible remediation options • Detailed evaluation of options • Select final remediation option		• Develop the remediation strategy • Remediation (and watching brief) • Produce a verification report • Long-term monitoring and maintenance (if required)

The first stage, Risk Assessment, is an essential component in achieving effective management of the risks from land contamination. Risk assessment for chemical contamination can be a highly detailed process as there are a range of specific technical approaches for different contaminants and circumstances. As shown in Table 10.2, the risk assessment stage is itself subdivided or tiered; assessors apply each tier in turn. Higher tiers require the assessment of more detailed information.

The common approach used by practitioners is to assess the direct effects of development on a site's land quality (through changes to ground and water conditions as a result of development) and the indirect effects of those changes on the ultimate end users of the land. To enable this assessment there are firstly two risk assessments that are undertaken:

- a *Development Impact Assessment* discusses the potential impacts of the proposed development via loss (removal, erosion, disaggregation or compaction) and pollution. The assessment considers impacts during construction and occupation of the Proposed Development.
- a *Preliminary Land Quality Risk Assessment* (PLQRA) of the chemical quality risks posed by the site:
    - during the construction phase to construction workers, and controlled waters; and;
    - the risks of chemical exposure to future human site end-users and controlled water receptors (including sensitive surface water ecology) from the period following completion of construction, taking into account the change in the land use brought about by the Proposed Development.

Where there is a historic contaminated land risk at a site, a Conceptual Site Model (CSM) of the site is prepared.

Potential land contamination impacts and associated risks to human health and controlled waters are assessed using a methodology based upon the CIRIA C552 Contaminated Land Risk Assessment – A Guide to Good Practice document (CIRIA, 2001). This method is specifically tailored to assess the impacts and risks that may arise from exposure to ground contamination, contaminated waters and ground gases. These are then used to inform the significance of environmental impact to the baseline conditions from development, in this case the Proposed Development.

10.3.3 Study Area / Survey Area

The study areas in this assessment are receptor specific as follows:

The ground conditions and contamination study area comprises the Site itself and a Core Study Area within a 1km radius of the Site, as shown in the Groundsure Report (Groundsure Ltd, 2022) contained within the Preliminary Land Quality Risk Assessment (PLQRA) (SLR, 2022) (Volume 3 Appendix 10.1). Important features and constraints are shown in the Groundsure Report.

The 1km zone of influence was chosen as this is the area within which it is considered that certain sources could potentially have an effect on the Site, and the Site could have an effect on off-site receptors.

A wider study area of up to 5 km from the Core Study Area has also been considered to assess potential effects on the downstream water environment (the Wider Study Area). At distances greater than 10 km within upland catchments, it is considered the Proposed Development is unlikely to contribute to a hydrological effect, in terms of chemical or sedimentation effects, due to dilution and attenuation of potentially polluting chemicals.

Cumulative effects: Cumulative effects related to land contamination and pollution of waters are assessed in the context of other developments within 5 km of the Site. Cumulative effects in this context are generally related to effects such as multiple developments or abstractions being constructed within proximity to one another. 5 km is therefore considered to be the conceivable maximum distance that these effects may occur.

10.3.4 Baseline Survey Methodology

Baseline conditions have been established through desktop studies, ground investigation, water quality sampling and regulatory consultation, including the Scoping Opinion (September 2022) included in Volume 3 Appendix 1.2. The following sources of information have been used to inform the baseline description set out in this Chapter:

- Groundsure Enviro+Geo Insight Data Report (EMS_827283_1023599, dated 24 November 2022)
- Ordnance Survey raster 1:25,000 mapping
- DEFRA Magic Map Application
- BGS Geological Mapping
- BGS GeoIndex Onshore
- Historical Ordnance Survey (OS) mapping
- Identification of surface water features, catchments and hydrological receptors;
- Identification of data on public and private abstractions and supplies;
- Collation of water quality data and groundwater aquifer status and vulnerability information
- Identification of other similar developments within 5 km
- Consultation with the Environment Agency (EA) and Bassetlaw District Council;
- SLR Consulting (2022) Preliminary Land Quality Risk Assessment (PLQRA), SLR Ref 416.11943.00001
- SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001
- SLR Consulting (2021) Lound PFA Tip – Groundwater Abstraction Due Diligence, SLR Ref 422.11943.00002

10.3.5 Methodology for the Assessment of Effects

Effects on an identified receptor can be described as direct, indirect or cumulative. The significance of the potential effects of the Proposed Development has been classified by consideration of the sensitivity of the receptor and the magnitude of the potential effect. The assessment aims to predict the likely effects (both beneficial and adverse) arising from the Proposed Development on the identified receptor(s).

The assessment of the potential effects of the Proposed Development in relation to ground conditions and contamination include:

- Details of consultation(s) undertaken and responses provided;
- Site walkover survey to visually appraise the Site and surrounding land use;
- Identification of key receptors that include human health, the water environment (groundwater, surface water quality), property and infrastructure,
- The development of a conceptual understanding of the Site to establish the potential contaminant linkages
- Assessment of methodologies for construction, operational and restoration phases;
- Identify mitigation measures, where necessary and how they would be applied;
- Identification of any residual effects following mitigation;
- Cumulative assessment with other developments within 5 km of the Site Boundary;
- Production of a succinct ground conditions and contamination assessment section within the impact assessment; and

- Statement of significance in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2017[13].

The residual effects following the mitigation measures put in place would be identified as having a negligible to major magnitude of effect, and whether this effect is local, short term and temporary; or on a more significant scale, long term and permanent; and whether these effects are adverse or beneficial.

By confirming the sensitivity of a receptor coupled with the magnitude of the potential effect caused by development, it is possible to confirm the significance of the impact, i.e. should the Proposed Development impact on a Site of Special Scientific Interest (SSSI) (High Sensitivity) resulting in a loss of this attribute (Substantial Magnitude), the significance of this would be Major adverse; and alternatively a reduction in contamination risk from the existing baseline conditions, e.g. land that has a very high contamination risk but undergoes site remediation and improvement compared to the baseline becomes a Major beneficial effect.

Table 10.3 Residual Effects

Residual Effect	Description
Major adverse	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk.
Moderate adverse	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk.
Minor adverse	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Negligible	Negligible change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk.

[13] Town and Country Planning (Environmental Impact Assessment) Regulations 2017 [Online] Available at: https://www.legislation.gov.uk/uksi/2017/571/introduction/made (Accessed 10/11/2022)

10.3.5.1 Sensitivity of Receptors

The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, would be assessed in line with best practice guidance, legislation, statutory designations and professional judgement.

The initial consideration of sensitivity of a receptor/asset to an effect reflects the level of importance assigned to it.

Table 10.4 details the framework for determining the sensitivity of receptors.

Table 10.4 Framework for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, and/ or is of very high environmental value, or of international importance. e.g. watercourse with a high flow, SPZ1 within a high intergranular or fracture flow Principal aquifer, essential infrastructure of highly vulnerable development, SSSI. Land use very sensitive to contamination (e.g. residential with private gardens, vulnerable or child settings such as nurseries and schools).
High	Land use remains sensitive to contamination (e.g. residential with or without private gardens, allotments or nurseries). Groundwater used for drinking water abstraction (site located within a SPZ2). Potable groundwater resource of regional importance. Surface water body of national ecological importance.
Medium	Land use sensitive to contamination e.g. play areas or public open space. Potable groundwater resource of regional importance. Surface water body of regional ecological importance. Construction/Demolition workers involved in significant disturbance of the ground.
Low	Land use with low sensitivity to contamination e.g. commercial or industrial use. Potable groundwater resource of local importance Surface water body of local ecological importance Construction/Demolition workers involved in limited disturbance of the ground.
Negligible	Low sensitivity site use e.g. car parking. No utilisable groundwater resource. Construction/Demolition workers involved in minimal disturbance of the ground.

10.3.5.2 Magnitude of Change

The magnitude of potential effects is identified through consideration of the development, the degree of change to baseline conditions predicted as a result of the development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

In determining the magnitude of effect, the values of the asset affected are first defined. This provides the baseline against which the magnitude of change can be assessed; the magnitude of effect being proportional to the degree of change in the asset's baseline value.

The criteria for assessing the magnitude of an effect are presented in Table 10.5.

Table 10.5 Framework for Determining Magnitude of Effects

Magnitude of Effects	Definition
High	Permanent changes to the physical, chemical or biological properties of a significant proportion of the receptor (e.g. significant adverse human health effect, pollution of aquifer or abstraction well, changes in ecological status)
Medium	Permanent or temporary changes to the physical, chemical or biological properties of an insignificant proportion of the receptor (e.g. potential adverse human health effect, pollution of aquifer or abstraction well, changes in ecological status)
Low	Temporary changes to the physical, chemical or biological properties of an insignificant proportion of the receptor (e.g. isolated pollution incident)
Negligible	No discernible change to existing environmental conditions

10.3.5.3 Significance of Effects

The sensitivity of the asset and the magnitude of the predicted change are used as a guide, in addition to professional judgement, to predict the significance of the likely effects. Table 10.6 summarises guideline criteria for assessing the significance of effects.

Table 10.6 Framework for Assessment of the Significance of Effects

Magnitude of Effect	Sensitivity of Resource or Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

Effects predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in light grey in the above table.

Effects can be beneficial or adverse and these are specified where applicable in the assessment within this Chapter.

For assessing significance, consideration is given to the national, regional and local baseline situation. The magnitude of the impact is determined in proportion to the area of impact relevant to each receptor.

In terms of land-use factors, potential effects are considered significant if the Proposed Development results in long-term human health impact, environmental quality degradation of soil or water or net loss of an important land-use (and water) receptor from ground condition activities or land contamination.

10.3.6 Assessment Limitations

All data considered necessary to identify and assess the potential significant effects resulting from the Proposed Development was available and was used in the assessment reported in this Chapter.

10.4 BASELINE CONDITIONS

The baseline conditions are the environmental conditions against which the potential environmental effects of the Proposed Development have been assessed. The conditions refer to the present time and with no significant change predicted during the interim period before development works are programmed to commence. The baseline conditions have been determined through the completion of a Preliminary Land Quality Risk Assessment (PLQRA) (SLR, 2022) for the Site which is included in Volume 3 Appendix 10.1. Findings from the PLQRA are summarised below.

The existing land use at the Site is grazing land, to which the Site was restored following historic PFA disposal. The Site is split between the 'Low-Rise' to the east (7.5 – 11 m Above Ordnance Datum (AOD)) and 'High-Rise' to the centre and west (17 – 19 m AOD). There is significant variation in PFA thickness between these areas with an average PFA thickness of 13.4 m and 3.6 m respectively. The primary reason for this is that the High-Rise comprises raised lagoon structures, with approximately 6m high embankments and a flat top.

Please refer to Volume 1, Chapter 4 of the ES for more detail of the existing site and baseline conditions.

10.4.1 Site Setting

National Grid Reference SK 69404 84864 identifies the approximate location of the Site. The Site is located within a relatively flat area within the floodplain of the River Idle which flows in a northerly direction between 100m and 500m to the south-east. The Site is surrounded by a series of water bodies which have formed within the pits of disused sand and gravel quarries along the floodplain of the River Idle.

The Site is situated within an area of rural agricultural land that is generally flat and low-lying. The majority of the Site is raised with vegetated banks around its perimeter and largely comprising of poor quality grazing land for pastoral farming, with a thin layer of topsoil overlying the deposited PFA, averaging 0.3m thickness over the Site. The area has historically been subject to a significant amount of sand and gravel extraction. The Site is also well screened owing to a combination of topography and existing vegetation, including tree planting and hedgerows along its perimeter and blocks of broadleaved woodland and hedgerows in the surrounding area.

The Site is relatively isolated, with the village of Lound located approximately 400 m to the north and the village of Sutton-cum-Lound located approximately 380 m to the northwest. The town of Retford is located approximately 670m to the south east. Distances are taken from the closest point to the settlement from the boundary of the Site. The closest residential properties are those associated with Low Farm and Sutton Grange Farm located immediately to the north of the Site. Two dwellings associated with the Wetlands Fishery are located on the opposite side of Lound Low Road, also to the north. There is also a group of residential properties associated with a small development at Bellmoor Farm located approximately 100m to the west. A residential property named Brooklyn is located adjacent to the hand car wash on North Road some 250m to the south west; and 300m to the south west is Cross Roads Farm, a second adjacent residential property and two semi-detached properties on the opposite side of the North Road and Sutton Lane crossroads. There are further dwellings located within 500m to

the south at properties identified as Merrydene, Botany Bay Farm, Cooks Cottages and Trinity Farm; and further to the east at Tiln Farm on the opposite bank of the River Idle.

There are a wide range of recreational users in the immediate area that include walkers, cyclists, equestrians, anglers and visitors to the Idle Valley nature reserve. The A.P.E. and Prime8 educational and outdoor facilities are also located to the north of Lound Low Road, close to the Wetlands Animal Park. There is also a public right of way (footpath) that crosses through the Site, although not in a location where PFA has been deposited.

There is no effective capping layer at the Site, as the cover system comprises a soil rather than a low permeability clay, which allows rainfall and surface water to infiltrate directly down into the PFA deposits. There are a number of field drains across the Site associated with field boundary ditches and channels which generally follow topography to the south and east. This surface water drainage network connects into the River Idle once it leaves the Site in southern and eastern areas.

10.4.2 Geology and Soils

The British Geological Survey (BGS) Geoindex maps[14] indicate the land to be underlain by sand and gravel River Terrace deposits across most of the Site, with alluvium comprised of clay, silt, sand and gravel to the north-east. As the River Terrace deposits have been worked, they are not present extensively onsite[15]. The superficial deposits are underlain by pebbly sandstone of the Chester Formation. Alternative names for the Chester Formation include the Bunter Sandstone Formation and Bunter Pebble Beds.

An intrusive ground investigation has been undertaken by SLR during May to June 2021 which comprised the drilling of 23 boreholes to a maximum depth of 18m bgl (depth determined by underlying Chester Formation, with at least 1m being proven) and excavation of 4 trial pits to a maximum depth of 4.5m bgl (also determined by the depth to the underlying Chester Formation). The investigation confirmed underlying ground conditions to consist of topsoil, PFA and sandstone of the Chester Formation. Occasional bands of sand and gravel were observed overlying the sandstone which was considered to be unworked River Terrace Deposits. The sandstone was observed at depths between 2.45m bgl and 16.1m bgl, with shallower bedrock present to the east of the Site, with a decrease in PFA thickness. Significant variation was noted in the thickness of the PFA deposits, particularly between the High-Rise and the Low-Rise.

10.4.2.1 Topsoil

Ground investigation undertaken by SLR has identified a thin layer of topsoil overlying the PFA with an average of 0.3m thickness over the Site. This was generally a brown sandy silt with some fine to medium quartzite gravel, used as a restoration cover/backfill over the top of the PFA. An agricultural land classification (ALC) survey has been undertaken, the results of which are in Volume 3 Appendix 10.2 and are discussed further in Section 10.4.2.9. It is understood that Site soils support poor quality grazing land for pastoral farming.

10.4.2.2 PFA

PFA was deposited into the void of a former sand and gravel quarry which underlies the majority of the Site. It is assumed that superficial deposits have been fully worked and the base of the PFA is located on the underlying sandstone of the Chester Formation. The PFA is mounded above the natural ground elevation across the centre of the Site to

[14] BGS (undated) GeoIndex Onshore [Online] Available at: GeoIndex - British Geological Survey (bgs.ac.uk) (Accessed 10/11/2022)
[15] SLR Consulting (2021) Lound PFA Ground Investigation Report, Version No 2, SLR Ref 416.11943.00001 (Accessed 10/11/2022)

a maximum elevation of c.18mAOD (surrounding ground elevations are at c. 8m-10mAOD).

The PFA was observed across the entirety of the Site. Generally, this was encountered as a soft to firm dark grey slightly sandy silt with occasional dark grey fine sand laminations. The PFA ranged in thickness from 0.05m to 15.9m. With an average thickness of 3.6m in the Low-Rise and an average of 13.4m (excluding those terminated in the sandstone bunds) in the High-Rise.

10.4.2.3 Superficial Drift Geology

The regional geology map for the area indicates that prior to any quarrying at the Site the geology was comprised of superficial River Terrace Deposits (Sands and Gravels) overlying Chester Formation Sandstone bedrock.

The superficial deposits across most of the site are recorded as River Terrace Deposits (sands and gravels), with alluvium comprised of clay, silt, sand and gravel to the north-east. The River Terrace Deposits (RTD) are described by the BGS as a "sand and gravel, locally with lenses of silt, clay or peat." Nearby borehole logs indicate that the River Terrace Deposits (RTD) are locally recorded at between 4m and 7m in thickness. As the deposits have been worked, they are not present extensively onsite.

During the ground investigation completed by SLR, River Terrace Deposits were not generally encountered however, at the top of the underlying sandstone bedrock, a dark grey organic fine to coarse sand and gravel was sometimes observed. This is likely the unworked River Terrace Deposits (RTD) overlying the Chester Formation.

10.4.2.4 Bedrock Geology

The bedrock deposits comprise pebbly sandstone of the Chester Formation. The deposits are described as a "pinkish red or buff-grey, medium to coarse grained, pebbly, cross-bedded sandstone" having been recorded to a depth of at least 137m below ground level and is understood to be up to 220m in thickness regionally. Alternative names for the Chester Formation include the Bunter Sandstone Formation and Bunter Pebble Beds.

During SLR's ground investigation, in-situ bedrock of the Chester Formation was observed from depths of between 2.45m bgl to 16.1m bgl. The bedrock was observed at shallower depths towards the east of the site where the PFA thickness decreases significantly. The in-situ bedrock was described as a reddish brown slightly silty fine to medium grained sandstone.

BH/21/02, BH/21/08 & BH/21/14 were terminated within the side slope of the sandstone bunds that comprise the former lagoon embankments. This was with the aim of determining the internal slope angle of the lagoon. Arisings recovered from the bunds indicate they are constructed predominantly from the underlying Chester Formation bedrock, often blended with River Terrace Deposits (RTD).

10.4.2.5 Mining and Extraction

There are 16no. recorded BritPit entries associated with the extraction of sand and gravel at Bellmoor Gravel Pit/Bellmoor Quarry. Each entry is recorded as a surface mineral working which has now ceased and closed by the operator. The Bellmore Quarry is recorded as a historical Mineral Planning Area.

Whilst the Site is located within a coal mining area as defined by the Coal Authority, there are no underground workings recorded, no degraded mining cavities that could result in hazardous subsidence (crown holes) or areas which could be affected by former coal mining and other mining in the Site area.

10.4.2.6 Ground Stability

Ground stability hazard risks from natural ground within 50m of the Site are as follows:

- Shrink-Swell Clays – Very low;
- Landslides – Very Low;
- Dissolution of soluble Rocks – Negligible;
- Compressible Deposits – Moderate;
- Collapsible Deposits – Very Low; and
- Running Sands – Low.

10.4.2.7 Radon

The Site is within a 'Less than 1%' zone for properties affected. No radon protection measures are required.

10.4.2.8 Geo-conservation

There are no identified geo-conservation resources, e.g. internationally and nationally designated sites or Local Geology Sites (LGS / RIGS) within the Study Area.

10.4.2.9 Agricultural Land Classification

An ALC report has been completed which indicates the land across the proposed extraction area (Area A) has thin (20-50 cm) restored natural sandy soils (topsoil & subsoil) over silty pulverised fuel ash (PFA) to depth. The report indicates that there were no plant roots or biology (earthworms) found to be present within the deposit, therefore suggesting that the PFA is phytotoxic. If crop roots cannot extract moisture from the PFA, the soils across the area are effectively shallow and sandy and most of the land is very droughty and poor quality (grade 4). A small area has been identified with deeper soils in the report and is therefore of slightly better quality (3b, potentially 3a), although it is viewed as too small to operate as an agricultural unit in its own right, therefore is farmed in the same way as the Grade 4 land and forms part of this unit. Notwithstanding this, the land does support sheep grazing; therefore, to accommodate this agricultural use, grazing has been designed into the proposed restoration scheme for the Site.

The ALC report completed for Area B has identified most of the land as moderate quality (grade 3b) and a small area in the north as good quality (grade 3a). Again, the latter would be farmed in the same way as the predominant Grade 3b land.

10.4.3 Hydrology

Ordnance Survey raster 1:25,000 mapping shows there are no mapped watercourses within the Site boundary, with the nearest Water Framework Directive (WFD) classified watercourse being the River Idle, which at its closest point meanders approximately 100m adjacent to the southeast of the Site boundary and flows from south to north. The wider area is extensively drained with several lagoons, waterbodies and canals, with two drains present onsite, one to the south-west, the other to the north. The Site is shown to be located within the operational boundary of an Internal Drainage Board (IDB) - the Isle of Axholme and North Nottinghamshire Water Level Management Board.

The Environment Agency 'Catchment Data Explorer' shows the site lies within the 'Idle (from Maun/Poulter to Tiln) River waterbody catchment (ID GB104028058091) with an overall classification of Moderate. The waterbody is required to meet Good status by 2027, however, it is currently failing. This is due to the water quality as phosphate on macrophytes has been found at monitoring points. It lies within the Idle and Torne management catchment within the wider Humber catchment.

Other surface water features identified in proximity to the Site are:

- Fishing lakes approximately 100m to the north

- Lake approximately 100m west
- Small lake and ponds south of central site area.

There are eight active surface water abstractions within 2km of the Site. These are for fish pass/canoe pass by Nottinghamshire Wildlife Trust with the remainder for agricultural/farming spray irrigation.

The Sutton and Lound Gravel Pits located to the east and northeast of the Site, are a SSSI due to the aggregations of non-breeding birds (Gadwall, Anas stepera, variety of passage species) and assemblages of breeding birds.

Statutory designated sites relating to water that are considered hydrologically connected to the Site are the River Idle Washlands SSSI (approx. 7.9km north) and Misson Line Bank SSSI (approx. 9.8km north) both of which are located downstream of the Site on banks of the River Idle.

Surface water sensitivity is considered to be high by virtue of the ecological designation on the site and the hydrologically connected statutory designated sites.

10.4.4 Hydrogeology

The Environment Agency 'Catchment Data Explorer' shows the Site is within the wider Humber groundwater body. The Humber groundwater body has an overall status of Poor. Reasons for this status include poor nutrient management, poor livestock management, groundwater abstraction and groundwater resource impacts.

The DEFRA Magic Map confirms that the River Terrace Deposits (RTD) are classified as a Secondary A Aquifer, described as

"*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.*"

The Environment Agency (EA) aquifer designation maps 2 indicate that the Sandstone bedrock is classified as a Principal Aquifer, described as:

"*layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.*"

The groundwater vulnerability classification is stated as medium - high.

Both aquifers are important aquifers regionally as they provide a significant number of both licensed and private abstractions as well as being a significant baseflow to rivers, including the River Idle.

There are three active groundwater abstractions within 2km of the Site. The nearest abstraction point is c.270m north pertaining to process water for Sutton Grange AD Ltd, for 35,500m3 annually. The next abstraction is c.637m north and the third is recorded c. 1.4km southwest both for spray irrigation.

There are no active potable abstractions recorded within 2km.

Consultation has been undertaken with Bassetlaw District Council requesting information on Private Water Supplies (PWS) within 2 km of the Proposed Development. No PWS were identified by the council within this area.

Information provided by the Environment Agency available on DEFRA's Magic Map viewer shows the site does not lie within a Drinking Water Safeguard Zone for Groundwater. The site, however, does lie within a Zone III total catchment Source Protection Zone.

The BGS Geoindex 1:625,000 Hydrogeology map shows the entire site lies within a 'Highly productive aquifer' which is described as 'principal sandstone aquifer up to 600 m thick and yielding up to 125 L/s'. Quality is reported as 'good but hard and becomes saline beneath confining Mercia Mudstone'. The direction of groundwater flow within the area is not known.

Two pump test wells, one to the north of the site as NGR SK 7006 85341 and another south-west of the site at NGR SK 6892 84463 both recorded resting groundwater levels at 2.5m and 3.0m below ground level respectively. This would suggest a resting groundwater level of c.6mAOD which appears to be reasonably consistent with the water elevations of the surrounding waterbodies which have formed in the nearby former sand and gravel workings which are typically at c.7mAOD.

Initial data from SLR's ground investigation indicates that the water table within the PFA is recorded at a similar elevation to the surrounding aquifer at a depth of 1-2m below natural ground level.

A large portion of the Site overlies a Principal Aquifer, which is located within an SPZ III and provides groundwater supply for industrial uses within 500m. Whilst the sandstone is a highly productive aquifer, it is noted there are no identified potable abstractions nearby and it does not lie within a Drinking Water Safeguard Zone.

Shallow baseflow interactions of groundwater in the PFA and superficial deposits of the River Terrace Deposits (RTD) and its hydraulic connectivity to surface water is considered to be of greater environmental significance given its connection to water sensitive ecological habitats. As such, the groundwater sensitivity is considered to be moderate-high.

During SLR's ground investigation and subsequent monitoring, groundwater was encountered beneath the entire Site during drilling, typically 8-10m bgl in the High-Rise and 2-3m bgl in the Low-Rise. Groundwater levels, inferred from water strikes during drilling, indicate the water table within the PFA is a similar elevation to the surrounding aquifer suggesting hydraulic continuity between the two.

Thickness of PFA above and below the water table are provided in SLR's PLQRA. The water table is likely subject to seasonal fluctuations which would be determined via ongoing monitoring.

Groundwater monitoring standpipes were installed within three of the borehole locations within the PFA (BH/21/03, BH/21/11 & BH/21/23) and at two surrounding perimeter wells within the River Terrace Deposits (RTD) / Sandstone (GW22/01, GW22/02).

Given the shallow depth to groundwater it is considered that groundwater will be in hydraulic continuity with the River Idle to the south-east / east of the site and that the water table will also be in continuity between the River Terrace Deposits (RTD) and the Chester Formation Sandstone.

Both the Chester formation and River Terrace Deposits (RTD) have high intergranular flows, permeability testing of the sandstone regionally indicates typical permeabilities of the Sherwood Sandstone (of which the Chester Formation is a member) of between 0.73 – 5.5m/day[4] whilst typical permeabilities for the River Terrace Deposits (RTD) are 0.078 – 5.2m/day[5].

By comparison the PFA has been recorded as a fine silty material which would typically record significantly lower permeabilities than the surrounding sands and sandstones of between $8.6x10^{-8}$ and 0.17m/day.

The initial groundwater level data for the PFA based on strikes observed during drilling indicates that the water table in the PFA is at a similar elevation to the surrounding aquifer, suggesting that the two are in hydraulic continuity, however the low permeability

of the PFA could potentially limit the amount of groundwater which is pulled into the site from dewatering, especially if an offset is maintained around the perimeter of the site to avoid any direct connection to the sandstone aquifer.

10.4.5 Land and Water Quality

10.4.5.1 Material Bulk Analysis

Forty-five blended bulk samples were sent for physical testing and geochemical analysis following the site investigation. The samples selected were representative of the entire deposit, covering both above and below the water table and across all five lagoons within the Site.

The test suite was scheduled on the basis of assessment for suitability against BS EN 450-:2012 Fly ash for concrete (EN 450). This comprised bulk material properties that included moisture content, loss in ignition, fineness, sulphate, loose bulk density and particle size distribution. Geochemical analysis[16] included calcium oxide, silicon dioxide, magnesium oxide, sulphate content, total alkalis and total phosphate. The chemical signature comprised main constituent compounds of residual oxide metals and metalloids (silicon, aluminium, iron, magnesium, chromium, titanium, manganese, strontium, barium) as well as major ions (calcium, sodium, potassium, phosphorus).

10.4.5.2 Groundwater Quality

Groundwater quality monitoring has been undertaken at three monitoring wells located within the PFA (BH21/03, BH21/11, BH21/23) and at two surrounding perimeter wells within the River Terrace Deposits (RTD) / Sandstone (GW22/01, GW22/02).

Water quality monitoring has to date been undertaken on 12no. occasions within the PFA (Aug '21 – Dec '22). and 9no. occasions within the perimeter wells (April – Dec '22). This monitoring is ongoing to ensure that winter peaks are recorded in water levels in both the PFA and groundwater and to ensure that seasonal variations in water quality are observed.

The groundwater level recorded within each well has remained largely consistent throughout the period of monitoring, with a seasonal range of less than 1.5m. The data indicates a saturated thickness of between 4.5 – 5.5m within the deeper thickness of PFA in the centre and south-west of the site but a very shallow saturated thickness at (BH 21/23) in the shallow deposits in the northeast which will potentially be almost dry in mid to late summer. The groundwater elevation recorded within the PFA wells is consistent with those recorded in the two perimeter boreholes (GW22/01, GW22/02).

The recorded data[17] indicate that the groundwater present within the PFA deposits has concentrations elevated above relevant groundwater and surface water limits for:

- Metals - arsenic, boron, manganese, mercury, sodium and vanadium
- Major Ions and Other Parameters – ammoniacal nitrogen, electrical conductivity, nitrate, nitrite, sulphate and a relatively high alkaline pH

The data recorded in the groundwater present in the perimeter wells indicates that groundwater samples are elevated in several major ions and metals:

- Metals – boron, zinc

[16] Full analysis suite – silicon oxide, aluminium oxide, iron oxide, calcium oxide, magnesium oxide, sodium dioxide, potassium dioxide, chromium dioxide, titanium dioxide, manganese oxide, phosphorus pentoxide, strontium oxide, barium oxide

[17] Full analysis suite – arsenic, boron, cadmium, total dissolved cadmium, cobalt, copper, dissolved iron, lead, manganese, mercury, nickel, sodium, vanadium, zinc, sulphate (SO4), chloride, nitrate (NO3), nitrite (NO2), ortho-phosphate (PO4), ammoniacal nitrogen (NH4), hexavalent chromium, total dissolved chromium III, electrical conductivity, pH

- Major Ions and Other Parameters – sulphate, iron, manganese, ammoniacal nitrogen.

Overall, it is considered that the groundwater within the perimeter boreholes shows a different geochemistry to that of the PFA groundwater.

In addition to the above, an extended suite of substances have also been tested for in groundwater samples obtained from the three PFA monitoring wells in November 2022 that has comprised; pesticides, herbicides, VOCs (including tentatively identified compounds), SVOCs (including tentatively identified compounds), polyaromatic hydrocarbons (PAH), phenols, phthalates, fluoride, dibutyltin, tributyltin, triphenyltin, formaldehyde, PFOS, chemical oxygen demand (COD), chlorine, total alkalinity, pH.

Any of these substances which are identified at elevated concentrations would be added to the ongoing monitoring, however the data does not indicate elevated concentrations from this suite to be present.

10.4.5.3 Surface Water Quality

Two rounds of surface water monitoring has to date been undertaken at one location along the River Idle in November and December 2022[18]. This sampling point is located to the south east of the Site. This location is provided in SLR's PLQRA which is provided in Appendix 10.1.

The data recorded in the surface water are elevated in several major ions and metals:

- Metals – boron, zinc
- Major Ions and Other Parameters – sulphate, nitrate, ammoniacal nitrogen, ortho phosphate.

In broad terms, the data indicates a different geochemistry to that of the groundwater within the PFA, but is similar in water quality signature to groundwater within perimeter boreholes in the RTD/sandstone. As such, the PFA groundwater does not appear to be significantly impacting on surrounding surface waters (or groundwater).

10.4.6 Visual Observations

During the ground investigation undertaken by SLR no observations of potential contamination were made during the drilling. The logs that were returned indicated a topsoil overlying the PFA before encountering the Chester Sandstone bedrock at depth. There were no odour or visual indications of contaminant impact, or the presence of 'other' buried waste materials (such as asbestos) at those locations investigated.

10.4.7 Ground Conditions and Contamination Receptors

The review of the baseline conditions has informed the identification of the following environmental receptors within the Site and the surrounding areas which are susceptible to be affected by contamination hazards.

The identified environmental receptors are summarised in Table 10.7.

Table 10.7 Environmental Receptors

Category	Pathways	Receptor	Details
Human Health	Dermal contact, ingestion and	On-site construction workers	Excavation and processing of PFA during construction works could expose workers to contamination.

[18] Full analysis suite – antimony, arsenic, boron, cadmium, total dissolved cadmium, copper, dissolved iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, zinc, bromide, sulphate (SO4), chloride, nitrate (NO3), nitrite (NO2), potassium, sodium, calcium, fluoride, ortho-phosphate (PO4), ammoniacal nitrogen (NH4), total alkalinity (CaCO3), dissolved oxygen, dissolved organic carbon, total dissolved solids (TDS), electrical conductivity, pH

Category	Pathways	Receptor	Details
	inhalation of dusts, vapours and ground gas.		Potential exposure could be associated with dermal exposure to high pH which could result in skin irritation, or inhalation of dusts during the excavation and processing of the PFA material.
		On-site commercial/ industrial users (site workers, visitors, site maintenance staff)	Other workers on the Site could be exposed to PFA from the extraction and processing of the material. This is most likely associated with inhalation of dusts and possible direct contact and ingestion of PFA in certain circumstances.
		Off-site residential	There are residential properties located adjacent to the north and in close proximity to the west of the Site. The main exposure pathway is the release of airborne dust particulates that could be transported and deposited from extraction and processing, as well as release of dusts from conveyors and/or articulated HGVs as they transport PFA material away.
		Off-site commercial/ industrial	There are commercial/industrial properties to the north and also to the east of the Main Processing Site. The main exposure pathway is the release of airborne dust particulates that could be transported and deposited from extraction and processing, as well as release of dusts from conveyors and/or articulated HGVs as they transport PFA material away.
		Off-site recreational	There are a wide range of leisure/amenity users that include walkers, cyclists, equestrians, anglers and visitors to the Idle Valley nature reserve. There are educational and outdoor facilities are located to the north, close to the Wetlands Animal Park. The greatest potential exposure pathways are considered to be the release of airborne dust particulates that could be transported and deposited in these recreational use areas, the release of dusts from articulated HGVs as they transport PFA material away from the Site and also impacts to surface water quality that could affect amenity value.
		On-site agricultural / pasture	Following restoration, the Site would be returned to a mixture of biodiversity led land-use and agriculture, including wet meadow, reed beds and pasture. Some farming uses, i.e. those associated with grazing, would be re-introduced, including as a necessary measure to manage habitat.
		On-site recreational	Following restoration, there would be a public right of way through the restored areas to which members of the public would have access. This is an existing footpath that is to be retained.
Controlled Waters	Migration via permeable strata in soil and groundwater	Groundwater in River Terrace Deposits (RTD) Secondary A aquifer	Whilst River Terrace Deposits (RTD) have been fully worked and the base of the PFA is located on underlying sandstone there is potential for residual unworked RTD at the quarry extents providing connectivity to groundwater off-site. The extraction and processing of the PFA has the potential to impact on the water quality within the RTD as the extraction would take place down to the water table. Therefore there is potential for an off-site migration pathway of PFA impacted groundwater via the RTD which would also be a receptor.
		Groundwater in Sandstone bedrock Principal aquifer	The base of the PFA is located directly on the underlying sandstone. Whilst it is likely that mixing of PFA will have impacted the upper stratum of the sandstone, the deposit will also be hydraulically

Category	Pathways	Receptor	Details
			connected and act as a conduit for groundwater in the surrounding RTD and sandstone bedrock, whilst providing baseflow to off-site surface waters. Therefore there is potential to impact on the sandstone aquifer as a receptor, and also to act as an off-site migration pathway of PFA impacted groundwater via the sandstone bedrock.
		Surface water bodies surrounding the Site and the River Idle	The Site is located adjacent to the Sutton and Lound Gravel Pits Site of Special Scientific Interest (SSSI). The River Idle and associated wetlands have other biodiversity and amenity value, given the presence of leisure activities, the nature reserve and the water sensitive habitats that rely on the freshwater quality. Surface water is therefore a sensitive receptor.
Property	Chemical attack and creation of migration pathways	On-site buildings and infrastructure	There would be PFA processing areas (the Main Processing Area and Processing Areas 1-3) on the Site where buildings would be constructed which would include office and welfare compound use. Materials are primarily foundations, services, in particular potable water pipes. Foundations and services may be damaged by potentially aggressive conditions (e.g. sulphate and pH) present in soils.
		On-site grazing livestock	Following restoration, the Site would be returned to a mixture of biodiversity led land-use and agriculture. Potential farming uses and grazing livestock receptors would be re-introduced.

The significance of any potential effect has been assessed both by the Conceptual Site Model (CSM) (source-pathway-receptor) which includes the potential for a contaminant linkage to be present, as well as the sensitivity of the receptor. Table 10.8 provides further detail on the assessment of receptor sensitivity for this study.

Table 10.8 Environmental Receptor Sensitivity

Receptor	Direction	Distance at Nearest Point	Sensitivity	Reason for Sensitivity Class
Human Health – construction workers	-	Onsite	Low	Adult age class in working environment undertaking activities in line with role and responsibilities, H&S protection measures, duty of care in place
Human Health – commercial workers / visitors	-	Onsite	Low	
Human Health – agricultural / pasture	-	Onsite	Medium	Farming/agricultural receptors present on and using restored soil areas.
Human Health – recreational	-	Onsite	Low	Public footpath access across soil restored areas.
Human Health – residential	North; West	Offsite <100m	High	Residential receptors of any potential age class located within close proximity to the Site.
Human Health – commercial/ industrial	North; East	Offsite <100m	Low	Adult age class in working environment undertaking activities in line with role and responsibilities, H&S protection measures, duty of care in place
Human Health – recreational	North; East	Offsite <100m	Low	Leisure/amenity users of adjacent wetlands and nature reserves.
Superficial Groundwater Aquifer	-	Offsite adjacent	Medium	Secondary A Aquifer. RTD have been removed from beneath the Site,

Receptor	Direction	Distance at Nearest Point	Sensitivity	Reason for Sensitivity Class
– River Terrace Deposits				however may become impacted in adjacent Site areas.
Bedrock Groundwater Aquifer - Chester Sandstone	-	Onsite - beneath the site	Medium	Principal Aquifer. Located within SPZ3 and supplies industrial use <500m. No recorded potable water supply <2km.
Surface Waters – Sutton & Lound Gravel Pits, River Idle		Offsite adjacent	High	SSSI and wetlands of high biodiversity and amenity value.
Property - foundations & site infrastructure	-	Onsite	Low	Foundations designed with ground and groundwater conditions assessment undertaken. Site infrastructure includes services and potable water supply.
Property – on site grazing livestock		Onsite	Medium	Farming/agricultural receptors present on and using restored soil areas.

10.5 DEVELOPMENT DESIGN MITIGATION

10.5.1 Mitigation by Design

A site-specific ground investigation has been undertaken to characterise the PFA and water quality at the Site which has included a suite of chemical and material property testing. This has been supplemented by a long-term groundwater quality monitoring programme and, more recently, surface water quality monitoring. As such, site conditions have been well characterised and baseline conditions determined. The data obtained from the intrusive works and monitoring have therefore informed design mitigation measures required for the Proposed Development from a ground conditions and contamination perspective. It should also be recognised that the Proposed Development would provide long term betterment from a contamination perspective, through removal of the PFA and protection of identified receptors.

10.5.1.1 Construction Environmental Management Plan

The operational phase would be underpinned by an outline Construction Environmental Management Plan (OCEMP), Volume 3 Appendix 5.3, which includes mitigation measures to be implemented as part of the embedded development design. These are summarised in more detail within Volume 1 Chapter 5 – Project Description, however include measures that comprise:

- Working hours ;
- Surface water and drainage management;
- Measures to protect Ground Water Dependent Terrestrial Ecosystems;
- Waste management;
- Oil and chemical delivery and storage;
- Water quality monitoring;
- Ecological protection measures;
- Construction noise management;
- Handling of excavated materials;
- Reinstatement and restoration;
- Traffic management;
- Environment incident response and reporting;
- Use and extent of borrow pit; and
- Method statements and risk assessments.

To ensure that the mitigation and management measures detailed within this ES are carried out, construction personnel and contractors would be required to adhere to the OCEMP which would form an overarching document for all construction site management requirements.

Contractors would also be required to adhere to the following to minimise environmental effects of the construction process:

- Conditions required under the Consent and deemed planning permission;
- Requirements of statutory consultees, including the EA and Natural England; and
- All relevant statutory requirements and published guidelines that reflect 'good practice'.

The Applicant would require that all contractors follow the requirements of ISO14001 - 'Environmental Management Systems - Specification and Guidance for Use.'

The OCEMP would be agreed with the relevant statutory bodies including the EA, Natural England and NCC prior to commencement of construction, and performance against the OCEMP would be monitored by the Applicant's Construction Project Manager throughout the construction period.

During construction, waste and pollution management measures would be implemented as set out within the OCEMP. As such, it is expected that minimal amounts of waste and associated residues would be generated.

The OCEMP also includes a Water Construction Environmental Management Plan (WCEMP) (Volume 3 Appendix 9.1). The OCEMP comprises methods of work which are established and effective measures that the Proposed Developer would be committed to throughout operation. Accordingly, the assessment of significance of effects of the Proposed Development has been considered with the inclusion of the OCEMP. Mitigation measures in order to protect the identified receptors are also outlined.

More specifically in relation to contamination and pollution control management, mitigation measures are summarised in Table 10.9.

Table 10.9 Management and mitigation measures

Measure	Description and comments	When implemented?
Wheel wash.	The Main Processing Site would include a wheel wash that would be utilised to prevent the tracking of materials onto the public highway. The facility would have sufficient capacity to deal with the maximum number of HGVs required to operate the Site.	Provided from the commencement of operations.
Jet wash.	An additional mobile jet wash facility to supplement the wheel wash would be provided as necessary. This would be used in the unlikely scenario that the wheel wash does not completely remove all debris.	Provided to supplement the wheel wash as necessary.
Dust management, including dampening down of surfaces during dry and/or windy weather.	Standard measures would be utilised, including water bowsers (tractor-mounted and/or stationary).	Provided from the commencement of operations.

Measure	Description and comments	When implemented?
	It should also be noted that the PFA that is to be extracted from the Site is saturated because it has been in the ground for many years. The Applicant has carried out a detailed drilling exercise to sample and test PFA from across the Site, including dozens of boreholes. This has confirmed that the PFA has an in-situ moisture content of 18% to 47%, or an average of 31% across the Site. It is therefore considered to have limited potential for dust generation when it comes out of the ground. To further manage dust generation the Site would be worked in phases with limited exposed areas, and all conveyor belts would be covered. The only area where the Applicant would intentionally seek to dry the PFA is at the Main Processing Site, where operations would be fully enclosed, including a storage building under negative pressure, enclosed drying plant with dust collection system, enclosed silos, and product taken away using enclosed powder tankers and/or sheeted wagons.	
Site drainage and water management.	The Proposed Development includes a comprehensive Drainage Management Plan (DMP) ES Volume 3, Appendix 9.3). This would be further supplemented by further detail in any Environmental Permit and reserved by suitable planning conditions, as is standard practice when dealing with drainage. The DMP includes measures to adequately manage groundwater, surface water and process water, in order to prevent contamination.	Provided from the start of operations as per the Site Phasing Plans.
Soils to be managed and stored in accordance with best practice for future use in restoration.	Soils present within the Site that are removed during the extraction operations would be managed and stored in accordance with best practice.	Provided from the commencement of operations.

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10.5.1.2 Environmental Permitting

The Proposed Development would be regulated by the Environment Agency (EA) under the Environmental Permitting (England & Wales) Regulations 2016 (as amended), given that the PFA is a waste material that is to be recovered. Therefore, impacts to ground and groundwater, and water discharges from Site would be monitored and reported in compliance with accepted regulatory permit limits. The Environmental Permit would have specific obligations that must be met in terms of mitigation and environmental protection. These would comprise:

- Environmental Permit for treatment of PFA: this is from the point of extraction and includes dewatering, pre-screening, feedstock storage, treatment by drying and product storage activities. The application (in production at this time) also requires a dust management plan to be submitted with it in accordance with EA guidance 'emissions management plan for dust'.
- Waste Recovery Plan (WRP) and Permit for the restoration of the void using waste - a waste recovery plan would be prepared and included with the recovery permit application in accordance with the EA's guidance 'waste recovery plans and deposit for recovery applications'. Note that there no proposals in the planning application to import waste, however reject material from PFA processing may be used beneficially in the restoration of the Site.
- Dewatering/Water Extraction Permit – a water abstraction license is required for dewatering of the PFA during extraction where it is at or below the water table (in production at this time).
- Water Discharge Permit – any abstracted water would be discharged back into the aquifer and therefore a water discharge permit is required (in production at this time).

Given that the Site would be a licensed under a waste recovery operation, restoration would be undertaken in accordance with an Environment Agency construction quality assurance (CQA) plan.

Further technical assessments would be undertaken to support these permit requirements as required, which would include a programme of surface water quality sampling and assessment, potential water treatment options prior to discharge, hydrogeological risk assessment and air deposition assessments.

10.5.1.3 Site Drainage and Water Management

As noted earlier in this Chapter, a comprehensive Drainage Management Plan (DMP) (Volume 3, Appendix 9.3) has been prepared in support of the planning application for the Proposed Development. This would be supplemented by further detail in the Environmental Permit and reserved by suitable planning conditions, as is standard practice when dealing with drainage. As such, the design of water and drainage controls at the Site would comprehensively and robustly manage the potential for release of contamination from all operational Site areas to the water environment.

The DMP includes measures to adequately manage groundwater, surface water and process water, in order to prevent contamination. Operations at the Site are likely to generate significant quantities of water through, if applied, active dewatering of groundwater in addition to surface water flows, through runoff and direct rainfall.

Initially inflow volumes would be relatively low due to the low permeability of the PFA, however once the excavation reaches the base of the PFA / top of the underlying sandstones the volumes would potentially be significantly higher due to groundwater upwelling from the quarry floor. Dewatering, where necessary, would be achieved by

excavating base ditches at the bottom of the wet extraction face, to collect groundwater. This would then travel into a sump or similar, where the top water would be removed allowing the remaining silt laden water to settle within the main dig.

In accordance with the drainage disposal hierarchy outlined in the CIRIA SuDS Manual it is proposed that the discharge of dewatering from active areas of the Site would be via pumping to settlement and soakaway ponds, to be constructed in LR P1 and LR P 2 along the southern boundary of the Site by excavating through the PFA and into the underlying sandstone. Initial settlement ponds and ditches would be maintained within the dig, with gravity flow from the open face. Flow controls would be implemented to improve silt retention within the dig (check dams etc).

A preliminary assessment of the viability of this disposal option has been carried out using infiltration rates derived from slug tests carried out in three PFA wells and two groundwater boreholes within the sandstone.

Additional slug testing would be carried out in the sandstone boreholes on the Site to validate the hydraulic conductivity values assumed in the assessment of infiltration rates from the proposed groundwater soakaway. Consideration would also be given to the potential volumes of leachate and runoff from areas of hardstanding at the Processing Areas (1-3) where material is stockpiled temporarily prior to screening and onward transport to the Main Processing Site. It is envisaged that this water would be intercepted by a system of sealed cut-off drains and collected in a sump where the top water would be pumped to the primary settlement lagoons. During HR P1, it is envisaged that an initial settlement pond and soakaway may be established within the main dig area prior to construction of the primary settlement and soakaway ponds to allow discharge of settled leachate to groundwater by infiltration. However, the more likely scenario is that the Applicant would avoid any groundwater abstraction until the main settlement and soakaway ponds are constructed.

If required, additional below ground storage and interceptors would be fitted into the drainage system to ensure that there is no adverse impact on the quality and quantity of drainage/water being discharged and managed at the Site.

10.5.1.4 Flood Risk

A Flood Risk Assessment (FRA) has been completed and is provided in Volume 3 Appendix 9.2.

Consultation with statutory consultees during the FRA identified that some sections of the lagoon embankments provide flood protection from the River Idle to the east. The Applicant subsequently redesigned the scheme to ensure that these embankments are retained at a suitable level to ensure that the same level of flood protection is retained. As such the scheme has been designed to ensure retained embankments are above flood level and, as such, reduce contamination risk to surface water by preventing flood water from entering and potentially washing out contaminants beyond the site boundary.

This is further detailed in Volume 1 Chapter 9 - Hydrology, Hydrogeology and Flood Risk.

10.5.1.5 Dust Management

In addition to the dust control measures outlined in the OCEMP, a Dust Impact Assessment and Dust Management Plan have been prepared and are provided in Volume 3 Appendix 13.

This dust assessment has assessed the potential impacts of dust on air quality and local amenity associated with the proposed PFA extraction and processing facility. The potential impact associated with the dust emissions on human and ecological receptor locations within the Site locale have been assessed used methodologies as outlined within

the IAQM minerals dust guidance. The assessment has specifically identified receptors to be assessed by potential impacts within 250m of the Site boundary.

The most important climatic parameters governing the release and dispersal of fugitive emissions from the development are wind speed, direction and rainfall:

- wind direction determines the broad direction of dispersal;
- wind speed affects ground level concentrations by increasing the initial dilution of pollutants in the emission. It would also affect the potential for dust entrainment; and
- rainfall naturally supresses dust release.

An assessment of wind direction confirmed that this is predominantly towards the north and east.

A range of dust mitigation measures have been incorporated into the scheme design which include location of processing activities away from receptors use of screens, canvas dust covers, stockpile management, water availability, use of hard paved areas which is swept and effectively watered, and the main processing area being fully enclosed and using negative pressure extraction systems, exhausts from dryers passing through cyclone and fabric filters prior to release to atmosphere. Wheel washes would be utilised and all material transferred off site contained either by powder tankers or sheeted wagons. Road sweepers would be used on site for use on local road network, access road and main processing area, as required.

In addition, management actions and dust control techniques would also be included as part of operational activities. This would include daily visual monitoring, activities in close proximity to offsite receptors would be planned only during favourable weather conditions, vegetation removal and soil stripping would be undertaken in discrete phases, hoppers would use dust flaps, drop heights would be reduced and material covered to prevent wind whipping.

Monitoring of impacts would be achieved by recording and monitoring complaints. Complaints may be reported directly to Site, or via the Mineral Planning Authority or Local Environmental Health Department. A complaints procedure would be implemented on Site.

A nominated Site representative would act as liaison with the regulator and local community for issues relating to dust nuisance. The representative shall respond promptly to all complaints by undertaking an investigation into the dust event, including weather conditions, operations on Site and mitigation measures in place at the time of the complaint. Complainants would be informed of the outcomes of the investigation.

Following the receipt of a complaint, a dust event form shall be completed, and the results of the subsequent investigation kept in the Site Log book.

These measures are all detailed within the Dust Management Plan.

The conclusions of the assessment are that the proposed operations would result in a not significant effect with regard to dust at sensitive receptors within the Site locale, in consideration of the designed-in and recommended mitigation measures which would be implemented.

10.6 ASSESSMENT OF LIKELY EFFECTS

An assessment of likely effects is undertaken to understand the potential impacts of the Proposed Development to human health, controlled waters (groundwater, surface water), property and infrastructure prior to mitigation during both the construction and operation of the Proposed Development. It also assesses the magnitude of each identified impact. The significance of any potential effect has been assessed (based on the sensitivity of

the receptor) as described in Table 10.4 and the magnitude of the potential impacts has been assessed as described in Table 10.5.

10.6.1 Potential Construction Effects

The construction phase works would comprise site establishment activities in preparation for the PFA extraction works to commence. This would include securing the Site and its boundaries, putting in place protection around retained woodland, advance planting of vegetation, the construction of parts of the haul and conveyor, the preparation of the filter ponds and creation of the overburden/soil store. A temporary construction compound(s) (TCC) would be located in the Main Processing Area (Area C). This would be located on existing hardstanding at the Site and temporary cabins would be used for site offices and welfare facilities. Further detail for the construction activities is provided in Volume 1 Chapter 5 – Project Description.

Given the nature of these preparatory works, there would be no significant disturbance of ground conditions or PFA that would result in effects other than to on-site construction workers or on-site operational workers / visitors.

There would however need to be consideration of potential chemical pollution of surface water and groundwater from accidental chemicals spills from fuel or chemical storage, refuelling, washing or leakages from plant onsite; and potential chemical pollution of surface water and groundwater from chemical spills or dusts from infrastructure construction, including concrete. These would be addressed through implementation of the design mitigation measures as outlined in Section 10.5.1, more specifically the OCEMP/WCEMP and DMP.

10.6.1.1 Human Health

On-Site Construction Workers

Construction activities would include disturbance of the ground during earthworks and installation of foundations with associated potential for dust generation and the potential to encounter PFA if it is close to the surface. The length of time of direct exposure would be limited to the duration of site works in which construction workers are directly involved. However, any health effects from potential contamination could have a medium to long term effect. Construction workers are assigned a low sensitivity due to the mitigation and control measures that would be in place.

All construction workers would be subject to mandatory health and safety requirements under the Construction (Design and Management) (CDM) Regulations 2015 and the Control of Substances Hazardous to Health Regulations 2002 (as amended). Construction workers would be made aware of the possibility of encountering contaminated soils in the ground through toolbox talks. Safe working procedures would be implemented, good standards of personal hygiene would be observed and appropriate levels of personal protective equipment (PPE) and respiratory protective equipment (RPE) would be provided and utilised as necessary, thereby minimising the risk of exposure to potentially contaminated soils, ground gas and groundwater. Where risks are identified they can therefore be managed as part of the construction phase such that the risks to human health would be low.

The potential effects upon construction workers would be limited for the duration of the construction phase activities. As such, the overall magnitude of the effect upon health of construction workers during the construction phase is defined as 'negligible'. The significance of the impact is therefore also 'negligible'.

On-Site Commercial site workers / visitors

A TCC(s) would be prepared where temporary cabins would be placed for site offices and welfare facilities. This would be located on existing hardstanding at the Site. If not located on existing hardstanding, any area to be used for a TCC would be stripped of topsoil to expose a suitable formation which would be stored for future re-instatement. A geosynthetic material base or similar would then be laid followed by a layer of suitable material then a further geosynthetic material laid prior to the top surface of blended fines.

Site workers and visitors who may occupy such areas would be subject to the same controls as construction workers on the Site, however would have a lower potential exposure risk when present in a commercial (office) setting. It is anticipated that there would not be potential for a significant exposure pathway to this type of worker from potential ground contamination. A hard surface or a geosynthetic material with granular cover would be in place across the area and there would be no direct contact with underlying soils or groundwork activity. Commercial site workers are assigned a low sensitivity due to the limited period of potential exposure and open site surroundings.

Commercial workers would also be subject to mandatory health and safety requirements under the Construction (Design and Management) (CDM) Regulations 2015 and the Control of Substances Hazardous to Health Regulations 2002 (as amended). Safe working procedures and good standards of personal hygiene would be observed with appropriate levels of personal protective equipment (PPE) where required. Where risks are identified they can therefore be managed as part of the construction phase such that the risks to human health would be low.

The potential effects upon commercial workers would be limited for the duration of the construction phase activities. As such, the overall magnitude of the effect upon health of construction workers during the construction phase is defined as 'negligible'. The significance of the impact is therefore also 'negligible'.

10.6.1.2 Controlled Waters - Groundwater

Superficial Aquifer (River Terrace Deposits)

Whilst the River Terrace Deposits (RTD) have largely been removed from beneath the PFA lagoon areas, it is likely the RTD could be present beneath the haul road (Area B) and main processing area (Area C). As such there is potential impact to this aquifer from potential chemical pollution of groundwater from accidental chemicals spills from fuel or chemical storage, refuelling, washing or leakages from plant onsite. Therefore, careful management and mitigation is required to protect impacts to this aquifer.

As such, construction activities would be controlled via a series of detailed Construction Method Statements (CMS) which would be prepared prior to construction by a Principal Contractor appointed by the Applicant, who would have overall responsibility for environmental management on the construction site. While these method statements can only be finalised at detailed design it is possible to indicate the outline of the methods that would be used, particularly in relation to environmental management. For example, an outline Construction Environmental Management Plan (OCEMP) (Volume 3 Appendix 5.3) which incorporates a water Construction Environmental Management Plan (WCEMP) (Volume 3 Appendix 9.1) has been prepared to support the planning application. The appointed Contractor would be required working with specialist advisors would ensure construction activities are carried out in accordance with the mitigation measures outlined in this ES.

During construction, waste and pollution management measures would be implemented as set out within the OCEMP. As such, it is expected that potential for environmental

pollution through leaks, spillages or other operational activities would be controlled and mitigated.

The magnitude of impact on groundwater within the River Terrace Deposits is 'low' and the significance of effect would be 'minor'.

Bedrock Aquifer (Chester Sandstone)

The sandstone bedrock aquifer is present beneath the entire Site area. Whilst it is a sensitive receptor, it is afforded some protection from construction phase activities by the presence of the overlying soils and River Terrace Deposits. It is considered that any potential contamination event would need to be relatively significant to impact on the underlying sandstone. Although it is recognised, that the overlying River Terrace Deposits are granular in nature, and can transmit mobile contamination due to its permeability.

Construction activities would be controlled via the aforementioned detailed CMS(s) and in accordance with the OCEMP) and WCEMP. The appointed Contractor would be required working with specialist advisors would ensure construction activities are carried out in accordance with the mitigation measures outlined in this ES.

During construction, waste and pollution management measures would be implemented as set out within the OCEMP/WCEMP. As such, it is expected that potential for environmental pollution through leaks, spillages or other operational activities would be controlled and mitigated.

The magnitude of impact on groundwater within the Chester Sandstone is 'low' and the significance of effect would be 'minor'.

10.6.1.3 Controlled Waters - Surface Water

Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)

Sutton and Lound Gravel Pit SSSI is located adjacent to the east and south of the Site, and the River Idle is at its closest point within 100m of the Site boundary. Given the water dependent biodiversity and habitats that rely on the surface water quality, it is a highly sensitive receptor.

Construction phase activities that would be in closest proximity to these surface waters include putting in place protection around retained woodland and advance planting of vegetation around the Site boundaries. The other construction phase activities, including c the construction of the haul route/conveyor, Processing Areas 1-3, the preparation of the filter ponds, creation of the overburden store and temporary construction compound (TCC) would all be located further away from these receptors.

Whilst there is potential for accidental chemicals spills from fuel or chemical storage, refuelling, washing or leakages from plant onsite, such contamination would need to migrate via surface water flow from the Site, or via groundwater migration pathways. Whilst such migration is possible, given the travel distance and nature of the construction activities, it would require a relatively large pollution incident to occur.

It should also be considered that construction activities would be controlled via the detailed CMS(s) and in accordance with the OCEMP and WCEMP. The appointed Contractor would be required working with specialist advisors would ensure construction activities are carried out in accordance with the mitigation measures outlined in this ES.

During construction, waste and pollution management measures would be implemented as set out within the OCEMP/WCEMP. As such, it is expected that potential for

environmental pollution through leaks, spillages or other operational activities would be controlled and mitigated.

The magnitude of impact on surface water within the Sutton and Lound Gravel Pit SSSI and River Idle is 'low' and the significance of effect would be 'minor'.

10.6.1.4 Property

Building Foundations & Infrastructure

A TCC would be prepared where temporary cabins would be placed for site offices and welfare facilities (likely limited to Area C). This would be located on existing hardstanding or a specifically placed geotextile with granular surface cover layer. It is not proposed to penetrate the ground with piles or other foundation solutions. There would however need to be some below ground infrastructure that services these areas, and in particular a clean potable water supply for welfare purposes.

Whilst the potential for chemical attack on buildings and structures is low risk, it would need to be ensured that pathways are not opened up or created for potential contamination to migrate, exposure potential receptors or that potable water supply is not placed in contaminated ground that could be present.

Construction activities would be controlled via the detailed CMS(s) and in accordance with the OCEMP. This would include the requirement for clean potable water supply provision.

The magnitude of impact on building foundations and infrastructure is 'negligible' and the significance of effect would be 'negligible'.

10.6.2 Potential Operational Effects

The operational phase would comprise the main PFA extraction (in Area A), and its subsequent screening, processing and export from Site. The operational phase would therefore comprise the greatest amount of intrusive work given the nature of the recovery activities proposed. Further detail for the operational activities is provided in ES Volume 1, Chapter 5 – Project Description.

10.6.2.1 Human Health

On-Site Workers

Whilst risks to workers, including those dealing with the extraction and processing of PFA, are typically relatively short-term, exposure could take place over a longer term period than for a typical construction project. The greatest risks are considered to be associated with dermal exposure to high pH which could result in skin irritation, or inhalation of dusts during the excavation and processing of the PFA material. Any works on the Site would be subject to work controlled under EA regulatory permit requirements, which would include the protection of site workers. Exposure risks to workers would be addressed via Contractor Health and Safety Plans and Risk Assessments as part of Health and Safety requirements. There would also be supporting documents such as the OCEMP, which details required mitigation measures such as monitoring of dusts at the Site and clean/dirty areas for contractor welfare. It is therefore considered that with such controls in place that exposure risks would be suitably mitigated.

The potential effects upon site workers would be limited for the duration of the construction phase activities. The magnitude of impact to on-site construction workers is 'low' and the significance of effect would be 'minor'.

On-Site Commercial site workers / visitors

Office accommodation and welfare facilities would be provided at Main Processing Site (Area C). These would be located on existing hardstanding and connected to the site drainage system.

Site workers and visitors who may occupy such areas would be subject to the same controls as construction workers at the Site, however would have a lower potential exposure risk when present in a commercial (office) setting. It is anticipated that there would not be potential for a significant exposure pathway to this type of worker from potential ground contamination. Commercial site workers are assigned a low sensitivity due to the limited period of potential exposure and open site surroundings.

Commercial workers would also be subject to mandatory health and safety requirements under the Construction (Design and Management) (CDM) Regulations 2015 and the Control of Substances Hazardous to Health Regulations 2002 (as amended). Safe working procedures and good standards of personal hygiene would be observed with appropriate levels of personal protective equipment (PPE) where required. Where risks are identified they can therefore be managed as part of the construction phase such that the risks to human health would be low.

The overall magnitude of the effect upon health of construction workers during the construction phase is defined as 'negligible'. The significance of the impact is therefore also 'negligible'.

Off-Site Residential

The closest residential properties to the Site comprise Low Farm and Sutton Grange Farm, located immediately to the north of the Site; residential properties at Bellmoor/Bellmoor Farm located approximately 100 m to the west; and two dwellings associated with the Wetlands Fishery beyond Lound Low Road to the north. There are further residential and farmhouse properties within 500m.

The greatest potential exposure pathways are considered to be the release of airborne particulates that, if not appropriately managed, could be transported and deposited at those residential properties immediately closest to the Site, as well as release of dusts from articulated HGVs and/or conveyors.

A Dust Impact Assessment and Dust Management Plan have been prepared and are provided in Volume 3 Appendix 13.

The works on Site would be undertaken in a controlled way under regulatory permit requirements and in accordance with other supporting documents such as the OCEMP and Dust Management Plan. It is not anticipated that there will be any 'other' buried wastes within the PFA, however a watching brief/suitable training would be implemented to identify such material so that it can be dealt with should it be uncovered. As such, mitigation measures would be put in place to monitor and control airborne exposure risks, and would include the wetting of the material (with a water bowser(s) or similar), as necessary, as it is worked and extracted.

It should also be noted that the PFA that is to be extracted from the Site is saturated because it has been in the ground for many years. The Applicant has carried out a detailed drilling exercise to sample and test PFA from across the Site, including twenty-three boreholes and four trial pits. This has confirmed that the PFA has an in-situ moisture content of 18% to 47%, or an average of 31% across the Site. It is therefore considered to have limited potential for dust generation when it comes out of the ground.

To further manage dust generation the Site would be worked in phases with limited exposed areas, and all conveyor belts would be covered. The only area where the Applicant would intentionally seek to dry the PFA is at the Main Processing Site, where

operations would be fully enclosed, including a storage building under negative pressure, enclosed drying plant with dust collection system, enclosed silos, and product taken away using enclosed powder tankers and/or sheeted wagons.

In addition to the measures set out above the Applicant would establish a community liaison group. A nominated Site representative would act as liaison with the regulator and local community for issues relating to dust nuisance. The representative would positively engage and respond promptly to all complaints by undertaking an investigation into the dust event, including weather conditions, operations on Site and mitigation measures in place at the time of the complaint reported directly to Site, via the Mineral Planning Authority or Local Environmental Health Department. The role of the Site representative is to have a direct point of contact with residents to ensure that dialogue and active engagement is maintained, and if there any issues, that these are captured and addressed at the earliest opportunity. It is intended that this open and accessible interface would enable proactive management of dust related issues, prompt implementation of improvement measures that avoid nuisance and ensure health protection of residential users in adjacent areas.

It is therefore considered that with such controls in place that exposure risks would be suitably mitigated. The magnitude of impact on off-site residential receptors is 'low' and the significance of effect would be 'minor'.

Off-Site Commercial / industrial

Commercial/industrial activity is located 100m north of the Site beyond Lound Low Road where an anaerobic digestion plant is located. Further 200m to the north, is a large pre-cast concrete works. A small metal fabricator is also located further to the west on Low Lound Road. Adjacent to the Main Processing Area at Bellmoor Industrial Estate there area number of industrial uses, including a stone mason and concrete batching plant.

The greatest potential exposure pathways are considered to be the release of airborne particulates that could be transported and deposited in those commercial use areas, as well as release of dusts from articulated HGVs.

A nominated Site representative would act as liaison with the regulator and local community for issues relating to dust nuisance. The Site representative would also act as a direct point of contact with local businesses to ensure that dialogue and active engagement is maintained, and if there any issues, that these are captured and addressed at the earliest opportunity. It is intended that this open and accessible interface would enable proactive management of dust related issues, and prompt implementation of improvement measures that avoid nuisance to off-site commercial/industrial use areas.

The works on Site would be subject to the same management and mitigation measures as referred to previously. The magnitude of impact on off-site commercial / industrial users is therefore 'negligible' and the significance of effect would be 'negligible'.

Off-Site Recreational

There are a wide range of leisure/amenity users in the immediate area that include walkers, cyclists, equestrians, anglers and visitors to the Idle Valley nature reserve located 500 m to the south of the main processing area. The A.P.E. and Prime8 educational and outdoor facilities are located on the other side of the Site to the north of Lound Low Road, close to the Wetlands Animal Park. The greatest potential exposure pathways are considered to be the release of airborne particulates that could be transported and deposited in these recreational use areas, the release of dusts from articulated HGVs as they transport PFA material away from the Site and also any impacts to surface water quality that could affect amenity value.

It is recognised that users of Idle Valley nature reserve could include individual users with higher levels of health sensitivity from potential exposure to airborne PFA which could impact on the respiratory system, those users with higher levels of activity (walkers, runners etc) and some who may be at constant exposure while occupying a static position (wetland users, anglers etc). There may be others who could be exposed through the direct ingestion or inhalation of dusts or exposure to the skin during other general leisure activity. In addition to this, the loss of amenity could impact on mental health and wellbeing. It is therefore important that the protection of such users is considered, as well as the amenity value of the nature reserve and the water sensitive habitats that rely on the freshwater quality.

The works on Site would be controlled by legislative Health and Safety requirements, planning controls, EA regulatory permit requirements and in accordance with other supporting documents, such as the OCEMP and Dust Management Plan.

Also, to reiterate, the PFA that is to be extracted from the Site is saturated because it has been in the ground for many years. The Applicant has carried out a detailed drilling exercise to sample and test PFA from across the Site, including dozens of boreholes. This has confirmed that the PFA has an in-situ moisture content of 18% to 47%, or an average of 31% across the Site. It is therefore considered to have limited potential for dust generation when it comes out of the ground.

To further manage dust generation the Site would be worked in phases with limited exposed areas, and all conveyor belts would be covered. The only area where the Applicant would intentionally seek to dry the PFA is at the Main Processing Site, where operations would be fully enclosed, including a storage building under negative pressure, enclosed drying plant with dust collection system, enclosed silos, and product taken away using enclosed powder tankers and/or sheeted wagons.

The Applicant would establish a community liaison group. A nominated Site representative would act as liaison with the regulator and local community for issues relating to dust nuisance. The representative would positively engage and respond promptly to all complaints by undertaking an investigation into the dust event, including weather conditions, operations on Site and mitigation measures in place at the time of the complaint. The role of the Site representative is to have a direct point of contact with the community which includes off-site recreational and leisure users to ensure that dialogue and active engagement is maintained, and if there any issues, that these are captured and addressed at the earliest opportunity. It is intended that this open and accessible interface would enable proactive management of dust related issues, prompt implementation of improvement measures that avoid nuisance and ensure protection to recreational/leisure use areas.

The drainage design would ensure that operational waters are contained within the Site through a series of pumping and treatment systems which would ensure that PFA impacted water would not be released to surface water and impact on or impair the sensitive water quality within the wetland areas.

Given the levels of robust regulatory requirements, in particular the impacts to the water environment, it is considered that with such controls in place, along with the other management and mitigation measures proposed, exposure risks to recreational users and amenity value of the wetlands would be suitably mitigated.

The magnitude of impact on off-site recreational users is 'negligible' and the significance of effect would be 'negligible'.

10.6.2.2 Controlled Waters - Groundwater

Superficial Aquifer (River Terrace Deposits)

Whilst geological mapping indicates the presence of RTD at the Site, it is assumed that the superficial deposits have been fully worked and the base of the PFA is predominantly located on the underlying sandstone of the Chester Formation. Nevertheless, there is likely to be some residual unworked RTD present, and at the quarry extents RTD could be present and provide connectivity with the deposit that extends off-site. The RTD is designated a Secondary A Aquifer by the EA and therefore requires protection as a resource, as well as being a conduit to both surface water and deeper groundwater.

Ground investigation has been undertaken which has included installation of boreholes within the PFA, which has allowed water quality sampling to be undertaken. The groundwater quality within the PFA has therefore been well characterised. There is no indication for the presence of 'other' buried material in the PFA contained within the chemical signature of the water analysis. As such, the risks from such unknown buried material is considered to be low.

The extraction and processing of the PFA has the potential to impact on the water quality within the RTD as the extraction would take place down below the water table. There is the possibility for the impact on water at the face of the extraction, as well as effects from damping down of the material and recirculation of operational water. Given the sensitivity of the water environment at and surrounding the Site, the operational activities would be subject to EA permit requirements and controls, and there would be a comprehensive drainage and water management system covering all areas of the Site and operational activities. This would include ongoing surface water and groundwater quality monitoring, specific drainage designs (as summarised earlier in this Chapter), surface water and groundwater risk assessments, settlement and treatment lagoon design, dewatering and pumped water discharges; all of which would be addressed through the EA regulatory permit and compliance requirements, and which has been set out in the DMP, with further detail proposed to be reserved by suitable planning condition(s). Pollution control from site activities would also be implemented in accordance with other supporting documents such as the OCEMP/WCEMP.

Given the levels of robust regulatory requirements, in particular the impacts to the water environment, and the proposed management and mitigation measures, it is considered that with such controls in place pollution risks to the RTD would be suitably mitigated.

The magnitude of impact on groundwater within the RTD is 'low' and the significance of effect would be 'minor'.

Bedrock Aquifer (Chester Sandstone)

The sandstone of the Chester Formation underlying the Site is designated a Principal aquifer by the EA. It is strategically important aquifer on a regional scale and provides process water for industrial use in the vicinity of the Site. It is assumed that the RTD that overlie the bedrock would have been fully worked and the base of the PFA is located directly on the underlying sandstone. As such, there is an existing direct contact pathway and mixing of the PFA within the upper unit of this aquifer that is already taking place. Nevertheless, given the proposed activities, the sandstone must be afforded protection given its Principal aquifer status. Whilst it is likely that mixing of PFA will have impacted the upper stratum of the sandstone, the deposit will also be hydraulically connected and act as a conduit for groundwater in the surrounding RTD and sandstone bedrock but will also provide baseflow to the sensitive surface waters. In this regard, it is important that surface water quality is not impacted from increased flows and pulses of PFA impacted groundwater that could occur during opening of the ground during extraction operations at the Site.

Given the known sensitivity of the water environment at and surrounding the Site, the operational activities would be subject to EA permit requirements and controls, as well as other site-specific measures. This would include ongoing surface water and groundwater quality monitoring, specific drainage designs (as summarised earlier in this Chapter), surface water and groundwater risk assessments, settlement and treatment lagoon design, dewatering and pumped water discharges; all of which would be addressed through the EA regulatory permit and compliance requirements, and which has been set out in the DMP, with further detail proposed to be reserved by suitable planning condition(s). Pollution control from site activities would also be implemented in accordance with other supporting documents such as the OCEMP/WCEMP.

Given the levels of robust regulatory requirements, in particular the impacts to the water environment, it is considered that with such controls in place pollution risks to the Sandstone would be suitably mitigated.

The magnitude of impact on groundwater within the Chester Sandstone is 'low' and the significance of effect would be 'minor'.

10.6.2.3 Controlled Waters - Surface Water

Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)

There are no mapped watercourses within the Site boundary, with the nearest Water Framework Directive (WFD) classified watercourse being the River Idle located immediately to the east of the Site boundary, flowing from south to north. The wider area is extensively drained with several lagoons, waterbodies and canals, with two drains present onsite, one to the south-west, the other to the north. The EA has classified the River Idle a waterbody of Moderate water quality in the vicinity of the Site.

The Site is located adjacent to the Sutton and Lound Gravel Pits SSSI, due to the aggregations of non-breeding birds and assemblages of breeding birds. Statutory designated sites relating to water that are considered hydrologically connected to the Site are the River Idle Washlands SSSI (approx. 7.9km north) and Misson Line Bank SSSI (approx. 9.8km north) both of which are located downstream of the Site, on banks of River Idle, albeit some distance downstream.

It is also recognised that the River Idle and associated wetlands have amenity value, given the presence of leisure activities, the nature reserve and the water sensitive habitats that rely on the freshwater quality. As such, this amenity value also needs to be protected.

As such, surface water sensitivity is considered to be high by virtue of the ecological designation and the hydrologically connected statutory designated sites. In addition to this, there are also eight active surface water abstractions within 2km of the Site, and whilst are not for sensitive potable uses, demonstrate the importance of the surface water as resource in a regional context.

Given the known sensitivity of the water environment at and surrounding the Site, the operational activities would be subject to EA permit requirements and controls, as well as other site-specific measures. This would include ongoing surface water and groundwater quality monitoring, specific drainage designs (as summarised earlier in this Chapter), surface water and groundwater risk assessments, settlement and treatment lagoon design, dewatering and pumped water discharges; all of which would be addressed through the EA regulatory permit and compliance requirements, and which has been set out in the DMP, with further detail proposed to be reserved by suitable planning condition(s). Pollution control from site activities would also be implemented in accordance with other supporting documents such as the OCEMP/WCEMP.

Given the levels of robust regulatory requirements, in particular the impacts to the water environment, it is considered that with such controls in place pollution risks to surface waters would be suitably mitigated.

The magnitude of impact on surface water within the Sutton and Lound Gravel Pit SSSI and River Idle is 'low' and the significance of effect would be 'minor'.

10.6.2.4 Property

Building Foundations & Infrastructure

These would be located on existing hardstanding or a specifically placed geotextile with granular surface cover layer. It is not proposed to penetrate the ground with piles or other foundation solutions. There would however need to be some below ground infrastructure that services these areas, and in particular a clean potable water supply for welfare purposes.

Whilst the potential for chemical attack on buildings and structures is a low risk, it would need to be ensured that pathways are not opened up or created for potential contamination to migrate, exposure potential receptors or that potable water supply is not placed in contaminated ground that could be present.

The magnitude of impact on building foundations and infrastructure is 'negligible' and the significance of effect would be 'negligible'.

10.6.3 Potential Restoration Effects

It is proposed to progressively extract the PFA in a phased approach and sequentially restore the Site as extraction proceeds into the next phase. Each phase is to be backfilled with unused overburden and restored with previously stripped and stored site-won topsoil. There may also be a requirement to import some engineering clay or similar to line and/or cap areas of the Site. Following restoration, the Site would be returned to a mixture of biodiversity led land-use and agriculture, including wet meadow, reed beds and pasture. Once the scheme is complete and restoration has taken place there would be no further impact to off-site residential, commercial/industrial or recreational users.

10.6.3.1 Human Health

On-Site Agricultural

Following restoration, the Site would be returned to a part agriculture land use which may include potential farming uses and grazing livestock. Such land use would need to be managed by farmers / agricultural tenants who would either manage the land itself or occupy the restored Site to tend to livestock. As such, potential on-site human health receptors would be re-introduced.

It would therefore need to be ensured that topsoil is suitable for its proposed use, there is a required thickness and there is no contamination risk to human health.

The restoration would be regulated under EA permit requirements and the OCEMP. It is therefore considered that controls would be in place to ensure that the topsoil used as a cover system across the Site would be of suitable thickness, quantity and quality for its proposed use.

The magnitude of impact to on-site agricultural users is 'negligible' and the significance of effect would be 'negligible'.

On-Site Recreational

A public right of way crosses through part of the Site. The footpath would be retained as part of the restored site. It would therefore need to be ensured that topsoil is suitable for its proposed use, there is a required thickness and there is no contamination risk to human health.

The restoration would be regulated as necessary under EA permit requirements and the OCEMP. It is therefore considered that controls would be in place to ensure that the topsoil used as a cover system across the Site would be of suitable thickness, quantity and quality for its proposed use.

The magnitude of impact to on-site recreational users is 'negligible' and the significance of effect would be 'negligible'.

10.6.3.2 Controlled Waters - Groundwater

Superficial Aquifer (River Terrace Deposits)

Given that the Site would be a licensed under a waste recovery permit, restoration would be undertaken in accordance with an EA construction quality assurance (CQA) plan; and would also meet planning requirements through the OCEMP/WCEMP.

Given the levels of robust regulatory requirements, in particular the CQA requirements for restoration, it is considered that with such controls in place pollution risks to the RTD would be suitably mitigated.

The magnitude of impact on groundwater within the RTD is 'negligible' and the significance of effect would be 'negligible'.

Bedrock Aquifer (Chester Sandstone)

Given that the Site would be a licensed under an environmental permit, restoration would be undertaken in accordance with an EA construction quality assurance (CQA) plan; and would also meet planning requirements through the OCEMP/WCEMP.

Given the levels of robust regulatory requirements, in particular the CQA requirements for restoration, it is considered that with such controls in place pollution risks to the sandstone bedrock would be suitably mitigated.

The magnitude of impact on groundwater within the Chester Sandstone is 'negligible' and the significance of effect would be 'negligible'.

10.6.3.3 Controlled Waters - Surface Water

Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)

Following restoration, the Site would be returned to a mixture of biodiversity led land-use which would include wet meadow and reed bed features that may have the potential to hydraulically connect to the adjacent Sutton and Lound Gravel Pit SSSI and River Idle. Surface water and run-off, if not managed, could migrate. As such, there remains potential for the restored Site to impact on surface water quality of these off-site receptors.

The restored site includes a network of new ditches that drain into an existing drain in the northern boundary of the Site. This takes water from the Site away from the closest parts of the SSSI to the south.

Whilst the drainage connectivity is possible, given the levels of robust regulatory requirements, in particular the CQA requirements for restoration, it is considered that with such controls in place pollution risks to the RTD would be suitably mitigated.

The magnitude of impact on surface water within the Sutton and Lound Gravel Pit SSSI and River Idle is 'negligible' and the significance of effect would be 'negligible'.

10.6.3.4 Property

Onsite Grazing Livestock

Following restoration, the Site would be returned to a part agriculture land use whereby grazing livestock receptors would be re-introduced. An ALC survey has undertaken to assess the quality of existing use. The restoration would also be regulated under EA permit requirements, as necessary, and the OCEMP. It is therefore considered that controls would be in place to ensure that the topsoil used as a cover system across the Site would be of suitable thickness, quantity and quality for its proposed use.

The magnitude of impact to on-site grazing livestock is 'negligible' and the significance of effect would be 'negligible'.

10.7 AGRICULTURAL LAND HOLDINGS (FARM IMPACT ASSESSMENT)

An ALC report has been completed which indicates the land across the proposed extraction area (Area A) has thin (20-50 cm) restored natural sandy soils (topsoil & subsoil) over silty fuel ash (PFA) to depth. The report indicates Area A would appear to be good quality land (deep and well drained); however, it notes there were no plant roots or biology (earthworms) found to be present within the deposit, therefore suggesting that the PFA is phytotoxic. If crop roots cannot extract moisture from the PFA, the soils across the area are effectively shallow and sandy and most of the land is very droughty and poor quality (grade 4). A small area has been identified with deeper soils in the report and is therefore of slightly better quality (3b Moderate, potentially 3a Good). The ALC report completed for Area B has identified most of the land as moderate quality (grade 3b) and a small area in the north as good quality (grade 3a).

The current landowner for the Proposed Development within Area A utilises the fields for sheep grazing. As part of the proposed restoration for the Site, some of the land would be returned to pasture. This has been balanced with the need to provide other habitats, refer to Figure 7.12 Indicative Landscape restoration plan, in order to maximise Biodiversity Net Gain (BNG) and in consultation with the Nottinghamshire Wildlife Trust. The current landowner has been involved with the decision making and design of the restoration scheme throughout the design process. It is therefore considered that returning part of the land to pasture post PFA removal, has been appropriately balanced against a more diverse biodiversity led land-use which includes wet meadow and reed bed habitats. Area B is utilised by separate farmers, with very limited use of their land holding in area terms, and therefore the limited degree if impact from the proposed haul road and conveyor is considered appropriate.

10.8 CUMULATIVE EFFECTS ASSESSMENT

The appropriate scale for considering cumulative development depends on the nature of the potential effect. There are considered in turn, for each category of potential effect.

There are a number of development sites, either consented or in the planning process, as set out in Table 10.10. Those summarised in the table are located within a 1.2km radius of the Site.

Table 10.10 Cumulative Sites

Development	Reference No / Authority	Status	Approximate Distance and direction from the Site
Land Adjacent To Bellmoor Farm	17/00931/FUL	Granted 04 Apr 2018	0.1 km west of the Site

Lound Low Road Sutton Cum Lound Retford Nottinghamshire DN22 8SD	Bassetlaw District Council	Erect Four Holiday Lodges, Single Storey Building for Fish Welfare/Reception/Equipment Store	
Trinity Farm, Retford	SITE HS7	Planning permission for Phase 1 comprising 196 dwellings and 11.11ha of employment/employment. A further 305 dwellings on 11.15 ha is proposed.	0.38 km southwest of the Site
Land North Of Chainbridge Road Lound Nottinghamshire	17/01509/FUL Bassetlaw District Council	Approved - 28 Jun 2022 Engineering Operations to Sub-Divide Lake into Four Smaller Lakes	1.09 km north of the Site
Tiln Farm Land Tiln Lane Retford Nottinghamshire	20/01405/FUL Bassetlaw District Council	Approved - 19 Feb 2021 Installation and Operation of a Solar Farm.	1.2km East of the Site

The ground conditions and contamination at the Site would be mitigated by a series of embedded control measures implemented as part of the overall design, as referred in this Chapter. The Site would undergo a process of betterment through reclamation and removal of PFA and remediation of soil and groundwater contamination that may be encountered to an acceptable standard for the protection of the identified receptors. However, ground condition and contamination cumulative impacts could potentially occur from similar developments in reasonable proximity to the Site or from land uses within the surrounding area.

The proposed schemes identified would be constructed under planning permission with contaminated land controls in place for the site enabling and construction phase of works. Site measures would be in place to monitor and protect against the release of contamination; and where an impact is identified under the planning permission, remediation would be required for the discharge of the condition. It can therefore be assumed that under a set of standard contaminated land related planning conditions, there would be an overall negligible cumulative impact from the proposed surrounding development in relation to ground conditions and contamination.

10.9 MITIGATION AND RESIDUAL EFFECTS

10.9.1 Embedded Mitigation

As previously stated, the Proposed Development, as necessary, would be subject to EA permit requirements and controls, as well as other site-specific measures. This would include ongoing surface water and groundwater quality monitoring, specific drainage designs (as summarised earlier in this Chapter), surface water and groundwater risk assessments, settlement and treatment lagoon design, dewatering and pumped water discharges; all of which would be addressed through the EA regulatory permit and compliance requirements, and which has been set out in the DMP, with further detail proposed to be reserved by suitable planning condition(s). Pollution control from site activities would also be implemented in accordance with other supporting documents such as the OCEMP/WCEMP.

As such, there would be extensive embedded mitigation measures applied throughout each stage of the Proposed Development.

10.10 SUMMARY OF EFFECTS

Table 10.11 provides a summary of effects detailed within this chapter.

Table 10.11 Summary of Effects

Receptor	Potential Effect	Significance of Effect	Additional Mitigation Proposed	Residual Significance
Construction Phase				
On-Site Construction Workers	PFA exposure	Negligible	H&S / PPE	Negligible
On-Site Commercial site workers / visitors	PFA exposure/ ground contamination	Negligible	H&S / PPE	Negligible
Superficial Aquifer (River Terrace Deposits)	PFA derived chemical pollution	Low	OCEMP/ WCEMP	Minor
Bedrock Aquifer (Chester Sandstone)	PFA derived chemical pollution	Low	OCEMP/ WCEMP	Minor
Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)	PFA derived chemical pollution	Low	OCEMP/ WCEMP	Minor
Building Foundations & Infrastructure	PFA / ground contamination	Negligible	None	Negligible
Operational Phase				
On-Site Construction Workers	PFA exposure	Low	H&S / PPE	Minor
On-Site Commercial site workers / visitors	PFA exposure/ ground contamination	Negligible	H&S / PPE	Negligible
Off-Site Residential	PFA dusts	Low	OCEMP / dust plan	Minor
Off-Site Commercial / industrial	PFA dusts	Negligible	OCEMP / dust plan	Negligible
Off-Site Recreational	PFA dusts	Negligible	OCEMP / dust plan	Negligible
Superficial Aquifer (River Terrace Deposits)	PFA derived chemical pollution	Low	OCEMP/ WCEMP/ DMP/ EA Permit	Minor

Receptor	Potential Effect	Significance of Effect	Additional Mitigation Proposed	Residual Significance
Bedrock Aquifer (Chester Sandstone)	PFA derived chemical pollution	Low	OCEMP/ WCEMP/ DMP/ EA Permit	Minor
Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)	PFA derived chemical pollution	Low	OCEMP/ WCEMP/ DMP/ EA Permit	Minor
Building Foundations & Infrastructure	PFA / ground contamination	Negligible	None	Negligible
Restoration Phase				
On-Site Agricultural Users	PFA / soil contamination	Negligible	EA Permit	Negligible
On-Site Recreational Users	PFA / soil contamination	Negligible	EA Permit	Negligible
Superficial Aquifer (River Terrace Deposits)	PFA / soil contamination	Negligible	OCEMP/ WCEMP/ EA Permit	Negligible
Bedrock Aquifer (Chester Sandstone)	PFA / soil contamination	Negligible	OCEMP/ WCEMP/ EA Permit	Negligible
Surface water bodies (Sutton and Lound Gravel Pit SSSI, River Idle)	PFA / soil contamination	Negligible	OCEMP/ WCEMP/ EA Permit	Negligible
Onsite Grazing Livestock	PFA / soil contamination	Negligible	EA Permit	Negligible

10.10.1 Summary of Restoration Effects

Following completion of the scheme and Site restoration, residual effects have all been identified as being negligible.

10.10.2 Summary of Cumulative Effects

Following completion of the scheme, residual cumulative effects have all been identified as being negligible.

10.11 STATEMENT OF SIGNIFICANCE

No significant effects in terms of the EIA Regulations are predicted on ground conditions and contamination during the construction, operation or restoration phases of the Proposed Development.

The Proposed Development would provide betterment from a contamination perspective, through removal of the PFA and protection of identified receptors. The Site would be licensed under a waste recovery operation, and therefore restoration would be undertaken in accordance with an EA construction quality assurance (CQA) plan; and would also meet requirements of the OCEMP and WCEMP. There are also the other mentioned management and mitigation measures, including a comprehensive drainage and water management regime.

An Agricultural Land Classification (ALC) has been undertaken. The soils across the extraction area (Area A) have been classified as poor agricultural quality with a small area identified as moderate, potentially good. It is considered that returning part of the land to pasture post PFA removal, has been appropriately balanced against an improved biodiversity led land-use which includes wet meadow and reed bed habitats. Area B where soils are mostly moderate quality is utilised by farmers. There is limited use of the land holding in area terms. The overall significance of agricultural land loss is therefore considered minor.

As such, the effect on ground conditions and contamination is not significant in terms of the EIA Regulations.