

PHASE 1 & 2 ENGINEERING & ENVIRONMENTAL ASSESSMENT

FOR A RESIDENTIAL DEVELOPMENT SITE ADJACENT BELLWOOD CRESCENT, HOYLAND, BARNSELEY

VOLUME 1

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1.0 INTRODUCTION

- 1.01 Following instructions from Ackroyd & Abbott Homes Ltd. during September 2007, CoDa Structures have undertaken an appraisal of a residential development site adjacent Bellwood Crescent, Hoyland. The appraisal assesses environmental and geotechnical ground conditions and associated highways and drainage issues.
- 1.02 This report was assigned to Cadam Construction Ltd on 28 April 2017 for use in a further planning application on the site.
- 1.03 The site was formerly an NHS Care Unit. The building was demolished in August 2007.
- 1.04 It is proposed to develop the site for housing.
- 1.05 Sections 2.0 – 7.0 of this report undertake a desk based assessment to determine the environmental quality of the land at the site and to identify the potential for any environmental risks as follows:-
- to establish the likely extent of any potential contamination at the site as a result of its current and previous use;
 - to establish the sensitivity of the site in relation to the site's geology, hydrogeology and hydrology;
 - to assess the significance of any potential contamination at the site with respect to possible harm to the surrounding environment and site end users;
 - to provide recommendations for further works as appropriate.
- 1.06 The interpretation provided in this report is based upon information gathered from public data sources.
- 1.07 A trial pit ground investigation was undertaken on 07 September 2007.
- 1.08 The local authority is Barnsley Metropolitan Borough Council (BMBC).

2.0 LOCATION, TOPOGRAPHY & CURRENT CONDITION

- 2.01 The site is located to the north of Bellwood Crescent, and is approximately 7 miles to the south of Barnsley town centre. A site location plan is attached in Volume 2, Appendix B.
- 2.02 The site can be accessed from Bellwood Crescent.
- 2.03 The Ordnance Survey co-ordinates for the centre of the site are 436320 mE, 400310 mN.

- 2.04 The site is approximately 0.39 hectares in area.
- 2.05 The boundaries of the site are defined as follows:-
- North western boundary : timber post and rail fence and hedgerow to the back of footway on Skiers View Road;
 - North eastern boundary : Hawthorn hedging and a section of brick wall to adjacent residential properties;
 - South western boundary: timber post and rail fence to adjacent residential properties;
 - South eastern boundary : Conifer hedging to adjacent residential properties, and back of footway to Bellwood Crescent.
- 2.06 A site walk-over was undertaken on 07 September 2007 and the following noted:-
- the site has been cleared and left as a plateau;
 - a stockpile of concrete in the centre of the site awaiting removal;
 - the tarmac access drive into the site is still in place;
 - mature hedgerows and bushes are present on the banking along the north western boundary;
 - brick retaining walls adjacent the north western boundary are still present;
 - grassed banking adjacent the north eastern boundary;
 - a mature hedgerow and trees along the south western boundary to the southern sector of the site;
 - earth banking adjacent the south western boundary in the northern sector of the site;
 - a mature hedgerow along the south eastern boundary;
 - no visual signs of contamination.
- 2.07 The site was formerly an NHS Care Unit, but was demolished in August 2007.
- 2.08 A site topographical survey (Fig.2) is attached in Volume 2, Appendix C.
- 2.09 Site photographs are attached in Volume 2, Appendix D.

3.0 HISTORIC SITE USAGE

3.01 Extracts from Ordnance Survey Sheets dating back to 1855 have been examined and the following constitutes a brief history of the entire site and the surrounding land:-

Map/Date & Scale	On-site Features	Features within 250m of site	Features within 1000m of site
1855 1:10,00	- the site appears to be undeveloped farmland;	- the surrounding area is undeveloped; - a sandstone quarry to the south east;	- the surrounding area is predominantly undeveloped; - the village of Upper Hoyland to the north; - the village of Nether Hoyland to the east.
1893 1:2,500	- little change noted;	- a small residential development to the north east;	- Not applicable (N/A).
1893/84 sheets 1:10,000	- little change noted;	- little change noted;	- the village of Hoyland Common to the west.
1905 1:2,500	- little change noted;	- little change noted;	- N/A
1905/07 sheets 1:10,000	- little change noted;	- little change noted;	- expansion of Hoyland Common to the west; - old ironstone pits to the south; - mining shafts to the south and south east.
1931 1:2,500	- little change noted;	- residential development to the west and north west; - road adjacent the western boundary;	- N/A
1938/48 sheets 1:10,000	- little change noted;	- little change noted;	- extensive development to the east and north east; - residential development to the west.
1956 1:2,500	- little change noted;	- further residential development to the west and south west; - residential development to the north east;	- N/A
1956 1:10,000	- little change noted;	- little change noted;	- further development to the west; - possible colliery spoil tips to the north west.
1965/66 sheets 1:10,000	- little change noted;	- little change noted;	- little change noted.
1969/70 sheets 1:2,500	- little change noted;	- residential development adjacent the northern boundary;	- N/A
1968/75 sheets 1:2,500	- little change noted;	- little change noted;	- N/A
1978/82 sheets 1:10,000	- the building formerly on the site is now present;	- residential development to the south and east;	- further residential development to the north, east and south east; - slurry ponds to the north west; - industrial development to the

			north east.
1993 1:2,500	- little change noted;	- little change noted;	- N/A
2000 1:10,000	- little change noted;	- little change noted;	- further residential development to the south east.
2006 1:10,000	- little change noted;	- little change noted;	- little change noted.

3.02 Historic Ordnance Survey plans are attached in Volume 2, Appendix E.

4.0 GEOLOGY AND HYDROGEOLOGY

4.01 Geology:

1:50,000 BGS geological map 87 Barnsley indicate the following:-

- The site is underlain by Pennine Middle Coal Measures (sandstones, siltstones and mudstones) of the Westphalian Age.
- No faults appear to traverse the site but faults lie within 100m of the north western, south western and south eastern boundaries of the site.
- Drift deposits are unlikely to be present at the surface.

4.02 Mining & Minerals:

A mining report has been prepared by D Bellis Consulting Surveyors and a mining report has been obtained from the Coal Authority. The reports are summarised as follows:-

The following seams have been recorded as worked and may be within the zone of influence of the site:-

Seam	Depth (m)	Section (m)	Date	Comments
Swallow Wood	126	0.85	1976	Adjacent
Lidgett	151	0.48	1914	Subjacent
Top Fenton	311	0.83	1977	Subjacent
Low Fenton	314	1.20	1954	Subjacent
Parkgate	332	1.37	1979	Subjacent
Thorncliffe	362	1.20	1904	Subjacent
Silkstone	415	1.14	pre 1980	Subjacent

- There is coal in reserve but no workings are currently planned.
- There are no recorded shafts or mine entries on or within 20.0m of the site.
- There are no faults or abnormal features noted on the site.
- Settlement from deep recorded old workings is likely to have been completed long ago.

- There is no evidence of coal mining related subsidence in relation to the site. However, there have been a number of mining related subsidence claims to the properties adjacent the north eastern boundary of the site.

The mining searches are attached in Volume 2, Appendix F.

There are no recorded BGS mineral sites within 1000m of the site.

4.03 **Hydrogeology:**

No watercourses are believed to run through or be located in the immediate vicinity of the site. However, watercourses are located approximately 440m to the south, 700m to the east and 500m to the north west of the site.

The site is not believed to be prone to flooding.

The site is underlain by a minor aquifer within geological formations of variable permeability. Although not producing large quantities of water for abstraction the aquifer is important for local supplies and for supplying base flow to rivers.

The overlying soils are classified as having high leaching potential, unless proved otherwise.

There are 4 no. discharge consents within 1000m of the site. Of these 1 no. is within 500m of the site and details are summarised as follows:-

- stormwater overflow 439m to the south east.

There have been 7 no. pollution incidents within 1000m of the site. Of these 1 no. has been within 500m of the site and details are summarised as follows:-

1 no. Category 3 Minor Incident involving:-

- oils/diesel 255m to the north west.

There are no water abstraction licenses held within 1000m of the site.

The site does not lie in a Source Protection Zone.

5.0 POLLUTION CONTROLS & WASTE

5.01 Pollution Controls:

There are 2 no. Local Authority Pollution Prevention or Control Permits held within 1000m of the site.

There are no Local Authority Integrated Pollution Prevention and Control Permits held within 1000m of the site.

There are no Integrated Pollution Control Permits held within 1000m of the site.

There are no integrated pollution prevention or control permits held within 1000m of the site.

There are no registered radio active substance licences held within 1000m of the site.

5.02 Waste:

There are no registered landfill sites within 1000m of the site.

There are no British Geological Survey recorded landfill sites within 1000m of the site.

There are no Local Authority recorded landfill sites within 1000m of the site.

There are no historic landfill sites within 1000m of the site.

There are no waste treatment/disposal sites within 1000m of the site.

There are no waste management facilities within 1000m of the site.

There are no waste transfer sites within 1000m of the site.

6.0 IDENTIFIED POSSIBLE SOURCES OF CONTAMINATION

The past history of the site would indicate that there are no obvious sources of contamination but the following should be noted:-

6.01 Soil Contamination:

The site does not appear to have been filled or artificially raised in level. However, any fill that has been imported onto the site may have elevated levels of contamination, depending upon the source and nature of the material used.

The site has been used for the following activities:-

- An NHS Care Unit (approximately 1978 – 2006)

This is considered to be a low risk contaminative activity.

Potentially contaminative activities in the vicinity (within 250m) of the site have included:-

- a quarry

Potentially contaminative activities in the surrounding area (between 250 – 1000m) of the site have included the following: -

- mining
- ironstone pits

The site is not considered to have been at risk from the uncontrolled tipping of waste products, residues and chemicals from surrounding past industries.

Contemporary Trade Directory entries in the vicinity of the site (within 500m) are as follows:-

- | | |
|---|------------------------|
| - Tool Design/Manufacturer (Inactive): | 195m to the south west |
| - Catering Equipment supplier (Inactive): | 251m to the north west |
| - Blinds/Awnings/Canopy suppliers (Inactive): | 304m to the west |
| - Cookers – Sales & Service (Active): | 312m to the south |
| - Blinds/Awnings/Canopy suppliers (Inactive): | 319m to the east |
| - Petrol Filling Station (Active): | 373 to the north east |
| - Firefighting Equipment Supplier (Active): | 378m to the east |
| - Hose, Tubings and Fittings (Inactive): | 423m to the west |
| - Radio Communication Equipment (Active): | 462m to the west |
| - Clothing/Fabric Manufacturer (Inactive): | 472m to the west |
| - Damp & Dry Rot Control (Active): | 493m to the north east |

There are no fuel station entries in the vicinity of the site (within 500m).

6.02 Pollution of Controlled Waters:

The possibility of leachate contamination, particularly within any uncontrolled filling or tipping that has occurred on the site, may need to be investigated to assess the potential for pollution to controlled waters.

6.03 Gas Contamination:

The development does not appear to be at risk from the migration of landfill gas onto the site.

Envirocheck information indicates that the site is in an area where Radon protection measures may be required. However, a BGS Radon report has been obtained for the site which advises that no protection measures are required.

The BGS Radon report is attached in Volume 2, Appendix G.

7.0 RISK ASSESSMENT

- 70.1 The following contaminated land risk assessment methodology is based on CIRIA C552 (2001) Contaminated Land Risk Assessment – ‘A Guide to Good Practice’, in order to quantify potential risk via risk estimation and risk evaluation, which can be adopted at the Phase 1 stage. This will then determine an overall risk category which can be used to identify likely actions. This methodology uses qualitative descriptors and is therefore a qualitative approach.

The methodology requires the classification of:

- the magnitude of the consequence (severity of risk occurring), and
- the magnitude of the probability (likelihood) of a risk occurring.

- 7.02 The potential consequences of contamination risks occurring at this site are classified in accordance with table 7.1, which is adapted from the CIRIA guidance.

Table 7.1 - Classification of Consequences:

Classification:	Definition of Consequence:
Severe	Short term (acute risks to human health). Short term risk of pollution of sensitive water resource or ecosystem. Catastrophic damage crops/buildings/property/infrastructure, including off-site soils.
Medium	Medium/long term (chronic) risks to human health. Medium/long term risk of pollution of sensitive water resource or ecosystem. Significant damage to crops/buildings/property/infrastructure (on or off-site). Contamination of off-site soils.
Mild	Easily preventable, permanent health effects on humans. Pollution of non-sensitive water resources. Localised damage to crops/buildings/property/infrastructure (on or off site).
Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soils. Easily repairable damage to crops, buildings/property/infrastructure.

- 7.03 The probability of contamination risks occurring at this site will be classified in accordance with Table 7.2, which is also adapted from the CIRIA guidance. Note that for each category it is assumed that a pollution linkage exists. Where a pollution linkage does not exist the likelihood is zero, as is the risk.

Table 7.2 – Classification of Probability:

Classification:	Definition of Probability:
High Likelihood	Circumstances are such that an event appears very likely in the short term, or almost inevitable in the longterm; or there is already evidence that such an event has occurred.
Likely	Circumstances are such that an event is not inevitable, but is possible in the short term, and is likely over the longterm.
Low Likelihood	Circumstances are such that it is by no means certain that an event will occur even over along period, and it is less likely in the short term.
Unlikely	Circumstances are such that it is improbable that an event would occur even in the longterm.

- 7.04 For each possible pollution linkage (source-pathway-receptor) identified the potential risk can be evaluated. Based upon this CIRIA C552 presents definitions of the risk categories, together with the investigatory and remedial actions that are likely to be necessary in each case, as indicated in Table 7.3. These risk categories apply to each pollutant linkage, not simply to each hazard or receptor.

Table 7.3 – Definition of Risk Categories and Likely Actions required:

Risk Category:	Definition of Likely Actions Required:
Very high	Severe harm to a defined receptor is very likely, or has already occurred. The risk is likely to result in a substantial liability. Urgent investigation (if not already undertaken) is likely to be required. Urgent remediation is likely to be required.
High	Harm to a defined receptor is likely. The risk, if realised, may result in a substantial liability. Urgent investigation (if not already undertaken) is likely to be required. Remediation is likely to be required in the long term, possibly sooner.
Moderate	Harm to a defined receptor is possible, but severe harm is unlikely. Investigation is likely to be required to clarify the level of potential liability and risk. Some remediation may be required in the long term.
Low	Harm to a defined receptor is possible, but is likely to be mild at worst. Liabilities could theoretically arise, but are unlikely. Further investigation is not required at this stage. Remediation is unlikely to be required.
Very low	Harm to a defined receptor is unlikely and would be minor at worst. No liabilities are likely to arise. Further investigation is not required at this stage. Remediation is unlikely to be required.

- 7.05 This relationship can also be represented as a matrix, as indicated in Table 7.4.

Table 7.4 – Probability / Consequence Matrix:

Probability	Consequence			
	Severe	Medium	Mild	Minor
High Likelihood	Very High Risk	High Risk	Moderate Risk	Low Risk
Likely	High Risk	Moderate Risk	Moderate Risk	Low Risk
Low Likelihood	Moderate Risk	Moderate Risk	Low Risk	Very Low Risk
Unlikely	Low Risk	Low Risk	Very Low Risk	Very Low Risk

- 7.06 The following potential contamination pathways have been identified on the site:-

Horizontal and vertical migration pathways of leachate through the potentially permeable soils and geological formations.

Human Uptake Pathways (derived from CLEA model and LQA for residential use with plant uptake):

- Ingestion of soil
- Ingestion of indoor dust

- Dermal contact with soil
- Contact with indoor dust
- Inhalation of vapours outside
- Inhalation of vapours inside
- Vertical and lateral migration of volatile vapours and ground gas
- Indirect ingestion
- Airborne hazardous fibres
- Plant root uptake.

7.07 The following environmental receptors have been identified on site:-

- Groundwater
- Buildings / structures
- Flora / Fauna
- Underground services
- Third party land.

7.08 The following human receptors have been identified on the site:-

- Construction and maintenance workers
- End users.

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7.09 Summary – Earthworks and Construction Phase:

A Risk Assessment of the site is summarised in the table below:-

Source	Receptor	Pathway	Consequence	Probability	Risk Category	Comments
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R1: Groundwater (aquifer). R2: Drainage ditches.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Unlikely	Low	
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R3: Buildings and structures.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Unlikely	Low	Made ground, if present on the site, may contain elevated sulphate levels which could result in corrosion of buried concrete structures. However, sulphate resisting cement can be used in concrete.
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R4: Construction Workers.	P2: Human uptake pathways (see 7.06).	Severe	Unlikely	Low	
S4: Gas generation in known landfill sites within 250m of the site.	R4: Construction Workers.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Unlikely	Low	
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R5: Neighbouring Sites.	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Medium	Unlikely	Low	

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7.10 Site Risk Assessment Summary Post Development:

Source	Receptor	Pathway	Consequence	Probability	Risk Category	Comments
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R6: Maintenance Workers.	P2: Human uptake pathways.	Severe	Unlikely	Low	
S4: Gas generation in known landfill sites within 250m of the site.	R6: Maintenance Workers.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Unlikely	Low	No landfill sites within 250m.
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R7: Site end users.	P2: Human uptake pathways. P3: Vertical migration of volatile vapours and ground gas.	Severe	Unlikely	Low	Hardcover areas will act as a barrier between contamination and end users. Remediation works such as contamination hot spot removal and provision of an inert capping layer to garden areas will reduce risk but such works are unlikely to be required.
S4: Gas generation in known landfill sites within 250m of the site.	R7: Site end users.	P3: Vertical migration of volatile vapours and ground gas.	Severe	Unlikely	Low	
S5: Radon generation in underlying geology.	R7: Site end users.	P3: Vertical migration of ground gas.	Severe	Unlikely	Low	
S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R8: Flora and Fauna.	P4: Plant root uptake.	Severe	Unlikely	Low	Remediation works, if required, such as contamination hot spot removal and provision of an inert capping layer to garden areas will reduce risk but such works are unlikely to be required.

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S1: Contamination in made ground if present on the site. S2: Uncontrolled tipping of waste products and residues from former industries in the vicinity of the site.	R9: Services	P1: Horizontal and Vertical migration of leachate through potentially permeable soils and service trenches.	Severe	Unlikely	Low	Service trenches to be back filled with inert materials. ‘Protector Line’ water pipes can be used if necessary.
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7.11 As the environmental risks to the development are low a site conceptual section has not been prepared.

8.0 GROUND INVESTIGATION

8.01 Fieldwork:

9 No. trial pits were excavated to depths of between 0.30m and 3.60m using a mechanical excavator on 07 September 2007. The purpose of the trial pits was to allow an insitu visual inspection of the superficial soils and recover samples for laboratory testing.

The locations of the trial pits are indicated on the Site Topographical Survey (Fig. 2) attached in Volume 2, Appendix C.

8.02 Laboratory Testing:

To provide an assessment of soil contamination with respect to the proposed residential development soil samples were screened for a range of potential contaminants. The screening included the following:-

Arsenic	Selenium	Sulphate (ws)
Cadmium	Copper	pH
Chromium	Nickel	PAH (16EPA)
Lead	Zinc	Asbestos
Mercury	Boron (ws)	

In view of the ground conditions encountered the following geotechnical testing was undertaken:

- Atterburg Limits 5 no.

8.03 Ground Conditions:

The following typical soil profile was encountered in the trial pit investigation:-

Made ground	0.05 – 0.90m
Firm Clay	0.20 – 0.80m
Stiff Clay	0.60 – 0.80m
Highly Mudstone	0.40 – 0.80m
Weathered siltstone	0.30 – 0.60m
Sandstone	

Made ground was encountered in all trial pits except TP9. The upper 0.5m of made ground in TP7 was topsoil. The made ground encountered generally comprised gravel, brick, concrete, limestone and sandstone, occasional broken roof tiles, wood, bitumen macadam and burnt shale.

A band of firm clay was encountered below the made ground in TP1, TP4, TP5, TP7 and TP8, and at the surface in TP9.

A band of stiff clay was encountered below the firm clay in TP4, TP5, TP7 and TP9, and directly below the made ground in TP6.

A 0.3m thick band of clayey sandy gravel was encountered in TP8 below the band of firm clay.

A band of weathered mudstone was encountered in TP5, TP6, TP7 and TP9 below the stiff clay, and directly below the firm clay in TP8.

A band of weathered siltstone was encountered in TP5, TP7, TP8 and TP9 below the weathered mudstone, and directly below the stiff clay in TP4. The thickness of the weathered siltstone band was not proved in TP7 or TP9.

Sandstone (fresh to highly weathered) was encountered in all trial pits, except TP7 and TP9.

Fresh to weathered competent rock was encountered in trial pits as follows:-

- TP1 fresh sandstone 0.4m below existing ground level
- TP2 highly weathered sandstone 0.6m below existing ground level
- TP3 fresh sandstone 0.2m below existing ground level
- TP4 highly weathered siltstone 1.4m below existing ground level
- TP5 highly weathered mudstone 1.1m below existing ground level
- TP6 highly weathered mudstone 1.0m below existing ground level
- TP7 highly weathered mudstone 2.3m below existing ground level
- TP8 highly weathered mudstone 1.6m below existing ground level
- TP9 highly weathered mudstone 1.2m below existing ground level

Trial Pit Logs are attached in Volume 2, Appendix H.

8.04 **Groundwater:**

Groundwater was not encountered during the trial pit investigation.

8.05 **Excavations:**

Excavations were generally stable while open.

8.06 **Laboratory Testing:**

Soils

The results of the chemical analyses on the soil samples are summarised below. Chemical Test result certificates are attached in Volume 2, Appendix I.

A sample taken from topsoil (TP7):

Contaminant	Concentration in soils mg/kg*	Number of samples tested
Arsenic	26.5	1
Cadmium	0.6	1
Chromium	25.2	1
Lead	61.9	1
Mercury	0.2	1
Selenium	<0.1	1
Copper	29.3	1
Nickel	23.3	1
Zinc	90.3	1
Boron (water soluble)	<0.5	1
Sulphate (water soluble)	0.019 g/l	1
pH	6.8	1
PAH	15.2	1

* unless noted otherwise

The result of a sulphate and pH determination indicated sulphate content expressed as 2:1 aqueous extract 0.019 g/l SO₄ with a pH value of 6.8.

Samples taken from Made Ground (TP2, TP4, TP5, TP6, TP7 and TP8):

Contaminant	Concentration in soils mg/kg*	Number of samples tested
Arsenic	2.1 – 9.4	5
Cadmium	0.3 – 2.7	5
Chromium	6.5 – 62.7	5
Lead	9.6 – 36.8	5
Mercury	0.1 – 0.2	5
Selenium	<0.1	5
Copper	7.4 – 35.7	5
Nickel	5.1 – 30.6	5
Zinc	50.0 – 166.5	5
Boron (water soluble)	<0.5	5
Sulphate (water soluble)	0.031 – 0.464 g/l	5
pH	7.8 – 11.7	5
PAH	<0.1 – 32.8	5
Asbestos	-	13

* unless noted otherwise.

The results of sulphate and pH determinations indicate sulphate content expressed as 2:1 aqueous extract between 0.031 and 0.464 g/l SO₄ with pH values of between 7.8 – 11.7.

Samples taken from Natural Ground (TP2, TP4, TP5, TP6 and TP7):-

Contaminant	Concentration in soils mg/kg*	Number of samples tested
Arsenic	1.8 – 10.6	3
Cadmium	0.2 – 0.5	3
Chromium	8.4 – 22.4	3
Lead	7.2 – 49.1	3
Mercury	0.1 – 0.4	3
Selenium	<0.1	3
Copper	13.4 – 26.3	3
Nickel	19.0 – 33.1	3
Zinc	33.6 – 99.9	3
Boron (water soluble)	<0.5 – 1.0	3
Sulphate (water soluble)	0.016 – 0.221 g/l	5
pH	6.9 – 7.2	5
PAH	<0.1 – 2.6	3

* unless noted otherwise.

The results of sulphate and pH determination indicate a sulphate content expressed as 2:1 aqueous extract, between 0.016 – 0.221 g/l SO₄ with pH values of between 6.9 – 7.2.

The results of Atterburg Limit tests are summarised in the following table:-

Trial Pit	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Plasticity
TP1	0.10	39	21	18	Low
TP4	1.00	41	19	22	Intermediate
TP5	0.70	40	19	21	Intermediate
TP8	0.80	40	19	19	Low
TP9	0.80	-	-	-	Non-plastic

Geotechnical test result certificates are attached in Volume 2, Appendix J.

8.07 Insitu Testing:

The results of falling head permeability tests are summarised in the following table:-

Location	Soil Infiltration Rate (m/sec)
S1	No Result
S2	No Result
S3	No Result
S4	No Result
S5	No Result

The test result certificates are attached in Volume 2, Appendix J.

9.0 CONTAMINATION – DESIGN OBJECTIVES & PHILOSOPHY

9.01 Identification of Potential Hazards:

In January 2015 Land Quality Management Ltd (LQM) published Safe for Use Levels (S4UL's) for Human Health Risk Assessment introducing updated guidance for the assessment of risk to human health from land contamination. The S4UL's are based on assumptions on soil conditions, the existence of exposure pathways behaviour and type of contaminants. The apparent exceedence of the quoted S4UL's is taken as indicating that further detailed assessment is required or that remedial actions should be taken.

9.02 Sensitivity of Development:

The presence of elevated concentrations of particular analytes may present hazards in terms of personal health, damage to plant life and other environmental issues. The CLEA model and SGVs classified particular end uses on a scale of sensitivity.

Residential with home grown produce
Residential without home grown produce
Residential public open space
Allotments
Commercial/Industrial

9.03 Design Life:

It is important to recognise when considering a particular problem that the solution has finite life, a concept with which those in the construction industry are familiar. The design life is influenced by the materials used in construction, the environment and the degree of maintenance carried out to extend the design life.

Monitoring is required to determine whether a design is functioning correctly, commensurate with the prevailing environmental conditions. It is essential that future users are aware of today's solutions since historically most buildings and infrastructure works continue in service. The effect of an increased design life should not be allowed to prejudice the original design principles.

9.04 Legislation:

The principle legislation relating to a potential pollution and contamination problems addressed in the Environmental Protection Act 1990 and Environmental Act 1995. For 'contaminated' land to exist a significant 'pollution linkage' must be present, that is, there should be a source of contamination, a pathway by which the contamination can migrate, to an identified 'receptor' where it could cause 'significant harm'.

Should any link within this chain be severed then the land may not strictly be regarded as 'contaminated land' under the Environmental Protection Act 1990.

Based on the historic site usage and activities on and in the vicinity of the site it was anticipated that there may be contamination present on site use.

A ground investigation was commissioned to investigate soils and the chemical constituents of these soils, especially any made ground. The site was not expected to be severally contaminated and therefore a comprehensive testing regime based on the current industry standard BS 10175 : 2001 was not considered necessary. However, a contamination survey was undertaken with a provision that return visits would have to be made if contamination was exposed at a sufficient concentration to justify more extensive investigations.

9.05 Design Objectives:

- i) The objective of reclamation works is to improve any marginal land into ground suitable for its use for residential use with home grown produce. The standards would be in accordance with the LQM/ CIEH S4UL's for Human Health Risk Assessment and SP1010: Development of Category 4 Screening Levels (C4SL's) for Assessment of Land Affected by Contamination as attached in Volume 2, Appendix K. The Assessment Criteria values are based upon an SOM of 1.0%. If considered appropriate a further quantitative risk assessment will be undertaken using calculated site specific target values or S4UL's for SOM values obtained for the site by laboratory testing.
- ii) Risk Assessment
A qualitative risk assessment of any contaminants identified on the site will be undertaken. This will consider the significance of the contaminants identified in terms of source, pathway, receptor (ie. pollution linkage).

10.0 REDEVELOPMENT PROPOSALS - DISCUSSION

10.01 Soils:

The investigation has revealed made ground on the site. The Desk Study sections of this report have indicated little potential for contamination at the site and the regime of chemical analyses adopted reflects this.

The results have been assessed using the Assessment Criteria for residential use with home grown produce proposed in Volume 2, Appendix K.

The test results from a sample of Topsoil on the site are compared in the following table:-

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Contaminant	Concentration in soils mg/kg*	Number of samples tested	Assessment Criteria mg/kg	No. of samples exceeding Intervention Value
Arsenic	26.5	1	37	0
Cadmium	0.6	1	26	0
Chromium	25.2	1	910	0
Lead	61.9	1	200	0
Mercury	0.2	1	40	0
Selenium	<0.1	1	250	0
Copper	29.3	1	2400	0
Nickel	23.3	1	180	0
Zinc	90.3	1	3700	0
Boron (water soluble)	<0.5	1	290	0
Sulphate (water soluble)	0.019 g/l	1	-	-
pH	6.8	1	<5	0
PAH	15.2	1	#	#

* unless stated otherwise

see later discussion

When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the topsoil on the site.

The test results of speciated PAH analysis of the sample from the topsoil sample on the site is summarised in the following table:-

PAH 16 EPA	Concentrations in soils mg/kg	No. of Samples tested	Assessment Criteria mg/kg	No. of Samples exceeding Assessment Criteria
Acenaphthene	0.2	1	210	0
Acenaphthylene	<0.1	1	170	0
Anthracene	0.8	1	2400	0
Benzo (a) Anthracene	1.0	1	7.2	0
Benzo (a) Pyrene	0.5	1	5.0	0
Benzo (b) Fluoranthene	0.6	1	2.6	0
Benzo (k) Fluoranthene	0.3	1	77.0	0
Benzo (g,h,i) Perylene	0.3	1	320	0
Chrysene	0.8	1	15.0	0
Di-benzo (a,h) Anthracene	<0.1	1	0.24	0
Indeno (1, 2, 3-cd) Pyrene	0.3	1	27.0	0
Fluoranthene	3.6	1	280	0
Fluorene	0.3	1	170	0
Napthalene	0.1	1	2.3	0
Phenanthrene	4.0	1	95.0	0
Pyrene	2.6	1	620	0
Total	15.2	1	-	-

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The test results from samples taken from the made ground on the site are compared in the following table:-

Contaminant	Concentration in soils mg/kg*	Number of samples tested	Assessment Criteria mg/kg	No. of samples exceeding Assessment Criteria
Arsenic	2.1 – 9.4	5	37	0
Cadmium	0.3 – 2.7	5	26	0
Chromium	6.5 – 62.7	5	910	0
Lead	9.6 – 36.8	5	200	0
Mercury	0.1 – 0.2	5	40	0
Selenium	<0.1	5	250	0
Copper	7.4 – 35.7	5	240	0
Nickel	5.1 – 30.6	5	180	0
Zinc	50.0 – 166.5	5	3700	0
Boron (water soluble)	<0.5	5	290	0
Sulphate (water soluble)	0.031 – 0.464 g/l	5	-	-
pH	7.8 – 11.7	5	<5	0
PAH	<0.1 – 32.8	5	#	#
Asbestos	-	13	present	6#

* unless noted otherwise.

see later discussion.

The results of the speciated PAH analysis of samples taken from the made ground on the site are summarised in the following table:-

PAH 16 EPA	Concentrations in soils mg/kg	No. of Samples tested	Assessment Criteria mg/kg	No. of Samples exceeding Assessment Criteria
Acenaphthene	<0.1 – 0.4	5	210	0
Acenaphthylene	<0.1	5	170	0
Anthracene	<0.1 – 1.5	5	2400	0
Benzo (a) Anthracene	<0.1 – 2.4	5	7.2	0
Benzo (a) Pyrene	<0.1 – 1.2	5	5.0	0
Benzo (b) Fluoranthene	<0.1 – 1.4	5	2.6	0
Benzo (k) Fluoranthene	<0.1 – 1.1	5	77.0	0
Benzo (g,h,i) Perylene	<0.1 – 0.9	5	320	0
Chrysene	<0.1 – 1.9	5	15.0	0
Di-benzo (a,h) Anthracene	<0.1 – 0.2	5	0.24	0
Indeno (1, 2, 3-cd) Pyrene	<0.1 – 1.6	5	27.0	0
Fluoranthene	<0.1 – 7.5	5	280	0
Fluorene	<0.1 – 0.6	5	170	0
Napthalene	0.5 – 0.2	5	2.3	0
Phenanthrene	0.3 – 7.8	5	95.0	0
Pyrene	0.1 – 5.6	5	620	0
Total	1.1 – 32.8	5	-	-

When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the made ground on the site.

The results of asbestos testing on 3 no. samples taken from TP2 at 0.3m, TP6 at 0.2m and TP7 at 0.8m indicated a trace of white asbestos in the sample from TP2.

The asbestos content was below <0.1% (<1000 ppm), the level at which asbestos is not considered to pose a significant risk to human health. It should be noted that a considerable amount of asbestos was removed from the building on the site prior to its demolition. Therefore, samples from TP1 at 0.05m, TP3 at 0.10m, TP5 at 0.05m and 4 no additional near surface samples taken from the area of TP2 (S1-S4 all at 0.10m), plus surface samples from TP4 at 0.1m, TP8 at 0.1m and TP9 at 0.1m were also tested for asbestos.

The results indicated:-

- a trace of white asbestos identified in the sample from TP1;
- a trace of brown asbestos identified in the sample from TP3;
- a trace of brown asbestos identified in the sample from TP2/S2;
- a trace of brown asbestos in the sample from TP2/S4;
- a trace of white asbestos in the sample from TP4/S1.

All the results were below 0.1% (<1000ppm), the level at which asbestos is not considered to pose a significant risk to human health.

The test results from samples taken from the natural ground on the site are compared in the following table:-

Contaminant	Concentration in soils mg/kg*	Number of samples tested	Assessment Criteria mg/kg	No. of samples exceeding Assessment Criteria
Arsenic	1.8 – 10.6	3	37	0
Cadmium	0.2 – 0.5	3	26	0
Chromium	8.4 – 22.4	3	910	0
Lead	7.2 – 49.1	3	200	0
Mercury	0.1 – 0.4	3	40	0
Selenium	<0.1	3	250	0
Copper	13.4 – 26.3	3	2400	0
Nickel	19.0 – 33.1	3	180	0
Zinc	33.6 – 99.9	3	3700	0
Boron (water soluble)	<0.5 – 1.0	3	290	0
Sulphate (water soluble)	0.016 – 0.221 g/l	5	-	-
pH	6.9 – 7.2	5	<5	0
PAH	<0.1 – 2.6	3	#	#

* unless noted otherwise

see later discussion.

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The results of the speciated PAH analysis of samples taken from the natural ground on the site are summarised in the following table:-

PAH 16 EPA	Concentrations in soils mg/kg	No. of Samples tested	Assessment Criteria mg/kg	No. of Samples exceeding Assessment Criteria
Acenaphthene	<0.1	3	210	0
Acenaphthylene	<0.1	3	170	0
Anthracene	<0.1 – 0.1	3	2400	0
Benzo (a) Anthracene	<0.1 – 0.2	3	7.2	0
Benzo (a) Pyrene	<0.1	3	5.0	0
Benzo (b) Fluoranthene	<0.1 – 0.3	3	2.6	0
Benzo (k) Fluoranthene	<0.1	3	77.0	0
Benzo (g,h,i) Perylene	<0.1	3	320	0
Chrysene	<0.1 – 0.2	3	15.0	0
Di-benzo (a,h) Anthracene	<0.1	3	0.24	0
Indeno (1, 2, 3-cd) Pyrene	<0.1	3	27.0	0
Fluoranthene	<0.1 – 0.8	3	280	0
Fluorene	<0.1	3	170	0
Napthalene	<0.1 – 0.4	3	2.3	0
Phenanthrene	<0.1 – 0.6	3	95.0	0
Pyrene	<0.1 – 0.5	3	620	0
Total	<0.1 – 2.6	3	-	-

When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the natural ground on the site.

In view of the above the following remediation measures are proposed on the site:-

- as a volume of material has to be removed to achieve the proposed site levels it is considered prudent to remove the made ground containing traces of asbestos to a suitably licensed tip as a precautionary measure;
- service trenches should be backfilled with inert materials or natural ground.

Excavated natural ground can be reused on the development.

10.02 Controlled Waters:-

The levels of contamination encountered on the site are not considered to pose a significant risk to controlled waters. In addition it should be noted that:-

- the site is underlain by a minor-aquifer;
- groundwater was not encountered in the investigation;
- there are no groundwater abstractions within 1000m of the site;

- there are no watercourses within 440m of the site.
- the site is not within a Source Protection Zone.

10.03 Mining:

The site does not appear to be affected by recorded mine entries or shallow coal workings.

In view of the subsidence claims to the properties adjacent the north eastern boundary of the site 2 no. rotary boreholes should be drilled on site to investigate the possible presence of shallow coal workings below the site.

It is possible the subsidence to the properties adjacent the north eastern boundary of the site are in relation to a geological fault that may have been activated at some time in the past by the collapse of deep coal workings below the site.

If a worked shallow coal seam is found to be present below the site with less than 12 time competent rock cover the working will need to be stabilised by concrete grouting.

10.04 Gas:

The development does not appear to be at risk from landfill gas migration onto the site.

Radon protection measures are not required on the development.

10.05 Foundations:

Traditional strip footings can be adopted on the site, designed to a safe working bearing pressure of 100 kN/mm, bearing on the firm or stiff clay at a minimum of 0.90m below finished ground levels, or weathered bedrock at a minimum of 0.6m below finished ground level.

Due to the presence of made ground, clay soils in the influence zone of trees and ground disturbed by the removal of historic foundations trench footings will be required in some areas of the site.

Plots should either be completely founded on clay or weathered rock to avoid any potential differential settlement that may occur by founding on different strata.

In addition, subject to the results of the rotary drilling and due to the potential location of geological faults adjacent the site, and differing rock types below the site footings should be mesh reinforced.

10.06 Ground Floor Construction:

Where sub-base thicknesses do not exceed 600mm ground bearing slabs can be used on the development.

Where sub-base thicknesses do exceed 600mm, or where ground has been disturbed by the removal of redundant foundations, suspended insitu mesh reinforced slabs should be adopted.

Where plots are over cohesive soils and in the influence zone of trees, suspended beam and block floors with an underfloor void should be adopted.

10.07 Sulphate attack on Buried Concrete:

The results of the sulphate analysis compared to BRE Special Digest 1, 'Concrete in Aggressive Ground' indicate:

- Class DS-1 conditions in made ground
- Class DS-1 conditions in natural ground
- ACEC site classification AC-1s.

10.08 Excavations:

Excavations in made ground are likely to be unstable, whereas excavations in natural ground are likely to be stable.

Groundwater is unlikely to be encountered in either foundation or drainage excavations, but seepages should be expected, particularly in made ground horizons. It should be noted that the groundwater table is likely to be subject to seasonal variations.

10.09 Pavements:

Pavement Design:

- CBR values on natural ground are likely to be reasonable, circa 2 - 3 %, but soft spots may be encountered in clay formations.
- CBR values in made ground are likely to be variable and some form of ground improvement (excavate, screen, crush and recompact, or excavate and replace with imported granular material) may be required.

10.10 Drainage:

Falling head permeability testing on the site have indicated that the use of soakaways for the disposal of surface water from the development is not feasible or appropriate.

Conventional granular bed and surround to drainage can be adopted in natural ground horizons.

11.0 CONTAMINATION ASSESSMENT

Due to the levels of contamination encountered on the site a contamination risk assessment is not required.

12.0 RECLAMATION PROPOSALS

The proposed works shall include the following, although this does not necessarily indicate the order or full extent of the works.

- Disconnect and/or divert any live services on the site.
- Protect any trees to be retained and grub out vegetation and remove from site.
- Inspect the site for hazardous materials (e.g. asbestos) and remove from site, together with any fly tipping, to a suitably licensed tip using approved methods and a suitably licensed contractor.
- Grub up historic foundations, slabs and redundant sewers. If economically viable crush masonry and concrete for reuse. Remove all deleterious and unsuitable material for reuse to a suitably licensed tip.
- After the site strip the formation is to be inspected. Any areas of deleterious material or contamination not identified in the ground investigation identified by visual or olfactory evidence and subsequent chemical testing is to be remediated if necessary following further risk assessment.
- All service trenches should be backfilled with clean inert soils.
- Remodel site levels as required by the development. As a precaution the made ground containing traces of asbestos should be excavated and removed from site to a suitably licensed tip.
- Any imported engineering fill material should be compacted in accordance with the Dpt. Highways Specification.
- Arisings from the made ground on the site are likely to be classified as inert, but guidance should be sought from the local Waste Management Regulation office regarding the disposal of soils from the site.

13.0 ADDITIONAL WORKS REQUIRED

13.01 Ground Investigation:

Two rotary boreholes should be drilled on the site to investigate possible shallow coal workings below the site.

14.0 SUMMARY

Site Name & Location	Bellwood Crescent, Hoyland, Barnsley
Proposal	Residential housing – 19 Units.
Local Authority	Barnsley Metropolitan Borough Council .
Site History	The site was undeveloped until approximately 1978 when the building that has recently been demolished appears to have been present. The site was an NHS Care Unit which is considered to be a very low risk contaminative activity. The surrounding area was predominantly undeveloped until approximately 1905, since when development has steadily taken place. A potentially contaminative activity in the immediate vicinity of the site has been quarrying. Potentially contaminative activities in the surrounding area have included quarrying and ironstone pits.
Geology	1:50,000 BGS geological map 87 Barnsley indicate the following:- - The site is underlain by Pennine Middle Coal Measures (sandstones, siltstones and mudstones) of the Westphalian Age. - No faults appear to traverse the site but faults lie within 100m of the north western, south western and south eastern boundaries of the site. - Drift deposits are unlikely to be present at the surface.
Hydrogeology	The site is in a relatively low sensitivity hydrogeological area, being underlain by a minor aquifer, is not in a Source Protection Zone and there are no groundwater abstractions within 1000m of the site. The nearest watercourse is in excess of 400m from the site.
Flooding	The site is not believed to be prone to flooding.
Ground Conditions	The following typical soil profile was encountered in the trial pit investigation:- Made ground was encountered in all trial pits except TP9. The upper 0.5m of made ground in TP7 was topsoil. The made ground encountered generally comprised gravel, brick, concrete, limestone and sandstone, occasional broken roof tiles, wood, bitumen macadam and burnt shale. A band of firm clay was encountered below the made ground in TP1, TP4, TP5, TP7 and TP8, and at the surface in TP9. A band of stiff clay was encountered below the firm clay in TP4, TP5, TP7 and TP9, and directly below the made ground in TP6. A 0.3m thick band of clayey sandy gravel was encountered in TP8 below the band of firm clay. A band of weathered mudstone was encountered in TP5, TP6, TP7 and TP9 below the stiff clay, and directly below the firm clay in TP8. A band of weathered siltstone was encountered in TP5, TP7, TP8 and TP9 below the weathered mudstone, and directly below the stiff clay in TP4. The thickness of the weathered siltstone band was not proved in TP7 or TP9. Sandstone (fresh to highly weathered) was encountered in all trial pits, except TP7 and TP9. Fresh to weathered competent rock was encountered in trial pits as follows:- - TP1 fresh sandstone 0.4m below existing ground level - TP2 highly weathered sandstone 0.6m below existing ground level - TP3 fresh sandstone 0.2m below existing ground level - TP4 highly weathered siltstone 1.4m below existing ground level - TP5 highly weathered mudstone 1.1m below existing ground level - TP6 highly weathered mudstone 1.0m below existing ground level - TP7 highly weathered mudstone 2.3m below existing ground level - TP8 highly weathered mudstone 1.6m below existing ground level - TP9 highly weathered mudstone 1.2m below existing ground level.

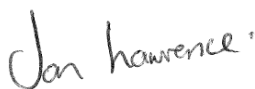
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Mining	The site does not appear to be affected by recorded mine entries or shallow coal workings. In view of the subsidence claims to the properties adjacent the north eastern boundary of the site 2 no. rotary boreholes should be drilled on site to investigate the possible presence of shallow coal workings below the site. It is possible the subsidence to the properties adjacent the north eastern boundary of the site are in relation to a geological fault that may have been activated at some time in the past by the collapse of deep coal workings below the site. If a worked shallow coal seam is found to be present below the site with less than 12 time competent rock cover the working will need to be stabilised by concrete grouting.
Foundations	Traditional strip footings can be adopted on the site, designed to a safe working bearing pressure of 100 kN/mm, bearing on the firm or stiff clay at a minimum of 0.90m below finished ground levels, or weathered bedrock at a minimum of 0.6m below finished ground level. Due to the presence of made ground, clay soils in the influence zone of trees and ground disturbed by the removal of historic foundations trench footings will be required in some areas of the site. Plots should either be completely founded on clay or weathered rock to avoid any potential differential settlement that may occur by founding on different strata. In addition, subject to the results of the rotary drilling and due to the potential location of geological faults adjacent the site, and differing rock types below the site footings should be mesh reinforced.
Ground Floor Slabs	Where sub-base thicknesses do not exceed 600mm ground bearing slabs can be used on the development. Where sub-base thicknesses do exceed 600mm, or where ground has been disturbed by the removal of redundant foundations, suspended insitu mesh reinforced slabs should be adopted. Where plots are over cohesive soils and in the influence zone of trees, suspended beam and block floors with an underfloor void should be adopted.
Gas Precautions	The development does not appear to be at risk from landfill gas migration onto the site.
Building Near Trees	Applicable.
Coal Mining	The site does not appear to be affected by shallow coal workings or mine entries.
Pavements	CBR values on natural ground are likely to be reasonable, circa 2 - 3 %, but soft spots may be encountered in cohesive strata. CBR values in made ground are likely to be variable and some form of ground improvement (excavate, screen, crush and recompact, or excavate and replace with imported granular material) will be required.
Radon	Radon protection measures are not required on the development.
Access	A visibility splay of x = 2.4m and y = 40.0m is likely to be required to the site access. Notwithstanding this the requirement should be confirmed with Barnsley Metropolitan Borough Council. Services may need to be lowered to construct the new entrance.
Dewatering	It is unlikely that foundation or sewer excavations will require dewatering. However, groundwater seepages should be expected, particularly in made ground horizons. The groundwater table is likely to be subject to seasonal variations.
Excavations	Excavations in made ground are likely to be unstable, whereas excavations in natural ground are likely to be stable. Trench support should be provided in accordance with current Health & Safety guidance.
Sulphate Classification	The results of the sulphate analysis compared to BRE Special Digest 1 'Concrete in Aggressive Ground' indicate: - Class DS-1 conditions in made ground - Class DS-1 conditions in natural ground - ACEC site classification AC-1s.
Contamination Assessment	When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the topsoil on the site. When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the made ground on the site.

	When compared with the proposed Assessment Criteria in relation to residential use with home grown produce no determinants with levels in excess of Assessment Criteria were encountered in the natural ground on the site.
Remediation Proposals	As a volume of material has to be removed to achieve the proposed site levels it is considered prudent to remove the made ground containing traces of asbestos to a suitably licensed tip as a precautionary measure; Service trenches should be backfilled with inert materials or natural ground.
Remediation Statement	Not required.
Drainage	Conventional granular bed and surround to drainage can be adopted in natural ground horizons.
Unforeseen Circumstances	Should any areas of previously unidentified potentially contaminated soil be encountered during site construction works we would recommend consultation with CoDA Structures to ensure that the recommendations continue to apply.
Construction Works	It is recommended that construction personnel with direct contact with the soils at the site use appropriate PPE equipment (i.e. gloves and overalls) together with welfare facilities in accordance with general health and safety guidelines.
Utilities	We would recommend that a copy of the ground investigation report when available, is supplied to Utility Companies, and that their recommendations relating to appropriate supply pipes are adhered to.
Statutory Consultation	We would recommend that a copy of the ground investigation report once prepared is issued to the Local Authority for comment and approval prior to the development of the site.
Further Investigation Work	Ground Investigation: Two rotary boreholes should be drilled on the site to investigate possible shallow coal workings below the site.

15.0 CAVEATS

- 15.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Discussions have not yet been held with statutory bodies and the local authority.
- 15.02 The comments and recommendations made in this report are based on the ground conditions encountered during the site work, and on the results of laboratory testing on a selected number of samples taken in the field. There may be conditions prevailing at the site with respect to ground conditions and contamination that have not been encountered during the investigations, and which have therefore not been taken into account in this reports.
- 15.03 This report has been prepared for the sole use of Cadam Construction Ltd and their development funders, unless agreed otherwise in writing by CoDA Structures.



Signed:

J Lawrence B Eng C Eng M I Struct E