

PHASE 2 INVESTIGATION

Former Ambulance Station

Cemetery Road

Ramsbottom

Bury

BL0 9PU

Project reference	25.372
Prepared by	Andrew Gaskell BSc Civil Engineering
Organisation	HOME Group NW Ltd
Purpose	Phase 2 site characterisation, quantitative screening and interpretative assessment in support of contaminated land Condition 4 / CL01.
Planning condition	Condition 4 / CL01 - Site Characterisation & Risk Assessment

1.0 Introduction

This report presents the findings and interpretation of the Phase 2 intrusive soil investigation undertaken at the Former Ambulance Station, Cemetery Road, Ramsbottom, BL0 9PU. It should be read in conjunction with the Phase 1 Environmental Desk Study, reference 25.372.

The Phase 1 assessment identified potential contaminant sources associated principally with the former ambulance station use, including possible fuel and oil spillages, localised Made Ground and a historic refuse tip/refuse heaps approximately 150-155 m northeast. The Phase 1 recommended intrusive investigation and chemical testing of shallow soils.

The proposed development comprises three detached dwellings with driveways, patios, gardens and landscaping. This report characterises the investigated soils, interprets the laboratory results against appropriate UK generic assessment criteria, considers the actual final use of each trial pit location, updates the conceptual site model and sets out proportionate remediation recommendations.

2.0 Assessment Framework

The assessment follows the source-pathway-receptor approach in the Environment Agency Land Contamination Risk Management (LCRM) framework and the principles of BS 10175. For accessible soft-landscaped areas, a conservative Residential with Home-Grown Produce exposure scenario has been adopted.

Defra Category 4 Screening Levels (C4SLs) are used where available, with LQM/CIEH Suitable 4 Use Levels (S4ULs) used where appropriate for additional determinands. These are generic screening criteria, not automatic remediation thresholds. Where a concentration exceeds a generic criterion, the significance is assessed against the actual development layout and whether a complete pollutant linkage remains.

Contaminant	Adopted residential screening value
Arsenic	37 mg/kg C4SL
Cadmium	22 mg/kg C4SL
Lead	200 mg/kg C4SL
Benzo[a]pyrene	5 mg/kg C4SL

3.0 Phase 2 Investigation

Five trial pit locations, TP1 to TP5, were investigated across the site. Representative soils were submitted to Environmental Chemistry Laboratories / Professional Soils Laboratory under analytical report E26/10854/PSL/26-35944. Nine samples were tested: TP1 Top, TP1 Clay, TP2 Top, TP2 Clay, TP3 Sand, TP3 Made Ground, TP4 Made Ground, TP4 Sand and TP5 Sand.

The analytical suite included metals, PAHs, petroleum hydrocarbons, volatile petroleum hydrocarbons, cyanide, phenols, pH, sulphate and related determinands. The laboratory certificate does not state the sample depth intervals; therefore, no trial pit depth or Made Ground thickness has been inferred in this report.

4.0 Trial Pit Locations and Proposed Final Use

Trial pit	Location / context of sampling	Proposed final use	Significance
TP1	Trial pit at the position of the proposed Plot 1 driveway. Top and underlying natural soil were sampled.	Driveway serving Plot 1	Future direct soil contact prevented by hardstanding; analytical results also low.
TP2	Trial pit within the grassed area between proposed Plots 2 and 3.	Accessible grassed / landscaped area	Principal tested location representing a future accessible residential soil exposure area.
TP3	Rear part of the site. Natural sand and localised Made Ground containing brick and bituminous fragments were sampled.	Rear patio / hardstanding	TP3 Made Ground has elevated heavier TPH; future direct contact is prevented by hardstanding. Landscaped ground behind this location is to be excavated and regraded.

TP4	Within the existing hardstanding / driveway immediately serving the former ambulance station bays.	Beneath Plot 2 floor	Localised Made Ground with elevated arsenic and heavier TPH will be isolated beneath the building floor construction.
TP5	Rear part of the site; natural sandy soil sampled.	Rear patio / hardstanding	Low contaminant concentrations. Landscaped ground behind this location is to be excavated and regraded.

The landscaped area behind TP3 and TP5 is currently sloping. It will be excavated and regraded and suitable new material will be imported as required to achieve the finished levels. The existing surface in that regraded area will therefore not form the final residential exposure surface.

5.0 Ground Conditions

Sample	Laboratory soil description
TP1 Top	Brown slightly gravelly silty clay with occasional rootlets
TP1 Clay	Yellow slightly gravelly silt
TP2 Top	Brown slightly sandy silty clay with occasional rootlets
TP2 Clay	Brown slightly clayey slightly gravelly silty sand
TP3 Sand	Brown slightly clayey slightly gravelly silty sand
TP3 Made Ground	Greyish brown sandy crushed rock with occasional brick fragments and bituminous material
TP4 Made Ground	Greyish brown sandy crushed rock with occasional brick fragments and bituminous material
TP4 Sand	Brown slightly clayey slightly gravelly silty sand
TP5 Sand	Brown gravelly silty sand

The investigation demonstrates that Made Ground is localised at TP3 and TP4, while the remaining analysed materials are predominantly natural soils. This distinction is important to the remediation strategy because the natural soils were generally below the adopted residential human-health screening criteria.

6.0 Human Health Screening

Contaminant	Maximum result	Location	Interpretation
Arsenic	56 mg/kg	TP4 Made Ground	Above 37 mg/kg C4SL; beneath Plot 2, so future direct-contact linkage is broken.
Cadmium	3.0 mg/kg	TP4 Made Ground	Below 22 mg/kg C4SL.
Lead	120 mg/kg	TP3 Made Ground	Below 200 mg/kg C4SL.
Benzo[a]pyrene	0.51 mg/kg	TP2 Top	Below 5 mg/kg C4SL.
TPH C10-C40	1,500 mg/kg	TP3 Made Ground	Elevated heavier hydrocarbons in bituminous Made Ground; final location beneath hardstanding.
TPH C10-C40	660 mg/kg	TP4 Made Ground	Elevated heavier hydrocarbons in bituminous Made Ground; final location beneath Plot 2.
VPH C5-C10	<0.20 mg/kg	All tested samples	No significant light volatile hydrocarbon source indicated by the analysis.

6.1 TP1 - Plot 1 Driveway

TP1 will lie beneath the proposed Plot 1 driveway. Arsenic was below 10 mg/kg and lead was 40 mg/kg in TP1 Top. The remaining analysed determinands were generally low. No significant contamination has been identified at TP1 and the completed driveway will provide an additional permanent barrier to direct soil contact.

Recommended remediation: none specifically required for contamination. Suitable natural soil may remain in situ or be reused, subject to the unexpected contamination procedure.

6.2 TP2 - Grassed Area Between Plots 2 and 3

TP2 is the key tested accessible landscaped location. TP2 Top recorded arsenic 18 mg/kg, cadmium 1.4 mg/kg, chromium 15 mg/kg, copper 38 mg/kg, lead 110 mg/kg, nickel 21 mg/kg and zinc 150 mg/kg. Benzo[a]pyrene was 0.51 mg/kg, total USEPA-16 PAH was 8.50 mg/kg and total TPH C10-C40 was 69 mg/kg.

These results are below the adopted residential human-health screening criteria. No unacceptable human-health pollutant linkage has therefore been identified for the tested soil in the future accessible grassed area.

Recommended remediation: no contaminated-land remediation is required at TP2 on the basis of the current analytical results. Natural soil may remain, subject to the unexpected contamination procedure.

6.3 TP3 - Rear Patio / Hardstanding

TP3 Made Ground comprises sandy crushed rock containing occasional brick fragments and bituminous material. Total TPH C10-C40 was 1,500 mg/kg and C10-C25 was 230 mg/kg. By comparison, TP3 natural Sand recorded only 36 mg/kg C10-C40. The distribution therefore indicates that the elevated heavier hydrocarbon concentration is associated with localised Made Ground rather than the underlying natural soil.

TP3 will be beneath the proposed rear patio/hardstanding. The completed hard surface will prevent direct ingestion, dermal contact, dust exposure and plant uptake by future residents.

Recommended remediation: where TP3-type Made Ground is excavated, segregate it from natural soils and do not reuse it in gardens, planting areas or other accessible landscaped areas unless separately demonstrated suitable. It may remain beneath permanent hardstanding where it is suitable as engineering fill, or be removed to an appropriately authorised facility. Clean natural soil may remain or be reused.

6.4 TP4 - Beneath Plot 2

TP4 was taken within the existing hardstanding/driveway immediately serving the former ambulance station bays and will lie beneath the proposed footprint of Plot 2. TP4 Made Ground recorded arsenic 56 mg/kg, lead 110 mg/kg, cadmium 3.0 mg/kg, nickel 83 mg/kg, TPH C10-C40 660 mg/kg and TPH C10-C25 100 mg/kg.

The arsenic concentration exceeds the Residential with Home-Grown Produce C4SL of 37 mg/kg by a factor of approximately 1.5. However, the generic residential screening scenario assumes accessible soil. TP4 will not form part of a garden or other accessible soil exposure area.

The proposed Plot 2 floor shall incorporate a proprietary reinforced gas-resistant damp-proof membrane selected for resistance to methane and carbon dioxide and suitable for the intended position in the floor construction. The membrane shall have appropriate independent third-party certification for use as a gas barrier and shall be installed in accordance with the manufacturer's details and the design principles of BS 8485. All joints, laps, service penetrations and perimeter details shall be fully sealed using compatible proprietary components.

The membrane will be protected by / incorporated with the proposed 100 mm concrete capping layer, with an air void and suspended beam-and-block floor above. The membrane installation shall be inspected and photographically verified before it is covered, with particular attention to laps, penetrations, corners and repairs. Verification shall follow the principles of CIRIA C735.

Recommended remediation: TP4 Made Ground may remain beneath Plot 2 provided it is not transferred into accessible landscaped areas, the proposed floor barrier construction is installed and verified, and no materially worse unexpected contamination is encountered during excavation. The future direct-contact source-pathway-receptor linkage is thereby incomplete.

6.5 TP5 - Rear Patio / Hardstanding

TP5 comprises natural gravelly silty sand. Arsenic was below 10 mg/kg, lead was 22 mg/kg and TPH C10-C40 was below 15 mg/kg. No significant contamination has been identified. The location will also be beneath proposed rear patio/hardstanding.

Recommended remediation: none required for contamination.

7.0 Rear Landscaped Area and Regrading

The landscaped area behind TP3 and TP5 will be excavated and regraded. The remediation approach shall therefore be selective and based on the distinction between clean natural soils and localised Made Ground.

- Natural clay, silt and sandy soils consistent with the tested natural strata may be retained or reused on site where no visual or olfactory evidence of unexpected contamination is present.
- Made Ground containing crushed construction material, brick, asphalt/bituminous fragments, staining or hydrocarbon odour shall be segregated during excavation.
- TP3/TP4-type Made Ground shall not be reused within the final accessible garden or landscaped soil profile unless separately tested and demonstrated to be suitable.
- Where Made Ground is unsuitable for retention beneath permanent buildings/hardstanding, it shall be removed to an appropriately authorised facility with waste transfer records retained.
- Imported fill, subsoil and topsoil used to form the final landscaped profile shall be source-controlled, tested and validated in accordance with the imported soil plan prepared for CL05 / Condition 8.

No wholesale removal of clean natural soils is required on the basis of the Phase 2 analytical results.

8.0 Controlled Waters and Vapour Considerations

The investigation does not indicate widespread mobile contamination. Elevated TPH is localised to bituminous Made Ground at TP3 and TP4, while adjacent natural soils contain much lower concentrations. VPH C5-C10 was below 0.20 mg/kg in all tested samples. On the available evidence, the controlled-waters risk is assessed as Low, subject to review if free product, strongly stained soils, significant hydrocarbon odours or contaminated groundwater are encountered during construction.

9.0 Laboratory Data Interpretation

The laboratory analytical results have been reviewed in conjunction with the recorded soil descriptions, the distribution of Made Ground and natural soils across the site, and the proposed final development layout. The results show a consistent distinction between the localised Made Ground encountered at TP3 and TP4 and the generally cleaner natural soils encountered elsewhere. Elevated total petroleum hydrocarbons are confined principally to the Made Ground containing bituminous material, while the corresponding natural soils record substantially lower concentrations. Volatile petroleum hydrocarbons (C5-C10) were below the laboratory detection limit in all analysed samples. The metals results similarly identify the principal arsenic elevation within TP4 Made Ground, while soils representative of future accessible landscaped areas remain below the adopted residential human-health screening criteria. The analytical dataset is therefore considered suitable for the purposes of the site characterisation and qualitative risk assessment presented in this report.

10.0 Updated Conceptual Site Model

Location/source	Potential pathway	Receptor	Final condition / mitigation	Residual risk
TP1 natural soil	Direct contact	Residents	Plot 1 driveway; analytical results low	Very Low
TP2 natural soil	Direct contact, ingestion, plant uptake	Residents	Accessible grassed area; concentrations below residential GAC	Low
TP3 Made Ground	Direct contact / ingestion	Residents	Rear patio/hardstanding; Made Ground controlled during earthworks	Very Low
TP4 Made Ground - arsenic	Direct contact, ingestion, dust	Residents	Beneath Plot 2; gas-resistant DPM, concrete capping, void and beam-and-block floor	Very Low / linkage incomplete
TP4 Made Ground - TPH	Contact / vapour	Residents	Beneath Plot 2 barrier construction; VPH below detection	Low
TP5 natural soil	Direct contact	Residents	Rear patio/hardstanding; analytical results low	Very Low

Rear regraded landscaping	Potential Made Ground / imported soil	Residents	Made Ground segregated; clean natural soil retained; imported soil validated	Low
Historic refuse tip NE	Methane / CO2 migration	Buildings / residents	Precautionary gas-resistant membrane and floor void at Plot 2; detailed installation verification	Low

11.0 Remediation Recommendations

Area	Required action
TP1 / Plot 1 driveway	No specific contamination remediation. Retain suitable natural soils; construct driveway.
TP2 / grassed area between Plots 2 and 3	No remediation required on current analytical results. Retain suitable natural soil.
TP3 / rear patio	Segregate TP3-type Made Ground if excavated; do not reuse in accessible landscaping. Retain beneath hardstanding only if suitable; otherwise remove off site.
TP4 / beneath Plot 2	Made Ground may remain. Install and verify certified methane/CO2-resistant DPM/gas membrane, 100 mm concrete capping layer, air void and beam-and-block suspended floor. Do not transfer Made Ground to landscaping.
TP5 / rear patio	No specific contamination remediation.
Rear landscaped regrading	Retain/reuse clean natural soil. Segregate/remove Made Ground. Form final levels with validated suitable imported material.
All earthworks	Apply unexpected contamination procedure and keep records of any suspect soils, disposal and corrective actions.

12.0 Verification Requirements

- Photographs of excavation/regrading and the distinction between Made Ground and retained natural soil.
- Confirmation that TP3/TP4-type Made Ground has not been reused in accessible gardens or landscaping.
- Waste transfer / disposal documentation for Made Ground removed from site.
- Imported soil source information, quantities, laboratory certificates and photographs in accordance with the CL05 plan.
- Product data and independent certification for the gas-resistant membrane beneath Plot 2.
- Pre-cover inspection and photographic record of the installed membrane, including laps, corners, penetrations, perimeter details and any repairs.
- Confirmation of the 100 mm concrete capping layer and completed suspended beam-and-block floor arrangement.
- Photographs of completed hardstanding and landscaped areas.
- Written confirmation of whether unexpected contamination was encountered.

13.0 Conclusion

The Phase 2 investigation indicates that contamination is localised principally to Made Ground at TP3 and TP4. Tested natural soils were generally below the adopted residential human-health screening criteria. TP2, which is located within the future accessible grassed area between Plots 2 and 3, is below the adopted residential screening criteria.

TP3 Made Ground with elevated heavier hydrocarbons will be beneath rear hardstanding. TP4 Made Ground, including arsenic at 56 mg/kg, will be beneath Plot 2 and isolated by the proposed gas-resistant membrane, 100 mm concrete capping, air void and suspended beam-and-block floor. The relevant future direct-contact pathways are therefore broken.

The rear landscaped slope will be excavated and regraded. Clean natural soils may be retained or reused; Made Ground shall be segregated and kept out of accessible landscaping; and imported soil-forming materials shall be tested and validated.

On this basis, no site-wide excavation, wholesale removal of natural soils or blanket clean-cover system is considered necessary. Subject to the stated selective earthworks controls, imported-soil validation, floor barrier verification and unexpected-contamination procedure, the site is considered capable of being made suitable for the proposed residential use.

14.0 References

- HOME Group, 25.372 Phase 1 Environmental Desk Study - Former Ambulance Station, Cemetery Road, Ramsbottom.
- Environmental Chemistry Laboratories / Professional Soils Laboratory, E26/10854/PSL/26-35944, PSL26/6587 Cemetery Road, BL0 9PU.
- Environment Agency, Land Contamination Risk Management (LCRM), including Stage 1 risk assessment and Stage 3 remediation and verification.
- Defra, Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.
- LQM/CIEH, Suitable 4 Use Levels (S4ULs).
- BS 10175, Investigation of potentially contaminated sites - Code of practice.
- BS 8485, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
- CIRIA C735, Good practice on the testing and verification of protection systems for buildings against hazardous ground gases.