

GeoInvestigations
9 Greenlands Business Park
Studley Road
Redditch
B98 7HD

0121 314 5432
07419 327 307
paul@geoinvestigations.co.uk



Remediation Strategy And Verification Plan For New Lidl Supermarket At Holbeach Road Spalding

REPORT PREPARED ON BEHALF OF Lidl UK GmbH

Paul Palgrave BSc (Hons) ARSM MSc C.Geol FGS
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Contents	Page No
1. INTRODUCTION.....	1
2. GEOINVESTIGATIONS 2019 INVESTIGATIONS	5
2.1 Tank Cradle Investigation.....	5
2.2 Contamination Delineation Exercise 31.1.19	12
3. RISK ASSESSMENT & REMEDIAL TARGETS.....	15
3.1 Assessment Criteria Human Health.....	15
3.2 Controlled Waters Quantitative Risk Assessment	17
4. PROPOSED REMEDIATION METHODOLOGY	18
4.1 Remedial Excavation	18
4.2 General Working Practices.....	20
4.3 Waste Management Regulations.....	23
4.4 Environmental Permit	23
5. VALIDATION/VERIFICATION REPORT	24

Tables

Table 1: Summary of Soil and Groundwater Chemical Test Results

Table 2: Equilibrium Concentrations of PCOC VOC's in Soil Atmosphere (C vap), ADE/HCV summary, and proposed groundwater remedial targets.

Drawings

696-D-01: Exploratory Hole Location Plan

1057-D-01: Conjectured Extent of Remedial Excavation

Appendices

Appendix 1: Trial Pit Logs

Appendix 2: Chemical Laboratory Test Certificates

Appendix 3: CLEA model output for calculation of Soil GACs

Appendix 4: CLEA model output for calculation of ADE/HCV for VOC compounds in the vadose zone, in equilibrium with groundwater.

Appendix 5: CLEA model output for calculation of VOC concentrations at source for VOC compounds to give ADE/HCV ratio of 1.

Appendix 6: Soil Importation Procedure.

1. INTRODUCTION

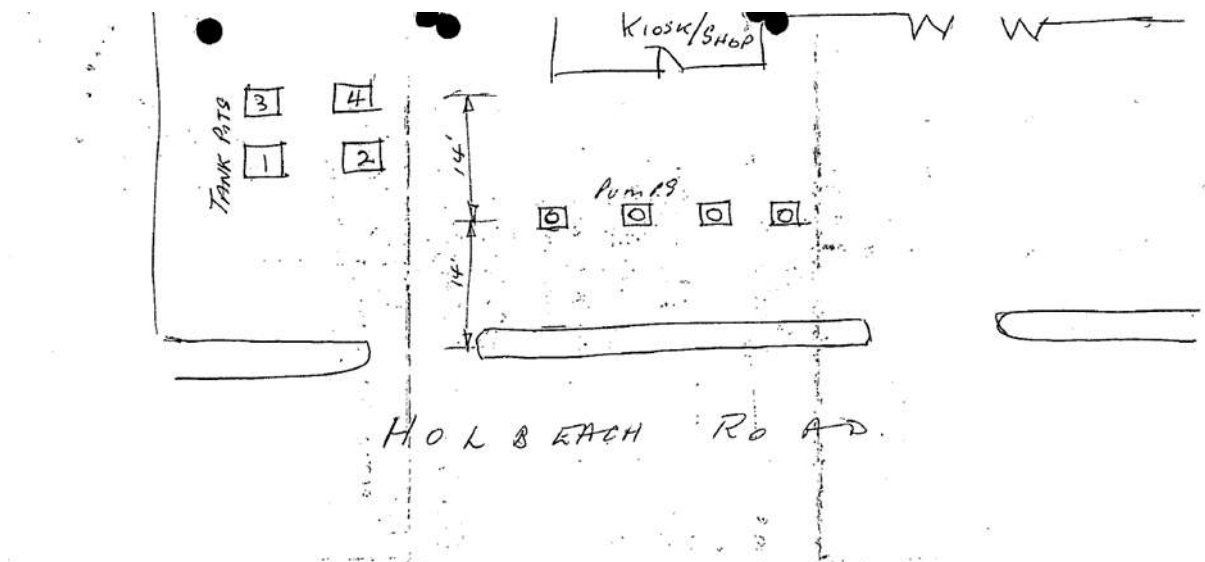
GeoInvestigations were instructed by Lidl UK GmbH (the 'Client') to prepare a Remediation Strategy and Verification Plan at the site of a proposed new Lidl supermarket development on Holbeach Road, Spalding Lincolnshire.

A previous Phase 1 and Phase 2 intrusive investigation by GeoInvestigations in 2016 targeted a former petrol filling station in the south-western corner of the site, where it was known from the Petroleum Licensing records and the previous owner that there were two buried tanks (with two compartments each).

The information provided regarding the petrol filling station is summarised as follows: -

- Tank details – Installed in 1959, 4 x 1,500 Gallons (6819 litres) Tanks, Petrol;
- Plans of last known tank locations – See plan of the site attached;
- Details of decommissioning – Permanently made safe by infilling with Concrete Slurry on 31st March 1998 by P.E.M.S. (Petrol Equipment Maintenance Services);
- Reported Spillages/Contamination/Incidents – No incidents known;
- Licence details – Licensed for 27,276 Litres of Petrol, last licence detailed on 8th April 1997 for twelve months."

A plan was also provided, as detailed below.



The location of the four tank inspection covers corresponded to the four steel manhole covers shown on the topographic survey of the site, which shows the covers set into a concrete slab. It was presumed that the square concrete slab covered the buried tanks.

The findings of the Phase 1 and Phase 2 investigation are presented in GeoInvestigations report referenced 696-R-01A, dated July 2017 (Rev A: August 2017).

The only area of potential concern identified with respect to ground contamination was associated with the two buried fuel underground storage tanks.

Four trial pits (TP9, TP10, TP11 and TP15) were excavated along each side of the concrete slab above the tanks, revealing brick walls around the tanks, showing that they had been placed within a below ground bund or cradle.

The cradle appeared to be holding perched groundwater, which leaked through joints or cracks in the brick walls of the cradle into the trial pits where exposed. The water was oily and with an odour of fuel, hence it was concluded that fuel had leaked into the bund, contaminating the water trapped or perched within the structure.

Three standpipes were installed in boreholes WS5, WS6 and WS7 around the USTs. Borehole WS6 was located immediately adjacent to the cradle at the up-hydraulic gradient side, WS5 was located down-hydraulic gradient, to the north-east of the tanks, and WS7 was located to the east of WS6, where groundwater elevation/hydraulic head was similar.

As expected, hydrocarbon impacted groundwater was detected within borehole WS6, and to a lesser extent borehole WS5, indicating that groundwater contamination was extending away from the UST down hydraulic gradient to the north-east. The groundwater sample from the standpipe in borehole WS7 showed no notable impact of concern by petroleum hydrocarbons.

It was noted that there was a residential dwelling located adjacent to the site boundary, close to the USTs. The foundations of the dwelling were measured on the topographic survey to be approximately 7 metres from the edge of the concrete slab above the tanks.

As the soil and groundwater close to the tank cradle was impacted at both the down hydraulic gradient and also the up-hydraulic gradient side, it was concluded that there may be potential risk from the migration of volatile organic compounds in soils and groundwater towards the adjacent residential property. The groundwater hydraulic gradient is very low in the area, and if the groundwater in the cradle is perched, it will create a local area at higher hydraulic gradient, driving groundwater seepage against the general flow in the area immediately surrounding the tanks to some degree, hence potentially causing contamination to spread up-hydraulic gradient to some extent.

However, as the contamination is at the depth of the water table, around 2.0 metres below ground level, and the soils above are low permeability clayey silts, the risk from lateral and upward migration of volatile organic compounds from

the source area within the tank cradle was considered low. There is no evidence to indicate that such migration has occurred in the past when the petrol filling station was operational, hence the risk should be reducing, since the closure of the petrol filling station, and stabilisation of the tanks.

But it was recommended that the opportunity be taken to further reduce the risk by removal of the fuel tanks, and to treat the contaminated soil and groundwater, so that any future risk to the adjacent residents is minimised.

An in-situ treatment was initially proposed, but, as this process can take 6 months to 18 months to achieve remedial targets, an alternative approach is now proposed, comprising wholesale removal of the tanks, the cradle and contaminated soils around the cradle by excavation, with off-site disposal of the unacceptably impacted material. Contaminated groundwater within and surrounding the cradle will also be removed by pumping to tankers so that the principal source is removed.

The groundwater level monitoring confirms the groundwater hydraulic gradient falls towards the north-east, as expected. Removal of the walls of the cradle will allow groundwater to flow from the south-west through the area and assist with natural degradation over time thus further reducing residual hydrocarbon concentrations in soils in contact with the groundwater over time, by flushing through with oxygenated water.

In order to determine the degree of contamination within the cradle, the opportunity was taken to examine the soils and groundwater within the cradle following the recent removal of the underground fuel storage tanks.

The material within the cradle above and around the sides of the tanks was placed in a stockpile. Sufficient excavation was undertaken to enable the tanks to be pulled without complete excavation of the soil beneath and around the lower part of the tanks. Once the tanks were pulled, the voids were temporarily backfilled for safety reasons with the clean spoil from above and around the tanks

GeoInvestigations were asked to visit the site on 18th January 2019 to inspect the tank pull excavation, to determine the potential extent of any remedial works.

The material within the tank cradle was excavated to reveal the walls, which were shown to comprise brick walls with concrete to the rear along the western side. A concrete base to the cradle was also proven. The backfill comprised an upper layer of clean soil with no evidence of hydrocarbon impact, but, a layer at the base of the cradle was found to be black stained and with an odour of aged fuel.

This layer was stockpiled separately on a polyethylene membrane, which was later covered over with polythene sheeting to minimise odour generation and infiltration/leachate generation.

The clean soil was used to backfill the cradle for safety reasons.

As the extent of lateral migration from the tank cradle had not been confirmed, a second return visit was undertaken on 31st January 2019 to undertake additional ground investigations to delineate the extent of the hydrocarbon impacted soil surrounding the tank cradle, and to sample the groundwater where encountered entering the excavations.

The findings of the recent additional investigations have been used to produce a remediation strategy for the impacted area, with remedial targets for the soils.

The records of the two recent visits are presented within the following section of this document.

2. GEOINVESTIGATIONS 2019 INVESTIGATIONS

2.1 Tank Cradle Investigation

Photographs taken on 18th January, showing the tank cradle inspection are presented below: -



The two fuel USTs (with two compartments each). Filled with weakly cemented sand slurry. Looking west from site. Tank excavation is located to the right hand side of the stockpile.



Close up of the tanks. Each has two access points (one for each compartment).



As above. Sand/cement slurry fill can be seen inside the tank.



Western face of excavation. Note batter for stability to ensure driveway was supported.



Looking south-east from north-west corner. Note water trapped/ponded on the concrete at the base of the excavation. The water was around 100mm deep in places.



Soil with no visual or olfactory evidence of impact from upper part of the cradle.



Survey staff lowered into the excavation to measure depth of excavation. Looking west across excavation. The concrete base is approximately 2.40m below original ground level.



View looking west across exposed cradle. The cradle brick walls are visible at the rear and along the sides. The walls are in poor condition, with collapse noted locally.



View looking west across cradle excavation.



Extension of excavation east to locate cradle wall on the eastern side of the tanks. It was concluded that there were only three sides remaining to the cradle. The wall along the eastern side was not proven.



Backfilling cradle for safety reasons. View west towards adjacent dwelling.

Samples were taken from the stockpile of contaminated spoil from the base of the cradle excavation, and from the stockpile of upper spoil with no visual/olfactory evidence of impact used to backfill the cradle.

In addition, samples were taken from the sides of the excavation at a few locations where the cradle wall had collapsed exposing the soil behind, and from the eastern face of the excavation, where the cradle wall was missing.

The test results are presented and discussed within the following Section 3 of this document.

2.2 Contamination Delineation Exercise 31.1.19

A return visit was undertaken on 31st January 2019 by GeoInvestigations to undertake a trial pitting exercise to delineate the extent of petroleum hydrocarbon impact around the cradle.

A smaller bucket (600mm wide) was used to undertake a trial pitting exercise around the cradle to minimise odour and spoil generation. Eight trial pits, TP100 to TP107, were excavated around the tank cradle.

The locations of the trial pits are shown on appended Drawing 1057-D-01. The trial pit logs are presented in Appendix 1, along with photographs of the trial pits.

A MiniRae 2000 photoionisation detector was taken to site to monitor the ambient air during excavation, and to measure the total volatile organic compound concentrations close to the impacted soils. The results are shown on the trial pit logs.

For safety and stability, trial pits TP100 and TP101 were excavated perpendicular to the boundary with the residential property, and into the remaining batter, as close as possible to the boundary. These trial pits proved an upper layer of natural grey, mottled orange brown, silt, which contains black peaty/organic rich pockets locally. At around 2.0 metres below original ground level, the soils become soft and light grey-brown mottled black. Trial pits TP100 and TP101 struck the rear wall of the tank cradle and when exposed oily water with an odour of aged fuel seeped in the pit from behind the wall. Away from the rear of the wall, closer to the site boundary, there was no noticeable odour associated with the soils, indicating that the lateral spread from the cradle was restricted.

Below around 2.45 metres below original ground level, a greyish brown, very silty fine sand was encountered, becoming less silty with depth.

Trial pit TP102 was excavated from near the south-east corner of the site, at an angle of 45 degrees to the site boundaries, towards the tank cradle. As with TP100 and TP101, the soils at the far end of the pit, away from the tank cradle were not apparently impacted by hydrocarbons, but closer to the tank cradle, there was

evidence of seepage of fuel and fuel contaminated groundwater, causing localised impact close to the cradle.

The ground conditions around the cradle were similar in each trial pit, including a thin layer of made ground where the reduced dig had not been undertaken (TP104, TP105 and TP106), above a brown, orange brown and orange mottled clayey silt, overlying fine sand below around 2.0 metres below original ground level.

Trial pit TP103 was excavated parallel to the southern side of the cradle, approximately 3 metres from the cradle wall. There was no visual or olfactory evidence of impact at that distance, along the previous TP9 had identified impact adjacent to the rear of the cradle wall.

Trial pit TP104 was positioned parallel to the western side of the cradle, approximately 3.0 metres from the edge of the concrete slab that covered the tanks. A slight odour was detected at around 1.60m below original ground level, associated with seepages of ground water at 1.50m below ground level. Samples were taken of this material.

Trial pit TP105 was therefore excavated further west, around 2 metres from TP104, but there was no detectable hydrocarbon odour or evidence of any hydrocarbon impact.

Trial pit TP106 was located across the north-eastern corner of the former cradle perpendicular to the groundwater flow direction, which is considered to be towards the north-east, in order to intercept any evidence of contamination migration in that direction. However, no impacted soil or groundwater was encountered.

Trial pit TP107 was excavated parallel to the northern side of the cradle, approximately 3 metres north of the cradle wall, to establish if contamination migration extended in a more northerly direction. However, there was no evidence of petroleum hydrocarbon impact on the soils to the full depth of the pit, which was taken to 3.0 metres below original ground level.

The trial pitting exercise showed no visual or olfactory evidence of petroleum hydrocarbon impact within soils located further than around 2.0 metres from the cradle wall.

Soils within 2.0 metres of the cradle wall are likely to show some impact, due to seepage of fuel and perched water contaminated by fuel, through the cradle wall. However, lateral migration of fuel appears restricted.

Soil samples taken from the trial pits were stored in amber glass jars and placed in cooler boxes with ice-packs to await collection by courier and delivery to the laboratory of QTS Environmental in Kent. Selected samples were subject to chemical analysis for banded extractable petroleum hydrocarbons, and where

impact was observed the hydrocarbons were subject to analysis for banded petroleum hydrocarbon analysis with aliphatic and aromatic split (in accordance with the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) methodology), and also for volatile organic compounds (VOCs).

It was possible to obtain one sample of groundwater, as seepage rates into the trial pits were generally very slow and the sides tended to collapse before sufficient water had collected.

The sample obtained was taken from trial pit TP102 and originated principally as a seepage through the cradle wall, hence it is considered representative of the water perched at the base of the cradle as opposed to groundwater away from the cradle. The water sample was subject to analysis for VOCs and petroleum hydrocarbons (TPHCWG methodology).

The soil chemical test results are presented in Appendix 2, and summarised within appended Table 1.

The results are compared against the proposed remedial targets, as discussed within the following Section 3 of this report.

3. RISK ASSESSMENT & REMEDIAL TARGETS

3.1 Assessment Criteria Human Health

The contamination test data for the soils were originally compared against published 'Tier 1' generic assessment criteria (GAC), for a commercial/industrial use in the first instance. However, as the site area underlain by the tank cradle and associated petroleum hydrocarbon impacted soils and groundwater is to be open space and access, the risk to workers, the general public and landscape maintenance workers is negligible from soil and impacted groundwater 2 metres below ground level.

As discussed previously, the principal potentially active pollutant linkage is considered to be from inhalation indoors of volatile organic compounds associated with the fuel impacted soils and groundwater within and close to the UST cradle.

For VOCs to enter the adjacent property, upwards and lateral migration would need to occur from the source area, which is considered restricted by the presence of the low permeability silt deposits above the contamination source.

However, to avoid extensive monitoring and modelling of VOCs, requiring installation of monitoring points beneath and within the adjacent property, a conservative approach has been taken, based on the CLEA model, which has been used to derive generic assessment criteria for the indoors inhalation pathway for soils, and also for vapours generated by volatilization of hydrocarbons from the dissolved phase in groundwater.

The CLEA model assumes that the impacted soil lies at a metre below the footprint of the residential property. The Johnson-Ettinger approach is adopted by the CLEA model to predict the concentration of volatile organic compounds within indoors air, and hence generate acceptable concentration in the soil beneath the property.

It is generally accepted that the Johnson-Ettinger model is conservative, and, furthermore, it does not allow for sources located laterally from the property, or degradation of VOCs within the soil atmosphere. Hence, the GAC derived are considered conservative, but, serve as initial remedial targets.

There is an additional pathway that has also been considered, comprising the inhalation of VOCs from contaminated groundwater. The CLEA model has been used in 'ratio mode', to forward model the VOC concentrations within indoors air, based on the calculated concentrations within the soil atmosphere beneath the property.

The concentrations of the VOCs in the soil atmosphere has been calculated using a simple partition equation, relating the concentration of the VOCs in the soil

atmosphere that would be generated if the air in the soil was in equilibrium with the groundwater below. The dimensionless Henry's Law constant is used to calculate the VOC concentrations within the soil atmosphere above the groundwater. The calculations are summarised in the appended Table 2. The source groundwater concentrations for the principal contaminants of concern are based on the result for the water sample taken from trial pit TP102 (sample 7/W), as presented in Table 2, and also the previous groundwater sample taken from borehole WS6. The maximum groundwater concentrations from WS6 and TP102 are used to calculate the VOC concentrations within the soil atmosphere above the groundwater.

The predicated VOC concentrations within the soil atmosphere are entered into the CLEA software, which, in 'ratio mode', provides the ratio of ADE (Average Daily Exposure) to the HCV (Health Criteria Value).

If the ratio is less than one, then the ADE does not exceed the HCV, and the soil atmosphere concentration is considered acceptable. If the ratio is 1 or above, then the concentration may not be acceptable.

Table 2 shows that the ADE/HCV ratios are above 1 is for the following compounds and petroleum hydrocarbon fractions:

Benzene
Xylenes
1,2,4 trimethylbenzene,
Aromatic >C10-C12
Aliphatic > C5-C6
Aliphatic >C6-C8
Aliphatic >C8-C10

Hence there is a theoretical unacceptable risk from these compounds and fractions (assuming the groundwater directly beneath the adjacent property contains elevated petroleum hydrocarbons) in relation to indoors air inhalation by adjacent residents. However, the indoors air inhalation model is conservative and does not allow for any degradation of the VOCs within the soil. But the modelled results are considered suitable for the purposes of generating an initial screening value for the groundwater results obtained after pumping the impacted water from the tank cradle remedial excavation.

Appendices 3 and 4 present the input and output data for the CLEA model for the generation of the soil GAC for indoors air inhalation from impacted soil, and from the groundwater respectively.

The CLEA model has been used to calculate the soil vapour concentrations at source for the above compounds and fractions that exceed the ADE/HCV ratio of 1. The vapour concentrations were divided by the ADE/HCV to derive a vapour concentration that gives an ADE/HCV of 1. The reduced vapour concentration was re-entered into the CLEA model to double-check that the ADE/HCV ratio equals 1.

The VOC vapour concentrations that give an ADE/HCV =1 are presented in Table 2, and the CLEA model output is presented in Appendix 5.

Groundwater remedial concentrations are calculated by taking the revised VOC vapour concentrations, using the partition equation (i.e. $C_w = C_{vap}/K_{aw}$ ug/l).

The groundwater remedial targets are also presented within Table 2.

For VOC compounds/fractions in groundwater that did not generate an ADE/HCV greater than one in relation to indoors air inhalation, the maximum groundwater concentrations detected within the samples taken from WS6 and TP102 have been adopted, so that the groundwater will not be any worse than currently identified and improved with respect to the VOCs that are currently elevated.

Table 1 includes the soil test data, along with the soil assessment criteria derived from the CLEA modelling and show that the concentrations of the petroleum hydrocarbons within the soils is unlikely to present a risk through indoors air inhalation, even if those soils were located at shallow depth immediately beneath the floor of the adjacent property.

3.2 Controlled Waters Quantitative Risk Assessment

The hydraulic gradient across the site is very low, in the order of 0.0005, based on the groundwater level monitoring data and the topographic survey, which were used to generate groundwater levels across the site, reduced to Ordnance Datum.

The permeability of the silty fine sands beneath the site are anticipated to be at the low end of the spectrum for sands, hence, in combination with a very gently hydraulic gradient, dissolved phase contaminant migration is considered very restricted and the risk of unacceptable impact on surface water receptors in the area from petroleum hydrocarbons associated with the UST area is considered to be minimal.

The concentrations of petroleum hydrocarbons within borehole WS3 located 80 metres down gradient of the USTs were below detection limit, demonstrating that the contamination associated with the USTs has not extended off-site.

The proposed remedial works to remove the source contamination associated with the tanks will further reduce the risk to surface water receptors.

The deposits beneath the site are unclassified by the Environment Agency in relation to a groundwater resource and were previously classified as 'non-aquifers'.

4. PROPOSED REMEDIATION METHODOLOGY

4.1 Remedial Excavation

The two USTs have already been excavated, cut up and disposed off-site. The tanks were filled with weakly cemented sand and there was no evidence of any fuel remaining within the tanks.

However, there is residual perched contaminated groundwater within the remnant cradle, and impacted soils located around the cradle walls.

The groundwater presents a theoretical risk of generating elevated volatile organic compounds, principally trimethylbenzene, which remains dissolved within the trapped groundwater within the cradle area.

The contaminated groundwater is contained by the walls of the cradle, but the dissolved phase contaminants are able to migrate through gaps in the wall and impact on the surrounding soil. Historically, this may have included floating free phase hydrocarbons which form a residual hydrocarbon phase within the soil in a smear zone close to the tank. The low permeability of the silty fine sand deposits would tend to restrict the migration of free phase due to capillary suction.

In order to reduce the risk of any potential ongoing or future impact on the adjacent property, it is proposed to pump the contaminated groundwater from the infilled cradle to tankers from a sump excavated into the backfill within the cradle.

The sump would comprise a stack of perforated manhole rings with a submersible pump.

The fringe of impacted soil around the cradle walls would also be excavated, and removal of the walls would allow any groundwater within the excavation around the cradle walls to drain towards the sump, eventually drawing in clean water surrounding the excavation. The extent of the impacted area is shown on Drawing 1057-D-01.

Contaminated soils were not detected along the eastern side of the cradle, as the walls had been removed previously, and any hydrocarbon impacted excavated material generated during the cradle inspection excavation works on 18th January 2019 had not been replaced within the excavation, but disposed off-site, hence that side of the cradle requires no further excavation works.

The base and sides of the excavation around the tank cradle shall be sampled on a 5m interval, with samples taken from the sides at the level of the impacted material around the water table at between around 1.80m and 2.20m below original ground level.

Groundwater pumped from the sump shall be sampled after removal of the impacted soil around the cradle and after one 2000 gallon (10m³) tanker of water has been pumped from the sump, which would approximate to emptying the residual water within the cradle, and allowance for some inflow from the surrounding ground.

Groundwater sampling standpipes will also be installed along the western boundary of the site, close to the adjacent residential property, and around the tank excavation.

The groundwater samples would be taken from these installations and the sump, and the test results shall be compared against the remedial targets presented in Table 2.

If the results exceed the targets, then further pumping will be undertaken and laboratory testing undertaken, followed by further action as necessary. This may include additional investigation and removal of further impacted soil as necessary.

The aim of the exercise however is to reduce risk, but not necessarily remediate groundwater to over conservative targets.

An alternative assessment approach may be taken to assess residual risk following the remedial excavation and groundwater pumping if the groundwater concentrations exceed the conservative CLEA model generated values. Such assessment may include monitoring of soil vapour concentrations in the shallow soils along the site boundary and above the cradle to establish the actual soil vapour concentrations, and further groundwater monitoring along the boundary.

More sophisticated modelling of soil vapour intrusion may also be undertaken to give a more realistic assessment of risk.

The soil material excavated from around the cradle shall be stockpiled to await sampling and testing. The materials shall be stockpiled on geomembranes and sheeted over whilst the chemical tests are being undertaken and the results assessed.

The pumped groundwater shall be tankered off-site by an appropriately licensed waste carrier and disposed of at a licensed facility.

The environmental consultant shall be on site during the excavation works to assist with separation of excavated soils from around the tanks into obviously contaminated and other soils considered 'uncontaminated' and likely to be suitable for off-site disposal as 'non-hazardous', or used as backfill subject to confirmatory testing.

Samples will be taken of the stockpiles to assist in waste classification including general screening suites and waste acceptance criteria analysis as required.

The environmental consultant will also inspect and obtain samples from the sides of the excavations generated to remove the tanks, on a spacing of approximately 5.0 metres. Samples from the sides will be taken of the different strata observed and at two vertical intervals as a minimum at each location, one from above the water table and one close to the water table. If potentially 'grossly' contaminated material is observed, the excavation will be extended to ensure that it is removed and stockpiled on the potentially hazardous stockpile.

Whether a soil is likely to be contaminated material will be judged by the environmental consultant on site, based on visual and olfactory evidence initially, and through the use of a Photoionisation Detector (PID).

Grossly contaminated material will typically be black stained, highly odourous, and with evidence of residual free phase product and would generally give PID readings in excess of 200 ppm when undertaking a head space test in the field. In relation to petroleum storage sites, this type of material is typically located within the 'smear zone' at around the level of the water table where historic floating product has been smeared through the soil column by the seasonal rise and fall of the groundwater table.

4.2 General Working Practices

4.2.1 Remediation Management Arrangement

The remedial works are to be undertaken by a contractor to be appointed by the Client, Lidl UK GmbH.

An appointed environmental specialist, will visit site as required to inspect and take soil and water samples from the excavation, and to produce a Verification Report on completion.

Construction Design Management Co-ordination (CDMC) will be organised by the Client, as it is assumed that the works will fall under the CDM Regulations.

The appointed remediation contractor shall provide a detailed Risk Assessment and Method Statement (RAMS) prior to commencement of the works based on the available information on ground conditions which will be provided with the tender documentation for the works.

4.2.2 Securing the Site

In order to prevent members of the public falling into excavations, coming into contact with machinery, or contaminated soils, the site shall be secured by 2.0m high 'Heras' style fencing with appropriate signage, warning of deep excavations. Other suitable barriers or hoarding may also be provided.

4.2.3 Welfare & First Aid facilities

Welfare facilities shall be provided, including as a minimum, toilets with hot and cold running water for washing, with 'clean' and 'dirty' ends for changing, through which access to and from the work area shall be undertaken. A full time first aider for the duration of the works shall be on site.

4.2.4 Underground and Overhead Services

Prior to any excavation works, the locations of all buried services shall be confirmed and appropriate measures taken to re-route live services, or alternatively the services shall be disconnected and terminated at the site boundary.

4.2.5 Traffic Management & Wheel Washing.

Vehicles leaving site shall be free of loose soil and a high pressure jet wash area to clean down wheels and the undersides of vehicles before they leave site may be required. Wash water should be directed to a sump to allow contaminated silt etc. to settle before discharge of the water.

4.2.6 P.P.E & Hygiene Facilities.

It is intended that the general public are kept off site and that operatives would only access the remedial excavation area whilst operating plant such as excavators and dumpers. Hence, it is not envisaged that personnel will frequently come into direct contact with soils containing heavy contamination.

However, the Contractor's RAMS shall assess the risk to all operatives entering the remediation excavation area. As a minimum, the site workers involved in excavation will be required to wear disposable overalls, gloves, hi-viz vests, steel toe capped boots and hard hats.

Operatives will not be allowed to eat, drink or smoke until they have changed and washed and only in the welfare area of the site.

4.2.7 Plant Cleanliness & Refuelling

All plant will be checked and washed down as necessary as it leaves the remediation works area. Plant will be refuelled so as to avoid spillages and a suitably sized spill kit shall be available.

4.2.8 Dust

During dry weather and any dusty operations, a water spray to generate a mist shall be available to damp down the excavation area before and during excavation.

The contractor shall include within their method statement, measures to ensure that excessive dust is not generated during excavation works.

The surfaces of soil stockpiles shall be sealed with the excavator bucket and covered over with a polythene sheeting to minimise dust and hydrocarbon odour generation.

4.2.9. Noise and Vibration.

The contractor shall take measures to minimise the impact on the adjacent properties through noise and vibration.

4.2.10. Odour and Volatile Organic Compounds

Odours shall be reduced as necessary on site by damping down the excavation area with a mist spray.

Stockpiled soils shall be smoothed with the excavator bucket to seal them and covered by polythene sheeting.

If weather conditions are such that strong odours become a nuisance to surrounding neighbours, then measures shall be taken by the contractor to reduce the odours. This may require temporarily covering the excavation over until the odours dissipate and weather conditions improve.

The ambient level of volatile organic compounds in the atmosphere is unlikely to exceed occupational exposure limits outside of the excavation, due to dilution.

Aged petroleum hydrocarbon fuel in the ground released strong odours on excavation, that are typically detected at concentrations significantly below the occupational exposure limit.

However, it is advised that a personal PID with low and high level alarms set to include safe exposure limits for 'BTEX', naphthalene and trimethylbenzenes.

Should the alarms trigger, measures should be taken to reduce the vapour concentrations within the vicinity of the excavation. Working smaller areas, and waiting for vapour levels to dissipate should enable work to continue safely, but it may indicate that breathing apparatus may be necessary, or other measures to reduce VOC concentrations.

4.2.11. Pollution Control Measures

The contractor shall operate the site in accordance with Environment Agency Pollution and Prevention Guidance PPG6, Working at Construction and Demolition Sites.

Pollution prevention measures shall include consideration of run-off from the site, particularly after stripping the site, which should be controlled to avoid silt and fines entering any surface water drains.

Dust control/suppression measures shall be adopted when necessary on dry windy days.

Any fuels and oils etc. shall be stored on areas where spills and leaks shall be contained and prevented from escaping into the ground. Bunds shall be provided to contain leaks and the refueling areas shall drain to a collection sump.

4.3 Waste Management Regulations

The Contractor shall ensure that disposal of the contaminated soils from the remedial excavation area is disposed of in accordance with the waste regulations (the 'Regulations').

The site must be registered as a producer of hazardous waste and consignment notes maintained for each load of waste.

The disposal of all waste types shall be undertaken in accordance with the Defra publication, 'Waste management duty of care – a code of practice'. This requires waste transfer notes to be maintained for each load of waste, including lorry registration plate details; ensuring the carrier is registered and that the destination has the appropriate permits.

4.4 Environmental Permit

The works are not envisaged to require an environmental permit. However, it is responsibility of the Contractor to ensure they have the necessary permits for the proposed works.

Re-use of excavated material is encouraged if it is shown to be suitable without any treatment or processing. In such circumstances, the material is not a waste as it would always be intended to be re-used as engineered fill.

However, the adoption of the CL:AIRE Development Industry Code of Practice¹ is advised to minimise the risk of backfill material being classified as waste.

A recommended procedure is presented within Appendix 6 for the importation of fill material to assist with ensuring waste is not imported to site, and the material is suitable for use.

¹ CL:AIRE. 'The Definition of Waste: Development Industry Code of Practice'. Version 2. 2011.

5. VALIDATION/VERIFICATION REPORT

In order to validate the remedial works, the following documentation shall be included within the verification report.

- Drawing showing the extent of the remedial excavations.
- Record photographs showing progress and final extent of excavations.
- Drawing showing location of validation samples.
- Drawing showing location of any in situ PID readings, if undertaken.
- Laboratory test results for validation samples and samples of stockpiled materials intended for use as backfill.
- Details of any imported materials, and test results for imported fill as appropriate (refer to Appendix 6).
- Copy of Waste Carrier's Licence.
- Copy of Waste Transfer Notes and Consignment Notes, including transport vehicle registration numbers.
- Copies of imported fill material delivery Tickets.
- Copies of the waste disposal site permits.

The above shall be presented in a Remediation Verification Report including a summary of the works undertaken, and identification of any residual risks.

Once appointed, the principal contractor shall provide a risk assessment and method statement (RAMS) for the removal of the USTs in conjunction with a specialist contractor in relation to the temporary stabilisation of the tanks and issue of a certificate prior to removal.

TABLES

HOLBEACH RD, SPALDING.
TABLE 1: Summary of Soil Chemical Test Data

Table 1: Summary of Soil Chemical Test Results		SP1	SP1	SP2	SP2	VAL 1	VAL 2	VAL 3	VAL 4	VAL 6	VAL 7	VAL 8	TP100	TP101	TP101	TP102	TP102	TP103	TP104	TP104	TP106	TP107	TP107	No.	Max	GAC	GAC ⁽ⁱ⁾
		1	2	1	2	2.0-2.5m	1.50-2.00m	2.40 - 2.50	1.50 - 1.80	2.40 - 2.50	1.80m	2.4-2.5m	1.40	0.50	1.8-1.9	0.90	1.6-1.7	1.30 - 1.50	1.50	2.00	1.80 - 2.00	2.00m	3.00		Max	Commercial	Residential
Determinand	Unit																										
Naphthalene	mg/kg														2.55		3.37							2	3.37	190	79.4
Acenaphthylene	mg/kg														< 0.1		< 0.1							0	0.00	83,000	
Acenaphthene	mg/kg														< 0.1		< 0.1							0	0.00	84,000	
Fluorene	mg/kg														0.14		0.17							2	0.17	63,000	
Phenanthrene	mg/kg														0.15		0.17							2	0.17	22,000	
Anthracene	mg/kg														< 0.1		< 0.1							0	0.00	520,000	
Fluoranthene	mg/kg														0.28		< 0.1							1	0.28	23,000	
Pyrene	mg/kg														0.3		< 0.1							1	0.30	54,000	
Benzo(a)anthracene	mg/kg														< 0.1		< 0.1							0	0.00	170	
Chrysene	mg/kg														< 0.1		< 0.1							0	0.00	350	
Benzo(b)fluoranthene	mg/kg														0.33		< 0.1							1	0.33	44	
Benzo(k)fluoranthene	mg/kg														< 0.1		< 0.1							0	0.00	1200	
Benzo(a)pyrene	mg/kg														0.18		< 0.1							1	0.18	35	
Indeno(1,2,3-cd)pyrene	mg/kg														0.26		< 0.1							1	0.26	500	
Dibenz(a,h)anthracene	mg/kg														< 0.1		< 0.1							0	0.00	3.5	
Benzo(ghi)perylene	mg/kg														< 0.1		< 0.1							0	0.00	3900	
Total EPA-16 PAHs	mg/kg														4.2		3.7							2	4.20		
EPH (>C8 - C10)	mg/kg												1			5			< 1	181	< 1	< 1		3	181	9700	150
EPH (>C10 - C12)	mg/kg												< 1			5			3	129	< 1	< 1		3	129	36000	297
EPH (>C12 - C16)	mg/kg												< 1			< 1			< 1	27	2	< 1		2	27	28000	4,400
EPH (>C16 - C21)	mg/kg												< 1			< 1			< 1	2	3	< 1		2	3	28000	
EPH (>C21 - C40)	mg/kg												< 6			< 6			< 6	< 6	< 6	< 6		0	0	28000	
EPH (C8 - C40)	mg/kg												< 6			9			< 6	340	< 6	< 6		2	340		
EPH Texas Banded (C6-C8)	mg/kg																		< 0.05	< 0.05				1	2	2000	75.4
EPH Texas Banded >C8 - C10	mg/kg																		5	< 1				4	254	9700	150
EPH Texas Banded >C10 - C12	mg/kg																		< 1	3				4	172	36000	297
EPH Texas Banded >C12 - C16	mg/kg																		< 1	< 1				3	39	28,000	4,400
EPH Texas Banded >C16 - C21	mg/kg																		< 1	< 1				2	5	28,000	
EPH Texas Banded >C21 - C40	mg/kg																		< 6	< 6				0	0	28,000	
EPH Texas Banded (C6 - C40)	mg/kg																		< 6	< 6				3	455		
Benzene	ug/kg	< 2	< 2	< 2	< 2		< 2	< 2	< 2	< 2			< 2		< 2		< 2						< 2	0	0	27,000	1,040
Toluene	ug/kg	35	< 5	1700	< 5		51	< 5	< 5	< 5			< 5		250		< 5						< 5	4	1700	56,000	2,250
Ethylbenzene	ug/kg	27	4	4915	194		18	159	3	< 2			1038		164		1466						< 2	10	4915	5,700	596,000
p & m-xylene	ug/kg	67	13	10552	254		60	104	6	9			1271		471		4055						< 2	11	10552	5,900	193,000
o-xylene	ug/kg	85	14	1771	59		44	< 2	< 2	< 2			36		287		45						< 2	8	1771	6,600	208,000
MTBE	ug/kg	< 5	< 5	< 5	< 5		249	< 5	< 5	< 5			< 5		< 5		< 5						< 5	1	249		
Aliphatic >C5 - C6	mg/kg	< 0.01	< 0.01	< 0.00	< 0.01		0.25	< 0.01	< 0.01	< 0.01			< 0.01		< 0.01		< 0.01						< 0.01	1	0	3200	206
Aliphatic >C6 - C8	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05		< 0.05	< 0.05	< 0.05	< 0.05			2.05		< 0.05		3.28						< 0.05	2	3	7800	547
Aliphatic >C8 - C10	mg/kg	< 2	< 2	100	27		< 2	44	< 2	< 2			11		32		50						< 2	6	100	2000	150
Aliphatic >C10 - C12	mg/kg	< 2	< 2	35	12		< 2	18	< 2	< 2			< 2		8		15						< 2	5	35	9700	297
Aliphatic >C12 - C16	mg/kg	< 3	< 3	5	4		< 3	3	< 3	< 3			< 3		< 3		< 3						< 3	3	5	59,000	4,400
Aliphatic >C16 - C21	mg/kg	< 3	< 3	< 3	< 3		< 3	< 3	< 3	< 3			< 3		< 3		< 3						< 3	0	0	1,600,000	
Aliphatic >C21 - C34	mg/kg	< 10	< 10	< 10	< 10		27	< 10	< 10	< 10			< 10		< 10		< 10						< 10	1	27	1,600,000	
Aliphatic (C5 - C34)	mg/kg	< 21	< 21	139	43		28	65	< 21	< 21			< 21		40		68						< 21	6	139		
Aromatic >C5 - C7	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01			< 0.01		< 0.01		< 0.01						< 0.01	0	0	2600	75.4
Aromatic >C7 - C8	mg/kg	< 0.05	< 0.05	1.7	< 0.05		0.05	< 0.05	< 0.05	< 0.05			< 0.05		0.25		< 0.05						< 0.05	3	2	56,000	168
Aromatic >C8 - C10	mg/kg	< 2	2	209	29		4	74	< 2	< 2			58		113		185						< 2	8	209	3500	7,210
Aromatic >C10 - C12	mg/kg	5	4	165	32		< 2	181	< 2	< 2			47		107		185						< 2	8	185	16,000	1,520
Aromatic >C12 - C16	mg/kg	3	3	26	4		< 2	38	< 2	< 2			8		22		36						< 2	8	38	36,000	7,200
Aromatic >C16 - C21	mg/kg	4	< 3	< 3	< 3		30	8	< 3	< 3			< 3		< 3		4						< 3	4	30	28,000	
Aromatic >C21 - C35	mg/kg	< 10	< 10	< 10	< 10		148	< 10	< 10	< 10			< 10		< 10		< 10						< 10	1	148	28,000	
Aromatic (C5 - C35)	mg/kg	< 21	< 21	402	66		183	301	< 21	< 21			113		242		410						< 21	7	410	28,000	
Total >C5 - C35	mg/kg	< 42	< 42	541	109		210	366	< 42	< 42			126		282		477						< 42	7	541		
MTBE	ug/kg		< 5				249	< 5	< 5	< 5			< 5	< 5	< 5	< 5	< 5							1	249		
Toluene	ug/kg		< 5				51	< 5	< 5	< 5			< 5	< 5	< 5	< 5	< 5							2	250		2250
Ethyl Benzene	ug/kg		4				18	159	3	< 2			1038	6	164	9	1466							9	1466		596000
m,p-Xylene	ug/kg		13				60	104	6	9			1271	7	471	240	4055							10	4055		193000
o-Xylene	ug/kg		14				44	< 2	< 2	< 2			36	< 2	287	3	45							6	287		208000
Isopropylbenzene	ug/kg		< 5				< 5	406	< 5	10			156	< 5	271	11	1597							6	1597	1,400,000	
n-Propylbenzene	ug/kg		< 5				8	535	< 5	36			959	< 5	810	73	1963							7	1963	97,000	
1,3,5-Trimethylbenzene	ug/kg		15				58	199	< 5	< 5			1828	< 5	1645	78	3931							7	3931		
1,2,4-Trimethylbenzene	ug/kg		8				31	1088	< 5	7			918	7	2870	505	14620							9	14620	42,000	13,900
sec-Butylbenzene	ug/kg		< 5				< 5	269	< 5	30			148	< 5	171	13	1376							6	1376		
p-Isopropyltoluene	ug/kg		< 5				< 5	167	< 5	< 5			91	< 5	257	< 5	760							4	760		

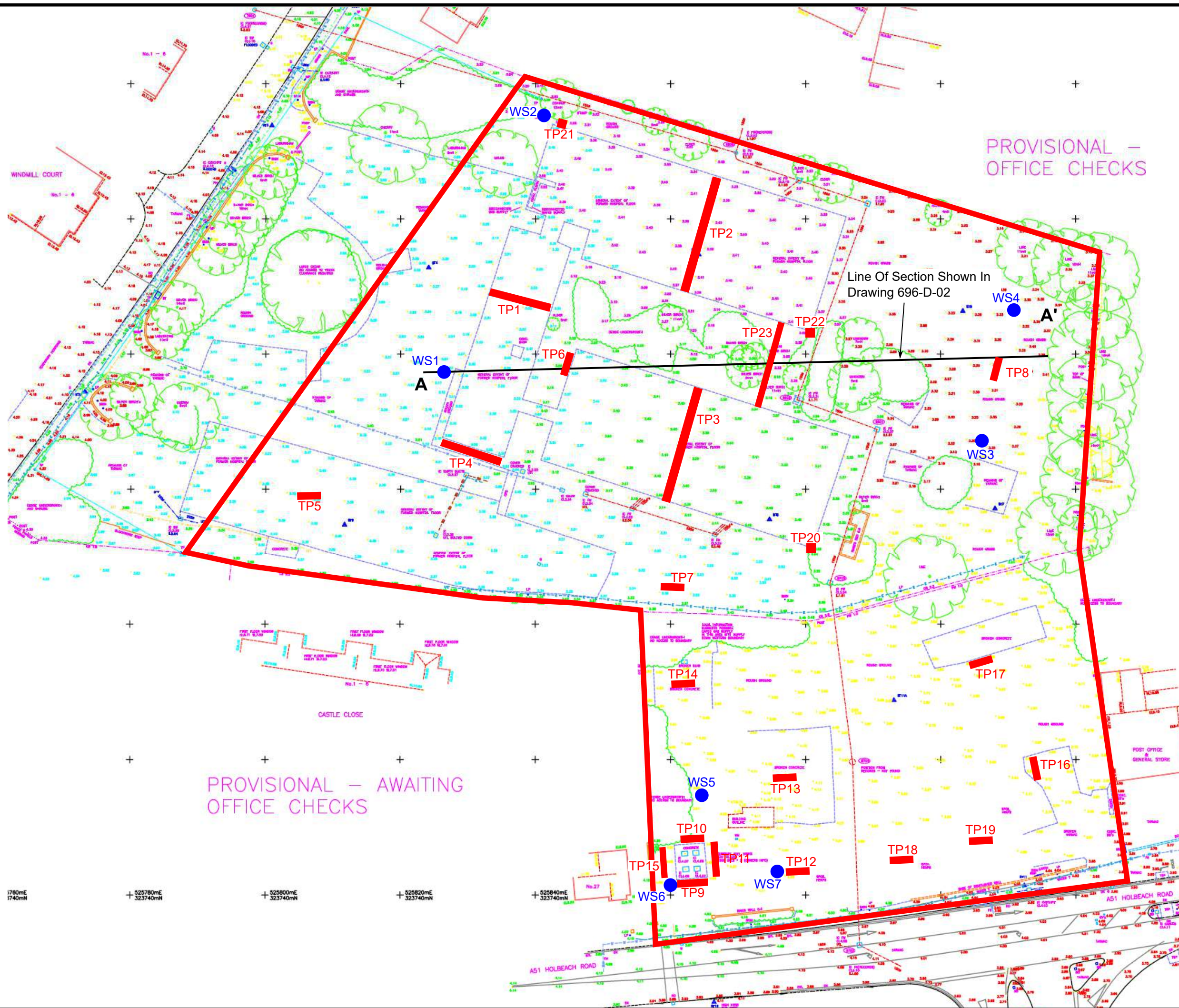
(i) Residential GAC are for indoors air inhalation pathway only

HOLBEACH ROAD,
SPALDING.

TABLE 2: Equilibrium Soil Vapour Concentrations, ADE/HCV Ratio for Inhalation of Indoors Air and groundwater remedial targets.

TABLE 2: Equilibrium Concentrations of PCOC VOC's in Soil Atmosphere (C vap), ADE/HCV summary and groundwater remedial targets.										
	Kaw	Cw	Cw	Cvap	Cvap	Cvap	CLEA Model	CLEA Model		
	cm3/cm3	ug/l	ug/l	ug/l	mg/l	mg/m3	Maximum Ratio of ADE/HCV	Cvap @ ADE/HCV of 1 mg/m3	Cw @ ADE/HCV of 1, ug/l	Proposed G/W Remedial Target, ug/l
ORGANICS - AROMATICS		WS6	TP102/7W							
Aromatic C5-7	0.119	716	209.0	85.2	0.1	85.2	0.026			716.0
Aromatic >C7-8	0.115	1341	802.0	154.2	0.2	154.2	0.048			1341.0
Aromatic >C8-10	0.004	114400	6500.0	421.0	0.4	421.0	0.285			114400.0
Aromatic >C10-12	0.049	35984	1600.0	1745.2	1.7	1745.2	1.081	1614	33278.4	33278.4
Aromatic >C12-16	0.018	2912	210.0	52.4	0.1	52.4	0.033			2912.0
ORGANICS - ALIPHATICS										
TPH Aliphatic C5-6	16.500	18156	85.0	299574.0	299.6	299574.0	2.025	147937	8965.9	8965.9
TPH Aliphatic >C6-8	23.500	494045	221.0	11610057.5	11610.1	11610057.5	78.461	147972	6296.7	6296.7
TPH Aliphatic >C8-10	32.900	572	160.0	18818.8	18.8	18818.8	2.355	7990	242.9	242.9
TPH Aliphatic >C10-12	130.000	< 10	23.0	2990.0	3.0	2990.0	0.374			23.0
BTEX'										
Benzene	0.115	716	209.0	82.3	0.1	82.3	1.808	44.4	386.1	386.1
Ethylbenzene	0.152	1340	563.0	203.7	0.2	203.7	0.004			1340.0
Toluene	0.136	20700	802.0	2815.2	2.8	2815.2	0.344			20700.0
Xylenes (all as p-xylene)	0.119	90100.0	4866.0	10721.9	10.7	10721.9	5.400	1985	16680.7	16680.7
1,2,4 Trimethylbenzene	0.086		1537.0	131.6	0.1	131.6	3.183	41.33	482.8	482.8
Naphthalene	0.006		72.0	0.4	0.0	0.4	0.015			72.0

DRAWINGS



KEY

- Windowless Sampler
- Borehole with Monitoring Installation

Extent and Location of Trial Pit

29 Greenlands Business Centre
Studley Road
Redditch, B96 7HD
Tel: 0121 314 5432
Email: mail@csge.co.uk

CSG
Consulting Engineers

CLIENT
LIDL UK GmbH

PROJECT
FORMER WELAND HOSPITAL, SPALDING

TITLE
EXPLORATORY HOLE LOCATION PLAN

DATE	JUNE 2017	DRAWN	DH
SCALE	SIZE	CHECKED	APPROVED
	A3	PP	PP
DRAWING NUMBER	REVISION		
696-D-02			

Appendix 1:

Trial Pit Logs (2019 Investigation)

TRIAL PIT LOG

Trial Pit No.
TP100

Date:
31.1.2019

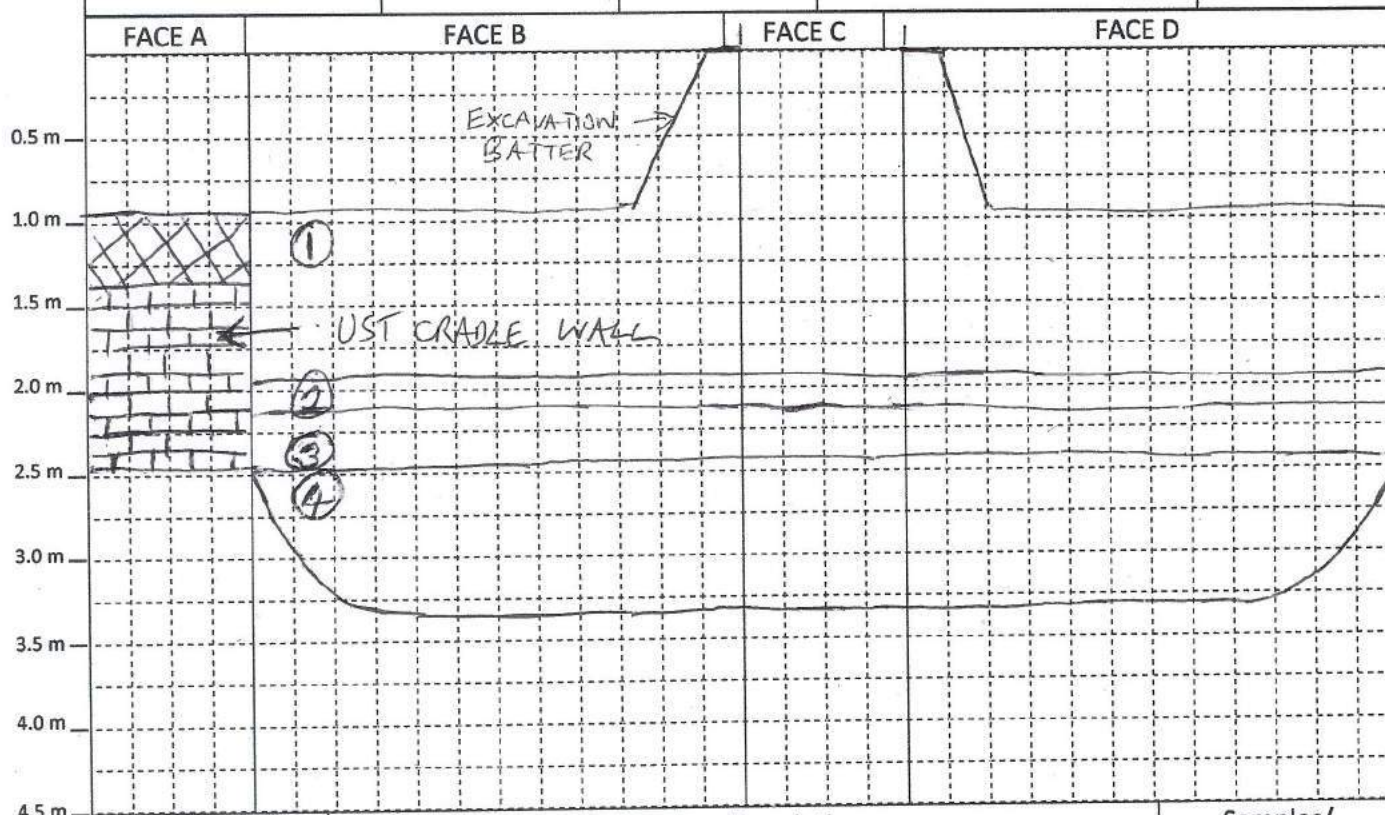


Project Name:
Holbeach Rd, Spalding

Project Number:
1057

Client:
Lidl UK GmbH

Logged By:
PJP



Strata Ref.	Depth (m)	Stratum Description	Samples/ In Situ Tests
1	0.0	Soft consistency, fissured, grey, mottled orange-brown clayey, sandy (fine) SILT, with faint laminations below 0.50m.	
2	1.0	With admixed lenses and pockets of amorphous peat.	J1. 1.0m PID. 3.3 ppm
3	1.2	Soft light grey brown, mottled black, SILT with pocket of peat. With odour of aged diesel close to cradle wall.	J2. 1.40m PID 4.4 – 9.8 ppm
4	1.50	Soft, grey-brown, very silty fine SAND with slight odour of diesel close to cradle wall. Becoming slightly greenish grey-brown and less silty with depth.	J3. 2.40m. PID 22 ppm locally.
	2.45m	Base of Excavation	

Remarks

- i) Seepage of oily groundwater from cradle wall at 1.80m below reduced level. Odour of diesel.
- ii). Pit sides unstable. Sudden collapse of side on reaching base of pit.
- ii). Odour of aged diesel in soils close to cradle wall, due to seepages through the wall.

Location Sketch (see trial pit location drawing)

↑
N

TRIAL PIT LOG

Trial Pit No.
TP101

Date:
31.1.2019

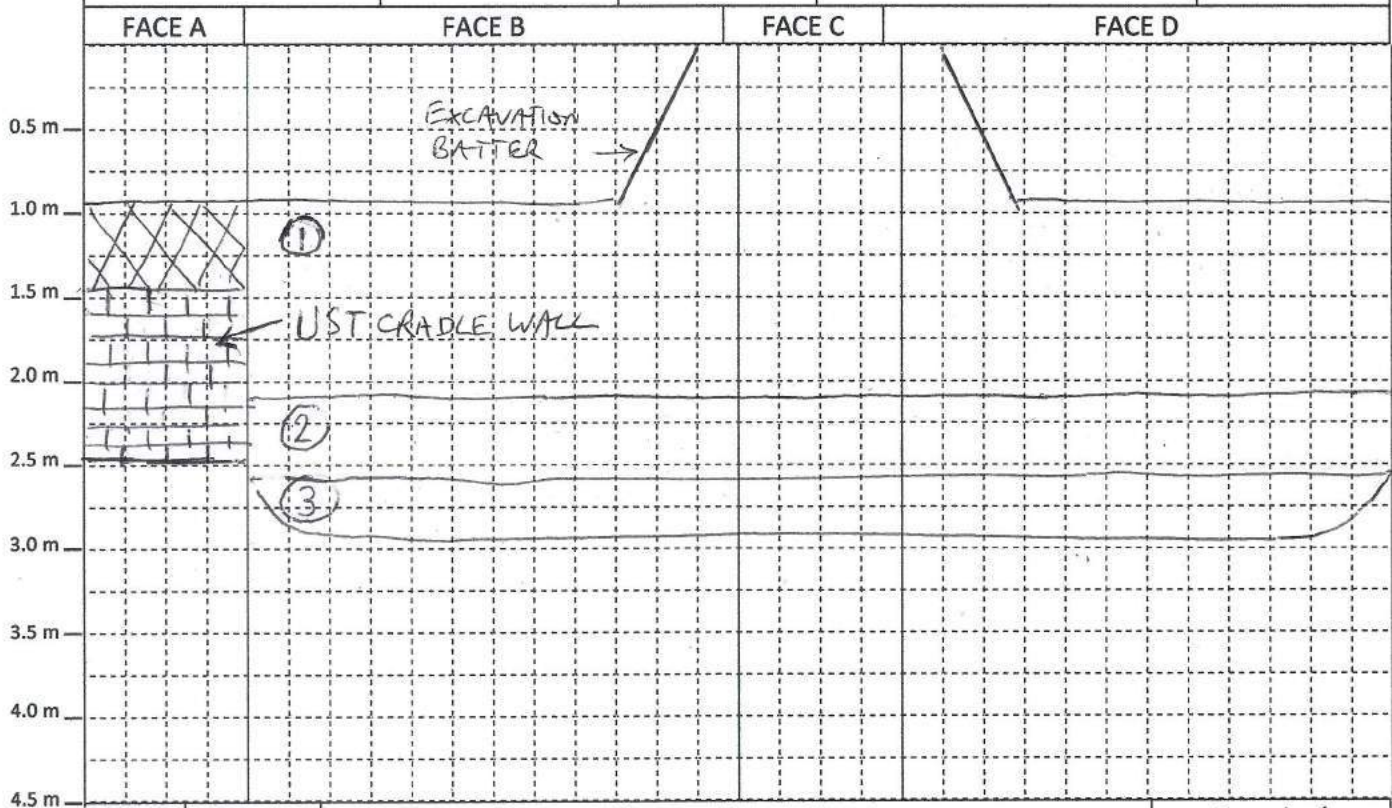


Project Name:
Holbeach Rd, Spalding

Project Number:
1057

Client:
Lidl UK GmbH

Logged By:
PJP



Strata Ref.	Depth (m)	Stratum Description	Samples/ In Situ Tests
1	0.0	Soft consistency, fissured, grey, mottled orange-brown and dark orange very clayey SILT.	4J. 0.5m. PID 0.5 ppm.
2	1.1	Becoming grey-brown, mottled black, peaty organic rich with odour of aged diesel close to cradle wall.	5J. 1.3m PID. 0.7 ppm.
3	1.6	Grey with black staining, silty fine SAND with odour of diesel close to cradle wall.	J6. 1.80-1.90m PID@1.90m: 68 ppm
	2.0m	Base of Excavation	7W. 2m.

Remarks

- i) Seepage of oily groundwater from cradle wall at 1.80m below reduced level. Odour of diesel.
- ii). Pit sides unstable. Sudden collapse of side on reaching base of pit.
- ii). Odour of aged diesel in soils close to cradle wall, due to seepages through the wall.

Location Sketch (see trial pit location drawing)

↑
N

Trial Pitting Record :TP102

Logged By: PP

Hire Company: Collins Demolition

Excavator: Trial Pit

Date: 31st January 2019

Location: Holbeach Rd : Spalding

Ground Elevation: (m AOD)

Depth: (m begl)

Bucket: 600 (mm)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm						In Situ/ Lab Test	Groundwater Levels		
					000	100	200	300	400	500				
		0.00		Brown, mottled orange-brown and dark orange, friable slightly clayey, silty fine SAND.										
		0.50												
8		1.00		Brown, mottled black, orange-brown and dark orange, friable, silty fine SAND. Below 1.20m: With strong diesel odour close to UST cradle.							PID = 0.0 ppm			
9		1.50												
10		2.00		Soft to firm consistency, greenish grey becoming brown CLAY with strong odour of aged diesel close to the UST tank farm.							PID = 700 ppm			
11		2.50												
12		3.00		Greyish brown silty to very silty fine SAND. No odour of aged diesel or staining.							PID = 747 ppm			
		3.50												
		4.00												

Groundwater Observations:

Slow seepages observed at 1.60m to 1.70m, with odour of aged diesel from 1.20m to 1.80m.

Trial Pitting Record :TP103

Logged By: PP

Hire Company: Collins Demolition

Excavator: Trial Pit

Date: 31st January 2019

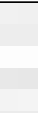
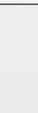
Location: Holbeach Rd : Spalding

Ground Elevation: (m AOD)

Depth: (m begl)

Bucket: 600 (mm)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm						In Situ/ Lab Test	Groundwater Levels		
					0	100	200	300	400	500				
B1		0.00		Brown friable fine sandy SILT with occasional thin organic rich/peat partings between 0.6m and 0.8m.										
		0.50												
13		1.00		Grey-brown slightly sandy (fine) SILT with rare shell fragments.										
		1.50		Firm bluish green, becoming fissured, blue-grey, mottled orange-brown, CLAY.										
B2+J14		2.00		Bluish grey mottled and streaked orange-brown very silty laminated SAND.										
		2.50												
		3.00												
		3.50												
		4.00												

Groundwater Observations:

No groundwater seepages observed. No odour of petroleum hydrocarbons.

Trial Pitting Record :TP104



Logged By: PP

Date: 31st January 2019

Depth: (m begl)

Hire Company: Collins Demolition

Location: Holbeach Rd : Spalding

Bucket: 600 (mm)

Excavator: Trial Pit

Ground Elevation: (m AOD)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm	In Situ/ Lab Test	Groundwater Levels		
					000 100 200 300 400 500 600 800				
15		0.00		MG: Brown slightly gravelly, slightly cobbly clay. Gravel and cobbles include mainly brick and concrete fragments.					
		0.50		Brown, mottled orange-brown and dark orange SILT.					
16		1.50				PID = 0.0 ppm			
		2.00		Grey-brown, mottled black with organic matter, slightly clayey, slightly sandy (fine) SILT. Very slight odour of aged diesel.					
		2.50							
		3.00							
		3.50							
		4.00							

Groundwater Observations:

Slight seepages below 1.50m, but not collecting at base of trial pit. Slight odour of aged diesel at 1.60m.

Trial Pitting Record :TP105

Logged By: PP

Date: 31st January 2019

Depth: (m begl)

Hire Company: Collins Demolition

Location: Holbeach Rd : Spalding

Bucket: 600 (mm)

Excavator: Trial Pit

Ground Elevation: (m AOD)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm						In Situ/ Lab Test	Groundwater Levels		
					0	100	200	300	400	500				
17		0.00		MG: Floor slab remnants (brick and concrete) over brick hardcore sub-base.										
		-0.50		Dark grey-brown, friable, very silty CLAY, mottled black (buried sub-soil).										
		-1.00		Brown, mottled orange-brown and dark orange-brown clayey SILT.										
		-2.00												
		-2.50												
		-3.00												
		-3.50												
		-4.00												

Groundwater Observations:

No groundwater seepages observed. Sides stable. No odour of petroleum hydrocarbons observed.

Trial Pitting Record :TP106



Logged By: PP

Date: 31st January 2019

Depth: (m begl)

Hire Company: Collins Demolition

Location: Holbeach Rd : Spalding

Bucket: 600 (mm)

Excavator: Trial Pit

Ground Elevation: (m AOD)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm	In Situ/ Lab Test	Groundwater Levels		
					000 100 200 300 400 500 600 800				
18		0.00		MG: Gravel and cobbles of brick and concrete in a clayey matrix.					
		0.50							
		1.00		Brown, light brown and greyish brown clayey fine sandy SILT.					
		1.50		Grey mottled orange-brown silty fine SAND.					
		2.00							
		2.50							
		3.00							
		3.50							
		4.00							

Groundwater Observations:

Slight seepages below 1.80m, but not collecting at base. No odour of aged diesel observed.

Trial Pitting Record :TP107

Logged By: PP

Date: 31st January 2019

Depth: (m begl)

Hire Company: Collins Demolition

Location: Holbeach Rd : Spalding

Bucket: 600 (mm)

Excavator: Trial Pit

Ground Elevation: (m AOD)

Shoring: (Y/N?) N

Sample Reference	Sample Range	Depth (mBGL)	Graphic Log	Soil or Rock Field Material Description	PID ppm	In Situ/ Lab Test	Groundwater Levels		
					000 100 200 300 400 500 600 800				
19		0.00		Brown slightly clayey sandy (fine) SILT, with black organic rich/amorphous peat pockets at 2.0m. No odour of petroleum hydrocarbons.					
		0.50							
19		1.00							
		1.50							
19		2.00							
		2.50							
20		3.00		Light grey-brown, mottled dark orange and orange-brown silty fine SAND.					
		3.50							
		4.00							

Groundwater Observations:

No groundwater seepages observed. Sides of pit collapsed suddenly a short while after reaching 3.0m.
No odour of petroleum hydrocarbons observed.





TP100. Prior to complete collapse.



TP100 after collapse, exposed black organic/peaty laminations within the natural silt.





TP101, within batter adjacent to driveway of residential property to the west.



TP101. Bucket scraping on UST brick cradle walls at nearest end of pit.



Typical natural estuarine deposits, excavated from trial pit TP101.





TP102, showing collapse at around the water table/seepages.





TP103, showing estuarine deposits. Holes are for PID probe.



TP103, just prior to collapse of side.



General view east showing TP103 excavation.



TP 104.



TP105.



TP106, made ground spoil (former floor slab/foundations).



TP106.



TP107 excavation spoil.



TP107, showing some spalling of sides.



TP107, typical laminated estuarine sand deposits from near base.



TP107 on completion. Some side instability evident.

Appendix 2:

Chemical Laboratory Test Certificates



Paul Palgrave
CSG Consulting Engineers Ltd
29 Greenlands Business Centre
Studley Road
Redditch
B98 7HD

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@dets.co.uk

DETS Report No: 19-00842

Site Reference: Holbeach Road, Spalding

Project / Job Ref: 1057

Order No: 2765

Sample Receipt Date: 22/01/2019

Sample Scheduled Date: 23/01/2019

Report Issue Number: 1

Reporting Date: 29/01/2019

Authorised by:

A handwritten signature in black ink, appearing to read "R Jarvis", written over a horizontal line.

Russell Jarvis
Associate Director of Client Services

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



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Rose Lane
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Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19			
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP2 (Contam)	PP/1056/SP2 (Contam)			
Project / Job Ref: 1057	Additional Refs	1	2			
Order No: 2765	Depth (m)	None Supplied	None Supplied			
Reporting Date: 29/01/2019	DETS Sample No	383829	383830			

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected				
pH	pH Units	N/a	MCERTS	7.9				
Total Cyanide	mg/kg	< 2	NONE	< 2				
Total Sulphate as SO ₄	mg/kg	< 200	NONE	925				
Total Sulphate as SO ₄	%	< 0.02	NONE	0.09				
Sulphide	mg/kg	< 5	NONE	129				
Arsenic (As)	mg/kg	< 2	MCERTS	9	7			
Barium (Ba)	mg/kg	< 5	NONE		66			
Beryllium (Be)	mg/kg	< 0.5	NONE		< 0.5			
W/S Boron	mg/kg	< 1	NONE	< 1	< 1			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2			
Chromium (Cr)	mg/kg	< 2	MCERTS	13	12			
Copper (Cu)	mg/kg	< 4	MCERTS	9	20			
Lead (Pb)	mg/kg	< 3	MCERTS	20	14			
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1			
Nickel (Ni)	mg/kg	< 3	MCERTS	12	11			
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3			
Vanadium (V)	mg/kg	< 2	NONE		21			
Zinc (Zn)	mg/kg	< 3	MCERTS	47	57			
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19			
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP2 (Contam)	PP/1056/SP2 (Contam)			
Project / Job Ref: 1057	Additional Refs	1	2			
Order No: 2765	Depth (m)	None Supplied	None Supplied			
Reporting Date: 29/01/2019	DETS Sample No	383829	383830			

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	3.22	1.20			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	0.22	< 0.1			
Pyrene	mg/kg	< 0.1	MCERTS	0.21	< 0.1			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.25	< 0.1			
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.19	< 0.1			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.15	< 0.1			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.31	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.16	< 0.1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	4.7	< 1.6			

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Soil Analysis Certificate - EPH Texas Banded

DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19	18/01/19	18/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP2 (Contam)	PP/1056/VAL1	PP/1056/VAL4	PP/1056/VAL7	PP/1056/VAL8
Project / Job Ref: 1057	Additional Refs	1	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 2765	Depth (m)	None Supplied	2.00 - 2.50	1.50 - 1.80	1.80	2.40 - 2.50
Reporting Date: 29/01/2019	DETS Sample No	383829	383831	383834	383836	383837

Determinand	Unit	RL	Accreditation					
EPH Texas (C6 - C8)	mg/kg	< 0.05	NONE	1.70	< 0.05	< 0.05	< 0.05	< 0.05
EPH Texas (>C8 - C10)	mg/kg	< 1	MCERTS	254	170	< 1	< 1	89
EPH Texas (>C10 - C12)	mg/kg	< 1	MCERTS	168	172	< 1	< 1	47
EPH Texas (>C12 - C16)	mg/kg	< 1	MCERTS	29	39	< 1	< 1	10
EPH Texas (>C16 - C21)	mg/kg	< 1	MCERTS	3	5	< 1	< 1	< 1
EPH Texas (>C21 - C40)	mg/kg	< 6	MCERTS	< 6	< 6	< 6	< 6	< 6
EPH Texas (C6 - C40)	mg/kg	< 6	NONE	455	385	< 6	< 6	147

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Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19	18/01/19	18/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP1	PP/1056/SP1	PP/1056/SP2 (Contam)	PP/1056/SP2 (Contam)	PP/1056/VAL2
Project / Job Ref: 1057	Additional Refs	1	2	1	2	None Supplied
Order No: 2765	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	1.50 - 2.00
Reporting Date: 29/01/2019	DETS Sample No	383827	383828	383829	383830	383832

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	0.25
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	100	27	< 2
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	35	12	< 2
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	5	4	< 3
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	27
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	139	43	28
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	1.70	< 0.05	0.05
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	2	209	29	4
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	5	4	165	32	< 2
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	3	3	26	4	< 2
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	4	< 3	< 3	< 3	30
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	148
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21	< 21	402	66	183
Total >C5 - C35	mg/kg	< 42	NONE	< 42	< 42	541	109	210

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Rose Lane
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Maidstone
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Tel : 01622 850410



Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19		
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/VAL3	PP/1056/VAL4	PP/1056/VAL6		
Project / Job Ref: 1057	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 2765	Depth (m)	2.40 - 2.50	1.50 - 1.80	2.40 - 2.50		
Reporting Date: 29/01/2019	DETS Sample No	383833	383834	383835		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	44	< 2	< 2		
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	18	< 2	< 2		
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	3	< 3	< 3		
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	65	< 21	< 21		
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	74	< 2	< 2		
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	181	< 2	< 2		
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	38	< 2	< 2		
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	8	< 3	< 3		
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aromatic (C5 - C35)	mg/kg	< 21	NONE	301	< 21	< 21		
Total >C5 - C35	mg/kg	< 42	NONE	366	< 42	< 42		

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19	18/01/19	18/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP1	PP/1056/SP1	PP/1056/SP2 (Contam)	PP/1056/SP2 (Contam)	PP/1056/VAL2
Project / Job Ref: 1057	Additional Refs	1	2	1	2	None Supplied
Order No: 2765	Depth (m)	None Supplied	None Supplied	None Supplied	None Supplied	1.50 - 2.00
Reporting Date: 29/01/2019	DETS Sample No	383827	383828	383829	383830	383832

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Toluene	ug/kg	< 5	MCERTS	35	< 5	1700	< 5	51
Ethylbenzene	ug/kg	< 2	MCERTS	27	4	4915	194	18
p & m-xylene	ug/kg	< 2	MCERTS	67	13	10552	254	60
o-xylene	ug/kg	< 2	MCERTS	85	14	1771	59	44
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	249

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19		
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/VAL3	PP/1056/VAL4	PP/1056/VAL6		
Project / Job Ref: 1057	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: 2765	Depth (m)	2.40 - 2.50	1.50 - 1.80	2.40 - 2.50		
Reporting Date: 29/01/2019	DETS Sample No	383833	383834	383835		

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene	ug/kg	< 2	MCERTS	159	3	< 2		
p & m-xylene	ug/kg	< 2	MCERTS	104	6	9		
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5		

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Tel : 01622 850410



Soil Analysis Certificate - Volatile Organic Compounds (VOC)						
DETS Report No: 19-00842	Date Sampled	18/01/19	18/01/19	18/01/19	18/01/19	18/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	PP/1056/SP1	PP/1056/VAL2	PP/1056/VAL3	PP/1056/VAL4	PP/1056/VAL6
Project / Job Ref: 1057	Additional Refs	2	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 2765	Depth (m)	None Supplied	1.50 - 2.00	2.40 - 2.50	1.50 - 1.80	2.40 - 2.50
Reporting Date: 29/01/2019	DETS Sample No	383828	383832	383833	383834	383835

Determinand	Unit	RL	Accreditation					
Dichlorodifluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Vinyl Chloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chloromethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Chloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromomethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Trichlorofluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
MTBE	ug/kg	< 5	MCERTS	< 5	249	< 5	< 5	< 5
trans-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
cis-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
2,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chloroform	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,1-Trichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloropropene	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Carbon Tetrachloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
1,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Trichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromodichloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Dibromomethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
TAME	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
cis-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Toluene	ug/kg	< 5	MCERTS	< 5	51	< 5	< 5	< 5
trans-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,2-Trichloroethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
1,3-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Tetrachloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Dibromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dibromoethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,1,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethyl Benzene	ug/kg	< 2	MCERTS	4	18	159	3	< 2
m,p-Xylene	ug/kg	< 2	MCERTS	13	60	104	6	9
o-Xylene	ug/kg	< 2	MCERTS	14	44	< 2	< 2	< 2
Styrene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromoform	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Isopropylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	406	< 5	10
1,1,2,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2,3-Trichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
n-Propylbenzene	ug/kg	< 5	MCERTS	< 5	8	535	< 5	36
Bromobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
2-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,3,5-Trimethylbenzene	ug/kg	< 5	MCERTS	15	58	199	< 5	< 5
4-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
tert-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2,4-Trimethylbenzene	ug/kg	< 5	MCERTS	8	31	1088	< 5	7
sec-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	269	< 5	30
p-Isopropyltoluene	ug/kg	< 5	MCERTS	< 5	< 5	167	< 5	< 5
1,3-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,4-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
n-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dibromo-3-chloropropane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Hexachlorobutadiene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5

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Tel : 01622 850410



Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2

DETS Report No: 19-00842		Date Sampled	18/01/19			Landfill Waste Acceptance Criteria Limits																											
CSG Consulting Engineers Ltd		Time Sampled	None Supplied			<table border="1"> <tr> <th>Inert Waste Landfill</th> <th>Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill</th> <th>Hazardous Waste Landfill</th> </tr> <tr> <td>3%</td> <td>5%</td> <td>6%</td> </tr> <tr> <td>--</td> <td>--</td> <td>10%</td> </tr> <tr> <td>6</td> <td>--</td> <td>--</td> </tr> <tr> <td>1</td> <td>--</td> <td>--</td> </tr> <tr> <td>500</td> <td>--</td> <td>--</td> </tr> <tr> <td>100</td> <td>--</td> <td>--</td> </tr> <tr> <td>--</td> <td>>6</td> <td>--</td> </tr> <tr> <td>--</td> <td>To be evaluated</td> <td>To be evaluated</td> </tr> </table>	Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill	3%	5%	6%	--	--	10%	6	--	--	1	--	--	500	--	--	100	--	--	--	>6	--	--	To be evaluated	To be evaluated
Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill																															
3%	5%	6%																															
--	--	10%																															
6	--	--																															
1	--	--																															
500	--	--																															
100	--	--																															
--	>6	--																															
--	To be evaluated	To be evaluated																															
Site Reference: Holbeach Road, Spalding		TP / BH No	PP/1056/SP2 (Contam)																														
Project / Job Ref: 1057		Additional Refs	1																														
Order No: 2765		Depth (m)	None Supplied																														
Reporting Date: 29/01/2019		DETS Sample No	383829																														
Determinand	Unit	MDL																															
TOC ^{MU}	%	< 0.1	0.5																														
Loss on Ignition	%	< 0.01	1.80																														
BTEX ^{MU}	mg/kg	< 0.05	18.90																														
Sum of PCBs	mg/kg	< 0.1	< 0.1																														
Mineral Oil ^{MU}	mg/kg	< 10	46																														
Total PAH ^{MU}	mg/kg	< 1.7	4.7																														
pH ^{MU}	pH Units	N/a	7.9																														
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	1.3																														
Eluate Analysis		10:1 mg/l		Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)																												
Arsenic ^U		< 0.01		< 0.1	0.5	2	25																										
Barium ^U		< 0.02		< 0.2	20	100	300																										
Cadmium ^U		< 0.0005		< 0.005	0.04	1	5																										
Chromium ^U		< 0.005		< 0.05	0.5	10	70																										
Copper ^U		< 0.01		< 0.1	2	50	100																										
Mercury ^U		< 0.0005		< 0.01	0.01	0.2	2																										
Molybdenum ^U		0.014		0.14	0.5	10	30																										
Nickel ^U		< 0.007		< 0.07	0.4	10	40																										
Lead ^U		< 0.005		< 0.05	0.5	10	50																										
Antimony ^U		< 0.0060		< 0.06	0.06	0.7	5																										
Selenium ^U		< 0.005		< 0.05	0.1	0.5	7																										
Zinc ^U		< 0.005		< 0.05	4	50	200																										
Chloride ^U		1		10	800	15000	25000																										
Fluoride ^U		0.5		5	10	150	500																										
Sulphate ^U		9		85	1000	20000	50000																										
TDS		81		810	4000	60000	100000																										
Phenol Index		0.05		0.5	1	-	-																										
DOC		9		90	500	800	1000																										
Leach Test Information																																	
Sample Mass (kg)		0.10																															
Dry Matter (%)		87.4																															
Moisture (%)		14.4																															
Stage 1																																	
Volume Eluate L10 (litres)		0.89																															

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and DETS Ltd cannot be held responsible for any discrepancies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test



DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 19-00842	
CSG Consulting Engineers Ltd	
Site Reference: Holbeach Road, Spalding	
Project / Job Ref: 1057	
Order No: 2765	
Reporting Date: 29/01/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
383827	PP/1056/SP1	1	None Supplied	18.3	Brown clayey sand
383828	PP/1056/SP1	2	None Supplied	19.7	Brown clayey sand
& 383829	PP/1056/SP2 (Contam)	1	None Supplied	12.6	Brown clayey sand
& 383830	PP/1056/SP2 (Contam)	2	None Supplied	13.1	Black loamy clay
383831	PP/1056/VAL1	None Supplied	2.00 - 2.50	19.3	Brown loamy clay
383832	PP/1056/VAL2	None Supplied	1.50 - 2.00	17.8	Brown sandy clay
383833	PP/1056/VAL3	None Supplied	2.40 - 2.50	22.6	Brown loamy sand
383834	PP/1056/VAL4	None Supplied	1.50 - 1.80	23.3	Brown clayey sand
383835	PP/1056/VAL6	None Supplied	2.40 - 2.50	22.7	Brown clay
383836	PP/1056/VAL7	None Supplied	1.80	22.7	Brown clayey sand
383837	PP/1056/VAL8	None Supplied	2.40 - 2.50	23.4	Brown clayey sand

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{1/5}

& samples received in inappropriate containers for hydrocarbon analysis



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Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Methodology & Miscellaneous Information	
DETS Report No: 19-00842	
CSG Consulting Engineers Ltd	
Site Reference: Holbeach Road, Spalding	
Project / Job Ref: 1057	
Order No: 2765	
Reporting Date: 29/01/2019	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



Paul Palgrave
CSG Consulting Engineers Ltd
29 Greenlands Business Centre
Studley Road
Redditch
B98 7HD

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@dets.co.uk

DETS Report No: 19-01523

Site Reference: Holbeach Road, Spalding

Project / Job Ref: 1057

Order No: 2782

Sample Receipt Date: 05/02/2019

Sample Scheduled Date: 05/02/2019

Report Issue Number: 1

Reporting Date: 08/02/2019

Authorised by:

A handwritten signature in black ink, appearing to read "R Jarvis", written over a horizontal line.

Russell Jarvis
Associate Director of Client Services

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DETS Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
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Soil Analysis Certificate						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19	31/01/19	31/01/19	31/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101	TP102	TP106	TP107	TP107
Project / Job Ref: 1057	Additional Refs	6	8	18	19	20
Order No: 2782	Depth (m)	1.80 - 1.90	0.90	1.80 - 2.00	2.00	3.00
Reporting Date: 08/02/2019	DETS Sample No	387256	387258	387263	387264	387265

Determinand	Unit	RL	Accreditation					
Organic Matter	%	< 0.1	MCERTS	0.8	0.5	0.4	3.1	0.6

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19			
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101	TP102			
Project / Job Ref: 1057	Additional Refs	6	11			
Order No: 2782	Depth (m)	1.80 - 1.90	1.60 - 1.70			
Reporting Date: 08/02/2019	DETS Sample No	387256	387259			

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	2.55	3.37			
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluorene	mg/kg	< 0.1	MCERTS	0.14	0.17			
Phenanthrene	mg/kg	< 0.1	MCERTS	0.15	0.17			
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Fluoranthene	mg/kg	< 0.1	MCERTS	0.28	< 0.1			
Pyrene	mg/kg	< 0.1	MCERTS	0.30	< 0.1			
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.33	< 0.1			
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.18	< 0.1			
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.26	< 0.1			
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1			
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	4.2	3.7			

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Soil Analysis Certificate - EPH Texas Banded

DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19			
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied			
Site Reference: Holbeach Road, Spalding	TP / BH No	TP103	TP104			
Project / Job Ref: 1057	Additional Refs	13	15			
Order No: 2782	Depth (m)	1.30 - 1.50	1.50			
Reporting Date: 08/02/2019	DETS Sample No	387260	387261			

Determinand	Unit	RL	Accreditation					
EPH Texas (C6 - C8)	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
EPH Texas (>C8 - C10)	mg/kg	< 1	MCERTS	5	< 1			
EPH Texas (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	3			
EPH Texas (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1			
EPH Texas (>C16 - C21)	mg/kg	< 1	MCERTS	< 1	< 1			
EPH Texas (>C21 - C40)	mg/kg	< 6	MCERTS	< 6	< 6			
EPH Texas (C6 - C40)	mg/kg	< 6	NONE	< 6	< 6			

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Soil Analysis Certificate - EPH Banded (Type F)						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19	31/01/19	31/01/19	31/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101	TP102	TP104	TP104	TP106
Project / Job Ref: 1057	Additional Refs	4	8	15	16	18
Order No: 2782	Depth (m)	0.50	0.90	1.50	2.00	1.80 - 2.00
Reporting Date: 08/02/2019	DETS Sample No	387255	387258	387261	387262	387263

Determinand	Unit	RL	Accreditation					
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	5	< 1	181	< 1
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	5	3	129	< 1
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	27	2
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	2	3
EPH (>C21 - C40)	mg/kg	< 6	MCERTS	< 6	< 6	< 6	< 6	< 6
EPH (C8 - C40)	mg/kg	< 6	MCERTS	< 6	9	< 6	340	< 6

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Soil Analysis Certificate - EPH Banded (Type F)						
DETS Report No: 19-01523	Date Sampled	31/01/19				
CSG Consulting Engineers Ltd	Time Sampled	None Supplied				
Site Reference: Holbeach Road, Spalding	TP / BH No	TP107				
Project / Job Ref: 1057	Additional Refs	19				
Order No: 2782	Depth (m)	2.00				
Reporting Date: 08/02/2019	DETS Sample No	387264				

Determinand	Unit	RL	Accreditation				
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1			
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1			
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1			
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	< 1			
EPH (>C21 - C40)	mg/kg	< 6	MCERTS	< 6			
EPH (C8 - C40)	mg/kg	< 6	MCERTS	< 6			

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Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19	31/01/19	31/01/19	
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Holbeach Road, Spalding	TP / BH No	TP100	TP101	TP102	TP107	
Project / Job Ref: 1057	Additional Refs	2	6	11	20	
Order No: 2782	Depth (m)	1.40	1.80 - 1.90	1.60 - 1.70	3.00	
Reporting Date: 08/02/2019	DETS Sample No	387254	387256	387259	387265	

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	2.05	< 0.05	3.28	< 0.05	
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	11	32	50	< 2	
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	8	15	< 2	
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	40	68	< 21	
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	0.25	< 0.05	< 0.05	
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	58	113	185	< 2	
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	47	107	185	< 2	
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	8	22	36	< 2	
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	4	< 3	
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	
Aromatic (C5 - C35)	mg/kg	< 21	NONE	113	242	410	< 21	
Total >C5 - C35	mg/kg	< 42	NONE	126	282	477	< 42	

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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19	31/01/19	31/01/19	
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Holbeach Road, Spalding	TP / BH No	TP100	TP101	TP102	TP107	
Project / Job Ref: 1057	Additional Refs	2	6	11	20	
Order No: 2782	Depth (m)	1.40	1.80 - 1.90	1.60 - 1.70	3.00	
Reporting Date: 08/02/2019	DETS Sample No	387254	387256	387259	387265	

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	
Toluene	ug/kg	< 5	MCERTS	< 5	250	< 5	< 5	
Ethylbenzene	ug/kg	< 2	MCERTS	1038	164	1466	< 2	
p & m-xylene	ug/kg	< 2	MCERTS	1271	471	4055	< 2	
o-xylene	ug/kg	< 2	MCERTS	36	287	45	< 2	
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Volatile Organic Compounds (VOC)						
DETS Report No: 19-01523	Date Sampled	31/01/19	31/01/19	31/01/19	31/01/19	31/01/19
CSG Consulting Engineers Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Holbeach Road, Spalding	TP / BH No	TP100	TP101	TP101	TP102	TP102
Project / Job Ref: 1057	Additional Refs	2	4	6	8	11
Order No: 2782	Depth (m)	1.40	0.50	1.80 - 1.90	0.90	1.60 - 1.70
Reporting Date: 08/02/2019	DETS Sample No	387254	387255	387256	387258	387259

Determinand	Unit	RL	Accreditation					
Dichlorodifluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Vinyl Chloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chloromethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Chloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromomethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Trichlorofluoromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
trans-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
cis-1,2-Dichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
2,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chloroform	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,1-Trichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1-Dichloropropene	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Carbon Tetrachloride	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dichloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
1,2-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Trichloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromodichloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Dibromomethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
TAME	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
cis-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	250	< 5	< 5
trans-1,3-Dichloropropene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,2-Trichloroethane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
1,3-Dichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Tetrachloroethene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Dibromochloromethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dibromoethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Chlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,1,1,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethyl Benzene	ug/kg	< 2	MCERTS	1038	6	164	9	1466
m,p-Xylene	ug/kg	< 2	MCERTS	1271	7	471	240	4055
o-Xylene	ug/kg	< 2	MCERTS	36	< 2	287	3	45
Styrene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Bromoform	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Isopropylbenzene	ug/kg	< 5	MCERTS	156	< 5	271	11	1597
1,1,2,2-Tetrachloroethane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2,3-Trichloropropane	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
n-Propylbenzene	ug/kg	< 5	MCERTS	959	< 5	810	73	1963
Bromobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
2-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,3,5-Trimethylbenzene	ug/kg	< 5	MCERTS	1828	< 5	1645	78	3931
4-Chlorotoluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
tert-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2,4-Trimethylbenzene	ug/kg	< 5	MCERTS	918	7	2870	505	14620
sec-Butylbenzene	ug/kg	< 5	MCERTS	148	< 5	171	13	1376
p-Isopropyltoluene	ug/kg	< 5	MCERTS	91	< 5	257	< 5	760
1,3-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,4-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
n-Butylbenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dichlorobenzene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
1,2-Dibromo-3-chloropropane	ug/kg	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
Hexachlorobutadiene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Water Analysis Certificate - Speciated PAH						
DETS Report No: 19-01523	Date Sampled	31/01/19				
CSG Consulting Engineers Ltd	Time Sampled	None Supplied				
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101				
Project / Job Ref: 1057	Additional Refs	7				
Order No: 2782	Depth (m)	None Supplied				
Reporting Date: 08/02/2019	DETS Sample No	387257				

Determinand	Unit	RL	Accreditation	(hs)				
Naphthalene	ug/l	< 0.01	NONE	72				
Acenaphthylene	ug/l	< 0.01	NONE	0.04				
Acenaphthene	ug/l	< 0.01	NONE	0.26				
Fluorene	ug/l	< 0.01	NONE	0.33				
Phenanthrene	ug/l	< 0.01	NONE	0.49				
Anthracene	ug/l	< 0.01	NONE	0.06				
Fluoranthene	ug/l	< 0.01	NONE	0.13				
Pyrene	ug/l	< 0.01	NONE	0.09				
Benzo(a)anthracene	ug/l	< 0.01	NONE	< 0.01				
Chrysene	ug/l	< 0.01	NONE	< 0.01				
Benzo(b)fluoranthene	ug/l	< 0.01	NONE	< 0.01				
Benzo(k)fluoranthene	ug/l	< 0.01	NONE	< 0.01				
Benzo(a)pyrene	ug/l	< 0.01	NONE	< 0.01				
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE	< 0.01				
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE	< 0.01				
Benzo(ghi)perylene	ug/l	< 0.008	NONE	< 0.008				
Total EPA-16 PAHs	ug/l	< 0.01	NONE	73.40				



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Water Analysis Certificate - TPH CWG Banded						
DETS Report No: 19-01523	Date Sampled	31/01/19				
CSG Consulting Engineers Ltd	Time Sampled	None Supplied				
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101				
Project / Job Ref: 1057	Additional Refs	7				
Order No: 2782	Depth (m)	None Supplied				
Reporting Date: 08/02/2019	DETS Sample No	387257				

Determinand	Unit	RL	Accreditation	(hs)				
Aliphatic >C5 - C6	ug/l	< 10	NONE	85				
Aliphatic >C6 - C8	ug/l	< 10	NONE	221				
Aliphatic >C8 - C10	ug/l	< 10	NONE	160				
Aliphatic >C10 - C12	ug/l	< 10	NONE	23				
Aliphatic >C12 - C16	ug/l	< 10	NONE	< 10				
Aliphatic >C16 - C21	ug/l	< 10	NONE	< 10				
Aliphatic >C21 - C34	ug/l	< 10	NONE	< 10				
Aliphatic (C5 - C34)	ug/l	< 70	NONE	488				
Aromatic >C5 - C7	ug/l	< 10	NONE	209				
Aromatic >C7 - C8	ug/l	< 10	NONE	802				
Aromatic >C8 - C10	ug/l	< 10	NONE	6500				
Aromatic >C10 - C12	ug/l	< 10	NONE	1600				
Aromatic >C12 - C16	ug/l	< 10	NONE	210				
Aromatic >C16 - C21	ug/l	< 10	NONE	< 10				
Aromatic >C21 - C35	ug/l	< 10	NONE	< 10				
Aromatic (C5 - C35)	ug/l	< 70	NONE	9321				
Total >C5 - C35	ug/l	< 140	NONE	9809				

(hs) Please note deviating sample due to head space in container



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Water Analysis Certificate - BTEX / MTBE						
DETS Report No: 19-01523	Date Sampled	31/01/19				
CSG Consulting Engineers Ltd	Time Sampled	None Supplied				
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101				
Project / Job Ref: 1057	Additional Refs	7				
Order No: 2782	Depth (m)	None Supplied				
Reporting Date: 08/02/2019	DETS Sample No	387257				

Determinand	Unit	RL	Accreditation	(hs)				
Benzene	ug/l	< 1	ISO17025	209				
Toluene	ug/l	< 5	ISO17025	802				
Ethylbenzene	ug/l	< 5	ISO17025	563				
p & m-xylene	ug/l	< 10	ISO17025	3950				
o-xylene	ug/l	< 5	ISO17025	916				
MTBE	ug/l	< 10	ISO17025	< 10				

(hs) Please note deviating sample due to head space in container



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Water Analysis Certificate - Volatile Organic Compounds (VOC)

DETS Report No: 19-01523	Date Sampled	31/01/19			
CSG Consulting Engineers Ltd	Time Sampled	None Supplied			
Site Reference: Holbeach Road, Spalding	TP / BH No	TP101			
Project / Job Ref: 1057	Additional Refs	7			
Order No: 2782	Depth (m)	None Supplied			
Reporting Date: 08/02/2019	DETS Sample No	387257			

Determinand	Unit	RL	Accreditation	(hs)				
Dichlorodifluoromethane	ug/l	< 5	ISO17025	< 5				
Vinyl Chloride	ug/l	< 5	ISO17025	< 5				
Chloromethane	ug/l	< 5	ISO17025	< 5				
Chloroethane	ug/l	< 5	ISO17025	< 5				
Bromomethane	ug/l	< 5	ISO17025	< 5				
Trichlorofluoromethane	ug/l	< 5	ISO17025	< 5				
1,1-Dichloroethene	ug/l	< 5	ISO17025	< 5				
MTBE	ug/l	< 10	ISO17025	< 10				
trans-1,2-Dichloroethene	ug/l	< 5	ISO17025	< 5				
1,1-Dichloroethane	ug/l	< 5	ISO17025	< 5				
cis-1,2-Dichloroethene	ug/l	< 5	ISO17025	< 5				
2,2-Dichloropropane	ug/l	< 5	ISO17025	< 5				
Chloroform	ug/l	< 5	ISO17025	< 5				
Bromochloromethane	ug/l	< 10	ISO17025	< 10				
1,1,1-Trichloroethane	ug/l	< 5	ISO17025	< 5				
1,1-Dichloropropene	ug/l	< 5	ISO17025	< 5				
Carbon Tetrachloride	ug/l	< 5	ISO17025	< 5				
1,2-Dichloroethane	ug/l	< 10	ISO17025	< 10				
Benzene	ug/l	< 1	ISO17025	209				
1,2-Dichloropropane	ug/l	< 5	ISO17025	< 5				
Trichloroethene	ug/l	< 5	ISO17025	< 5				
Bromodichloromethane	ug/l	< 5	ISO17025	< 5				
Dibromomethane	ug/l	< 5	ISO17025	< 5				
TAME	ug/l	< 5	ISO17025	< 5				
cis-1,3-Dichloropropene	ug/l	< 5	ISO17025	< 5				
Toluene	ug/l	< 5	ISO17025	802				
trans-1,3-Dichloropropene	ug/l	< 5	ISO17025	< 5				
1,1,2-Trichloroethane	ug/l	< 10	ISO17025	< 10				
1,3-Dichloropropane	ug/l	< 5	ISO17025	< 5				
Tetrachloroethene	ug/l	< 5	ISO17025	< 5				
Dibromochloromethane	ug/l	< 5	ISO17025	< 5				
1,2-Dibromoethane	ug/l	< 5	ISO17025	< 5				
Chlorobenzene	ug/l	< 5	ISO17025	< 5				
1,1,1,2-Tetrachloroethane	ug/l	< 5	ISO17025	< 5				
Ethyl Benzene	ug/l	< 5	ISO17025	563				
m,p-Xylene	ug/l	< 10	ISO17025	3953				
o-Xylene	ug/l	< 5	ISO17025	916				
Styrene	ug/l	< 5	ISO17025	< 5				
Bromoform	ug/l	< 10	ISO17025	< 10				
Isopropylbenzene	ug/l	< 5	ISO17025	193				
1,1,2,2-Tetrachloroethane	ug/l	< 10	ISO17025	< 10				
1,2,3-Trichloropropane	ug/l	< 5	ISO17025	< 5				
n-Propylbenzene	ug/l	< 5	ISO17025	119				
Bromobenzene	ug/l	< 5	ISO17025	< 5				
2-Chlorotoluene	ug/l	< 5	ISO17025	< 5				
1,3,5-Trimethylbenzene	ug/l	< 5	ISO17025	414				
4-Chlorotoluene	ug/l	< 5	ISO17025	< 5				
tert-Butylbenzene	ug/l	< 5	ISO17025	< 5				
1,2,4-Trimethylbenzene	ug/l	< 5	ISO17025	1537				
sec-Butylbenzene	ug/l	< 5	ISO17025	28				
p-Isopropyltoluene	ug/l	< 5	ISO17025	15				
1,3-Dichlorobenzene	ug/l	< 5	ISO17025	< 5				
1,4-Dichlorobenzene	ug/l	< 5	ISO17025	< 5				
n-Butylbenzene	ug/l	< 5	ISO17025	< 5				
1,2-Dichlorobenzene	ug/l	< 5	ISO17025	< 5				
1,2-Dibromo-3-chloropropane	ug/l	< 10	ISO17025	< 10				
Hexachlorobutadiene	ug/l	< 5	ISO17025	< 5				

(hs) Please note deviating sample due to head space in container



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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 19-01523	
CSG Consulting Engineers Ltd	
Site Reference: Holbeach Road, Spalding	
Project / Job Ref: 1057	
Order No: 2782	
Reporting Date: 08/02/2019	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
387254	TP100	2	1.40	21.9	Black loamy clay
387255	TP101	4	0.50	17.2	Brown loamy clay
387256	TP101	6	1.80 - 1.90	20.3	Black loamy clay
387258	TP102	8	0.90	20.3	Brown clayey sand
387259	TP102	11	1.60 - 1.70	22.5	Brown clay
387260	TP103	13	1.30 - 1.50	19	Black loamy sand
387261	TP104	15	1.50	22.5	Brown clayey sand
387262	TP104	16	2.00	21.6	Brown clayey sand
387263	TP106	18	1.80 - 2.00	24.5	Brown sand
387264	TP107	19	2.00	23.8	Black clay
387265	TP107	20	3.00	21.3	Brown sand

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{I/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information	
DETS Report No: 19-01523	
CSG Consulting Engineers Ltd	
Site Reference: Holbeach Road, Spalding	
Project / Job Ref: 1057	
Order No: 2782	
Reporting Date: 08/02/2019	

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 – C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 19-01523

CSG Consulting Engineers Ltd

Site Reference: Holbeach Road, Spalding

Project / Job Ref: 1057

Order No: 2782

Reporting Date: 08/02/2019

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GI-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered

Appendix 3

CLEA model output for calculation of Soil GACs

CLEA Software Version 1.071		Page 1 of 11
Report generated	22-Feb-19	
Report title	Holbeach Rd, Spalding. Residential Indoors Air Inhalation of VOCs. Deriv:	 Environment Agency
Created by	Paul Palgrave at GeolInvestigations	
RESULTS		

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	Average Daily Exposure ($\text{mg kg}^{-1} \text{ bw day}^{-1}$)	Distribution by Pathway (%)
	Direct soil ingestion Consumption of homegrown produce and attached soil Dermal contact with soil and dust Inhalation of dust Inhalation of vapour Background (oral) Background (inhalation)	Direct soil ingestion Consumption of homegrown produce and attached soil Dermal contact with soil and dust Inhalation of dust Inhalation of vapour (indoor) Inhalation of vapour (outdoor) Background (oral) Background (inhalation)
1 Benzene	0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.40E-03 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
2 Toluene	0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.37E+00 5.63E-04 3.15E-02	0.00 0.00 0.00 0.00 97.75 0.00 0.00
3 Ethylbenzene	0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.12E-01 2.81E-04 7.88E-03	0.00 0.00 0.00 0.00 96.42 0.00 0.00
4 Xylene, o-	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.15E-02 6.19E-04 8.49E-03	0.00 0.00 0.00 0.00 85.86 0.00 0.00
5 Xylene, m-	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.15E-02 6.19E-04 8.49E-03	0.00 0.00 0.00 0.00 85.86 0.00 0.00
6 Xylene, p-	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.15E-02 6.19E-04 8.49E-03	0.00 0.00 0.00 0.00 85.86 0.00 0.00
7 Aromatic C5-7	0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.10E-01 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
8 Aromatic >C7-8	0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.10E-01 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
9 Aromatic >C8-10	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.50E-02 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
10 Aromatic >C10-12	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.50E-02 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
11 Aromatic >C12-16	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.50E-02 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
12 TPH Aliphatic C5-6	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E+00 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
13 TPH Aliphatic >C6-8	0.00E+00 0.00E+00 0.00E+00 0.00E+00 5.00E+00 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
14 TPH Aliphatic >C8-10	0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.70E-01 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
15 TPH Aliphatic >C10-12	0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.70E-01 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
16 TPH Aliphatic >C12-16	0.00E+00 0.00E+00 0.00E+00 0.00E+00 2.70E-01 0.00E+00 0.00E+00	0.00 0.00 0.00 0.00 100.00 0.00 0.00
17 1,2,4-Trimethylbenzene	0.00E+00 0.00E+00 0.00E+00 0.00E+00 1.00E-03 1.35E-03 5.21E-03	0.00 0.00 0.00 0.00 50.00 0.00 10.29
18 naphthalene	0.00E+00 0.00E+00 0.00E+00 0.00E+00 6.90E-04 3.94E-04 1.70E-04	0.00 0.00 0.00 0.00 80.26 0.00 0.00
19		
20		

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Appendix 4:
CLEA model output for calculation of ADE/HCV
for VOC compounds in the vadose zone, in
equilibrium with groundwater.

CLEA Software Version 1.071		Page 1 of 11
Report generated	20-Feb-19	
Report title	Holbeach Road, Spalding. Calculation of ADE/HCV for inhalation indoors	
Created by	Paul Palgrave at GeolInvestigations	
RESULTS		

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Appendix 5

CLEA model output for calculation of VOC concentrations at source for VOC compounds to give ADE/HCV ratio of 1.

CLEA Software Version 1.071		Page 1 of 11
Report generated	20-Feb-19	 Environment Agency
Report title	Holbeach Road, Spalding. Calculation of VOC concentrations.	
Created by	Paul Palgrave at GeolInvestigations	
RESULTS		

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[illegible]

[illegible]

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Appendix 6

Soil Importation Procedure

MATERIAL IMPORTATION PROCEDURE

1. INTRODUCTION

The procedures presented within this Appendix aim to ensure that soil and general fill materials are not imported and deposited illegally in contravention of the waste permitting regulations, or so as to cause an unacceptable risk due to chemical contamination.

Any material is considered to be waste if it is discarded, intended to be discarded or required to be discarded, by the holder. Once discarded, it remains a waste until fully 'recovered' (i.e. processed in some way to produce a useful product). This remains the case even when the holder of the waste changes and the subsequent holder have a use for it.

This often causes confusion, particularly with respect to naturally occurring 'uncontaminated' soils that are surplus to requirement on a development site. But, as such materials were always intended to be discarded, they remain 'waste'.

Importation of waste to a site, or re-use of waste on a site, requires either a permit or a waste exemption.

Waste materials that are recovered may no longer be considered waste provided the material produced is suitable for the intended use. Non-waste materials imported to site, or re-used on the site, and building products that are not classified as waste, can be imported or used without contravening the waste regulations.

However, irrespective of whether the material is a waste or not, it should also be capable of being used without harm to the broader environment or presenting an unacceptable risk to human health. For example, a naturally occurring soil that contains elevated concentrations of naturally occurring arsenic, (e.g. as is common in Northamptonshire), may not be considered suitable of placement in soft landscaped areas on the site, irrespective of whether it is a waste at source or not.

The procedures presented in this document also aim to ensure that unacceptably contaminated waste or non-waste materials are not brought onto the site.

2. WASTE EXEMPTIONS

Suitable material can be imported to site for use in engineering works under a waste exemption that is obtained from the Environment Agency. The relevant waste exemption is a 'U1' exemption.

The Environment Agency has produced guidance on U1 exemptions entitled 'U1 - Use of waste in construction'.

A checklist is also presented to assist with the importation of material to sites under a U1 exemption.

In summary, the spirit of the U1 exemption is to encourage re-use of suitable waste materials within engineering works.

The volumes and types of waste that can be used are strictly defined in the guidance. For example, a total of 5,000 tonnes of mixtures of concrete, bricks, tiles and ceramics can be imported and used within the period of the exemption and a total of 50,000 tonnes of bituminous mixtures and/or road sub-base only, can be used to construct roads.

These total volumes are cumulative and cannot be exceeded within the term of the U1 exemption, and only one U1 can be registered to any site at any one time.

However, it should be noted that the issue of the U1 exemption is made on the basis that the site has planning, or other relevant permission, for the engineering project or construction activity associated with the import of the material.

On many sites, the issue of flood compensation should also be taken into account; if the site is on a floodplain, materials should not be deposited on the floodplain without agreed flood compensation measures being adopted. If materials are excavated and taken off-site and the imported materials simply replace the excavated materials, and no increase in site levels occurs as a result, then under these circumstances, the need for flood compensation does not arise.

Planning permission, if required for the construction activity, should be obtained prior to importation of the waste to avoid contravention of planning regulations, and the U1 exemption is given on the basis that planning permission has been obtained as necessary.

A record of the material imported under the U1 exemption should be maintained to demonstrate that the total volumes permitted are not exceeded.

3. CHEMICAL ANALYSIS OF MATERIAL TO BE IMPORTED TO SITE

Before any topsoil, subsoil or fill material is brought onto site, it is recommended that the material is inspected and sampled at source, and samples submitted for chemical analysis prior to import of the soils to site.

The inspection will aim to ascertain whether the material contains potentially deleterious materials that are not suitable for location within the intended location within the site. For example, if a potential topsoil source material containing sharps, suspected asbestos containing material (ACM), tarmac, ash or oversize demolition wastes, then it is clearly not worth testing, as it would fail.

The chemical testing suite should take into account the known history of the source site use and the potential contaminants associated with that use. For example, testing of soils derived from a site used for pesticide manufacture would need to take that particular use into account.

The frequency of testing should also reflect the volume of material intended for import from the source site. A minimum of 3 samples for any individual source site is recommended.

Each Local Authority generally has a standard sampling frequency rate for import of soils to sites, and typically the following are adopted to give some indication of the number of samples considered appropriate.

- Soil from a 'brownfield' source site intended for use in soft landscaped areas is typically required to be subject to sampling at a frequency of 1 sample every 50m³ or a minimum of six samples which ever is the greater.
- Soils from a 'greenfield' source intended for use in soft landscaping are typically required to be subject to sampling at a frequency of one sample per 250m³, with a minimum of 3 samples for any source site.
- Hardcore/recycled aggregates: 1 sample per 500m³.

Sufficient samples should be taken so as to be representative of the different types of materials present on the source site that are intended for import.

In addition to screening for potential contaminants of concern, topsoil should ideally also meet the requirements of BS3882:2015 for multipurpose topsoil so that it provides a healthy growth medium.

Contaminated soils may present a risk to the health of the site users, but also surface water quality, and the wider environment (i.e. vegetation, wildlife) and these other receptors should also be given consideration prior to importing material. For example, leachable contaminants may potentially impact the quality of surface water in the lakes and water courses.

Assessment of the results of the chemical testing of the source materials should be undertaken to ensure the material is suitable for use. There are published industry standard 'Tier 1 screening values' which can

be used in the first instance to identify contaminants that may be present at unacceptably high concentrations in the samples. Consideration can then be given to whether the source is worth investigating further if these Tier 1 screening values are exceeded.

The Tier 1 screening criteria to be adopted are based on the LQM/CIEH S4ULs (Suitable 4 Use Screening Levels) for Human Health Risk Assessment (Copyright Land Quality Management Limited reproduced with permission; Publication No. S4UL3429. All rights reserved), for a commercial land use.

The S4ULs currently exclude Lead, hence the Defra approved Category 4 Screening Levels² (C4SLs) have been adopted. For the proposed development, the C4SL for a 'residential with home grown produce' use is relevant for the apartment development, for which 2300 mg/kg Lead is presented.

A peer-reviewed in-house value of 40 mg/kg free cyanide has been derived for a residential with home grown produce usage, which is adopted as a GAC for initial screening purposes.

4. POLICING OF MATERIAL IMPORTATION

Having identified a suitable source of material, based on site inspection and chemical test results, the next stage is to import the required quantity of material to site.

The supplier of the material has a responsibility to maintain appropriate records, if the material is 'waste' under the 'Duty of Care' regulations, and the holder of the U1 exemption also has a duty to maintain records of the material imported.

It cannot always be assumed that the material inspected and sampled is the actual material that arrives on site, and for various reasons, other materials can arrive on site that have not been inspected or tested. It is advisable therefore to 'police' the importation procedure by inspecting the source site during delivery to ensure that the material is arriving on site from the correct source.

Some Local Authorities also insist on material being tested after placement on the destination site rather than at the source site, although this can present unacceptable risk to the supplier and/or the purchaser of the material, and we advise that the material is assessed prior to import to avoid where possible these conflicts occurring after import. However, spot checks on the imported material are advisable to correlate with the source material, particularly if the appearance and consistency changes. Liaison with the Local Authority Environmental Health Officer is recommended prior to importation to ensure the required testing is undertaken.

A flowchart is presented on the following page that summarises the importation procedure.

² Defra. SP1010. 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document.' December 2014.

Earthworks Material Importation Procedure

