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**REMEDIAL STRATEGY
for land at
PARK STREET, WOMBWELL**

**Prepared for
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APPENDICES

Appendix A – Drawings

Drawing No.	Title
6177/1	Site Location Plan
6177/2	Site Features
6177/3	Conceptual Site Model
6177/4	Site Layout

Appendix B - Correspondence

Appendix C - Encia Protocol for Importation & Use of Soil Cover (Capping)

**REMEDIAL STRATEGY
for land at
PARK STREET, WOMBWELL**

1 INTRODUCTION

1.1 The Commission and Brief

1.1.1 Encia Environmental Limited (Encia), have been commissioned by Gladedale South Yorkshire Limited (Gladedale) to prepare a Remedial Strategy for land off Park Street, Wombwell.

1.1.2 Encia have already issued the following reports:

- Geoenvironmental Appraisal of land at Park Street, Wombwell. Report No. 6177/1, dated March 2005
- Quantitative Risk Assessment. Report No. 6177/2, dated March 2005
- Quantitative Risk Assessment. Report No. 6177/3, dated June 2005
- Letter report (Revised QRA), dated 16th March 2006

1.1.1 This document outlines the remediation objectives necessary to protect environmental receptors, and render the site suitable for the proposed development. A Method Statement should be prepared, in order to detail how the objectives will be achieved.

1.1.3 The Method Statement should be accompanied by a Designer's Risk Assessment in accordance with the CDM Regulations, 2007. The Method Statement and Risk Assessment should be submitted to, and approved by, the Engineer.

1.2 The Proposed Development

1.2.1 The proposed residential development comprises 42 two and three storey residential dwellings with gardens, POS and adoptable roads and sewers in accordance with their Viability Sketch layout drawing (Drawing 6177/4 included in Appendix A).

1.2.2 The houses will be founded on strip/trench fill foundations, piles could be required in areas of deeper made ground, subject to final ground levels.

1.2.3 Access to the development will be from Park Street within the east of the site.

1.2.4 This report has been prepared to satisfy Condition 6 of the planning permission.

2 BACKGROUND

2.1 Site Description

2.1.1 Site details are summarised below.

Detail	Remarks
Location	Off Park Street on the eastern edge of Wombwell, approximately 7km south east of Barnsley town centre
NGR	(NGR SE 404 027)
Area	1.7ha (4.2 acres)
Known services	Underground electric & sewer

2.1.2 A location plan and current salient features are shown on Drawing Nos 6177/1 and 6177/2 in Appendix A.

2.1.3 The site can be divided into three separate areas based on the historic and present day uses, as summarised below and shown on Drawing 6177/2.

Site Area	General Location	Area (m ²)
A	Disused former plant service depot	9880
B	Disused former fuel filling station	1180
C	Unoccupied office building ('The Grange') surrounded by grassed areas	5505

2.2 Ground Investigation

2.2.1 Encia's ground investigation included the excavation of 10 trial pits and advancement of 8 window-sampling boreholes.

2.2.2 Previous ground investigation by Sirius Geotechnical & Environmental Limited included 10 trial pits, 13 window sample holes, 5 cable percussion boreholes and 4 rotary probeholes.

2.2.3 A total of 23 samples of made ground and 15 samples of natural ground were analysed for inorganic contaminants.

2.2.4 A total of 60 samples of made and natural ground were analysed for organic contamination.

Made Ground

2.2.5 The made ground on site is a heterogeneous mixture of materials and it is unlikely, even with a huge amount of sampling, that it could be accurately characterised. Nonetheless, the bulk of the made ground across the majority of the site (both areas A & B) can be categorised as granular fill.

2.2.6 The granular fill comprises locally clayey sand and gravel with a mixture of fragments in varying proportions of brick, ash, clinker, sandstone, limestone, concrete, metal, glass and timber.

2.2.7 The thickness of the made ground typically increases towards the north east from about 0.5m to 3.5m adjacent to the retaining wall dividing Areas A and B.

2.2.8 The majority of the external areas of the site (Areas A & B) are covered by either reinforced concrete or tarmac hardstanding between 0.2 and 0.3m thick.

Natural Ground

- 2.2.9 Beneath the made ground, natural ground was encountered in the majority of the exploratory holes, and typically comprised medium dense sand and gravel/cobble sized sandstone fragments over weak weathered sandstone.

Contamination

Inorganic

- 2.2.10 No significant inorganic contamination has been identified within the made ground materials.
- 2.2.11 However the made ground is considered undesirable near surface in gardens or areas of soft landscaping. Where made ground materials remain such areas, they should be isolated beneath a minimum 600mm clean cover (comprising 150mm topsoil and 450mm subsoil).

Organic

- 2.2.12 Two significant "hotspots" of gross hydrocarbon contamination have been located across much of Areas A and B, seemingly associated with nearby fuel tanks.
- 2.2.13 The organic contamination is summarised in the table below:

Areas of Organic Contamination

Area	Material	Depth m bgl	Observations & Typical Composition
Area A & B	MG: Granular Fill Weathered Sandstone	GL - c. 3.5	Up to 1,300 mg/kg PAH Up to 23,000 mg/kg TPH contamination (both diesel & lubricating range organics)
Area A	MG: Granular Fill Weathered Sandstone	GL - c. 2.0	Up to 1,200 mg/kg PAH Up to 13,000 mg/kg TPH contamination (both diesel & lubricating range organics)

- 2.2.14 Assessment of the site investigation data enabled formulation of a conceptual model, which is presented as Drawing No 6177/3 in Appendix A.
- 2.2.15 In terms of the proposed redevelopment plausible pollutant linkages, and feasible remediation options, are summarised below:

Receptors	Pathways	Contaminant Source	Remediation Options
Human Health (Future residents) ◇	Consumption of contaminated vegetables	Metals, Hydrocarbons in the made ground	No elevated inorganic determinands.
	Ingestion		Removal/treatment of hydrocarbon contamination validated to site remediation targets.
	Inhalation (dust and/or vapours)		
	Dermal contact		
	Migration & accumulation of explosive gas	Methane, Hydrocarbons in the made ground	N/A
	Infiltration of water supply pipes	Hydrocarbons in the made ground	Removal/treatment of hydrocarbon contamination validated to site remediation targets.
Buildings	Migration & accumulation of explosive gas	Methane, Hydrocarbons in the made ground	Simple gas protection measures required in new buildings.

Receptors	Pathways	Contaminant Source	Remediation Options
	Contact with "aggressive" soil and/or groundwater	Sulphate in the made ground	DS2/ACEC AC-4 ₂ conditions should be assumed for concrete in contact with natural and made ground.
Plants	Uptake of phytotoxic elements	Cu, Ni, Zn & B in the made ground	No elevated phytotoxic determinands.
Groundwater River Dove	Migration of leachable components	Metals, Hydrocarbons in the made ground	Removal/treatment of hydrocarbon contamination validated to site remediation targets.
	Surface water run-off		

◊ transient risks to construction workers will be addressed by the adoption of appropriate health and safety measures in accordance with the Health and Safety at Work Act 1974, and regulations made under the Act including for example the COSHH Regulations.

3 RISK ASSESSMENT & TARGET CONCENTRATIONS

- 3.1.1 Quantitative risk assessment (QRA) has been undertaken to derive site-specific clean-up criteria for the contaminants of concern (various hydrocarbons associated with leakage/spillage of fuels).
- 3.1.2 The QRA has been submitted to Barnsley Metropolitan District Council for comment and their approval letter is presented in Appendix B.
- 3.1.3 Remedial target concentrations for contaminants of concern in soil are:

Determinant	Target Concentrations (mg/kg)
Naphthalene	3.3
C6 - C8 Aliphatic Hydrocarbons	687
C8 - C10 Aliphatic Hydrocarbons	72
C10 - C12 Aliphatic Hydrocarbons	37,700
C12 - C16 Aliphatic Hydrocarbons	7.49x10 ⁵
C16 - C21 Aliphatic Hydrocarbons	9.23x10 ⁷
C21 - C35 Aliphatic Hydrocarbons	9.23x10 ⁷
C5 - C7 Aromatic Hydrocarbons	0.41
C7 - C8 Aromatic Hydrocarbons	48.7
C8 - C10 Aromatic Hydrocarbons	110
C10 - C12 Aromatic Hydrocarbons	375
C12 - C16 Aromatic Hydrocarbons	748
C16 - C21 Aromatic Hydrocarbons	2310
C21 - C35 Aromatic Hydrocarbons	18,400

4 REMEDIAL STRATEGY (GENERAL)

4.1 Aims

4.1.1 Remediation aims are:

- Resolve contamination issues in order to protect environmental receptors, and *render the site suitable for the proposed development*
- Provide a stable development platform (to agreed levels and gradients) for subsequent construction of the proposed development and associated infrastructure
- Satisfy requirements of the Local Planning Authority and the National House Building Council (NHBC)

4.2 Overview

4.2.1 The following remedial works are required:

- General site clearance of surface materials and vegetation
- Demolition of buildings and removal of below ground obstructions
- Break-up of slabs and hardstand
- Post demolition investigation of the ground beneath the former buildings and slabs, which were inaccessible during the earlier investigations
- Crushing of all suitable artificial hard material (i.e. concrete/brick etc)
- Removal of underground tanks
- Excavation of localised organic contamination, followed by treatment of hydrocarbon impacted soil by ex-situ on-site bioremediation, for subsequent re-use on site
- Backfill of all resultant excavations, with nominal compaction
- Re-grade of site, levels to be specified
- Excavation of up to a maximum depth of 2m beneath proposed adoptable road footprints and controlled re-engineering of selected materials in layers to approximately 650mm below final road levels
- Provision of a minimum 600mm thick cover layer of 'clean' soils in all garden and landscaped areas

4.3 Site Set-up, Organisation and Safety

- 4.3.1 Site works shall be supervised throughout by a suitably qualified Engineer, who will report to a *Project Manager*. Supervision may be *part-time for certain activities*, but must be full-time during the removal of any grossly contaminated soil/fill and any placement of fill to an engineering specification.
- 4.3.2 Site cabins and welfare facilities are to be established at a location to be agreed with the Engineer. All welfare facilities must be established in accordance with the relevant health & safety statutory requirements. Provision shall be provided on site for car parking for all site employees
- 4.3.3 All site personnel shall undergo a site-specific health and safety induction prior to commencement of work on site.
- 4.3.4 The Engineer shall be informed prior to any proposed entry of a confined space or deep excavation. Entry must be restricted to suitably qualified and equipped personnel.

- 4.3.5 Works will be carried out with proper regard to current statutory requirements. Reference could be made to Encia's Safety Management Systems, Procedure SP2 (Legal Requirements).
- 4.3.6 During the remediation works, all personnel on site will comply with guidance provided in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following shall be provided:
- A designated "clean" area should be fenced off and suitable warning signs posted. The only access to or from the "dirty" area should be via a hygiene facility (personnel) or wheel wash (vehicles)
 - Protective clothing, footwear and gloves. (Personnel should be instructed in why and how they are to be used)
 - Hand-washing and boot-washing facilities
 - Smoking shall be limited to designated areas
- 4.3.7 If at any time during the works personnel begin to feel unwell, they are to inform the Engineer, who will determine appropriate action.
- 4.3.8 Access into excavations etc. must be controlled. The atmosphere in shored trenches in excess of 1.2m should be monitored for oxygen and hazardous gas (methane & carbon dioxide), prior to personnel entering such excavations. Monitoring should continue whilst personnel are working in deep excavations.
- 4.3.9 All visitors to site must enter and register at the main Site Office.

4.4 Contractor's Responsibilities

- 4.4.1 Prior to the commencement of any works the Contractor, in agreement with the Engineer, shall:
- Comply with any requirements of Client's contract documentation
 - Establish the boundaries of the site and the working areas
 - Undertake a dilapidation survey of site boundaries, adjacent properties and highways, via dated photographs or video footage
 - Liaise with the Local Authority regarding working hours, noise/dust/odour control, and protected trees
 - Liaise with the Local Water Company regarding any proposed discharge to sewer
 - Complete a full services search and liaise with all relevant utility companies regarding work in close proximity to their apparatus
 - Obtain a Type III asbestos survey report for all buildings to be demolished
 - Prepare a detailed Method Statement outlining how the objectives of this Remedial Strategy will be achieved (and obtain approvals)
 - Inform the Engineer of any risk, identified and assessed, which could impact upon the Engineer's activities
 - Prepare the necessary COSHH statements and Health & Safety Plan in accordance with CDM regulations.
- 4.4.2 The Contractor shall satisfy the Health & Safety Executive with regard to all matters concerning the health, safety and welfare of persons on the site.
- 4.4.3 The Contractor shall ensure that:
- Personnel, plant, materials and other equipment related to the contract are *confined within the boundaries of the site*

- Any live services lying within the site boundary are marked and protected, or appropriate arrangements made to truncate them
 - Good practices relating to personal hygiene are adopted
 - Suitable precautions are implemented at all times to prevent off-site migration of pollutants via airborne dust and vapours
 - Suitable precautions are taken to prevent the spread of mud and debris on public highways
 - Refuelling of mobile plant is undertaken in a designated area. Above ground oil storage tanks shall comply with the requirements of Pollution Prevention Guideline PPG2. A spill kit shall be kept on site, adjacent to the designated refuelling area
- 4.4.4 The Contractor must have reviewed and acknowledged the Encia 'Standard Rules for Sub-Contractors on Safety, Health & Environment' GOP 2; a copy of which can be obtained from Encia's Health & Safety Manager.

4.5 Engineering Supervision and Verification

- 4.5.1 The Engineer will ensure that the requirements of this Remedial Strategy are complied with in a safe and orderly manner.
- 4.5.2 The responsibilities of the Engineer shall include, but not be limited to, the following:
- Ensuring that all site personnel are suitably qualified and given an appropriate induction at the beginning of their first day
 - Supervision of the remedial and ground preparatory works
 - Advice on the correct handling of materials and conditions encountered
 - Guidance on the appropriate protective clothing and safety equipment that is to be made available and used
 - Ensuring that personal hygiene arrangements are adequate
 - Retrieval of soil and water samples and the subsequent scheduling of appropriate laboratory analysis to enable verification of various aspects of the works, and to advise the Project Manager of progress
 - Liaison with statutory authorities as required
- 4.5.3 The Engineer will maintain records of the works to include the following:
- Daily record sheets to include a summary of the day's activities
 - Date and weather conditions
 - Plant, personnel and visitors present
 - Aspects relating to Health and Safety, Environmental Control, or non-compliance with either this Remedial Strategy or the Contractor's Method Statement
 - Site surveys as necessary to record the locations of demolition, excavation and filling activity
 - Test results
- 4.5.4 On satisfactory completion of all the works the Engineer will prepare a Verification Report. Copies of the Verification Report will be issued to Gladedale, Barnsley Metropolitan Borough Council and the NHBC.
- 4.5.5 The Verification Report will stand as certification that the remedial and ground preparatory works have been carried out in accordance with this Remedial Strategy.
- 4.5.6 The Verification Report will include:
- A summary of the preparatory & remedial works undertaken, including any works associated with unforeseen ground conditions

- Verification test results associated with "hot-spot" treatment, including plans showing sample locations & levels, and the extent of any "hot-spot" excavations
 - Details of the fate of any arisings excavated from "hot-spot"
 - Verification test results associated with proposed source materials for clean cover
 - Moisture content and plate bearing test results associated with ground improvement beneath proposed highways and dwellings
 - Copies of any correspondence with Regulators relating to specific aspects of the remedial works
- 4.5.7 For reasons of practicality, detailed daily records prepared by the Engineer during the works will not be appended to the Verification Report, but copies can be submitted to the Local Authority under separate cover, if required.
- 4.5.8 The Verification Report also provide recommendations with respect to:
- Foundation Solution(s)
 - Gas Measures
 - Placement of Soil Cover
 - Handling of Contaminated Soils
- 4.5.9 The above recommendations will take account of the actual remedial works undertaken, and may differ significantly from recommendations originally presented in the site investigation report.

5 REMEDIAL STRATEGY (SPECIFIC OBJECTIVES)

5.1 Site Clearance

- 5.1.1 Any trees currently under a preservation order shall be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO shall be clearly identified and protected by chestnut paling with fluorescent tape.
- 5.1.2 The site shall then be cleared of all residual debris, any vegetation, shrubs, bushes and unprotected trees as instructed by the Client.

5.2 Asbestos

- 5.2.1 Current legislation requires a Type III asbestos survey to be undertaken, immediately prior to demolition of any building. The Contractor shall request a copy of the Type III survey report from the Client or Engineer. If no survey report is available, the Contractor will instruct a Type III asbestos survey.
- 5.2.2 The licensed contractor shall submit a Method Statement detailing how the works will be carried out in accordance with: *Control of Asbestos at Work Regulations (CAWR), 2002*.
- 5.2.3 Localised fragments of asbestos cement sheeting may be encountered during the site remedial and preparatory works. All suspected asbestos-containing material should be recovered by hand and placed in double sealed bags, within a sealed skip for off-site disposal at a suitably licensed landfill site. Personnel involved in this activity should be equipped with appropriate personal protective equipment, including dust masks (3M Type 8810 or equivalent).

5.3 Demolition

- 5.3.1 Demolition works will commence on completion of any asbestos removal and a "soft-strip" of the existing buildings.

- 5.3.2 Existing buildings will be demolished in a safe and controlled manner and any concrete slabs will be broken out.
- 5.3.3 All demolition operations shall conform to BS 6187:2000 Code of Practice for Demolition. All personnel working on these operations shall be fully qualified to do so.
- 5.3.4 A detailed Method Statement specific to the project must be prepared by the Contractor and submitted to the Engineer and Gladedale.

5.4 Removal of Below Ground Obstructions

- 5.4.1 All foundations associated with existing buildings and other relict structures will be chased out and grubbed-up, in order to remove potential obstructions to new foundations and infrastructure.
- 5.4.2 Where relict structures are found to retain fluid contaminants, they shall be drained first.
- 5.4.3 Deep excavations for the removal of structures etc will be unstable in the short term and continuous side support will be necessary.
- 5.4.4 Where significantly deep foundations (e.g. piles) cannot be removed by conventional means, they are to be cut at a depth to be agreed with the Engineer and the position of the remaining lower section is to be accurately recorded by survey.
- 5.4.5 Suitable materials derived from grubbing-up shall be stored in a location on site, to be agreed with the Engineer, prior to crushing (see Section 5.8). Any unsuitable materials shall be removed to a suitably licensed landfill site (see Section 5.18).

5.5 Tank Removal

- 5.5.1 The contractor shall inform the local Petroleum Licensing Officer (PLO) prior to undertaking any works in the immediate vicinity of the underground fuel tanks. The PLO should be able to provide a list of approved tank removal contractors.
- 5.5.2 Each tank shall be carefully emptied of any residual product, purged of potentially explosive vapour, and safely disposed of from the site by an appropriately qualified and licensed contractor.
- 5.5.3 Any underground distribution pipe work should be purged of any residual product and explosive vapours and then carefully removed.
- 5.5.4 The Engineer will inspect the resultant excavations, and supervise the chasing-out of any grossly contaminated soil/fill encountered (see Section 5.10).

5.6 Supplementary Ground Investigation

- 5.6.1 On completion of the demolition, hardstand grubbing-up and tank/fuel line removal, the Engineer will supervise the excavation of trial pits in areas of particular interest, most notably within former petrol filling station and within building footprints.
- 5.6.2 All pits will be excavated to at least 3m depth (from proposed final levels).
- 5.6.3 Representative samples soil/fill samples will be taken by the Engineer. The number of samples taken will be reflective of the fill/geological complexity actually encountered. However, in general about 3 samples will be taken from most pits.
- 5.6.4 Selected samples will be sent to a suitably accredited laboratory and scheduled for appropriate chemical analysis (likely to comprise BTEX, GRO and Speciated TPH). Analysis for other determinands may be appropriate and will be requested by the Engineer as necessary.

- 5.6.5 The investigation will be undertaken in general accordance with current DoE guidelines (Contaminated Land Reports 1-6) and current legislation detailed in Part IIA of the Environmental Protection Act 1990. The soils encountered during this investigation will be logged in general accordance with BS5930: 1999.

5.7 Contingency for Unknowns

- 5.7.1 Even after an appropriate preliminary investigation and ground investigation, with exploratory holes on a closely spaced grid (say trial pits at 30m centres), a geoenvironmental appraisal is typically based on inspection of the ground underlying less than 0.5% of the total site area (and much less at depths in excess of about 3.5m). Consequently, there is always a possibility that unanticipated ground conditions will be encountered during the remedial works.
- 5.7.2 If unanticipated ground is encountered during the remedial works, the Contractor should immediately seek further advice from the Engineer.
- 5.7.3 Any unanticipated grossly contaminated soil/fill should be placed in temporary stockpiles on hardstand or visqueen, suitably covered and bunded.
- 5.7.4 Analysis of at least 6 samples, for an appropriate range of determinands should be undertaken. On receipt of the results, the Engineer will liaise with the Contractor regarding the most appropriate remedial option.

5.8 Crushing

- 5.8.1 Production of a selected granular fill should be possible if suitable materials (generated by demolition operations and grubbing-up of floor slabs, foundations and other relict structures) are crushed.
- 5.8.2 The crushed product should be screened to remove any unsuitable elements and stockpiled for re-use during the subsequent construction works. Generation of a Class 6 material as defined in the Highways Agency Specification (Series 600) should be possible.
- 5.8.3 6F2 graded material can contain up to 50% recycled tarmac/asphalt (provided it does not pose a contamination risk to controlled waters). Recycled tarmac can be crushed to yield a 6F3 selected granular material, provided the recovered bitumen content is less than 10% (determined in accordance with BS598-102).
- 5.8.4 The Engineer shall check the suitability of crushed product for re-use, instruct the removal of any unsuitable material and schedule appropriate confirmatory geotechnical or chemical testing.

5.9 Clean-up Criteria

- 5.9.1 Remedial target concentrations for both soils and groundwater have been derived by the human health and groundwater risk assessments. These concentrations are to be used as "clean-up" criteria during the required remedial works.
- 5.9.2 Site-specific remedial target concentrations, for each determinand of concern, have been determined by comparing the human health SSTC with the controlled waters SSTC, and adopting the lower value as a remedial target concentration.

5.9.3 Site-specific remedial target concentrations for soils are presented in the table below:

Remedial Target Concentrations for Soils

Determinand	Human Health SSTC (mg/kg)	Controlled Waters SSTC (mg/kg)	Site Wide SSTC (mg/kg)
Naphthalene	3.3	-	3.3
Benzo(a)pyrene	Residual Saturation	-	Residual Saturation
C6 - C8 Aliphatic	Residual Saturation	687	687
C8 - C10 Aliphatic	72	4,980	72
C10 - C12 Aliphatic	Residual Saturation	37,700	37,700
C12 - C16 Aliphatic	Residual Saturation	7.49×10^5	7.49×10^5
C16 - C21 Aliphatic	Residual Saturation	9.23×10^7	9.23×10^7
C21 - C35 Aliphatic	Residual Saturation	9.23×10^7	9.23×10^7
C5 - C7 Aromatic	0.41	0.5	0.41
C7 - C8 Aromatic	65	48.7	48.7
C8 - C10 Aromatic	110	150	110
C10 - C12 Aromatic	Residual Saturation	375	375
C12 - C16 Aromatic	Residual Saturation	748	748
C16 - C21 Aromatic	Residual Saturation	2,310	2310
C21 - C35 Aromatic	Residual Saturation	18,400	18,400

5.9.4 Some contaminants reach residual saturation before a vapour risk is predicted to occur by the QRA model. However, Encia recognise that it is unacceptable to leave free product in the ground where redevelopment of a site is proposed. Consequently, this Remedial Strategy advocates the removal/treatment of soils that contain significant free product.

5.9.5 In this context, significant free product is readily identifiable by the naked eye, and pervasive throughout the soil mass, probably with noticeable seepages. Traces of free product in fissures or localised, cobble-sized pockets would not normally be considered significant.

5.10 Excavation of Contaminated Soil/Fill

5.10.1 Fuel contaminated material shall be excavated under the full time supervision of the Engineer, who will be equipped with a portable PID instrument.

5.10.2 Following excavation of the grossly contaminated ground, the Engineer will inspect and sample the resultant excavations.

5.10.3 A minimum of 5 verification samples shall be taken from the excavation sidewalls and base. These samples shall be tested for Speciated TPH. Analysis for other determinands may be appropriate and will be requested by the Engineer as necessary.

5.10.4 The Engineer will instruct continued removal of soil/fill if verification samples yield concentrations in excess of the clean-up criteria outlined in Section 5.9.

5.10.5 Grossly contaminated soil/fill shall be placed in temporary stockpiles on hardstand or polythene sheeting and be suitably covered to minimise the potential for dust/odour nuisance, and prevent surface water run-off.

5.10.6 Given the proximity of residential housing, and in order to avoid any potential odour nuisance, stockpiles of material should be exported from site as soon as practically possible.

5.10.7 Excavations should not be left open for longer than is necessary, and should be securely cordoned-off using 2m high Herras-type fencing, with appropriate warning signs whenever excavation works are suspended.

5.10.8 On completion of tank/soil removal, excavations are to be backfilled (see Section 5.19).

5.11 Control of Water

5.11.1 Groundwater shall be controlled in accordance with CIRIA report 113 "Control of Groundwater for Temporary Works".

5.11.2 Arrangements should be made to prevent ponding in any excavation "hollows"; the Contractor shall ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips.

5.11.3 Any potentially contaminated water shall not be allowed to escape to other areas until the results of the analysis are available and, if required, a suitable means of water treatment has been agreed.

5.11.4 Pumping from over-excavated sumps may be required to maintain satisfactory working conditions.

5.11.5 Water collected in sumps should be passed through a series of oil/water separators to remove any oily contamination. Oils trapped in the absorbent medium that shall be disposed of a suitably licensed landfill site (see Section 5.18).

5.11.6 Treated water shall then be tankered off-site, or be discharged to sewer, subject to local water treatment company consent.

5.12 Dust, Vapour & Odour Control

5.12.1 The excavation of grossly contaminated soil/fill should not present a significant problem with regard to emission of dust during excavation and transport because the material to be excavated should have a high moisture content. Nonetheless, the monitoring and mitigation measures outlined below will be required.

5.13 Dust & VOC Monitoring

5.13.1 Monitoring for dust and total volatile organic compounds (VOCs) in air will be carried out by the Engineer, during the excavation of soil/fill. This monitoring will be undertaken at the up-wind and down-wind site boundaries. Monitoring will be undertaken no less than three times a day, at approximately 09:00, 13:00 and 17:00 hours.

5.13.2 In addition, the atmosphere inside closed cabs of plant involved in the excavation of grossly contaminated soil will be regularly monitored for total VOCs concentration.

5.14 Odour Monitoring

5.14.1 Olfactory monitoring for odour nuisance will be undertaken at the site boundary down-wind of the excavation area during all excavation works. Odour monitoring will be carried out at these locations no less than three times a day during active site works.

5.14.2 At each monitoring event, the odour level will be subjectively classified as none, slight, moderate, or high, where:

- A slight odour level is detectable but not particularly noticeable,
- A moderate odour level is noticeable but not offensive, and
- a high odour level is offensive

- 5.14.3 If high odour levels are detected in the same location on more than two occasions during any three-day period, then one or more of the actions outlined Sections 5.16 to 5.17 below will be undertaken in order to reduce the odour levels.

5.15 Monitoring Equipment

- 5.15.1 Total VOC concentrations will be monitored using pocket photo-ionisation detectors (PID) (or similar), calibrated to benzene. Each PID unit will also serve as a personal alarm, programmed to give an audible alarm at the short-term and long-term exposure limits for benzene. These units should also be capable of logging the concentration of total VOCs at given intervals during a working day. The data should be downloaded to a PC for interrogation, which might result in revision of working procedures to reduce vapour release.
- 5.15.2 Dust will be monitored using a 'real-time' particulate monitor. The real time particulate monitor will provide an instantaneous measurement of the concentration of particulates in the air stream passing through it. The real-time measurement will allow for rapid initiation of mitigation measures in the event of dust generation becoming problematic.

5.16 Trigger Levels

- 5.16.1 Action limits for requiring respirator protection in the vicinity of the excavations and for taking corrective action to mitigate against the generation of air-borne dust or volatile organic contamination have been agreed with the Local Authority. They are based on EH40/2002, Occupational Exposure Limits, Health and Safety Executive. EH40 trigger levels for total VOCs and dust are:

VOC & Dust Trigger Levels

Determinand	Long-term exposure limit (8 hour time-weighted average)	Short-term exposure limit (15 minute reference period)
Total VOCs	1 ppm	3 ppm
Dust	4 mg/m ³	12 mg/m ³

- 5.16.2 The long-term exposure limit for total VOCs is based on the EH40/2002 long-term exposure limit (8-hour time-weighted average) for benzene. The short-term exposure limit is set at three times the long-term exposure limit as recommended in EH40/2002.
- 5.16.3 The long-term exposure limit for dust is based on the EH40/2002 long-term exposure limit (8-hour time-weighted average) for respirable dust, which is taken from the General COSHH Approved Code of Practice, 1997. Again, the short-term exposure limit is set at three times the long-term exposure limit.

5.17 Mitigation

- 5.17.1 At all times during the excavation works, Best Practicable Means shall be employed to minimise dust, odour and VOC generation and their emission off site.
- 5.17.2 If dust or VOC concentrations in air exceed the long-term trigger levels in the vicinity of the excavation area, but are below the long-term trigger levels at the site boundary, then respirator protection will be required for all site personnel working in the excavation area.
- 5.17.3 Respiratory protection that conforms to the European Product Directive (CE) shall be readily available for personnel exposed to odours. Twin cartridge respirators, that conform to EN140, fitted with class A1 filters cartridges, which conform to EN141 (organic gases and vapours), shall be used. If highly odorous material is encountered on site then masks with Class A2 filters shall be used.

- 5.17.4 In addition, one or more of the following corrective actions to mitigate against the generation of air-borne dust or volatile organic contamination will immediately commence:
- Mist and water spraying to eliminate dust and/or reduce generation of volatile compounds
 - Reduction of the exposed active excavation area by backfilling or covering to reduce the generation of volatile compounds
- 5.17.5 In addition, as a contingency measure, the Engineer may instruct use of de-odourising equipment (as typically used at landfills) and enzyme degraders.
- 5.17.6 If dust or VOC concentrations in air exceed the long-term trigger levels at the site boundary then excavation activities will be stopped immediately and one or more of the above corrective actions will commence. Work will not begin again until the air quality at the site boundary has returned to an acceptable level and only after all reasonable actions have been taken to prevent the air quality at the site boundary from again declining to an unacceptable level.

5.18 Export to Landfill

- 5.18.1 Any material exported from site to landfill should be hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, 1991 and the Landfill (England & Wales) Regulations 2002.
- 5.18.2 A transfer note should be completed, signed and retained by the parties involved. The transfer note should include the volume of waste, the nature of the material and a statement of its chemical composition, details of the source and destination sites, and details of the haulier.
- 5.18.3 In order to protect the general public from dust and vapour emissions, wagons that are to be used for the haulage of the contaminated material from the site must be sheeted. In addition, the Contractor must ensure that no fluids seep from the wagons.
- 5.18.4 In order to provide the landfill facility with information regarding chemical composition of the waste, analysis of any material that requires removal from site will be undertaken.
- 5.18.5 A minimum of 6 samples per material/waste type will be scheduled for: *pH, total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc), PAH, BTEX and TPH.*
- 5.18.6 Waste Acceptance Criteria (WAC) analysis will also be required for inert or hazardous waste.

5.19 Backfill of Excavations

- 5.19.1 Excavations (to remove tanks, relict structures, contamination etc) should be backfilled as necessary to achieve the desired levels, with suitable materials and subjected to nominal compaction, to be agreed with the Engineer.
- 5.19.2 Excavations (to remove relict structures, contamination etc) should be backfilled with suitable materials as agreed with the Engineer, and subjected to nominal compaction. However, where an excavation conflicts with the footprint of a proposed highway, compaction in accordance with the Specification for Highway Works Table 6/1 will be required.
- 5.19.3 Trenches for services including site drainage and water supply should be cut over size in order to isolate pipe materials from potential contaminants and to enable maintenance to be conducted in "clean" material.

5.20 Earthworks Levels/Regrade

5.20.1 Final site levels will be agreed with Gladedale, via an External Works Drawing, which should show:

- Proposed finished floor levels
- Proposed finished road levels
- Garden & driveway levels and gradients

5.20.2 It is anticipated that the volume of cut will broadly equate to the volume of fill. However, there may be a need to export some soil/fill off-site.

5.21 Boundary Issues

5.21.1 The Client's Designer should ensure that proposed levels tie in with the surrounding infrastructure, and ground levels of adjacent properties (after allowance for the placement of any required soil cover).

5.21.2 Advice should be sought from the Engineer if mobile contamination is encountered close to the site's boundaries.

5.22 Highways

5.22.1 In the footprint of proposed highways, the contractor, under supervision, must ensure that relict obstructions are removed to a minimum of 1.0m below finished road level. In addition, any "cellar fill", or other unsuitable material, must be removed to its full depth. The resultant sub-formation should then be proof rolled, in accordance with the Specification for Highway Works.

5.22.2 If any deep excavation beneath a highway, results in sub-formation slopes greater than 1:5 (v:h) , the sub-formation should be stepped (max. 0.5m high) and benched (min. 1m wide). The supervising engineer will keep records of any such work undertaken.

5.22.3 The Contractor should agree acceptable performance criteria, and an appropriate Specification for any necessary ground improvement, with the Ben Bailey Homes and the adopting authority.

5.22.4 The Contractor will arrange for the necessary compliance testing to be undertaken at formation level on road alignments, as required by the adopting authority and Engineer.

5.23 Surveying

5.23.1 The Contractor shall arrange for the following survey work as directed by the Engineer:

- Establishment of profile boards
- Setting-out of estate roads
- Depth and extent of localised areas of overdig (such as those required to remove tanks)
- Depth and extent of excavations associated with removal of contaminated soil/fill
- The ground surface prior to placement of fill to raise site levels/provide clean cover in garden/landscaped areas
- The finished surface

5.23.2 The Contractor should supply the results of this survey work (disc & hard copy) to the Engineer for inclusion in Encia's Verification Report.

5.24 Placement of Soil Cover

- 5.24.1 Clean inert fill will be placed over the made ground in proposed garden and landscaped areas (but not beneath hardstanding). This cover layer is to comprise 450mm of "clean" subsoil plus 150mm of topsoil.
- 5.24.2 Crushed product could be used to form the lowermost layers of cover, subject to test results, and providing that crushed product is at least 600mm below finished levels in garden/landscaped areas.
- 5.24.3 It is considered unlikely that a significant volume of subsoil suitable for use as cover material will be sourced on site. Consequently, there will be a need for soil import.
- 5.24.4 Any material imported for use as cover should be validated in accordance with Encia's Protocol for Importation & Use of Soil Cover, copied in Appendix C. This Protocol includes chemical assessment criteria which should not be exceeded, and provides guidance on how the depth of placement should be verified.
- 5.24.5 This work may be undertaken as part of the contract for the preparatory & remedial works, in which case imported soils should be stockpiled in a location agreed with the Engineer. Alternatively, the developer may choose to import soil at a later stage in the development.

5.25 Hazardous Gas Protection

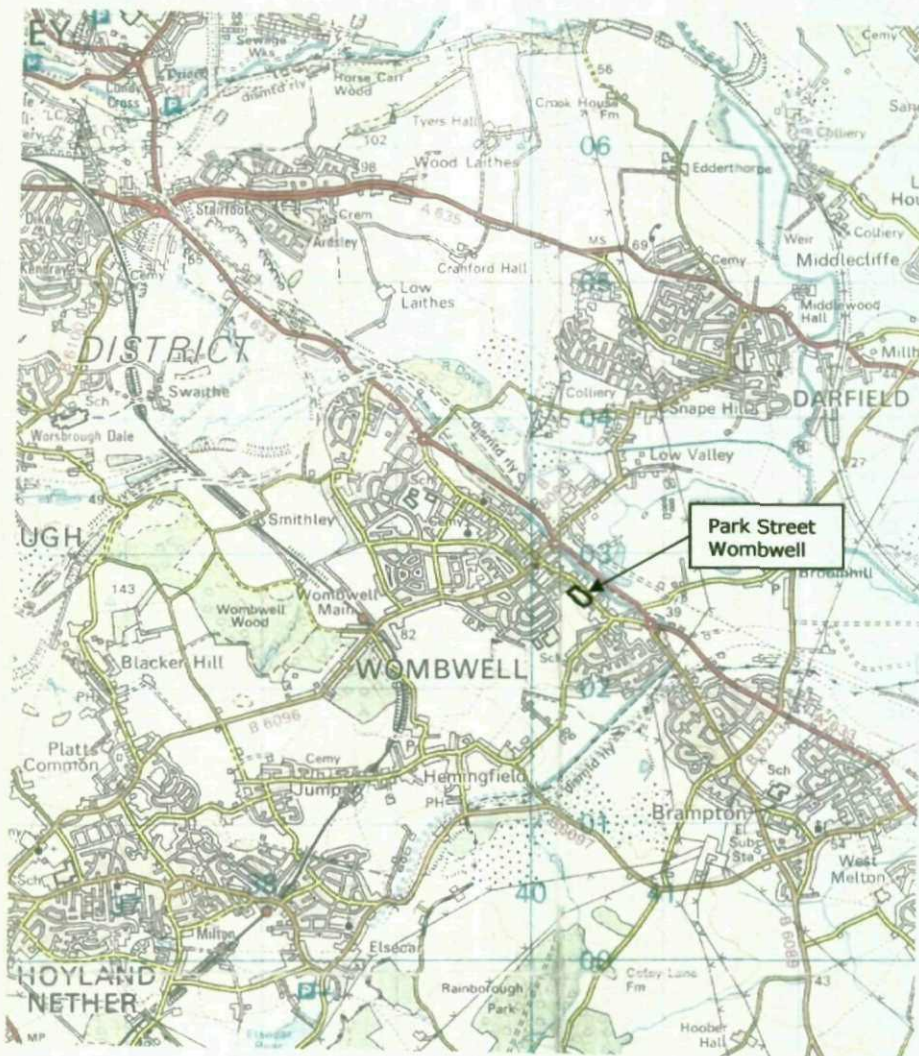
- 5.25.1 Based on worst-case maximum values, the site would be classed as Characteristic Situation 2 (Wilson & Card, 1999).
- 5.25.2 Based on the soil-gas regime and the resultant site characterisation and the proposed foundation solution the following gas protection measures are recommended:

Characteristic Situation (Wilson & Card, 1999)	Protective Measures			
	Floor Slab	Sub-floor ventilation	Membrane	
			Type	Product Examples
2	suspended	Min. 200mm clear void. Min. ventilation = 2,000 mm ² /m (via air bricks on each of 2 opposite sides). Any sub-floor sleeper walls should be honeycombed.	Waterproof DPM. Lapped & sealed in accordance with BR 414	2000g polyethylene

Footnotes:

1. The membrane should always be lapped and sealed in accordance with BRE/Environment Agency Report BR 414 (2001) - "Protective Measures for housing on gas-contaminated land". The membrane should be continuous across cavity walls, and there should be a cavity tray in external walls
2. In all cases there should be minimum penetration of floor slab by services; any penetrations should be suitably sealed
3. Integral garages with occupied rooms above, or direct access through a doorway from the garage to the house, should be provided with the same protective measures as the rest of the dwelling
4. Check manufacturer's specification if hydrocarbon vapours are present; hydrocarbons will degrade some membrane materials

**APPENDIX A
DRAWINGS**



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CLIENT

GLADEDALE SOUTH YORKSHIRE LIMITED

JOB TITLE

PARK STREET, WOMBWELL

DRAWING TITLE

SITE LOCATION PLAN

DRAWN BY

JWH

SIGNATURE

DATE

31/03/05

STATUS

FINAL

APPROVED

RLM

SIGNATURE

DATE

31/03/05

SCALE

1:50,000

DRG NO.

6177/1

NOTES

 BUILDING NUMBER (see report text)

 TANK LOCATIONS

 AREA BOUNDARY

 SITE BOUNDARY



REV.	DESCRIPTION	DATE
------	-------------	------



ENCIA HOUSE
 AUDBY LANE
 WETHERBY
 LS22 7RD
 TEL: 01937 589955
 FAX: 01937 589944

E-Mail: info@encia.co.uk
 Web: www.encia.co.uk

CLIENT

GLADEDALE SOUTH
 YORKSHIRE LIMITED

JOB TITLE

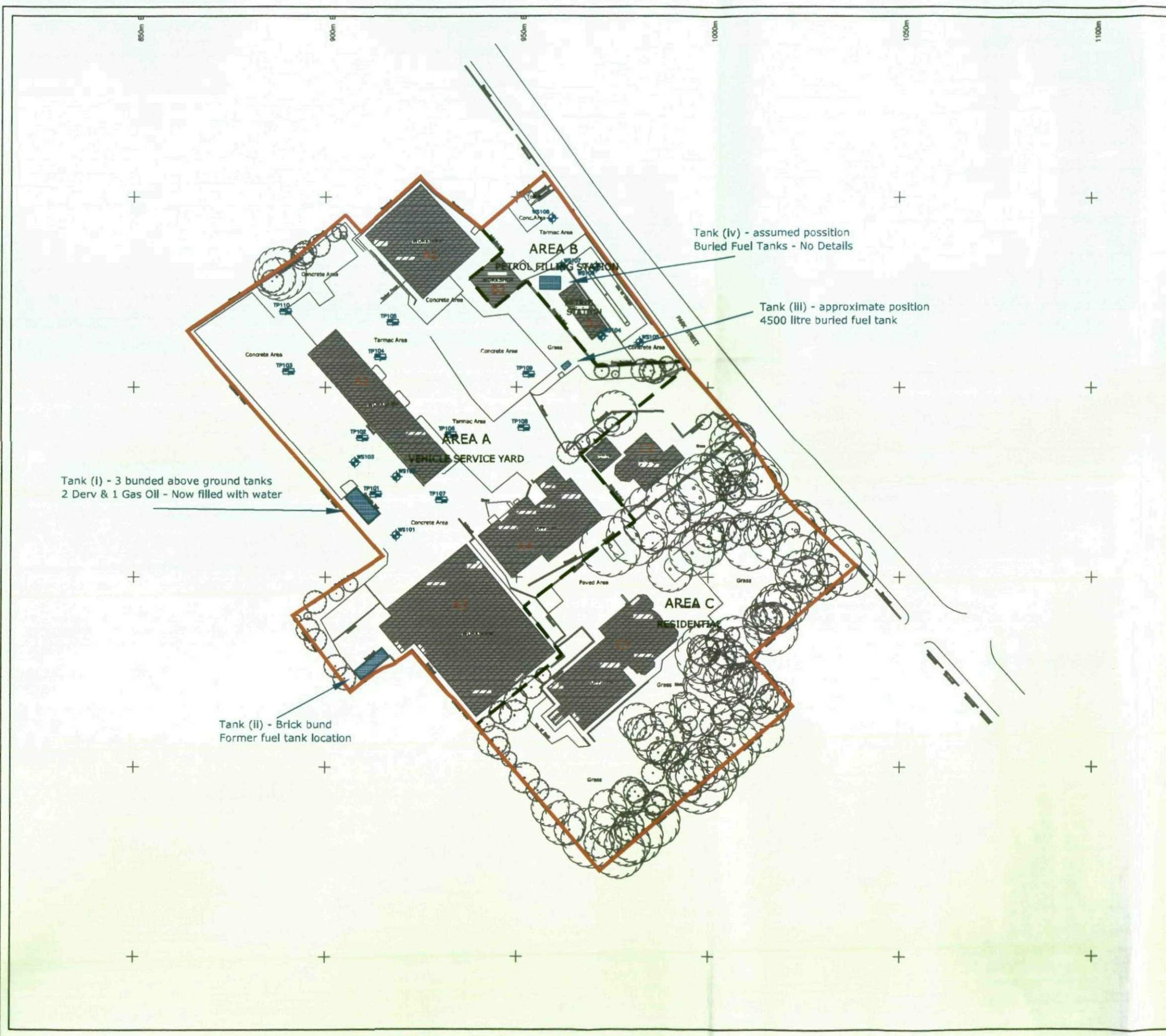
PARK STREET,
 WOMBELL

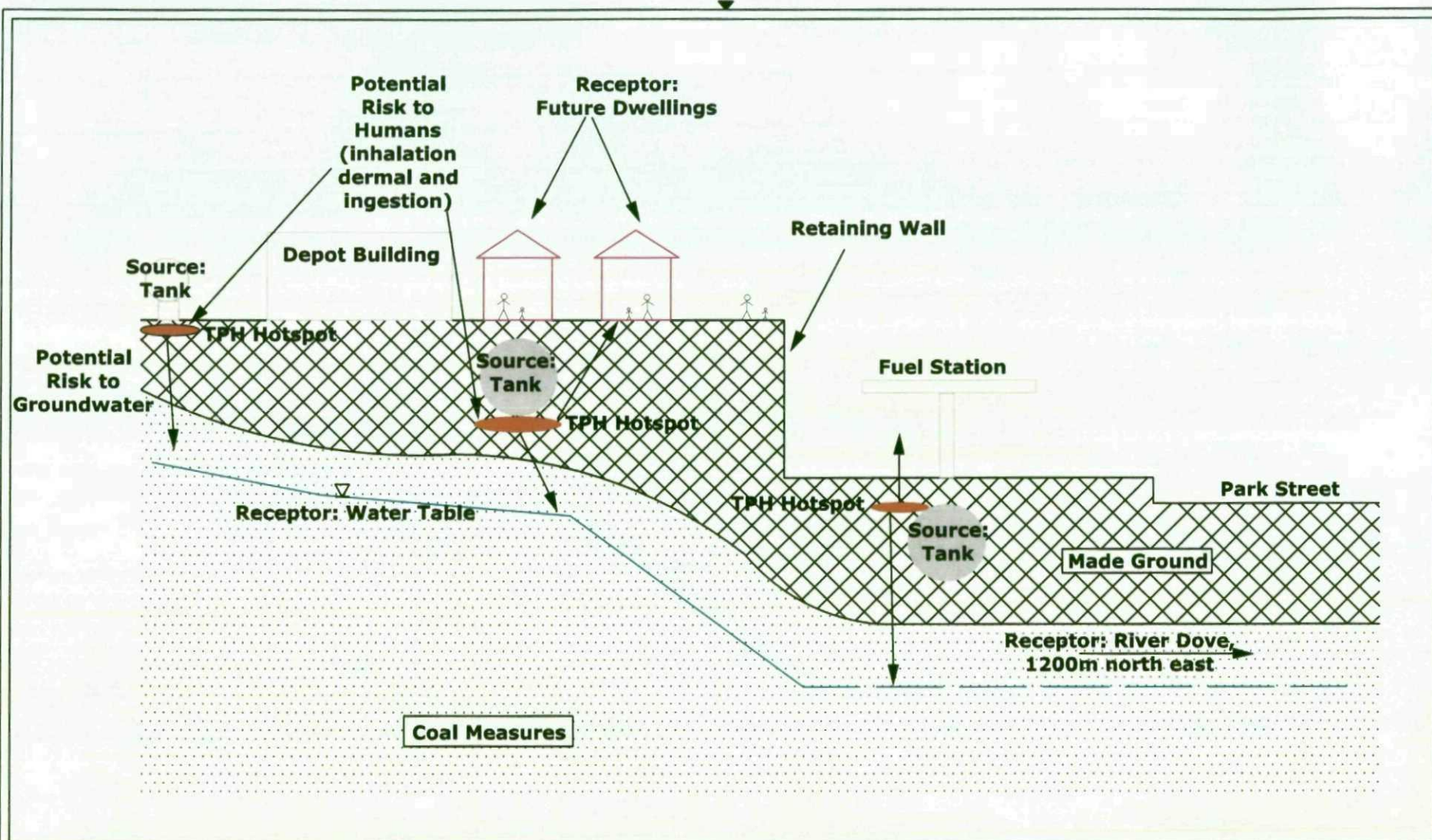
DRAWING TITLE

SITE FEATURES PLAN

DRAWN	SIGNATURE	DATE	STATUS
OGO		MAR 05	FOR COMMENT ☐
APPROVED	SIGNATURE	DATE	FOR APPROVAL ☐
RLM		MAR 05	DRAFT ☐
			FINAL ☒

SCALE	SHEET	DRAWING NO.	REVISION
1:1,000	A3	6177/2	0





ENCIA HOUSE
AUDBY LANE
WETHERBY
LS22 7RD
TEL: 01937 589955
FAX: 01937 589944

**GLADEDALE SOUTH
YORKSHIRE LIMITED**

**PARK ST
WOMBWELL**

**CONCEPTUAL SITE
MODEL**

NAME	JWH	DATE	JUNE 05
NAME	RLM	DATE	JUNE 05
FOR COMMENT ☐		DRAFT ☐	
FOR APPROVAL ☐		FINAL ☒	
SCALE	NTS	REVISION NO.	A4
DATE	6177/3	REVISION	A

**APPENDIX B
CORRESPONDENCE**



BARNSELEY

Metropolitan Borough Council

6177
e-mail JPB

Regulatory Services

Assistant Director: Ken E Eastwood
Central Offices, Kendray Street, Barnsley. S70 2TN.

My Ref: JSC/133394

Your Ref: 9164/JWH

Date: 28 September 2006

Enquiries Mr J Scott

Dial Direct: (01226) 772456

Fax: (01226) 775699

To: PollutionControl@barnsley.gov.uk

Dear John

Re Park Street, Wombwell – Planning Application 2006/0008

Following our conversation regarding the above site, I have further reviewed the quantitative risk assessment report that was submitted and have the following comments to make.

My main concern regarding the risk assessment was with regard to the derivation of the combined value for the TPH contamination on the site. I was unsure how this figure has been derived, and whether this methodology is an acceptable approach. However, following our conversation, you have stated that any remediation works on the site will be validated by using the carbon banded TPH fractions. This is an acceptable approach to us, and as such I have no further concerns regarding the submitted information. The previously submitted information has provided the Environment Agency's approval of the P20 risk assessment.

I look forward to receiving the remediation strategy in the near future. In the mean time, should you have any further queries please don't hesitate to contact me.

Yours sincerely

John Scott
Contaminated Land Officer

2 5671

RECEIVED	02 OCT 2006
DATE	TIME
DISTRIBUTION	

Mr John Harrison
ENCIA Consulting Ltd
Encia House
Audby Lane
Wetherby
LS22 7RD

APPENDIX C
ENCIA PROTOCOL FOR IMPORTATION & USE OF SOIL COVER

Protocol for Importation & Use of Soil Cover (Capping)



Introduction.

Isolation of made ground in garden and landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended on residential developments where made ground is left in-situ; most notably when it contains some inorganic contaminants at concentrations above guidance threshold values. A cover solution is not generally appropriate for organic contamination (fuels, solvents etc); removal or treatment will probably be required.

The "clean" soil cover blocks potential linkages between the contaminated fill and future residents. Such a cover is only required in proposed garden and landscaped areas underlain by made ground (i.e. not beneath drives, garages or houses).

The thickness of cover is dependant on the nature and degree of contamination (and often the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. However, if the made ground is essentially "clean", but contains materials generally considered undesirable as a near-surface material in garden areas (colliery spoil, construction\demolition rubble etc) then a 300mm thick cover, in accordance with NHBC Standards, Chapter 9.2, should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

The **CML initiative**, which came into force on 1st April 2003, requires house builders to submit to NHBC (or other warranty providers) a validation report confirming the thickness and quality (ie contaminant-free) of the soil cover. Validation reports are normally prepared by independent geoenvironmental consultants such as Encia Environmental.

Soil **quality** is best determined by sampling of the **source** at least 7 working days before importation to the development site. If this is achieved, further, on-site (post-placement) quality testing should not usually be necessary providing cover material is stockpiled on site away from site horizons and not placed before the first fix to avoid unnecessary tracking over, compaction and movement of contamination.

Soil **thickness** can only be checked after placement, but should be done before turfing, fencing etc. Thickness could be checked via the excavation of an appropriate number of inspection pits or by survey carried out prior to and immediately after the placement of cover material.

Soil cover is usually placed many weeks after completion of the preparatory\remedial works, and issue of the associated Verification Report. Consequently, site visits, to generate supplementary letter reports, are typically required after soil cover has been placed in the gardens of each plot, or set of plots.

Failure to submit cover validation reports (a **RED** item) promptly will delay NHBC finalling plots - this will delay the release of mortgage funds and hence legal completion - ie the financial implications are very significant.

Given the potential for cross-contamination of soil cover (by excavation arisings, builders rubble etc), it should be validated at a relatively late stage in the construction programme (ideally after scaffolding has been dismantled). However, it is essential that Encia is instructed at least 2 weeks prior to the anticipated finalling date.

Cover material can sometimes be sourced on-site from foundation\drainage excavations in natural in-situ strata, but import is often necessary. The following protocol (testing at source) is recommended.

Protocol for Importation & Use of Soil Cover (Capping)



Protocol (Testing at Source)

The materials should be inspected by Encia Environmental **at source**.

Soil material should:

- be clean and free of foreign debris, building waste materials or contaminants;
- not have a stone content of greater than 20% by dry weight and
- have a maximum stone size of 150mm in any one direction.
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

Encia should take representative samples of the cover material from the proposed source. The number of samples taken will be dependant on the nature of the source and the quantity of material to be imported. However, as a guide, a **minimum** of 6 samples of each soil type should be tested, with a further sample for each 250m³ of subsoil, where the quantity exceeds 1,500m³; and a further sample for each 50m³ topsoil, where the quantity exceeds 300m³.

A less frequent sampling rate may be appropriate for soils from a greenfield source or where large volumes (say > 5,000m³) of soil are imported from a single, relatively homogenous source.

Each sample taken should be forwarded to an analytical laboratory for testing in accordance with the following schedule:

Table 1 – Test schedule

Source	Definition	Test Schedule	Other requirements
Greenfield	No 'source' of contamination present i.e. possibly undeveloped; absence of made ground; current and historic use of the site has been assessed in terms of potential sources. Metal analysis undertaken to permit haulage.	<i>pH, total metals (Cu, Ni, Zn, Cr, As, Hg, Se, Cd & Pb), water soluble boron.</i>	Site visit and soil inspection by Encia engineer or review of Encia prepared DS/SI reports. Photographs of site and stockpile for import.
Brownfield	Potential source anticipated i.e. current or historical industrial or commercial use; storage of fuel/solvents; evidence of bonfires; presence of made ground; particularly ashy material. Soil transfer stations	<i>pH, total metals (Cu, Ni, Zn, Cr, As, Hg, Se, Cd & Pb), water soluble boron. Speciated PAH and banded TPH.</i>	Site visit and soil inspection by Encia engineer. Photographs of stockpile for import.

NB The schedules detailed above have been prepared in accordance with the Secondary Model Procedures. This document state that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

Additional determinands could be scheduled, although if considered necessary, would probably suggest the material is unlikely to be suitable for use as clean cover in gardens.

The analytical testing should be undertaken on a 3 or 5-day turnaround and the Client\Contractor should be notified of the soil's suitability (or otherwise) immediately after receipt of the results. Chemical assessment (Tier 1) criteria for imported soils are tabulated on page v.

Protocol for Importation & Use of Soil Cover (Capping)



On receipt of written confirmation from Encia, the Client should instruct his Contractor to commence importation. It will probably be necessary to stockpile the cover prior to placement in garden\landscaped areas. Encia should inspect the stockpiled material prior to placement, to confirm that it is the same material as previously tested, or the Contractor should provide the Client with appropriate haulage notes.

Validation letter reports should be issued by Encia as each plot, or set of plots, is completed.

Imported **topsoil** should be subject to the above protocol, wherever it is *not* being sourced from an approved supplier. In addition, some analysis in accordance with BS3882 may be appropriate.

Protocol for Importation & Use of Soil Cover (Capping)



Protocol (Testing after Placement)

Clearly, if soil cover is imported and placed before confirmation of its suitability, we cannot guarantee that our validation work will yield the desired results. In which case, it may be necessary to excavate and export the placed soil cover and/or import further "clean" soil.

The materials should be inspected by Encia Environmental via inspection pits excavated through the entire thickness of placed cover material.

Encia should take representative samples of soil from each pit. It will typically be necessary to retrieve 1 sample per 250m³ (Subsoil), and 1 sample per 50m³ (Topsoil). For a development with "standard" gardens comprising a total area of 100m² (front and rear), and a soil cover thickness of 300mm or 600mm, incorporating a minimum 150mm topsoil, this will typically require a minimum of one pit per 3 plots.

Soil material should:

- be clean and free of foreign debris, building waste materials or contaminants;
- not have a stone content of greater than 20% by dry weight and
- have a maximum stone size of 150mm in any one direction.
- not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc).

Each sample taken should be forwarded to an analytical laboratory for testing in accordance with Table 1 above.

The analytical testing should be undertaken on a 3 or 5-day turnaround and the Client/Contractor should be notified of the soil's suitability (or otherwise) immediately after receipt of the results. Chemical assessment (Tier 1) criteria for imported soils are tabulated on page v.

Validation letter reports should be issued by Encia as each plot, or set of plots, is completed.

Placed **topsoil** should be subject to the above protocol, wherever it is *not* being sourced from a reputable supplier able to provide analytical certificates, in accordance with BS3882.

Protocol for Importation & Use of Soil Cover (Capping)



Chemical assessment criteria for imported soils to the above site to create the soil cover system

Contaminant	Source	Tier 1 Assessment Criteria (mg/kg)	Comments/Notes
		Resi with gdns	
pH	CLEA		Initial assessment only
As	CLEA	32	-
Cd	CLEA	1, 2 & 8	pH variable
Cr	CLEA	130	-
Pb	CLEA	450	-
Hg	CLEA	170	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV
Ni	CLEA	130	Assessment of human health risk only
Se	CLEA	350	-
B	ICRCL 23/79	50	Mid range between trigger and target conc (2-100)
Cu	MAFF	80 to 200	pH variable
Zn	MAFF	200 to 300	pH variable
Naphthalene	Encia Tier 1	6	Driven by outdoor inhalation and direct contact (does not consider indoor inhalation)
Benzo(a)pyrene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Indeno(1,2,3-c,d)pyrene Dibenzo(a,h)anthracene	Encia Tier 1	5	Main PAHs that affect direct contact pathway, all assessed in line with value derived for BaP
GRO	Encia Tier 1	0.5	Based on an outdoor inhalation and direct contact value for Benzene (does not include indoor inhalation). If no benzene present and GRO <10mg/kg no risk from individual fractions.
DRO	Encia Tier 1	60	Assumes all DRO fraction is in the aromatic C10 to C12 range. If aromatic C10 to C12 range <60mg/kg, adopt 540mg/kg as Tier 1 value, based on next lowest derived value for this range of aliphatic and aromatic fractions.
LRO	Encia Tier 1	580	Based on Aromatic C21-C35 for direct contact and outdoor inhalation (does not consider indoor inhalation).

It should be noted that many of the compounds detected by laboratory analysis for TPH and PAH are naturally occurring in coal, humic acid, bark, leaf litter etc; these are clearly not 'sources' within the legal definition. Encia can undertake further risk assessment where PAH screening values are exceeded, *but* inspection of the soils has not identified any petroleum or combustion derived material.