



SILVERTOWN TUNNEL

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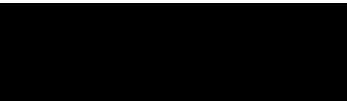

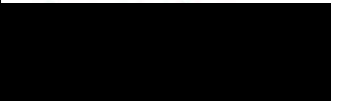
Pressure Reduction Station (PRS) Ground Contamination Risk Assessment and Remediation Strategy DCO Requirement 17 (Parts 1, 2 and 3)

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1. Introduction

A decision on the application for the Silvertown Tunnel Development Consent Order (DCO) was taken on 10 May 2018 and has now been issued (The Silvertown Tunnel Order 2018). The RiverLinx consortium has been appointed by Transport for London (TfL) to design, build, finance and maintain the Silvertown Tunnel. Construction is expected to commence in 2020 with the tunnel opening in 2025.

The DCO authorises TfL to acquire the necessary land footprint either on a temporary basis during construction, or permanently to accommodate the schemes permanent works. For the land acquisition, legal agreements have been entered with the landowners/occupiers requiring specific alteration works to each area that mitigates the impact of the planned works. Works within this scope have been termed 'Supplementary Works'. Each impacted location has a Detailed Design approved by the Stakeholder and landowner/occupier.

The Scheme's permanent highway design will redirect the A102 (Northbound) toward the new Silvertown Tunnel. In doing so the existing SGN Pressure Reduction Station (PRS) will be relocated by SGN to facilitate the new highways design. For SGN to relocate the existing PRS, a new access will be constructed to connect directly to the northbound carriageway of Millennium Way. The works are to be carried out from July 2020 in advance of the schemes permanent works. The area of the PRS works, in the context of the wider Silvertown Tunnel scheme (general alignment shown in green), is illustrated in Figure 1.

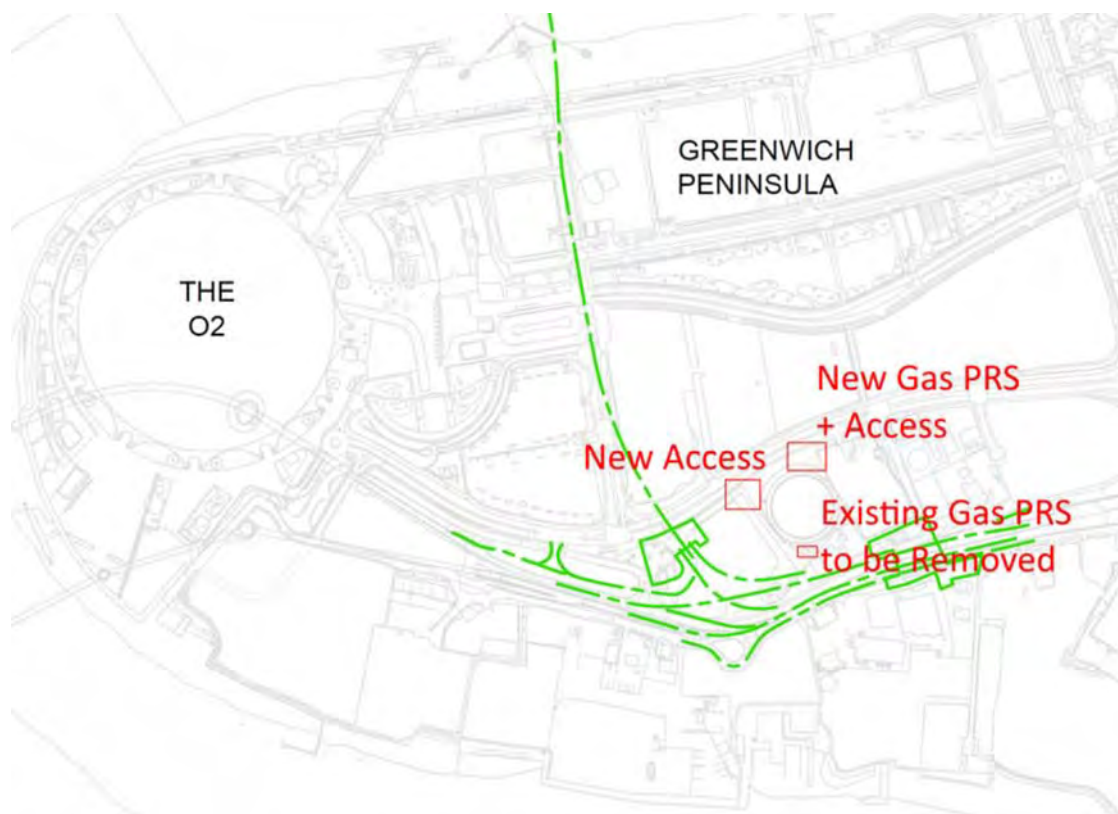


Figure 1 General area of PRS works

2. Purpose

This report presents information to address the requirement for a contamination risk assessment and remediation strategy for the Supplementary Works associated with the relocation of the PRS. The DCO (Schedule 2) sets out the requirement to address contaminated land (Requirement 17 (Parts 1-7)). This report addresses Requirement 17 (Parts 1, 2 and 3) for the PRS works to be submitted to the Royal Borough of Greenwich (RBG) for prior agreement. The remediation strategy sets out the contaminated land control measures that will be adopted during the PRS works to be implemented by Riverlinx CJV.

3. Scope

3.1. Ground contamination assessment

This ground contamination risk assessment and remediation strategy is specific to the PRS works defined herein. The assessment considers the nature and extent of the proposed works (Section 3.2), which comprise shallow utilities and work to the highway pavements and kerbs. The contamination condition of the site is assessed based on desk-based and investigation information available for the wider Silvertown Tunnel scheme and investigation on SGN land (Section 5).

The assessment has been carried out in accordance with the Environment Agency guidance Land Contamination: Risk Management¹ and comprises an assessment of potential risks to human health, property and environmental receptors.

A separate ground contamination risk assessment has been carried out for the Silvertown Tunnel scheme² which is based on two phases of dedicated ground investigation. The Silvertown Tunnel assessment considers all contamination risks associated with construction and the operation of the scheme. The PRS works are very minor in comparison, with ground disturbance limited to shallow soils.

3.2. PRS works

3.2.1. Overview of groundworks

The PRS design information is provided in document reference ST150030-RLC-ZZZ-06-S10-PEM-TP-0001 (drawings accompanying consent submission). The PRS works comprise the construction of two new access splays, to the gasholder and PRS, on the northbound carriageway of Millennium Way. Groundworks will be required for installation of utilities, such as drainage and lighting, for surfacing, and foundations to security fencing and access gate. The deepest excavation is for drainage, up to 2.1m depth, to tie in with the existing drainage network beneath Millennium Way.

A foundation for a new gas governor will comprise a 300mm thick reinforced concrete base over 150mm of Type 1 subbase. Soft spots below the foundation are to be replaced with compacted Type 1 to achieve the minimum allowable bearing capacity.

The pavement detail for the access splays will be 660mm thick, comprising: 40mm surface course; 60mm binder course; 110mm base course; over 450mm subbase (minimum Type 1). The subbase will be placed over Terram geotextile (or equivalent).

3.2.2. Sequence of works

Key sequence activities for the PRS works are provided below. Riverlinx CJV will undertake the following activities:

- Mobilisation on site and site compound set up
- Temporary Traffic Management Set up
 - Including land closure
- Site Clearance
 - Removal of vegetation
 - Relocation of existing lighting columns
 - Removal of existing hard landscaping (Kerbs, fencing, Vehicle Barrier System (VBS))
 - Relocation of existing signage
- Excavation:
 - Topsoil strip
 - Excavation of existing made ground

¹ gov.uk/guidance/land-contamination-how-to-manage-the-risks

² Riverlinx CJV (2020), Silvertown Tunnel – Greenwich, Ground Contamination Risk Assessment, DCO Requirement 17 (parts 1 and 2), Ref. ST150030-ARU-FAE-06-ZZ-ASM-EN-0001

- Utility Protection
- Backfill to formation level
- Drainage works

On completion SGN's subcontractor will do all the required works for the installation of the new PRS. Once the new PRS is installed Riverlinx CJV will finalise the access, to comprise:

- Reinstating lighting columns
- Reinstating permanent perimeter fencing

4. Acronyms, Abbreviations and Reference Documents

4.1. Acronyms and Abbreviation

ACM	Asbestos containing materials
ALARP	as low as reasonably practicable
bgl	below ground level
BTEX	Benzene, toluene, ethylbenzene and xylenes
CAR	Control of asbestos regulations 2012
EMCo	Environmental Management Co-ordinator (Arup)
EMS	Greenwich Peninsula Environmental Method Statement
EMS consultants	Atkins (Project EMS Consultant - GLA land); Arup (KDDL's EMS Consultant - KDDL land)
PRS	Pressure reduction station
NAPL	Non-aqueous phase liquid
PAH	Polycyclic aromatic hydrocarbons
PPE	Personal protective equipment
PRS	Pressure reduction station
RSFR	Greenwich Peninsula Remediation strategy framework report
TPH	Total petroleum hydrocarbons
VOC	Volatile organic compounds

4.2. Reference Documents

Various assessments and investigations of ground conditions were undertaken to inform the Environmental Statement (and associated documents) for the DCO application. The following information on contaminated land referenced in the Environmental Statement, has been reviewed to inform this assessment:

- TfL (April 2016), Silvertown Tunnel, Environmental Statement, Document Reference 6.1
- TfL (April 2016), Silvertown Tunnel, Code of Construction Practice (CoCP), Document Reference 6.10
- Mott MacDonald Ltd (2013), Phase 1 Contamination Assessment
- Atkins Ltd (1998), Greenwich Peninsula: Summary of Ground Remediation
- Atkins (2015), Silvertown Tunnel, Ground investigation report
- Atkins (2016), Greenwich Peninsula Environmental Method Statement, Volume 1 (Procedures) and Volume 2 (Code of Practice)
- Arup (2007), Greenwich Peninsula Development Area, Remediation Strategy Framework Report
- Soil Engineering (2015), Silvertown Tunnel, Ground Investigation

The following additional information has been reviewed to inform this assessment for the PRS works:

- WSP (March 2017), East Greenwich Holder Station, Ground investigation factual report and health and safety file
- Atkins (December 2003), Blackwell Lane, Greenwich. Mentor no. 011740. Environmental Assessment Site Investigation Transco Final Factual Report. Second Site Property Holdings. (Project No. 4094842/GTG.2000078)
- Fugro (2018), Silvertown Tunnel, Ground Investigation

5. Site conditions

5.1. Site setting

The PRS works area is adjacent to the northbound carriageway (west) of the Millennium Way, and to the east of a former gasholder (Gasholder No. 1) site owned by SGN. Gasholder No. 2 is to the north and was dismantled prior to 1995. The works area is shown in Figure 2 (extract from consent submission drawings). The PRS in the context of the Silvertown Tunnel DCO order limits and tunnel alignment is shown in Drawing 1.

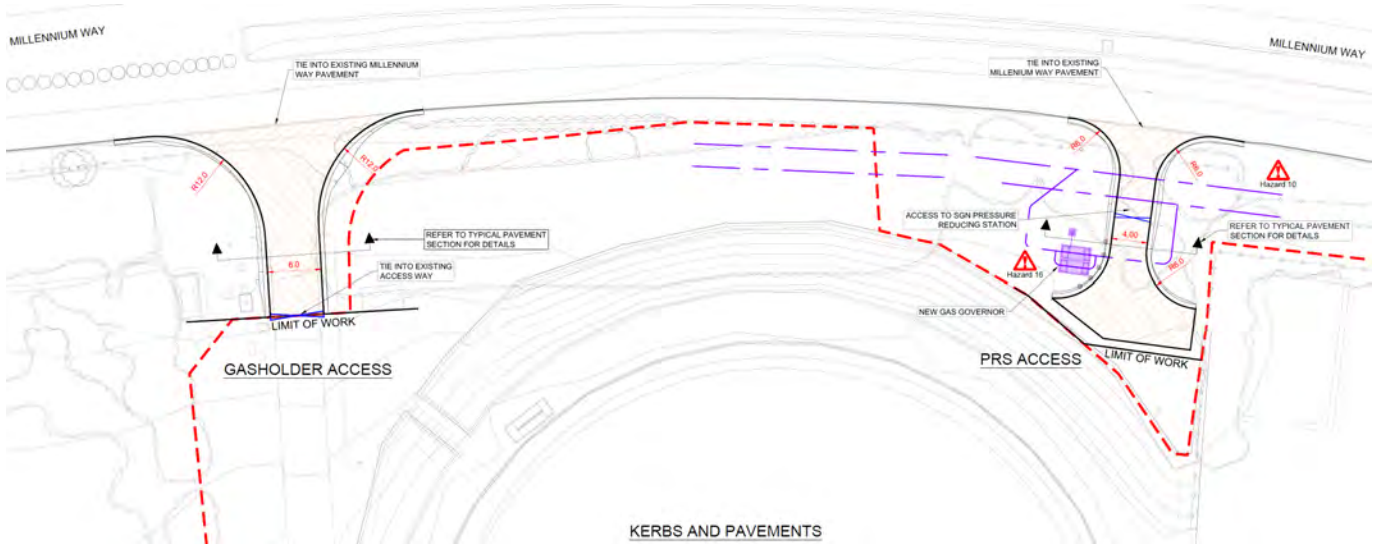


Figure 2 The PRS works and the DCO order limit

The PRS works area is to the west of the Millennium Exhibition Site (includes Millennium Way) which was subject to extensive ground contamination remediation work by British Gas and English Partnerships between 1996 and 1999.

An Environmental Method Statement (EMS) was produced in response to a planning condition of the 2004 outline planning permission for mixed use redevelopment of the Millennium Exhibition Site. The EMS concerns all construction works on the former Millennium Exhibition Site that disturb the ground or have the potential to cause pollution. It comprises a set of Procedures and Codes of Practice for all ground-related activities and a 'permit to dig' system for those activities. The EMS has been regularly updated since its first issue in 2004 and the latest revision is 2016. The revision in 2008 introduced the role of the Environmental Management Co-ordinator (EMCo), who is responsible for managing the execution of the environmental management system, with responsibility for the coordination, supervision and approval of site-specific Work Method Statements and the issue of Permits to Dig. Arup is appointed by Knight Dragon Developments Ltd as the EMCo.

In 2007 Arup produced a remediation strategy framework report (RSFR) for the mixed-use development on the former Millennium Exhibition Site and on the development lands to the west of Millennium Way which were included in the 2004 outline planning permission. The RSFR is a live document which has recently been updated to reflect regulatory changes and the parties involved in the redevelopment works. The Greenwich EMS boundary and zones referenced in the RSFR are shown on Drawing 1.

5.1.1. Site history

The gasholders formed part of the Southern Metropolitan Gasworks which occupied the northern and eastern parts of the Greenwich Peninsula from the 1860s until 1987. The PRS area was predominantly used for gas storage and distribution, it was not used for the manufacturing of coal gas.

Gasholder No. 1 is a frame-guided below-ground gasholder and had been built by 1896 with adjacent structures comprising governor house and pump house.

Potential sources of current and historical sources of contamination have been identified in the area (as included in the Environmental Statement) and are presented in Table 1.

Table 1 Potential sources of contamination

Source	Potential contaminants of concern	Comments
<p>Ground contamination (soil / vapour / groundwater) from onsite sources:</p> <ul style="list-style-type: none"> Residual historical contamination from South Metropolitan Gasworks. East Greenwich landfill (offsite) Contaminated perched water in the Made Ground. Contaminated groundwater in the RTD. 	<p>Cyanide, polyaromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene and xylene (BTEX), mineral oil, total petroleum hydrocarbons (TPH), phenols, ammoniacal compounds, sulphate and sulphide, heavy metals and asbestos. Organic contaminants exceeding solubility limits may be present as non-aqueous phase liquids (NAPL).</p>	<p>The Southern Metropolitan Gasworks was present onsite from 1860s to 1987. Remediation of the Millennium Exhibition Site was undertaken in the 1990s, although residual contamination in soils and groundwater is understood to remain. The SGN land was not subject to remediation. LNAPL (light non-aqueous liquid) may be present floating on top of groundwater and DNAPL (dense non-aqueous phase liquid) may be present at the boundary between the RTD and underlying low permeability London Clay.</p>
<p>Residual offsite contamination on Greenwich Peninsula</p>	<p>PAHs, TPH, ground gas (carbon dioxide and methane), heavy metals and asbestos.</p>	<p>Two historical inert landfills have been identified in the area. There is potential for a range of contaminants and a source of ground gas to be present.</p>

5.1.2. Environmental setting

Three distinct aquifers are recognised:

- An 'upper aquifer' associated with the River Terrace Deposits (RTD) (secondary A aquifer) which is located above the low permeability London Clay Formation;
- An 'intermediate aquifer' associated with the Harwich Formation and granular beds within the upper Lambeth Group (a secondary A aquifer) located below the London Clay; and
- A 'lower aquifer' associated with the lower Lambeth Group (Upnor Formation), Thanet Sand which are hydraulically connected to the underlying Chalk (principal aquifer), known as the Chalk and basal sands aquifer.

The site is not located within a groundwater source protection zone (SPZ) for potable water supply.

The nearest surface water feature is the River Thames which is approximately 250m south west and 550m to the east of the works area. The River Thames is tidal within this section of London, with a maximum range of spring tides between Mean Low Water Springs (MLWS) -2.78mOD and Mean High Water Springs (MHWS) 3.76mOD.

5.2. Ground conditions

Two phases of ground investigation have been carried out in the immediate area of the proposed PRS works on the SGN land in 2003³ and 2016⁴. The results of those investigation are considered below in addition to nearby investigations for the Silvertown Tunnel in 2015⁵ and 2018⁶. A summary of the ground conditions near the PRS works is shown in Table 2 based on nine exploratory holes within the vicinity (north of gasholder No.1) as shown in Drawing 2.

³ Atkins (December 2003), Blackwell Lane, Greenwich. Mentor no. 011740. Environmental Assessment Site Investigation Transco Final Factual Report. Second Site Property Holdings. (Project No. 4094842/GTG.2000078)

⁴ WSP (March 2017), East Greenwich Holder Station, Ground investigation factual report and health and safety file

⁵ Soil Engineering (2015), Silvertown Tunnel, Ground Investigation

⁶ Fugro (2018), Silvertown Tunnel, Ground Investigation

Table 2 Anticipated ground conditions

Stratum	Elevation of top of stratum (mOD)	Thickness (m)	Depth to base of stratum (m)	Elevation of base of stratum (mOD)
Made Ground	6.53 to 2.62	1.4 to 4.5	1.4 to 4.5	4.78 to -0.26
Alluvium	4.78 to -0.26	1.5 to 5.88	4.25 to 9.85	-1.76 to -4.78
RTD	-1.37 to -4.78	0.6 to 5.8	8.0 to 12.5	-2.52 to -6.84
London Clay*	-6.84 to -10.50	2.00 to >9.15	15.12 to >20.05	-12.50 to -12.57

* Information from London Clay taken from nearby investigations for Silvertown Tunnel

The typical description of each strata is as follows:

- Made Ground typically comprised dark brown sandy gravelly clay or clayey gravel, with anthropogenic fragments of brick, concrete, tile, coke and clinker. Locally pockets of white friable clayey gravel (possible fowl lime) and blue staining (possible spent oxide) were encountered in the top 2m bgl.
- Alluvium typically comprised dark brown slightly organic clay, with occasional bands of dark brown peat. Evidence of contamination (hydrocarbon odour and staining) was identified in Alluvium elsewhere on the SGN site to the south and west.
- RTD typically comprised pale grey gravelly sand or sandy gravel. Evidence of contamination, comprising black staining and odour was identified in a borehole (BH104) close to the northern access splay (between 7.6 to 8.5m bgl).

Groundwater levels were reported at depths greater than 4m bgl during drilling and at a typical level of -1mOD from standpipe response zones installed in the Alluvium and RTD. Perched groundwater was monitored at approximately 1.26mOD in one standpipe (BH205) adjacent to gasholder No. 1.

5.2.1. Ground contamination

Sampling of soils and groundwater has been undertaken close to the PRS works. During the 2016 investigation 50 soil and 25 groundwater samples were analysed for a broad suite of contaminants. The soil results identified high concentrations of PAH and TPH, predominantly in the aromatic ranges (>EC₁₂-EC₄₄), and locally lead, ammonia and cyanide. The highest concentrations were located away from the PRS works (in the south and west of the SGN land) and adjacent to the gasholder.

Asbestos was infrequently identified in soils (in two of 49 samples analysed from the wider investigation) in the form of ACM debris and loose fibres (possible lagging at a concentration of 0.0306%w/w) to the south of the gasholder.

A summary of the results near to the PRS works (north of gasholder No. 1) is presented below:

- Slightly higher concentrations of lead (643mg/kg), ammonia (66.7mg/kg), total PAH (653mg/kg) and TPH (1500mg/kg) were locally recorded in soil in the area; the highest levels were next to the gasholder.
- No asbestos was detected in soils analysed from north of the gasholder.
- Analysis of groundwater samples from the RTD identified elevated concentrations of ammonia (17.6mg/l), cyanide (3.4mg/l), TPH (>EC₅-EC₃₅) (1.6mg/l) and PAH (0.01mg/l) when compared against water quality standards.

Monitoring of hazardous ground gases from standpipes installed in the Made Ground, Alluvium and RTD (BH201-BH205, WS201-WS204, BH104 and BH106) identified typically low concentrations and low flow rates (maximum 0.4l/hr). Carbon dioxide was consistently <5%v/v. One standpipe (BH203 – Alluvium response zone) recorded elevated methane (max. 20.4%v/v) which was located immediately to the south east of the gasholder and approximately 50m south west of the PRS works area. Gas monitoring from standpipes within and immediately adjacent to the PRS works area (BH201, BH204 and BH205) did not detect any elevated hazardous ground gases.

6. Contamination risk assessment

The potential risks to human health and environmental receptors have been considered in accordance with the current UK approach to contaminated land assessment taking into consideration the available information on the construction and operational phases of the development.

The method for risk evaluation takes into consideration the magnitude of the potential severity of the risk as well as the probability of the risk occurring. The risk characterisations are assessed on a scale from very high to very low based on the CIRIA guidance C552⁷ and NHBC/EA/CIEH risk classification methodology⁸ as defined in Table 3. The full risk assessment methodology is described in Appendix A.

Table 3 Definition of risk classification

Risk classification	Description of risk
Very high	There is a high probability that severe harm could arise to a designated receptor from an identified pollutant linkage at the site without appropriate remediation action. OR there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in substantial liability.
High	Harm is likely to arise to a designated receptor from an identified pollutant linkage at the site without appropriate remediation action. Realisation of the risk is likely to present a substantial liability.
Moderate	It is possible that without appropriate remediation action harm could arise to a designated receptor from an identified pollutant linkage. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified pollutant linkage. It is likely that if any harm was realised, at worst any effects would be mild.
Very low	The presence of an identified pollutant linkage does not give rise to the potential to cause harm to a designated receptor.

6.1. Human health

The PRS works comprise near surface excavations for resurfacing, and shallow excavations for foundations and utilities (up to approximately 2.1m). Existing investigation data suggests that excavation will predominantly be in the Made Ground and may occasionally reach the Alluvium. Made Ground may, locally, contain visual evidence of contamination in the form of asbestos containing materials (ACM), spent oxides and hydrocarbons (staining and odour).

The soil analyses in the immediate area recorded elevated concentrations of lead and TPH, however the levels would not be regarded as posing an acute risk to construction workers providing good quality, standard industry level measures for a typical urban brownfield site are employed (see Section 7).

Low or very low concentrations of asbestos fibres were identified in the Made Ground in the wider area at a low frequency. The asbestos levels are typical of conditions observed on brownfield developments. In addition to appropriate personal protective equipment (PPE) and site hygiene procedures specific precautions will be taken to reduce potential exposure to asbestos fibres in accordance with the principle of 'as low as reasonably practicable' (ALARP) and in accordance with CAR-SOIL^{TM9} and CIRIA C733¹⁰ (see Section 7).

⁷ CIRIA C552 (2001), Contaminated land assessment – A guide to good practice, London

⁸ EA, NHBC & CIEH (2008), Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D66

⁹ CL: AIRE (2016), Control of Asbestos Regulations 2012, Interpretation for managing and working with asbestos in soil and construction and demolition materials, Industry guidance

¹⁰ CIRIA C733 (2014), Asbestos in Soil and Made Ground: A guide to understanding and managing risks

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It is considered that the risk to human health receptors during the works without enhanced mitigation are **moderate** (due to potential exposure to contaminated soil and asbestos fibres). Appropriate risk management measures will be adopted to reduce the risk of harm to human health receptors to very low.

On completion of the works the site condition will comprise hard standing (access splays and slab for the new gas governor). The site will be secured by new security fence. Human health receptors following completion of the works will be limited to future maintenance workers and the risk is assessed to be **low**. Appropriate mitigation to protect future maintenance workers by appropriate specification of backfill to utilities trenches is required (see Section 7).

6.2. Controlled waters

The excavations will be limited to the Made Ground and upper Alluvium and will therefore not interfere with the RTD aquifer and associated groundwater (controlled waters). The ground investigation indicates that locally perched groundwater may be encountered in the Made Ground. Provision for dealing with potentially contaminated perched groundwater is required (see Section 7).

The works are not anticipated to penetrate significant free product or mobile contamination, for example, excavation through the gas holder is not proposed. The nearby ground investigation has identified a potential for locally stained and odorous soils (hydrocarbon contaminants) however the concentrations in the immediate vicinity were relatively low.

Due to the limited depth and extent of excavation the risk potential for the utilities trenches to act as migration conduits for mobile contamination is assessed to be **low**.

6.3. Summary of residual risks

Table 4 outlines a summary of the risk assessment and the mitigation measures to be adopted as part of the remediation strategy and verification plan.

Table 4 Summary of contamination risks

Receptor	Risk characterisation	Control measures to be adopted (see remediation strategy)
Human health during construction (construction workers, neighbours and visitors to site)	Moderate (due to potential contaminants, including asbestos exposure, and ground gases)	Measures will need to be employed during construction to protect construction workers against contaminated soil and groundwater, to include good quality, standard industry level PPE and site hygiene procedures. Measures to mitigate the potential for loose asbestos fibres to be adopted in line with CAR-SOIL™. The appropriate site safety and control, particularly when working in confined spaces such as excavations (where workers could be exposed to ground gases), and asbestos mitigation measures will be adopted. A contamination watching brief and strategy for dealing with unexpected contamination should be implemented.
Human health during operation (future maintenance workers)	Low (contact with soil backfill to utilities trenches)	Backfilled soils should be uncontaminated and suitable for use and not present a risk to future workers. Works to be carried out in accordance with the general approach set out in the Greenwich Peninsula EMS.
Groundwater (RTD secondary A aquifer)	Low (migration of mobile contamination)	The excavation will be limited to shallow soils above the groundwater table. Perched groundwater may be encountered, which may be contaminated and a strategy for dealing with perched groundwater will be required. Design of service corridors will limit migration of contamination. A contamination watching brief and strategy for dealing with unexpected contamination will be implemented.

7. Remediation strategy

This remediation strategy has been developed to address the potential contamination risks identified by the risk assessment. It sets out the approach to remediation and includes a verification plan to address DCO requirement 17 (part 3). The strategy considers that the post-development ground conditions must be suitable for use and will not meet the definition of “contaminated land” under Part 2A of the Environmental Protection Act 1990, as required by the DCO.

7.1. General requirements

The Greenwich Peninsula EMS forms part of an Integrated Management System (IMS) for the redevelopment of Greenwich Peninsula. The general approach set out in the Greenwich Peninsula EMS - Volume 2 Code of Practice (EMS COP) will be adopted to mitigate the risk posed from ground contamination. EMS-COP-07 refers to Underground Services and Drainage, the general requirements are summarised below.

- Any ‘hotspots’ of gross contamination encountered in the works will be excavated and disposed offsite or treated. This should be undertaken where hotspots fall within the excavation envelope. It is not proposed to excavate (chase out) contaminated ground.
- Underground services will be laid in clean service corridors with, where necessary, a liner to restrict cross-contamination by the surrounding ground and measures to control potential lateral migration of contaminated perched groundwater (only if encountered).
- Rainfall infiltration into the ground (which could cause the build-up of contaminated perched water) should be minimised by the provision of impermeable landscaping, piped surface water drainage, and soft landscaping under-drainage.
- Validation and monitoring of all works.

It is to be confirmed whether the scheme will comply with the permit to dig system requiring agreement of a series of works method statements for design and construction (WMS(D) and WMS(C)). These are required to be submitted to the Greenwich EMCo for approval and the WMS(D) is also subject to the approval of the Greater London Authority (GLA) EMS consultant. Ground works cannot commence without the EMCo and EMS consultant’s agreement.

7.2. Site safety and control

The works should be undertaken in compliance with the general site safety and control requirements in the Code of Construction Practice (CoCP) and Construction Environmental Management Plan (CEMP) for the project. Measures should be in place for the protection of construction workers (health and safety) and adjacent site users during groundworks, due to potential for high concentrations of organic contamination (hydrocarbons) in soil and groundwater, and asbestos in the Made Ground. Site safety and control measures are outlined below.

- Adoption of best practice construction guidance, such as CIRIA R132 ‘A guide for safe working on contaminated sites’ should be implemented, to include the adoption of hygiene protocols and provision of appropriate welfare facilities, personal protective equipment (PPE), minimisation of dust and particulate generation and tracking of dirt (especially offsite) and safe methods for confined space working.
- Sufficient hygiene units and PPE should be provided for the works. Suitably competent personnel should advise on and supervise the works and all staff should be briefed on the working methods.
- Atmospheric monitoring of excavations should be carried out to confirm a safe working atmosphere and absence of flammable / explosive gases. No one should enter excavations until it is confirmed safe.
- The contractor is responsible for preparation of contractor specific documentation, such as method statements, risk assessments, health and safety plans and construction phase plans, undertaking as required toolbox talks and site inductions.
- The works should be undertaken in a fashion to prevent the creation of dusts and hence prevent fibre release and dust emissions. All Made Ground should be kept damp when being handled or when exposed at the surface to minimise the release of fugitive dust. Dust prevention should be proactive with measures in place before work commences, and surfaces wetted before and during excavation works as necessary.

Mitigation measures may be localised, using hoses or bowsers, or over a wider area using misting sprays or boundary spray installations.

- Low concentrations of asbestos were identified at low frequency within the area (detected in only two of 49 soil samples tested). The requirements described in the Control of Asbestos Regulation (CAR) 2012 will be followed where they apply. CAR-SOIL™ confirms that all work with asbestos in soil should be carried out under a 'plan of work' and defines the contents of that plan. Based on soil description from ground investigation there was limited visual identification of asbestos. Excavations should be undertaken under a watching brief by an asbestos specialist (Section 7.5). Should pieces of ACM or particular asbestos hotspots be encountered, these should be segregated, stored and disposed of where practical to do so.
- Some materials to be excavated (soils and any perched groundwater) may have organic odours and volatiles associated with them. These conditions should be proactively identified under the watching brief (Section 7.5) and strategy in the event of encountering contamination. Odour suppression may be required, using mist sprays of neutralising additives.

7.3. Pollution prevention

To prevent additional land and groundwater contamination the scheme should adhere to Environment Agency Pollution Prevention Guidelines. The pollution prevention measures listed in the CoCP and summarised below.

- Provision of wheel washing facilities and defined clean down areas for vehicles and equipment.
- Regular cleaning of site access points.
- Defined access routes and haul roads for onsite vehicles.
- Defined areas for loading and unloading of plant and materials.
- Defined areas for the storage of plant and materials used during construction.
- Production of and adherence to an emergency spill response plan (as part of the Emergency Plan), and ready availability of associated equipment and materials.
- Sediment control measures (to be compliant with the Site Waste Management Plan).

7.4. Excavation and materials management

Robust material and waste management procedures should be adopted, ensuring that all necessary permits and waste documentation are compliant with the relevant regulations and guidance. Testing of the soil arisings should be undertaken to classify the material for waste disposal, or for reuse as backfill to utility trenches. Backfill to service corridors should be undertaken using certified 'clean' site arising materials as fill wherever possible. This material should be tested to prove it passes the relevant Soil Quality Criteria, as defined in the Remediation Strategy Framework Report.

Any stockpiles of soils arising from construction should be appropriately managed to prevent the spread of material and potential cross contamination.

If perched groundwater is encountered during the excavation works, groundwater should be pumped from the excavation. The groundwater should be tested to confirm the approach for discharge or disposal.

7.5. Contamination watching brief

There is a possibility that previously unidentified contamination may be encountered within soils and perched groundwater during excavation works. A watching brief for ground contamination will be maintained. If visually contaminated or odorous material is encountered during the works, the assistance of a suitably qualified and experienced person (a geo-environmental engineer) will be sought. The watching brief will include special consideration to identify potential asbestos containing materials or loose fibres within soils.

Site inspections will be conducted and recorded during the works. These should include, but not necessarily limited to:

- confirmation that the works are being implemented in line with approved strategies and method statements;

- observing weather conditions at the site (e.g. heavy rainfall with tracking of mud and surface water runoff or windy, dry conditions leading to airborne dust);
- inspection of the site haul roads and site exit and roads in the surrounding area for mud;
- detailing any environmental control measures implemented (e.g. dust suppression, road cleaning and inspection of vehicles);
- checking for potential evidence of spills and leaks for example from any refuelling and storage and to confirm that the appropriate spill kits are being maintained on site;
- inspections of any soil stockpiles and dewatering works to confirm that any associated pollution control measures are effective;
- identifying evidence of any pollution at the site boundary (e.g. dust or odours);
- undertaking inspections for potential visual and/or olfactory indicators of contamination (and recording any actions taken), for example:
 - oil staining, black liquids, tars and unusual colours;
 - odours, such as hydrocarbons and solvents;
 - buried tanks, drums or structures;
 - bulk asbestos containing material; the absence of any obvious visual evidence of asbestos does not mean that the soil is free from asbestos contamination; and
- maintaining a record and confirmation of all waste disposal movements and ensuring that all associated documentation is correctly completed.

If previously unidentified areas of potential contamination such as hydrocarbon impacted soils (black or other coloured staining, odours, etc.), coloured soils, unusual odours (sweet, organic, solvents, acidic, sulphurous or acrid) or ACM (sheeting, lagging, fibrous, materials, gaskets, paper, rope, etc.) are encountered the following steps will be taken:

- an appointed specialist will be consulted;
- soil will either be sampled in-situ in the ground (and left undisturbed while the samples are tested, and the results interpreted) or be excavated and stockpiled separately in an appropriate manner (i.e. banded and covered stockpile); and
- measures will be taken to restrict dust and surface water run-off. On receipt of the results, soils should be disposed off-site to a suitable licensed treatment facility or landfill.

Sampling will be undertaken by suitably qualified and experienced personnel. The laboratory chemical analysis will be undertaken in accordance with MCERTS and UKAS validated methods. Onsite testing may be used to supplement any laboratory testing and a strategy for undertaking such work will be agreed in advance.

7.6. Verification plan

The DCO requires that the remediation strategy is implemented as part of the authorised development and a verification report prepared, based on the data collected as part of the remediation strategy (Requirement 17 (parts 4 and 5)). The requirements for verification are set out in this verification plan.

The verification report will demonstrate that the remediation has been successfully implemented and will be based on documentary evidence produced and maintained onsite during the works. The verification report will consist of the items outlined below:

General:

- details of the various parties involved in the work;
- a summary of the original site conditions with reference to relevant reports including a summary of the risk assessment(s) for the site;
- a description of the verification plan including methods of data collection and interpretation;
- colour photographs of key stages of the development work;
- details of all communications held with the Environment Agency, RBG contaminated land office and other regulatory bodies during implementation (if undertaken); and
- supporting information, such as health and safety and quality management documentation.

Materials management:

- a summary of the waste sampling and testing exercise to be undertaken to inform the classification of soil arisings generated for offsite disposal (records to include plan showing the sample locations, logs and testing reports);
- laboratory and in-situ test validation results for soil reused in the scheme and for imported soils (backfill to utility trenches); and
- a summary of volumes and characteristics of material handled in accordance with waste Duty of Care, waste consignment notes, compliance with permit requirements, discharge consents.

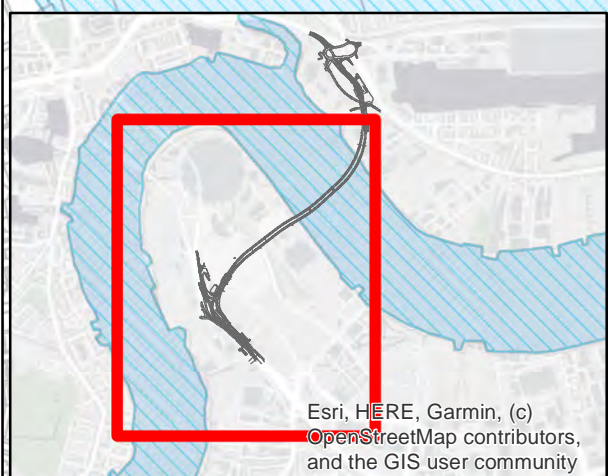
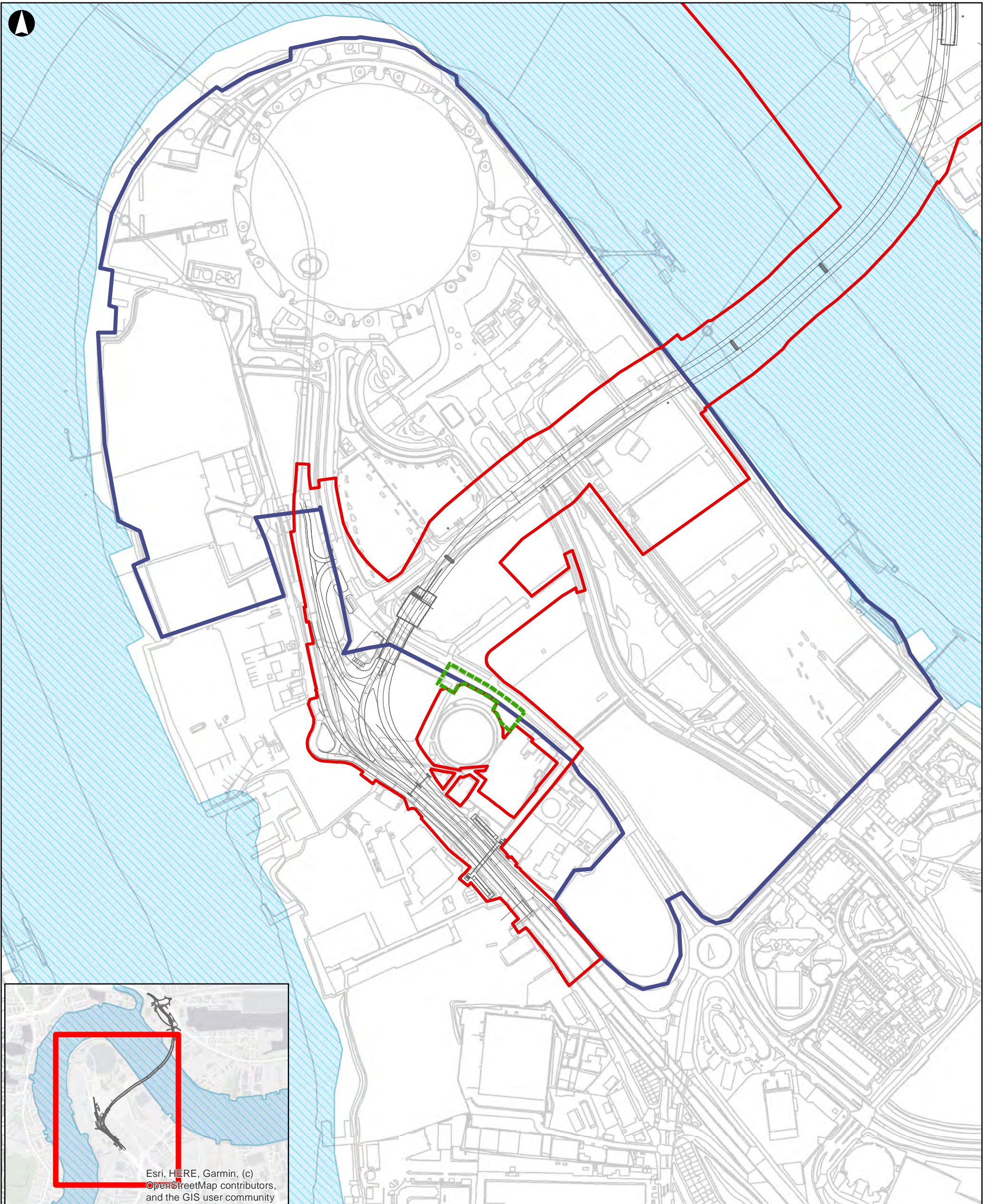
Contamination watching brief:

- details of any unexpected contamination encountered, and the actions taken.

Drawings

Drawing 1 Location of PRS supplementary works

Drawing 2 Exploratory hole location plan



- Legend**
- Silvertown Tunnel alignment
 - DCO boundary
 - Greenwich EMS boundary
 - PRS boundary

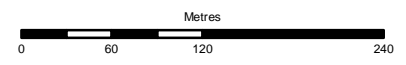
F1	2020-04-03	CN	JW	NB
Issue	Date	By	Chkd	Appd

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Client
RiverLinx CJV

Job Title
Silvertown Tunnel



Location of PRS supplementary works

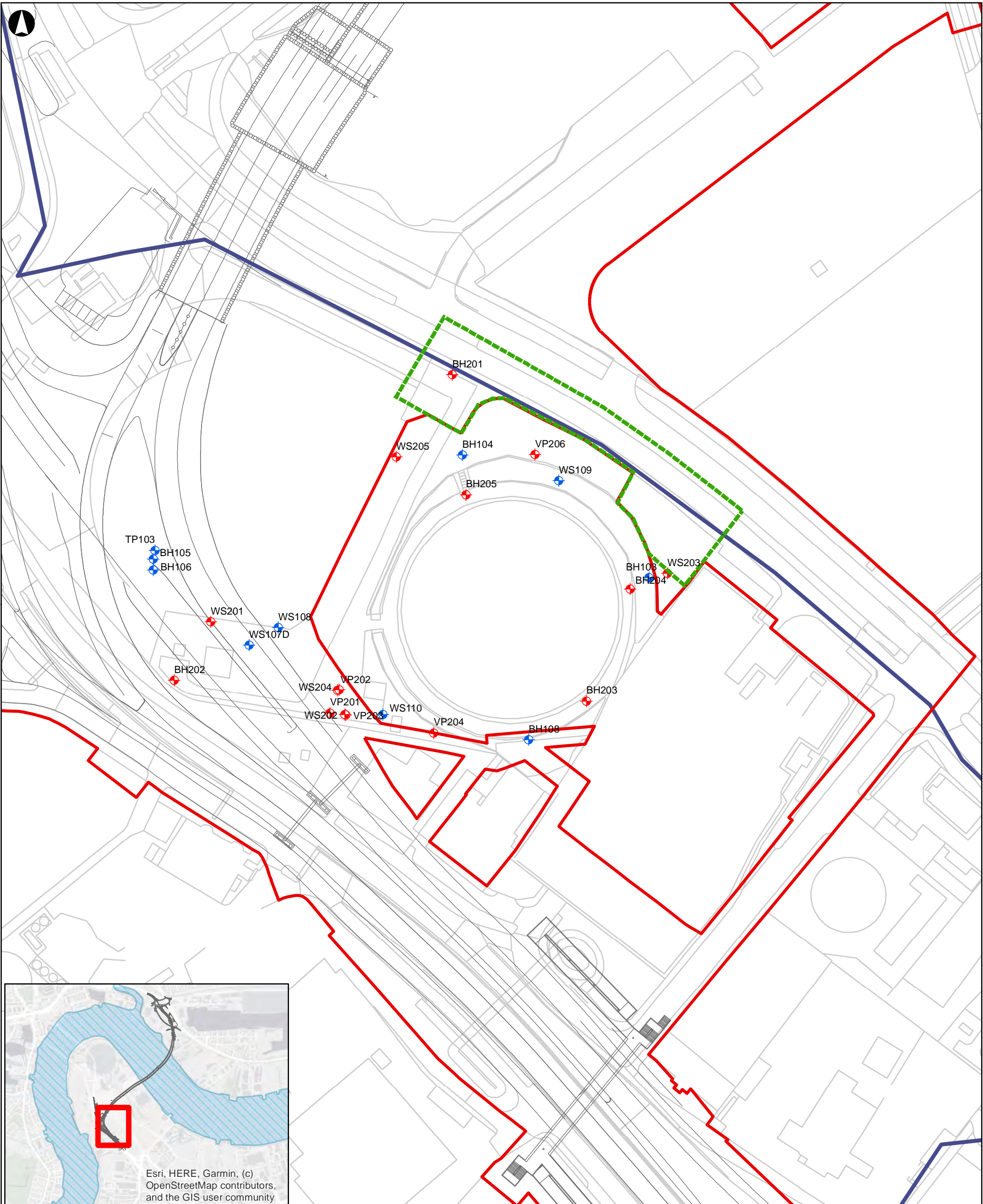
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Drawing Status
For Issue

Drawing No
Drawing 1

Issue
F1



<p>Legend</p> <ul style="list-style-type: none"> Silvertown Tunnel alignment DCO boundary Greenwich EMS boundary PRS boundary <p>GI Phase</p> <ul style="list-style-type: none"> 2003 2016 		<p>ARUP</p> <p>13 Fitzroy Street London W1T 4BQ Tel +44 20 7636 1531 Fax +44 20 7580 3924 www.arup.com</p> <hr/> <p>Client RiverLinx CJV</p> <hr/> <p>Job Title Silvertown Tunnel</p>		<p style="text-align: right;">Metres</p> <p>0 15 30 60</p> <p style="text-align: center;">Exploratory hole location plan</p> <p>Scale at A3 1:1,250</p> <hr/> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Job No 255415</td> <td style="width: 50%;">Drawing Status For Issue</td> </tr> <tr> <td>Drawing No Drawing 2</td> <td>Issue F1</td> </tr> </table>		Job No 255415	Drawing Status For Issue	Drawing No Drawing 2	Issue F1								
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Appendix A Risk assessment methodology

The potential risks to human health and environmental receptors have been considered in accordance with the current UK approach to contaminated land assessment taking into consideration the available information on the construction and operational phases of the development.

The method for risk evaluation takes into consideration the magnitude of the potential severity of the risk as well as the probability of the risk occurring. The risk characterisations have been assessed based on the qualitative method of interpretation set out in CIRIA guidance C552 and NHBC/EA/CIEH risk classification methodology. The method for risk evaluation involves the classification of the:

- magnitude of the potential consequence (severity) of the risk occurring (refer to Table A1-1); and
- magnitude of the probability (likelihood) of the risk occurring (refer to Table A1-2).

Table A1-1 Classification of consequence

Classification	Definition
Severe	Short-term (acute) risk to human health likely to result in 'significant harm' as defined by the Environmental Protection Act 1990, Part IIA. Short-term risk of pollution of a sensitive water resource. Catastrophic damage to buildings or property. A short-term risk to an ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health. Pollution of a sensitive water resource. A significant change to an ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of a non-sensitive water resource, such as non-classified groundwater. Damage to buildings, structures and services.
Minor	Harm, which may result in a financial loss, or expenditure to resolve. Non-permanent effects to human health, which could easily be prevented by means such as personal protective clothing. Easily repairable effects of damage to buildings, structures and services.

Table A1-3 presents the risk assessment matrix and Table A1-4 defines the risk classifications.

Table A1-2 Classification of probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible over the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is not certain that such an event would take place.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

Table A1-3 Comparison of consequence against probability

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High likelihood	Very high risk	High risk	Moderate risk	Moderate / low risk
	Likely	High risk	Moderate risk	Moderate / low risk	Low risk
	Low likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
	Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

Table A1-4 Risk classification

Risk classification	Description of risk
Very high	There is a high probability that severe harm could arise to a designated receptor from an identified pollutant linkage at the site without appropriate remediation action. OR there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in substantial liability.
High	Harm is likely to arise to a designated receptor from an identified pollutant linkage at the site without appropriate remediation action. Realisation of the risk is likely to present a substantial liability.
Moderate	It is possible that without appropriate remediation action harm could arise to a designated receptor from an identified pollutant linkage. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
Low	It is possible that harm could arise to a designated receptor from an identified pollutant linkage. It is likely that if any harm was realised, at worst any effects would be mild.
Very low	The presence of an identified pollutant linkage does not give rise to the potential to cause harm to a designated receptor.