Statutory Consultation 2022

Preliminary Environmental Information Report

Volume 3: Appendix 17.5

Remediation Strategy

Contents

APPENDICES

Appendix A - Remediation Options Appraisal

Tables

1 INTRODUCTION

1.1 Scope

1.1.1 This Remediation Strategy has been developed by Luton Rising (a trading name of London Luton Airport Limited) (the applicant) to support the application for development consent for the expansion of the airport ('Proposed Development').

1.1.2 This document is a live document and may be subject to revision due to scheme design changes or to address comments after consultation with the regulators.

1.2 Area covered by the report

1.2.1 The extent of the Proposed Development boundary is shown in **Figure 1** and is described in detail in **Section 2**. The Proposed Development is split into four distinct geographical components:

a. the Main Application Site;
b. Off-site Car Parks;
c. Off-site Highways Interventions; and
d. Off-site Planting.

1.2.2 This report sets out the remediation strategy for the main area of concern with regard to potential contamination, located within the Main Application Site. This is the area of the former landfill (Eaton Green Landfill) which was referred to as Area A in the various assessment reports, for the purposes of this report referred to as 'the site', the location of which is shown on **Figure 1.**

1.2.3 The northwestern edge of the landfill forms part of existing airport land and has been redeveloped for two aircraft hangars. It is understood that most of the landfill was removed in these areas as part of the work to develop these hangars. Where material was retained gas protection measures are understood to have been incorporated within the structures. Further details are provided in the Preliminary Risk Assessment (Ref. 1). Therefore, this area of the landfill does not form part of this remediation strategy.

1.3 Report objectives

1.3.1 The purpose of the remediation strategy is to:

a. define the remediation objectives;
b. describe feasible remediation options;
c. evaluate the feasible options for each of the identified relevant contaminant linkages (RCLs);
d. identify the best practicable remediation option;
e. present the RCLs addressed by this strategy and how the proposed remediation works will mitigate the associated risks, to render the site suitable for the Proposed Development;
f. identify the regulatory regime under which the works are to be undertaken and any regulatory controls, i.e. required permits/licences;

g. how the proposed works will achieve the remediation options appraisal objectives including sustainability issues/targets;

h. identify methods for verifying the remediation works, including; monitoring, measuring, recording and reporting;

i. identify control measures required to manage the risk from RCLs/PCLs during remediation works to human health (site workers/adjacent site users), ecology and surrounding environment;

j. describe how the works will be integrated into the earthworks/construction and design of site redevelopment;

k. be practical, achievable, effective, durable and verifiable; and

l. outline the approach to dealing with unexpected contamination/contingency planning.

1.4 Information sources

1.4.1 This report is based on the findings of the following reports:

a. Luton Rising (2021). Preliminary Risk Assessment (PRA) of Land Contamination. LLADCO-3B-ARP-00-00ARP-CG-0003. (Ref. 1);

b. Luton Rising (2021). Land Contamination. Generic Quantitative Risk Assessment (GQRA) Report. LLADCO-3C-ARP-00-00-RP-CG-0002. (Ref. 2);

c. Luton Rising (2021). Detailed Quantitative Risk Assessment Report: Human Health and Ground Gases. LLADCO-3C-ARP-00-00-RP-CG-0003.(Ref. 3);

d. Luton Rising (2021). Detailed Quantitative Risk Assessment Report: Controlled Waters. LLADCO-3C-ARP-00-00-RP-CG-0001. (Ref. 4);

e. Arup (2019) Earthworks Design Report (Ref. 5);

f. Arup (2019) Geotechnical Investigation Report (GIR). LLADCO-3C-ARP-00-00-RP-CG-0004 (Ref. 6);

g. Luton Rising (2021) Hydrogeological Characterisation Report. LLADCO-3B-ARP-00-00-RP-CG-0001 (Ref. 7);

h. Luton Rising (2021) Foundation Works Risk Assessment for Former Eaton Green Landfill. In preparation (Ref. 8); and

i. Luton Rising (2021). Drainage Design Statement. LLADCO-3A-CAP-CD-00-RP-CD-0003. Draft (Ref. 9).

1.5 Key stakeholders

1.5.1 Details of the key stakeholders with regards to remediation at the former landfill are shown in **Table 1.1.**

Table 1.1 Key stakeholders for remediation of the site

Stakeholder	Details
Luton Rising	Client for the project who are responsible for airport development. Luton Rising are wholly owned by Luton Borough Council.
Environment Agency	Statutory consultee with specific responsibilities for protection of controlled water and waste management regulation.
Luton Borough Council (LBC) and neighbouring councils.	Local Authority consultee with regard to protection of human health from contaminated land
London Luton Airport Operator Limited (LLAOL)	Airport operator will require operation of existing airport not to be disrupted by remediation activities
Local residents/schools	There are a number of residential properties in close proximity to the site as well as schools in the local area.
Remediation Contractor	To be confirmed. Appointment of contractor will depend on procurement approach by Client.

1.6 Limitations

This report has been prepared by Luton Rising and takes into account their particular instructions and requirements. The benefit of this report may not be assigned to any third party. All reasonable skill, care and diligence have been exercised within the timescale available in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team by undertaking the assessment and preparing the report, it is possible that other ground contamination or conditions as yet undetected may exist and consequently reliance on the findings of this report must be limited accordingly.

2 THE PROPOSED DEVELOPMENT

2.1 Introduction

2.1.1 The Main Application Site covers approximately 360 hectares (ha). The majority of this land lies to the east of the existing airport, but also included are areas of the existing airport, runway and isolated land parcels north and west of the airport where road infrastructure will be upgraded.

2.1.2 The development includes the creation of a second terminal, extension to the existing apron and relocation of car parking to the east of the new terminal building. The proposed masterplan for the site is presented in Figure 2. The Proposed Development will include the following principal elements:

a. Extension and remodelling of the existing passenger terminal (Terminal 1) to increase the capacity;

b. New passenger terminal building and boarding piers (Terminal 2);

c. Earthworks to create an extension to the current airfield platform, material for these earthworks would be generated on site;

d. Airside facilities including new taxiways and aprons, together with relocated engine run-up bay and fire training facility;

e. Landside facilities, including buildings which support the operational, energy and servicing needs of the airport;

f. Enhancement of the existing surface access network, including a new dual carriageway road accessed via a new junction on the existing New Airport Way (A1081) to the new passenger terminal along with the provision of forecourt and car parking facilities;

g. Extension of the Direct Air to Rail Transit (DART) with a station serving the new passenger terminal;

h. Landscape and ecological improvements, including the replacement of existing open space; and

i. Further infrastructure enhancements and initiatives to support our goal of a net zero airport operation by 2040, with interventions to support carbon neutrality being delivered sooner including facilities for greater public transport usage, improved thermal efficiency, electric vehicle charging, on-site energy generation and storage, new aircraft fuel pipeline connection and storage facilities and sustainable surface and foul water management installations.

2.2 Phased development

2.2.1 The works will be phased to match airport capacity demand. There are four main elements to the expansion works, as described below:

a. Preparatory works- provide replacement to Wigmore Valley Park, re-provision of airport long-stay car parking and site establishment;

b. Phase 1 currently anticipated to commence in 2025 and be complete by mid 2027- interim capacity up to 21.5 million passengers per annum (mppa),

comprising works that develop capacity in advance of Terminal 2 opening including substantial earthworks to construction the development platform for Phase 2 development. This will involve the excavation and processing of about 27,000m^3 of landfill;

c. Phase 2a currently anticipated to commence in early 2033 and be complete in 2036 – Construction of terminal 2, other infrastructure and new aprons enabling 27mppa capacity for the airport. This will involve the excavation and processing of about 312,000m^3 of landfill; and

d. Phase 2b currently anticipated to commence in early 2037 and be complete in 2041 – Construction of further aprons enabling 32mppa capacity for the airport with the remaining elements of the proposals. This will involve the excavation and processing of about 11,000m^3 of landfill.

2.3 Earthworks

2.3.1 The earthworks required to facilitate development across the site are described in **Table 2.1.**

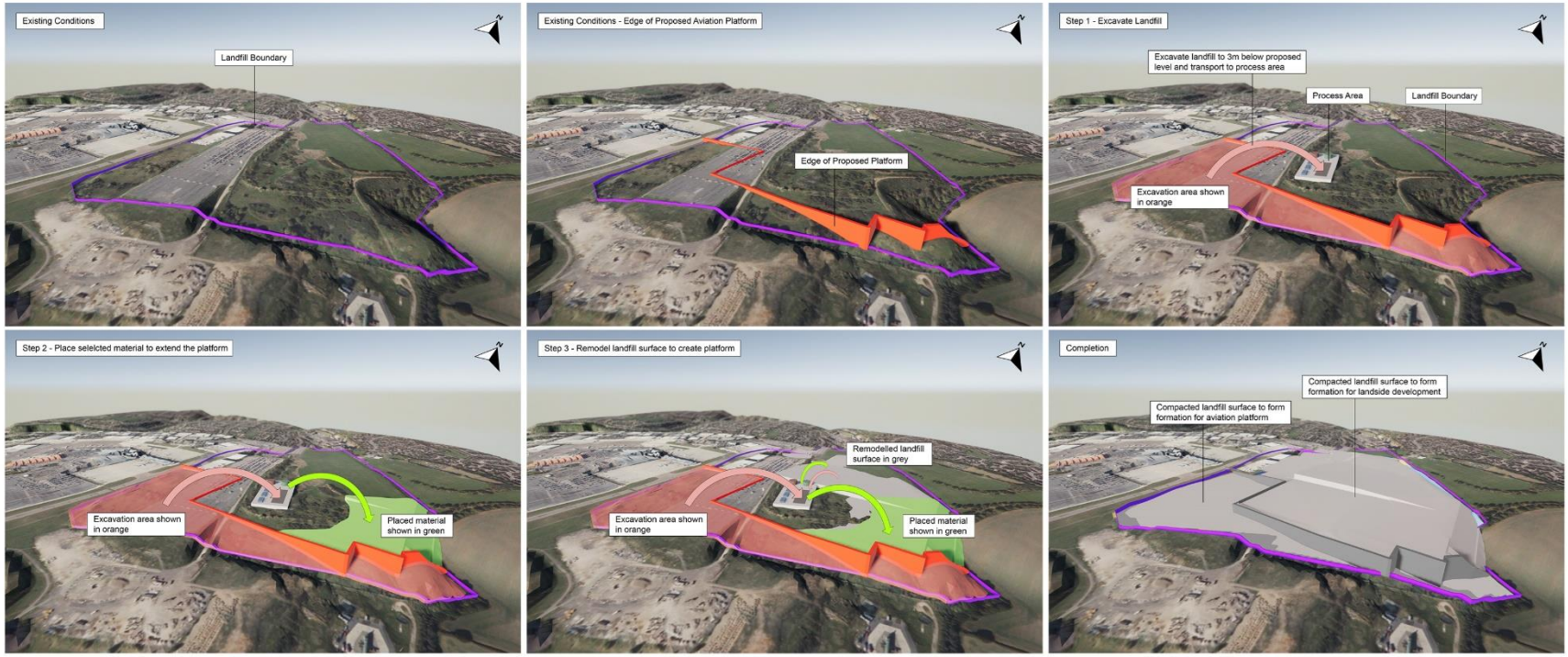
Table 2.1 Summary of Proposed Development within the site and associated earthworks

Proposed Development	Likely earthworks required
Apron, stands and taxiways. A new terminal building. Extension to the Luton Direct Air to Rail Transit (DART) to the new terminal and new station. A temporary 'decked' car park New Century Park development including: a. Buildings such as offices and hotel. b. Car parking, new road infrastructure and landscaping. A multi-storey car park (MSCP). Other airport buildings.	a. In the southern end of the site major earthworks will be required to create a development platform to tie-in with the existing airport levels. This will require excavation, processing and relocation of a significant volume of landfill wastes/made ground. b. Excavation of landfill material for provision of airport access road. c. For New Century Park Development remodelling of the landfill surface will be required. d. Import of engineering fill for development platform. e. Piling through the landfill into underlying chalk for foundations. f. Excavation of landfill waste to create tunnel for DART extension.

2.3.2 The works will require a large volume, approximately 350,000m3 of landfill material to be excavated and processed, approximately 310,000m (Ref 3) expected to be reused to create part of the 'landside' platform. (losses are from recycled materials, unsuitable disposed off-site and loss from compaction). The

landfill material is required to be removed to facilitate the construction of the development platform as it does not have the geotechnical properties required to meet settlement standards for aviation. A simplified schematic of the earthworks required to create the development platform for the expansion work is shown in **Drawing 1.**

Drawing 1 Simplified schematic of the work required to create the development platform for the expansion work



please note vertical exaggeration has been applied the above images to aid understanding

3 BACKGROUND

3.1 Site details

3.1.1 The site background has been summarised from the PRA (Ref. 1) and GQRA reports (Ref. 2). The site is the former Eaton Green landfill which forms part of the wider DCO development area, referred to in previous reports as Area A.

3.1.2 **Table 3.1** provides an overview of the site details in relation to the wider Proposed Development.

Table 3.1: Overview of the site in relation to the wider Proposed Development

Feature	Description
Location	The area included in eth application for DCO is located approximately 3.5km east of Luton town centre and is located around the airport. **Figure 1** shows the location of the site in relation to the Proposed Development.
National Grid Reference	The approximate national grid reference for the centre of the site is, 512426, 221744.
Topography and Features	The Proposed Development is characterised by a series of dry valleys which were formed during the last glacial period. Two dry valleys cross the Proposed Development. The site fills part of the head of one of the dry valleys. The site has an undulating surface of elevation between 150m AOD and 155m AOD with the southern part being particularly uneven. The elevation at the bottom of the dry valley adjacent to the site is approximately 130m AOD.
Approximate site area	The site sits within the Main Application Site which covers an area of approximately 360 hectares (ha), the site accounts for approximately 40ha.
Site Boundaries	The site is bound by the airport to the west, Eaton Green Road to the north, the airport fire training area and LLAOL contractor's compound to the south. Public recreational area to the northeast, and arable land at the east/southeast boundaries.
Current Land Use	The site comprises public open space, known as Wigmore Valley Park (WVP). The central and southern part is a County Wildlife Site (CWS), with sports pitches present in the northeastern part of the site. The long-stay car park for the airport is present in the west of the site, operated by LLAOL. In the northwest is another car park (operated by TUI).
Adjacent Land Use	Residential housing is present within 50m of the north boundary. The airport is adjacent to the western and southern boundaries. Wigmore Valley Park Community Centre and allotments are situated 50m and 150m to the northeast, respectively. Arable land is present to the east/southeast.

3.2 Site setting

Table 3.2: Site setting

Feature	Description
Geology	**Made Ground**: Landfill (the characteristics of the waste are described further in GQRA (Ref. 3) and **Section 4.2.5** of this report. **Superficial Geology**: Clay with Flints present on the valley plateaus but absent in the valley areas. Head deposits (clay) present in the valleys and Dry Valley deposits comprising silty clay and gravel within the valley bottom. **Solid Geology:** Chalk Group comprising; Lewes Nodular Chalk Formation, Chalk Rock Member, New Pit Chalk Formation and Holywell Nodular Chalk Formation. Dissolution features (sinkholes, pipes, widened discontinuities) are present in the Chalk, and at the interface between the Clay with Flints formation and the Chalk. Dissolution features were found to be present beneath the site. Characterised as the presence of greater thicknesses of cohesive deposits or an alternating sequence of weathered chalk and cohesive deposits. Further detailed description is presented in GQRA, Section 5.0 (Ref. 3).
Hydrology and Hydrogeology	Clay with Flints – not designated as an aquifer. Head Deposits – Secondary undifferentiated aquifer Chalk groups (Lewes Nodular, Chalk Rock Member, Holywell Nodular and New Pit Chalk formations) – Principal aquifer. There are two main water body catchments which cover the Luton area; the Lee and the Mimram catchments. The site lies in the Mimram catchment and there is a groundwater divide to the west of the long-stay car park. The existing terminal lies to the west of the groundwater divide within the Lee catchment. A detailed review of the hydrogeological conditions beneath the site has been undertaken (Ref. 7). The groundwater levels beneath the landfill are typically 112 mAOD (40 mbgl) and range between 17.5m to 36 m below the base of the landfill. No watercourses are present on site. The nearest watercourse is the River Lee (200m southwest) which lies in a different catchment from the landfill. The River Mimram emerges approximately 6km south east of the site[10].
Groundwater abstraction	There are three abstraction licences recorded within 2km of the main area of development in the Mimram catchment : a. 1.5 km northeast, potable water supply operated by Affinity Water Limited; b. 1.9km north east, private water supply; c. 1.5km southeast, private water supply; A further three abstractions were identified in the Lee catchment: d. 1.5 km west, general use relating to secondary category (medium loss) operated by IBC Vehicles Limited; e. 1.7km south (potable water supply operated by Affinity Water); and f. 1.85km south west (for commercial and domestic purposes).

Feature	Description
	Furteh detail on the abstractions is provided in the GQRA.
Waste Disposal	Former Eaton Green landfill was operated by Luton County Borough Council circa 1937-1978. Aerial photography and historical mapping suggest it was in use until the 1970s and a non-engineered capping layer was placed during the 1990s and landscaped to its present form between 2000 and 2002. Records on the waste deposited within the former landfill are limited. Environment Agency records suggest that the following waste types may have been deposited; inert, industrial, commercial, household and liquid sludge. A detailed review of the records pertaining to the landfill was undertaken previously by the applicant (Ref. 11). This indicated that the landfill does not appear to be as extensive as the recorded Environment Agency boundary. The extent of the former landfill is shown on **Figure 2.**

4 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

4.1 Introduction

4.1.1 The risk assessment process aims to establish whether unacceptable risks exist and if so what further actions need to be taken in relation to the site. It is an iterative tiered approach which consists of three progressively detailed stages of risk assessment; PRA, generic quantitative risk assessment (GQRA) and detailed quantitative risk assessment (DQRA). Depending on the nature of the site and contamination present, not all stages of risk assessment may be required.

4.1.2 A PRA (Ref. 1), GQRA (Ref. 2) and DQRAs (Ref. 3 and Ref. 4) have been undertaken for the site. The key findings are discussed in the **Section 4.2** below and the identified contaminant linkages requiring consideration in the remediation strategy.

4.2 Summary of risk assessment findings

4.2.1 A preliminary and detailed GI has been undertaken within the landfill area. The sampling locations have a good spatial, lateral and vertical distribution, encompassing all the main eras of waste deposition. A significant number of soil (1219 samples), groundwater and leachate (328 tests) and gas/ volatile organic compounds (VOC) samples (96 tests) have been undertaken and analysed to industry standards providing a comprehensive data set for the area. The investigations undertaken to date provide a good understanding of the general composition of the waste, groundwater, leachate and landfill gas conditions within this area. The data was considered adequate to inform the risk assessment.

4.2.2 The waste characteristics indicated that overall there is no distinct spatial variation in the waste types or chemistry. As such it was not considered necessary to sub-divided the landfill for the risk assessment.

4.2.3 The risk assessment considered a reasonable worst-case scenario is representative of the conditions at the landfill. This is considered conservative but allows for the heterogenous nature of the landfill in the assessments.

4.2.4 However, due to the nature of historical landfills i.e. no specific controls on waste types deposited, there is likely to be a high degree of heterogeneity in the waste. Whilst a substantial amount of ground investigation data is available; no ground investigation can completely characterise a site and contamination may exist or in an area where contamination was not expected. Therefore, the assessment recommended that the remediation strategy include measures to detect and deal with unexpected contamination.

Waste characteristics

4.2.5 A forensic assessment of samples of the waste, review of the exploratory logs, site photographs and site observations on the former landfill indicated the following:

a. Much of the waste was deposited 40-50 years ago, and initial filling started almost 80 years ago. The most recent material, was deposited 30 to 40 years ago to form the capping layer;

b. A large portion of the waste is categorised as construction (36 vol.%) or cover material (27 vol.%). The overall total percentages and estimated volumes of different waste types within the landfill are shown in Table 4.1;

c. The waste is reasonably well degraded with no discernible biowastes. Only the slower degradable fractions of material are remaining such as newspaper;

d. An analysis of the waste components indicates that 69% is entirely composted of non-organic/non-combustible material. The remaining components comprise of plastics, glass, metal and organics i.e. newspaper and wood. The waste components as average volume percent are shown in Drawing 2;

e. The waste contains a high proportion of cover material (both non-chalky and chalky), particularly in the more recent wastes (1970s onwards);

f. Chemical analysis of the landfill leachate indicated the levels of contaminants are broadly consistent with leachate from aged waste, with the concentrations of many contaminants lower than those typical of an aged waste e.g. ammoniacal nitrogen, magnesium, manganese, zinc and lead;

g. A 3D model was constructed of the different eras of filling within the landfill (full details in PRA). The results of logging, forensic waste and chemical analysis were compared to the model. The comparison indicated that the nature and spatial extent of the landfill material was consistent with other published case studies and previous experience. For example, older domestic wastes containing more ash and recent waste with higher plastic content; and

h. Overall the nature and chemistry of the waste does not vary significant throughout the landfill. For the purposes of the risk assessment the landfill was considered as a single source, with no separation of specific areas. Therefore, the risk assessment was undertaken using a precautionary approach assuming that worst case conditions encountered are representative of the landfill as a whole.

Table 4.1 Total percentage and estimated volumes of different waste within the landfill

Waste Type	% volume	Estimated volume m^3
General Made Ground*	2%	85,000
Commercial	3%	130,000
Old Domestic	4%	170,000
Recent Domestic	10%	440,000
Chalky cover material	11%	485,000
Industrial	18%	790,000
Non-chalky cover material	16%	700,000
Construction	36%	1,600,000
	Total	4,400,000

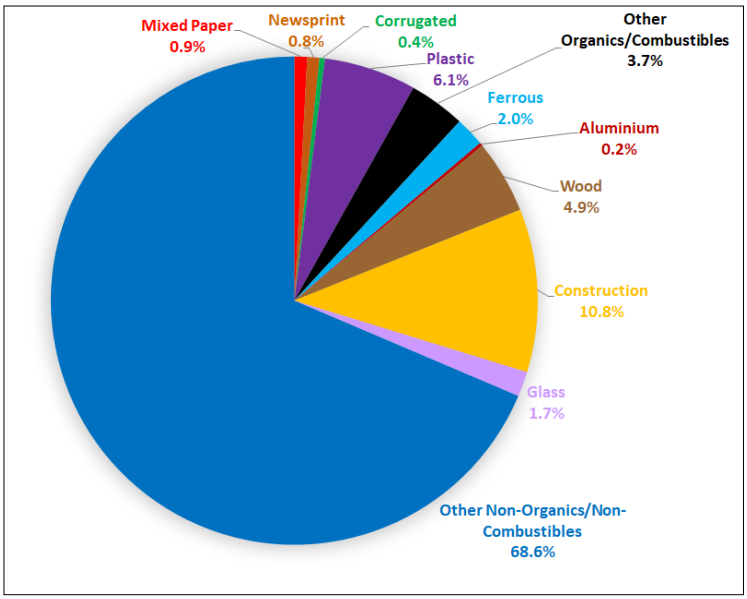
Waste Type	% volume	Estimated volume m^3

Notes:

a. Estimated total volume of material in the landfill is based on volumes calculated from the ground model.

b. * General Made Ground is material within the landfill not material placed post filing. For a description of waste types see **Table 8.1** in the GQRA.

Drawing 2 Waste components presented as average percent in the landfill



Human health risk assessment

Soils- chronic assessment

4.2.6 The GQRA indicated that overall there were very few exceedances in relation to the overall number of tests undertaken. For all contaminants less than 3% of the samples undertaken for analysis had exceedances. Most of the exceedances were within one order of magnitude of the generic assessment criteria (GAC), with a number only marginally exceeding the criteria. The majority of these exceedances were within the construction waste type (40%).

4.2.7 Overall the concentration of contaminants in the landfill were not considered significantly elevated. Most contaminants which exceeded pose a risk through direct contact. The development is largely hardstanding and therefore future users are unlikely to come into direct contact with the underlying material. However, given the heterogeneous nature of landfills and the lack of engineered cover system, a key conclusion of the GQRA was that it should be assumed that measures will be required, particularly in landscape areas to prevent direct contact with the waste.

4.2.8 The RCLs in this regard are set out in **Section 4.3** and the remediation options and remediation requirements are discussed in **Section 5.5.**

Soil vapours

4.2.9 Soil gas vapour samples were taken during the ground investigation (GI) works using the methods recommended within Environment Agency guidance. The GI provided sufficient information to characterise the potential risks from soils vapours. The vapour assessment results showed none of the soil vapour concentrations had a hazard index greater than 1.0, indicating the soil vapours are unlikely to pose a risk to future occupants of the site. Therefore, it was concluded a vapour membrane is unlikely to be required within the development. However, due to the variable nature of landfill and potential for variability in vapour generation over time, further monitoring was recommended prior to, during and post earthworks to confirm the assessment.

4.2.10 The age assessment of the likely age of the landfill supported the assertion that the landfill waste is old, and the source term is nearing depletion. However, the odour assessment indicated there could be a risk of strong odours arising during any earthworks undertaken on site.

Groundwater vapours

4.2.11 Volatile contaminants in groundwater have the potential to cause risk to human health via volatilisation and migration of vapours into overlying buildings or outdoor air space followed by inhalation. During the 2018 GI some perched water was encountered, therefore, the potential risks associated with volatile contaminants in perched water were assessed.

4.2.12 Exceedances for TPH >C10-C12 Aliphatic and 1,2,4- Trimethylbenzene were noted at one location (WS224). The solubility limit for TPH >C10-C12 aliphatic was exceeded, suggesting that free product may be present at this location. It was concluded that overall groundwater vapours were unlikely to pose a risk to future users of the site. However, the 'hotspot' location of free product noted at WS224 was recommended to be removed for protection of controlled water purposes, this is discussed in **Section 4.2.31**.

4.2.13 The RCLs in this regard are set out in **Section 4.3** and the remediation options and requirements are discussed in **Section 5.5.**

Soils-acute assessment

4.2.14 Comparison of the soil samples against the acute generic assessment criteria (AGAC) (Ref. 12) indicated one exceedance for arsenic of the oral criteria for a child trespasser during construction works, which was considered an unlikely scenario. Appropriate measures should be undertaken during construction to ensure the site is secure and dusts are controlled. Based on the results of the acute assessment no special precautions, above and beyond best practice, are considered necessary during construction works to control potential acute risks.

Asbestos

4.2.15 No gross asbestos contamination was identified during the ground investigation, with only sporadic occurrences of visual asbestos identified in the soil.

4.2.16 Construction work has the highest potential to physically disturb any ACMs and Asbestos Containing Soils (ACS), therefore leading to an increased risk of fibre release. Using CARSOIL™ guidance (Ref. 13) and Joint Industry Work Group Decision Support Tool (JIWG DST) (Ref. 14) a hazard and exposure ranking for the earthworks involving the soil and landfill material has been assessed to determine the anticipated preliminary licensing status for the works. The JIWG assessment indicated the overall hazard and exposure ranking was medium. Therefore, the preliminary licensing status for groundworks, including ground excavation is anticipated as non-licensable works (NLW).

4.2.17 The DQRA concluded that the GI provided sufficient information to characterise the condition of asbestos present within the landfill and inform this assessment, but it is recognised that the landfill is heterogenous in nature and as such localised areas of increased frequency of ACMs may exist. Therefore, it was recommended a strategy for managing ACMs is developed for the works. The assessment confirmed that risk of harm to futures users of the development from asbestos fibres i.e. public, airport operatives and maintenance workers is very low. The development is predominately hardstanding and measures will be incorporated into the design to prevent future contact with landfill materials i.e. a cover system.

4.2.18 The RCLs in this regard are set out in **Section 4.3** and the remediation options and requirements are discussed in **Section 5.5**.

Ground gas

4.2.19 The assessment of the gas monitoring data and GasSim modelling[1] has identified that the landfill is past the stage of peak gas generation. Whilst there are high concentrations of bulk landfill gases (carbon dioxide and methane) within the waste, there are low or negligible standpipe emission flow rates, indicating low/very low rates of continuing biodegradation of residual organic matter.

4.2.20 A methane/carbon dioxide of characteristic situation (CS)4[2] based on guidance in CIRIA C665 is considered protective of the landfill area. While CS4 was only encountered on rare occasions within the landfill, it is considered that this will allow for any changes to the gas regime within the landfill as a result of the proposed earthworks and construction to be mitigated The development areas outside of the landfill can be considered as CS2 due to the low concentrations of ground gases recorded in this part of the site, which is considered low risk. Based on the gas regime across the development site, gas protection measures will be required within all new buildings proposed for the site and the design of Aprons and other infrastructure should take account of the presence of ground gas.

4.2.21 The area to be excavated to create the development platform is anticipated to generally comprise 1950s to 1960s waste which is estimated to have a very low

[1] GasSim 2.5 Model developed by Golder Associates on behalf of the Environment Agency to model landfill gas generation.
[2] CS4 is classed as a moderate to high risk, detail of Characteristic situation classifications is provided in GQRA Table 11.1

gassing potential. However, there may still be some degradable content remaining. At present it is not easily accessible to bacteria and therefore the degradation rates are low. If the material is excavated and processed the degradable material can become available to bacteria and gas generation can re-start at rates which may not be suitable for the proposed development. Although this is likely to be temporary effect, the time to return to low levels of gas generation are unpredictable.

4.2.22 Therefore, to manage this as part of the reprocessing works the total organic content (TOC) of the fill material used within the development platform will be controlled following the guidance in CL:AIRE RB17 (Ref.15) and BS8584:2015+A1:2019 (Ref. 16). A period of post-earthworks gas monitoring will be undertaken to validate the gas regime on site, to ensure the proposed gas protection measures are still sufficiently protective.

4.2.23 In its current state there is no evidence of significant landfill gas migration beyond the landfill which could be considered to pose a risk to other receptors (e.g. neighbouring airport buildings and residential areas). However, it is possible that the proposed development on the landfill could increase the risk of gas migration to offsite receptors due to a lack of proper treatment of old or abandoned underground services or due to surcharging the surface of the landfill. It is not possible to predict the impact surcharging of the landfill due to the proposed development will have on the gas migration off-site. Therefore, to mitigate any potential risks to off-site properties mitigation measures along the boundaries of the landfill will be incorporated into the proposed development and existing services will be located and appropriately treated.

4.2.24 The RCLs in this regard are set out in **Section 4.3** and the remediation options and requirements are discussed in **Section 5.5**.

Controlled waters

4.2.25 A detailed assessment of the risk that the landfill presents to controlled waters was undertaken, it was based upon a cautious assessment of the GI data and reasonably conservative assumptions about ground conditions and hydrogeology.

4.2.26 ConSim modelling undertaken to inform the DQRA indicated that given current conditions at the site there are contaminants within the landfill material which have the potential to break through the base of the unsaturated zone and migrate to identified receptor/compliance points. Concentrations of ammoniacal nitrogen and benzene were predicted to reach the potable abstraction within 100 years.

4.2.27 However, while there is evidence of a weak leachate plume in groundwater down-gradient of the site, on-site groundwater monitoring provides little evidence that the landfill is causing significant contamination of the groundwater.

4.2.28 Leaching of contaminants from the landfill through the unsaturated zone are likely to be inhibited by localised layers of Clay-with-Flints, lower permeability layers of weathered putty chalk and marl and flint bands. The presence of these

features may contribute to contaminants being attenuated more in the unsaturated zone than predicted by ConSim.

4.2.29 The proposed airport development will result in the landfill being covered within buildings and hardstanding which will significantly reduce the volume of infiltration into the landfill waste material and generation of landfill leachate. ConSim modelling has predicted that in this scenario none of the potential contaminants of concern would break through the base of the unsaturated zone within a 1,000-year time period.

4.2.30 In addition, it should be noted that the earthworks proposed as part of the airport development will result in the excavation of a significant part of the waste across the southern end of the landfill. The materials will be processed and where suitable reused to build the development platform. As part of this excavation it is anticipated that any significant contamination (e.g. free product) encountered in the waste would be removed from site and only materials considered suitable for re-use (to be protective of both human health and controlled waters) would be incorporated into the development platform.

4.2.31 The most significant risk to controlled waters from the proposed development is considered to be from the driving of contaminants into the aquifer during piling. A piling risk assessment will be required to determine the appropriate pile design and construction method to ensure that contaminated material is not pushed down into the aquifer or a pathway is created through the unsaturated zone.

4.2.32 The exposure of landfill material during earthworks will require careful control to ensure that infiltration into the waste is not temporarily increased.

4.2.33 The DQRA concluded that the GI provided sufficient information to characterise the condition of the landfill and inform this assessment, but it is recognised that the landfill is heterogenous in nature. It is likely to contain accumulations of material that may not be large enough or have sufficient concentrations to impact the groundwater quality, as indicated by the extensive monitoring undertaken. However, these accumulations may have the capacity to cause short term local impacts if exposed/mobilised during works and not treated appropriately.

4.2.34 An example of this is the conditions found at WS224 where exceedances for total petroleum hydrocarbon (TPH) >C10-C12 aliphatic and 1,2,4- Trimethylbenzene were noted. The solubility limit for TPH >C10-C12 aliphatic was exceeded, suggesting that free product may be present at this location. Site observations and during the monitoring rounds confirmed the presence of free product at this location.

4.2.35 The RCLs in this regard are set out in **Section 4.3** and the remediation options and requirements are discussed in **Section Error! Reference source not found..**

4.3 Potential contaminant linkages (PCLs) and identified relevant contaminant linkages (RCLs)

4.3.1 The DQRA indicated that the site generally represents a low risk to all receptors and remedial action is not required to protect current site users, neighbours or groundwater. However, the development will change the potential risk to future users and other receptors. Where a PCL has been identified and mitigation measures inherent in the construction or operation of the Proposed Development might not be sufficient to break the pollutant linkage, there is assessed to be a RCL that would require specific measures to be implemented. For ease of identification within this remediation strategy these PCLs have also been assigned an identifying RCL number and are detailed in **Table 4.2.**

4.3.2 In addition to the RCLs, a number of PCLs were identified within the DQRA associated with the enabling/construction phase of the development. No specific remediation activities are required to address these PCLs. However, these linkages need to be considered in the selection of an appropriate remediation technique and the works must address and manage these PCLs to protect site users and site neighbours. Recommended mitigation measures for theses PCLs are also included in this Remediation Strategy and presented in **Table 4.2**.

Table 4.2 Revised conceptual site model (CSM) RCLs

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
Gas							
1	RCL1	DEV	Ground gases from former landfill e.g. methane	Migration into future buildings and aviation apron resulting in build-up of gases	Users of future development – public/airport operatives/ New Century Park users	Moderate	High concentrations of bulk landfill gases (carbon dioxide and methane) were recorded within the waste but there are low or negligible standpipe emission flow rates, indicating low/very low rates of continuing biodegradation of residual organic matter. A methane/carbon dioxide characteristic situation (gas regime) of CS4 (maximum) is considered protective – many parts of the site might be only CS2 or CS3. Gas protection measures are required in proposed buildings consistent with those detailed in DQRA volume 2 and BS8485.
2	RCL2	DEV CON		Migration off-site	Adjacent site users (e.g. residential housing and other buildings on Luton Airport, WVP Community Centre/ pavilion)	Low/ Moderate	Results to not suggest a current potential risk from gas migration but the proposed development may increase the potential risk of migration therefore boundary mitigation measures are required. Measures will be required to treat existing preferential pathways e.g. Thames Valley Drain.
Human Health							
6	RCL3	DEV	Waste in former landfill	Direct contact e.g. dermal contact, soil ingestion	Future maintenance workers	Low/ Moderate	The GQRA indicated there was very few exceedances and the risk to future maintenance workers at the new airport development is low. Maintenance workers may be exposed to areas of landfill waste during future excavation. This can be reduced by placing of services in a clean cover system.
7	RCL4	DEV			Users of future development – public/airport operatives/ New Century Park users	Low	The GQRA indicated there was very few exceedances and the risk to future users of the new airport development is low. The future development will comprise buildings & hardstanding, therefore there is unlikely to be any contact

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
							with landfilled wastes. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required, particularly in landscape areas to prevent direct contact with the waste.
9	RCL5	DEV		Direct or indirect contact with radionuclides – incurring radiation dose by indirect dose received from ingestion of radium (or other alpha emitting contaminated material) or direct risk from contact with beta emitters such as Carbon-14 or Caesium-137	Future maintenance workers	Low	The recent GI included testing for radionuclides, which indicated levels observed were consistent with background levels. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required. Maintenance workers may be exposed to areas of landfill waste during future excavation. This can be reduced by placing of services in a clean cover system.
10	RCL6	DEV			Users of future development – public/airport operatives/ New Century Park users	Low	The recent GI included testing for radionuclides, which indicated levels observed were consistent with background levels. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required, particularly in landscape areas to prevent direct contact with the waste.

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
14	RCL7	DEV		Inhalation of airborne contaminants/ dust/ asbestos fibres and microorganisms	Users of future development – public/airport operatives/ New Century Park users	Low	The future development will comprise buildings & hardstanding, therefore there is unlikely to be any contact with landfilled wastes. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required, particularly in landscape areas to prevent generation of dusts which may contain asbestos fibres.
21	RCL8	DEV	Leachate in former landfill[3]	Direct contact e.g. dermal contact	Future maintenance workers	Moderate/ Low	The GI undertaken indicates there is likely to be limited leachate present. Maintenance workers may be exposed to areas of landfill waste during future excavation. This can be reduced by placing of services in a clean cover system.
22	RCL9	DEV			Users of future development – public/airport operatives/ New Century Park users	Low	The GI undertaken indicates there is likely to be limited leachate present. The future development will be buildings and hardstanding and is likely to include an engineered cover layer and leachate control system, therefore there is limited potential for contact with any leachate in the landfill.
29	RCL10	DEV	Contaminants in Made Ground (car park, capping material)	Direct contact e.g. dermal contact, soil ingestion	Future maintenance workers	Moderate/ Low	The GQRA indicated there was very few exceedances and the risk to maintenance workers of the new airport development is low. Maintenance workers may be exposed to areas of Made Ground during future excavation. This can be reduced by placing of services in a clean cover system and adoption of appropriate site management protocols and personal protective equipment (PPE).

[3] The source of the leachate in assumed to be the landfill waste material

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
30	RCL11	DEV			Users of future development – public/ airport workers/users of New Century Park	Low	The GQRA indicated there was very few exceedances and the risk to future users of the new airport development is low. The future development will comprise buildings & hardstanding, therefore there is unlikely to be any contact Made Ground. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required, particularly in landscape areas to prevent direct contact with the Made Ground.
32	RCL12	DEV		Inhalation of soil derived dusts/asbestos fibres	Future maintenance workers	Low	The future development will comprise buildings & hardstanding, therefore there is unlikely to be the potential for generation of soil derived dusts. Maintenance workers may be exposed to areas of Made Ground during future excavation. This can be reduced by placing of services in a clean cover system and adoption of appropriate site management protocols and PPE.
33	RCL13	DEV			Users of future development – public/ airport workers/users of New Century Park	Low	The future development will comprise buildings & hardstanding, therefore there is unlikely to be the potential for generation of soil derived dusts. However, given the heterogeneous nature of landfills and the lack of engineered cover system, it should be assumed that measures will be required, particularly in landscape areas to prevent generation of dusts which may contain asbestos fibres.
Controlled Waters							

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
17	RCL14	CON	Waste in former landfill	Driving of contaminants downward during any future piling	Principal aquifer in Chalk	Moderate	The GQRA has indicated that there are isolated hot spots of contaminants present and a localised area of free product was encountered at location WS224. Care will be required during construction not to create a pathway. This may involve localised remove of hotspots in locations where works may create a pathway. Incorporation of localised removal at select locations in remediation strategy for site to reduce potential for creation of pathways Risk from piling and construction can be mitigated by completion of piling risk assessment report to determine appropriate assessment for pile design and construction.
23	RCL15	DEV	Leachate in former landfill[4]	Downward migration of leachate	Principal aquifer in Chalk	Moderate/ Low	DQRA has identified the potential for downward migration of leachate from the landfill. A weak leachate plume appears to be present immediately down gradient of the landfill, however groundwater monitoring completed to date does not suggest there is a significant contaminant plume affecting the aquifer. The sensitivity analysis indicated that minimising the rate of infiltration will prevent contaminants breaking through the base of the unsaturated zone and reaching receptors. Installation of a cover system with a drainage system to collect all infiltration in the area of the landfill will minimise any future risks to the groundwater from contaminants within the landfill.

[4] The source of the leachate in assumed to be the landfill waste material

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
26	RCL16	CON	Contaminants in perched water	Driving of contaminants downward during any future piling	Principal aquifer in Chalk	Low	GQRA indicated that perched water was present in some locations within the landfill. The GQRA indicated that there are isolated hot spots of contaminants present and a localised area of free product. Care will be required during construction not to create a pathway. This may involve localised remove of hotspots in locations where works may create a pathway. Risk from piling and construction can be mitigated by completion of piling risk assessment report to determine appropriate assessment for pile design and construction.
27	RCL17	CON		Migration of contaminants via preferential pathways e.g. drainage	Principal aquifer in Chalk	Moderate	Survey and assessment of purpose of drain passing through landfill to be undertaken and incorporated into design. Measure to be incorporated in design to prevent creation of preferential pathways.
40	RCL18	DEV	Contaminants in groundwater (dissolved phase)	Lateral migration of contaminants in groundwater	Controlled waters (including potable water groundwater abstraction)	Moderate	Overall there were relatively few exceedances of potential contaminants of concern recorded in groundwater beneath the site. DQRA indicated that whilst there is evidence of a weak leachate plume in groundwater down-gradient of the site, on-site groundwater monitoring provides little evidence that the landfill is causing significant contamination of the groundwater. The sensitivity analysis indicated that minimising the rate of infiltration will prevent contaminants breaking through the base of the unsaturated zone and reaching receptors. Installation of a cover system with a drainage system to collect all infiltration in the area of the landfill will minimise any future risks to the groundwater from contaminants within the landfill.
Others							

PCL No.	RCL no.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk and identification of required remediation
25	RCL19	DEV		Leachate breakout and plant uptake	Areas of Landscaping in the airport and New Century Park developments/WVP allotments	Low	No evidence of leachate breakout currently occurring. The GI undertaken indicates there is likely to be limited leachate present. A clean cover system with suitable depth of growth medium will further reduce this risk.

KEY:
CON- RCL during excavation, remediation and construction phase
DEV- RCL associated with future use of proposed development

Table 4.3 Revised conceptual site model (CSM) possible impacts

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
Gas						
Human Health						
3	DEV	Volatile radionuclides occupying buildings overlying radioactive land contamination	Migration into future buildings and build-up of gases	Users of future development – public/airport operatives/ New Century Park users	Low	The recent GI included testing for radionuclides, which indicated levels observed were consistent with background levels. No further risk assessment of the radionuclide risks is required. However, a watching brief will be required during excavation works and procedures in place to ensure any suspected radionuclide containing material encountered is appropriately managed.
4	DEV		Migration off-site through preferential pathways	Adjacent site users (e.g. residential housing and other buildings on Luton Airport, WVP Community Centre/ pavilion)	Low	
5	CON	Waste in former landfill	Direct contact e.g. dermal contact, soil ingestion	Construction worker	Low	Based on the results of the GQRA no special precautions, above and beyond best practice, are considered necessary during construction works to control potential acute risks. Appropriate measures should be undertaken during construction to ensure the site is secure and dusts are controlled. Any risks to construction worker can be reduced by adoption of appropriate site management protocols and PPE.
8	CON		Direct or indirect contact with radionuclides – incurring radiation dose by indirect dose received from ingestion of radium (or other alpha emitting contaminated material) or direct risk from contact with beta emitters such as	Construction workers	Low/ Moderate	Potential for radioactive materials to be present within the earlier waste which was deposited prior to the introduction of the Radioactive Substances Act in 1963. Potential for arisings from piling and foundation activities to encounter such materials. The recent GI included testing for radionuclides, which indicated levels observed were consistent with background levels. Procedures during construction should be in place to detect any radionuclides which may be encountered.

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
		Waste in former landfill	Carbon-14 or Caesium-137			
11	CON		Inhalation of vapours	Construction worker	Low	The GI provided sufficient information to characterise the potential risks from soils vapours. No elevated soil vapours were identified. However, due to the variable nature of landfill and potential for variability in vapour generation over time, vapour monitoring should be continued; prior to, during and post earthworks to confirm this assessment. A detailed monitoring strategy should be included in the remediation strategy. In addition, due to the heterogenous nature of the landfill, the remediation strategy should include measures to detect and appropriately deal with material encountered which is different from those assessed and may have high vapour generation potential. The odour assessment indicates odour suppression techniques are likely to be required during the excavation works. Any future works should have an odour management plan in place to control any odours generated during works.
12	DEV			Future maintenance workers	Low	The GI provided sufficient information to characterise the potential risks from soils vapours. No elevated soil vapours identified during DQRA assessment which could be considered to pose a risk to the future development. Post earthworks monitoring will be undertaken to confirm assessment. A detailed monitoring strategy should be included in the remediation strategy. If elevated concentrations are detected post earthworks the need for specific mitigation measures to prevent vapour intrusion into buildings should be reassessed.
13	DEV			Users of future development – public/airport operatives/ New Century Park users	Low	
15	CON		Inhalation of airborne contaminants/ dust/ asbestos fibres and microorganisms	Adjacent site users (e.g. residential housing, Luton Airport visitors and operatives, users of WVP)	Low	The GI provided sufficient information to characterise the condition of asbestos present within the landfill and inform this assessment. Overall the risk is considered to be low based on; the ACMs types encountered, their degradation state and fibre content. However, it is recognised that the landfill is heterogenous in nature and as such localised areas of increased frequency of ACMs may exist. Future works will require

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
		Waste in former landfill				significant movement of waste i.e. for waste processing/re-engineering, therefore there is the potential for generation of airborne contaminants, which could affect adjacent site users. Careful consideration of techniques for waste processing/re-engineering will be required to minimise dust production, as well as good site management practices, monitoring and mitigation measures to reduce the potential risk. Any future works should have appropriate Environmental Management Plans in place to include perimeter monitoring, with adoption of additional control measures as necessary.
16	CON			Construction workers	Moderate	The GI provided sufficient information to characterise the condition of asbestos present within the landfill/Made Ground and inform this assessment, but it is recognised that the landfill/Made Ground is heterogenous in nature and as such localised areas of increased frequency of ACMs may exist. Therefore, a strategy for managing ACMs should be developed as part of a remediation strategy for the works. Construction workers are likely to be exposed to areas of landfill waste during future excavation. Any excavation work would adopt appropriate site management protocols and PPE to include personal monitoring and protection against airborne asbestos fibres as necessary based on outcome of risk assessments.
20	CON	Leachate in former landfill[5]	Direct contact e.g. dermal contact	Construction workers	Moderate/ Low	Construction workers may be exposed to landfill leachate during future excavation works. The GI undertaken indicates there is likely to be limited leachate present. Any excavation work would adopt appropriate site management protocols and PPE.
28	CON	Contaminants in Made Ground (car	Direct contact e.g. dermal contact, soil ingestion	Construction workers	Moderate/ Low	Based on the results of the GQRA no special precautions, above and beyond best practice, are considered necessary during construction works to control potential acute risks. Appropriate measures should be undertaken during construction to ensure the site is secure and dusts are

[5] The source of the leachate in assumed to be the landfill waste material

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
		park, capping material)				controlled. Any risks to construction worker can be reduced by adoption of appropriate site management protocols and PPE.
31	CON		Inhalation of soil derived dusts/asbestos fibres	Construction workers	Moderate	The GI provided sufficient information to characterise the condition of asbestos present within the landfill/Made Ground and inform this assessment, but it is recognised that the landfill/Made Ground is heterogenous in nature and as such localised areas of increased frequency of ACMs may exist. Therefore, a strategy for managing ACMs should be developed as part of a remediation strategy for the works. Construction workers are likely to be exposed to areas of landfill waste during future excavation. Any excavation work would adopt appropriate site management protocols and PPE to include personal monitoring and protection against airborne asbestos fibres as necessary based on outcome of risk assessments.
34	CON	Contaminants in Made Ground (car park, capping material)	Inhalation of soil derived dusts/asbestos fibres	Adjacent site users (e.g. residential housing, Luton Airport, WVP)	Low	The GI provided sufficient information to characterise the condition of asbestos present within the Made Ground and inform this assessment. Overall the risk is considered to be low based on; the ACMs types encountered, their degradation state and fibre content. However, it is recognised that Made Ground is heterogenous in nature and as such localised areas of increased frequency of ACMs may exist. Future works will require significant movement of material, therefore there is the potential for generation of airborne contaminants, which could affect adjacent site users. Careful consideration of techniques will be required to minimise dust production, as well as good site management practices, monitoring and mitigation measures to reduce the potential risk. Any future works should have appropriate Environmental Management Plans in place to include perimeter monitoring, with adoption of additional control measures as necessary.
35	CON		Inhalation of vapours	Construction worker	Low	The GI provided sufficient information to characterise the potential risks from soils vapours. No elevated soil vapours were identified. However, due to the variable nature of Made Ground and potential for variability in vapour generation over time, vapour monitoring should be continued; prior to, during and post earthworks to confirm this assessment. An outline monitoring strategy should be included in the remediation strategy. The remediation strategy should include measures to detect and

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
						appropriately deal with material encountered which is different from those assessed and may have high vapour generation potential.
36	DEV			Future maintenance workers	Low	The GI provided sufficient information to characterise the potential risks from soils vapours. No elevated soil vapours identified during DQRA assessment which could be considered to pose a risk to the future development. Post earthworks monitoring will be undertaken to confirm assessment. A detailed monitoring strategy should be included in the remediation strategy. If elevated concentrations are detected post earthworks the need for specific mitigation measures to prevent vapour intrusion into buildings should be reassessed.
37	DEV			Users of future development – public/ airport workers/users of New Century Park	Moderate/ Low	
38	DEV	Contaminants in Made Ground (car park, capping material)		Adjacent site users (e.g. residential housing, Luton Airport, WVP Buildings)	Low	DQRA indicated that risks from soil vapours is low. During construction works an appropriate Environmental Management Plan should be in place to include perimeter monitoring, with adoption of additional control measures as necessary. Post earthworks monitoring will be undertaken to confirm assessment.
Controlled Waters						
39	CON	Contaminants in Made Ground (car	Balancing pond	Principal aquifer in Chalk	Very Low	Thames Water balancing pond present in the north of the former landfill area, it will remain in place during the Proposed Development. Appropriate site management and construction techniques will be

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
		park, capping material)				required during the development construction process in the vicinity of the current pond to reduce the risk.
Others						
18	DEV	Waste in former landfill	Direct contact of foundations of future development	Foundations of future buildings	Moderate	Presence of landfill waste in contact with building foundations may cause damage to foundations through aggressive ground conditions. Site investigation data will be considered in the design of the foundation. Risk can be mitigated by appropriate geotechnical design to select suitable foundation materials/concrete classification.
19	CON	Japanese Knotweed (JKW)	Direct contact with rhizomes on floor slabs, external pavement and drainage	Floor slabs/drainage/pavement	Moderate/ Low	Japanese Knotweed has been identified in WVP, this can cause damage to buried infrastructure/buildings and pavement through growth of rhizome. Risk can be mitigated through application of treatment with herbicide/removal/on-site burial/containment.

PCL No.	Phase applicable to (see key)	Source	Pathway	Receptor	Qualitative Assessment of Risk	Justification of Qualitative Assessment of Risk
24	DEV	Leachate in former landfill	Direct contact with foundations of future development	Foundations of future buildings	Moderate/ Low	Presence of leachate in contact with building foundations may cause damage to foundations through aggressive ground conditions. The GI undertaken indicates there is likely to be limited leachate present. Consider in the geotechnical design.
41	CON	Unexploded Ordnance	Driving of piles impact UXO	Construction workers/public/ terminal buildings	High/ Moderate	Based on Detailed UXO Risk Assessment 'Very High' probability of UXO on-site. Low risk where works are to be undertaken within post war fill material- correct detection and monitoring procedures will be required during site works to mitigate risks.
KEY: CON- PCL during excavation, remediation and construction phase DEV- PCL associated with future use of proposed development						

5 OVERARCHING REMEDIATION STRATEGY

5.1 Approach and guidance

5.1.1 In line with Environment Agency guidance, the approach to developing the outline remediation strategy is based on the guidance 'Land contamination risk management' from the Environment Agency. The approach involves completion of the following steps:

a. undertake risk assessment (summarised in Section 4);

b. define relevant contaminant linkages (summarised in Table 4.2, Section 4);

c. define remediation objectives and remediation criteria;

d. identify technically feasible options which address relevant contaminant linkages and meet remedial objectives; and

e. selection of most suitable option or combination of options to create an outline remediation strategy.

5.2 Remediation objectives

5.2.1 There are two categories of objectives: technical and managerial. Technical objectives primarily address the site-specific RCLs. Management objectives reflect the main drivers for the successful execution of the remedial works to ensure the identified RCLs have been managed effectively. All objectives relate either directly or indirectly to the reduction or control of risks on the site and deal with both general objectives and those individual pollutant linkages identified as requiring some form of risk management. These are summarised below in **Table 5.1.**

Table 5.1 Summary of remediation objectives

Remediation Objectives	Type of Objective
Enable the former landfill to be remodelled and its surface redeveloped without risks to future site users, neighbours and maintenance workers following completion of development works by addressing the RCLs/PCLs identified in Section 80.	Technical
Ensure the former landfill does not pose a risk of detrimental impact to quality of controlled waters by addressing the RCLs/PCLs identified in Section 4.	Technical
To ensure the Proposed Development is not at risk from gases within the landfill or that neighbouring properties are not at risk from gases migrating off-site by addressing the RCLs/PCLs identified in Section 4.	Technical

Remediation Objectives	Type of Objective
To use materials and concrete for permanent structures which are resistant to degradation in the ground conditions.	Technical
Produce a remediation strategy that accords with the requirements of both aviation design standards and regulatory authorities.	Management
Reuse of excavated landfill material in a way that meets the requirements of and enables future use of the site.	Technical
Minimise all environmental impacts during implementation of remediation strategy.	Management
Minimise all health & safety impacts during implementation of remediation strategy	Management
Minimise/avoid long term monitoring and management requirements	Management
To utilise a remediation technique whereby any requisite permissions can be obtained within required timescales.	Management
Remediate site within acceptable timescales	Management
Ensure that the work is sustainable from the point of view of resources, cost and environment.	Technical

5.3 Remediation criteria

5.3.1 Remediation criteria provide a measure against which conformity with the remediation objectives outlined in **Error! Reference source not found.** can be measured. The remediation criteria below are considered to be what will be acceptable to the regulatory authorities to protect human health and controlled waters:

a. Confirmation that no significant pollution is caused to the underlying principal Chalk Aquifer;

b. Materials to be reused within the works must not pose a risk to human health, controlled waters or other receptors, see **Section 11.2**; and

c. No accumulation of ground gases or volatile vapour phase contaminants within the buildings in the development.

5.4 Site characteristics and constraints relevant to remediation

5.4.1 A number of features of the site and constraints have been identified which will affect site remediation, these are detailed in **Table 5.2.**

Table 5.2 Identified potential remediation constraints

Remediation constraint	Details
Invasive species	Previous ecological surveys have confirmed the presence of JK within the area of Wigmore Valley Park (former landfill). JK is an invasive non-native plant that is listed under Part II Schedule 9 (of the Wildlife and Countryside Act 1981 (as amended) where it is an offence to plant or grow in the wild. The presence of JK will impact the construction works and therefore will be a requirement to eradicate what is present to prevent the spread of rhizomes during works. Invasive species can require extended treatment (chemical treatment can take approximately 3 years to be fully effective).
Protected species	Previous ecological surveys have indicated the presence of badger setts within Wigmore Valley Park. Badgers and their setts are protected under the Protection of Badgers Act 1992. The badgers will require relocation prior to construction work, this can take an extended period of time and can require a number of repeat surveys. Work to relocate badger setts can only be carried out between July and November in accordance with best practice. Sufficient time will be required in programme for this to ensure it does not impact on commencement of remediation works.
Potential preferential pathways - Drains	Decommissioning of Thames Water drain beneath the former landfill to ensure it does not present a preferential pathway for landfill gas or leachate. Any other drains and services present should also be appropriately decommissioned prior to works.
Space constraints	The site is approximately 40ha within the wider Proposed Development site. The phasing of the Proposed Development may mean there are space constraints in terms of operation and storage of plant involved in the remediation works, or for stockpiling or ex-situ treatment of contaminated or uncontaminated material. There is also a need to maintain a substantial area of the site as a temporary car park during the works. Careful phasing will be required to ensure efficient working.
Operational airport	The former landfill is adjacent to the airport which will be operational throughout the development work. Therefore, the remediation strategy will need to accommodate ongoing operations during its implementation.
Proximity to sensitive human health receptors	Residential housing and users of the airport are adjacent to the former landfill site. Therefore, there are sensitive human health receptors in close proximity to the site. The remediation strategy will need to minimise the potential impacts to these receptors from odours and dusts which may be generated during the remediation activities.

Remediation constraint	Details
Traffic	The roads around Luton are currently very congested. The remediation technique used will need to minimise the amount of lorry movement to and from the site.
Unexploded ordnance	The area of the former landfill was identified as having a 'Very high' risk from UXOs. The older material within the landfill (1940s-1950s) is considered to present the highest risks as this was being place during WWII. The risk will need to be considered in the remediation and construction works.
Landfill heterogeneity	Due to the nature of historic landfills i.e. no specific controls on waste types deposited, there is likely to be a high degree of heterogeneity in the waste. A substantial amount of ground investigation data is available; however, no ground investigation can completely characterise a site and contamination may exist or be in an area where contamination was not expected. Therefore, the remediation strategy will need to include measures to detect and deal with unexpected contamination.
Weather	Conditions during the remediation period could cause problems for some remediation techniques. Summer working could lead to increase dust and odour issues- suppression techniques would be required. Similarly, winter working could be affected by increased rainfall affecting the soil/landfill waste and trafficking of plant.

5.5 Identification of feasible remediation options

5.5.1 The DQRA indicated that the concentrations of contaminants present within the landfill are not currently posing a risk to human health or controlled waters. However, it is noted that:

a. the nature of historical landfills i.e. no specific controls on waste types deposited, means there is likely to be a high degree of heterogeneity in the waste. Therefore, whilst site investigation has appropriately characterised conditions there may be localised areas not yet encountered where contamination conditions vary; and

b. The construction works required and subsequent development will alter the potential risk to future users and other receptors.

5.5.2 The assessment presented in **Table 4.2** in **Section 4** identifies potential risks where measures inherent in the construction or operation of the Proposed Development might not be sufficient to break the pollutant linkage. These PCLs were identified as RCLs and will be subject to remediation measures as described in the following sections.

5.5.3 There are three general types of remediation that can "break" the RCLs, these are as follows:

a. Managing the receptor;
b. Breaking the pathway; and
c. Reducing (or removing) the source term.

5.5.4 To identify the feasible remediation options that could address the RCLs a remediation options appraisal (ROA) of the available treatment processes and technologies has been undertaken. A screening matrix for remediation technologies is present in **Appendix A**. No techniques relating to groundwater remediation have been considered as the DQRA indicated no specific remediation of the groundwater was required.

5.5.5 Details on the suitability, clean up time, costs and reliability for the screening matrix have been obtained from the following key sources:

a. Environment Agency. Land contamination risk management (Ref.
b. CIRIA C622 Selection of remedial treatments for contaminated land (Ref. 17); and
c. CIRIA C549 Remedial processes for contaminated land principles and practice (Ref. 18).

5.5.6 The three general types of remediation in relation to the RCLs is discussed below and reference is made to the feasible remediation options identified in the appraisal in **Appendix A.**

Managing the receptor

5.5.7 Managing the receptor is not considered a suitable approach as for controlled waters it is not possible to move or manage the underlying Principal Aquifer. In addition, for human health there are few changes that can be made to the proposed masterplan which would further reduce the relevant human health linkages. Therefore, this is not considered a feasible option for these receptors.

Reducing (or removing) the source term

5.5.8 It is not considered feasible or necessary to remove the source term i.e. remove all landfill material. This would involve the removal of approximately 4,400,000m3 of landfill material. It would remove all potential linkages, but it is considered an unfeasible option due to the following:

a. Excavation and disposal of all the landfill material would not be the most sustainable or the best option for the environment according to the waste hierarchy set out in The Waste Regulations 2011. Reuse of existing landfill

materials within the scheme would best achieve the requirements of the waste hierarchy;

b. Create an unfeasibly large number of lorry movements on local and regional roads. Lorry movements and the related traffic impacts and pollution was identified during the non-statutory consultation process as a key concern for the public and should be minimised wherever possible;
c. If the landfill material was removed the resulting void would require a significant amount of material for backfilling, which would use natural resources. This is not considered sustainable practice, when it is possible to retain the existing materials;
d. No local landfill capacity for disposal of the volume of material;
e. Treatment of all the landfill material to reduce contamination concentrations would be impractical and unwarranted based on the DQRA;
f. Potentially exposing construction workers to contamination in large volumes of landfill material; and
g. Treatment of the volume of material would not be achievable in programme timescales.

5.5.9 Therefore, based on the above points the excavation of former landfill material will be minimised. However, where the aviation platform is to be constructed it is necessary to excavate the top part of the landfill material and compact the material that remains as it does not have the geotechnical properties required to meet settlement standards for aviation (**see Section 2.3.2** and **Drawing 1**)**Error! Reference source not found.**. Further areas of reprofiling will be undertaken north of the aviation platform to create the formation level for the new structures and access road. The material recovered from the landfill will be suitable for reuse in this reprofiling. This would limit the potential construction related risks associated with disturbing the landfill and address constraints relating to space and construction programme.

5.5.10 The landfill material which is excavated will be recovered and processed to improve its physical properties before reuse elsewhere in the development. Feasible options for treatments to improve its physical properties were identified in the screening matrix in **Appendix A**. Details are provided in **Section 8.**

5.5.11 The approach also supports sustainability objectives; an essential element for the success of the development is to minimise the number of heavy goods vehicles (HGV) movements (see constraints in

Table 5.2 and discussed above). Recovery and reuse of the waste materials on site would help to meet this objective. The recovery of waste also contributes to other sustainability aspects; the use of waste as a replacement for non-waste materials will both conserve natural resources and reduce pressure on landfill by retaining the materials on site.

5.5.13 Whilst it is not considered practical to use remediation technologies to treat the majority of the landfill material, it may feasible to use specific remediation technologies to treat small areas of localised free product identified (eg WS224) (RCL14) or additional areas encountered during works, to allow it to be reused on site. The ROA presented in **Appendix A** identified that treatment through bioremediation (windrows or biopiles) is likely to be the most effective for this small volume of material.

Breaking the pathway

5.5.14 The most feasible option to address the identified RCLs is considered to break or manage the pathway. The remediation options appraisal identified there is only a single solution available to break the pathway for each RCLs (except for RCL 14 discussed above).

5.5.15 The majority of the RCLs can be addressed with an engineered cover system. Cover systems are a proven approach for managing historic landfills and would minimise infiltration rates, thereby decreasing the potential for leaching of contaminants from the fill to groundwater. The method would also break the pathways between contaminated soil and future site users. The method would limit the amount of material requiring off-site disposal. Gas protection measures could be incorporated into the overall cover system design.

5.5.16 For migration of gases off-site, both during and post construction, the use of an in-ground barrier such as virtual gas curtain will provide an appropriate pathway break.

5.5.17 Proposed remediation methods detailed in **Table 5.3** below indicate the techniques considered to be the most feasible to break the RCLs.

5.5.18 An assessment of how each of the proposed techniques addresses the objectives set out in **Section 5.2** is provided in **Table 5.3.**

Table 5.3 Techniques considered to be the most feasible to break the RCLs

RCL no. (see Table 4.2)	Source	Pathway	Receptor	Remediation required
Ground Gases				
RCL1	Ground gases from former landfill e.g. methane	Migration into future buildings and build-up of gases	Users of future development – public/airport operatives/ New Century Park users	Gas protection measures in development **(See 7.3.1)**

RCL no. (see Table 4.2)	Source	Pathway	Receptor	Remediation required
RCL2		Migration off-site	Adjacent site users (e.g. residential housing and other buildings on Luton Airport, WVP Community Centre/ pavilion)	In ground barrier such as virtual gas curtain **(see Section 7.3.19).** Measures required to treat existing preferential pathways e.g. Thames Valley Drain (see 7.3.21)
Human Health				
RCL3	Waste in former landfill	Direct contact e.g. dermal contact, soil ingestion	Future maintenance workers	Engineered cover system **(see Section 7.4)**
RCL4			Users of future development – public/airport operatives/ New Century Park users	Engineered cover system **(see Section 7.4)**
RCL5		Direct or indirect contact with radionuclides – incurring radiation dose by indirect dose received from ingestion of alpha emitting contaminated material or direct risk from contact with beta emitters	Future maintenance workers	Engineered cover system **(see Section 7.4)**
RCL6			Users of future development – public/airport operatives/ New Century Park users	Engineered cover system **(see Section 7.4)**

RCL no. (see Table 4.2)	Source	Pathway	Receptor	Remediation required
RCL7		Inhalation of airborne contaminants/ dust/ asbestos fibres and microorganisms	Users of future development – public/airport operatives/ New Century Park users	Engineered cover system **(see Section 7.4)**
RCL8	Leachate in former landfill[6]	Direct contact e.g. dermal contact	Future maintenance workers	Engineered cover system **(see Section 7.4)**
RCL9			Users of future development – public/airport operatives/ New Century Park users	Engineered cover system **(see Section 7.4)**
RCL10	Contaminants in Made Ground (car park, capping material)	Direct contact e.g. dermal contact, soil ingestion	Future maintenance workers	Engineered cover system **(see Section 7.4)**
RCL11			Users of future development – public/ airport workers/users of New Century Park	Engineered cover system **(see Section 7.4)**
RCL12		Inhalation of soil derived dusts/asbestos fibres	Future maintenance workers	Engineered cover system **(see Section 7.4)**
RCL13			Users of future development – public/ airport workers/users of New Century Park	Engineered cover system **(see Section 7.4)**
Controlled Waters				
RCL14	Waste in former landfill	Driving of contaminants downward during any future piling	Principal aquifer in Chalk	Removal of localised area of free product identified in WS224 and any additional areas identified during excavation. Treatment through bioremediation **(see Section 7.2)** Selection of appropriate piling technique **(see Section Error! Reference source not found.)**

[6] The source of the leachate in assumed to be the landfill waste material

RCL no. (see Table 4.2)	Source	Pathway	Receptor	Remediation required
RCL15	Leachate in former landfill[7]	Downward migration of leachate	Principal aquifer in Chalk	Engineered cover system **(see Section 7.4 and 7.5)** Measures to control potential leachate encountered during works are discussed in **Section 9.7.**
RCL16	Contaminants in perched water	Driving of contaminants downward during any future piling	Principal aquifer in Chalk	Selection of appropriate piling technique **(see Section Error! Reference source not found.).**
RCL17		Migration of contaminants via preferential pathways e.g. drainage	Principal aquifer in Chalk	Measures required to treat existing preferential pathways e.g. Thames Valley Drain **(see Section 7.3.21)**
RCL18	Contaminants in groundwater (dissolved phase)	Lateral migration of contaminants in groundwater	Controlled waters (including potable water groundwater abstraction)	Engineered cover system **(see Section 7.4 and 7.5)**
Other				
RCL19	Leachate in former landfill	Leachate breakout and plant uptake	Areas of Landscaping in the airport and New Century Park developments/WVP allotments	Engineered cover system **(see Section 7.4 and 9.7)**

5.6 PCLs where impact is possible but can be mitigated by design and/or managed

5.6.1 **Section 4** identifies a number of PCLs where the potential impact could be managed or mitigated by design. The measures to manage these PCLs are summarised in **Table 5.4.**

Table 5.4 PCLs where potential impact can be managed or mitigated by design

Source	Pathway	Receptor	Design mitigation and/or management measure	PCLs	Comments

[7] The source of the leachate in assumed to be the landfill waste material

Source	Pathway	Receptor	Design mitigation and/or management measure	PCLs	Comments
Radionuclides in waste in former landfill	Migration into future buildings and build-up of gases	Users of future development	Watching brief for unexpected conditions and management plan for any encountered	PCL 3 PCL 4 PCL 8 PCL 11 PCL 12 PCL 13 PCL 35 PCL 36 PCL 37 PCL 38	**See section 9.12.1**
	Migration off-site through preferential pathways	Adjacent site users			
	Direct or indirect contact	Construction workers			
Waste in former landfill and/or contaminants in Made Ground	Inhalation of vapours and dusts	Construction worker	Management plans and monitoring for dusts, odours etc. Use of suppression techniques where required	PCL 11 PCL 12 PCL 13 PCL 15 PCL 35 PCL 36 PCL 37 PCL 38	**See section 10 and 10.3.6.**
		Adjacent site users			
	Inhalation of asbestos fibres	Construction worker	Asbestos management strategy including completion of risk assessment, preparation of plan of work, watching brief and action plan for unexpected asbestos finds	PCL 15 PCL 16 PCL 31 PCL 34	**See section 9.5**
		Adjacent site users			
Waste in former landfill and/or contaminants in Made Ground	Direct contact	Construction workers	Site management protocols, construction techniques and adoption of appropriate PPE	PCL 5 PCL 15 PCL 20 PCL 28 PCL 31 PCL 39	**See Section 9**
Leachate in former landfill					
Leachate in former landfill	Direct contact with foundations of future development	Foundation of future buildings	Mitigation of damage to foundations/ services due to aggressive ground conditions through design and use of appropriate foundation/ concrete class	PCL 18 PCL 24	**See section 6.2.1**
Waste in former landfill					
Japanese knotweed			Damage to floor slabs, drainage and pavement from rhizomes	PCL 19	**See section 6.2.3**
Unexploded Ordnance	Driving of piles impact UXO	Construction workers/ public/ terminal buildings	UXO detection and monitoring during works	PCL 41	**See section 9.6**

6 REMEDIATION PROCESS AND PROGRAMME

6.1.1 This section provides an overview of the process involved with the management of landfill materials and remediation in terms of the key steps and what these involve. An indication of the construction programme is also outlined. A schematic of the remediation process and materials management is presented in **Drawing 3** . Details of the remediation methods to be used are provided in **Section 7** and management of landfill earthworks in **Section 8.**

6.2 Key stages

Design development

6.2.1 Further design development is required to inform the landfill earthworks. The following, but not limited to, require further development at the detailed design stage:

a. Consult and agree remediation strategy with regulators, amend as necessary.
b. Settlement predictions and design of utilities to protect from settlement;
c. Complete segregation trials/additional site investigation to identify the best combination of treatment technologies and efficient process. These may be done at either design development or preparatory stage;
d. Determine the detailed phasing for the earthworks and material movements;
e. Determine suitability criteria for materials to be reused and criteria for surrender of permit;
f. Develop the earthworks specification detailing the geotechnical requirements for the processed landfill material;
g. A general description of the requirements of the cover system is provided in **Section 7.4**. However, the final design will be completed at detailed design stage when additional requirements such as location of tree pits, further drainage layers and membrane specifications will be decided;
h. A Foundation Works Risk Assessment (FWRA) to inform the most appropriate technique for foundation piling to minimise the potential risk of creating a pathway through the annulus of the pile. It is key to managing and breaking the pathway for RCLs 14 and 16;
i. The gas protection measures for each building will need to be considered further during the detailed design stage. The general gas protection requirements based on a conservative assessment are detailed in **Section 7.3.**
j. Develop the detailed design with regards to gas protection for DART and the apron and other infrastructure;
k. Determine best compaction technique to be used within the landfill earthworks; and
l. Foundations within the landfill may be exposed to aggressive ground conditions as identified in Table 4.3 (PCL18, 24). Further assessment is required at the detailed design stage to confirm the requirements.

Planning stage

6.2.2 Several activities will require completing during the planning stage as presented in Table 6.1 below.

Table 6.1 Planning stage activities

Activity		Details
1	Obtain necessary permits and licences.	Appropriate licenses will be required for the materials management and for certain aspects of the remediation works. Further detail is presented in **Sections 8.2 and 9.3.**
2	Agree monitoring plans with regulators	Agree baseline conditions with regulators and agree intervention and action criteria. **See Section Error! Reference source not found..**
3	Agree plan for submission of verification documentation and surrender of permit	Agree programme for submission of verification documents based on the phasing of works. **See Section 11.5.**

Preparatory works

6.2.3 There are a number of site preparation and enabling work activities which are required prior to commencement of the landfill earthworks/remediation work, these are detailed in **Table 6.2.**

Table 6.2 Site preparation and enabling works required prior to commencement of landfill earthworks

Activity		Details
1	Japanese Knotweed (JKN) – eradication prior to site establishment (PCL 19)	JKN was identified as a potential constraint in **Error! Not a valid result for table.**. Several stands of knotweed were identified in the Habitat Study completed in May 2018 and are recorded in the Ecology Baseline Report (Ref. 19); the stands are located at two distinct areas; the northern boundary adjacent the Thames Valley balancing pond, and in the south eastern (woodland) area of the site. JKN is classed as a noxious weed, under the Wildlife and Countryside Act 1981 it is illegal to plant or allow it to be spread. It can also be classed as a statutory nuisance if the plant spreads onto neighbouring property. Removal of Japanese Knotweed is required prior to start of earthworks to prevent spread of the plant. It can be very difficult and take several years to treat effectively with chemicals. Soils affected by Japanese Knotweed rhizomes cannot be reused within the general fill materials on site. JKN requires either burial consistent with special conditions under Environment Agency permission, specialist disposal off-site or chemical eradication over several seasons to be completed in accordance with current guidance (Ref. 20). It is understood that the LBC are currently undertaking a programme of spraying the plant with herbicide. However, a survey will be required by a specialist contractor and a strategy developed to deal with JKN prior to commencement of earthworks.

Activity		Details
2	Relocation of badger setts	Protected species was identified as a potential constraint within **Error! Not a valid result for table..** There are currently two active badger setts on site located within the County Wildlife Site on the landfill. Badgers are a protected species under the Protection of Badgers Act 1992. Therefore, a licence to exclude the badgers from their sett and relocate them will be obtained from Natural England, before site preparation works commence.
3	Relocation of Wigmore Valley Park	Wigmore Valley park to be relocated to the east to allow for the earthworks.
4	Relocation of Long Stay Car Park	The current long stay car park will need to be relocated to allow for the earthworks. Alternative provision to be provided.
5	Decommissioning of wells which have been identified as redundant due to their location in respect to excavation/ construction works.	The groundwater/ground gas monitoring wells which are no longer required will be formally decommissioned in accordance with Environment Agency guidance (Ref. 21) to prevent pathways to the underlying Chalk during construction.
6	Install fencing	Secure the construction area for remediation and ensure there is adequate security provisions.
7	Create haul roads	Set up haul roads for transportation of material within the site boundary
8	Locate and treat old utilities such as the drain along the base of the landfill.	To remove potential pathway for migration of contamination; landfill leachate/ groundwater/ground gas (RCL 17)
9	Establish Site Compound for stockpiling and processing of soils	To control works and potential for pollution i.e. installation of temporary drainage and waste water treatment system, boundary air monitoring (dust, vehicle emissions, vapours and asbestos fibres), prevent unauthorised access.
10	Install permanent boundary gas protection (see Section 7.3.18).	Install gas protection on boundary of landfill to prevent any migration off-site during and post works.
11	Install monitoring points and other gas/leachate controls to perimeter	Installation of monitoring points and protection of boreholes in appropriate locations to ensure they can be retained during construction work. Install gas control to boundary i.e. vent trench/virtual curtain. (RCL 2,14)
12	Installation of sheet pile wall to west and south of terminal between the landfill and aviation platform.	To allow excavation of landfill waste.
13	Preparation of existing surfaces e.g. benching etc	Prepare surfaces in areas where material is to be placed.

Landfill earthworks

6.2.4 The earthworks to create the development platform will necessitate the excavation of landfill materials. The works will be completed prior to creation of the cover system outlined in **Section**

7.4. The main activities are described in **Table 6.3** below and presented schematically on **Drawing 3:**

Table 6.3 Landfill earthworks process

Activity		Purpose
1	Remodel the landfill adjacent to Eaton Green Road	For highways works
2	Remodel the landfill surface generally	Enable the construction of the development
3	Excavation and selective separation of former landfill materials beneath the proposed airside platform and for reprofiling works on the landside platform.	Achieves the required remodelling of the landfill to allow the construction of the new aviation platform
5	During excavation of material separation of any soils grossly impacted with hydrocarbons such as around WS224 (see Section 7.2).	To prevent cross contamination of other material and remediate to improve properties to allow reuse on site.
6	Separation of clean cover materials from waste materials requiring treatment at source.	Maximise the material that can be reused and minimise waste.
7	Physical treatment (primary), waste materials to be screened and sorted into their component parts i.e. wood, plastic, metal etc.	Allows materials with high gassing/leachate potential i.e. wood waste to be separated for further treatment. Improves physical condition of material for reuse, if required.
8	Verification- chemical testing of materials	Testing of treated/stockpiled materials for reuse to ensure they meet required criteria **(see Section 11.2)**
9	Selective blending of material prior to reuse within the scheme to improve its properties	Improves geotechnical properties for reuse and can reduce overall gassing/leachate potential by combination of materials.
10	Placement of treated material within suitable areas of the scheme.	Selective placement of certain materials allows long term risks to be managed.
11	Compaction of existing and treated materials where required	Compaction improves geotechnical properties and reduces long term risks associated with gas, leachate and settlement.

6.3 Post landfill earthworks

Remediation implementation

6.3.1 The key activities with regards to the remediation works are detailed in **Section 6.4.6** and **Drawing 3**. The majority of which will be undertaken during Phase 1 of the construction programme after the landfill earthworks.

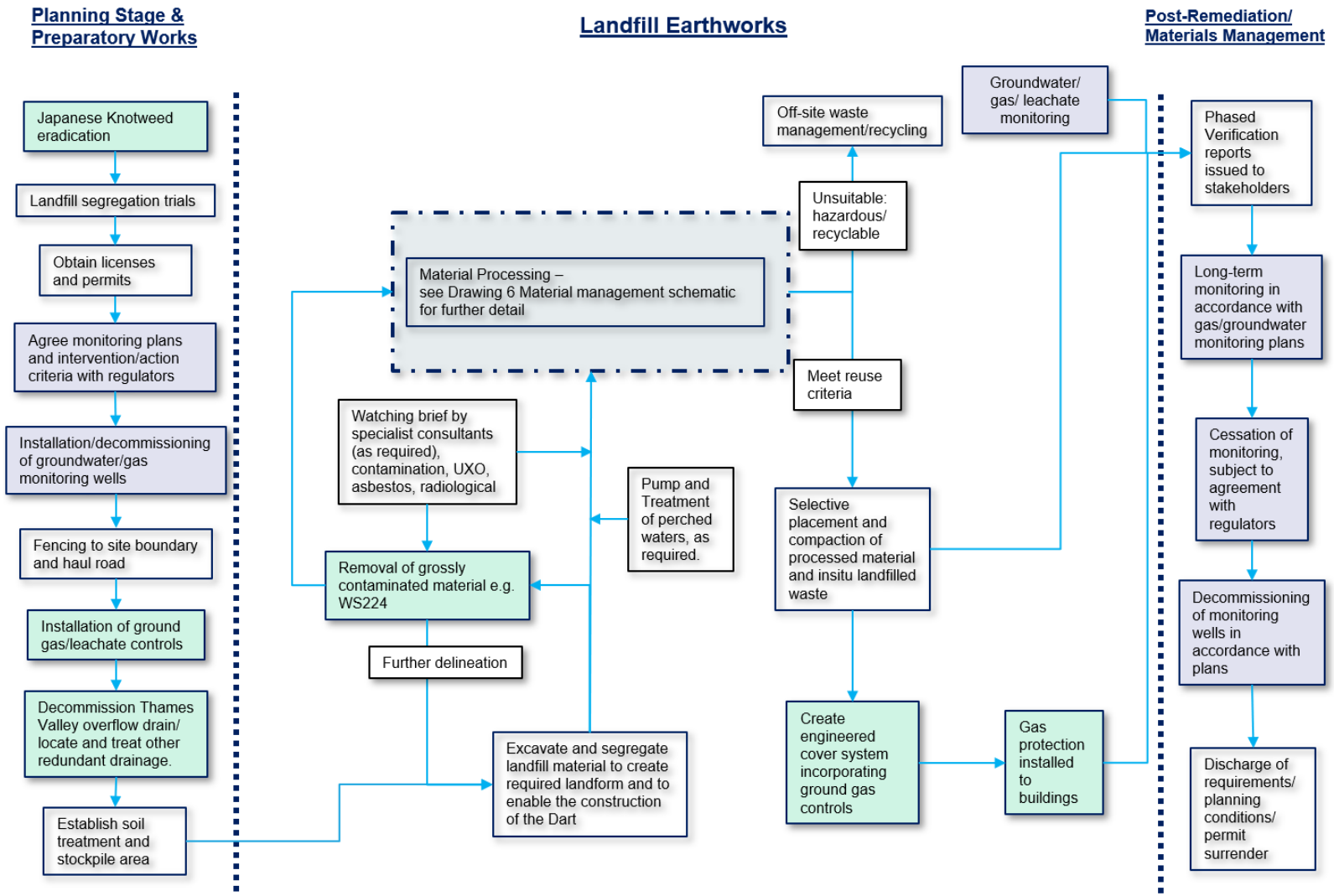
6.3.2 Due to the duration of the construction programme it is likely that interim monitoring reports will also be required to confirm environmental controls are effective and there is no migration of contamination off site. This will be agreed with the relevant regulators in the preparatory stage **(see Error! Reference source not found.).**

Table 6.4 Key activities during remediation works

Activity		Purpose
1	Cover system across the surface of the site **(see Section 7.4).**	Prevent future users of the site coming into contact with materials, provides a clean corridor for services and utilities and prevents future infiltration into the landfill.
2	Gas and leachate control systems **(see Sections 7.3.15, 7.3.17 and 9.7.1 for details).**	The re-engineered waste will have a low residual risk with regards to leachate and gas. However, the remaining in-situ landfill materials will have a higher residual risk, even after improvement through compaction. Therefore, gas and leachate control systems will be required to prevent potential impacts. The control system will be incorporated within the cover system design.

Activity		Purpose
3	Build in gas protection measures in buildings and vulnerable infrastructure on the site (see **Section 7.3** for gas protection measures).	Prevent landfill gas risks associated with build-up of gases in structures.
4	Submission of verification reports	UK guidance requires a verification report to be submitted on completion of the remediation work. The verification report is then submitted to the Planning Authority for regulatory agreement. Due to the timescales and phasing of the development it is likely that more than one verification report may be required and that a programme for submission of these reports will be agreed, prior to works commencing, with the Planning Authority in accordance with the phasing.
5	Submission of long-term monitoring reports	Long term monitoring of groundwater, leachate and gas conditions is likely to be required as a condition of both the Environmental Permit and DCO. A programme for submission of regular monitoring reports will need to be agreed with the Regulators, prior to works commencing. **See** Table 6.1 and **Section 10Error! Reference source not found.** for further details.
6	Surrender Environmental Permit and discharge of DCO requirements	Once agreed compliance levels have been achieved an application to surrender the environmental permit will be made. In addition, when the DCO requirements have been met an application will be made to the planning authority to discharge the requirements. This may occur over a different timescale to the surrender of the Environmental Permit.
7	Decommissioning of gas/groundwater wells.	The groundwater/gas monitoring wells will be formally decommissioned, subject to agreement with the regulator, once agreed compliance levels have been achieved. **See Section 11.6** for further details.

Drawing 3 Indicative schematic of key remediation/ landfill earthworks stages



6.4 Construction programme

6.4.1 The indicative construction programme is shown in **Table 6.5** below. It should be noted that this programme is indicative and is subject to change.

Table 6.5 Indicative construction programme

Phase	Commence work	Complete work
Phase 1	2025	2027
Phase 2a	2033	2036
Phase 2b	2037	2041

6.4.2 Preparatory works described in **Table 6.2** will be undertaken along with the relocation of Wigmore Valley Park during preparatory works phase of the construction programme.

6.4.3 The bulk of the landfill earthworks works will be completed during Phase 1 and 2a to include;

a. Excavation, treatment and placement of recovered materials;
b. Piling works; and
c. The treatment compound will be reduced in size to allow the construction of Terminal 2.

6.4.4 Construction of external gas control and engineered cover systems will be on-going during all phases.

6.4.5 Landfill treatment compound will be retained on site at a reduced size to allow for recovery of material from the landfill which is likely to occur due to completion of developments on site during Phase 2b of the construction programme i.e. processing material associated with plots used for temporary carparks during earlier phases and pile arisings from all plots. Materials from these activities will be reused in earthworks to create the final development levels.

6.4.6 Groundwater, ground gas and leachate monitoring will be completed during preparatory works to add to baseline information then through the whole of the construction programme and for a period after completion of Phase 2b to confirm agreed targets have been met post construction, see **Section 10Error! Reference source not found.**. The scope and duration of the monitoring will be set out in groundwater/gas monitoring plans to be agreed with regulators prior to start of works.

7 REMEDIATION METHODS

7.1.1 This section of the strategy sets out the specific details of the remediation methods to be used at the site.

7.2 Excavation of hotspots of contamination (RCL 14)

7.2.1 During landfill earthworks there will be a watching brief in place **(see Section 9.4**) to identify hotspots of gross contamination identified during the landfill earthworks, such as that identified at location WS224. This material will be excavated and segregated from the rest of the material.

7.2.2 Where visual hotspots of contamination are encountered a 5m x 5m area will be excavated around the hotspot to the required depth until all visually identified gross contamination (free product) has been removed. The impacted soils will be transferred to the treatment compound for appropriate treatment i.e. bioremediation. The soils will be reused onsite if the remedial criteria are achieved. The soils will be included on the materials tracking **(Section 8.8)** and treated soils will be subject to verification as described in **Section 11.**

7.3 Ground gases (RCLs 1 and 2)

Gas management for buildings

7.3.1 Gas protection measures are to be incorporated into the buildings to protect future occupants/users. As detailed in **Section 4.2.19** the DQRA established that gassing conditions representative of CS4 were considered protective of the landfill area and allow redundancy in the design to account for the landfill earthworks being undertaken, which may change conditions.

7.3.2 The objective for all buildings is to provide multi-element protection to prevent landfill gases from entering the building and to provide a “pressure relief pathway” for gases to discharge safely beyond the edges of the building. Each of the buildings should be considered on a case-by-case basis at detailed design stage, taking into account: the depth and nature of the landfill; GI results; the form and size of the building; the foundation and floor slab structural design; the size, use and ventilation of internal spaces; and any other relevant details.

7.3.3 For CS4 conditions, BS8485:2015 (+A1:2019) (Ref. 22) requires 3.5 gas protection points **(see Table 7.1 below)** for a Type D Building (such as most or all of Terminal 2 and some of the technical services and warehouse buildings). For Type C Buildings (such as the hotel and office buildings), BS8485:2015 (+A1:2019) requires 4.5 gas protection points for CS4 conditions.

Table 7.1 Summary of ground gas protection measures

Area	Building type	Ground Gas Protection Measures	Ground Gas Protection Scores	Total Protection Score	Required protection score
Terminal Building	Type D	***Structural Barrier (foundations)*** Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations.	1.0-1.5	4.5- 6	3.5
		Ventilation measures Active dispersal layer*	1.5-2.5		
		Gas membrane	2		
Office buildings and smaller rooms within terminal building	Type C	***Structural Barrier (foundations)*** Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations.	1.0-1.5	4.5- 6.0	4.5
		Ventilation measures Passive sub floor dispersal layer	1.5- 2.5		
		Gas membrane	2		

*Once design of ground floor of terminal is confirmed may be possible to assume ventilated and achieve score of 4.

7.3.4 For all buildings, the floor and substructure design should be detailed and constructed to resist the ingress of ground gases and have minimal penetrations, such that 1.5 gas protection points can be awarded.

7.3.5 The gas protection measures should also comprise:

7.3.6 a gas resistant membrane should be installed and verified across the full footprint (2.0 gas protection points); and

7.3.7 a pressure relief pathway layer (0.5 gas protection points) or passive gas dispersal layer (at least 1.0 gas protection points) should be installed beneath the membrane.

7.3.8 The pressure relief pathway layer could be formed of either a layer of no/low fines granular material, a blanket of geocomposite void former or interleaved strips of geocomposite void former. It is important that the layer is terminated with effective vents at the perimeters of the building, for example with periscope airbricks, low level bollards or high (roof) level vent pipes. For Type C Buildings in a CS4 situation, where 1.0 ventilation gas protection points are required, high (roof) level vents will probably be required.

7.3.9 **Figure 3** indicates the gas protection measures required. The gas protection measures installed will be independently verified see **Section 11.4**.

Gas management for the DART tunnel

7.3.10 The Direct Air to Rail Transit (DART) will be extended from the existing Terminal 1 to the new Terminal 2 via a tunnel. To ensure this structure is protected from gas ingress it should be protected by a combination of:

a. Appropriate structural detailing of the tunnel (to resist gas ingress);
b. An external gas membrane tanking of the tunnel; and
c. The high level of internal ventilation that will be provided.

7.3.11 Gas protection detail for the tunnel will be incorporated into the design, see **Section 6.2**.

Gas management for aviation apron

7.3.12 The aviation apron will be partially constructed over landfill and therefore will also require gas protection measures to prevent build up of gases beneath the pavement.

7.3.13 Venting gases within the area of aviation is undesirable from an aviation operation perspective. Therefore, where landfill is present beneath the proposed apron area, it is recommended that the high permeability 'gas pathway/venting layer' is installed across the area. This would be vented via a network of gravel trenches, located in areas away from the stands and taxiways and would diffuse gases away preventing any build up.

7.3.14 Further details will need to be developed at the detailed design stage alongside the development of the design for the aviation apron.

Gas protection for hard paved areas

7.3.15 Where there is a significant thickness of landfill waste below hard paved areas it is recommended that the high permeability 'gas pathway/venting layer' shown in Figure 4 is installed across the area above the landfill waste or selected arisings (in areas of fill) and is vented via a network of gravel filled vertical drains, gravel filled trenches (or bollard type low level vents in areas where these are more suitable).

7.3.16 The MSCP can be regarded as a hard-paved area and not as a building for the purpose of gas protection requirements.

Gas protection for landscaped areas

7.3.17 In soft landscaping areas there will be a geomembrane or clay fill layer installed to prevent surface water infiltration into underlying waste **(see Section 7.4 and Figure 5).** This low permeability layer will confine additional gases generated and potentially cause them to migrate laterally. Therefore, a passive pressure relief layer should be installed below the geomembrane leading to vents at the perimeters of the areas.

Gas migration off-site

7.3.18 The Proposed Development has the potential to alter the current ground gas regime within the landfill and increase the potential for lateral migration of

ground gas which could pose a risk to off-site properties including the residential area to the north of the site. Landfill boundary gas protection measures will be incorporated into the development to mitigate against any potential risks.

7.3.19 The preferred option is to install a virtual gas barrier, due to several advantages over gas vent trench including; minimal excavation of contaminated material, no import of aggregate venting media and use of recycled and recyclable materials for its creation. The feasibility of this will option will be confirmed by detailed design and the remediation contractor. Detail of virtual gas barrier is presented on **Figure 6.**

7.3.20 In areas where a virtual barrier cannot be placed e.g. at the northern boundary due to access constraints (**see Figure 7).** Passive venting will be used, if required, using measures such as gas venting stacks. The requirement will be subject to the results of ground gas monitoring.

7.3.21 Existing services including the Thames Water overflow sewer, which runs along the base of the landfill, will be diverted and old structures grouted to prevent potential pathways for landfill gas to migrate off-site. Detail of gas control measures to prevent off-site migration are presented on **Figure 7.**

7.3.22 The service corridors will be lined with concrete and a gas membrane and backfilled with clean fill to prevent landfill gas ingress and potential for migration off-site. This will also protect future maintenance workers see **Section 7.4.6.** Further measures to prevent gas migration such as use of low permeability plugs or venting will be incorporated where required in the detailed design process. An illustrative cross section of a service corridor is shown on **Figure 6.**

7.4 Protection of human health (RCL3-13,19)

Engineered cover system

7.4.1 It is proposed to install an engineered cover system on the landside development platform. An engineered cover system is designed to provide the complete separation of the receptor from the hazard. Detailed guidance on this type of cover system is given in CIRIA Special Publications 105 (Ref. 23), 106 (Ref. 24) and 124 (Ref. 25)

7.4.2 The capping system is detailed on **Figures 4 and 5,** which also show the incorporated gas control measures in areas of hard and soft landscaping respectively.

7.4.3 The design detail for the capping system is described below:

a. To avoid future excavation into the underlying landfill waste a minimum depth of 1500mm is to be adopted (includes pavement make-up or planting medium in areas of landscaping). This will be made up of selected processed landfill material. Locally increased depth may be required for tree-pits/ utility corridors;

b. A brightly coloured geotextile marker layer is placed onto the insitu landfilled waste, above which selected site-won arisings which meet the reuse criteria for the cover system **(See Section 11.2)** are placed;
c. A second geotextile layer is placed onto the selected arisings above which a capillary break layer is formed to a minimum depth of 300mm thickness. This layer also serves to provide drainage for the cover system;
d. A geomembrane or compacted clay layer (from site won clays) is to be placed above the capillary break layer; and
e. A third geotextile layer is placed above the clay layer on which the pavement make-up 200mm minimum thickness (sub-base and pavement or topsoil/subsoil) is placed.

7.4.4 A second lateral drainage layer could be included above the geomembrane/clay layer for collection of surface water and to prevent surface water logging in landscaped areas. This will be considered at detailed design stage. Verification of the cover system is described in **Section 11.3.**

7.4.5 Creation of the cover system in areas of soft landscaping also protect plants (RCL 19) and prevent maintenance workers coming into contact with residual landfill material (RCL 3). The cover system is likely to be locally deepened to create sufficient planting depth for deeper rooted vegetation i.e. tree pits, as shown in **Figure 8.** Appropriate growth medium will be used within the cover system and topsoil should meet both remedial criteria, requirements of BS3882:2015 (Ref. 26) and landscape architects specification.

Protection of drainage and other services

7.4.6 Drainage and other services should be installed within the engineered cap and coordinated so they can occupy prepared service runs which will be; lined and backfilled with clean material which meets the reuse criteria for clean cover materials **(Figure 6).** This will prevent risks to future maintenance workers by preventing exposure to landfill waste.

7.4.7 Drainage corridors will need to be designed in a way which would allow for settlement up to the maximum amount. Preliminary assessments indicate there are two proposed solutions in achieving an adequate design which takes account of the high settlement involved within the landfill area, these are indicated below:

7.4.8 Where pipes are located adjacent to structures, suspended drainage can be incorporated to the design to mitigate the settlement risks. However, areas outside of the vicinity of any structures could be flexible to withstand approx. 200mm of settlement. This would not be enough and therefore would include re-laying of any pipework when settlement values of larger than approx. 200mm, which would entail a double trench width of the drainage corridor; or

7.4.9 Where pipes are located adjacent to structures, suspended drainage can be incorporated to the design to mitigate the settlement risks. Areas outside of the vicinity of structures will be laid within concreted corridors (or similar) along with monitoring sensors for real time results of settlement. When this settlement occurs, an expansive geopolymer resin will be injected through small holes on each side of the trench to raise the drainage back up to the required level.

7.5 Protection of controlled waters (RCLs 15 and 18)

7.5.1 The cover system described in **Section 7.4** will reduce infiltration into the landfill /recovered waste, thereby reducing potential for leachate generation and break-out of contaminants to the underlying aquifer. The capillary break layer and the compacted clay layer in combination act as a 'barrier layer' and serves to minimise percolation of surface water through the cover system.

7.5.2 A positive drainage system will be constructed across the landfill, incorporated into the engineered cover system, as previously described, to ensure all surface waters are collected and directed off the landfill. The surface water will enter a water treatment system and subsequently be discharged to ground via an attenuation tank. Further description is provided in the drainage design statement (Ref. 9)

7.5.3 Although there are not anticipated to be significant quantities of leachate. Installation of leachate sumps as a precautionary measure during the earthworks/construction phase, which will be retained for a period post construction, will also address RCL 15 and reduce potential for leachate break-out, through collection and periodic removal of the leachate. See **Section 9.7.1** for further details.

7.5.4 Long-term groundwater monitoring will be undertaken, see **Section 10.5.**

8 MANAGEMENT OF LANDFILL EARTHWORKS

8.1.1 To create the earthwork platforms (airside and landside) it will be necessary to excavate a section of landfill and the arisings will be recovered and processed prior to reuse. The excavation and reuse of the landfill material is essential to the viability and sustainability of the development, as described in **Section 5.5.12.**

8.1.2 The following sections describe the regulatory regimes and processes for excavation and recovery of the waste.

8.2 Regulatory regime

8.2.1 Initial consultation with the Environment Agency identified that a bespoke deposit for recovery permit under Environmental Permitting Regulations (2019) (Ref. 27) is likely to be required for reuse of the landfill material. A formal response from the Environment Agency to the Preliminary Environmental Information Report (PEIR) (Ref. 28) has confirmed this stance.

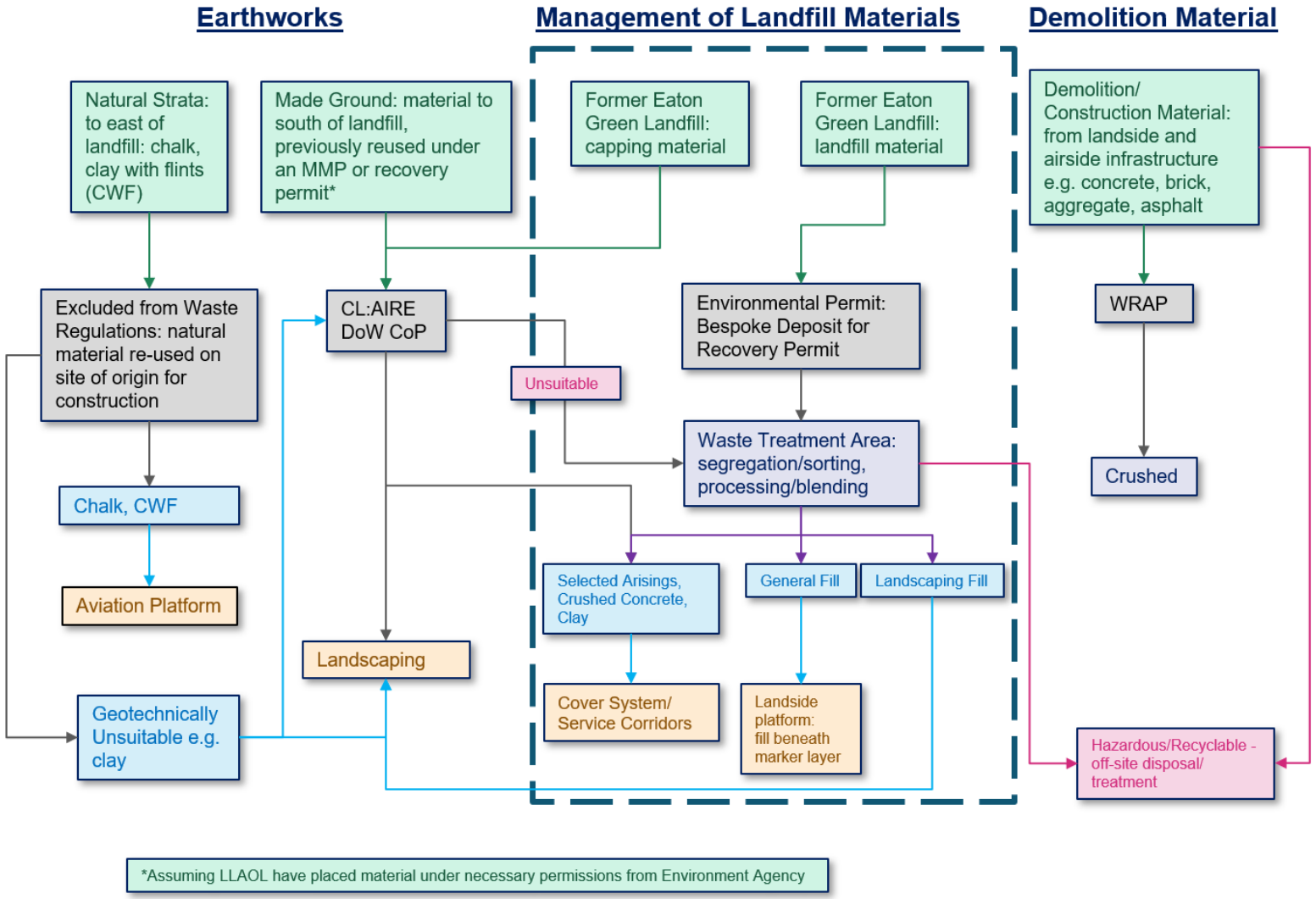
8.2.2 It is proposed to use a combination of CL:AIRE DoW CoP (Ref. 29) and bespoke environmental permit (Ref. 30), for the earthworks and management of the landfill materials, subject to regulatory approval.

8.2.3 DoW CoP will be used for the re-use of made ground materials. This includes material present to the south of the landfill boundary (within LLAOL Contractor Compound and adjacent areas) and the capping material placed on the landfill post filling.

8.2.4 The natural chalk soils excavated for the airside platform are considered to be excluded from waste regulation in accordance with Waste Framework Directive (2008) (Ref. 31) and can be excavated and reused on site without the requirement for an environmental permit, exemption or use of DoW CoP.

8.2.5 A flow chart depicting the reuse of materials under the different regulatory regimes is presented **at Drawing 4**

Drawing 4 Management of materials under the waste management regulatory regimes



8.3 Waste processing compound

8.3.1 The waste processing and treatment area will be established prior to commencement of earthworks. Specification and layout of the site compound will be described in the Remediation Method Statement (RMS).

8.3.2 The treatment area will include design features to control surface water run-off with water treatment facilities, to prevent discharge to ground and wider environment. As a minimum, a concrete base with overlying membrane will be placed across the whole processing area with a perimeter ditch and collection and treatment of run off. Illustrative arrangement is indicated on **Figure 9.**

8.4 Excavation process

8.4.1 Landfill material will be excavated in sections to minimise the area of landfill exposed at any one time. This will reduce the risks associated with vermin, birds, dust, odours and reduce the amount of rainwater which could enter the remaining in-situ waste. The environmental controls are described in further detail in **Sections 9.8.1**. Prior to relocation to the soil treatment area the materials will be subject to an initial segregation process.

8.4.2 The processes described below will also apply to the made ground and waste materials excavated for the reprofiling of the landside platform. Location of areas of cut are indicated on **Figure 10.**

Segregation at source

8.4.3 During ground investigations at the site the waste in the landfill was classified into different waste types. Based on a forensics assessment, further detail is provided in DQRA Volume 1 (Ref. 4). A summary of types and descriptors are presented in **Table 8.1** below:

Table 8.1 Waste types

Waste Type	Overall Description
Non-chalky Cover	Cover material with a non-chalky matrix – largely derived from superficial deposits such as Clay with Flints/Dry Valley deposits.
Chalky Cover	Cover materials with a chalky matrix – largely derived from Chalk.
Old-domestic	Household waste from pre-1970 – typically comprising ashy household waste.
Recent domestic	Household waste from post 1970 – typically brown to dark grey in colour largely comprising ‘black plastic bag’ waste from household bins.
Commercial	Office and retail waste – typically greater amounts of mixed paper, newsprint, corrugated, plastic and wood in the form of pallets.

Waste Type	Overall Description
Industrial	Waste arising from factories, scrapyards etc – varied composition as spans all eras of deposition, derived from local factories, garages and former scrapyard in the northwest of the site.
Construction	Material from construction projects – largely derived from reworked natural superficial deposits, with anthropogenic inclusions; mainly brick and concrete with smaller quantities of wood, plastic, glass ferrous and other organics.
Made Ground	Typically, arisings from past airport projects, but also includes the construction of car parks etc. Includes material, south of the landfill from LLAOL contractor's compound and adjacent areas.

8.4.4 The waste will be segregated and stockpiled as excavation proceeds based on visual identification into the following categories:

a. Cover materials (clay/chalk) which is likely to be uncontaminated and therefore unlikely to require treatment for contamination prior to reuse (geotechnical treatment may be required);
b. Made Ground;
c. Mixed landfill waste;
d. Hydrocarbon impacted materials; and
e. Unsuitable wastes for recycling and off-site treatment/disposal i.e. sofas, car parts, tyres, metal drums etc.

8.4.5 A watching brief for ACMs during excavation and stockpiling will be required, see **Section 9.5** for details of management of asbestos.

8.4.6 A watching brief will also be required to identify any unexpected contamination conditions. The process for identification and further excavation of hotspots is detailed in **Section 9.12.**

8.4.7 The wastes identified for further treatment may be processed as described below, actual processes will be determined by the remediation contractor following segregation trials. A schematic showing how the materials management might be implemented is presented at **Drawing 5.** The actual management methods will be determined as part of the detailed design.

8.5 Processing

Mixed landfill waste - complex sorting

8.5.1 The waste material will be transferred to the waste processing compound where material will be screened, washed (if required) and sorted into their component parts and stockpiled separately, these are likely to be:

a. Wood;
b. Plastic;
c. Sand and Gravel*;
d. Metal; and

e. Silt/organic matter*.
f. *Incidental materials resulting from their association with the waste materials.

8.5.2 Metals derived from this process shall be recycled off-site. Wood, silts and separated organic matter will be subject to secondary treatment as well as any hydrocarbon impacted soils, see section below on secondary treatment.

8.5.3 The processing plant used will depend on the results of the segregation trials, which will identify the most efficient configuration.

Hydrocarbon impacted soils

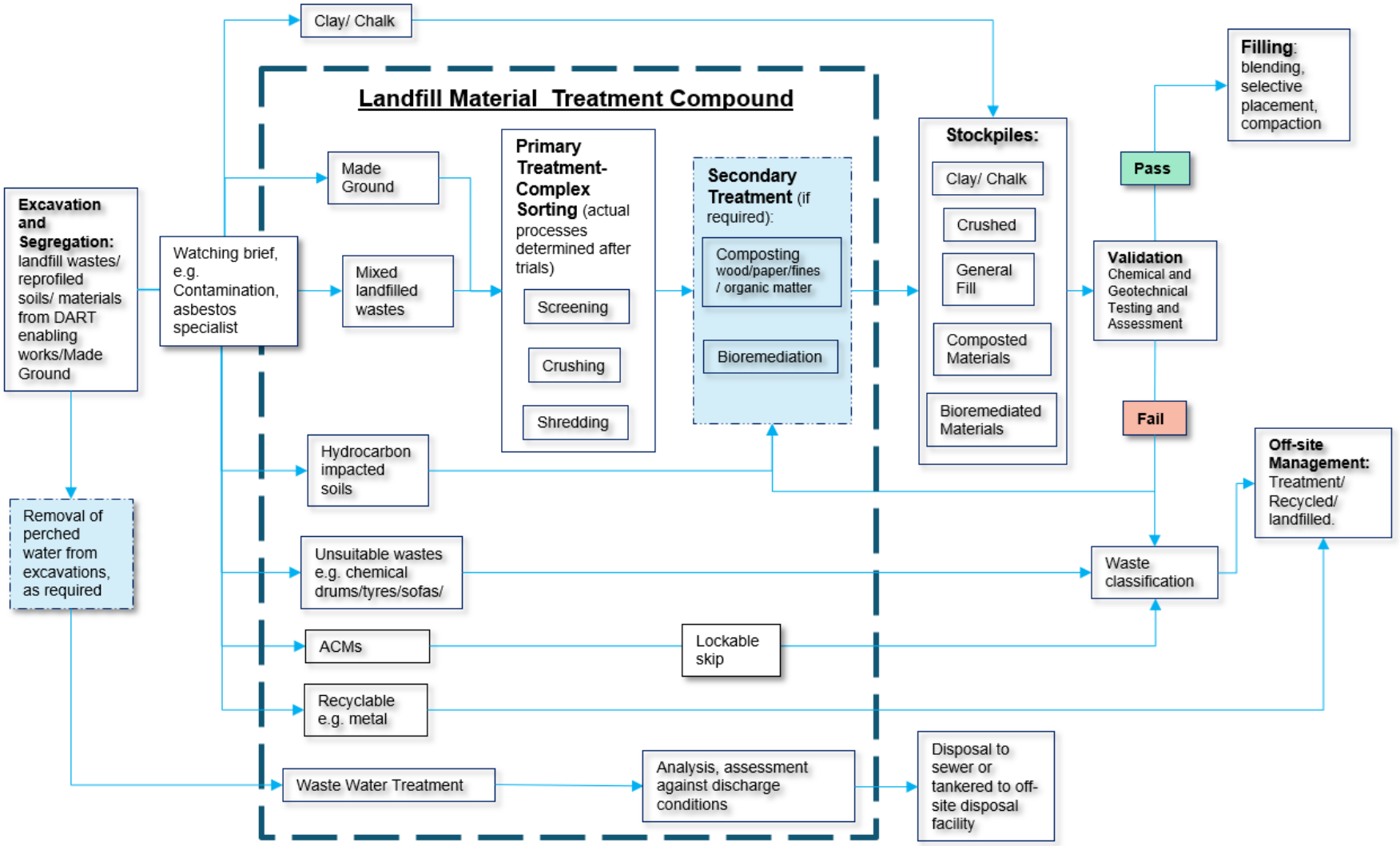
8.5.4 Soils contaminated with free-phase hydrocarbons i.e. hotspot at WS224 (RCL 14) are proposed to be subject to bioremediation to reduce contaminant loading to an acceptable level, subject to confirmation by remediation contractor.

Aerobic composting

8.5.5 Wood from the landfill is proposed to be treated using aerobic composting to biodegrade the wood into a product suitable for reuse on site and reduce its gassing potential.

8.5.6 The application of this process will be dependent on the results of the segregation trials indicating there would be sufficient volumes of suitable materials to warrant aerobic composting and will be subject to regulatory agreement.

Drawing 5 Indicative material management process flowchart



8.6 Filing process

8.7 Filling processes

8.7.1 The current masterplan includes three main areas where the processed material will be reused within the development; to the southeast and across the east of the site and in the northwestern area, see **Figure 10**.

8.7.2 The main area of filling is in the southeast of the former landfill, where re-engineered landfill material will be placed (up to 15m in places) to achieve the required levels. Between 2m to 4m of fill is to be placed across the remaining areas.

8.7.3 The filling process is likely to comprise of three main elements:

Blending

8.7.4 Depending on the nature of the materials produced from waste processing, blending of materials may be possible to form structural and non-structural fill, i.e. plastics could be shredded on-site and mixed with cohesive and granular fill materials using in-situ rotavation equipment to form a modified class 2C fill suitable for the construction areas or blended with composted materials and used to create non-structural fill within landscape areas.

Compaction

8.7.5 A dynamic compaction (DC) methodology is proposed to improve the geotechnical characteristics of the in-situ wastes and reduce risks from settlement. The re-engineered waste materials will also be placed in layers and dynamic compacted to reduce settlement. The compaction of recovered materials will reduce the potential for future gas and leachate generation. However, the potential impacts on surrounding land from vibration caused by the compaction process will require consideration by the contractor.

Placement

8.7.6 All soils will be validated prior to reuse to ensure it meets the specified reuse criteria, see **Section 11.2** The existing landfill surface will be prepared through stripping of vegetation etc. Where the materials are to be placed onto an existing slope e.g. at the eastern extent of the landfill, the surface will be benched to allow placement of soils. A geotextile marker layer will be placed between the selected arisings (processed materials) and in-situ waste, see **Section 7.4.**

8.7.7 In areas where there is to be follow-on construction of buildings at a later phase the membrane will be placed onto the landfill surface overlain by a temporary capping layer to prevent exposure to contaminants and damage of the membrane due to trafficking of construction vehicles. It is proposed to remove the capping layer locally over the building footprints during piling and construction of the pile caps. The floor slabs will then be cast on the pile caps which will replace the capping layer locally.

8.7.8 The re-engineered landfill material will likely be placed selectively depending on its properties. For example, material which may still contain some organic matter (i.e. material undergoing secondary treatment) may be placed in areas where gassing of this material would not present a risk, i.e. open space areas. Materials which meet the criteria for cover materials e.g. clay previously used as capping may be used within the cover system.

8.8 Material tracking

8.8.1 Key to the excavation and reuse of the processed materials on site is the monitoring and tracking of material movements and volumes. This will be a requirement for both the Environmental Permit and DoW CoP.

8.8.2 For materials moved under DoW CoP a Materials Management Plan (MMP) will be prepared and maintained by the remediation contractor which will detail how compliance will be achieved and provide a material tracking system. The material tracking system will be developed by the remediation contractor and include volumes, locations of excavation and placement, material description, combining of materials and results of chemical and geotechnical testing. The remediation contractor will prepare a materials management verification report.

8.8.3 A similar auditable record will be created for the works done under the deposit for recovery permit and will form an element of the Construction Quality Assurance Plan and verification (Ref. 32).

8.8.4 A rigorous protocol for the proper tracking of the materials under the two diferent regimes will be developed during the detailed design for the works;

8.8.5 Records will also be kept by the remediation contractor for materials disposed off-site with copies of all waste transfer documentation, details of waste carriers and disposal facilities will also be provided.

9 SITE MANAGEMENT AND CONTROLS

9.1.1 To reduce the risk to human health and the environment from the landfill wastes and contaminants within it, the works will need to be strictly managed and controlled to meet environmental and health and safety regulations. The following sections describe the measures which will be implemented and will address the PCLs identified in **Table 4.2.**

9.1.2 The works will be managed by the contractor to ensure protection of the environment and human health and to meet health and safety requirements under the Construction (Design and Management) Regulations (CDM) (Ref. 33) and relevant guidance such as; Protection of workers and the general public during the development of contaminated land (HSE, 1991) (Ref. 34) and Annex C of BS 10175 (Ref. 35). This will require the establishment of controls and monitoring during the works, examples of which are set out in the following sections.

9.2 Site establishment

9.2.1 Site security will be integral to safe management of the works and as a minimum will include securing the construction zones and site compounds with fencing and minimal secured access/egress points. Vehicle access points will include such measures as jet-wash and inspection of vehicles, pre-sheeting etc to prevent vehicles tracking contaminants/soils off-site. Secured access will also allow the recording of vehicle movements onto and off site for purposes of material tracking. It is likely that there will also be restricted access into the waste management areas to ensure only appropriately trained personnel enter these zones with the required PPE.

9.2.2 The earthworks have been designed to retain almost all the excavated materials on-site, with engineering fill materials also sourced within the development boundaries, thus internal haul roads will be constructed within the site boundaries for movement of materials. Haul roads will be constructed and maintained to reduce generation of dusts with methods to clean and suppress dust along the routes.

9.2.3 A main site construction compound, including welfare facilities is proposed to be established to the east of the landfill within the main construction area. The site compound will include a decontamination unit (DCU) appropriate to the contaminants likely to be found in the landfill materials i.e. asbestos, as a minimum this will include clean and dirty ends and showering facility.

9.3 Permit requirements

9.3.1 Aside from the re-use of materials on site other elements of the proposed remediation process will require the relevant permits/licenses/exemptions to be obtained by the contractor. These are likely to include:

a. A discharge consent from the local water company (Thames Water) will be required for treated water collected from excavations to be disposed to sewer;

b. Environmental permit (mobile treatment licence (MTL) for treatment/processing of waste on site e.g. crushing, screening, bioremediation etc; and
c. If Japanese knotweed is to be treated/disposed on site appropriate notice will be given to the Environment Agency, in accordance with current UK guidance (Ref. 21) (PCL 19).

9.4 Site supervision

9.4.1 The remediation contractor will be responsible for the verification of the remediation works/materials management of the landfill. The remediation contractor is expected to have a representative(s) on site full-time overseeing the remediation/materials management who has appropriate experience and is suitably qualified/competent.

9.4.2 The remediation contractor will appoint specialist contractors as necessary e.g. asbestos, radionuclide and unexploded ordnance.

9.4.3 Given the complex nature of the works Luton Rising may choose to appoint an environmental consultant to provide independent scrutiny of the remediation works to ensure specifications are achieved and audit the works on an ongoing basis.

Documentation and training

9.4.4 The appointed remediation contractor will prepare relevant documents to guide the works including the remediation method statement (RMS) which will provide detailed design of the recovery process and re-engineering of materials and include detail of the segregation trials.

9.4.5 Groundwater/gas monitoring plans will also be prepared by the remediation contractor for the prior to, during remediation works and long-term monitoring post-construction and agreed with the regulators, **see Section 10**.

9.4.6 Health and Safety issues associated with the remediation works will be dealt with as part of the remediation contractor's health and safety plan to be produced prior to the start of works and communicated to all personnel. The plan will include advice on the requirement and level of personal protective equipment (PPE), and designation of respiratory protective equipment (RPE) zones etc. Taking into account specific requirements identified within this strategy.

9.4.7 Risk assessments will be completed for specific activities in accordance with relevant guidance (Ref. 36), to control potential environmental impacts. This will be part of the environmental management plan (EMP) which will be prepared by the remediation contractor prior to start of the works.

9.4.8 Appropriately qualified personal will be appointed to undertake the works and all personnel will receive a site induction and training prior to commencement of works to ensure their roles are adequately understood, including;

a. health and safety requirements;
b. good house-keeping;

c. tracking of materials;
d. tool-box talks;
e. specific roles regarding environmental issues;
f. asbestos awareness; and
g. dealing with unforeseen environmental incidents.

9.4.9 A draft construction code of practice CoCP (Ref. 37) has been prepared as part of the submission for the DCO which includes detail regarding management of health and safety and monitoring/management of air, noise, vibration, traffic etc, including procedures to be followed should threshold levels be breached. A specific strategy is required to address risks from asbestos this is described in the following section.

9.5 Asbestos management (PCLs 15,16,31 & 34).

9.5.1 The DQRA concluded that based on the GI data to date **(Section 4.2.17)** specific advanced remediation of the landfill and scrapyard area for asbestos was not required. However, control measures are required to reduce the potential risk to construction workers and adjacent site users during works.

9.5.2 The relatively small proportion of asbestos in soils indicates that the most efficient method of managing the asbestos would be via excavation with relevant controls in place. Concentrations of asbestos have been identified above trace levels[8] within the site. As such all excavation in the former landfill and scrapyard would be classed as 'work with asbestos' based on the Control of Asbestos regulations 2012 (Ref. 38) and should be carried out under a specialist asbestos brief.

9.5.3 The JIWG DST assessment concluded the work would be NLW, however, it may be prudent to assume some works may be Notifiable Non-Licensed Work (NNLW) so that this is planned as a contingency should certain conditions prevail. This is turn may limit the potential for delay due to the requirements for advance notifications and the associated procedures and assessments required. For NNLW the relevant enforcing body must be notified prior to commencement of the works by the remediation contractor.

9.5.4 CL:AIRE Interpretation for managing and working with asbestos in soils CAR-SOIL™ (Ref. 13) should be followed by the remediation contractor. A plan of work and risk assessments should be completed by the remediation contractor in accordance with the requirements of asbestos regulations (CAR 2012) and the appointed remediation contractor will employ an asbestos specialist to advise on the works.

Controls required during earthworks and construction

9.5.5 Based on the assessment within the DQRA of the asbestos type, concentration and conditions in the landfill the control measures will include:

[8] CAR-SOIL defines 'trace' as soil and construction and demolition materials where no fragments of ACMs are isolated and fewer than three fibres are identified during the detailed and extended identification and gravimetric analysis procedures combined, the mass concentration of asbestos fibre is likely to be many orders of magnitude below the 0.0001% w/w Limit of Detection.

a. The remediation contractor is to adopt a methodology which limits / reduces to as low as reasonably practicable the intensity and the potential for the asbestos to deteriorate during the works;
b. Defined working areas with controlled access and egress;
c. Dedicated area for decontamination of site workers and waste to be allocated and clearly demarked;
d. All personnel to have had an appropriate level of training and be provided with sufficient level of information and instruction to complete the task safely;
e. All personnel to be equipped with appropriate PPE and RPE;
f. In the compound area appropriate containment and collection of water runoff should be undertaken to prevent dispersion of asbestos fibres mobilised by water in the drainage system;
g. All landfill material should be kept damp when being handled or when exposed at the surface including in stockpiles. Dust prevention will be proactive (i.e. not reactive). Dust prevention measures will be in place before work commences and surfaces wetted before and during excavation works as necessary. Landfill material will be managed so that it cannot be tracked off-site this will require wheel-washing;
h. Stockpiles of landfill material should be appropriately managed by the remediation contractor to prevent the spread of material, dust generation and potential cross contamination;
i. The contractor should provide appropriate specialist supervision for the duration of the earthworks to inspect landfill materials during the excavation as part of a watching brief. This will include continuous inspection of excavations and stockpiles for visible ACMs;
j. Visual ACMs were most common in the commercial waste type and segregation of this waste type should be undertaken (where readily identifiable in sufficient quantities) such that more detailed inspection can be completed;
k. Following identification of visible ACMs in soil, potential treatment or processing should be considered to facilitate re-use onsite or to provide a cost-effective solution for offsite disposal at suitably licensed facilities;
l. The complete removal of ACM and fibres is not required, and may not be possible, but reasonable efforts to segregate significant amounts of larger visually identifiable ACM may be beneficial;
m. Such treatment could be in the form of ad-hoc hand-picking of visible ACMs or creation of a treatment picking station if significant quantities are identified during the earthworks; and
n. ACMs should be stored in clearly labelled lockable containers, prior to off-site disposal.

Monitoring

9.5.6 Sampling and representative testing of materials and ACM to be completed during the works as part of the verification process, see **Section 11.2;**

9.5.7 Airborne fibre concentration monitoring will be required during works to confirm control limits are not exceeded in the area of excavation including personal monitoring for workers. Reassurance boundary monitoring for asbestos fibres is

required to demonstrate low risk to adjacent site users. Monitoring to be completed by an asbestos specialist; and

9.5.8 If asbestos fibre concentrations are higher than trigger levels, then excavation methodology or control measures may require altering to reduce fibre generation.

Procedure for unexpected ACMs

9.5.9 If during the excavation of waste unexpected ACM conditions or a significant cache are identified the following procedure is recommended:

a. Excavation works in the location to stop;
b. Suspect ACMs to be sampled and covered over;
c. Sample to be tested for asbestos identification, quantification and respirable fibre index;
d. If laboratory analysis proves positive for asbestos fibres, risk assessment to be undertaken by the remediation contractor to re-evaluate control measures and licensing status, based on the analysis results;
e. Plan of work to be completed and methodology identified for removal of ACM; and
f. Excavation to recommence with appropriate controls in place and management of landfill material in accordance with the plan of work.

Post earthworks controls

9.5.10 Asbestos risks will also have to be managed during excavation for foundations (piles and pile caps). This will require completion of a risk assessment in accordance with CAR 2012 to identify appropriate control measures and plan of works. The piling contractor should be supported in this by a specialist asbestos consultant.

9.5.11 The piling technique will be either continuous flight auger (CFA) or rotary bored, the type will be subject to detailed design. Both are classed as non-displacement techniques and will therefore generate arisings at the surface, which will include material from the landfill, see FWRA (Ref. 8) for further details.

9.5.12 The controls required will be dependent on the risk assessment but will include:

a. Use of PPE/RPE as identified by the risk assessment;
b. Use of dampening down measures during the piling works so materials are dampened as they arrive at the surface;
c. Airborne fibre monitoring at piling locations with control measures adapted should trigger levels be exceeded;
d. Watching brief by specialist consultant to identify if visible ACMs are brought to the surface, with hand picking as required; and
e. Relocation of landfill arisings (if ACMs identified) to waste treatment compound, where they will be treated as described in **Section 9.5.5.**

Cover system

9.5.13 The landfill material which is excavated to allow the development of the aviation platform will be subject to the measures described in the section above to remove visible ACMs. In practice, it is not possible to remove all asbestos from the soils and therefore low-level fibres and fragments of ACM may remain in the material to be reused. A cover system to prevent future contact with any residual asbestos contaminated soils will mitigate the potential risks, providing it is adequately maintained. **Section 7.4** describes the formation of the cover system.

9.5.14 Soils used within the engineered cover system will be free of visible ACMs and asbestos fibres, confirmed through the verification process. Material reused below the marker layer may contain asbestos fibres, see **Section 11.2** for criteria.

9.5.15 The position of the marker layers and depth of cover above them should be recorded for maintenance records.

9.6 Unexploded ordnance (UXO) (PCL 41)

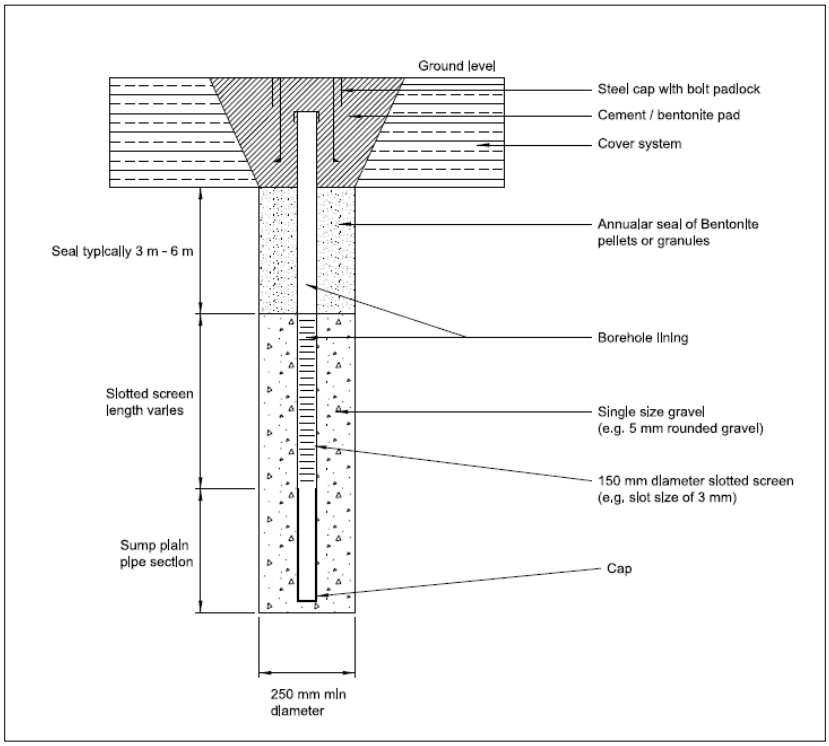
9.6.1 Most of the waste was deposited during the 1950 to 1980 period but UXO have been identified as a moderate to high risk in wastes which were deposited prior and during WWII period. Lower risk has been identified for wastes deposited during the post war period. UXO risk should be specifically addressed by the remediation contractor. The remediation contractor should raise awareness of UXO through tool-box awareness talks, and an emergency response procedure will be established, in accordance with CIRIA guidance, C681 (Ref. 39). A watching brief by a specialist UXO contractor will be required for earthworks in older wastes identified as higher risk.

9.7 Leachate control measures (RCL 15, PCL 20)

9.7.1 The GI indicated that here are currently limited volumes of leachate recorded in the landfill waste. However, the earthworks have the potential to increase leachate generation or mobilise existing leachate. As a precautionary measure it is proposed to install leachate control system. This will likely be a series of strategic sump points around the area to be excavated to the required depth (based on GI data) and pipework installed. If significant quantities of leachate are collected these will be pumped out and either passed through the water treatment system prior to disposal to sewer (subject to a discharge consent from Thames Water) or removed to an offsite waste treatment facility.

9.7.2 The locations and design of the leachate network will need to be agreed with the Environment Agency. A general arrangement is shown in Figure 9 and assumes that nine wells will be required across the former landfill site based on guidance in LFTGN02 (Ref. 40). It is anticipated in the long-term leachate sumps will not be required and can be decommissioned post construction subject to findings of the groundwater monitoring see **Section 10.5.** A detail showing typical leachate sump is presented below in Drawing 6 Detail of Typical Leachate Sump.

Drawing 6 Detail of Typical Leachate Sump



9.7.3 The leachate sumps and groundwater/gas monitoring wells will require protecting during the construction works and may require relocating/replacing as necessary.

9.8 Airborne emissions and odour control measures (PCLs 11, 15, 16, 31, 34, 35, 38)

9.8.1 The remediation contractor should control and limit dust, air pollution, odour and exhaust emission during the construction works as far as reasonably practicable and in accordance with best practicable means (BPM).

9.8.2 Control measures should be employed on site for dust, odours, and vapours. These could include:

9.8.3 Boundary odour control system, i.e. use of masking or scrubbing agent;

9.8.4 Covering of stockpiles to; control odour and potential for contaminated run-off and dust generation especially in dry weather, compacting stockpiles will also reduce dust/odour generation; and

9.8.5 Dust suppression measures i.e. covering of waste, dampening of stockpiles and haul roads, reduce drop-heights when loading.

9.8.6 The remediation contractor should prepare a dust management plan as part of their environmental management plan (EMP). Further detail of measures is provided in the draft CoCP.

9.9 Noise and vibration control

9.9.1 Best practicable means (BPM) measures will be employed to minimise noise (including vibration) arising from construction activities. This could include the following;

a. Maintenance of plant and equipment;
b. Fit noise reducing equipment to machinery;
c. Erect sound barrier if it cannot be addressed through amendments to operational procedures;
d. Restricted operational hours; and
e. employ appropriate PPE to protect workers.

9.9.2 Further details are provided in the draft CoCP (Ref. 37)

9.10 Bird strikes

9.10.1 Luton Airport has a 15km safeguarding zone around the aerodrome to ensure no developments/activities within the zone can have an adverse effect on the airports operation. The proposed earthworks have the potential to impact the airport's operation if the movement of wastes attract birds to congregate, which can cause a potential hazard for aircraft. This is considered a low risk, however as a precaution, control methods will be established to modify bird behaviour to encourage them to avoid the area these could include:

a. Using bio-acoustic technology, sonic cannons, recorded predator calls, and other noise generators to disrupt birds;
b. Using lasers at dawn and dusk to simulate predators and scare birds away; and
c. Scarecrow Technology which is already in use at Luton Airport and could be extended to cover the development area.

9.11 Incident reporting

9.11.1 Environmental incidents can occur due to accidents, uncontrolled releases of chemicals /fuels stored on site or due to mobilisation of contaminants in the landfilled wastes. It is expected the remediation contractor will prepare an incident response plan for such occurrences.

9.12 Unexpected contamination

9.12.1 A set of protocols should be established by the remediation contractor describing the actions to be taken in the event of unexpected contamination or much higher concentrations of known contaminants being identified during the remediation/earthworks. A draft set of protocols for ACMs is described in **Section 9.5.**

9.12.2 This will ensure any unexpected contamination is appropriately identified, recorded and treated. This process will be documented and verified consistent with the verification reporting requirements set out in **Section 11.5**.

9.12.3 If ground conditions are encountered that are not in keeping with the data or if visual and olfactory evidence of contamination is encountered, then works will be stopped and the following approach taken:

Stop – Analyse – Assess – Reuse (or treat and reuse) – Validate.

9.12.4 Unexpected contamination may be identified by:

a. Odour, for examples hydrocarbons and chlorinated hydrocarbons; and
b. Visual evidence for example asbestos, free-phase hydrocarbons etc.

9.12.5 It is recognised that soils may be contaminated without any obvious visual or olfactory evidence; however, an extensive series of ground investigations has been completed at the site. If markedly different materials are exposed then additional testing may be required to determine whether the existing risk assessment is appropriate, given the heterogenous nature of the landfilled materials this is entirely feasible.

9.12.6 Works will be stopped, additional soil or groundwater samples taken for testing and the risks assessed by a suitably qualified person. Should mitigating or remedial action be required to render the materials suitable then further treatment will be carried out on the materials.

9.12.7 The regulator will be informed in writing of the scale and area of any unknown contamination encountered and the approach for mitigation/remediation works, validation and reporting agreed.

9.13 Communication strategy

9.13.1 Stakeholder engagement is key during the process and a communication strategy should be developed as part of the detailed remediation method statement (RMS).

9.13.2 Local residents are likely to have high levels of concern about the health and environmental implications of the site remediation within the community. The communication strategy should outline the communication channels to be used. At other similar sites the following have successfully been used:

a. Delivery of a monthly newsletter to residents;
b. Dedicated website to provide monitoring results and up to date information about the work;
c. Information regularly posted on noticeboards at prominent locations about the work;
d. Monthly meeting with the key regulators, contractor, Luton Rising and residents' groups to review the monitoring from the site and discuss any other issues arising
e. 24-hour telephone lined manned by the contractor for residents to report concerns or ask questions;
f. A manned on-site drop in centre/café;
g. Site tours and awareness training; and
h. A complaints system will also be established to ensure timely and appropriate response and maintenance of comprehensive records.

9.14 Regulatory approvals

9.14.1 The DCO permission will include requirements that must be met for which regulatory sign-off will be necessary. This will require the statutory regulators to review the documentary evidence for verification of remediation works and provide confirmation to the planning authority that remediation objectives have been achieved to their satisfaction.

9.14.2 The criteria for completion of the remediation and/or surrender of permits or discharge of planning conditions will be agreed with the LBC contaminated land officer as part of future consultation regarding the remediation specification/methodology prior to start of remediation works by the remediation contractor.

9.14.3 A series of verification reports will be required to obtain regulatory sign off for the bulk earthworks of the landfill remediation to enable discharge of associated requirements/conditions, see **Section 11.5.**

10 MONITORING REQUIREMENTS

10.1.1 Monitoring and measurement of groundwater, ground gas and air quality is required to ensure that remediation/earthworks and subsequent construction on site will not create new contamination issues or cause migration of current contamination. It is also required to demonstrate the success of the remediation undertaken at site.

10.1.2 Full details of the monitoring requirements will be provided within the individual monitoring plans prepared by the remediation contractor to include monitoring locations and contaminants to be monitored. The monitoring plans will be agreed with the relevant regulators and will cover baseline, during remediation/materials management, post works and long-term.

10.1.3 Significant baseline monitoring of; groundwater, vapour, leachate and ground gas has been completed, over 12 months of monitoring. A further monitoring plan is currently being prepared to obtain data whilst DCO approval is sought and until commencement of remediation/earthworks and a remediation contractor appointed. This further monitoring is covered by a separate document and is not discussed below, the proposed monitoring will be agreed with the relevant Regulators.

10.1.4 Outline likely monitoring requirements pre-, during and post- remediation/earthworks are provided below.

10.2 Pre-remediation/earthworks monitoring (baseline)

Groundwater

10.2.1 Baseline monitoring will be undertaken at a rate to be agreed with the regulators for at least 6 months prior to the implementation of the remediation scheme. Monitoring will be required from boreholes across the entire site area and at down-hydraulic gradient, the existing groundwater installations installed as part of previous GIs will be monitored, their locations are shown on Figure 9. The monitoring suite will be established during the detailed remediation design phase. However, samples will likely be screened for a full suite of metals, VOCs, SVOCs, TPH, PAHs, PFAS, and ammoniacal nitrogen as well as groundwater levels.

Leachate

10.2.2 The leachate wells installed for previous GIs will continue to be monitored on a regular basis for levels and quality as part of baseline information to identify any changes which could influence the proposed control measures.

Ground gas/vapour monitoring

10.2.3 Ground gas/vapour monitoring will be undertaken to provide additional information on soil and groundwater vapours ahead of the main phases of remediation/earthworks. In particular there should be focus on the boundaries of the site close to residential areas. The ground gas and vapour suites will be the same as those for the GI phases.

Air monitoring

10.2.4 Baseline monitoring sites will be established 3 months prior to remediation/earthworks commencing (or at a time agreed by LBC) to provide information on the local baseline. Suitable monitoring sites and contaminants to be monitored for will be established during the detailed remediation design phase. However, it is likely that as a minimum monitoring at the boundary of the site will be required and consideration will be made to monitoring at sensitive receptor locations, where appropriate.

10.2.5 Air quality monitoring should include (but not limited to) the following:

a. Dust as airborne PM_{10};
b. Asbestos fibres;
c. Vehicle emissions;
d. Odour;
e. VOCs;
f. Noise;
g. Vibration; and
h. Meteorological.

10.2.6 An on-site meteorological station will record wind speed and wind direction data to inform monitoring positions/location of treatment works.

10.3 Monitoring during landfill earthworks

10.3.1 The pre-remediation monitoring regime should continue during the remediation/earthworks works. Samples should be taken from the same locations as pre-works monitoring. For groundwater/ground gas monitoring existing installations will therefore be used where possible with additional wells installed as considered necessary where wells are removed due to progression of the earthworks.

10.3.2 The samples will be analysed for the same suite of contaminants to identify effects of the remediation on groundwater, ground gas, vapour and air quality.

Groundwater/leachate

10.3.3 The groundwater monitoring will be used to judge the effectiveness of the control measures being utilised on site. The results will be assessed against 'investigation' and 'action levels' **(see Section 10.4)** usually set for down-hydraulic gradient wells (Ref. 40), where levels are breached further risk assessment will be required to determine if adjustments to remediation methodology is required, implementation of further control measures or groundwater remediation. The likely measures will be described in the monitoring and management plan and a contingency plan should be prepared by the remediation contractor.

10.3.4 Leachate sumps will be installed as part of control measures, these will be monitored on a regular basis for levels, volumes and quality such that there can be periodic removal, as required.

Ground gas/vapour

10.3.5 Gas monitoring to the site boundaries is proposed to confirm there is no off-site migration of landfill gas/vapours and confirm efficacy of the gas control measures. Monitoring of in-situ wastes will be continued to determine if the works are impacting the existing gas regime, which will assist in finalising the risk assessment for gas protection measures for buildings.

Air monitoring

10.3.6 Routine monitoring will be completed by the remediation contractor with specialist contractors employed on a less frequent basis and in response to complaints. Monitoring will be in accordance with the relevant plans e.g. dust monitoring plan and in accordance with agreed consents.

10.3.7 Monitoring results should be reviewed regularly to ensure the investigation/action levels are not exceeded and provided to the regulators to demonstrate compliance, see **Section 10.4.** Indicative monitoring locations are identified on **Figure 9.**

10.3.8 Airborne asbestos fibres monitoring will be completed during the remediation works/ recovery of landfill materials, as detailed in **Section 9.5.**

10.4 'Investigation' and 'Action' levels

10.4.1 The baseline monitoring will be used to establish 'Investigation' and 'Action' Levels for the site during works. These levels will be used to inform the appropriate measures to be taken during the remediation if exceeded.

10.4.2 Investigation Levels are intended to draw the attention of site management to adverse or unexpected trends in monitoring data; such trends may result from ongoing construction, failure of site engineering and/or management systems. Investigation levels are primarily used as an early warning to enable appropriate investigative or control measures to be implemented before significant action is required.

10.4.3 Action Levels are higher than Investigation Levels. They indicate a greater probability that site activities may be causing an adverse impact. For example, they might indicate a large release of potential contamination as opposed to a slight seepage that might be picked up by the Investigation Levels. If the Action Levels are breached a more immediate response is usually required to identify the cause and mitigation required to protect the environment/human health.

10.4.4 Investigation/action levels for air emissions will be agreed with the regulators prior to works commencing and will be in accordance with Control of pollution act (Ref. 41)

10.4.5 Ground gas/vapour control levels will also be set to be protective of construction personnel and will meet requirements of DSEAR (Ref. 42) and Occupational Health exposure limits.

10.4.6 The specific action/ investigation levels and measures to be taken if exceeded will be provided in the relevant monitoring and management plans to be produced by the remediation contractor and agreed with the regulators.

10.5 Post works and long-term monitoring

10.5.1 Monitoring will be required throughout the construction works so retaining the monitoring locations, where possible, will ensure a continuous data set. The requirements for site wide long-term monitoring and any necessary management measures will be identified following the remediation/main earthworks at the verification stage.

10.5.2 Post construction groundwater and ground gas monitoring will be completed in accordance with groundwater and ground gas monitoring plans which will be agreed with the appropriate regulators prior to commencement of earthworks. The monitoring strategies may be amended during the course of the works based on the monitoring results. The plans will establish appropriate compliance criteria for cessation of monitoring. At which point approval will be sought from the regulators to cease monitoring and formally decommission the monitoring wells. Discharge of relevant requirements or conditions will subsequently be sought from the planning authority.

11 REMEDIATION CRITERIA AND VERIFICATION PROCEDURE

11.1.1 This section provides detail on the soil remediation criteria and verification plan against which the recovered materials and imported soils will be assessed to confirm the materials reused do not present a significant risk to human health, environment or groundwater receptors.

11.1.2 An earthworks specification will be developed for geotechnical re-use criteria for materials and compaction specification, in accordance with design manual for roads and bridges (Ref. 43) This remediation strategy will inform the earthworks specification.

11.2 Remediation criteria

Soil reuse criteria

11.2.1 The regulatory regime under which material will be excavated, treated and reused will require further discussion and agreement with the regulator. For materials reused under CL:AIRE DoW CoP, a materials management plan (MMP) will be prepared which will refer to the DQRA and this remediation strategy as supporting evidence that reuse of treated materials on-site will not present a significant risk to human health or the environment.

11.2.2 Generic soil and groundwater criteria have been identified which would be considered appropriate to validate the recovered materials and confirm their suitability for use. The criteria adopted are protective of both human health and controlled waters.

11.2.3 Under the environmental permit regime, a deposit for recovery permit would be supported by a waste recovery plan, hydrogeological risk assessment and construction quality assurance plan which will include site specific soil reuse criteria based on waste acceptance criteria (WAC).

11.2.4 The DQRA did not identify any significant risks to human health or groundwater from the recorded contaminant concentrations within the landfill materials. The generic criteria proposed are based on the post development conceptual site model which assumes an engineered cover system in areas of both hard and soft landscaping to remove the direct contact pathway and reduce potential leaching of contaminants to groundwater.

11.2.5 Reuse criteria will be developed based on appropriate land use criteria and local / regional background concentrations, to be agreed with the regulators.

11.2.6 For materials used in the formation of the cover system, landscaping and reused as general fill below the cover system, the following typical criteria may be appropriate. These criteria will be reviewed and may be revised as part of the detailed design of the works.

Table 11.1 Reuse criteria for soils

Material Type	Description/Location	Human Health Criteria	Soil Criteria protective of Groundwater
General Fill	Recovered landfill materials placed beneath the engineered cover system below the geomembrane marker layer in areas of fill.	Generic assessment criteria (GAC) for commercial/industrial land use. Asbestos <1% fibres and no visible ACMs (i.e. below hazardous waste limit).	Soil Leachate criteria based on UK DWS or criteria based on WAC if placed under an environmental permit (to be derived by the remediation contractor for the permit application).
Landscaping Fill	Recovered materials used within landscaping	GAC for public open space (POS) – female 0-6 years. No asbestos detected. Higher organic content could be appropriate in areas of soft landscaping.	
Selected Arisings	Recovered materials used within the cover system, **see Figures 5 and 6**.	GAC for POS – adult maintenance. No asbestos detected. Organic content <4% [44] & [22] in areas of hard landscaping. Higher organic content could be appropriate in areas of soft landscaping.	
Clay Fill	Clay materials selected from recovered materials, **see Figures 5 and 6**		
Imported Materials – pavement make-up	Imported materials used within cover system, **see Figure 5.**	GAC for POS – adult maintenance. No asbestos detected. Materials to meet geotechnical specifications (Ref. 43).	

Imported soils - topsoil	Imported soils used within cover system, see **Figure 6.**	GAC for POS - female 0-6 years. No asbestos detected. Topsoil to meet BS3882:2015 (Ref. 26) and landscape architects specification.	

Soil sampling frequencies

11.2.7 Sampling rate will be agreed with the regulators and included in documentation submitted for the deposit for recovery permit/MMP. However, based on previous schemes, likely testing rates could be as follows:

a. Recovered material/general fill 1:1000m^3;
b. Cover materials/selected arisings/landscaping 1:250m^3; and
c. Imported topsoil 1:5000m^3 (in accordance with BS3882 (Ref. 26).

11.2.8 Sampling frequency is subject to variation during the works dependent upon source of the materials, its homogeneity and analyses results.

11.3 Verification procedure for cover system

11.3.1 The verification procedure for the cover system is based on Environment Agency guidance (Ref. 32) further detail will be provided in RMS; the main elements are likely to be:

a. Verification of soil profile – topographical survey prior to placement, to confirm thickness of impermeable layer and post placement of surface layer;
b. Photographic evidence;
c. Site diary;
d. Procedures for record keeping and selection of appropriate materials for location and depth of placement;
e. Supervision by appropriately qualified engineer, attendance to be appropriate to volume of material being re-laid;
f. Materials to meet reuse criteria as specified and geotechnical properties, records kept of all chemical/geotechnical test results, and material tracking; source, quantity, dates etc;
g. Hand-dug inspection pits and verification sampling post placement; and
h. Record kept of unsuitable materials and action taken.

11.4 Verification of gas protection

11.4.1 Verification procedure will be in accordance with CIRIA C735 (Ref. 44) and be completed by an independent third party. A verification plan will be developed by the third-party and agreed with the regulators. This is likely to include a programme of visual inspections and integrity testing as below:

a. Inspection of ground prior to placement;
b. Inspection of membrane in particular; laps, joints, sealing around penetrations etc;
c. Inspection of venting system;
d. Inspection of integrity;
e. Confirmation products installed meet specification; and
f. Review of post installation conditions.

11.4.2 The guidance recommends early engagement with the consultant to ensure the verifier is present throughout the entire process such that issues can be addressed early in the programme.

11.4.3 The gas protection should be installed by a suitably qualified installation workforce as dictated by the gas regime and complexity of the design.

11.4.4 Due to the phasing of the works a verification report is likely to be produced for the whole site, with certificates for each building to allow occupation.

11.5 Verification reporting

11.5.1 Due to the timescales and phasing of the development (see Section 2.2) it is likely that more than one verification report may be required and that a programme for submission of these reports will be agreed with the Planning Authority in accordance with the construction phasing.

11.5.2 A MMP verification report would be produced under the DoW CoP scheme and a CQA verification report for the bespoke waste recovery permit.

11.5.3 The reports will be submitted on completion of each phase of works to the regulatory authorities for their approval. The remediation and verification works can only be considered as completed once written approval is provided by the regulators and DCO requirements discharged.

11.5.4 The verification reports will provide a detailed account and photographic evidence of the on-site operations (remediation and validation) as well as interim assessment of the ground and groundwater conditions on site. Consignment notes will be provided for all materials excavated and removed off site, and tracking records for those processed and reused. The report will be produced by an appropriately qualified engineer/environmental consultant.

11.5.5 A separate independent verification report will be produced to confirm adequacy of gas protection measures.

11.5.6 The report will include sufficient lines of evidence to confirm the remediation objectives have been achieved this will include, but not be limited to, the following:

11.5.7 The details and roles of contractor / sub-contractors involved in the remediation work;

11.5.8 A summary of the original site conditions, with reference to the original site;

a. Investigations and assessments;
b. A description of the remedial works;

c. A statement of the remediation objectives, and how these have been achieved;
d. The CSM for the remediation and reference to the lines of evidence which demonstrate that the pollutant linkages have been broken or mitigated;
e. Plans showing the remediated (i.e. hotspot excavations) and validated areas;
f. Tracking sheets and volumes of materials processed and reused and their final location on site;
g. Site records; engineers daily records, visual inspections, non-conformance and actions taken monitoring records and results;
h. Photographic record of the remedial works;
i. Quality assurance data for construction of the cover system;
j. Records of consultations with regulators, as required;
k. Details of any required deviations from the strategy;
l. Records of excavated materials disposed/recycled off-site including a description of the material, chemical quality, weights or volumes, as well as waste transfer and consignment notes;
m. Validation chemical test certificates for groundwater, gas and leachate monitoring and treated waters disposed to sewer;
n. Validation chemical tests certificates for the imported and/or site-derived materials, as well as their origin and location on site;
a. Validation geotechnical test certificates for site-won and imported materials;
b. Validation sampling plans and chemical test certificates for any hotspot excavations/unexpected contamination excavated and removed across the site;
c. 'As-built' plans and sections;
d. Justification for any deviations from the agreed plan;
e. Any post remediation arrangements that require further management; and
f. A final summary of the ground conditions and groundwater quality across the site, including any information on residual contamination and ongoing monitoring.

11.6 Operating and maintenance manual

11.6.1 Throughout the design, implementation and verification stages an operating and maintenance manual will be collated for the site. This will incorporate the information required for the Health and Safety file and include data, records and guidance that will allow the future maintenance of the remediated site and management of any residual risks. It will include the following:

a. Significant background data;
b. Reports, strategies and specifications;
c. Verification records;
d. Surveys;
e. Locations of residual asbestos contamination to form part of an asbestos management plan;
f. Manufacturer's handbooks for installed plant and membranes etc; and
g. Guidance for the design of new construction on the site, this is of particular relevance as T2 is planned to be extended in 2030-34 as part of Phase 3 works.

12 REMEDIATION STRATEGY SUMMARY

12.1.1 A remediation strategy has been developed for the former Eaton Green Landfill considering the complexity of the works to be undertaken and the constraints. A summary of the overall remediation strategy is provided in the following sections.

12.2 Remediation requirements

12.2.1 The site generally represents a low risk to all receptors and remedial action is not required to protect current site users, neighbours or groundwater. However, the development will change the potential risk to future users and other receptors, therefore these pollutant linkages were identified as Relevant Pollutant linkages (RCLs) requiring remediation measures to break the linkage.

12.2.2 The remediation strategy evaluated the feasible remediation options for each of the identified RCLs. The most feasible option to address the identified RCLs is considered to break or manage the pathway. The remediation options appraisal identified there is only a single solution available to break the pathway for each RCLs (except for RCL 14) as follows:

12.2.3 The majority of the RCLs can be addressed with an engineered cover system. Cover systems are a proven approach for managing historic landfills and would minimise infiltration rates, thereby decreasing the potential for leaching of contaminants from the fill to groundwater. The method would also break the pathways between contaminated soil and future site users. The method would limit the amount of material requiring off-site disposal. Gas protection measures could be incorporated into the overall cover system design.

12.2.4 For migration of gases off-site, both during and post construction, the use of an in-ground barrier such as virtual gas curtain will provide an appropriate pathway break; and

12.2.5 For small localised areas (hotspots) of hydrocarbon contamination (RCL 14) which may be identified during excavation it is proposed to use bioremediation to reduce concentrations to allow reuse on site wherever possible.

12.2.6 In addition to the RCLs, a number of PCLs were identified within the DQRA associated with the enabling/construction phase of the development. No specific remediation activities are required to address these PCLs. However, these linkages need to be managed throughout the works to protect users, the environment and site neighbours. These measures are set out in Section 8.8.5 of the strategy.

12.2.7 A key requirement to managing these PCLs is to undertake a watching brief during excavation works, to ensure risks associated with asbestos and unexpected contamination conditions are controlled and managed.

12.3 Landfill earthworks

12.3.1 A substantial amount of landfill material is required to be excavated as part of the earthworks at the site. This will be recovered and processed to improve its

physical properties before reuse elsewhere in the development. No specific remediation is required to make this material suitable for use. The landfill earthworks will be undertaken in a manner to ensure that no potential contaminant linkages (PCLs) are created and to achieve betterment of environmental conditions. It is proposed this work will comprise:

a. Selective segregation at point of excavation- this will segregate materials which do not require processing and can be directly reused subject to meeting assessment criteria; and
b. Complex sorting- divide the waste material into its different components. Components such as metals will be sent for recycling off-site. Wood will undergo aerobic composition (subject to confirmation of viability by contractor and regulatory agreement) to biodegrade to a product suitable for reuse on site.

12.3.2 Depending on the nature of the material produced from the complex sorting, processing and blending of the materials may be possible to form structural and non-structural fill i.e. plastics could be shredded on-site and missed with cohesive and granular fills to provide modified class 2C fill.

12.3.3 The re-engineered landfill material will be placed selectively within the development depending on its properties.

12.3.4 The landfill earthworks will predominately be undertaken under a bespoke waste recovery Environmental Permit. The specific details of this permit and material types which are permitted to be reused within the scheme still need to be discussed and agreed with the Environment Agency Environmental Permitting Team.

12.4 Achieving remediation objectives

12.4.1 The overall objectives of the remediation strategy were detailed in **Section 5.2**. **Table 12.1** below details how the proposed remediation and landfill earthworks detailed in the strategy meets the overall objectives, any residual risks and uncertainties are also noted

Table 12.1 Summary of remediation objectives achieved by the strategy, including identified risks and uncertainties.

Remediation Objectives	Type of Objective	How objective is met by strategy	Risks/ uncertainties
Enable the former landfill to be remodelled and its surface redeveloped without risks to future site users, neighbours and maintenance workers following completion of development works.	Technical	Monitoring, with appropriate intervention and action thresholds, to be undertaken during remodelling works to ensure no impacts. Incorporation of cover system and selective placement of re-engineered landfill material will ensure no risks to future site users, neighbours and maintenance workers following completion of development works	None
Ensure the former landfill does not pose a risk of	Technical	Incorporation of cover system and selective placement of re-	Risk that piling activities will impact underlying

Remediation Objectives	Type of Objective	How objective is met by strategy	Risks/ uncertainties
detrimental impact to quality of controlled waters		engineered landfill material ensures no risk posed to controlled waters. Monitoring and controls during work to assess leachate and groundwater quality to ensure no detrimental impact to controlled waters.	aquifer. A piling risk assessment will be undertaken to establish the most suitable technique to ensure no impacts to the underlying aquifer.
To ensure the Proposed Development is not at risk from gases within the landfill or that neighbouring properties are not at risk from gases migrating off-site.	Technical	Incorporation of gas protection measures in building and boundary gas protection to prevent migration of gases.	Uncertainty surrounding post earthworks gassing conditions. Gases to be monitored to verify and redundancy incorporated into design to allow for variability in conditions post works.
To use materials and concrete structures which are resistant to degradation in the ground conditions that remain below ground.	Technical	Initial geotechnical assessment has been undertaken and recommended concrete class.	Uncertainty of conditions post landfill earthworks. Strategy recommends further assessment at detailed design stage.
Produce a remediation strategy that accords with the requirements of both aviation design standards and regulatory authorities.	Management	The strategy has been developed around the performance requirements for aviation settlement standards, which has driven the need to excavate a significant quantity of landfill material.	Settlement may occur within the area of the landfill. The strategy incorporates measures to protect drainage and other services from settlement.
Reuse of excavated landfill material in a way that meets the requirements of and enables future use of the site.	Technical	Strategy sets out criteria for reuse of material in Section 11.2 to ensure that the site is suitable for use.	Complexity of regulatory regimes means differing criteria may be required materials. Material being treated and reused under Environmental Permit will be subject to waste acceptance criteria which need to be agreed with the Environment Agency.
Minimise all unacceptable environmental impacts during implementation of remediation strategy.	Management	Proposed environmental controls detailed in Section 8.8.5 of the strategy.	Due to the heterogenous nature of the landfill there is a risk unexpected contamination may be encountered. Strategy

Remediation Objectives	Type of Objective	How objective is met by strategy	Risks/ uncertainties
			incorporates measures to detected and deal with such occurrences.
Minimise all unacceptable health & safety impacts during implementation of remediation strategy	Management	Required site management and controls are set out in Section 9 and detail requirements to minimise health & safety impacts of work.	Due to the heterogenous nature of the landfill there is a risk unexpected contamination may be encountered. Strategy incorporates measures to detected and deal with such occurrences.
Minimise/avoid long term monitoring and management requirements	Management	Monitoring and management of gas protection/cover system will be required. The requirements are set out in the strategy in **Sections 10** and **Section 11.6.**	Length of monitoring required will be determined by Environmental Permit requirements. There is a risk that there will be onerous requirements within the Environmental Permit which necessitate long term monitoring.
To utilise a remediation technique whereby any requisite permissions can be obtained in required timescales.	Management	Remediation techniques i.e. cover system and gas protection are well established techniques which are achievable in timescales.	Whilst remediation techniques are well established, the Environmental Permit requirements for the landfill earthworks can take a substantial amount of time to agree with the Environment Agency. Early engagement will reduce this risk.
Remediate site within acceptable timescales	Management	Remediation techniques i.e. cover system and gas protection are well established techniques which are achievable in timescales.	Landfill earthworks will be the main constraining factor to achieving timescales. Early contractor engagement and segregation trials can reduce the uncertainty associated with processing rates and reduce this risk.

Remediation Objectives	Type of Objective	How objective is met by strategy	Risks/ uncertainties
Ensure that the work is sustainable from the point of view of resources and cost	Technical	The feasible remediation options were reviewed in Section 5.5. The strategy developed is based on the most sustainable option.	

REFERENCES

[1]Luton Rising. Preliminary Risk Assessment of Land Contamination. 2021. LLADCO-3B-ARP-00-00ARP-CG-0003. Issue 1
[2] Luton Rising. Land Contamination. Generic Quantitative Risk Assessment (GQRA) Report. 2021. LLADCO-3C-ARP-00-00-RP-CG-0002.
[3]Luton Rising. Detailed Quantitative Risk Assessment Report: Human Health and Ground Gases. 2021. LLADCO-3C-ARP-00-00-RP-CG-0003.
[4] Luton Rising. Detailed Quantitative Risk Assessment Report: Volume 3 Controlled Waters. 2021. LLADCO-3C-ARP-00-00-RP-CG-0001. Final.
[5] Arup (2019) Future Luton. Earthworks Design Report. 26th July 2019. LLADCO-3B-ARP-00-00-RP-CE-0002 | Issue 1
[6] Arup (2019) Geotechnical Investigation Report (GIR). LLADCO-3C-ARP-00-00-RP-CG-0004
[7] Luton Rising. Hydrogeological Characterisation. 2021. LLADCO-3B-ARP-00-00-RP-CG-0001
[8] Luton Rising. Foundation Works Risk Assessment for Former Eaton Green Landfill. 2020. Draft 1
[9] Capita (2019) Future Luton. Drainage Design Statement. LLADCO-3A-CAP-CD-00-RP-CD-0003. Draft.
[10] Arup (2019) Future Luton. Hydrogeological Characterisation. LLADCO-3B-ARP-00-00-RP-CG-0001
[11] Arup (2017) Century Park Development. Contamination Preliminary Risk Assessment - Former Eaton Green Landfill. Issue 1
[12] Society of Brownfield Risk Assessment (SoBRA) (2019) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.
[13] Contaminated Land: Applications in Real Environments (CL:AIRE) (2016). Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance. CL:AIRE, London. ISBN 978-1-905046-30-0. Download at www.claire.co.uk/asbestos
[14] Joint Industry Working Ground (JIWG) (2016) 'Decision support tool for the categorisation of work activities involving asbestos in soil and construction and demolition materials'
[15] CL:AIRE (2012) A Pragmatic Approach to Ground Gas Risk Assessment. Research Bulletin 17. (RB17)
[16] British Standards Institution (2019) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS8485:2015+A1:2019
[17] CIRIA (2004) Selection of remedial treatments for contaminated land: a guide to good practice. C662
[18] CIRIA (2001) Remedial processes for contaminated land - principles and practice. C549
[19] Arup (2019) Future Luton. Preliminary Environmental Information Report. Appendix 16.1 Ecology Baseline Report.
[20] Regulatory position statement (RPS) 178: The treatment and disposal of invasive non-native plants; Environment Agency, March 2016 (updated January 2018).
[21] Environment Agency (EA) (2012) Good practice for decommissioning redundant boreholes and wells
[22] British Standards Institution (BS) (2019) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings. BS8485:2015+A1:2019
[23] CIRIA (1995) Special Publication 105 - Remedial Treatment for Contaminated Land - Volume V: Excavation and disposal
[24] CIRIA (1996) Special Publication 106 - Remedial treatment for contaminated land: Volume VI: Containment and hydraulic measures
[25] CIRIA (1996) Special Publication 124 - Barriers liners and cover systems for containment and control of land contamination
[26] British Standards Institute (2015) Specification for topsoil. BS3882:2015
[27] The Environmental Permitting Regulations (England and Wales) (Amendment) (EU Exit) Regulations 2019
[28] Arup (2019) Future Luton. Preliminary Environmental Information Report. Volumes 1 to 3. October 2019.
[29] CL:AIRE (2011) The Definition of Waste: Development Industry Code of Practice, Version 2.
[30] Environment Agency (2016) Regulatory Guidance Series, No.EPR 13 'Defining Waste Recovery: Permanent Deposit of Waste on Land'.
[31] Directive 2008/98/EC on waste (Waste Framework Directive)
[32] Environment Agency (2016) Waste recovery engineering: create a construction quality plan
[33] Construction (Design and Management) Regulations (CDM)
[34] Health and Safety Executive (HSE) (1991) Protection of workers and the general public during the development of contaminated land
[35] British Standards Institute (2017) Investigation of potentially contaminated sites - code of practice (+A2:2017). BS10175:2011+A2:2017
[36] Department for food and rural affairs & Environment Agency (2016) Risk assessments for specific activities: environmental permits
[37] Arup (2019) Future Luton. Draft Code of Construction Practice.LLADCO-3B-ARP-00-00-RP-YE-0011. Issue. October 2019
[38] Control of Asbestos Regulations (CAR) (2012). SI/2012/632.
[39] CIRIA (2009) Unexploded ordnance (UXO) A guide for the construction industry (C681)
[40] Environment Agency (2003) Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water LFTGN02
[41] Control of Pollution Act 1974. Section 61 Prior consent for work on construction sites.

[42] Dangerous Substances and Explosives Atmospheres Regulations 2002
[43] Highways England (2019) Design Manual for Roads and Bridges
[44] CIRIA (2014) Good practice on the testing and verification of protection systems for buildings against hazardous ground gases (C735)

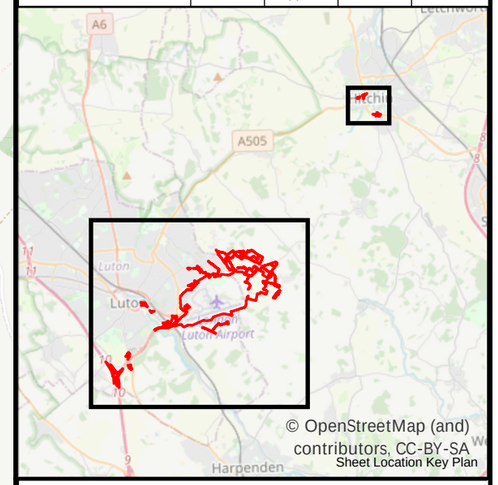
FIGURES

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Legend

Proposed Development Boundary

Revision History	Drawn	Checked / Approved	Date	Rev.
First Issue	AB	RB / TB	13/12/21	P01



Sheet Location Key Plan

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

Our airport. Our community. Our planet.

London Luton Airport
Development Consent Order

Drawing Title

Figure 1
Location of Proposed Development

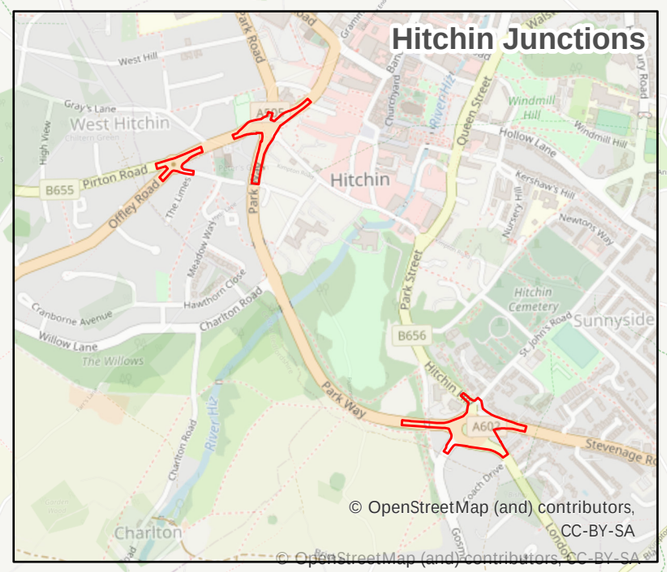
Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

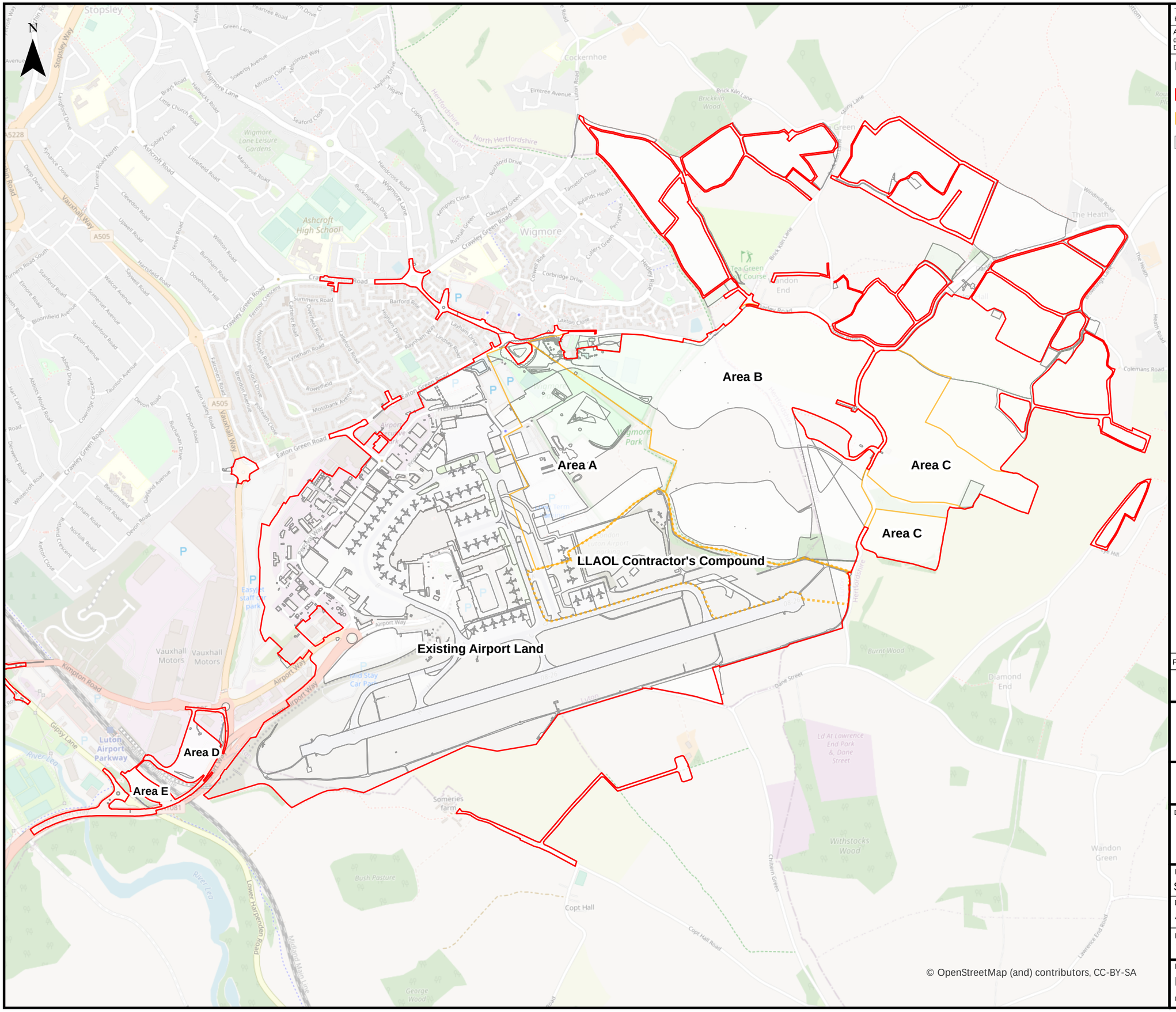
Drawn	Checked	Approved	Date	Scale	Size
AB	RB	TB	13/12/21	1:25,000	A3

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0186	P01

Project - Phase - Originator - Asset/Zone - Sub Asset - Type- Discp. - Number





All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Legend

- Proposed Development Boundary
- Site Subdivisions
- Scheme Layout 21mppa

Revision History	Drawn	Checked / Approved	Date	Rev.
First Issue	AB	RB / TB	13/12/21	P01

Luton Rising
Our airport. Our community. Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport
Development Consent Order

Drawing Title

Figure 2a
Proposed Masterplan - Phase 1

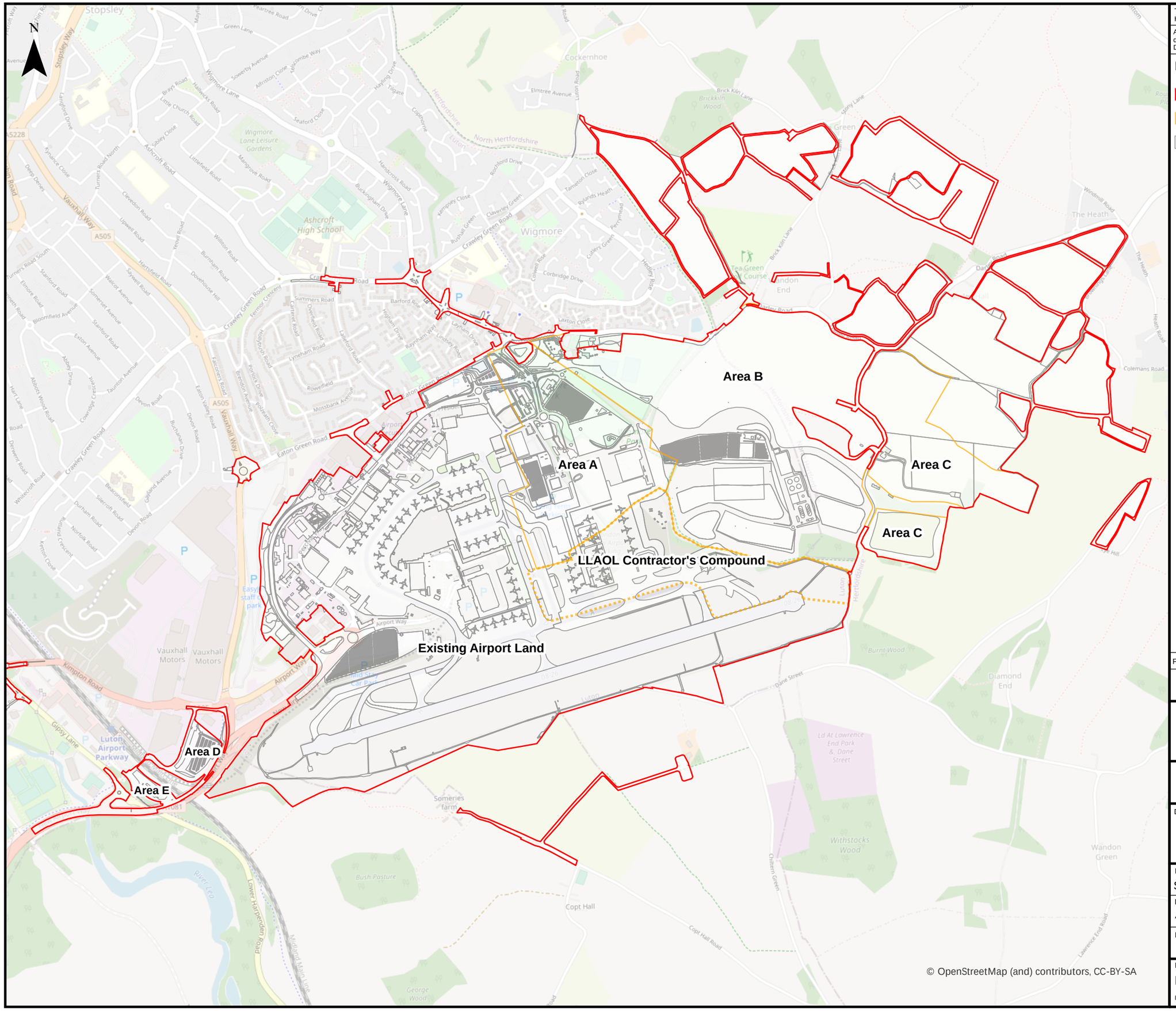
Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
AB	RB	TB	13/12/21	1:15,000	A3

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0187	P01

Project - Phase - Originator - Asset/Zone - Sub Asset - Type- Discp. - Number



All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Legend

- Proposed Development Boundary
- Site Subdivisions
- Scheme Layout 27mppa

Revision History	Drawn	Checked / Approved	Date	Rev.
First Issue	AB	RB / TB	13/12/21	P01

Luton Rising
Our airport. Our community. Our planet.

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport
Development Consent Order

Drawing Title

Figure 2b
Proposed Masterplan - Phase 2a

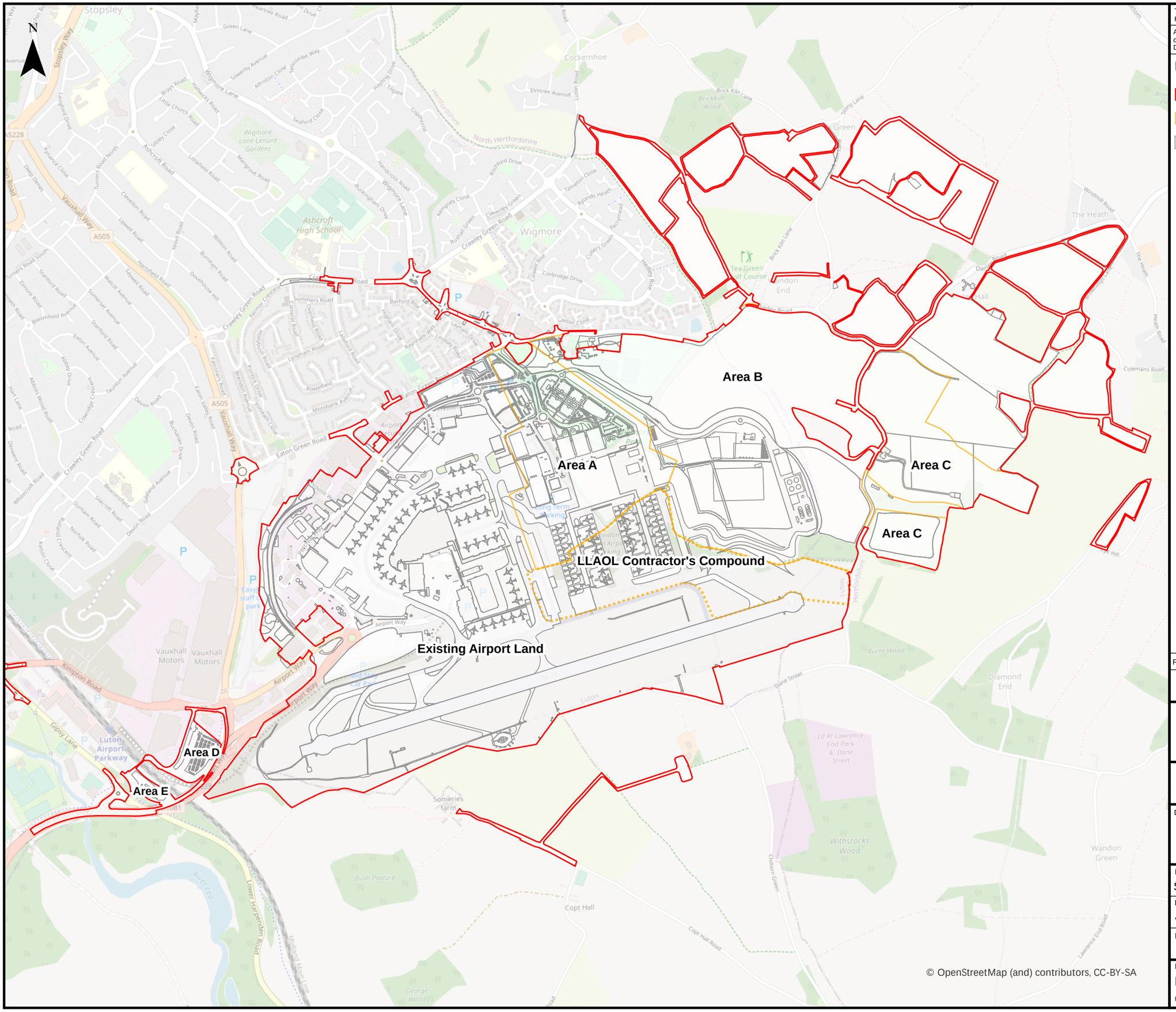
Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
AB	RB	TB	13/12/21	1:15,000	A3

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0188	P01

Project - Phase - Originator - Asset/Zone - Sub Asset - Type- Discp. - Number



All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Legend

- Proposed Development Boundary
- Site Subdivisions
- Scheme Layout 32mppa

Revision History	Drawn	Checked / Approved	Date	Rev.
First Issue	AB	RB / TB	13/12/21	P01

Luton Rising
Our airport. Our community. Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport
Development Consent Order

Drawing Title

Figure 2c
Proposed Masterplan - Phase 2b

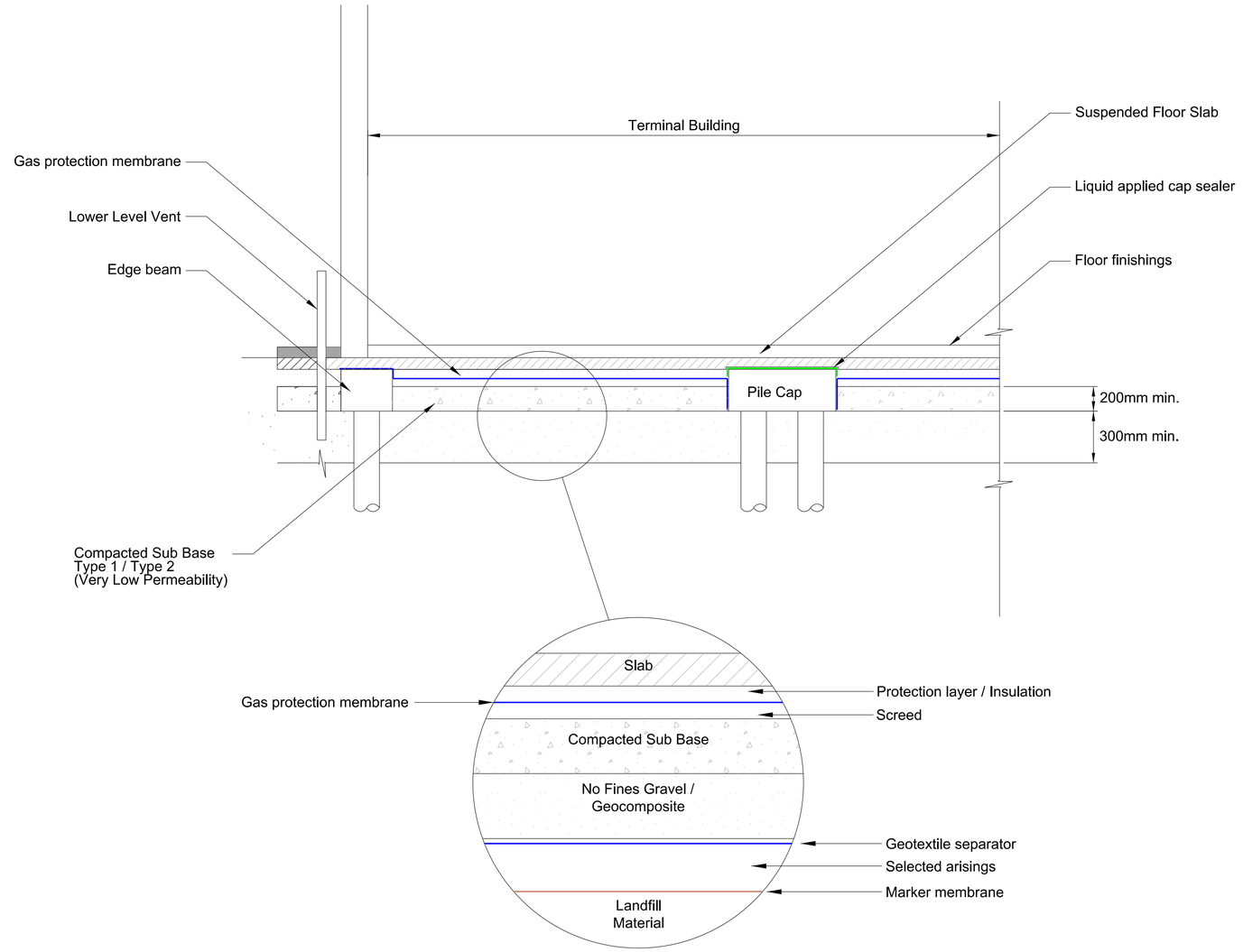
Purpose of issue	Suitability
SUITABLE FOR INFORMATION	S2

Drawn	Checked	Approved	Date	Scale	Size
AB	RB	TB	13/12/21	1:15,000	A3

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0189	P01

Project - Phase - Originator - Asset/Zone - Sub Asset - Type- Discp. - Number

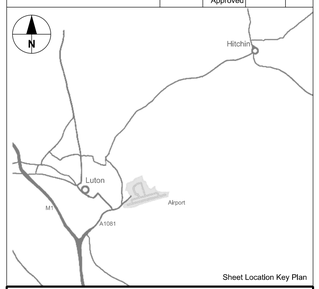


Illustrative Section of Gas Protection Measures
for buildings located on the Landfill

Not to Scale

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Revision History	Drawn	Checked Approved	Date	Rev.
Issue	IJ	RB TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

Our airport.
Our community
Our planet.

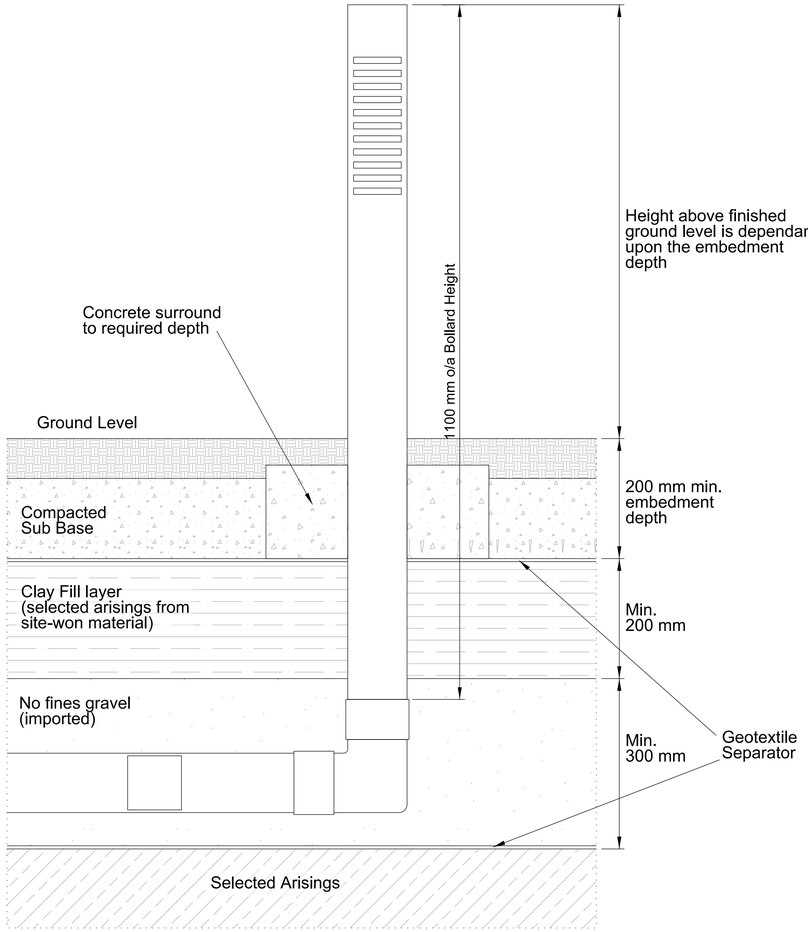
London Luton Airport
Development Consent Order

Drawing Title

Figure 03
Illustrative Gas Protection Measures

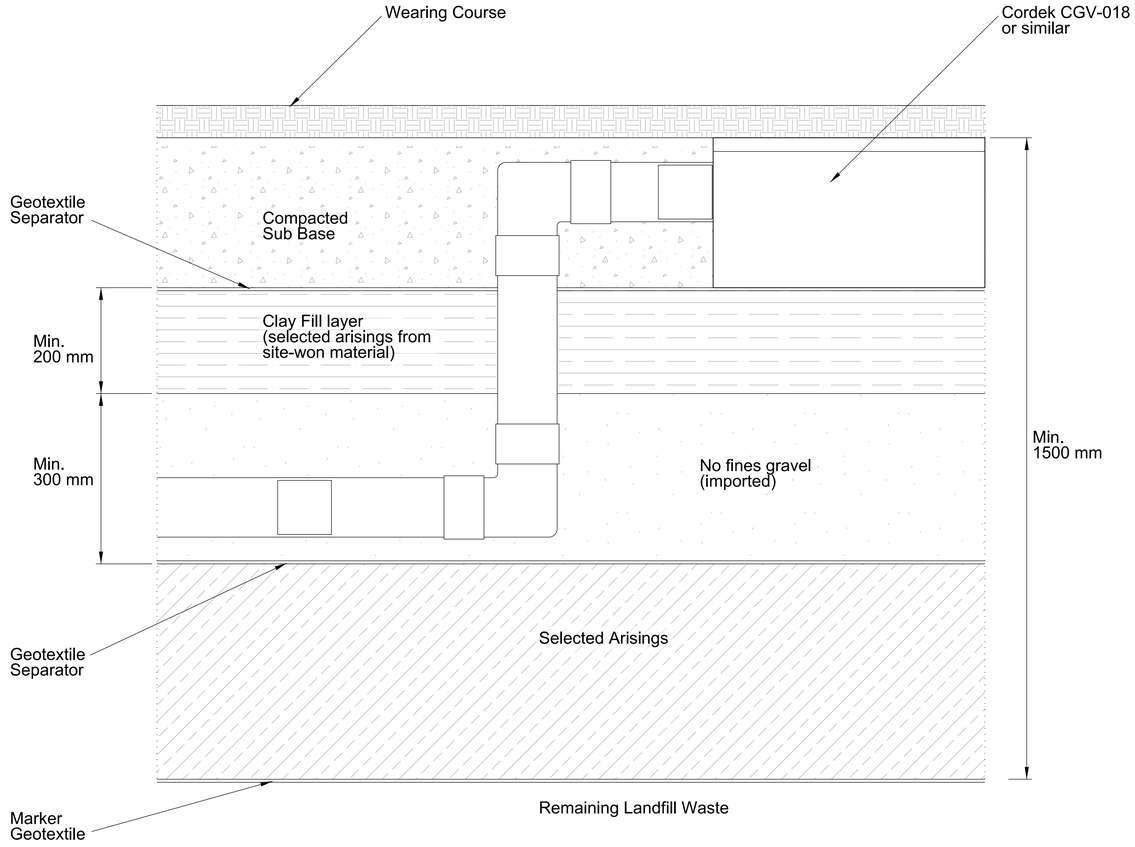
Purpose of issue				Suitability
SUITABLE FOR COORDINATION				S2
Drawn	Checked	Approved	Date	Scale / Size
IJ	RB	TB	16/12/21	NTS / A1
DCO Application Ref.	APFP Regulation	DCO Document Ref.		
TR020001				
Drawing Number				Revision
LLADCO-3C-ARP-00-00-DR-YE-0190				P01

Project – Phase – Originator – AssetZone – Sub Asset – Type – Discp. – Number



Typical Standard Detail for Vent Bollard

Not to Scale



Typical Standard Detail for Ground Level Vent Box

Not to Scale

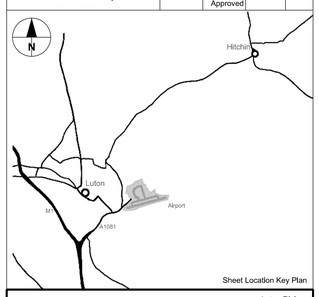
Capping Detail for Hard Paved Areas (Including MSCP)

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Notes

1. Vent bollard will require protection if in car park area.
2. Spacing and layout to be determined
3. No fines gravel could be replaced with suitable geo composite and vent detail amended accordingly
4. Drainage above clay layer to be determined

Revision History	Drawn	Checked / Approved	Date	Rev.
Issue	IJ	RB / TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

Luton Rising — Our airport. Our community Our planet.

London Luton Airport
Development Consent Order

Drawing Title

Figure 04
Capping and gas control detail
for hard paved areas

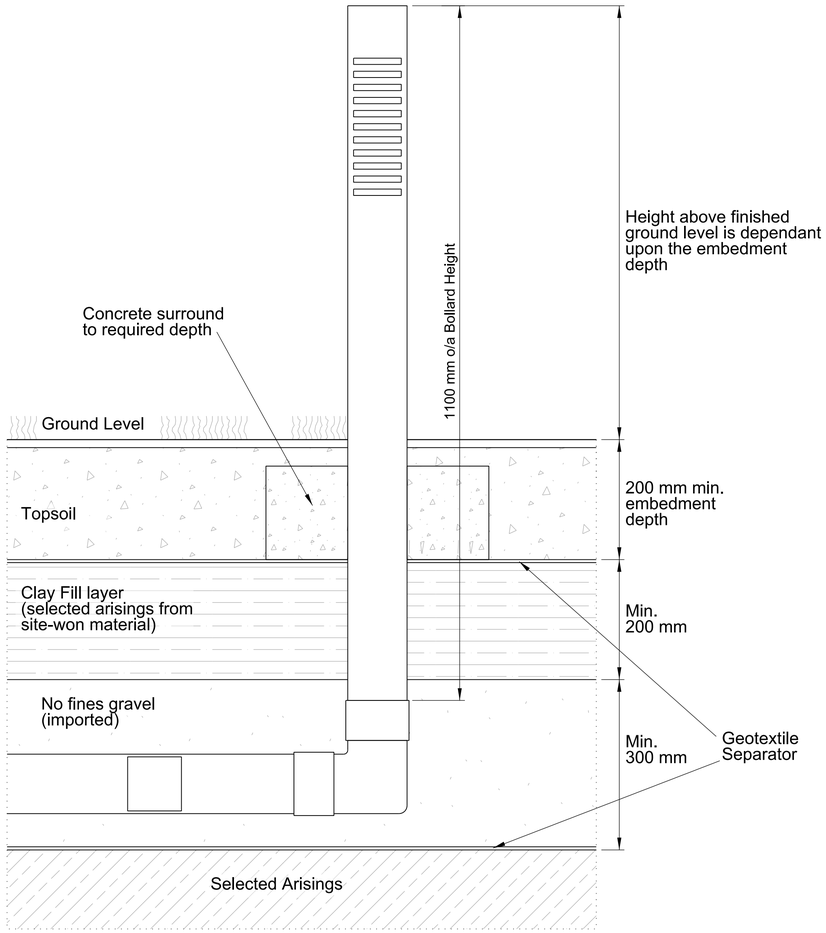
Purpose of issue	Suitability
SUITABLE FOR COORDINATION	S2

Drawn	Checked	Approved	Date	Scale	Size
IJ	RB	TB	16/12/21	NTS	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

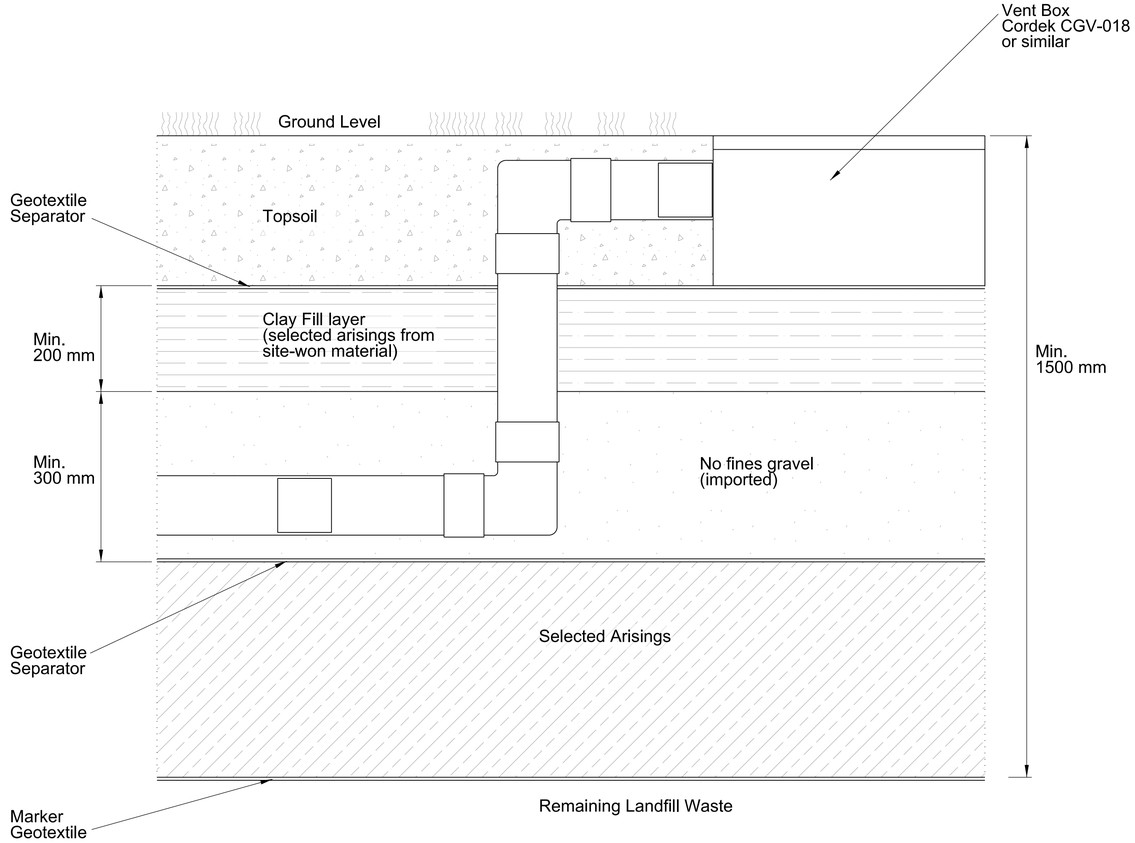
Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0191	P01

Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Discp. – Number



Typical Standard Detail for Vent Bollard

Not to Scale



Typical Standard Detail for Ground Level Vent Box

Not to Scale

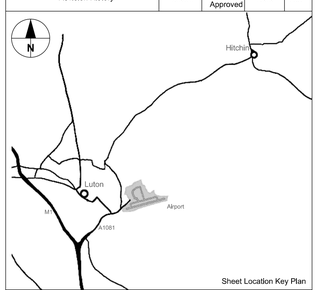
Capping Detail for Landscaping Areas

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Notes

1. Vent type depends on area of landscaping. Vents only required at perimeter of area.
2. Spacing and layout to be determined
3. No fines gravel could be replaced with suitable geocomposite and vent detail amended accordingly
4. Drainage above clay layer to be determined

Revision History	Drawn	Checked / Approved	Date	Rev.
Issue	IJ	RB / TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

Our airport.
Our community
Our planet.

London Luton Airport
Development Consent Order

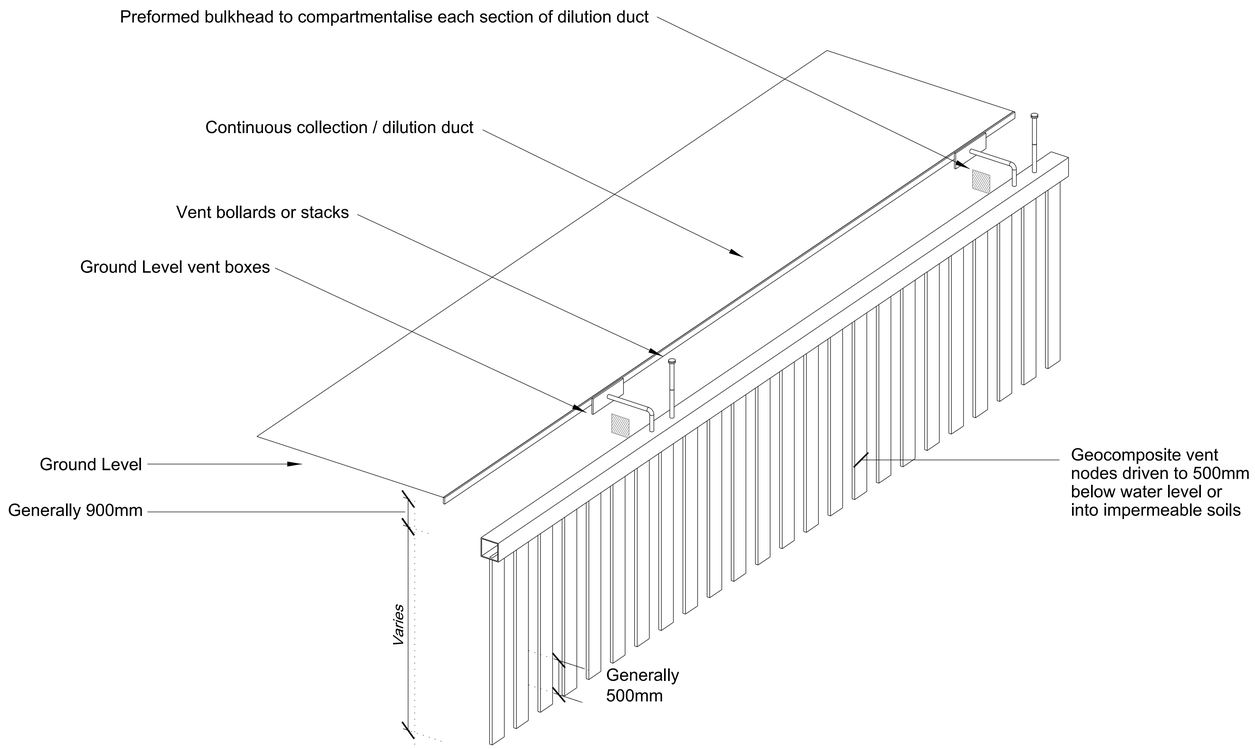
Drawing Title

Figure 05
Capping and gas control detail
for landscaping areas

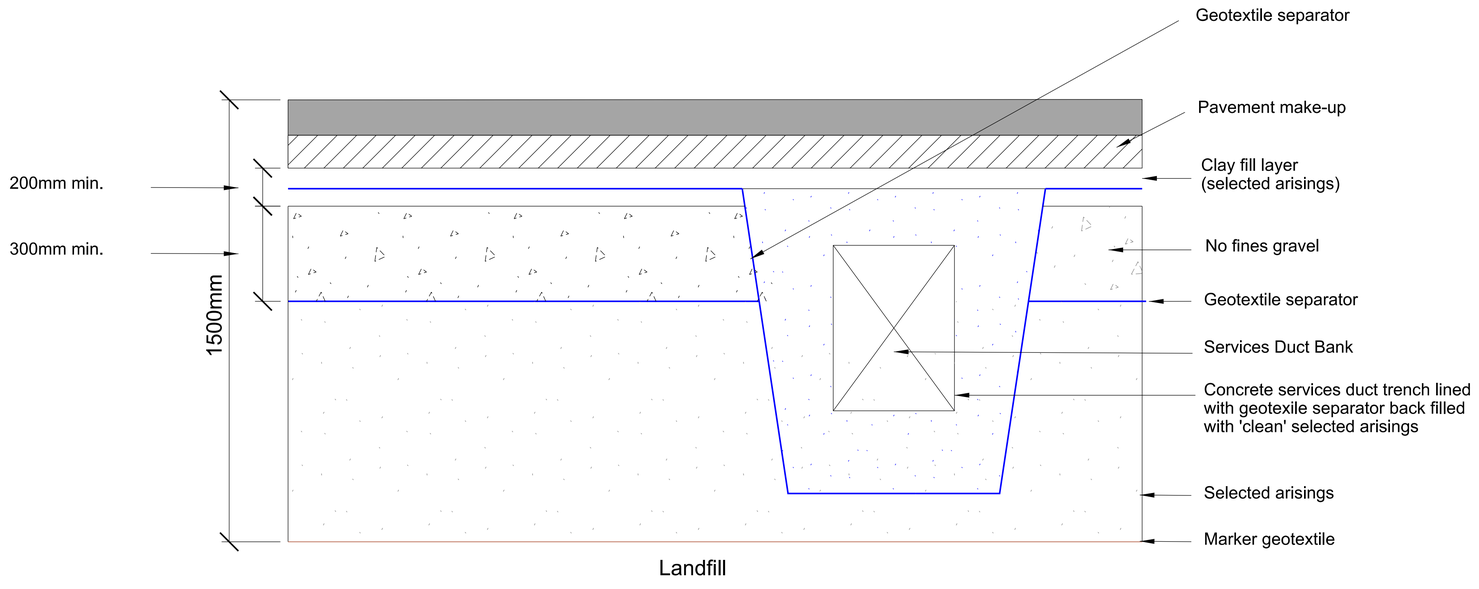
Purpose of issue				Suitability
SUITABLE FOR COORDINATION				S2
Drawn	Checked	Approved	Date	Scale / Size
IJ	RB	TB	16/12/21	NTS / A1
DCO Application Ref.	APFP Regulation	DCO Document Ref.		
TR020001				

Drawing Number: LLADCO-3C-ARP-00-00-DR-YE-0192
Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Discp. – Number

Revision: P01



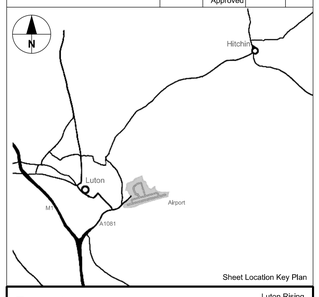
Virtual Gas Barrier Schematic for Boundary Gas Protection



Gas Protection for Service Corridors

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Revision History	Drawn	Checked / Approved	Date	Rev.
Issue	IJ	RB / TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

Our airport. Our community Our planet.

London Luton Airport Development Consent Order

Drawing Title

Figure 06
Gas Protection Details

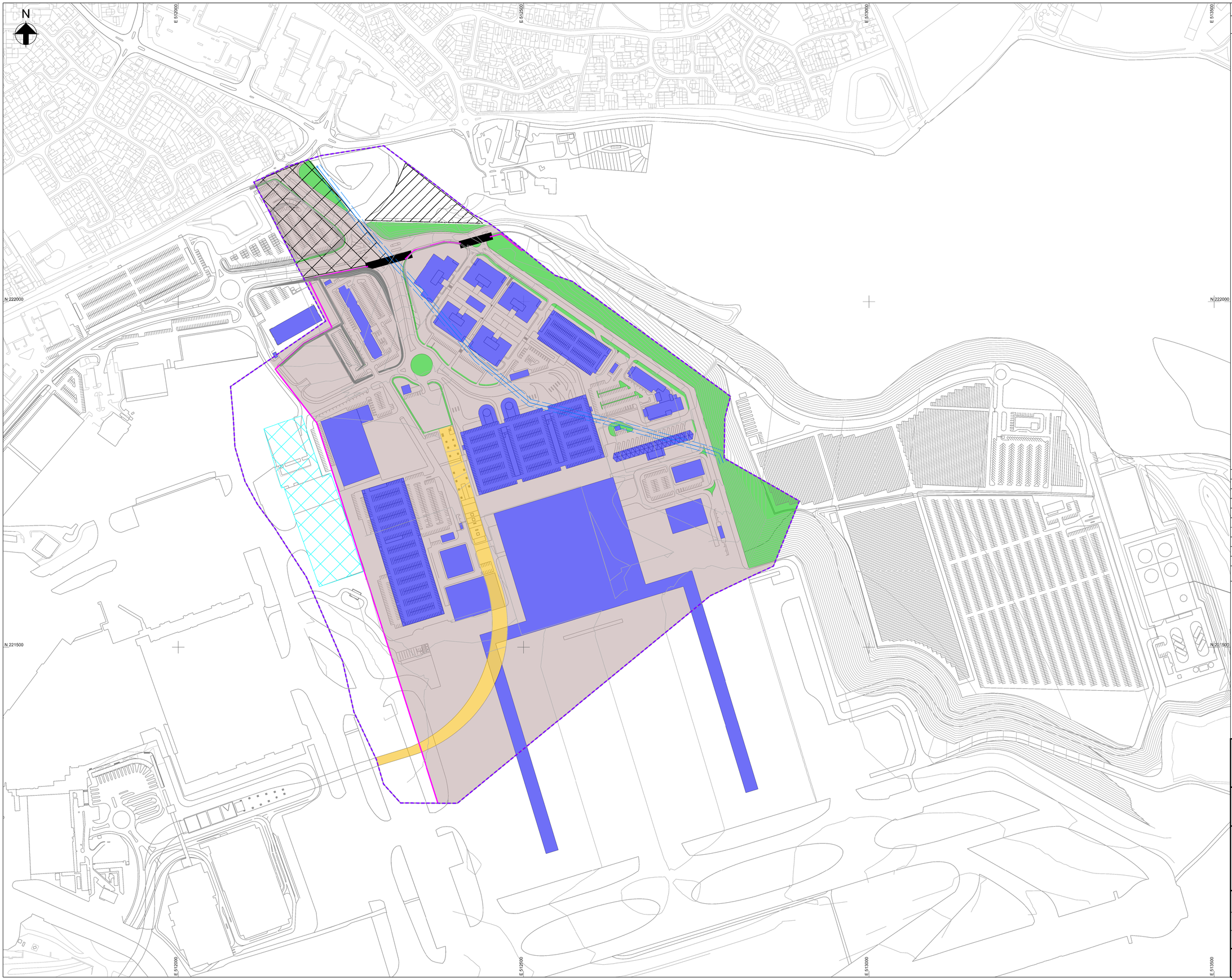
Purpose of issue	Suitability
SUITABLE FOR COORDINATION	S2

Drawn	Checked	Approved	Date	Scale	Size
IJ	RB	TB	16/12/21	NTS	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0193	P01

Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Discp. – Number



All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

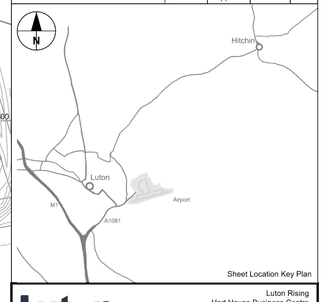
Legend

- Landfill Boundary
- Virtual Gas Barrier
- Existing Thames Valley Drain (to be treated)
- DART
- Buildings
- Gas Control in landscaping
- Gas control in hard paved areas
- Low Permeability Clay Barrier
- Passive venting. e.g. vent stacks
- Landfill Material removed as part of AAR
- Approx. extent of area previously remediated

Notes

1. Do not scale from this drawing.
2. All levels are in metres above ordnance datum unless noted otherwise.
3. These drawings are primarily intended to be viewed electronically. Some details may not be clear or visible on a printed version.

Revision History	Drawn	Checked / Approved	Date	Rev.
Issue	IJ	RB / TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Our airport. Our community. Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport Development Consent Order

Drawing Title

Figure 07
Landfill Gas Control Measures

Purpose of issue	Suitability
SUITABLE FOR COORDINATION	S2

Drawn	Checked	Approved	Date	Scale	Size
IJ	RB	TB	16/12/21	1:2500	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

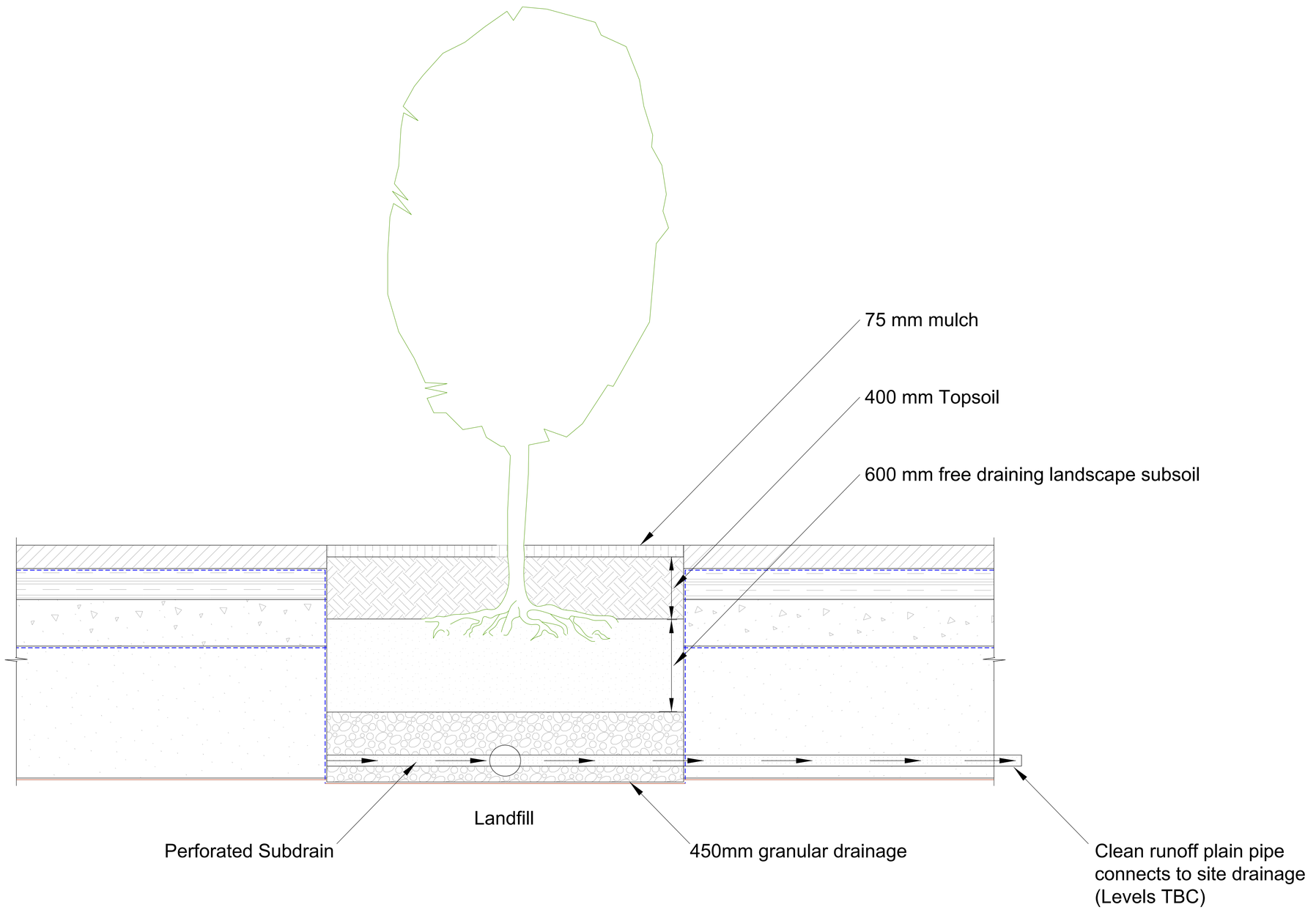
Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0194	P01

Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Disc. – Number

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

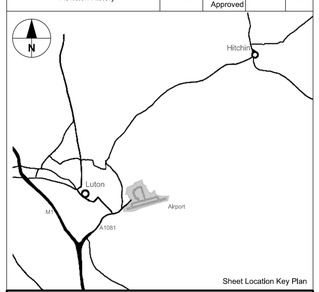
Legend

- Clay
- No fines gravel
- Selected arisings
- Geotextile separator
- Marker membrane
- Pavement/soft landscaping make-up



Tree Pit Detail

Issue	IJ	RB TB	16/12/21	P01
Revision History	Drawn	Checked Approved	Date	Rev.



Sheet Location Key Plan

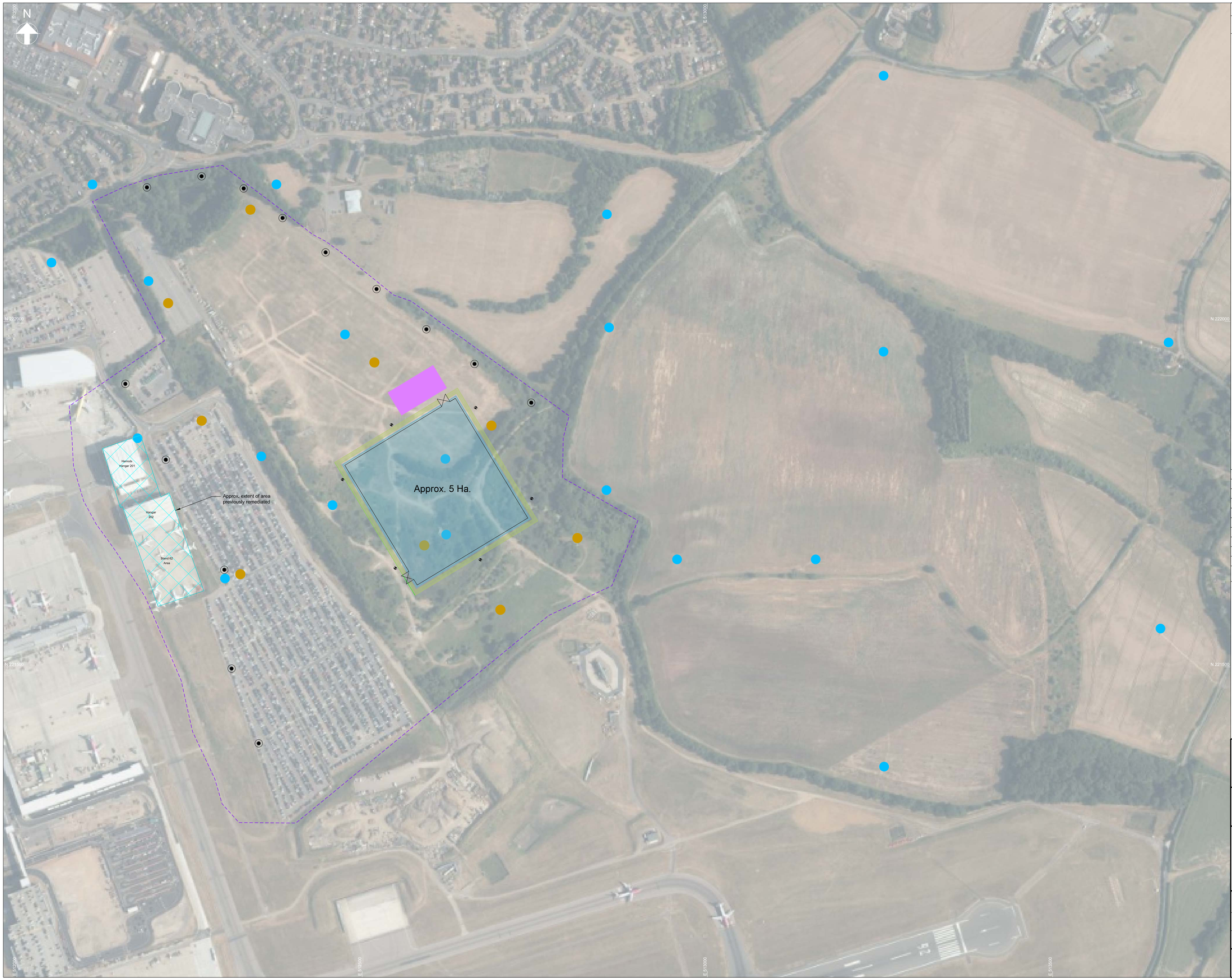
Luton Rising
Our airport. Our community Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport Development Consent Order

Drawing Title

Figure 08
Tree Pit Details

Purpose of issue				Suitability	
SUITABLE FOR COORDINATION				S2	
Drawn	Checked	Approved	Date	Scale	Size
IJ	RB	TB	16/12/21	NTS	A1
DCO Application Ref.	APFP Regulation		DCO Document Ref.		
TR020001					
Drawing Number					Revision
LLADCO-3C-ARP-00-00-DR-YE-0195					P01
Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Discp. – Number					



All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

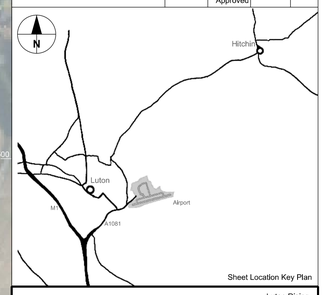
Legend

- Landfill boundary
- Waste treatment compound
- Indicative waste water treatment area
- Approx. extent of area previously remediated
- Boundary monitoring
- Treatment compound monitoring
- Leachate control wells
- Groundwater monitoring locations

Notes

1. Do not scale from this drawing.
2. All levels are in metres above ordnance datum unless noted otherwise.
3. These drawings are primarily intended to be viewed electronically. Some details may not be clear or visible on a printed version.
4. Bing Maps Aerial - © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

Issue	IJ	RB / TB	16/12/21	P01
Revision History	Drawn	Checked / Approved	Date	Rev.



Sheet Location Key Plan

Luton Rising
Our airport. Our community. Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport Development Consent Order

Drawing Title

Figure 09
Site Management
Monitoring and Controls

Purpose of issue				Suitability
SUITABLE FOR COORDINATION				S2
Drawn	Checked	Approved	Date	Scale / Size
IJ	RB	TB	16/12/21	1:2500 / A1
DCO Application Ref.	APFP Regulation	DCO Document Ref.		
TR020001				

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0196	P01
Project – Phase – Originator – Asset/Zone – Sub Asset – Type – Discp. – Number	

This drawing may contain mapping by permission of Ordnance Survey on behalf of HMSO © Crown Copyright and database rights 2019 Ordnance Survey 0100031673

All structure positions are indicative. The proposed works will be subject to detailed design development. The changes will be within limits of deviation specified in the Development Consent Order.

Legend

- Landfill Boundary
- Approx. extent of area previously remediated
- Area of Chalk Material Excavated

Landfill Isopach - Cut and Fill Depths

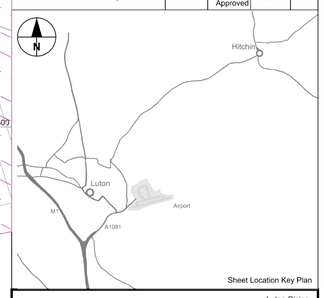
Area of Deposition (Fill):
16.00m, 15.00m, 14.00m, 13.00m, 12.00m, 11.00m, 10.00m, 9.00m, 8.00m, 7.00m, 6.00m, 5.00m, 4.00m, 3.00m, 2.00m, 1.00m, 0.25m

Area of Excavation (Cut):
-0.25m, -1.00m, -2.00m, -3.00m, -4.00m, -5.00m, -6.00m, -7.00m, -8.00m, -9.00m, -10.00m, -11.00m, -12.00m, -13.00m, -14.00m, -15.00m, -16.00m, -17.00m

Notes

1. Do not scale from this drawing.
2. All levels are in metres above ordnance datum unless noted otherwise.
3. These drawings are primarily intended to be viewed electronically. Some details may not be clear or visible on a printed version.

Revision History	Drawn	Checked / Approved	Date	Rev.
Issue	IJ	RB / TB	16/12/21	P01



Sheet Location Key Plan

Luton Rising
Our airport. Our community. Our planet.
Luton Rising
Hart House Business Centre
Kimpton Road, Luton, LU2 0LA
www.lutonrising.org.uk

London Luton Airport Development Consent Order

Drawing Title

Figure 10
Landfill Areas of Cut and Fill

Purpose of issue	Suitability
SUITABLE FOR COORDINATION	S2

Drawn	Checked	Approved	Date	Scale	Size
IJ	RB	TB	16/12/21	1:2500	A1

DCO Application Ref.	APFP Regulation	DCO Document Ref.
TR020001		

Drawing Number	Revision
LLADCO-3C-ARP-00-00-DR-YE-0197	P01

Project – Phase – Originator – AssetZone – Sub Asset – Type – Discp. – Number

Appendix A

Table A1.1 Summary of Remediation Options Screening Matrix

Remediation technology	Contaminants							Screening criteria					Applicable RPLs or constraints preventing use
	VOCs	Heavy metals	TPH	PAHs	Asbestos	Pesticides	Landfill gases	Cost	Capital or operational/ maintenance intensive	Reliability	Suitable for ground conditions	Clean-up time (years)	
Civil Engineering Methods													
Containment-cover systems	✓	✓	✓	✓	✓	✓	✓	£	Capital intensive	Average to high	✓	<1	RPLs 1, 3-13,15,18,19
In ground gas barrier i.e. virtual gas curtain	✘	✘	✘	✘	✘	✘	✓	£	Capital intensive	Average to high	✓	<1	RPL 2
Physical treatment													
Complex Materials Sorting and Reuse	✘	✘	✘	✘	✘	✘	✘	££	Capital and O&M intensive	Average	✓	1-2	Not required to address RPLs but will improve physical properties of material to be reused
Screening/ Handpicking	✘	✘	✘	✘	✓	✘	✓	££	Capital and O&M intensive	Average to high	✓	1-2	Not required to address RPLs but option should be kept under review as option dependant on conditions encountered.
In-situ biological treatment													
Bioventing or sparging	✓	✘	✓	✓	✘	✘	✘	£	Not capital or O&M intensive	Average	O	0.5-3	RPL14
Phytoremediation	✓	✓	✓	✓	✘	✓	✘	£	Not capital or O&M intensive	Low	✘	>3	Not feasible. Time frame and low reliability.
In-situ physical/chemical treatment													
Soil vapour extraction (SVE)	✓	✘	✓	✓	✘	✘	✘	£	O&M intensive	Average	O	1-3	RPL 14
Chemical oxidation	✓	O	✓	✓	✘	✓	✘	££	O&M intensive	Average	O	<1	RPL 14
Electrokinetic separation	✘	✓	✘	✘	✘	✘	✘	£££	O&M intensive	Average	O	1-3	Considered not feasible due to limited application, timeframe and excessive cost.
Soil flushing	✓	✓	✓	✓	✘	✓	✘	£££	O&M intensive	Average	O	1-3	RPL 14
Stabilisation and solidification (e.g.	✓	✓	✓	✓	✓	✓	✘	££	Capital intensive	Average	O	<0.5	Not required to address RPLs but will improve physical properties of

Remediation technology	Contaminants							Screening criteria					Applicable RPLs or constraints preventing use
	VOCs	Heavy metals	TPH	PAHs	Asbestos	Pesticides	Landfill gases	Cost	Capital or operational/ maintenance intensive	Reliability	Suitable for ground conditions	Clean-up time (years)	
cement, hydraulic binders)													material to be reused. Only viable in conjunction with other remediation methods (e.g. material sorting and reuse).
In-situ thermal methods													
Thermal desorption	✓	✓	✓	✓	✖	✓	✖	£££	Capital and O&M intensive	High	✓	<0.5	N/A (excessive cost and energy)
Vitrification	✓	✓	✓	✓	✓	✓	✓	£££	Capital and O&M intensive	High	✓	<0.5	N/A (excessive cost and energy)
Ex-situ biological treatment													
Landfarming	✓	✖	✓	✓	✖	✖	✖	£	Not capital or O&M intensive	Average	O	1-3	RPL 14 Requires very large area for treatment therefore space unlikely to be available.
Windrows	✓	✖	✓	✓	✖	✖	✖	£	Not capital or O&M intensive	Average	O	0.5-2	RPL 4
Biopiles	✓	✖	✓	✓	✖	✖	✖	£	Not capital or O&M intensive	Average	O	0.5-2	RPL 14

Remediation technology	Contaminants							Screening criteria					Applicable RPLs or constraints preventing use
	VOCs	Heavy metals	TPH	PAHs	Asbestos	Pesticides	Landfill gases	Cost	Capital or operational/ maintenance intensive	Reliability	Suitable for ground conditions	Clean-up time (years)	
Slurry phase biotreatment	✓	✗	✓	✓	✗	✗	✗	£	Not capital or O&M intensive	Average	O	0.5-2	RPL 14 Requires very large area for treatment therefore space unlikely to be available.
Ex-situ physical/chemical treatment													
Soil washing	✓	✓	✓	✓	✗	✓	✗	££	Capital and O&M intensive	High	✗	<0.5	RPL 14 Soil washing is typically suited to granular soils (i.e. a fines content <10%). Fine content in landfill is high.
Stabilisation and solidification (e.g. cement, hydraulic binders)	✓	✓	✓	✓	✓	✓	✗	££	Capital intensive	Average	O	<0.5	Not required to address RPLs but will improve physical properties of material to be reused. Only viable in conjunction with other remediation methods (e.g. material sorting and reuse).
Ex-situ thermal methods													
Incineration	✓	✓	✓	✓	✓	✓	✓	£££	Capital and O&M intensive	High	✓	<0.5	N/A (excessive cost and energy)
Thermal desorption	✓	✓	✓	✓	✓	✓	✓	££	Capital and O&M intensive	Average	✓	<0.5	N/A (excessive cost and energy)
Pyrolysis	✓	✓	✓	✓	✓	✓	✓	£££	Capital and O&M intensive	High	O	<0.5	N/A (excessive cost and energy)

Key:

✓ Technique is applicable

✗ Not applicable

O: Limited suitability dependant on ground conditions or contaminant type

£: Low cost

£+: Low to medium cost

££: Medium cost

£££: High cost

Remediation technology	Contaminants							Screening criteria					Applicable RPLs or constraints preventing use
	VOCs	Heavy metals	TPH	PAHs	Asbestos	Pesticides	Landfill gases	Cost	Capital or operational/ maintenance intensive	Reliability	Suitable for ground conditions	Clean-up time (years)	
Technically feasible technique													
Technical feasible in combination with other technologies													