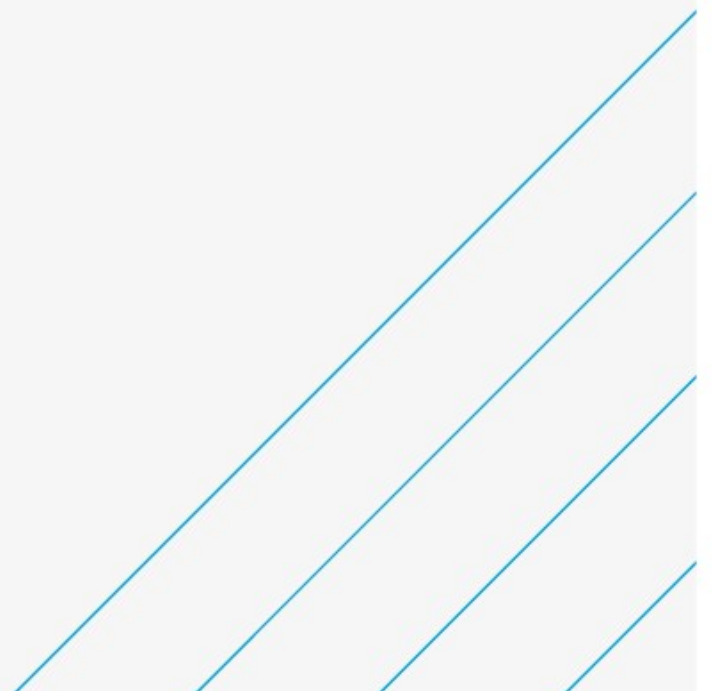


NGET Arriva Bus Depot, Tottenham (8021)

Factual Site Investigation Report
National Grid Property Holdings

January 2024



Notice

This document and its contents have been prepared and are intended solely as information for National Grid Property Holdings (NGPH) and National Grid Electricity Transmission plc (NGET) use in relation to providing an environmental investigation for the NGET Non-Operational Land at the Former Bus Depot located at Leaside Road, Tottenham, London, N17 0SG (herein referred to as 'the site').

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1. Introduction

1.1. General

Atkins Limited (Atkins) was commissioned by National Grid Property Holdings Limited (NGPH), on behalf of National Grid Electricity Transmission plc (NGET), to undertake an intrusive site investigation of their NGET Non-Operational Land at Former Bus Depot, Leaside Road, Tottenham, London, N17 0SG (herein referred to as 'the site'). A site location plan is included as Figure 1.

This report presents the factual findings of the Atkins' 2023 intrusive site investigation and has been produced in accordance with Atkins' Offer of Services [1] dated 16 March 2023.

1.2. Background

The site is located off Leaside Road, Tottenham, London, N17 0SG and situated in the north-east of the Mowlem Trading Estate, approximately 1.5 km to the east of Tottenham.

The site comprises Non-Operational NGET-owned Land, which was formerly leased to Arriva for use as a bus depot, and currently comprises a builder's merchants, steel fabricator and logistics yard. The site is included in the National Grid site registry as the 'Former Bus Depot' referring to the former site usage.

It is understood that the lease on the site is ending in early 2024 to allow for an upgrade to the existing substation adjacent to the east and south, from 275kV to 400kV. This redevelopment forms part of the North London Reinforcement Project (NLRP), comprising five sites collectively named the Hackney - Waltham Cross 275kV to 400kV Upgrading (HWUP) scheme.

This document is to be submitted to partially discharge Requirement 11 of the North London Reinforcement Development Consent Order (DCO) (2014 No. 1052) for Stage 3a of the development works.

Stage 3a of the works constitutes the preparatory stages of work to clear the site and demolish the on-site structures, to enable Stages 3b and 4 to take place, that comprises the construction of the infrastructure to upgrade the adjacent substation.

The proposed upgrade works on site, and beneath Tottenham Marshes to the east, comprise the construction of underground cables and a cable sealing end compound in the north-east of the site.

1.3. Objectives and Scope of Works

The objective of the investigation and subsequent reporting is to provide information on the current conditions of the site with respect to land contamination from on-site land uses.

The scope of works of the investigation detailed herein is as follows:

- up to date statutory service plans were obtained for the site;
- site attendance by Atkins Lead Engineer to the Initial Site Visit (ISV) and the undertaking of a survey of the historical wells within the Bus Depot site (completed 2 March 2023);
- completion of a detailed unexploded ordnance (UXO) survey to determine if UXO oversight was required during the site investigation;
- service assessment of 3 locations. Prior to excavation, the locations were assessed by a specialist service location subcontractor, using a Cable Avoidance Tool (CAT), generator (genny) and ground penetrating radar (GPR);
- vacuum excavation (where accessible) of 3 inspection pits to 1.5 m below ground level (m bgl) for mechanical boring follow-on in up to three locations (BH23-03 to BH23-05), assessment of ground conditions, in-situ testing using a Photo-ionisation Detector (PiD) and collection of soil samples;
- drilling of one rotary percussive borehole (BH23-04) to a depth of 5.70 m bgl to intercept the perched or superficial groundwater aquifer (regionally recorded between 2 to 3 m bgl);
- laboratory analysis of soil and soil-leachate samples at a United Kingdom Accreditation Service (UKAS) and Monitoring Certification Scheme (MCERTS) accredited laboratory.
- topographic survey of the three sampling locations (BH23-03, BH23-04 and BH23-05);

- three monitoring rounds collecting groundwater samples using low-flow sampling techniques (peristaltic pump) from 16 existing groundwater monitoring wells (BH11B, BH12, BH12-01, BH21-2D, BH21-03, BH21-04, BH21-05, BH21-06, WS12-01, WS12-02, WS12-03, WS12-04, WS12-05, WS12-06, WS12-07, WS12-08), and three newly installed boreholes / hand pits (BH23-03, BH23-04 and BH23-05);
- Dense non-aqueous phase liquids (DNAPL) drawdown testing during the third monitoring round undertaken in two of the historical boreholes where DNAPL was previously identified (BH11B and BH12-01);
- hydraulic conductivity testing was undertaken in BH23-04 monitoring well only;
- laboratory analysis of groundwater samples was undertaken using the National Grid (NG) water suite;
- removal of waste soils and groundwater generated during works to a licensed facility using a licensed haulier; and
- surface water sampling in Pymmes Brook; laboratory analysis of surface water samples at a UKAS and MCERTS accredited laboratory.

1.4. Data Sources

This report incorporates factual information from the following sources:

- UK Government and Environment Agency (EA) website, accessed in June 2023 [2]
- Groundsure Report (Ref: GS-8497006, 04 February 2022) [3]; Appendix H
- WorleyParsons. Environmental Assessment, Factual Site Investigation, Arriva Bus Depot, Tottenham, April 2013. Ref 51576-00; [4]
- Geological maps from the British Geological Survey (BGS) website, accessed in May and June 2023 [5]
- WorleyParsons. Geotechnical and Environmental Assessment Site Investigation Factual Report. Proposed Cable Route, Tottenham, 1 August 2013. Ref: 305008-00018 51603-00 [6]
- UXO desk study and risk assessment. [7]

1.5. Assumptions and Limitations

While it is considered that the site investigation conducted is adequate to meet the objectives stated in Section 1.3 and as defined by Atkins' Offer of Services, due to site constraints there is still the potential for unidentified issues to be present on-site, such as localised areas of contamination, or additional contaminants not analysed for as part of the site investigation.

The report draws upon data from the intrusive investigation and monitoring of a relatively small proportion of the sub-surface site conditions, including but not limited to where access was constrained by site constraints including site traffic, the presence of site buildings, above and below-ground services and infrastructure associated with the adjacent operational electricity substation. Inferences drawn from these assessments are subject to the inherent limitations of any such study.

Historical plans for the site referred to by WorleyParsons [6] have not been provided to Atkins and therefore the locations of certain historical features that have been digitised should not be relied upon.

This report is prepared and written in the context of an agreed scope of works and should not be used in a different context. Furthermore, new information, improved practices and changes in legislation may necessitate the re-interpretation of the report in whole, or in part, after its original submission.

2. Site Information

2.1. Location

The site is located off Leaside Road, Tottenham, north London, N17 0SG and situated in the north-east of the Mowlem Trading Estate, approximately 1.5 km east of Tottenham centre and located approximately 300 m east of the Tottenham Reservoirs at Ordnance Survey (OS) National Grid Reference: 535413E, 191516N.

The average elevation of the site is 10 metres above ordnance datum (m AOD), with the topography of the land being generally flat with minor localised dips. A site location plan is presented as Figure 1.

2.2. Current Site Layout

The site is accessed from Leaside Road, north-east of the Mowlem Trading Estate. The site covers an area of 1.21 hectares (ha) of non-operational land within a rectangular parcel of land. The boundary of the site is secure and comprises an approximately 2.5 m high steel palisade fence with access via a double steel palisade gate from Leaside Road. There are a variety of internal palisade fences throughout the site to segregate current operations.

The site includes several active commercial units housed within a two-storey, rectangular, brick building, with steel cladding exterior and an adjacent concrete/tarmac storage yard. Within the site boundary there is a small brick structure that appears to be a maintenance/security hut. Historically the site had been used as a bus depot.

The site is leased from National Grid to J O'Doherty Group that uses the southern third of the site for the storage/parking of empty waste skips, vehicles, trailers and storage of tonne-bags of aggregates. J O'Doherty Group sub-let the northern two thirds of the site to three businesses. A small portion of the north-west of the site and a small portion of the main bus depot building (labelled Commercial Building on Figure 2) is sub-leased by L. Jeffery, a roofing contractor. The majority of the northern two-thirds of the main building and two yard areas are sub-leased to Build It Limited which is a builders merchants. Build It Ltd use the lower floor of the building for trade and the upper level is used as office space/storage. The yard areas are used for materials storage and parking. The southern third of the building and some adjacent yard space is sub-let to Lomas Steel Structures Limited for metal fabrication.

The inaugural site visit (ISV) completed by Atkins on 2 March 2023 noted that the former Arriva bus depot main building now houses a number of commercial premises, with the surrounding yard area also used for storage of vehicles, skips, and waste materials. No electricity transmission infrastructure is present on-site, however, the site is directly adjacent to the active substation. No fuel storage tanks were present at the time of the walkover.

High voltage overhead cables are present in the land immediately to the east.

A site layout plan is presented as Figure 2.

2.3. Ground Cover

The majority of the site is covered in concrete hardstanding or buildings / structures. Minor vegetative growth, comprising grasses and shrubs is present and there is no evidence of any invasive species around the site boundary. A summary of ground cover is presented in Table 2-1. In areas of gravel or vegetation the ground cover is assumed to be permeable, whereas areas of hardstanding are assumed to be impermeable.

Table 2-1 – Summary of Ground Cover

Total Site Area:	1.21 ha (approximately)
Type	% Area (approximately)
Concrete Hardstanding	80
Buildings	20

2.4. Perimeter and Site Boundary Details

Boundary and adjacent land use information is provided in Table 2-2 below.

Table 2-2 – Summary of Site Boundary and Adjacent Land Uses

Orientation from Site	North	East	South	West
Description*	Metal palisade fencing	Metal palisade fencing	Metal palisade fencing	Metal palisade fencing
Height (m)	2.5	2.5	2.5	2.5
Approximate length (m)	30	220	30	250
Adjacent land use	Former gasholder site, currently used for temporary car parking	NGET transmission station, overhead cable towers.	Tottenham Marsh Electricity Transformer Station	Mowlem Trading Estate – various commercial/industrial units off Leaside Road
Total site perimeter (m)		530 (approximate)		

2.5. Services

A review of service drawings was undertaken prior to the start of the site investigation and a number of services were identified adjacent to and within the site boundary. These include:

- BT telecommunications, entering the site from Leaside Road to the north-east and orientated in several different directions between the rectangular building and the centre western site boundary of the site. This service then crosses the site area and runs along the western site boundary, exiting site at the south-west corner.
- A surface drain enters the site from Leaside Road crossing the northern boundary in a north-east to south-east orientation, exiting the site at the eastern boundary.

The service plans as provided by the utility companies are presented in Appendix A and a combined service plan is presented as Figure 4. Measures taken to avoid damage to below-ground services during the site investigation are detailed in Section 3.2.2.

Drainage plans held within the site office were inspected by the Atkins Project Manager during the ISV.

2.6. Previous Site Investigations

A review of the historical investigations undertaken at the site are detailed in the following sections. Exploratory holes excavated by RSK in 2008 are present on site but Atkins has not been provided with the supporting ground investigation reports.

2.6.1. WorleyParsons. Environmental Assessment, Factual Site Investigation, Arriva Bus Depot, Tottenham, April 2013 Ref 51576-00

WorleyParsons was instructed by NGPH on behalf of NGET in 2013 to conduct an environmental assessment of site to provide information regarding environmental risks from potentially contaminated soil and groundwater.

The intrusive site investigation comprised:

- 14 boreholes; six of which were undertaken by combined percussive sampling/rotary coring, and eight by a window sampler.

Ground conditions found comprised Made Ground overlying superficial deposits of Alluvium and Kempton Park Gravels. Underlying the superficial deposits, the bedrock geology of the London Clay Formation was encountered.

Of the 14 boreholes, 12 were installed as groundwater monitoring wells. The six percussive/rotary boreholes were installed in the Kempton Park Gravels, and six of the window sampler boreholes were installed in Made Ground.

A summary of the ground conditions encountered during the 2013 site investigation by WorleyParsons is included in Table 2-3.

Table 2-3 - Ground Conditions Summary, WorleyParsons April 2013

Strata	Depth (m bgl)	Description	Contamination Reported
Made Ground	0.0 - 4.0	Gravelly sands with fine to coarse, subangular to subrounded gravel of concrete, brick, chalk, and sandstone, with glass, wood, slag, and clinker	Tar staining and hydrocarbon odours were noted, with possible asbestos containing materials (ACMs), including staining and odours at exploratory locations BH12-02D, BH12-06, WS12-07 and WS12-02
Alluvium	1.2 - 5.5	Soft to very stiff brown/grey silt and clay with some sand and gravel	Tar and hydrocarbon odours were noted between 1.9 – 5.0 m bgl at several locations including WS12-02
Kempton Park Gravels	3.8 - 6.5	Grey and brown sandy gravel with silt. Gravels consisted of fine to coarse, angular to rounded flint, quartz, and sandstone in a sandy matrix	Hydrocarbon odours and black staining were observed in some locations including WS12-02
London Clay Formation	6.5 – 8.0*	Soft to stiff greyish brown fissured clay	No contamination observations reported.

*the base of the London Clay Formation was not proven

Surface water levels were measured as part of a topographic survey, with Pymmes Brook found at 7.35 m AOD, River Lea Navigation Canal at 10.07 m AOD, and the River Lea at 7.0 m AOD.

Groundwater was encountered between 0.86 m bgl and 1.6 m bgl in Made Ground, and between 2.25 m and 3.96 m bgl in the Kempton Park Gravels.

DNAPL was observed in the wells in the south of the site (thickness of approximately 0.4 m in BH12-03, and thickness of approximately 1.5 m in BH12-01). Light non-aqueous phase liquids (LNAPL) was also observed.

The 2013 report also states that generally groundwater elevations were found to be highest at the south of the site and lowest at the north.

In total 18 soil samples were submitted for asbestos screening analysis, with 13 samples found to contain chrysotile fibres, 11 contained amosite and one sample contained anthophyllite. No asbestos quantification testing was completed. During site investigation potential ACM was noted in BH12-02B and BH12-02C.

The summary of soil and groundwater chemical analysis indicates that high concentrations of contaminants encountered at the site, several analyses could not be performed under UKAS. This was stated by WorleyParsons in their report to be due to reasons including asbestos containing materials within the sample, results coming in outside of calibration due to high concentrations and requirements for significant dilutions.

The historical features plan indicates the presence of a suspected underground storage tank (UST). It is stated in the report that the age and condition of this tank is not known. As the source historical map provided by National Grid has not been provided and WorleyParsons did not encounter the tank during their targeted ground investigations in the vicinity, exact details on the location of the tank are unknown. It has not been possible to ascertain whether the former tank was underground or above ground.

2.6.2. WorleyParsons. Geotechnical and Environmental Assessment Site Investigation Factual Report. Proposed Cable Route, Tottenham, 1 August 2013. Ref: 305008-00018 51603-00

WorleyParsons were commissioned by National Grid to carry out a geotechnical and environmental site investigation at the site in August 2013. The objective of the site investigation was to obtain factual

geotechnical and environmental data in the vicinity of a proposed new high voltage cable route at locations specified by National Grid to assist with geotechnical design and environmental assessment.

The intrusive site investigation comprised:

- 11 boreholes drilled using rotary and percussive drilling techniques. All of the boreholes progressed through the superficial deposits and into the London Clay Formation. One borehole was progressed through the London Clay Formation into the Lambeth Group. All of the boreholes were installed as groundwater monitoring wells with response zones in the River Terrace Deposits (RTD);
- ten hand dug pits were completed for the purposes of in-situ thermal resistivity testing. A further eighteen pits were completed in order to undertake repeat testing in locations where thermal resistivity exceeded the threshold value;
- two rounds of groundwater monitoring and groundwater sampling were undertaken;
- chemical analysis of 34 soil samples obtained from boreholes and four soils samples obtained from hand pits;
- chemical analysis of 19 groundwater samples (including duplicates) collected from installed monitoring wells across two monitoring rounds.

A summary of the ground conditions encountered by WorleyParsons during their August 2013 site investigation within the extents of the site are included in Table 2-4 (BH11 and BH12).

Table 2-4 - Ground Conditions Summary. WorleyParsons August 2013

Strata	Depth (m bgl)	Description	Contamination Reported
Made Ground	0.0 – 3.40	Clayey sands and gravels containing brick concrete, flints, clinker, ash and other debris	Slight hydrocarbon odour reported.
Alluvium	1.20 – 4.70	Soft to firm organic clay with occasional bands of peat or sand.	Hydrocarbon odour reported.
Kempton Park Gravels	4.20 – 6.40	Sandy flint gravel interspersed with layers of gravelly sand, silt and occasionally thin bands of silty clay	Oily sheen on gravels and hydrocarbon odour reported.
London Clay Formation	6.40 – 15.60*	Firm to very stiff clay, with occasional fine sand	A slight hydrocarbon odour was noted in BH12 from 8.3 m bgl.

*the base of the London Clay Formation was not proven.

Evidence of Non-Aqueous Phase Liquid (NAPL) was observed at five of the eleven locations (across the site and the wider area) within the River Terrace Deposits as an oily sheen. Measured PiD concentrations in wells included maximum values of 566.8 ppm in BH8, 2,506 ppm in BH10 and 1,757 ppm in BH12.

Return monitoring visits recorded approximately 0.4 m thickness of DNAPL in the base of BH11 and 0.25 m thickness of LNAPL present in BH10.

2.7. Site History

The following summary is based on a review of the information provided within the Groundsure report [3]. A historical features plan is provided as Figure 3.

2.7.1. On-site Development

The earliest available historical map from 1872-1873 shows that the site was predominately undeveloped land. There were no significant changes until 1955. By 1955 – 1956, a pond is shown to be present in the south of

the site. By 1967, buildings are shown in the north-west corner of the site and a square pond in the southern half of the site is present, to the north of the southernmost pond. An extract of the 1967 OS 1:1,250 map is presented below in Figure 2-1.

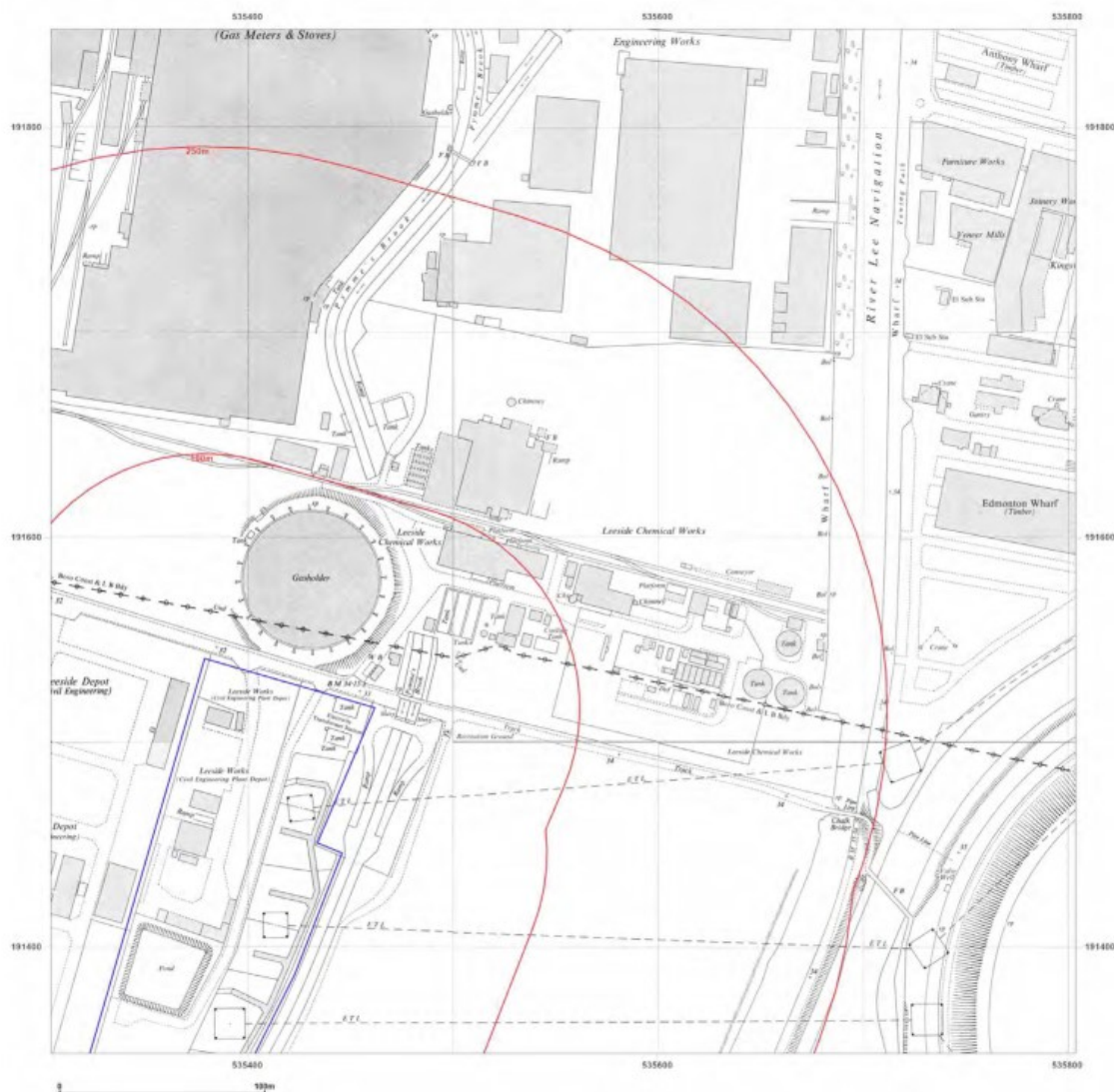


Figure 2-1 - 1967 OS Map 1:2,000 Extract (blue line is not representative of the site boundary for this report) (Groundsure, 2023) [3]

Between 1967 and 1981 the buildings in the north-west corner were demolished and a large rectangular building was constructed in the north-east corner. Several smaller rectangular buildings appeared along the eastern boundary and centre of the site, and the ponds are no longer present on-site, and are assumed to have been infilled.

There were no significant changes to the site area between 1981 and 1991.

Between 1991 and 2001, all previous buildings have been demolished and a long rectangular building was constructed in the north-east corner of the site. An above ground tank was shown to the south of this building and a small rectangular feature along the western site boundary.

The 2003 OS map presented in Figure 2-2 for the site (1:1,250) indicates that there is a tank located in the central eastern extent of the site, to the south of the main building. It is stated in the WorleyParsons report [4] that there was a UST located in this position; however, it has not been possible to establish whether the tank is underground or above ground.

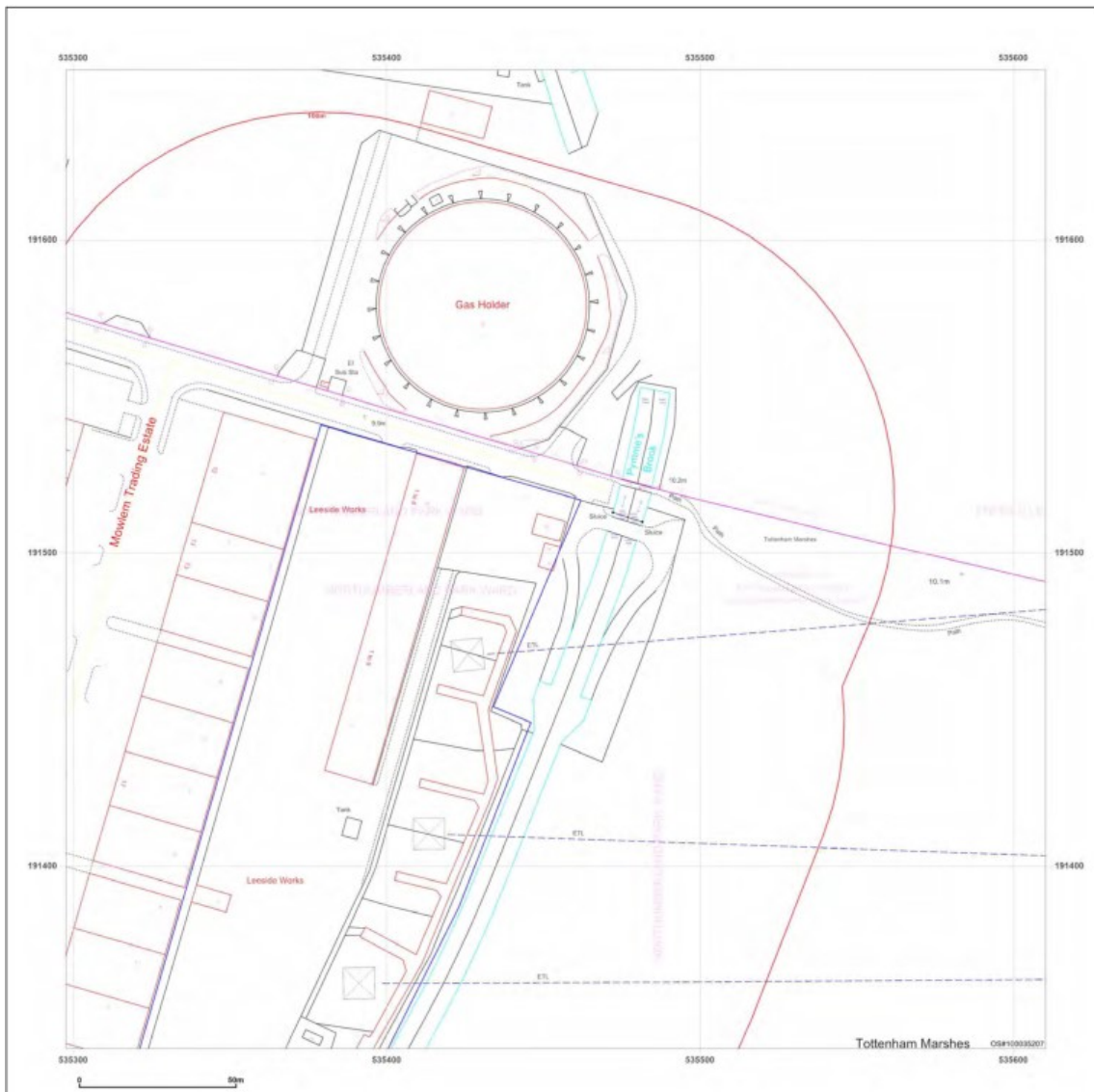


Figure 2-2 - 2003 OS Map 1:1,250 Extract (Groundsure, 2023) [3]

No significant changes are shown on historical mapping on-site between 2001 to the present day, however the above ground tank to the south of the main building appears to have been removed. It is understood that the site was used as a bus depot until circa 2016.

2.7.2. Off-site Development

The historical maps available from circa 1868 to 1920 show the adjacent site area mainly to be undeveloped open fields.

The 1872-1873 OS plan shows an un-named brook along the east boundary of the site (later mapped as Pymmes Brook). The Lea Navigation (River Lea) is located approximately 260 m east of the site, parallel with the brook. A rifle range is located between the brook and the Lea Navigation. The Great Eastern Railway is mapped approximately 350 m west of site running a north-north-east to south-south-west orientation.

Tottenham and Edmonton Gasworks (TEGW), including several tanks and gasholders is mapped approximately 370 m north-west of the site. Tottenham Marsh and Wild Marsh are shown immediately east and south-east of the site.

The 1894 map shows that the TEGW was expanded to feature more gasholders, a nursery was constructed 270 m west, and new industrial sites were erected approximately 500 m north.

By 1920 large-scale industrial features had been constructed in the land to the north and east; the TEGW expanded northwards and a new gasworks (Gothic Works) was established approximately 115 m north of the site. The Banbury reservoir was built approximately 370 m east of site.

Mapping from 1935 shows a small pond immediately south-east of the site and a gasholder was built immediately north of the site. The rifle range to the east of the site was converted into a recreation ground around this time. The 1935 map shows the first appearance of the gasholder located directly north of the site.

The historical OS maps show that between 1938 and 1952 the pond immediately south-east of site had extended and several tanks and ancillary buildings were constructed around the gasholder immediately north of the site. Railway sidings were constructed along the Great Eastern Railway approximately 350 m west of site.

Between 1952 and 1957 unspecified tanks are mapped at the adjacent land to the northeast. Several subsequent maps through to 1991 label this area as 'tanks'.

The 1956 map shows an area to the north-west of the site labelled as 'Leeside Depot'. Several new industrial units were built within 200m west of the site by 1957.

Between 1957 and 1967 an electricity transformer station was built immediately south of the site comprising three buildings to house electrical infrastructure. Three electricity towers were constructed immediately adjacent to the eastern site boundary. The 1967 map also shows an 'Electricity Transfer Station' is present adjacent to the southern boundary.

By 1969 the Leeside civil engineering depot expanded with warehouse buildings and additional tanks. Leeside Chemical Works was mapped approximately 100 m north of the site adjacent to the gasholder.

Between 1967 and 1981 Leeside Depot was redeveloped into Mowlem Trading Estate, with multiple commercial units built immediately west of the site. The chemical works north-east of the site was removed.

Mapping from 1988 shows that several industrial features adjacent to site were removed, including parts of the gasworks north of site. Mapping from 2001 shows that part of the gasworks 500 m north of the site was converted into a superstore.

According to the available historical maps, the gasholder north of site had been removed between 2010 and 2022. Some additional warehouses were constructed approximately 500 m north and north-east of site, within the former industrial works area.

2.8. Environmental Setting

2.8.1. Geology

A summary of the geology underlying the site is provided below, this summary is based on a review of regional geology using BGS online data viewer [5], publicly available borehole logs, Groundsure Report [3], and the previous WorleyParsons site investigations [4] [6].

2.8.1.1. Made Ground

The BGS Online Data Viewer [5] and the Groundsure Report [3] do not indicate the presence of Made Ground on-site. Although no Made Ground is shown associated with the site, it should be anticipated due to the historical development of the site.

The Groundsure report [3] records 22 historical boreholes within 100 m north of the site, with the nearest log (reference TQ39SE838) within 20 m north of the site having encountered Made Ground comprising brown sandy clayey gravel up to a depth of 2.7 m bgl with occasional tarmac and concrete present. According to the log, Made Ground was underlain by brown gravelly slightly sandy clay to 3.0 m bgl. A strong hydrocarbon odour and staining was noted.

As previously discussed in Section 2.6.1 and 2.6.2, Made Ground was encountered during the 2013 site investigations. The Made Ground encountered was described as gravelly sands with abundant anthropogenic material and visual and olfactory evidence of contamination including hydrocarbon odours and tar staining.

2.8.1.2. Superficial Geology

The Groundsure report [3] indicates that the site is underlain by Alluvium (clay, silt, sand and gravel). The BGS online mapping database [5] reports the site is underlain by Kempton Park Gravel Member (Sand and Gravel) present on eastern part of the site.

During the April 2013 WorleyParsons site investigation, Alluvium was encountered to a maximum depth of 5.5 m bgl and comprised soft to very stiff brown/grey silts and clays with some sand and gravel. Tar and hydrocarbon odours were noted at BH12-04 and WS12-06

Kempton Park Gravels was found to a maximum depth of 6.55 m bgl, underlying the Alluvium and comprised grey and brown sandy gravel with silt. Gravels consisted of fine to coarse, angular to rounded flint, quartz, and sandstone in a sandy matrix. Hydrocarbon odours and black staining were observed in some locations at BH12-04 and WS12-06

Within the 2013 August site investigation, WorleyParsons encountered Alluvium between maximum depths of 3.1 m bgl and 5.85 m bgl comprised of soft to firm organic clay with occasional bands of peat or sand.

Kempton Park Gravels were found between depths of 5.7 and 7.8m and consisted of sandy flint gravel interspersed with layers of gravelly sand, silt and occasionally thin bands of silty clay.

2.8.1.3. Bedrock Geology

BGS mapping [5] and the Groundsure Report shows that the site is underlain by London Clay Formation.

The WorleyParsons site investigations [4], [6] encountered London Clay Formation bedrock beneath the Kempton Park Gravels which comprised soft to stiff, fissured, grey and brown clay. The full thickness of London Clay Formation was not proven during the WorleyParsons site investigations.

2.8.1.4. Mineral Workings and Coal Mining

The Groundsure Report [2] records two historical surface ground working areas identified as ponds on-site. Two other entries belong to unnamed wharfs recorded 169 m east of site. There are no records of BritPits, non-coal mining, mining cavities or underground workings on or within 250 m of the site.

The Groundsure Report [2] and the Coal Authority website [8] record the site as being in an area that is not affected by coal mining, furthermore no coal mining affected areas have been identified with 1 km of the site.

2.8.2. Hydrogeology

The Groundsure report [3] indicates that the superficial Kempton Park Gravel deposits are classified as a Secondary A aquifer, defined by the Environment Agency as *“Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers”*. The bedrock London Clay Formation is classified as an Unproductive aquifer, defined by the Environment Agency as: *“rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow”*.

The site lies within an Outer Catchment (Zone 2) Source Protection Zone (SPZ). The Environment Agency [9] defines SPZs as *“zones which show the level of risk to the source from contamination SPZ 2 as having “[a] 400 day travel time of pollutant to source. This has a 250 or 500 metres minimum radius around the source depending on the amount of water taken.”*

The groundwater vulnerability of the superficial aquifers is recorded as high and the bedrock aquifer vulnerability is classified as unproductive. The Groundsure report combined classification is recorded as unproductive.

Previous investigations by WorleyParsons [4] [6] have recorded perched water between 0.86 m bgl and 1.6 m bgl in Made Ground, and groundwater between 2.25 m and 3.96 m bgl in the Kempton Park Gravels.

Additional groundwater monitoring was undertaken by WorleyParsons in September 2013 [6] and found groundwater between 8.61 m and 9.37 m AOD in the made ground, and between 6.87 m and 8.37 m AOD in the Kempton Park Gravels.

2.8.3. Groundwater Abstractions

The Groundsure report [3] records 19 licensed groundwater abstractions located within 1 km of the site. The closest abstraction is located approximately 320 m west of site and related to a commercial laundry. One historical entry is also listed for the same location and same purpose.

A summary of groundwater abstraction details is provided in Table 2-3.

Table 2-5 - Summary of Groundwater Abstractions within 1 km of site

Abstraction Type	Distance	Direction
Laundry Use (Historical)	321 m	West
Laundry Use (Active)	321 m	West
Pollution Remediation (Historical)	456 m	North-West
Pollution Remediation (Historical)	483 m	North-West
Potable Water Supply – Direct (Historical)	493 m	South-West
Potable Water Supply – Direct (Historical)	547 m	South-East
Potable Water Supply – Direct (Active)	570 m	South-East
Process Water (Historical)	659 m	North
Potable Water Supply – Direct (Historical)	840 m	East
General Use Relating to Secondary Category (Active)	849 m	Unknown
Potable Water Supply – Direct (Active)	855 m	East
Potable Water Supply – Direct (Active)	899 m	South
Water Bottling (Historical)	904 m	North
General Use Relating to Secondary Category	908 m	North
Water Bottling (Historical)	910 m	North
Water Bottling (Historical)	910 m	North
General Use Relating to Secondary Category (Historical)	914 m	North
Water Bottling (Historical)	920 m	North
Potable Water Supply – Direct (Historical)	933 m	South
Pollution Remediation (Historical)	991 m	North-West

2.8.4. Hydrology

The Groundsure report [3] shows the closest surface water feature to the site is the Pymmes Brook located approximately 31 m east of site parallel to the eastern site boundary. The brook flows from the north-north-east to south-west direction. The River Lea Navigation Canal is located 230 m east of the site and the River Lea is located approximately 250 m east of the site. Other water features include the Banbury Reservoir located approximately 360 m east of the site and the Lockwood Reservoir located approximately 530 m south of the site.

The section of Pymmes Brook closest to the site had a 'moderate' ecological status in 2019 according to Water Framework Directive assessments. [10]

There are no reported licensed surface water abstractions within 1 km of the site.

2.8.5. Discharge Consents

The Groundsure report [3] indicates that the Pymmes Brook is an Environment Agency main river, and is a Water Framework Directive waterbody.

2.8.6. Landfills

The Groundsure report [3] did not identify any known operating or historical landfills within 250 m of the site.

2.8.7. Surface Water Abstractions

The Groundsure report [3] indicates that there are no reported surface water abstractions with 1 km of the site.

2.8.8. Flooding

The Environment Agency's Flood Risk map service [11] and the Groundsure report [3] state the entire site lies within Flood Zone 2 (medium flood risk). The majority of the site is considered to lie within an area of moderate risk of groundwater flooding, with some areas closest to the Pymmes Brook lying in an area of low risk.

2.8.9. Pollution Incidents

The Groundsure report [3] records five pollution incidents to controlled waters within 250 m of the site, with four of them recorded on-site. These included:

- the release of diesel fuel oil on 19 March 2002 (Water Impact: Category 4 – No Impact);
- the release of asbestos on 7 May 2002 (Water Impact: Category 4 – No Impact); and
- two recorded incidents of the release of inert construction and demolition wastes on 7 May 2002 (Water Impact: Category 4 – No Impact).

The fifth pollution incident occurred on 20 August 2010 approximately 56 m east of site and involved the release of gas and fuel oils (Water Impact: Category 2 – Significant).

2.8.10. Ecological Sensitivity

The Groundsure report [3] records a Site of Special Scientific Interest (SSSI) - Walthamstow Reservoirs approximately 468 m south of the site. A Conserved Wetland Site (Ramsar), Lea Valley is located approximately 476 m south of site.

2.8.11. Historical and Local Authority Recorded Landfills

The Groundsure report [3] does not identify any active or historical landfills within 500 m of the site.

2.8.12. Licensed Waste Management Facilities

The Groundsure Report records a two historical waste sites within 250 m of the site. A summary of waste management facilities details is provided in Table 2-6.

Table 2-6 - Summary of Waste Management Facilities

Type of Site	Description	Distance from site	Direction from site	Data Source
Waste Transfer Station	Project comprises the conversion of builders' yard to a waste transfer station including the erection of a building of 420m ² .	12 m	East	Historical
Waste Transfer Station	Scheme comprises construction of a new waste transfer	180 m	West	Historical

Type of Site	Description	Distance from site	Direction from site	Data Source
	station facility with the provision of a new building for the transfer, sorting and compaction of waste materials. Works will include construction of a waste compactor machine together with the provision of ancillary office space and temporary office building. Construction – 10 m high brick walls and metal cladding pitched roof with metal sheeting.			

2.8.13. Control of Major Accident Hazard Sites (COMAH)

The Groundsure report [3] does not identify any active or historic landfills within 250 m of the site. There is one historical COMAH site recorded approximately 495 m north-west of site listed as British Gas, Tottenham Holder Station.

2.8.14. Unexploded Ordnance

According to the Zetica Unexploded Bomb Risk Map [12] indicates that the site is in an area assessed as being at moderate risk from UXO. A UXO Desk Study and Risk Assessment [7] was completed by Zetica, covering the site (see Appendix I). The report summarised that risks from unexploded ordnance are “moderate”. A UXO engineer was present during the site investigation, prior to breaking ground and during the drilling of exploratory locations on-site, providing a UXO watching brief during all intrusive works as part of this site investigation.

3. Intrusive Site Investigation Methodology and Findings

3.1. Introduction

The site investigation methodology and physical investigation findings are presented below, with a summary of the scope of works and key dates specified in Table 3-1. The site investigation works were undertaken in accordance with BS10175:2017 [13].

Atkins' intrusive site investigation was undertaken between 17 and 28 April 2023. The first round of groundwater and ground gas monitoring took place over 9, 10 and 11 May 2023, the second monitoring round on 6, 7 and 8 June 2023 and the third monitoring round on 4, 5 and 6 July 2023 with the waste collection on 4 August 2023. All works were undertaken under the full-time supervision of a suitably qualified Atkins Lead Engineer meeting the required NGPH and NGET competencies.

The site investigation location plan is presented on Figure 5 and exploratory hole logs are included as Appendix B. Site photographs are included as Appendix C.

Table 3-1 - Summary of Fieldwork

Date	Works Undertaken	Parties Involved
23 to 25 April 2023	Non-intrusive service assessment and clearance of intrusive positions.	Atkins (Principal Contractor (PC))
	Intrusive site investigation works comprising: - excavation of three inspection pits by vacuum excavation to a maximum of 1.5 m bgl; - drilling of three dynamic rotary borehole locations (BH23-03 to BH23-05); - collection of soil and soil leachate samples; - installation of three 50 mm diameter high-density polyethylene (HDPE) groundwater monitoring standpipes; - well development of three boreholes; and - setting up asbestos management zone	CC Ground Investigation Limited (CCGI) (sub-contractor) Land Utility Group (LUG) (sub-contractor) Zetica (sub-contractor)
9 to 11 May 2023	Groundwater monitoring and sampling visit one, comprising: - ground gas monitoring of 14 locations; and - collection of groundwater samples from 14 boreholes.	Atkins (PC)
6 to 8 June 2023	Groundwater monitoring and sampling visit two, comprising: - gas monitoring of 15 locations; and - collection of groundwater samples from 15 boreholes.	Atkins (PC)
4 to 6 July 2023	Groundwater monitoring and sampling visit three, comprising: - ground gas monitoring on 14 locations; - collection of groundwater samples from 14 locations; and - drawdown test of DNAPL in BH11 and BH12-01 with DNAPL sampling	Atkins (PC)
04 August 2023	- rising and falling head permeability tests of BH23-03, BH23-04 and BH23-05; and - collection and removal of general waste bins, soil and groundwater waste drums, and skip from site.	Atkins (PC) J. O'Doherty Haulage

The following changes to the scope of works occurred:

- due to encountering free phase product, BH23-03 was terminated at 0.7 m bgl;
- due to encountering free phase product, BH23-04 was terminated at 5.7 m bgl;
- due to encountering free phase product, BH23-05 was terminated at 1.3 m bgl;
- during the second monitoring round a historical borehole was located in the Building Merchants yard and it was included during monitoring and sampling. Access was lost for the third round; and
- rising and falling head permeability test was cancelled at BH23-03, BH23-04 and BH23-05 due to the contamination encountered.

3.2. Methodology

3.2.1. Initial Site Visit, Inaugural Safety Meeting, Inductions and Site Mobilisation

Prior to the start of the intrusive investigations works, an ISV and an Inaugural Safety Meeting (ISM) were attended by Atkins on the 02 March 2023 and 13 March 2023 respectively. Both meetings included walkovers of the site. The ISV and ISM were attended by Simon Dunstan (Atkins' Project Manager at the time of the ISV/ISM), the ISM was attended by Zita Czinke (Atkins' Lead Engineer).

3.2.2. Service Tracing, Concrete Coring and Vacuum Excavation

Statutory and site-held utility service plans were obtained and consulted prior to the works commencing and supplied to Land Utility Group's specialist service assessment operative. Copies of the services plans are presented as Appendix A.

A GPR, CAT and genny survey was undertaken across a 5 m² area at each proposed borehole location, to assess the presence of below-ground services prior to breaking ground. The locations of services detected near exploratory hole locations were marked on the ground using temporary spray paint.

Following the service assessment, exploratory hole starter pits were excavated using vacuum excavation to a minimum depth of 1.20 m bgl. Vacuum excavation was undertaken using air to loosen soil where required and pits were inspected for services during excavation.

Concrete coring was conducted on exploratory hole locations BH23-03, BH23-04 and BH23-05 to break through the hardstanding (tarmac and concrete) surface cover.

Locations were relocated if the service plans or the service scanning indicated the presence of a possible service.

3.2.3. Dynamic Rotary Boreholes

A rotary drilling rig was used by CCGI to progress all borehole locations.

Due to encountering free phase product, BH23-03 was terminated at 0.7 m bgl, BH23-04 terminated to 5.7 m bgl and BH23-05 was terminated at 1.3 m bgl.

The Fraste rig dynamically sampled to progress the borehole. Initially a cylindrical barrel with an inner plastic liner was driven into the ground. At the end of each 1.5 m run, the inner barrel and core sample were removed and replaced with a new plastic liner and the process repeated. Due to possible presence of asbestos contamination water was used during all drilling process.

All three locations were installed with 50 mm HDPE diameter standpipes with slotted sections used within the required response zone. The wells were completed with 10 mm filter gravel within the annulus of the response zone and sealed with hydrated bentonite pellets. All head works were completed using traffic-rated flush-mounted covers cemented in place. The screened response zone of the wells corresponds with the Kempton Park Gravels or Made Ground.

A summary of the installation details is provided in Table 3-2.

Table 3-2 - Summary of Borehole Locations

Site	Hole ID	Maximum Depth	Response Zone Depth	Response Zone Strata
NGET Bus Depot	BH23-03	0.7	0.35 – 0.7	Made Ground
	BH23-04	5.7	1.0 – 4.0	Kempton Park Gravels
	BH23-05	1.3	0.5 – 0.8	Made Ground

3.2.4. Soil Sampling

Soil sampling and geological logging was undertaken in accordance with BS5930 [14] at all of the exploratory hole locations.

Soil sample selection and scheduling was designed to ensure a suitable spread of data, both laterally and vertically, including samples from deeper strata. Sampling was also informed by the use of the PiD as well as visual and olfactory indicators of contamination.

A total of four soil samples including one duplicate soil sample were submitted to Chemtest Ltd, a UKAS and MCERTS accredited laboratory for the following suite of analysis:

- asbestos screen, identification and quantification where asbestos was detected;
- moisture, soil colour, other material, soil texture;
- inorganic parameters: pH, boron, cyanide (total, free and complex), thiocyanate, sulphate, sulphur, chloride, and ammonium;
- fraction of organic carbon (FOC) on selected samples;
- metals / metalloids: arsenic, cadmium, chromium, chromium (hexavalent), copper, mercury, nickel, lead, selenium and zinc;
- polycyclic aromatic hydrocarbons (PAHs);
- benzene, toluene, ethylbenzene and xylene (BTEX);
- Extractable petroleum hydrocarbons (EPH) C10-C40;
- Volatile petroleum hydrocarbons (VPH) C5-C10;
- total phenols; and
- polychlorinated biphenyls (PCBs) for selected samples.

With each environmental soil sample taken, a small sample volume was added to a sealable plastic bag which later had a headspace test conducted upon it. A PiD was used to record the vapour concentration created over a period of a few hours, as calibrated against decane. PiD results are summarised in Table 3-6.

A total of 3 soil-leachate samples were scheduled for the following analysis:

- inorganic parameters: pH, electrical conductivity, chloride, ammonium, sulphur, sulphate, cyanide (total, free and complex), thiocyanate and sulphide;
- total organic carbon (TOC);
- metals / metalloids: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc;
- PAHs;
- Total Petroleum Hydrocarbons – Criteria Working Group (TPH CWG);
- Phenols; and
- PCBs for selected samples.

3.2.5. Surface Water Sampling

A total of six surface water samples were obtained from upstream and downstream locations from the nearby surface water receptor, the Pymmes Brook that is located approximately 30 m to the east. These samples were obtained using a telescoop (a plastic 1L beaker on the end of a telescopic pole) from pedestrian bridges that cross the watercourse. It is noted that the banks are too overgrown with vegetation to allow mid-stream samples to be obtained.

These samples were scheduled for the following analysis:

- inorganic parameters: pH, electrical conductivity, suspended solids, cyanide (total, free and complex), thiocyanate sulphate, sulphide, chloride, ammonium, germanium,
- TOC;
- metals: arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium and zinc;
- PAHs;
- BTEX;
- TPH CWG; and
- Phenols.

3.2.6. Groundwater Monitoring

Newly installed monitoring wells were developed after completion and prior to being sampled, which involved the purging of three well volumes of water or complete emptying of the well. This was conducted through the use of bailers and/or low flow peristaltic pump. The purged water was transferred to the adjacent substation site banded wastewater storage drums located in the waste storage area.

Three rounds of groundwater monitoring and sampling were undertaken in the three newly installed groundwater monitoring wells following the site investigation (BH23-03, BH23-04 and BH23-05) as well as twelve historical boreholes installed during the WorleyParsons 2013 site investigations respectively (BH12-06, WS12-07, WS12-08 – accessed only on the second round, BH12-05, BH11, BH12-04, BH12, WS12-03, WS12-02D, WS12-01, BH12-02D and BH12-02). The first monitoring round was conducted on 9 to 11 May 2023, the second monitoring round on 6 to 8 June 2023 and the third monitoring round on 4 to 6 July 2023.

During the groundwater monitoring visits, an oil/water interface probe was used to measure groundwater and (where relevant) non-aqueous phase liquids (NAPL) levels in the boreholes.

Groundwater sampling was undertaken in accordance with British Standards [15] using low-flow methodology comprising the use of a peristaltic pump and a YSI pro water quality meter with flow cell recording water quality parameters (pH, temperature, dissolved oxygen, redox potential and conductivity). A YSI was not used in notably contaminated exploratory locations at BH23-03, BH23-04, BH23-05 (10/05/2023), due to concerns of damaging equipment. Groundwater samples were collected when the water parameters were considered to be sufficiently stable. Groundwater sampling parameter data are presented in Appendix E.

Low-flow sampling techniques were used to obtain samples with minimal disturbance of the surrounding water body and without significant drawdown of the water column, which minimised the likelihood of introducing silty water from surrounding soil.

During the third round of groundwater monitoring, falling head/rising head tests were also undertaken in the Atkins 2023 monitoring wells (BH23-03, BH23-04 and BH23-05). Data was collected with a water displacement slug, dip tape and YSI. The data collected is presented in Appendix E.

A summary of the groundwater installation details from Atkins 2023 site investigation is presented in Table 3-3. For comparison, a summary of the historical WorleyParsons site investigation groundwater installation details is provided in Table 3-4.

Table 3-3 - Summary of Atkins 2023 Groundwater Installations

Hole ID	Borehole Depth (m bgl)	Installation (50 mm HDPE) slotted section (m bgl)
BH23-03	0.7	0.35 – 0.7
BH23-04	5.7	1.0 – 4.0

Hole ID	Borehole Depth (m bgl)	Installation (50 mm HDPE) slotted section (m bgl)
BH23-05	1.3	0.5 – 0.8

Table 3-4 - Summary of Historical Groundwater Installations by WorleyParsons in 2012 and 2013

Hole ID	Borehole Depth (m bgl)	Installation (50 mm HDPE) slotted section (m bgl)
BH12-01	8.0	2.80 – 6.5
BH12-02D	7.0	4.80 – 6.50
BH12-03	7.20	4.25 – 6.70
BH12-04	7.00	4.40 – 5.85
BH12-05	7.00	4.40 – 6.50
BH12-06	6.90	4.90 – 6.10
WS12-01	5.00	1.00 – 3.00
WS12-02	5.40	1.00 – 3.00
WS12-03	2.70	1.00 – 2.20
WS12-06	5.30	0.6 – 2.80
WS12-07	4.00	1.00 – 3.00
WS12-08	5.00	1.00 – 2.00

3.2.7. Groundwater Testing

A total of 35 groundwater samples including four duplicate samples and one trip blank were scheduled for the following analysis:

- inorganic parameters: pH, electrical conductivity, suspended solids, cyanide (total, free and complex), thiocyanate sulphate, sulphide, chloride, ammonium, germanium,
- TOC;
- metals: arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium and zinc;
- PAHs;
- BTEX;
- TPH CWG; and
- Phenols.

The groundwater laboratory results are presented in Appendix D.

3.2.8. Ground Gas Monitoring

Ground gas monitoring was carried out during all three monitoring rounds in the wells (BH12-06, WS12-07, WS12-08, BH12-05, BH11, BH12-04, BH12, WS12-03, WS12-02D, WS12-01, BH12-02D, BH12-01, BH23-03, BH23-04 and BH23-05) using an infra-red gas analyser (GA5000) recording peak flow rate and ground gas concentrations for oxygen, carbon dioxide, methane and hydrogen sulphide. The data collected is presented in Appendix E.

3.3. Physical Investigation Findings

3.3.1. Site-Specific Geology

The exploratory hole logs from the Atkins 2023 site investigation are provided in Appendix B. A summary of the findings is presented in Table 3-5.

Table 3-5 - Summary of Encountered Geology at Intrusive Sampling Locations

Stratum	Depth Range (m)	General Description
Made Ground	0.00 – 0.35	Concrete – black staining. Dark brownish black medium dense to loose gravelly clayey Sand. Sand is medium to coarse. Gravel is sub-angular, and sub rounded medium coarse. Slightly hydrocarbon odour (Made Ground)
	0.35 – 4.00	Dark brown to black loose to medium dense slightly gravelly clayey Sand. Sand is fine to coarse. Gravel is sub-angular to sub rounded fine to coarse of brick, concrete. Occasional clinker and fragments of coal and wood. Strong hydrocarbon odour and frequent black staining noted.
River Terrace Deposits (RTD)	4.00 – 5.70	Light greyish brown loose to fine sandy Gravel. Sand is fine to medium. Gravel is sub-angular to sub rounded medium.

3.3.2. Visual and Olfactory Evidence of Contamination

Visual and olfactory observations of potential contamination were identified during the intrusive site investigation and during the groundwater monitoring rounds and are summarised below in Table 3-6.

Suspected ACMs were not visually identified within any locations during the site investigation.

Hydrocarbon odours and black staining were identified in the WorleyParsons investigation [4] in BH12-04 and WS12-06, that were located in the vicinity of the suspected underground tank in the central eastern extent of the site. These occurrences were reported in the Made Ground and the Alluvium.

Table 3-6 - Summary of Visual and Olfactory Evidence of Contamination

Stage of works	Location	Strata	Depth (m bgl)	Visual and Olfactory Evidence of Contamination
Site investigation	BH23-03	Made Ground	0.35-0.7	Black staining between gravelly clayey Sand. Dark red, chemical staining in soil. Free product (LNAPL) observed on perched groundwater. Ash. Strong hydrocarbon odour.
	BH23-04	Made Ground/ River Terrace Deposits	0.35-0.7 2.70-4.0	Pockets of black staining. Strong hydrocarbon odour.
	BH22-05	Made Ground	0.7-1.30	Rare black staining between fractures. Strong hydrocarbon odour.
Post site work groundwater monitoring round	BH11B		5.93 – 6.62	DNAPL noted between 5.93 m bgl and 6.62 m bgl. (Round 1)
	BH23-03	Made Ground	0.330	LNAPL noted on groundwater at 0.330 m bgl. (Round 1)
	BH23-04	Made Ground/ River Terrace Deposits	NA	Strong hydrocarbon odour noted. (Round 1,2 and 3)
	BH23-05	Made Ground	NA	Strong hydrocarbon odour noted (Round 1)
	BH12-01	River Terrace Deposits	4.7-6.2	Strong hydrocarbon odour noted. DNAPL noted between 4.70 m bgl and 6.2 m bgl (Round 1). 5.40-6.20 m bgl (Round 2) and 4.92 5.70 m bgl (Round 3)

Stage of works	Location	Strata	Depth (m bgl)	Visual and Olfactory Evidence of Contamination
	WS12-01		NA	DNAPL drops in water sample noted (Round 1, 2 and 3).
	WS12-02D		NA	DNAPL encountered (Round 1, 2 and 3)
	BH12-05		NA	Black stain noted (Round 1, 2 and 3)

With each environmental soil sample taken, a small sample volume was added to a sealable plastic bag for subsequent in-situ headspace testing. A PiD was used to screen soils for volatile organic compounds (VOCs) which were left to accumulate in the sample bag over a period of a few hours prior to testing. The headspace testing results recorded during the site investigation are presented on the exploratory logs in Appendix B. A summary of PiD readings recorded above 0.1 parts per million (ppm) during the ground gas/groundwater monitoring rounds are included in Table 3-8.

Table 3-7 - Summary of PiD readings

Location	Date Measured	PiD result (ppm)
BH23-03	10/05/2023	0.2
	07/06/2023	8.6
	06/07/2023	3.1
BH23-04	10/05/2023	364
	07/06/2023	288.5
	06/07/2023	338.9
BH23-05	10/05/2023	15.0
	07/06/2023	5.5
	06/07/2023	4.5
BH12-04	10/05/2023	3.5
	07/06/2023	32.2
	06/07/2023	37.7
BH11	10/05/2023	1.5
	07/06/2023	1.1
	06/07/2023	46.6
BH12-06	10/05/2023	35.5
	07/06/2023	22.6
	06/07/2023	35.3
WS12-07	10/05/2023	65.2
	07/06/2023	15.3
	06/07/2023	335.2
BH12-05	10/05/2023	0.2
	07/06/2023	0.0
	06/07/2023	0.0
BH12	10/05/2023	0.0

Location	Date Measured	PiD result (ppm)
WS12-03	07/06/2023	0.1
	06/07/2023	0.1
	10/05/2023	1.9
WS12-02D	07/06/2023	5.4
	06/07/2023	3.9
	10/05/2023	33.2
WS12-01	07/06/2023	56.9
	06/07/2023	27.3
	10/05/2023	19.8
BH12-02D	07/06/2023	44.2
	06/07/2023	17.2
	10/05/2023	1.2
BH12-01	07/06/2023	1
	05/07/2023	0.9
	10/05/2023	156.9
WS12-06	07/06/2023	186.2
	05/07/2023	205.3
	08/06/2023	0.2

3.3.3. Groundwater Observations

Groundwater levels as measured from monitored wells during post-investigation monitoring visits are presented in Table 3-8.

Table 3-8- Summary of Groundwater Elevations

Location	Response zone (m bgl)	Strata	Round 1		Round 2		Round 3	
			GW Depth (m bgl)	m AOD	GW Depth (m bgl)	m AOD	GW Depth (m bgl)	m AOD
BH12-04	4.30 – 5.85	ALL, RTD, LC	3.000	7.48	3.32	7.16	3.24	7.24
BH11	4.10 – 6.50	KPR	2.960	7.50	3.20	7.26	3.22	7.24
BH23-03	0.35 – 0.70	MG	0.330	10.14	0.60	9.84	0.70	9.74
BH23-04	1.00 – 4.00	KPR	2.270	8.11	2.28	8.10	2.89	7.49
BH23-05	0.50 – 0.80	MG	1.280	9.02	Dry	-	Dry	-
BH12-06	4.80 – 6.10	ALL, RTD, LC	2.560	7.59	2.83	7.32	2.82	7.33
BH12-01	2.70 – 6.50	MG and RTD	2.25	8.52	2.12	8.65	1.99	8.78

Location	Response zone (m bgl)	Strata	Round 1		Round 2		Round 3	
			GW Depth (m bgl)	m AOD	GW Depth (m bgl)	m AOD	GW Depth (m bgl)	m AOD
BH12-02D	4.70 – 6.80	ALL, RTD, LC	0.740	9.79	0.74	9.79	0.77	9.76
WS12-03	1.00 – 2.20	MG	1.590	8.90	1.66	8.83	1.74	8.75
BH12	4.60 – 6.50	KPR	2.860	7.56	3.15	7.27	3.10	7.32
WS12-01	1.00 – 3.00	MG, ALL	0.760	9.76	0.80	9.72	0.83	9.69
WS12-07	0.90 – 3.00	MG, ALL	1.530	8.77	1.70	8.60	1.66	8.64
WS12-02D	1.00 – 3.00	MG, ALL	1.550	9.04	0.76	9.83	0.77	9.83
BH12-05	4.30 – 6.50	ALL, RTD, LC	2.650	7.74	3.06	7.33	2.99	7.40
WS12-08	0.90 – 2.10	MG, ALL	No access (BH covered)	Unable to locate	1.80	No m AOD, (topographic survey was not carried out in this location)	No access (BH covered)	NA
WS12-06	0.50 – 3.00	ALL	Unable to locate	NA	Unable to locate	NA	Unable to locate	NA
BH12-03	4.15 – 6.70	ALL, RTD, LC	Unable to locate	NA	Unable to locate	NA	Unable to locate	NA

Note: MG – Made Ground, ALL – Alluvium, RTD – River Terrace Deposits, KPR – Kempton Park Gravels

3.4. Health, Safety and Environment

All sub-contractors working on-site had the appropriate NGET competencies and were given a full site induction by the Atkins Lead Engineer prior to commencing works. In addition, a site log of health, safety or environmental incidents was maintained throughout the duration of the works.

All works complied with the Control of Asbestos Regulations (CAR) 2012 [16] and were managed in accordance with Joint Industry Working Group (JIWIG) guidance and associated tools. The requirements and specification for personal protective equipment (PPE) including respiratory equipment and other protective measures were detailed in a site-specific Health and Safety Plan developed for the sampling activities that was reviewed and approved by an appointed CDM auditor prior to the works commencing.

There were several hazards identified during the works which were reported to NGPH on a good catch report form and submitted by Atkins' Lead Engineer to the National Grid Incident Desk. No near misses or incidents occurred during the works. An Atkins Project Manager safety audit was completed on 21 April 2023 along with a CDM-A audit on 25 April 2023.

3.5. Waste Disposal

Waste storage and disposal was carried out by Wasteway and J. O'Doherty Haulage, organised through CCGI. A skip was utilised during the site works for disposal of site investigation-derived waste comprising soil arisings. In addition, eleven 205 litre wastewater drums, stored on plastic bunds, were used for collection and storage of purged water during well development and sampling. Additionally, a plastic bin was used to collect any inert wastes such as packaging materials.

On completion of site works and monitoring, the drums, plastic bund, plastic bin and skip were collected on 4 August 2023. Waste consignment notes are provided in Appendix F.

3.6. Laboratory Quality Assurance / Quality Control

3.6.1. Trip blanks

Three sealed sets of trip blank water containers were transported to the site during each monitoring rounds. The trip blanks were analysed as control samples to identify any cross-contamination within the field or during transit to or from the field. The analytical results are presented in Appendix D.

3.6.2. Duplicate Analysis

For quality assurance / quality control (QA/QC) purposes, duplicates were collected during the investigation works. The collated duplicate samples are summarised in Table 3-9

Table 3-9 - Summary of Duplicate Samples

Sample Type	Sample ID	Duplicate ID	Depth (m bgl)
Soil	BH23-04	BH23-04	1.7
Groundwater	BH12-05	BH12050	6

Comparison of the duplicate samples results can provide an indicator of laboratory analytical precision. This is commonly undertaken by the use of relative potential difference (RPD) between the sample and its duplicate. The RPD is calculated using the following equation:

$$\%RPD = \frac{(sample\ result - duplicate\ result) * 100}{(sample\ result + duplicate\ result)/2}$$

For the purposes of comparison, where a result is given as below the laboratory LOD, it has been assumed to be at the LOD. For environmental samples and given the potential for heterogeneity between samples an RPD below 50% is considered to be acceptable.

3.6.2.1. Soil Samples

The maximum RPD of laboratory results for soil samples was 49.98%.

The RPD results are presented in Appendix D.

3.6.2.2. Groundwater Samples

The maximum RPD of laboratory results for groundwater samples was 195%. RPDs above 50% were identified within the following constituents:

- Suspended Solids;
- Copper (dissolved);
- Acenaphthene;
- Total of 16 PAH's; and
- Zinc (dissolved).

All values with exceeding RPD values are from BH12-05 and BH12-05D, this sample was taken on 08 June 2023. Only one groundwater duplicate was taken.

3.6.3. Duplicate Analysis Summary

Although these RPD exceedances have been identified, the sampling techniques employed onsite should ensure a homogenous sample overall; however, some stratification in groundwater samples and contamination "hotspots" in soil may occur in which differing physical or chemical characteristics of the matrix may consequently be collected in the different primary and duplicate samples. As all other analytes RPDs for the

duplicates conform to the RPD thresholds for these analytes, it is the opinion of Atkins that the precision of the data is adequate for the purposes of this investigation.

3.6.4. Shewhart Charts

Shewhart charts from the laboratory (Chemtest Ltd) are presented within Appendix G. The results from the Shewhart show that there were outlying results. The laboratory reports that where quality control results fall outside the assigned control limits (+3SD) all associated sample testing is repeated. The laboratory analysis of these constituents identified concentrations which were predominantly in the same order of magnitude as their corresponding samples.

3.6.5. Sample Deviations

No sample deviations have been recorded for any of the soil or groundwater samples obtained.

3.6.6. Summary

Based on the quality control / quality assurance discussed above, the data quality is considered to be acceptable and sufficient for its intended use.

4. Summary of Analytical Data

4.1. Soil Results

A total of 4 soil samples were scheduled for chemical analysis, including one duplicate. The laboratory analytical results are summarised in Table 4-1.

Table 4-1 - Summary of Soil Analytical Results

Determinand	Unit	Limit of Detection	Number of Samples	Minimum Value	Maximum Value
ACM Type	-	N/A	4	-	-
Asbestos Identification	-	N/A	4	-	-
Asbestos by Gravimetry	-	N/A	4	-	-
Total Asbestos	%	0.001	4	-	-
Moisture	%	0.020	4	15	49
Soil Colour	-	N/A	4	-	-
Other Material	-	N/A	4	-	-
Soil Texture	-	N/A	4	-	-
pH	-	4.0	4	7.7	8.8
Boron (Hot Water Soluble)	mg/kg	0.40	4	0.9	3.3
Sulphate (2:1 Water Soluble) as SO ₄	g/l	0.010	4	0.71	1.9
Sulphur (Elemental)	mg/kg	1.0	4	7.4	170
Chloride (Water Soluble)	g/l	0.010	4	<0.01	0.36
Cyanide (Complex)	mg/kg	0.50	4	<0.5	4300
Cyanide (Free)	mg/kg	0.50	4	<0.5	5
Cyanide (Total)	mg/kg	0.50	4	<0.5	4300
Thiocyanate	mg/kg	5.0	4	<5	22
Ammonium (Extractable)	mg/kg	0.50	4	1.6	250
Arsenic	mg/kg	0.5	4	23	330
Barium	mg/kg	0	4	55	510
Beryllium	mg/kg	0.5	4	<0.5	2.1
Cadmium	mg/kg	0.10	4	0.39	1.7
Chromium	mg/kg	0.5	4	2	33
Copper	mg/kg	0.50	4	24	140
Mercury	mg/kg	0.05	4	1.5	33
Nickel	mg/kg	0.50	4	14	39
Lead	mg/kg	0.50	4	170	2200
Selenium	mg/kg	0.25	4	1.5	20
Vanadium	mg/kg	0.5	4	1.7	63
Zinc	mg/kg	0.50	4	91	400

Determinand	Unit	Limit of Detection	Number of Samples	Minimum Value	Maximum Value
Aliphatic VPH >C5-C6	mg/kg	0.05	4	<0.05	7.15
Aliphatic VPH >C6-C7	mg/kg	0.05	4	<0.05	7.8
Aliphatic VPH >C7-C8	mg/kg	0.05	4	<0.05	7.2
Aliphatic VPH >C8-C10	mg/kg	0.05	4	<0.05	14
Total Aliphatic VPH >C5-C10	mg/kg	0.25	4	<0.25	36
Aliphatic EPH >C10-C12	mg/kg	2.00	4	42	1800
Aliphatic EPH >C12-C16	mg/kg	1.00	4	110	9800
Aliphatic EPH >C16-C21	mg/kg	2.00	4	26	4300
Aliphatic EPH >C21-C35	mg/kg	3.00	4	8.8	360
Aliphatic EPH >C35-C40	mg/kg	10.00	4	<10	200
Total Aliphatic EPH >C10-C35	mg/kg	5.00	4	190	16000
Aromatic VPH >C5-C7	mg/kg	0.05	4	<0.05	410
Aromatic VPH >C7-C8	mg/kg	0.05	4	<0.05	88
Aromatic VPH >C8-C10	mg/kg	0.05	4	<0.05	54
Total Aromatic VPH >C5-C10	mg/kg	0.25	4	<0.25	550
Aromatic EPH >C10-C12	mg/kg	1.00	4	16	3700
Aromatic EPH >C12-C16	mg/kg	1.00	4	730	16000
Aromatic EPH >C16-C21	mg/kg	2.00	4	860	14000
Aromatic EPH >C21-C35	mg/kg	2.00	4	980	13000
Aromatic EPH >C35-C40	mg/kg	1.00	4	140	1700
Total Aromatic EPH >C10-C35	mg/kg	5.00	4	2600	46000
Total VPH >C5-C10	mg/kg	0.50	4	<0.5	590
Total EPH >C10-C35	mg/kg	10.00	4	2800	63000
LOI	%	0.10	4	4.7	69
Fraction of Organic Carbon	-	0.0010	4	0.056	0.42
Benzene	mg/kg	0.001	4	0.0047	170
Toluene	mg/kg	0.001	4	0.0022	400
Ethylbenzene	mg/kg	0.001	4	<0.001	32
m & p-Xylene	mg/kg	0.001	4	<0.001	440
o-Xylene	mg/kg	0.001	4	<0.001	110
Naphthalene	mg/kg	0.10	4	0.93	1600
Acenaphthylene	mg/kg	0.10	4	0.42	57
Acenaphthene	mg/kg	0.10	4	0.14	26
Fluorene	mg/kg	0.10	4	0.2	65
Phenanthrene	mg/kg	0.10	4	0.62	1200
Anthracene	mg/kg	0.10	4	0.38	68

Determinand	Unit	Limit of Detection	Number of Samples	Minimum Value	Maximum Value
Fluoranthene	mg/kg	0.10	4	1.5	860
Pyrene	mg/kg	0.10	4	1.7	660
Benzo[a]anthracene	mg/kg	0.10	4	0.69	97
Chrysene	mg/kg	0.10	4	0.67	99
Benzo[b]fluoranthene	mg/kg	0.10	4	1.2	290
Benzo[k]fluoranthene	mg/kg	0.10	4	0.43	51
Benzo[a]pyrene	mg/kg	0.10	4	0.95	260
Indeno(1,2,3-c,d)Pyrene	mg/kg	0.10	4	0.94	92
Dibenz(a,h)anthracene	mg/kg	0.10	4	0.18	17
Benzo[g,h,i]perylene	mg/kg	0.10	4	0.92	80
Total Of 16 PAH's	mg/kg	2.0	4	12	4900
PCB 28	mg/kg	0.010	4	<0.01	<0.01
PCB 52	mg/kg	0.010	4	<0.01	<0.01
PCB 90+101	mg/kg	0.010	4	<0.01	<0.01
PCB 118	mg/kg	0.010	4	<0.01	<0.01
PCB 153	mg/kg	0.010	4	<0.01	<0.01
PCB 138	mg/kg	0.010	4	<0.01	<0.01
PCB 180	mg/kg	0.010	4	<0.01	<0.01
Total PCBs (7 Congeners)	mg/kg	0.10	4	<0.1	<0.1
Resorcinol	mg/kg	0.020	4	<0.02	<0.02
Phenol	mg/kg	0.020	4	<0.02	12
Cresols	mg/kg	0.020	4	<0.02	44
Xylenols	mg/kg	0.020	4	<0.02	79
1-Naphthol	mg/kg	0.020	4	<0.02	<0.02
Trimethylphenols	mg/kg	0.020	4	<0.02	64
Total Phenols	mg/kg	0.10	4	<0.1	150

4.2. Soil-leachate Results

A total of three soil-leachate samples were scheduled for soil-leachate laboratory analysis. The laboratory analytical results are summarised in Table 4-2.

Table 4-2 - Summary of Soil-leachate Analytical Results

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
pH	-	N/A	3	8.3	8.7
Electrical Conductivity	µS/cm	1.0	3	160	250
Chloride	mg/l	1.0	3	<1	20
Ammonium	mg/l	0.050	3	<0.05	2.4
Sulphur	mg/l	1.0	3	8.7	38
Sulphate	mg/l	1.0	3	26	110
Cyanide (Total)	mg/l	0.050	3	<0.05	<0.05
Cyanide (Free)	mg/l	0.050	3	<0.05	<0.05
Thiocyanate	mg/l	0.50	3	<0.5	<0.5
Cyanide (Complex)	mg/l	0.050	3	<0.05	<0.05
Sulphide	mg/l	0.050	3	<0.05	<0.05
Arsenic (Dissolved)	mg/l	0.0002	3	0.0035	0.08
Cadmium (Dissolved)	mg/l	0.00011	3	<0.00011	<0.00011
Chromium (Dissolved)	mg/l	0.0005	3	<0.0005	<0.0005
Copper (Dissolved)	mg/l	0.0005	3	0.00054	0.0024
Mercury (Dissolved)	mg/l	0.00005	3	<0.00005	<0.00005
Nickel (Dissolved)	mg/l	0.0005	3	0.00079	0.0021
Lead (Dissolved)	mg/l	0.0005	3	0.00058	0.0042
Selenium (Dissolved)	mg/l	0.0005	3	0.00058	0.0076
Zinc (Dissolved)	mg/l	0.0025	3	0.015	0.022
Iron (Dissolved)	mg/l	0.005	3	0.015	9.8
Total Organic Carbon	mg/l	2.0	3	3.3	27
Aliphatic TPH >C5-C6	mg/l	0.0001	3	<0.0001	<0.0001
Aliphatic TPH >C6-C8	mg/l	0.0001	3	<0.0001	0.14
Aliphatic TPH >C8-C10	mg/l	0.0001	3	<0.0001	1.7
Aliphatic TPH >C10-C12	mg/l	0.0001	3	<0.0001	0.068
Aliphatic TPH >C12-C16	mg/l	0.0001	3	<0.0001	<0.0001
Aliphatic TPH >C16-C21	mg/l	0.0001	3	<0.0001	<0.0001
Aliphatic TPH >C21-C35	mg/l	0.0001	3	<0.0001	<0.0001
Aliphatic TPH >C35-C44	mg/l	0.0001	3	<0.0001	<0.0001
Total Aliphatic Hydrocarbons	mg/l	0.005	3	<0.005	1.9
Aromatic TPH >C5-C7	mg/l	0.0001	3	<0.0001	0.13

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Aromatic TPH >C7-C8	mg/l	0.0001	3	<0.0001	0.42
Aromatic TPH >C8-C10	mg/l	0.0001	3	<0.0001	4.4
Aromatic TPH >C10-C12	mg/l	0.0001	3	<0.0001	0.55
Aromatic TPH >C12-C16	mg/l	0.0001	3	<0.0001	0.97
Aromatic TPH >C16-C21	mg/l	0.0001	3	<0.0001	0.13
Aromatic TPH >C21-C35	mg/l	0.0001	3	<0.0001	<0.0001
Total Aromatic Hydrocarbons	mg/l	0.005	3	<0.005	6.6
Total Petroleum Hydrocarbons	mg/l	0.01	3	<0.01	8.5
Naphthalene	mg/l	0.0001	3	<0.0001	0.077
Acenaphthylene	mg/l	0.0001	3	<0.0001	<0.0001
Acenaphthene	mg/l	0.0001	3	<0.0001	<0.0001
Fluorene	mg/l	0.0001	3	<0.0001	<0.0001
Phenanthrene	mg/l	0.0001	3	<0.0001	<0.0001
Anthracene	mg/l	0.0001	3	<0.0001	<0.0001
Fluoranthene	mg/l	0.0001	3	<0.0001	0.013
Pyrene	mg/l	0.0001	3	<0.0001	0.013
Benzo[a]anthracene	mg/l	0.0001	3	<0.0001	<0.0001
Chrysene	mg/l	0.0001	3	<0.0001	<0.0001
Benzo[b]fluoranthene	mg/l	0.0001	3	<0.0001	<0.0001
Benzo[k]fluoranthene	mg/l	0.0001	3	<0.0001	<0.0001
Benzo[a]pyrene	mg/l	0.0001	3	<0.0001	<0.0001
Indeno(1,2,3-c,d)Pyrene	mg/l	0.0001	3	<0.0001	<0.0001
Dibenz(a,h)anthracene	mg/l	0.0001	3	<0.0001	<0.0001
Benzo[g,h,i]perylene	mg/l	0.0001	3	<0.0001	<0.0001
Total of 16 PAHs	mg/l	0.002	3	<0.002	0.1
Benzene	mg/l	0.001	3	<0.001	1.9
Toluene	mg/l	0.001	3	<0.001	0.19
Ethylbenzene	mg/l	0.001	3	<0.001	0.017
m & p-Xylene	mg/l	0.001	3	<0.001	0.072
o-Xylene	mg/l	0.001	3	<0.001	0.031
PCB 28	mg/l	0.00001	3	<0.00001	<0.00001
PCB 52	mg/l	0.00001	3	<0.00001	<0.00001
PCB 90+101	mg/l	0.00001	3	<0.00001	<0.00001
PCB 118	mg/l	0.00001	3	<0.00001	<0.00001
PCB 153	mg/l	0.00001	3	<0.00001	<0.00001
PCB 138	mg/l	0.00001	3	<0.00001	<0.00001

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
PCB 180	mg/l	0.00001	3	<0.00001	<0.00001
Total PCBs (7 congeners)	mg/l	0.00001	3	<0.00001	<0.00001
Resorcinol	mg/l	0.0050	3	<0.005	<0.005
Phenol	mg/l	0.0050	3	<0.005	0.13
Cresols	mg/l	0.0050	3	<0.005	0.35
Xylenols	mg/l	0.0050	3	<0.005	0.46
1-Naphthol	mg/l	0.0050	3	<0.005	<0.005
Trimethylphenols	mg/l	0.0050	3	<0.005	0.081
Total Phenols	mg/l	0.030	3	<0.03	1

4.3. Asbestos

A total of four soil samples taken from site were screened for asbestos ID. No positive asbestos identification was detected in any of the samples.

4.4. Groundwater Results

A total of 35 groundwater samples were scheduled for laboratory analysis, including four duplicates and one trip blank sample. The laboratory analytical results are summarised in Table 4-3.

Table 4-3 - Summary of Groundwater Analytical Results

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Electrical Conductivity	µS/cm	1.0	35	610	4200
Suspended Solids At 105C	mg/l	5.0	35	15	2300
Chemical Oxygen Demand	mg/l	10	35	25	1500
Chloride	mg/l	1.0	35	19	1000
Ammonium	mg/l	0.050	35	0.054	110
Sulphur	mg/l	1.0	35	5.7	800
Sulphate	mg/l	1.0	35	17	2400
Cyanide (Total)	mg/l	0.050	35	0.06	1.3
Cyanide (Free)	mg/l	0.050	35	0	0
Thiocyanate	mg/l	0.50	35	0.53	13
Cyanide (Complex)	mg/l	0.050	35	0.06	1.3
Sulphide	mg/l	0.050	35	0	0
Calcium (Dissolved)	mg/l	2.00	9	88	780
Potassium (Dissolved)	mg/l	0.50	9	5.6	55
Magnesium (Dissolved)	mg/l	0.20	9	3.4	81
Sodium (Dissolved)	mg/l	1.50	9	18	380
Arsenic (Dissolved)	mg/l	0.0002	35	0.0003	0.36
Cadmium (Dissolved)	mg/l	0.00011	35	0.00012	0.00085
Cobalt (Dissolved)	mg/l	0.0005	35	0.00052	0.025
Chromium (Dissolved)	mg/l	0.0005	35	0.00055	0.021
Copper (Dissolved)	mg/l	0.0005	35	0.00051	0.013
Iron (Dissolved)	mg/l	0.005	35	0.0067	170
Mercury (Dissolved)	mg/l	0.00005	35	0.00005	0.00005
Molybdenum (Dissolved)	mg/l	0.0002	35	0.0005	0.0033
Nickel (Dissolved)	mg/l	0.0005	35	0.0021	0.085
Lead (Dissolved)	mg/l	0.0005	35	0.00094	0.19
Selenium (Dissolved)	mg/l	0.0005	35	0.00054	0.027
Vanadium (Dissolved)	mg/l	0.0005	35	0.00092	0.02
Zinc (Dissolved)	mg/l	0.0025	35	0.0029	0.35
Total Organic Carbon	mg/l	2.0	35	4.9	500
Aliphatic TPH >C5-C6	mg/l	0.0001	35	0.062	0.17
Aliphatic TPH >C6-C8	mg/l	0.0001	35	0.03	1.6

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Aliphatic TPH >C8-C10	mg/l	0.0001	35	0.047	12
Aliphatic TPH >C10-C12	mg/l	0.0001	35	0.021	21
Aliphatic TPH >C12-C16	mg/l	0.0001	35	36	36
Aliphatic TPH >C16-C21	mg/l	0.0001	35	48	48
Aliphatic TPH >C21-C35	mg/l	0.0001	35	0.045	25
Aliphatic TPH >C35-C44	mg/l	0.0001	35	2.5	2.5
Total Aliphatic Hydrocarbons	mg/l	0.005	35	0.045	150
Aromatic TPH >C5-C7	mg/l	0.0001	35	0.026	36
Aromatic TPH >C7-C8	mg/l	0.0001	35	0.034	64
Aromatic TPH >C8-C10	mg/l	0.0001	35	0.048	72
Aromatic TPH >C10-C12	mg/l	0.0001	35	0.039	160
Aromatic TPH >C12-C16	mg/l	0.0001	35	0.027	380
Aromatic TPH >C16-C21	mg/l	0.0001	35	0.042	270
Aromatic TPH >C21-C35	mg/l	0.0001	35	0.031	190
Aromatic TPH >C35-C44	mg/l	0.0001	35	<0.0001	<0.0001
Total Aromatic Hydrocarbons	mg/l	0.005	35	0.14	1100
Total Petroleum Hydrocarbons	mg/l	0.01	35	0.36	1300
Total BTEX	mg/l	0.001	35	0.0031	180
Benzene	mg/l	0.001	35	0.0023	140
Toluene	mg/l	0.001	35	0.001	16
Ethylbenzene	mg/l	0.001	35	0.026	4.5
m & p-Xylene	mg/l	0.001	35	0.011	21
o-Xylene	mg/l	0.001	35	0.001	12
Naphthalene	mg/l	0.0001	35	<0.0001	98
Acenaphthylene	mg/l	0.0001	35	<0.0001	19
Acenaphthene	mg/l	0.0001	35	<0.0001	2.6
Fluorene	mg/l	0.0001	35	<0.0001	7.2
Phenanthrene	mg/l	0.0001	35	<0.0001	19
Anthracene	mg/l	0.0001	35	<0.0001	5.5
Fluoranthene	mg/l	0.0001	35	<0.0001	4.9
Pyrene	mg/l	0.0001	35	<0.0001	6.9
Benzo[a]anthracene	mg/l	0.0001	35	<0.0001	1.9
Chrysene	mg/l	0.0001	35	<0.0001	1.2
Benzo[b]fluoranthene	mg/l	0.0001	35	0.0023	<0.0001
Benzo[k]fluoranthene	mg/l	0.0001	35	<0.0001	<0.0001

Determinands	Unit	LOD	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Benzo[a]pyrene	mg/l	0.0001	35	<0.0001	<0.0001
Indeno(1,2,3-c,d)Pyrene	mg/l	0.0001	35	<0.0001	<0.0001
Dibenz(a,h)anthracene	mg/l	0.0001	35	<0.0001	0.046
Benzo[g,h,i]perylene	mg/l	0.0001	35	<0.0001	<0.0001
Total of 16 PAHs	mg/l	0.002	35	<0.0001	170
Resorcinol	mg/l	0.0050	35	0.018	0.15
Phenol	mg/l	0.0050	35	0.005	12
Cresols	mg/l	0.0050	35	0.005	33
Xylenols	mg/l	0.0050	35	0.014	12
1-Naphthol	mg/l	0.0050	35	<0.0050	<0.0050
Trimethylphenols	mg/l	0.0050	35	0.01	0.89
Total Phenols	mg/l	0.030	35	0.047	58
Germanium	mg/l	0.001	9	270	390

4.5. Surface Water Results

A total of eight surface water samples were scheduled for laboratory analysis, including two duplicates. The laboratory analytical results are summarised in Table 4-4

Table 4-4 - Summary of Surface Water Analytical Results

Determinands	Unit	LOD (ug/l)	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Electrical Conductivity	µS/cm	1.0	8	620	1200
Suspended Solids At 105C	mg/l	5.0	8	<5	140
Dissolved CO2	mg/l	0.60	8	1.6	250
Chloride	mg/l	1.0	8	<0.05	83
Ammonium	mg/l	0.050	8	0.16	0.27
Nitrite as NO2	mg/l	0.020	8	0.16	0.16
Nitrate as NO3	mg/l	0.50	8	69	69
Sulphur	mg/l	1.0	8	26	90
Sulphate	mg/l	1.0	8	79	270
Cyanide (Total)	mg/l	0.050	8	<0.05	<0.05
Cyanide (Free)	mg/l	0.050	8	<0.05	<0.05
Thiocyanate	mg/l	0.50	8	<0.5	<0.5
Cyanide (Complex)	mg/l	0.050	8	<0.05	<0.05
Sulphide	mg/l	0.050	8	<0.05	<0.05
Hydrogen Sulphide	mg/l	0.050	8	<0.05	<0.05

Determinands	Unit	LOD (ug/l)	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Arsenic (Dissolved)	µg/l	0.20	8	0.00094	0.0013
Cadmium (Dissolved)	µg/l	0.11	8	<0.00011	<0.00011
Chromium (Dissolved)	µg/l	0.50	8	<0.0005	<0.0005
Copper (Dissolved)	µg/l	0.50	8	0.0021	0.0044
Iron (Dissolved)	µg/l	5.0	8	0.02	0.038
Mercury (Dissolved)	µg/l	0.05	8	<0.00005	<0.00005
Nickel (Dissolved)	µg/l	0.50	8	0.0038	0.0068
Lead (Dissolved)	µg/l	0.50	8	<0.0005	<0.0005
Selenium (Dissolved)	µg/l	0.50	8	0.00076	0.0024
Zinc (Dissolved)	µg/l	2.5	8	0.017	0.027
Manganese [II]	µg/l	1.0	8	<0.001	<0.001
Manganese [IV]	µg/l	1.0	8	<0.001	<0.001
Iron [II]	µg/l	20	8	<0.02	<0.02
Iron [III]	µg/l	20	8	<0.02	<0.02
Total Organic Carbon	mg/l	2.0	8	6.8	9.8
Dissolved Methane	mg/l	0.050	8	<0.05	<0.05
Aliphatic TPH >C5-C6	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C6-C8	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C8-C10	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C10-C12	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C12-C16	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C16-C21	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C21-C35	µg/l	0.10	8	<0.0001	<0.0001
Aliphatic TPH >C35-C44	µg/l	0.10	8	<0.0001	<0.0001
Total Aliphatic Hydrocarbons	µg/l	5.0	8	<0.005	<0.005
Aromatic TPH >C5-C7	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C7-C8	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C8-C10	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C10-C12	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C12-C16	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C16-C21	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C21-C35	µg/l	0.10	8	<0.0001	<0.0001
Aromatic TPH >C35-C44	µg/l	0.10	8	<0.0001	<0.0001
Total Aromatic Hydrocarbons	µg/l	5.0	8	<0.005	<0.005
Total Petroleum Hydrocarbons	µg/l	10	8	<0.01	<0.01

Determinands	Unit	LOD (ug/l)	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Total BTEX	µg/l	1.0	8	<0.001	<0.001
Dichlorodifluoromethane	µg/l	1.0	8	<0.001	<0.001
Chloromethane	µg/l	1.0	8	<0.001	<0.001
Vinyl Chloride	µg/l	1.0	8	<0.001	<0.001
Bromomethane	µg/l	5	8	<0.005	<0.005
Chloroethane	µg/l	2.0	8	<0.005	<0.005
Trichlorofluoromethane	µg/l	1.0	8	<0.001	<0.001
1,1-Dichloroethene	µg/l	1.0	8	<0.001	<0.001
Trans 1,2-Dichloroethene	µg/l	1.0	8	<0.001	<0.001
1,1-Dichloroethane	µg/l	1.0	8	<0.001	<0.001
cis 1,2-Dichloroethene	µg/l	1.0	8	<0.001	<0.001
Bromochloromethane	µg/l	5	8	<0.005	<0.005
Trichloromethane	µg/l	1.0	8	<0.001	<0.001
1,1,1-Trichloroethane	µg/l	1.0	8	<0.001	<0.001
Tetrachloromethane	µg/l	1.0	8	<0.001	<0.001
1,1-Dichloropropene	µg/l	1.0	8	<0.001	<0.001
Benzene	µg/l	1.0	8	<0.001	<0.001
1,2-Dichloroethane	µg/l	2.0	8	<0.002	<0.002
Trichloroethene	µg/l	1.0	8	<0.001	<0.001
1,2-Dichloropropane	µg/l	1.0	8	<0.001	<0.001
Dibromomethane	µg/l	10	8	<0.010	<0.010
Bromodichloromethane	µg/l	5	8	<0.005	<0.005
cis-1,3-Dichloropropene	µg/l	10	8	<0.010	<0.010
Toluene	µg/l	1.0	8	<0.001	<0.001
Trans-1,3-Dichloropropene	µg/l	10	8	<0.010	<0.010
1,1,2-Trichloroethane	µg/l	10	8	<0.010	<0.010
Tetrachloroethene	µg/l	1.0	8	<0.001	<0.001
1,3-Dichloropropane	µg/l	2.0	8	<0.002	<0.002
Dibromochloromethane	µg/l	10	8	<0.010	<0.010
1,2-Dibromoethane	µg/l	5	8	<0.005	<0.005
Chlorobenzene	µg/l	1.0	8	<0.001	<0.001
1,1,1,2-Tetrachloroethane	µg/l	2.0	8	<0.002	<0.002
Ethylbenzene	µg/l	1.0	8	<0.001	<0.001
m & p-Xylene	µg/l	1.0	8	<0.001	<0.001
o-Xylene	µg/l	1.0	8	<0.001	<0.001
Styrene	µg/l	1.0	8	<0.001	<0.001

Determinands	Unit	LOD (ug/l)	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Tribromomethane	µg/l	1.0	8	<0.001	<0.001
Isopropylbenzene	µg/l	1.0	8	<0.001	<0.001
Bromobenzene	µg/l	1.0	8	<0.001	<0.001
1,2,3-Trichloropropane	µg/l	50	8	<0.050	<0.050
N-Propylbenzene	µg/l	1.0	8	<0.001	<0.001
2-Chlorotoluene	µg/l	1.0	8	<0.001	<0.001
1,3,5-Trimethylbenzene	µg/l	1.0	8	<0.001	<0.001
4-Chlorotoluene	µg/l	1.0	8	<0.001	<0.001
Tert-Butylbenzene	µg/l	1.0	8	<0.001	<0.001
1,2,4-Trimethylbenzene	µg/l	1.0	8	<0.001	<0.001
Sec-Butylbenzene	µg/l	1.0	8	<0.001	<0.001
1,3-Dichlorobenzene	µg/l	1.0	8	<0.001	<0.001
4-Isopropyltoluene	µg/l	1.0	8	<0.001	<0.001
1,4-Dichlorobenzene	µg/l	1.0	8	<0.001	<0.001
N-Butylbenzene	µg/l	1.0	8	<0.001	<0.001
1,2-Dichlorobenzene	µg/l	1.0	8	<0.001	<0.001
1,2-Dibromo-3-Chloropropane	µg/l	50	8	<0.050	<0.050
1,2,4-Trichlorobenzene	µg/l	1.0	8	<0.001	<0.001
Hexachlorobutadiene	µg/l	1.0	8	<0.001	<0.001
1,2,3-Trichlorobenzene	µg/l	2.0	8	<0.002	<0.002
Methyl Tert-Butyl Ether	µg/l	1.0	8	<0.001	<0.001
Naphthalene	µg/l	0.10	8	<0.0001	<0.0001
Acenaphthylene	µg/l	0.10	8	<0.0001	<0.0001
Acenaphthene	µg/l	0.10	8	<0.0001	<0.0001
Fluorene	µg/l	0.10	8	<0.0001	<0.0001
Phenanthrene	µg/l	0.10	8	<0.0001	<0.0001
Anthracene	µg/l	0.10	8	<0.0001	<0.0001
Fluoranthene	µg/l	0.10	8	<0.0001	<0.0001
Pyrene	µg/l	0.10	8	<0.0001	<0.0001
Benzo[a]anthracene	µg/l	0.10	8	<0.0001	<0.0001
Chrysene	µg/l	0.10	8	<0.0001	<0.0001
Benzo[b]fluoranthene	µg/l	0.10	8	<0.0001	<0.0001
Benzo[k]fluoranthene	µg/l	0.10	8	<0.0001	<0.0001
Benzo[a]pyrene	µg/l	0.10	8	<0.0001	<0.0001
Indeno(1,2,3-c,d)Pyrene	µg/l	0.10	8	<0.0001	<0.0001
Dibenz(a,h)anthracene	µg/l	0.10	8	<0.0001	<0.0001

Determinands	Unit	LOD (ug/l)	No. of Samples	Minimum Value (mg/l)	Maximum Value (mg/l)
Benzo[g,h,i]perylene	µg/l	0.10	8	<0.0001	<0.0001
Total Of 16 PAH's	µg/l	2.0	8	<0.002	<0.002
PCB 28	µg/l	0.010	8	<0.00001	<0.00001
PCB 52	µg/l	0.010	8	<0.00001	<0.00001
PCB 81	µg/l	0.010	8	<0.00001	<0.00001
PCB 77	µg/l	0.010	8	<0.00001	<0.00001
PCB 90+101	µg/l	0.010	8	<0.00001	<0.00001
PCB 105	µg/l	0.010	8	<0.00001	<0.00001
PCB 114	µg/l	0.010	8	<0.00001	<0.00001
PCB 118	µg/l	0.010	8	<0.00001	<0.00001
PCB 123	µg/l	0.010	8	<0.00001	<0.00001
PCB 126	µg/l	0.010	8	<0.00001	<0.00001
PCB 138	µg/l	0.010	8	<0.00001	<0.00001
PCB 153	µg/l	0.010	8	<0.00001	<0.00001
PCB 156	µg/l	0.010	8	<0.00001	<0.00001
PCB 157	µg/l	0.010	8	<0.00001	<0.00001
PCB 167	µg/l	0.010	8	<0.00001	<0.00001
PCB 169	µg/l	0.010	8	<0.00001	<0.00001
PCB 180	µg/l	0.010	8	<0.00001	<0.00001
PCB 189	µg/l	0.010	8	<0.00001	<0.00001
Total PCBs (7 congeners)	µg/l	0.010	8	<0.00001	<0.00001
Resorcinol	mg/l	0.0050	8	<0.005	<0.005
Phenol	mg/l	0.0050	8	<0.005	<0.005
Cresols	mg/l	0.0050	8	<0.005	<0.005
Xylenols	mg/l	0.0050	8	<0.005	<0.005
1-Naphthol	mg/l	0.0050	8	<0.005	<0.005
Trimethylphenols	mg/l	0.0050	8	<0.005	<0.005
Total Phenols	mg/l	0.030	8	<0.03	<0.03

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Appendices

