REPORT C6054-RS
MAY 2017

STRATEGY FOR REMEDIAL AND PREPARATORY WORKS

For land at
BARUGH GREEN, BARNSLEY

prepared for
BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

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APPENDICES

APPENDIX A FIGURES AND DRAWINGS

Drawing No.	Title	Scale
C6054-RS/01	Site Location Plan	1:50,000
C6054-RS/02	Site Features Plan	Not to Scale
HLM/MSE/2625	Topgraphical Survey (Midland Surveying and Engineering Ltd)	1:1,000 @ A1
R/1667/1B-1 Rev C (FDA Landscape)	Landscape Masterplan	1:500 @ A0
E14/6120/003 (Haigh Huddleston & Associates)	Road & Sewer Engineering Plan	1:500 @ A0

APPENDIX B SIRIUS SPECIFICATION FOR ENGINEERED FILLS

APPENDIX C SIRIUS GAC VALUES

APPENDIX D STAGE 1 & 2 THRESHOLD CONCENTRATIONS FOR CLEAN COVER MATERIAL FOR USE IN GARDENS OF PRIVATE RESIDENTIAL PROPERTIES

APPENDIX E SIRIUS SPECIFICATION FOR THE TREATMENT OF SHALLOW MINEWORKINGS

1. INTRODUCTION

Sirius Geotechnical Ltd (Sirius) were commissioned by Barratt and David Wilson Homes (Yorkshire West) Ltd (BDWH) to produce a Strategy for Remedial and Preparatory Works required to facilitate development of land at Barugh Green, Barnsley (the 'site').

It is understood that BDWH are intending to develop the site with 170 low-rise residential properties with private gardens and associated infrastructure. The proposed site layout is shown on FDA Landscape Drawing No. R/1667/1B-1 Rev C (dated May 17), presented in Appendix A. The proposed roads and drainage layout, as well as proposed finished floor levels, is shown on Haigh Huddleston & Associates Drawing No. E14/6120/003, included in Appendix A. The proposed development has planning approval from Barnsley Metropolitan Borough Council (Planning Application Reference 2015/0891).

It is understood that outline foundation proposals for the proposed development generally comprise strip / trench-fill foundations (reinforced within the area subject to treatment of shallow mine workings). This is on the basis that areas of identified deeper made ground in the north, south and south-west of the site, generally associated with infilled ponds, an infilled canal and former railway land, are predominantly located below areas of soft landscaping. However, locally, conventional spread foundations may not be feasible for residential properties, more specifically within these areas, due to the excessive depth required for excavation. As such, an alternative foundation solution, for example piles or ground improvement via vibro-replacement methods may be required.

The site has been subject to previous investigations and assessments by Sirius, as detailed below:

- *Geoenvironmental Appraisal Report of land at Barugh Green,* Barnsley (Report Ref: C1277), dated July 2006.
- *Preliminary Investigation Report (Desk Study) of land at Barugh Green, Barnsley* (Report Ref: C4855R2), dated November 2013.
- *Geoenvironmental Appraisal of land at Barugh Green, Barnsley* (Report Ref: C6054), dated October 2016.
- *Barugh Green, Barnsley – Gas Risk Assessment* (letter from Sirius, ref. C6054/MB/6941), dated 16th September 2015.

The above documents are the principal sources of information used in the preparation of this Strategy, and should be read in conjunction with this document.

This document summarises the works undertaken to date and details the works required to provide a site considered suitable for the proposed low-rise residential development. The main aims of this Strategy are summarised as follows:

- To mitigate the existing unacceptable risks to human health for the proposed end use (i.e. residential properties with gardens and associated infrastructure) whilst ensuring construction workers and environmental receptors are not put at an unacceptable short term risk during the remediation and development of the site.

- To satisfy the Local Planning Authority (LPA), Environmental Health Department and building warranty provider that the remediated site will provide a site ready and suitable for the proposed development.

- In the interests of sustainability, to promote the use of site-won materials where possible, providing they are suitable for the proposed end use.

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The principal parties to the works are:

- **Client:** Barratt and David Wilson Homes (Yorkshire West) Ltd
- **Design and Build Contractor:** Sirius
- **Local Planning Authority:** Barnsley Metropolitan Borough Council (BMBC)

2. SITE DETAILS AND DESCRIPTION

2.1. Site Location and Description

Table 2.1 Current Site Overview

Location	The site is located to the south of Dearne Hall Road, within the village of Low Barugh, approximately 5km north-west of Barnsley town centre. A site location plan is included as Drawing No. C6054-RS/01 within Appendix A.
National Grid Reference	431690, 408730.
Topography and Features	The site covers an area of approximately 9.9 hectares and is irregular in shape, measuring c. 400m from east to west and c. 380m from north to south. Ground levels generally slope downward from elevations of approximately 72m AOD in the south-west to approximately 55m AOD in the north-east. The site is generally occupied by open fields, with waterlogged rough grassland located in the south-east and a pond in the north-east. Land adjacent to the pond was also waterlogged. An embankment, generally ranging between 2m to 4m in height, is located in the south-east of the site. This embankment was recorded as being heavily vegetated with semi-mature trees and shrubs. A row of mature trees runs from east to west in the northern part of the site. Overhead power lines, generally aligned north-west to south-east and east to west, supported on electricity pylons and wooden poles, are present in the east and south of the site, respectively. An unoccupied residential property with private garden (No.1 Claycliffe Road) and an adjoining gravel-surfaced car park are located within the south-western corner of the site. A Topographical Survey, undertaken by Midland Surveying and Engineering Ltd (Drawing Ref. HLM/MSE/2625), is included within Appendix A.

Site Boundaries	The boundary of the site is generally delineated by either barbed wire or wooden fencing. Land to the north and west of the site is occupied by residential properties and public highways. A railway embankment lies immediately east of the site. Land to the south of the site is occupied by an electrical substation and commercial / industrial premises.
Invasive Plant Species	Japanese knotweed is understood to be present in the south-western corner of the site, within the curtilage to No.1 Claycliffe Road.

The main site features are shown on Drawing No. C6054-RS/02 presented within Appendix A.

2.2. Historical Development

A review of historical maps indicate that the majority of the site has remained undeveloped from at least 1854. This is with the exception of a former canal and man-made channel located within the north of the site and railway land in the south-west (in cutting) and south-east (on an embankment). All of these features date from at least 1854. A well was recorded on the 1854 historical map approximately mid-way along the southern site boundary. Two cooling ponds were formerly shown in the south of the site between the early 1930s and late 1960s.

The canal was shown as having been infilled during the 1960s, the man-made channel as being infilled in the late 1960s / early 1970s and railway cutting as being infilled from the 1980s. Existing residential properties located in the south-west corner of the site were first shown in the 1890s.

Significant features, recorded on historical maps within approximately 250m of the site include several depots, tanks, an industrial estate, reservoir (subsequently infilled), coalite works, coke & by-product works, electricity transformer station, slag heaps and refuse tips.

2.3. Recorded Geology

Sources of Information	The following sources of information have been referenced: • BGS 1:50,000 scale geological map (Sheet 87 Barnsley, Solid and Drift Edition). • BGS 1:10,000 scale geological map (SE 30 NW). • The Coal Authority (CA) Mining Report (Reference 51000094105001, dated 23rd May 2012). • BGS on-line borehole records.
Made Ground	Made ground is recorded on the published 1:10,000 scale geology sheet within the south-western part of the site, associated with an infilled railway cutting. Although not reported on the geological plans, areas of deep made ground were encountered during the Sirius fieldworks (discussed in more detail below) within the southern and northern parts of the site associated with infilled cooling ponds and canal / channel, respectively. Areas of made ground, annotated as 'domestic refuse' and 'industrial refuse and quarry debris on colliery waste' are shown immediately to the east and south-east of the site associated with a former reservoir and disused tips / slag heaps, respectively. An area of 'worked-out opencast coal-seam (backfilled) or backfilled quarry' is reported a short distance to the south-west of the site.
Drift Geology	Drift deposits are reported to be absent across the majority of the site with the exception of the northern part which is shown to be underlain by alluvium associated with the River Dearne.
Solid Geology	The site is reported to be underlain by Carboniferous Middle Coal Measures strata, dipping at approximately 3º to the north-east. The Haigh Moor Rock (sandstone) is shown below the majority of the site, with the exception of the south-east which is reported to be underlain by undifferentiated strata, comprising mudstone, siltstone, sandstone and coal.
Faults	An east/west orientated fault, downthrown to the north, is conjectured to underlie the northernmost section of the site.

BGS Borehole Records	Exploratory hole records provided by the BGS (available on-line) were examined and included four trial pits excavated by Norwest Holst in 1981, approximately 100m to the south-west of the site. The trial pit records indicate the area to the south-west of the site to be underlain by made ground to approximately 4.2m and 4.9m below ground level (bgl), which in turn is underlain by weathered grey mudstone to a maximum proven depth of 6.5m bgl. A borehole (SE 30 NW 24), drilled by the National Coal Board (dated October 1971) approximately 50m to the south-east of the site was also reviewed. This refers to an exploratory borehole drilled to a depth of c. 150m bgl. However, only strata located below approximately 90m bgl was recorded. This generally comprised undifferentiated mudstone, siltstone, sandstone and seat earth, with the following coal seams recorded: Silkstone seam (c. 1.80m thick) at c. 90m bgl, the Black Band seam (c. 1.10m thick) at c. 137m bgl and the Whitmore seam (c. 1.18m thick) at c. 147m bgl.	
Mining and Quarrying	**Coal Seams:**	The Top Low Haigh Moor and Low Haigh Moor coal seams are conjectured to outcrop approximately 100m and 150m to the west of the site respectively, dipping to the north-east beneath the property. The Swallow Wood coal seam is conjectured to outcrop immediately to the east of the site. A review of the generalised vertical section provided with the 1:10,000 scale geological plan indicates the Top and Low Haigh Moor coal seams and the Swallow Wood coal seam to range in thickness between 0.69m to 1.19m; 0.43m to 1.02m; and 0.30m to 1.15m, respectively.
	Coal Mining:	The Coal Authority (CA) Report obtained for the site states that: • *'The property is in the likely zone of influence from past workings in four seams of coal at shallow to 170m depth, and last worked in 1984'.* • *'The property is not in the likely zone of influence of any present underground coal workings'.* • *'The property is not in an area for which the CA is determining whether to grant a license to remove coal using underground methods'.*

		Consultation with the CA at the time of the 2013 Sirius report confirmed the shallowest worked seam beneath the site to be the Top Haigh Moor coal seam. A copy of the CA abandonment plan for underground workings in the Top Haigh Moor coal seam confirmed the location and extent of the Barugh Colliery together with indicating that that underground mineworkings encroach into the central / southern part of the site.
	Mine Entries:	The CA record no known coal mine entries within, or within 20 metres of, the site.
	Quarries/ Opencast:	Historical maps do not indicate the presence of any pits or quarries within the site. However, an infilled sandstone quarry and backfilled opencast workings to the Low and Top Haigh Moor coal seams are annotated/reported on the 1:10,000 scale geological plan located a short distance to the south and south-west of the site, respectively.

2.4. Hydrology and Hydrogeology

The nearest Environment Agency (EA) GQA classified watercourse is the River Dearne, located adjacent to the northern site boundary. The GQA grade of the River Dearne was recorded as being classified as River Quality C – Fairly Good.

From a recent site walkover (January 2017), it is apparent that a drainage ditch has been constructed within the south-eastern part of the site, flowing approximately from south-west to north-east. This feature appears to drain the far south-eastern part of the site to the pond within the north-east part.

Information from the previous reports indicates that recorded superficial deposits in the north of the site (Alluvium) are classified as a 'Secondary A' Aquifer'. Solid geology beneath the site (Middle Coal Measures) is classified by the EA as a 'Secondary A Aquifer'.

The site does not lie within a Groundwater Source Protection Zone (SPZ).

There are no surface water or groundwater abstractions relating to the site itself.

A former well was noted on the 1854 historical map approximately mid-way along the site's southern boundary. At this stage, it is unknown whether the well has been infilled / treated.

2.5. Proven Ground Conditions

Previous intrusive works have revealed the ground conditions across the majority of the site to comprise topsoil over residual Middle Coal Measures strata, typically comprising firm and stiff clay and locally medium dense and dense sandy gravel / gravelly sand. The exception to this was within the far northern part of the site, where soft, extremely low to very low strength alluvial clay was encountered, to a maximum proven depth of 4.0m bgl.

Made ground of variable thickness was encountered (to a maximum depth of 4.3m bgl) in the northern, southern and south-western parts of the site. This is conjectured to be associated with the infilled canal, channel, railway cutting / embankment and cooling ponds.

Superficial deposits were found to be underlain by competent Middle Coal Measures bedrock comprising mudstone, sandstone and coal. The Top and Low Haigh Moor coal seams underlie the site at shallow depth.

Voids and / or broken ground were encountered beneath the central southern part of the site, at depths of between 7.8m and 10.8m bgl. These are interpreted as being indicative of former mineworkings within the Top Haigh Moor coal seam.

Groundwater was recorded at a range of depths during previous intrusive ground investigation works, with post-fieldwork monitoring recording standing groundwater levels at depths in the range 0.1m bgl to 8.7m bgl. This is considered representative of perched groundwater within made ground / superficial strata together with deeper groundwater within solid bedrock.

2.6. Identified Soil Contamination Issues

The following contamination issues were identified by previous intrusive investigation works undertaken by Sirius.

Arsenic within Made Ground

Made ground encountered within the north and south parts of the site was found to contain concentrations of arsenic that exceed the Sirius GAC for residential with homegrown produce land use (37mg/kg), but not for informal public open space land use (79mg/kg).

It is therefore proposed that all made ground retained on site following the remedial and preparatory works should be placed below a suitable depth of clean cover where present in private gardens, or relocated below areas of hardstanding.

Based upon the current development layout, it is considered that private gardens to Plots 151-153 and 160-170 encroach onto the infilled railway cutting / embankment and that Plots 132-138 encroach on the backfilled former cooling ponds, where made ground is known to be present. However, it is possible that made ground extends beyond the footprint of these historical features.

Sulphates and Low pH within Made Ground

Localised elevated concentrations of water soluble sulphates and total sulphate and low pH values were recorded within made ground.

It should be noted that the elevated concentrations of sulphates do not present a risk to site end-users of the proposed development, but may have implications regarding the built environment i.e., foundations (adopting appropriate concrete specifications), which can be mitigated by following guidance given in BRE Special Digest 1.

Potentially Combustible Made Ground Soils

Potentially combustible materials (ash, coal and / or clinker) were encountered locally within made ground in the north and south of the site, in areas corresponding to the infilled canal, channel and railway cutting / embankment. Samples of made ground containing these materials were found by laboratory analysis to have calorific values greater than 2MJ/kg and are therefore considered potentially combustible.

The potentially combustible soils were identified predominantly in areas of proposed public open space / landscaped areas; specific remedial works in relation to potentially combustible soils are not required within these areas, unless new services (e.g., diverted electrical cables) are to be placed within them.

Potentially combustible made ground soils may be present in the area of proposed private gardens locally, in the southern part of the site. However, the placement of a clean capping layer, as detailed in Section 8, will effectively mitigate the risk from combustion following development.

2.7. Risk to Controlled Waters

The intrusive investigations and subsequent assessments have not identified any significant risks to controlled waters.

2.8. Potential for Previously Unidentified Contamination

In addition to the above identified contamination, given the former uses of the site, there is the possibility that as-yet undiscovered sources of contamination may be present, which will require remediation. It is therefore considered that the following actions should be undertaken during site reclamation and preparatory works.

A watching brief should be carried out by an experienced geoenvironmental engineer (GE) with particular attention to:

- Evidence of relict structures, unrecorded mine entries, bell pits and former wells.
- Made ground differing significantly in nature from that previously identified during the previous site investigation works.
- Evidence of potential asbestos containing materials.
- Evidence of potentially combustible soils.
- Visual or olfactory evidence of hydrocarbons (both soil and groundwater).

The GE shall carefully inspect soils during the watching brief and advise the Earthworks/Remediation Contractor of any testing requirements to adequately classify the materials for potential re-use or removal from site. Subject to the results of this testing, the current risk assessment may be re-evaluated.

2.9. Potential Geotechnical Considerations

Due to the previous uses of the site and the ground conditions encountered during previous site investigations, the depth of made ground across the site is anticipated to be variable.

In addition, it is expected that relict structures / foundations may be encountered during the enabling and remedial works with associated areas of deeper made ground. This is with particular regard to proposed access roads / service corridors in the north and south of the site.

2.10. Invasive Plants

Japanese knotweed is believed to be present on the site, in the area of No.1 Claycliffe Road, which is scheduled for demolition as part of the works. It is recommended that a comprehensive invasive plant survey is undertaken by a qualified consultant ecologist prior to the commencement of the proposed works, with their recommendations for removal/treatment undertaken at the earliest opportunity.

2.11. Service Constraints

Existing services are present on the site and are detailed further in Section 4.1. The status of all overhead and underground services present on the site should be confirmed by BDWH and the relevant service providers prior to the commencement of the proposed works.

2.12. Hazardous Ground Gases

The Geoenvironmental Appraisal for the site identified that no radon protection measures are required for the proposed development.

Based on the findings of the previous ground gas risk assessment, the recorded gas monitoring results indicate that the proposed development area would be classified as Characteristic Situation 2 (CS2) in accordance with BS8485:2015, '*Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings'*.

It is acknowledged that the monitoring results indicate that under the NHBC Traffic Light system, the development area could be classified as 'Green'. However, at this stage, due to the proximity of several sources of hazardous ground gases to the proposed development area (i.e., backfilled canal and rail cutting and shallow coal mine workings), and in the absence of floor slab construction details and regulatory input, it is suggested that CS2 be assumed.

Within BS8485:2015, CS2 requires gas protection measures achieving a gas protection point score of 3.5. Such mitigation measures may typically comprise any one or more of the following:

- Ventilation of confined spaces within the proposed residential dwellings;
- Well-constructed reinforced suspended, raft or cast in situ ground slab;
- Methane and carbon dioxide resistant membrane, suitably lapped;

- Passive subfloor ventilation system;
- Minimum penetration of ground slab by services;
- All joints and penetrations to be sealed; and,
- Independent verification of gas protection measures.

By way of example, the required protection score of 3.5 could be achieved by the use of good performance passive venting (1.5 points) and a suitable gas resistant membrane (2 points).

Installation and subsequent verification (by an independent third-party installer or consultant) should be undertaken in accordance with the CIRIA Report C735, '*Good Practice on the Testing and Verification of Protection Systems for Buildings against Hazardous Ground Gases'* (2014).

Within CIRIA Report C735, the scope of requirements for verification of ground gas protection measures depends upon the following factors:

- Qualifications of the installer;
- Complexity of the ground floor design;
- Number of plots within the development;
- Level of risk from ground gases.

Details of the proposed gas protection measures, including ventilation arrangements, materials and construction method, as well as a verification plan, should be submitted to the LPA and building warranty provider for their approval prior to installation.

Subsequent reports confirming the satisfactory installation and independent verification of the required gas protection measures should be submitted by BDWH to the Local Authority / building warranty provider.

3. REMEDIATION STRATEGY AND OBJECTIVES

The primary objective of the remediation works is to discharge the relevant planning conditions whilst mitigating the transient and long-term risks to receptors, including human health and the environment from chemical contaminants within the made ground soils on the site.

The main requirements of the remediation works are given below in the approximate sequence of works. Pertinent elements of the works are discussed in greater detail in subsequent sections of this document.

- Pre-demolition asbestos survey and demolition of existing residential property (No. 1 Claycliffe Road), including breaking out of existing floor slabs, foundations / substructures and processing hard materials to produce a material suitable for re-use on site in accordance with the specification for engineered fills for the works.
- Treatment / removal of Japanese knotweed and any other invasive plant species present.
- Site clearance of existing trees, shrubs and vegetation from the proposed development footprint area necessary to facilitate the works.
- Stripping of suitable topsoil and stockpile for assessment and potential re-use on site.
- Inspection of natural ground surface to confirm the absence of unrecorded mine entries (i.e. bells pits / crop workings) below the proposed development area. If mine entries are identified, these should be dealt with in accordance with the Sirius Specification for The Treatment of Shallow Mineworkings (included in Appendix E of this report).
- Investigation and, if required, decommissioning of a historical well.
- Excavation and re-engineering of made ground soils below the majority of proposed highways in accordance with the Specification for Engineered Fills for the works to a maximum depth of 2.0m below finished remediated road level or 0.5m below the invert level of drainage, whichever is greater.
- Ground improvement (using methods to be agreed with the local authority and issued under separate cover) below adoptable highways at the northern and south-western ends of the proposed main road through the site, where deep made ground / low strength natural clay soils are present.

- Place, level and compact suitable imported fill in accordance with the specification for engineered fills for the works to achieve formation levels (including construction of an attenuation basin in the east of the site).

- Break out any relict foundations or below ground obstructions encountered during the earthworks which are likely to hinder subsequent foundation, utility/service and highway construction.

- Process (where necessary) arisings from the earthworks to produce materials suitable for re-use on site in accordance with the engineering specification for the works.

- Removal or relocation to non-structural areas (where applicable) of any material which cannot achieve the engineering specification.

- Treatment of shallow coal mineworkings within the Top Haigh Moor coal seam, in accordance with the Sirius Specification for the Treatment of Shallow Mineworkings (included as Appendix E of this report).

- Trim, level and compact across the formation to create the required levels.

- Undertake all geotechnical and chemical testing as required throughout the earthworks.

- Carry out a watching brief by a qualified geoenvironmental engineer during all of the above, to identify any previously unidentified sources of contamination (see Section 2.8).

- A validation report produced by a suitably qualified geoenvironmental engineer on completion of the works. This initial report will provide a record of the remediation works including the results of testing to demonstrate the integrity of the work and confirm the work has been carried out in accordance with the relevant legislation, the remediation specification and planning conditions.

The remedial and preparatory works should be undertaken under a Materials Management Plan (MMP) written and declared in accordance with the CL:AIRE Definition of Waste Code of Practice.

4. CONSTRAINTS

4.1. Services

The site is crossed by existing overhead power lines, generally aligned north-west to south-east and east to west, located in the east and south of the site, respectively. These overhead power lines are understood to be the property of Northern Powergrid and include a combination of 11kV, 66kV and 132kV power lines, generally associated with two electricity substations located just beyond the site's south-eastern boundary.

Underground services are present within the site, including water mains in the north-west and east of the site, together with combined sewers present below the south-west, north and north-west of the site. It is understood that existing spurs off a gas main running along Dearne Hall Road are present in the south-west corner of the site, associated with the existing residential properties to be demolished. An existing low voltage electricity cable is also located in the south-west corner of the site associated with the existing residential properties. A buried telecommunications cable is understood to underlie the southern site boundary and is shown to encroach into the site along parts of its alignment.

Prior to any works, the location of all known services should be checked against service plans and clearly marked on site, detailed within drawings and discussed as part of the site induction. Any services which remain live as works progress should be protected and have a suitable easement / stand-off. Works in the vicinity of live services should be undertaken in accordance with an approved method statement. Treatment of mine workings by drill and grout methods may require the use of angled boreholes to mitigate the risk of contact with overhead electrical cables.

Should any existing services be retained post-development, consultations with the appropriate service providers should be undertaken at an early stage in order to confirm any easements / stand-off which may be required.

4.2. Potentially Combustible Soils

Localised areas of potentially combustible made ground soils, recorded as pockets of ash-rich made ground, have been identified, which have the potential to impact upon buried services. It is recommended that additional laboratory calorific value testing is undertaken where ash-rich made ground is encountered within the vicinity of service trenches during remedial works, to evaluate the

potential for combustion 'en masse' in accordance with ICRCL 61/84, which states that there is an unacceptable risk of smouldering if the calorific value of soils exceeds 7MJ/kg 'en masse'.

Should the presence of potentially combustible soils be proven within proposed service runs, then these soils should be delineated on site and removed from the service run to a distance of 1m in all directions and be replaced with a suitable non-combustible fill to prevent ignition from possible heat sources (such as electricity cables).

4.3. Shallow Mine Workings

Voids and/or broken ground were encountered in rotary probeholes located in the southern-central part of the site, at depths of between 7.80m and 10.80m bgl, assumed to be associated with the working of the Top Haigh Moor coal seam. The depth and thickness of the workings encountered in the central southern part of the site have the potential to affect surface stability and will therefore require consolidation through drilling and pressure grouting.

Outside this localised zone, the Top Haigh coal seam was found to be intact and no evidence of historic mine workings (i.e. broken ground/void/soft ground) have been encountered. On this basis it is considered the possibility of unrecorded pillar and stall mine workings being present within this coal seam at influencing depth beneath the site, out with the zone of identified workings, is low.

The possibility of encountering unrecorded mine entries on site cannot be discounted. Following a topsoil strip the entire area should be inspected for evidence of mine entries (including bell pits).

A Specification for the Treatment of Shallow Mine Workings is included as Appendix E.

4.4. Ecological Constraints

The following reports by BSG Ecology have been uploaded to the local authority's planning website in relation to the proposed development:

- *Low Barugh, Barnsley: Ecology Report*. Dated March 2013, reference 3568.02_R_APPR_060313.
- *Low Barugh, Barnsley: Great Crested Newt Survey Report*. Dated June 2014, reference 3568.04_R_APPR_250614.

These reports identify that great crested newts and their habitats are present in the eastern part of the site, and that mitigation measures are required within the proposed development.

Reference should be made to these and any other relevant documents for the full requirements for ecological works at the site in advance of remediation / development works.

4.5. Invasive Species

Japanese knotweed is believed to be present on the site in the area of No.1 Claycliffe Road, which is scheduled for demolition as part of the works. It is recommended that a comprehensive invasive plant survey is undertaken by a qualified consultant ecologist prior to the commencement of the proposed works, with their recommendations for removal/treatment undertaken at the earliest opportunity.

4.6. Trees

An Arboricultural Report has been prepared for the site by JCA Ltd Ref. 10974/AJB, dated 30th January 2013. This identifies several trees around the edges of the site that require protection during development works, and recommends that an Arboricultural Method Statement is produced, detailing tree protection requirements.

The report states that an enquiry was made with Barnsley Metropolitan Borough Council in 2013, which identified that no Tree Protection Orders (TPOs) apply to the site. However, the report recommends that a further check is carried out prior to any works being undertaken.

Any remediation or associated works should be undertaken following adoption of appropriate tree protection measures.

4.7. Archaeological Constraints

A '*Written Scheme of Investigation – Archaeological Strip, Map & Record and Watching Brief'* has been produced for the site by Prospect Archaeology (Report No. BYW13-02, dated October 2016).

This requires archaeological works in the western part of the site, and an archaeological watching brief of excavations deeper than 1.5m in an area in the northern part of the site.

Reference should be made to this document for the full requirements for archaeological works at the site in advance of remediation / development works.

4.8. Historical Well

A well is shown in the southern part of the site on a historical OS map. Whilst the precise location, condition and dimensions of this feature is unknown, the location of this well should be investigated

and the well decommissioned as part of the proposed new development. Made ground in the vicinity of the well's conjectured location should be excavated and natural ground inspected to confirm the location or absence of this feature. If located, this well should be clearly marked prior to any development works commencing and then decommissioned in accordance with the guidance within the Environment Agency (EA) document *'Good Practice for Decommissioning Redundant Boreholes and Wells*' dated October 2012.

4.9. River Dearne

The River Dearne lies approximately 25m to the north of the site, generally flowing from west to east. It is imperative that potentially contaminated materials, waters and leachate from the proposed works (excavations, stockpiling, etc.) do not reach the river either directly or via surface water drains, etc. Any works undertaken in proximity to the River Dearne should be in accordance with the EA PPG5 document, '*Works and Maintenance in or near Water'.*

Should any proposed works have the potential to directly impact the river banks, or are within 10m of the River Dearne, a licence may be required from the EA.

4.10. Waterlogged Ground

An area of heavily waterlogged ground in the southern part of the site was identified by the 2014 Sirius Geoenvironmental Appraisal.

A site survey undertaken in January 2017 identified that the area of waterlogged ground had increased.

Therefore, appropriate drainage measures should be incorporated into the proposed development to prevent future waterlogging of garden and landscaped areas. Similarly, access restrictions associated with the presence of soft boggy ground, prior to installation of appropriate drainage system, should be considered within the logistics of the enabling works.

4.11. Slopes / Embankment

It is proposed that the existing grassland and woody vegetation be retained along the south and south-east public open space, since this part of the site can remain unaffected by the development. Any enabling works, including works to vegetation, in this area should carefully consider slope stability.

5. GEOENVIRONMENTAL ENGINEER

A suitably experienced and qualified Geoenvironmental Engineer (GE) will be appointed for the works, to supervise (as required) and advise on relevant matters.

The GE shall attend site as required to ensure that the requirements of this strategy are complied with. The responsibilities of the GE shall include, but not be limited to, the following:

- Liaison with the Client and statutory bodies in relation to the remedial and ground preparatory works;
- Supervision and quality control of the remedial and ground preparatory works;
- Advice on the correct handling of materials and conditions encountered;
- Supervision of soil sampling as required under this Strategy;
- Supervision and testing as required under the Engineering Specification;
- Implementation of contingency measures if unexpected contamination is found during the works; and,
- Review of site records and test results as they become available and make comment and act upon those results accordingly.

6. PREPARATORY WORKS

6.1. Site Clearance

Following the erection of any required tree protection and removal/treatment of any invasive plant species present, all remaining vegetation including trees and shrubs within the development footprint shall be stripped/cleared and stockpiled on site for subsequent removal. Any general debris shall be cleared and placed in skips for off-site disposal.

6.2. Topsoil Strip

At this stage, based on visual assessment and laboratory test results obtained as part of the Sirius ground investigations, it is thought that the natural and reworked topsoil encountered on site is likely to be suitable for re-use within landscaped areas and gardens.

All potentially suitable (both chemically and texturally) topsoil excavated during the enabling works shall be carefully stockpiled at an agreed location away from other intrusive works, for subsequent confirmatory testing, before being approved for re-use.

Chemical analysis should be undertaken by the Earthworks Contractor in accordance with Section 10 of this Strategy.

Glass fragments were encountered locally within the reworked topsoil in the northern part of the site (more specifically, in the area of the backfilled former canals). Consequently, topsoil within this part of the site may not be texturally suitable for re-use within gardens. Consideration could be given to re-use following screening (hand picking) to remove deleterious inclusions of glass and other anthropogenic materials, and subsequent validation (including chemical testing).

Topsoil considered texturally and/or chemically unsuitable for re-use within gardens and/or soft landscaping shall be either re-located to other less sensitive areas of the site, where possible, or, alternatively removed from site to a suitably licensed facility.

7. EARTHWORKS

7.1. General

In order to achieve the required development platform as noted in Section 3 of this Strategy, it is proposed to undertake a cut and fill earthworks exercise principally involving the placement of imported fill to achieve development levels. Such works will be undertaken in accordance with the Sirius Specification for Engineered Fills in Appendix B.

7.2. Grubbing up of Slabs/Hardstands and Foundations

All remnant hardstanding, slabs, foundations, drainage and other relict structures encountered during the proposed works shall be broken out and removed where they are likely to hinder subsequent foundation, utility/service and highway construction. Selected materials suitable for re-use or recycling shall be retained on site for potential re-use within the works.

Any deeper structures, e.g., piles, encountered during the works shall be broken out to a depth of 2m below existing or finished ground levels, whichever is the deeper, surveyed and marked on a plan and then discussed with the Client to determine if they cause a constraint to the proposed development.

All hard materials, where appropriate, should be stockpiled and crushed in an agreed location. Appropriate materials shall be crushed to a maximum particle size of 125mm to generate a suitable granular fill material. Unsuitable materials, including those listed in Section 3.4 of the Specification for Engineered Fills in Appendix B shall not be incorporated into the crushed product.

Unsuitable material, including, but not limited to, metal, steel reinforcement, rags, plastic, timber or degradable material shall be segregated from the crushed product and removed from site. The crushed product shall be inspected by the GE to confirm such materials have been removed as far as practicable.

The Earthworks/Remediation Contractor shall undertake geotechnical testing at the frequencies detailed in Table 1 within the Sirius Specification for Engineered Fills in Appendix B.

The results of all chemical testing undertaken should be reviewed by the GE who will advise on the suitability of materials for re-use on site.

7.3. General Excavations

As part of the remedial and preparatory works, it is proposed to undertake cut and fill earthworks, principally comprising the placement of imported fill materials in order to achieve agreed development levels, as detailed in Section 3 of this Strategy.

Previous investigation works have revealed localised areas of made ground soils which are both chemically unsuitable and texturally unsuitable for retention below gardens without remedial action. However, these made ground soils are considered suitable for retention below areas of informal public open space without remedial action.

On this basis, the above made ground soils, if retained on site, would need to be placed below suitable hardstanding or an appropriate cover system within private gardens. Final remediation formation levels will allow for the placement of a minimum depth of 600mm of clean validated topsoil/subsoil within gardens where made ground is present.

In addition to the above, any soils exhibiting visual and/or olfactory evidence of gross contamination encountered during preparatory/enabling works shall be placed in temporary stockpiles on suitable hardstanding or heavy duty plastic sheeting, suitably covered and bunded with appropriate signage and identification. The GE shall inspect the soils and advise the Earthworks/Remediation Contractor of any testing requirements to adequately classify the materials for potential re-use or removal from site.

Any potentially combustible soils shall be inspected by the GE, who shall advise the Earthworks/Remediation Contractor of any testing requirements to adequately assess the potential for combustion together, with any remedial action considered necessary (as detailed in Section 4.2).

Any made ground excavated as part of the preparatory/enabling works, and which are to be re-used on site as engineered fill, should processed/screened (as required) to remove any oversized materials or other unsuitable material. All arisings, if re-used in the works, should have a maximum particle size of 125mm. Oversized hard material shall be crushed to generate a granular fill material suitable for re-use within the works, or alternatively removed from site.

All materials to be re-used as an engineered fill should be classified in accordance with the Department of Transport's Manual of Contract Documents for Highway Works (MCHW): Series 600, Volume 1, dated November 2009.

Granular and cohesive soils should be stockpiled separately.

7.4. Adoptable Highways

With regard to adoptable roads, in order to minimise the risk of any future settlements, it is generally proposed to excavate made ground below areas of proposed highways to a depth of 2.0m below finished road level or 0.5m below invert level of drainage, whichever is deeper, and to re-engineer with suitable site-won materials to a finished remediated formation of 0.5m below finished road level, in accordance with the Sirius Specification for Engineered Fills in Appendix B.

There will be two significant exceptions to the above, at either end of the proposed road that will pass through the proposed development that will require alternative methods of ground improvement to minimise risk of future settlement, as summarised below:

- At the south-western corner of the site (including location of the proposed roundabout), due to the depth of made ground (up to 5.4m recorded) from backfilling of a former rail cutting, a requirement for a new road embankment up to c. 1.7m higher than existing ground level, and the risk of differential settlement due to part of this area being underlain by thin made ground (WS103; south of the former rail cutting);

- At the northern end of the site, approaching the proposed junction with Dearne Hall Road, due to the depth of existing made ground from backfilling of former canals and underlying natural low strength alluvial clay soils, in combination with a requirement for a new embankment up to c. 1.2m above existing ground level.

Detailed proposals for improvement of existing made ground below the adoptable highway at these locations will be agreed with the local authority and issued under separate cover.

7.5. Re-profiling / In-Filling

Any areas requiring infilling shall be made level, with a nominal fall of 1v in 50h. The base of all excavations shall be surveyed, prior to the placement of any engineered fill.

The base of any excavation or surface prepared by the Earthworks Contractor to accept fill material shall be proof-rolled using a vibratory roller and any soft (or hard) spots encountered investigated, removed as necessary and replaced with suitable fill materials.

Once a clean working surface has been exposed, inspected and approved by the GE, suitable fill materials shall be laid and compacted in accordance with the Sirius Specification for Engineered Fills presented in Appendix B to this Strategy.

Areas of fill shall be benched into adjacent areas in accordance with BS6031:1981 *'Code of Practice for Earthworks'.*

Any materials excavated not immediately placed in the deposition area shall be stored in clearly identified stockpiles. Surveys of any stockpiles shall be undertaken at regular intervals through the remediation works and provided to the GE, together with a description of their intended use.

Any stockpile of made ground shall be assumed to contain elevated concentrations of contaminants. It shall be ensured that such materials are not allowed to cross-contaminate any clean areas of the site, nor are they allowed to contaminate any off-site areas or controlled waters.

7.6. Compaction Requirements

Compaction works shall be undertaken in accordance with the Sirius Specification for Engineered Fills presented in Appendix B of this Strategy.

Method Compaction shall be used for granular material. Cohesive materials shall be compacted in accordance with an end-product specification. Any deviation from this shall be subject to the approval of the GE.

Reference should be made to the tables included within Appendix B to the Sirius Specification for Engineered Fills for each material type.

7.7. Control Testing

The Earthworks Contractor shall undertake earthworks control testing in accordance with Table 1 within the Sirius Specification for Engineered Fills, presented in Appendix B of this Strategy.

All control testing shall be carried out in accordance with the relevant British Standard or other relevant guidance, except where the specification adopts alternative methodologies.

If the results of control/validation tests indicate that the fill is being placed and compacted in such a way that the desired level of compaction is not being achieved, the Earthworks Contractor shall further compact or, if necessary, shall excavate the affected work and replace with new fill, compacted to meet the specification requirements.

7.8. Control of Groundwater

Any groundwater or leachate arising from the site shall be considered to be contaminated and therefore potentially hazardous until proven otherwise. The Earthworks Contractor shall ensure that potentially contaminated waters and leachate from excavations or stockpiling areas do not reach the River Dearne, surface water drains, ponds, etc. The Earthworks Contractor shall ensure contaminated waters or leachate do not discharge onto ground external to the site or on the site.

All such waters will be treated on site as necessary for subsequent disposal or alternatively removed from site by tanker to a suitable disposal facility.

The Earthworks Contractor will be responsible for obtaining all necessary permits, licenses and consents for disposal.

Contaminated waters pumped from excavations should be stored in a holding tank and chemically tested prior to disposal. Any discharges should be recorded in relation to date, time, quantity and quality. All records should be maintained at all times and be made available to the GE upon request.

8. COVER SOILS

8.1. General

The remediation strategy for the site, with respect to protection of future end users, requires the provision of a 'clean' cover soil capping system where made ground is left in situ (anticipated to apply to Plots 132-138, 151-153 and 160-170).

The construction of the clean cover system shall be as shown in Table 8.1.

Table 8.1 Clean Cover Thickness

Area	Subsoil (mm)	Topsoil (mm)	Total (mm)
Gardens	450	150*	600

* minimum recommended thickness. However, an increased thickness may be placed if desired, with corresponding reduction in subsoil thickness to achieve a minimum total thickness of 600mm.

All topsoil and subsoil for use within the 'clean' cover system, or as a growing medium, shall be clean and free of foreign debris, building waste materials, timber or other deleterious matter.

8.2. Re-use of Site-won Materials as Cover Soils

Any site-won materials intended for use in the cover system shall be tested prior to placement at a frequency of one sample per 250m^3 to confirm its chemical suitability for re-use on the site. All testing shall be carried out at a UKAS accredited laboratory, with MCERTS accredited analysis undertaken where available, for the following suite of determinands:

- pH and water-soluble sulphate;
- Total metals (copper, nickel, zinc, chromium (total and hexavalent), arsenic, mercury, selenium, cadmium and lead);
- Speciated polycyclic aromatic hydrocarbons (PAH);
- Phenols (total);
- Asbestos;
- Total organic carbon / soil organic matter.

The analytical testing will be undertaken on a maximum of five working day turnaround and shall be forwarded to the GE as they become available.

The results shall be compared with the Sirius Stage 1 and 2 Generic Assessment Criteria (GAC) values for Residential with Homegrown Produce, or Public Open Spaces (as applicable), given in Appendix C of this Strategy. If all recorded contaminant concentrations / chemical parameter values fall within the GAC, the material is considered chemically suitable for re-use. Should any analyte exceed the respective threshold value, detailed consideration of the results, including soil organic matter and statistical analysis undertaken in accordance with the CL:AIRE & CIEH document, *'Guidance on Comparing Soil Contamination Data with a Critical Concentration*' (2008) shall be undertaken to determine whether the material is suitable for re-use.

The re-use of site-won natural soils within the clean cover layer will require careful control of excavation arisings and soil management during the development. Clean cover soils won on site, should be stored in stockpiles at agreed locations and sealed/covered to reduce water ingress and softening.

8.3. Use of Imported Soils as Cover Materials

For any imported materials required to complete the cover soils, the frequency of testing to be undertaken shall be as given in the YALPAG document, '*Verification Requirements for Cover Systems*', Version 3.3, dated October 2016, as summarised in Table 8.2.

Table 8.2 Sampling and Testing Matrix for Imported Soils

Type	Number of Samples	Testing Schedule	Assessment Criteria
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert natural of the material	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)	See Appendix D.
Crushed Hardcore, Stone, Brick	Minimum 1 per 1,000m³	Standard metals/metalloids (as above) PAH (16 USEPA speciation) Asbestos	
Greenfield/ Manufactured Soils	Minimum 3 or 1 per 250m³ (whichever is greater)	Standard metals / metalloids (as above) PAH (16 USEPA speciation) Asbestos	
Brownfield/ Screened Soils	Minimum 6 or 1 per 100m³ (whichever is greater)	Standard metals / metalloids (as above) PAH (16 USEPA speciation) TPH (CWG banded) Asbestos Any additional analysis dependant on the history of the donor site.	

Topsoil, granular and cohesive subsoils shall be stored in separate stockpiles and be clearly identified.

The analytical testing will be undertaken on a maximum five working day turnaround and the test results shall be made available to the GE, who must give their approval prior to any material being delivered to site.

The results shall be compared with the Sirius Stage 1 Threshold Concentrations for Clean Cover Material for Use in Gardens of Private Residential Properties, provided within Appendix D of this Strategy to determine the suitability or otherwise of the material for its intended use. If all recorded contaminant concentrations / chemical parameter values fall within the threshold values, the material is considered chemically suitable for importation. Should any analyte exceed the respective threshold value, detailed consideration of the results, including soil organic matter and statistical analysis undertaken in accordance with the CL:AIRE & CIEH document, *'Guidance on Comparing Soil Contamination Data with a Critical Concentration*' (2008) shall be undertaken to determine whether the material is suitable for importation to the site.

8.4. Verification of Required Depth

Where placement of a capping layer is required due to the presence of contaminated made ground, verification of quality, chemical suitability and depth of topsoil and subsoil shall be carried out by a suitably qualified GE by excavation of small trial pits following placement, with appropriate samples taken of both topsoil and subsoil. Trial pits shall be excavated within rear garden areas at a frequency of 1 plot in 4. Evidence for validating the depth and quality of cover shall accord with the YALPAG document, '*Verification Requirements for Cover Systems'*, Version 3.3 dated October 2016.

Placement of clean site-won topsoil in garden areas to provide a growing medium is not considered to represent remediation, and therefore verification of the thickness of a growing medium is not considered necessary.

Should any excavation of foundations, drainage and services etc., extend below any placed 'clean' capping layer, and therefore encounter underlying made ground materials, there is a potential for cross-contamination and should be avoided where possible. Detailed Risk Assessments and Method Statements outlining the soil management for the site, shall be provided for this work by BDWH and their specialist sub-contractors.

9. GENERAL SITE REQUIREMENTS

9.1. Introduction

The Earthworks Contractor shall comply at all times with this Strategy, the Conditions of Contract and all relevant health and safety requirements.

Site works will be supervised by a GE appointed by Earthworks Contractor on behalf of BDWH.

The Earthworks Contractor shall prepare and submit a programme for the works to BDWH prior to the commencement on site.

Site cabins, stores and welfare facilities shall be established at a convenient location to be agreed between the Earthworks Contractor and BDWH.

Prior to commencement of works, the Earthworks Contractor shall establish the boundaries of the site and working areas and shall make adequate provision to secure the site boundary and prevent unauthorised access to the site during the course of the works.

Site working hours shall be discussed and agreed with the LPA prior to commencement.

9.2. Access/Egress

It is understood that access to the site will be off the junction of Barnsley Road and Claycliffe Road. Appropriate care and attention should be paid by all vehicles/plant accessing/egressing the site.

9.3. Services

BDWH or their nominated representative shall be responsible for obtaining all relevant service records for the site and undertake any consultation with the statutory undertakers in relation to identifying the location of live services, including those to any adjacent properties. BDWH or their nominated representative shall ensure the safe disconnection of all existing services entering the site, except for those which are to remain operational.

Prior to site works commencing, the position and depth of all services shall be determined and clearly identified on site by the Earthworks Contractor. The locations should be confirmed on site by appropriate investigation and observations. The following should be undertaken:

- Copies of a consolidated services location drawing should be retained and displayed in the Earthworks Contractor's office;
- Cable Avoidance Tool (CAT) scanning of areas where works are to be carried out;
- Hand dug holes to expose services location shall be undertaken (where possible);
- Physical marking out on the site of service routes on the ground and appropriate lay-offs/ easements using paint, pegging, bunting etc.;
- Retaining on the site drawings showing locations of all services;
- Where services are being re-routed during the works both the drawings and site markings must be kept up to date;
- When works commence on a new area of the site the site manager or relevant foreman must brief all operatives on the location of services in this area;
- Method statements/risk assessments must be read by all relevant personnel and their understanding of them confirmed in writing; and,
- If coloured sands, service ductwork or services are exposed during operations then work must cease until the site manager has confirmed it is safe to continue.

All manholes to remain should be located and clearly identified on site to prevent damage. The location, overall depth and diameter of each manhole, and the size and depth of all connections, shall be recorded.

Service providers shall be contacted by the Earthworks Contractor to determine any precautions, safe working distances etc. relating to services, both underground and overhead.

9.4. Health and Safety

The earthworks shall be undertaken in accordance with all relevant legislation including, but not limited to:

- The Health and Safety at Work etc. Act, 1974;
- The Construction (Design and Management) Regulations (current version);

- Construction (Health Safety and Welfare) Regulations, 1996;
- The Control of Substances Hazardous to Health Regulations, 2002; and,
- The Control of Asbestos at Work Regulations, 2012.

Contaminated materials are present on site. During the remediation and construction it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document *'Protection of Workers and the General Public during the Redevelopment of Contaminated Land'* (HS(G)66). In summary, the following measures are suggested to provide a minimum level of protection.

- All ground workers should be issued with high visibility clothing, hard hats, protective footwear and impermeable heavy duty gloves. Personnel should be instructed as to how they are to be used;
- Hand washing and boot cleaning facilities shall be provided;
- No smoking on site other than in designated areas if any are present on site; and,
- Good practices relating to personal hygiene shall be adopted.

Before site operations are commenced the necessary COSHH Assessment, Method Statements and Health and Safety Plans should be completed and issued by the Earthworks Contractor in accordance with the current CDM Regulations at the time of the works.

All site personnel shall undergo a site-specific health and safety induction prior to commencement of work on site.

Gas monitoring of deep confined excavations, where man entry is required (including plant operators), shall be undertaken prior to commencement of work each day or after short-term suspension of works and shall be continuous throughout the working day.

9.5. Mobile Plant

Mobile plant shall be operated by competent personnel for each item of plant. When not in use all plant shall be locked to prevent unauthorised access.

All traffic entering or working on site shall obey the site speed limit.

Fuelling of any plant shall be undertaken in a designated area and all above ground fuel storage tanks shall comply with the requirements of the Pollution Prevention Guidelines PPG2 (August 2011).

Specifically, any fuel storage tanks should:

- Be situated within an oil-tight secondary containment system such as an impermeable bund;
- The secondary containment must provide storage of at least 110% of the tanks maximum capacity;
- Be located within a secured area; and,
- All taps and valves should be fitted with a lock and be adequately secured when not in use.

Waste oil, hydraulic fluid etc. should not be tipped directly or otherwise discharged onto site. Such materials shall be stored separately, in a secure bunded area, for off-site disposal. Waste oil is a Hazardous Waste, and disposal shall be undertaken by a registered carrier in accordance with the Duty of Care (DoC) Regulations (2006) and the Waste (England and Wales) Regulations (2011).

Contractors shall provide a fuel spill kit, to be kept on site in an accessible place near to the designated refuelling area.

9.6. Dust

Appropriate measures shall be implemented at all times during the remediation works, to minimise any dust emissions. During all operations, the risk of dust release will be continuously assessed and appropriate mitigation measures will be put in place where necessary. This is typically a bowser with hose attachment to wet down working areas and suppress dust although other alternative techniques will be considered as necessary.

Any haul roads, shall where practical to do so, be constructed of crushed hardcore products.

These haul roads shall be maintained for the duration of their use to minimise any build-up of mud, loose spoil, etc. Mobile water bowsers and sprayers shall be made available to dampen unpaved haul roads and working areas. An adequate supply of clean water shall be maintained on site at all times to allow dust suppression activities to be carried out at short notice.

Traffic both entering and working on the site shall obey the site speed limit.

Regular inspections of the public highway adjacent to the site entrance shall be carried out by the Earthworks Contractor. If deemed necessary, the highway shall be swept regularly to remove any mud, slurry or dust deposited by vehicles entering or departing the site, and a wheel wash provided for exiting vehicles if required. If the Earthworks Contractor considers that significant amounts of any detritus have been deposited on the public highway then operations shall be temporarily suspended until appropriate cleaning operations have been undertaken.

Any wagons that are to be used for the haulage of potentially contaminated material from the site shall be sheeted to prevent the release of fugitive dust.

9.7. Odour

In general terms the excavation works are not considered likely to give rise to any significant odour problems.

Whilst considered unlikely, if highly odorous materials are encountered which may give rise to nuisance to neighbouring properties, odour control measures can be considered at that time and an appropriate method statement supplied by the Earthworks Contractor.

Any odorous materials shall be covered at the end of each working day and any stockpiles will be located away from any residential properties. This shall be continually assessed through the programmed works.

9.8. Noise

The requirements of BS 5228:2009 ‘Noise and vibration control on construction sites’ shall be adhered to at all times.

All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No items of plant shall be operated with engine covers raised.

The location of any crushing plant shall take into consideration the location of neighbouring properties and other noise sensitive receptors and shall be located away from these areas and located adjacent to proposed stockpile locations, where possible and practicable.

9.9. Off-Site Disposal

Materials for off-site disposal shall be sampled and analysed, by UKAS accredited laboratory employed by the Earthworks Contractor, at a frequency sufficient to allow the material to be adequately categorised.

The Earthworks Contractor shall ensure that any material exported from site to a suitably licensed facility is hauled by a registered waste carrier in accordance with the requirements of the Duty of Care Regulations, the Landfill Directive and where appropriate the Hazardous Waste Regulations, 2005 and the List of Waste Regulations 2005.

A transfer or consignment note shall be completed, signed and retained by all parties involved. The transfer note shall state the volume of waste, the nature of the material and statement of its chemical composition. The waste transfer notes shall be kept by the Earthworks Contractor for a period of at least two years.

9.10. General

No fires shall be permitted on site, unless previously agreed with the local authority.

Details of all monitoring will be retained on site by the Earthworks Contractor and made available to the Local Authority Environmental Health Department on request.

10. CONTRACTOR'S RESPONSIBILITIES

10.1. Introduction

The following regulations, guidance and legislation relating to the works shall be complied with at all times:

- Health and Safety Executive *'Protection of Workers and the General Public during Redevelopment of Contaminated Land'*, HS(G)66, HMSO 1991;
- The current Construction, Design and Management Regulations and the Pre-tender and Construction Phase Health and safety Plans;
- The Control of Substances Hazardous to Health Regulations 2002; and,
- The Control of Asbestos at Work Regulations, 2012.

10.2. Surveying

The Earthworks Contractor shall be responsible for the following survey work:

- Establishment of profile boards;
- Setting out of building footprints;
- Surveying the base and extent of all excavations following proof rolling and prior to placement of any fill to be engineered;
- Areas of localised overdig, i.e. areas required to remove deep relict structures etc.;
- Any obstructions encountered in the works that are not possible to remove, i.e. piles;
- The finished surface (remediation level and interim capping layer) prior to handover to the Client;
- Interim surveys to be undertaken during the infilling works to provide information on issues such as progress, earthworks quantities, base/top of made ground etc.; and,
- The location and elevation of test and sample locations.

10.3. Testing

The Earthworks Contractor shall be responsible for undertaking all geotechnical and chemical testing necessary to satisfy the GE that the works have been carried out in accordance with, and comply with the Specification for Engineered Fills.

All soils and chemical testing shall be carried out by a UKAS accredited laboratory, with MCERTS accredited analysis used where available, to the approval of the GE.

10.4. General

The Earthworks Contractor shall also be responsible for the following:

- Provision of method statements and reports;
- Environmental Permits (waste and remediation) are in place prior to works commencing;
- The provision of health and welfare facilities;
- Obtaining all relevant permits/consents/licenses i.e. discharge consents;
- Environmental monitoring; and,
- Mitigation measures.

11. VALIDATION AND REPORTING

The GE and/or site manager will maintain records of the works to include the following:

- Daily record sheets to include a summary of the day's activities;
- Weather conditions;
- Plant, personnel and visitors present;
- Aspects relating to Health and Safety, environmental control or non-compliance with the General Specification or the Earthworks Contractors Method Statement; and,
- Test results.

On satisfactory completion of all of the remediation works, the GE will provide an initial validation report, comprising relevant site records and act as certification that the remedial and ground preparation works have been carried out in accordance with this Strategy.

The validation report shall include the following:

- A description of the works undertaken;
- Records of the works;
- Progress photographs;
- Waste transfer notes;
- Chemical and geotechnical validation test results;
- As built surveys, including base of excavation and final level survey, base and top of made ground; and,
- A statement that the works have been undertaken in accordance with the agreed specification.

Subsequent validation reports will be required following the final placement of the clean cover (by others) post remediation works, in order to confirm its suitability both chemically and textually, as well as its thickness, at the frequencies stated within Section 10 of this Strategy.

Subsequent validation reports will be required for ground gas protection measures, as discussed in Section 2.12.

12. POST RECLAMATION REQUIREMENTS

A validation report will be provided to BDWH on satisfactory completion of the remediation works (excluding the placement and testing of clean cover).

BDWH and their sub-contractors shall be responsible for all construction works following handover of the works. Elements that need to be included in any subsequent method statements shall include:

- Compliance with environmental issues;
- Construction of foundations;
- Placement of subsoil and topsoil to form the cover system in garden/soft landscaping areas;
- Validation report(s) confirming the above works;
- The provision of gas preventative measures as specified in the investigatory reports or following any additional monitoring and assessment;
- Appropriate protection of underground services; and,
- Disposal of any arisings which cannot be accommodate on site.

BDWH and their sub-contractors shall be responsible for the placement of the clean cover layer as required. The placement, final thickness, chemical suitability etc. of this capping layer will require validation.

Should any excavation of foundations, drainage and services etc. extend below any placed 'clean' capping layer, and therefore encounter underlying made ground materials, then there is a potential for cross-contamination. This should be avoided where possible. Detailed risk assessments and method statements outlining the soil management for the site shall be provided for this work by BDWH and their specialist sub-contractors.

BDWH and their sub-contractors shall be responsible for the installation of ground gas protection measures and arranging appropriate independent verification, if required.

13. REGULATORY APPROVAL

A copy of this specification shall be forwarded to the Local Planning Authority (LPA), and other regulators as appropriate for their approval prior to the works.

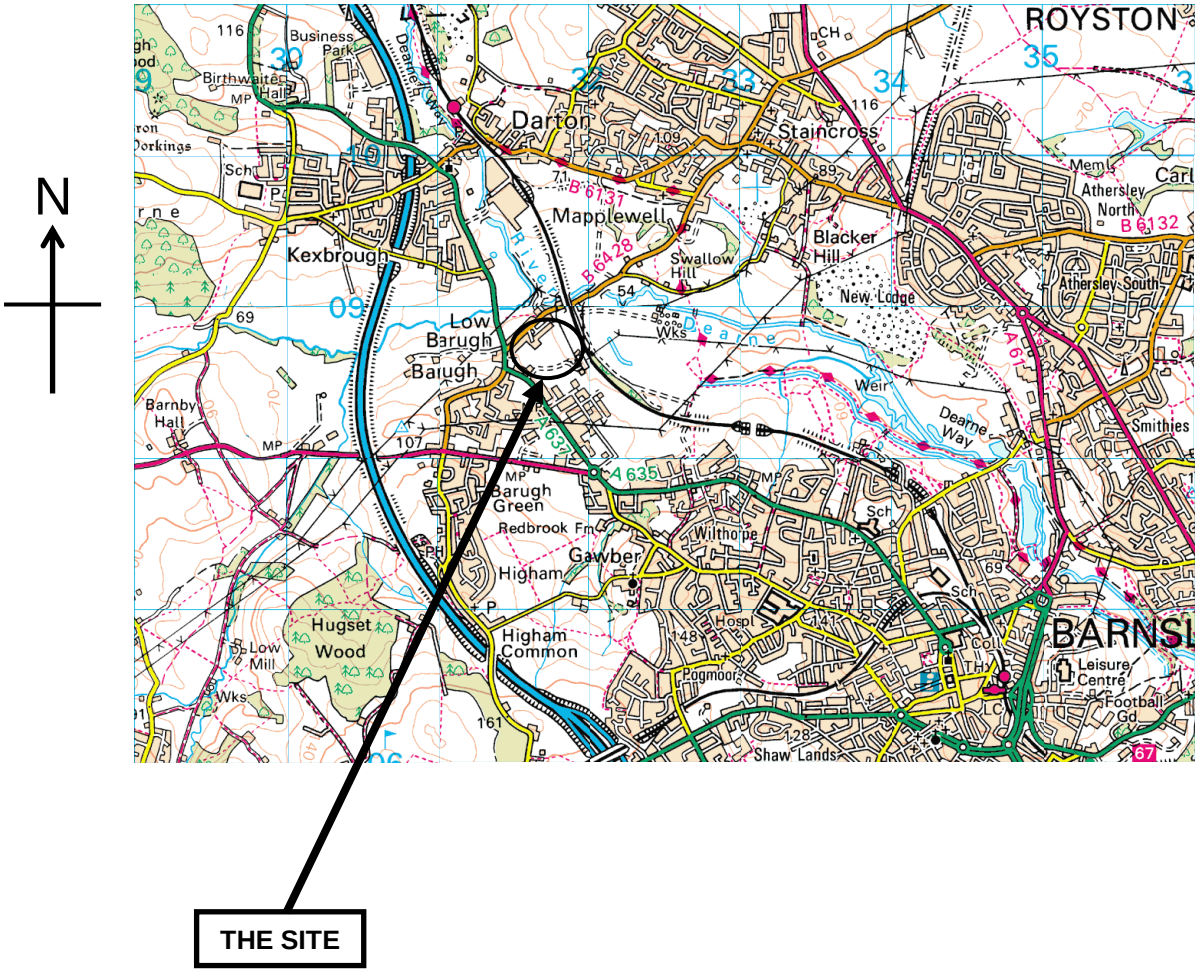
Detailed method statements from the Earthworks Contractor and any nominated subcontractors may also be required to be submitted and approved in writing by the LPA prior to commencement of these works. Sufficient time should be allowed for regulatory approval to be obtained during the development programme.

APPENDIX A

FIGURES AND DRAWINGS

Site Location Plan

Contract Number	**C6054**
Contract	**Barugh Green, Barnsley**
Client	**Barratt and David Wilson Homes (Yorkshire West) Ltd**



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Licence No. 100042005

Scale	1:50,000		
Drawn by	AMG	**Approved**	AMG
Drawing Number	C6054/RS/01		

N

Dearne River
Barugh House Farm
Water Mill Court
A 637
B 6428
Pylon
Drainage ditch
Electricity Substation
Fuel Suppliers / Sales (Coal)
BARNSLEY ROAD
DEARNE HALL ROAD
DEARNE HALL FOLD
Agricultural fields
Railway Line (Embankment)
Overhead Power Lines
Residential
Former Coalite works
ROYAL COURT
Royal Hotel
(PH)
Church
SHAW
Car Park
Residential dwelling and garden
Overhead Power Lines
Transformer Station (former Coke and By Product works and latterly a refuse tip)
MOT Garage
CLAYCLIFFE ROAD
LANGDALE ROAD
HOLMWOOD DRIVE
GRESHAM CROFT
DOVEDALE WAY
Distribution Centre
WHALEY ROAD


View of River Dearne to North


View to North


View to South West


View of waterlogged area - South


View to East - Car Park


MOT Garage (Off-site) - South


Transformer Station (Off-site) - East

NOTES

Current Features

- Area Investigated by Sirius in July 2006
- Site Boundary - Additional Areas (2012)
- Flow Direction
- Slope Direction
- Heavily Waterlogged
- Pond
- Heavily Vegetated (long grass, mature trees and low lying shrubs)
- Area of raised embankment
- Electricity substation

Historical Features

- Area of former railway cutting / embankment
- Location of former depot
- Former reservoir / infilled
- Former route of canal / infilled
- Former well
- Former pond features / infilled
- Former cooling ponds / infilled

All historical feature locations are approximate

REVISION		BY	DATE
0	For Information	AG	18/05/17
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

SIRIUS GEOTECHNICAL & ENVIRONMENTAL
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CLIENT

Barratt and David Wilson Homes (Yorkshire West) Ltd

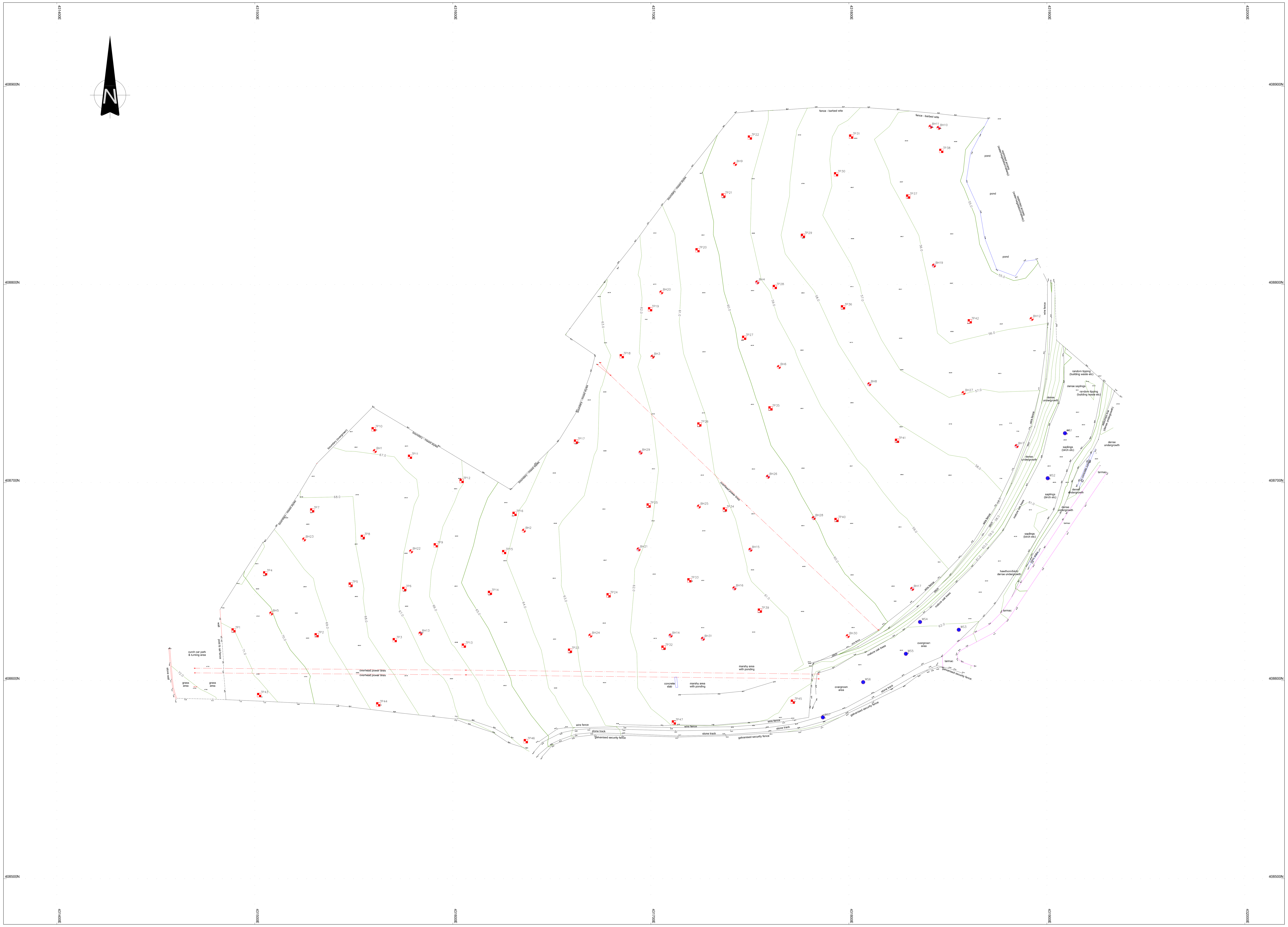
SITE

Barugh Green, Barnsley

DRAWING TITLE

Site Features Plan

DRAWING NO.	REVISION NO.
C6054/RS/02	0
DRAWN BY: AG	APPROVED BY: AG
DATE: May 2017	SCALE: NTS	PAPER SIZE: A1



Midland Surveying & Engineering

Telephone: 01773 811867 Fax: 01773 819736
Email: midsurvey@aol.com

Reference

MH	Manhole - cover level shown
BH	Borehole (with cover plate)
BH	Borehole (no cover plate)
	Trial Hole
EP	Electricity pole
Stay	Pole stay
	Ground Investigation

Co-rdinates and levels are based upon OSGB 1936 National Grid (OSGB36) and Ordnance Survey Datum Newlyn (ODN). They are derived using on site GPS survey, the Active OS GPS Network, the National Grid Transformation OSTN02 and the National Geoid Model OSGM02.

Contours are at 1m intervals.

Site

Dearne Hall Road
Barnsley

Project

Proposed
Development

Plan

Topographic Survey
of
Existinging Site

Scale : 1/1000 Date: 13/07/06

Plan Ref. : HLM/MSE/2625-1

HALLAM LAND MANAGEMENT

Hallam Land Management
Banner Cross Hall
Sheffield
S11 9PD

KEY

- Existing trees to be retained (refer to tree survey & report by JCA Ltd for details)
- Existing trees to be removed
- Existing grassland to be retained
- Proposed Extra heavy standard (14-16cm girth) tree
- Proposed heavy standard (12-14cm girth) tree
- Proposed selected standard (10-12cm girth) tree
- Proposed standard (8-10cm girth) tree
- Proposed light standard (6-8cm girth) tree
- Proposed Beech hedging
  Proposed evergreen flowering hedge (Escallonia)
  Proposed evergreen hedging (Laurel)
- Proposed photinia hedge
- Proposed native hedge
- Proposed mixed species native trees and shrubs
- Proposed mixed species native shrub planting
- Proposed ornamental shrub planting
- Proposed turf
- Proposed grass seed to rear gardens
- Proposed amenity grass seed
- Proposed wildflower grass seed
- Proposed 1800mm high close boarded timber fencing (detailed by others)
- Proposed 1800mm high brick wall / fence (detailed by others)
- Proposed division fence (detailed by others)
- Proposed 1100mm high vertical metal railing (detailed by others)
- Proposed 450mm high timber trip rail (detailed elsewhere)
- Proposed compacted stone footpath (detailed elsewhere)
- Proposed block paving (detailed by others)
- Proposed mounding (maximum 1.5m above prevailing ground levels)

NOTES

PROTECTION OF EXISTING VEGETATION

The majority of the existing trees and scrubby vegetation to the boundaries shall be retained and protected where necessary during the works by 2.3m high metal mesh fencing secured to a scaffold tube framework, all in accordance with BS 5837:2012. The protected area shall remain an exclusion area throughout the construction period and suitable signs shall be fixed to the fencing at no less than 10 metre intervals (or at any change in direction) stating that the area is a tree protection exclusion zone. The fencing shall remain fixed in place through out the construction period. No chemicals or building materials which may potentially contaminate the soil shall be stored within 5metres of the protected area and no bonfires shall be lit within 5m of the canopy spread. In the event that any excavation work is required within the protected area for the erection of garden fencing, for example, this shall be carried out by hand. Where retained vegetation needs to be cut back/ lifted to enable fencing to be erected, this shall be done in accordance with the requirements of BS3998:2010 by qualified and certified tree surgeons and overseen by the consultant Landscape Architect as required.

PROPOSED TREE PLANTING

In order to protect the rural character on the southern and western boundaries, at the new settlement edge, new tree planting will consist of predominantly mixed native species chosen to complement the existing composition as well as be in keeping with the scale of the garden areas. On the northern boundary with Yew Tree Lane, tree planting will be carried out within the front garden areas to the new dwellings to extend the retained line of trees to the south-eastern conner in front of proposed plots 1-3.

Within the site tree planting of ultimately large growing native tree species (or their cultivars) is proposed around the central area of open space. This will, in conjunction with the retained trees and new road frontage and rear garden planting, help to soften the built form and filter views into the site from the south, south-west and north. e, trees will be planted into front gardens to soften the building line and filter views of the development from this aspect.

Trees will be selected from the following indicative but not exhaustive list.

Species to be chosen from:

- Acer campestre (Ac)
- Acer campestre 'Streetwise' (AcS)
- Acer platanoides (Ap)
- Aesculus hippocastanum (Aeh)
- Alnus glutinosa (Ag)
- Alnus incana (Ai)
- Amelanchier lamarkii (Al)
- Betula pendula (Bp)
- Betula pubescens (Bpub)
- Carpinus betulus (Cb)
- Carpinus betulus 'Frans Fontaine' (ChFF)
- Corylus columa (Cc)
- Fagus sylvatica (Fs)
- Malus sylvestris (Ms)
- Pinus sylvestris (Psyl)
- Prunus padus (Ppad)
- Prunus padus 'Albertii' (PpA)
- Prunus serrula (Pse)
- Pyrus calleryana 'Chanticleer' (PyC)
- Quercus robur (Qr)
- Quercus rubra (Qrub)
- Sorbus aria (Sa)
- Sorbus aucuparia
- Sorbus 'Embley' (Se)
- Sorbus 'Joseph Rock' (Sj)
- Tilia cordata (Tc)
- Tilia cordata 'Greenspire' (TGs)
- Tilia x europaea (Txe)

Foundation design of new buildings shall accommodate proposed tree planting in accordance with NHBC guidelines.

LANDSCAPE PROPOSALS TO PUBLIC OPEN SPACE AREA

The proposed Public Open Space (POS) for this development runs around the eastern and southern boundaries of the residential area. This drawing shows the proposals for the whole of the POS southern boundary and part of the proposals for the eastern side of the development. For the remaining proposals on the eastern boundary please refer to FDA drawing nr. R/1667/2.

It is proposed that the existing grassland and woody vegetation be retained along the south and south-east of the POS since this part of the site can remain unaffected by the development. The proposals for the southern area area are ultimately to create a naturalistic landscape into which new blocks of native trees and shrubs are introduced along the residential road to soften the development and provide a transition between the open space and the built form. An informal compacted stone path will provide access though this linear space linking through to the larger area of open space to the east of the development. A mown edge to the footpath will define the route through the space and provide areas for passive leisure and seating. Beyond the mown edge any areas disturbed by the works will be sown with a wildflower meadow grass to complement the existing sward.

PROPOSED TREE PLANTING

In order to protect the rural character of this part of the development, new tree planting will consist of a relatively small palette of native species based on the composition of the existing cover together with a small number of additional native species to increase the biodiversity and habitat vaue of the area. Trees will be planted as either extra heavy standard or selected standard to provide a degree of instant maturity.

Trees will be selected from the following indicative but not exhaustive list.

- Acer campestre (Ac)
- Acer platanoides (Ap)
- Aesculus hippocastanum (Aeh)
- Alnus glutinosa (Ag)
- Alnus incana (Ai)
- Amelanchier lamarkii (Al)
- Betula pendula (Bp)
- Betula pubescens (Bpub)
- Carpinus betulus (Cb)
- Corylus columa (Cc)
- Crataegus monogyna (Cm)
- Fagus sylvatica (Fs)
- Malus sylvestris (Ms)
- Populus nigra (Pn)
- Prunus avium (Pa)
- Prunus padus (Ppad)
- Prunus padus 'Albertii' (PpA)
- Prunus serrula (Pse)
- Quercus robur (Qr)
- Quercus rubra (Qrub)
- Sorbus aria (Sa)
- Sorbus aucuparia
- Tilia cordata (Tc)
- Tilia cordata 'Greenspire' (TGs)
- Tilia x europaea (Txe)

For trees planted near proposed dwellings the foundation design of the new buildings shall accommodate proposed tree planting in accordance with NHBC guidelines.

Rev.C: Amended in line with technical layout G (SEL)	May 17
Rev.B: Amended to latest client layout Rev.E	Dec 15
Rev.A: Amended to latest client layout	Sep 15

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client: Barratt Homes Yorkshire West

project: Residential Development
Low Barugh, BARNSLEY

drawing title: LANDSCAPE MASTERPLAN

scale	date	drawn by	drawing
1:500	Dec. 2014	EW/JT	R/1667/1B-1

NEW SURFACE WATER HEADWALL OUTFALL TO RIVER DEARNE WITH A RESTRICTED FLOW RATE OF 12.3LIT/SEC. RIGHTS TO CONSTRUCT SEWER OUTFALL THROUGH THIRD PARTY LAND TO BE GRANTED PRIOR TO WORK COMMENCING. INVERT LEVSL OF EXISTING SEWERS TO BE CONFIRMED ON SITE PRIOR TO WORK COMMENCING. ANY DISCREPANCIES TO BE REPORTED.

WHERE PROPOSED SURFACE WATER CROSSES PUBLIC SEWERS, EXISTING INVERT LEVELS TO BE CONFIRMED ON SITE. ANY DISCREPANCIES TO BE REPORTED.

Millers Inn (PH)

2 No. BOLLARDS ADDED TO END OF ROAD 1B. REFER TO HHA Drwg E14/6120033-08 FOR DETAILS

River Dearne

B 6428

Weir

Water Mill Court

60.1m

63.3m

96.8m

BARNSLEY ROAD

DEARNE HALL ROAD

DEARNE HALL FOLD

B 6428

ROYAL COURT

Church

Garage

El Sub Stn

Sub Station

NEW DALLYS TO UTILISE EXISTING DAILY CONNECTIONS INTO EXISTING SEWER WHERE POSSIBLE

HYDROBRAKE MODEL: SHE-0165-7290-4200-1230 FITTED TO S17 HEAD: 1.2m MAX FLOW: 12.3l/sec

FLOOD ZONE

POST & RAIL FENCING TO REAR OF PLATEAU REQUIRED WHERE EMBANKMENT IS GREATER THAN 1m HIGH

EXISTING TREE TO BE REMOVED

700D Land drain to connect into existing 300D culvert

PROPOSED FOUL WATER SEWER TO CONNECT INTO EXISTING 3.0m DIAM COMBINED SEWER ALONG DEARNE HALL ROAD. LOCATION AND INVERT LEVEL OF EXISTING SEWER TO BE CONFIRMED ON SITE PRIOR TO WORKS COMMENCING. ANY DISCREPANCIES TO BE REPORTED. EXISTING MANHOLE MUST BE INSPECTED BY A 'VX' INSPECTOR TO ENSURE THAT THE MANHOLE CAN ACCOMMODATE THE NEW CONNECTION AND CHECK IF ANY REMEDIAL WORKS ARE REQUIRED PRIOR TO STARTING ON SITE (IT MAY BE NECESSARY TO RECONSTRUCT THE MANHOLE AT THE CLIENTS EXPENSE).

NEW FLOOD COMPENSATION AREA FORMED WITH 1:6 SLOPES, 0.6m MIN DEPTH, MIN 740m³ VOLUME REQUIRED.

HYDROBRAKE MODEL: SHE-0153-6000-2300-8000 FITTED TO S13 HEAD: 2.3m MAX FLOW: 8l/s/sec

40m MIN STAND OFF DISTANCE TO EXISTING POND

Pond

Ward Bdy

ETL

Secondary Pond

Drain

PROPOSED DETENTION BASIN TO CATER FOR MAX 2000m³ OF SURFACE WATER STORAGE. TWL 1 in 2yr: 56.149m TWL 1 in 30yr: 56.889m TWL 1 in 100yr: 57.125m TWL 1 in 100yr +30%: 57.418m

ROAD 1 ROAD 1A ROAD 1B ROAD 2 ROAD 3 ROAD 3A ROAD 4 ROAD 5 ROAD 5A ROAD 6

Haigh Huddleston & Associates

Civil Structural Engineering Consultants

Firth Buildings, 99 - 101 Leeds Rd, Dewsbury, WF12 7BU t 01924 464342 f 01924 450662

e trevor.haigh@haighhuddleston.co.uk

Client
BARRATT DAVID WILSON HOMES

Project
DEARNE HALL ROAD, LOW BARUGH

Detail
ROAD & SEWER ENGINEERING PLAN

Dwn	Chkd	Date	Scale	Dwg No.
HH		DEC-16	1:500@A0	E14/6120/003

APPENDIX B

SIRIUS SPECIFICATION FOR ENGINEERED FILLS

SPECIFICATION C6054-EF
MAY 2017

SPECIFICATION FOR ENGINEERED FILLS

For land at
BARUGH GREEN, BARNSLEY

prepared for
BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

REPORT NUMBER:	C6054-EF	**REPORT STATUS:**	FINAL
REPORT TYPE:	SPECIFICATION FOR ENGINEERED FILLS		
REPORT DATE:	MAY 2017		
SITE:	LAND AT BARUGH GREEN, BARNSLEY		
PREPARED FOR:	BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD		
PREPARED BY:	SIRIUS GEOTECHNICAL LTD 4245 PARK APPROACH THORPE PARK LEEDS LS15 8GB	Tel: 0113 264 9960 Fax: 0113 264 9962	

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SPECIFICATION FOR ENGINEERED FILLS

of land at

BARUGH GREEN, BARNSLEY

Prepared for

BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

CONTENTS

1.0 Site Description/ General Information 1
2.0 Preamble to Specification 3
3.0 Engineered Fill 4
4.0 Type of Compaction Specification 6
5.0 End Product Compaction 6
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7.0 Compaction Site Trials 7
8.0 Preparation of Site 9
9.0 Deposition of Fill 10
10.0 Placing and Compacting Fill 11
11.0 Control of Compaction and Testing 13
12.0 Monitoring of Fill Performance 14

APPENDICES

APPENDIX A MCHW Tables 6/1, 6/2 & 6/4

APPENDIX B Table 1: Testing to be carried out by the Contractor

1.0 Site Description/ General Information

1.1 The site covers an area of approximately 9.9 hectares and is irregular in shape, measuring approximately 400m from east to west and approximately 380m from north to south. Ground levels generally slope downward from elevations of approximately 72m AOD in the south west to approximately 55m AOD in the north-east.

1.2 The site is generally occupied by open fields, with waterlogged rough grassland located in the south-east with a pond in the north-east. Land adjacent to the pond was also waterlogged.

1.3 An embankment, generally ranging between 2m to 4m in height, is located in the south-east of the site. This embankment was recorded as being heavily vegetated with semi-mature trees and low lying shrubs.

1.4 An unoccupied residential property with a private garden (No.1 Claycliffe Road) and an adjoining gravel surfaced car park is located within the south-western corner of the site.

1.5 It is understood that Barratt and David Wilson Homes (Yorkshire West) Ltd propose to redevelop the site for a residential end-use comprising 170 No. low-rise residential properties with private gardens and associated infrastructure.

1.6 With regard to adoptable roads, in order to minimise the risk of any future settlements, it is generally proposed to excavate made ground below areas of proposed highways to a depth of 2.0m below finished road level or 0.5m below invert level of drainage, whichever is deeper, and to re-engineer with suitable site-won materials to a finished remediated formation of 0.5m below finished road level. Exceptions to this are in the vicinity of the proposed new junctions with Barnsley Road at the south-western corner of the site and the new junction within Dearne Hall Road at the northern end of the site, where deep made ground has been identified as a result of backfilling of former rail cutting / canals. Detailed proposals for improvement of existing made ground below the adoptable highway at these locations will be agreed with the local authority and issued under separate cover.

1.7 Outside the footprint of proposed highways, cut and fill earthworks shall be undertaken to achieve formation levels, including the construction of an attenuation basin in the east of the site.

1.8 For highways, formation levels will generally be set 500mm below proposed finished road level.

1.9 For development plots, formation levels will generally be set:

- 300mm below finished floor levels where clean natural soils / re-worked natural soils are present; or

- 750mm below finished floor levels where contaminated made ground is present (e.g., former rail cutting in the southern part of the site) to accommodate placement of a 600mm clean cover layer.

1.10 Earthworks are to be prepared to a contoured surface, rather than plot specific steps, which would likely deteriorate through the development process. Tolerance for the earthworks would be +/-50mm.

1.11 Information from previous site investigation works by Sirius indicates ground conditions to generally comprise reworked topsoil over granular and cohesive made ground. Natural superficial deposits generally comprise medium and high strength slightly silty clay with occasional gravel and cobbles of mudstone, sandstone and coal with localised bands of medium dense and dense gravelly sand / sandy gravel.

1.12 An area of soft, low strength alluvial clay was recorded in the north of the site to a maximum proven depth of 4m below ground level (m bgl).

1.13 Underlying solid geology comprises Pennine Middle Coal Measures mudstone and sandstone at depths of between 0.8m and 5.4m bgl. Treatment of shallow underground coal mineworkings is to be undertaken in accordance with a Coal Authority *'Permission to Enter or Disturb Coal Authority Mining Interests'* and is detailed under separate cover.

1.14 Based upon the findings of previous investigations, it is considered that the cohesive made ground and natural subsoils will generally be classified as Class 2 engineering fills, in accordance with the Highways Agency '*Specification for Highway Works'*, Volume 1 of the Manual of Contract Documents for Highway Works (MCHW), November 2009. Such soils are susceptible to changes in moisture content. Should the as dug moisture content / prevailing weather conditions jeopardise the fill materials and indicate that the compaction requirements of this Specification (as detailed within Sections 5 and 6) may not be achieved, then modification / stabilisation works may be required to improve the geotechnical properties of cohesive fills.

1.15 Granular made ground and natural subsoils were not identified as widespread by the previous site investigations. Furthermore, where predominantly granular materials were identified, they were generally described as 'slightly clayey' or 'clayey' and could therefore be classified as either Class 1 granular fills or Class 2 cohesive fills in accordance with the '*Specification for Highways Works'.*

2.0 Preamble to Specification

2.1 This specification is intended to be used in connection with the construction of low-rise residential buildings and highways on engineered fill. The specification is considered to be suitable for most purposes but there may be special conditions existing at some sites which are not treated in this document and which should be taken into account in arriving at a properly engineered fill. It is emphasised that clay fills can be at least as susceptible to settlement or heave due to climatic, vegetation or other effects, as naturally occurring cohesive soils.

2.2 This specification is for contracts which are designed and supervised by Sirius.

2.3 With respect to materials sourced from within the site, a site investigation has been undertaken to provisionally classify cut materials prior to the commencement of the works. The Geotechnical Engineer shall request supplementary testing to enable satisfactory classification of materials in accordance with Table 6/1 and 6/2 appended to this specification. Notwithstanding the above, compaction of materials shall not take place until the classification of materials is confirmed.

2.4 In the event materials are to be imported to site, the Contractor is required to refer to Table 1, Appendix B of this Specification. Compaction of materials imported to site shall not commence until classification of materials in accordance with Table 6/1 has taken place to the Geotechnical Engineer's satisfaction.

2.5 Note should be taken of the requirements of the Construction (Design and Management) Regulations: 2015 to the extent that they may be relevant to the works.

2.6 This specification has been prepared by Sirius and is based on the Highways Agency 'Specification for Highway Works', Volume 1 of the Manual of Contract Documents for Highway Works (MCHW), November 2004 (as amended), as described in the following sections.

3.0 Engineered Fill

3.1 Engineered fill is defined as fill which is selected, placed and compacted to an appropriate specification so that it will exhibit the required engineering behaviour.

3.2 Grading limits for the most common types of general fill are presented in Table 6/1 and Table 6/2 which is appended to this specification.

3.3 Fill shall be clearly categorised into those materials which are 'suitable' and those which are unsuitable for incorporation into the works. The following four categories shall be used:

- Unsuitable fill.
- General fill.
- Restricted fill.
- Special fill.

Note: material classifications are as defined within MCHW Volume 1, Tables 6/1 and 6/2.

3.4 *Unsuitable Fill (U1 and U2)*

3.4.1 Unsuitable fill shall comprise any material so designated by the Geotechnical Engineer and shall include:

- Cohesive soils having a liquid limit in excess of 90% or plasticity index in excess of 65%.
- Chalk having a fine faction (<400μm) in excess of 10%.
- Any material containing topsoil, wood, peat or lignite.
- Any material with a biodegradable content.
- Any materials containing scrap metal.
- Frozen or waterlogged substances.
- Material defined as unsuitable by the Engineer because of its type or level of contamination.
- Material which, by virtue of its particle size or shape, cannot be properly and effectively compacted (e.g. oversize material, gravels which are tabular and some slate wastes).
- Expansive steel slag.

Unsuitable fill shall not be used at any structurally load bearing location but may be used under public open space with the specific agreement of the Engineer. The final placed location of any unsuitable fill shall be shown on the as-built drawings.

3.5 *General Fill (Classes 1 A, B and C & 2 A, B, C and D)*

3.5.1 General fill shall comprise all fill except unsuitable fill, restricted fill and special fill. The majority of fill on site will probably be classified as general fill.

3.6 *Restricted Fill*

3.6.1 Restricted fill shall comprise material which would otherwise be classified as general fill but which contains materials hostile to the built environment and shall include:

- Pyritic shales.
- Gypsiferous clays.
- Burnt colliery discard.
- Pulverised fuel ash.
- Steel slag.
- Spent oil shale.
- Incinerator waste.
- Some demolition and construction industry waste, at the discretion of the Geotechnical Engineer.

3.6.2 Such fill shall be precluded from use in designated zones, or may be exported from site in lieu of backfilling with more suitable materials. Such zones will be agreed with the Geotechnical Engineer prior to remedial earthworks, including locations where groundwater may rise to the level of the underside of the deepest foundation and where its use will be condemned by the appropriate authorities on pollution or engineering grounds. Such fill shall not be placed to a depth less than one metre from the underside of the deepest foundation.

3.7 *Special Fill (6 A, B and C and 6F 1, 2, 3 and 5)*

3.7.1 Special fill shall comprise material which would otherwise be classed as general bulk fill, but which contains durable well graded natural sand and natural gravel or crushed rock, other than argillaceous rock, or durable clean crushed demolition rubble of similar particle size and free from any contaminants.

4.0 Type of Compaction Specification

4.1 Dependant on material type and the ability to perform laboratory classification tests, such as dry density moisture content relationship testing, the fill shall be compacted to either an end product specification or a method specification.

5.0 End Product Compaction

5.1 End product compaction should be used for all material classified as cohesive general fill and for specific special fills.

5.2 For end product compaction, a graph should be produced which shows dry density plotted against moisture content for each compaction test, the corresponding optimum moisture content and maximum dry density and 0%, 5% and 10% air voids lines (air voids to be related to the determined particle density of the soil tested).

5.3 The required level of compaction will be indicated by selecting appropriate moisture content and dry density values. This level of compaction shall form the basis of the end product compaction specification. As a minimum, compaction shall achieve >95% relative compaction (when compared to the 2.5kg compaction test) and <5% air voids. These criteria shall be met to establish acceptable levels of compaction.

5.3 Should a higher level of compaction be required, then consideration could be given to undertaking stabilisation works to improve the geotechnical properties of cohesive fills.

Note: Fills with a significant proportion of coarse particles present a problem for determination of acceptability criteria, as these soils often prove inappropriate for either laboratory testing or in-situ density determination. A compaction site trial may be required to be carried out for these materials, combined with an experience based approach to allow the Geotechnical Engineer to determine the most appropriate method for testing and management of the fill. The expert advice of the Geotechnical Engineer should be sought as required.

6.0 Method Compaction

6.1 Method compaction should be used for all materials classified as granular general fill, for specific special fills and for cohesive general fill with a significant proportion of coarse particles. When method compaction is used, site trials shall be carried out to confirm the effectiveness of the prosed method(s).

6.2 A separate compaction trial shall be carried out for each class of fill to be used on the site.

6.3 Crushed product derived from the screening and crushing of relict foundations, concrete slabs and oversize materials, should yield good quality granular Class 6F1 and 2 graded materials (125mm to dust) which, at the discretion of the Geotechnical Engineer, does not require a site trial to confirm the method specification for its compaction and the method given in Table 6/1 of MCHW Volume 1, which is appended to this specification can be adopted.

7.0 Compaction Site Trials

7.1 Notwithstanding the requirements of Clause 612 and sub clause 6 of the MCHW Volume 1, the following shall form an addendum to the aforementioned Clause.

7.2 Sufficient quantities of each type of material shall be excavated and screened of deleterious material to lay a 10m x 4m x approximately 0.25m thick trial pad on a previously rolled horizontal area of the site. Any soft spots in the subgrade below the trial pad should be removed and replaced with compacted granular material. A guide to the thickness of layer that may be suitable may be obtained from Table 6/1 appended to this specification.

7.3 The trial shall be conducted using the same compaction plant as is proposed for the main compaction works. A guide to the size and type of plant that may be suitable may be obtained from MCHW Table 6/4 appended to this specification.

7.4 The bulk density and moisture content of the fill in the trial pad shall be determined by sand replacement test (granular) or clay corecutter (cohesive) and oven-drying in two locations immediately after placement and spreading by the dozer but before any rolling. Use of nuclear density gauges may be permitted if conditions allow.

7.5 Bulk density and moisture content determinations shall be carried out at different locations after subsequent passes by the roller to give density and moisture content determinations after 2, 4, 6, 8 and 10 passes of the roller.

Note: This will give a total of ten tests for each material.

7.6 Two laboratory determinations of particle density, grading and Atterberg limits/ remoulded shear strength (if applicable), shall be carried out for each type of material.

7.7 The graph of dry density against number of passes shall be drawn and the number of passes required to achieve maximum dry density in the field trial shall be determined.

7.8 As a guide, the number of passes derived in 7.5 above should be equal to or greater than the number derived from Table 6/4 appended to this specification. The number of passes derived from the site trial shall form the method specification for site compaction of that type of material at the in situ moisture content.

7.9 If it is required to calibrate a Nuclear Density Meter (NDM) then measurements of bulk density and moisture content shall be made using the NDM at locations adjacent to those carried out by sand replacement tests or corecutter samples, depending on material type, in Section 7.4.

7.10 If the source for the fill materials alters, and a new material is therefore proposed for use, then a site trial shall be performed on this material to demonstrate that it can be compacted satisfactorily before this material is used in the works.

8.0 Preparation of Site

8.1 Drainage grips or trenches shall be excavated, as necessary, uphill of the area to be filled to prevent the area becoming flooded. Drainage shall be affected without causing siltation or erosion and water shall be disposed of in a manner to be agreed with the Geotechnical Engineer.

8.2 The area to be filled, whether an existing excavation or otherwise undisturbed ground, shall be graded to falls, and sump pumping or other suitable dewatering facilities shall be provided as necessary by the Contractor to keep the base of the excavation dry at all times.

8.3 Where the area to be filled comprises an existing excavation, the excavation shall be inspected and subsequently monitored by the Contractor, to ensure that there is no danger of collapse during the works with consequences for safety, for existing buildings or for other construction adjoining.

8.4 All topsoil present shall be stripped and, where required for further use, stockpiled in an area provided by the Contractor and agreed by the Geotechnical Engineer.

8.5 All soft and compressible soils or existing fill shall be removed and run to spoil in dumps provided by the Contractor and agreed by the Geotechnical Engineer. The works shall be accomplished in such a way that there is no undercutting of the sides of existing excavations.

8.6 Existing foundations or ledges of hard rock, roots of trees or former pipelines or services at the base of the area to be filled shall be excavated and replaced with compacted general fill which shall be compacted to the same specification as adopted for subsequent compaction works.

Note: *No tree roots greater than 5mm diameter, no root balls and no masses of fibrous roots shall remain at the base of the excavation.*

8.7 The base of the area to be filled shall be proof rolled with a dead weight roller and all soft materials replaced with compacted fill. Where unsuitable material has been excavated, the underlying natural ground shall be compacted to the same specification as adopted for subsequent compaction works.

9.0 Deposition of Fill

9.1 Where construction is required upon fill placed over sloping natural ground, and where fill thickness is less than 5m, the adjacent ground shall be benched, with the maximum vertical height of each bench not exceeding 500mm and providing that the fill depth below any building does not vary by more than 15%.

9.2 It is anticipated that the greatest depth to natural ground is likely to be encountered in the south-west of the site, within the footprint of a former railway embankment. The maximum recorded depth to natural ground, encountered in previous investigations in this area, was 5.4m below original ground level.

9.3 Where, because of the current method of working, previously engineered fill placed during the current works has to be benched as in Section 9.1 to allow new fill to be placed adjacent to it, then the benches only require to be 0.5m high by 1.0m wide, even where these occur beneath buildings providing that the fill is the same material throughout the building.

9.4 Where a development contains landscaped areas on which no structures are proposed, the underlying fill shall be selected, placed and compacted in the same way as the engineered fill, unless otherwise directed by the Geotechnical Engineer. Where some relaxation of the specification for fill compaction underlying landscaped areas is permitted, there shall be a transition zone between the fill underlying the landscaped area and the fill underlying the structure. The dimensions of the transition zone will depend on the degree to which fill compaction was relaxed for the fill in the landscaped area. The location and extent of fill placed to a reduced standard of compaction shall be recorded.

10.0 Placing and Compacting Fill

10.1 Clause 612 of MCHW Volume 1 applies. However, where there is conflict with the Clauses below, Clauses from this specification shall take precedence over Clause 612.

10.2 Fill shall be placed and compacted in the near-horizontal layers of the thickness required to achieve the specified end product or in accordance with the approved method specification, and shall, as far as practicable, be brought up at a uniform rate so that all parts of the site or particular sections of the site reach finished (formation) level at the same time.

10.3 The compaction plant selected, the number of passes made and the fill layer thickness and moisture content used shall have regard either to the specified end product and the means and manner of control testing or the specified method and the means and manner of control testing.

10.4 Where different types of fill material (all meeting the requirements of Section 3 of this specification) are to be employed, they shall be deposited in such a way that all parts or particular sections of the site receive roughly equal amounts of a given material, in roughly the same sequence, thus ensuring a uniform distribution of fill types over the whole fill thickness.

10.5 The Contractor shall take all necessary steps to ensure that the fill is placed at the moisture content necessary to achieve the specified level of compaction and shall, where necessary, add water to or dry the fill, in order to obtain this value. Where it is necessary to add water, this shall be done as a fine spray and in such a way that there is time for the water to be absorbed into the fill before being rolled by the plant.

10.6 Cobbles, boulders, rock or waste fragments, the largest dimension of which is greater than two-thirds of the compacted layer thickness, shall not be incorporated into the fill.

10.7 No fill shall be placed and left uncompacted at the end of the working day. Compacted fill shall be graded to falls to ensure free run-off of rainwater without ponding.

10.8 Compaction plant and compaction method shall be selected having regard to the proximity of existing trenches, excavations, retaining walls or other structures and all work shall be performed in such a way as to ensure that their existing stability is not impaired.

10.9 If weather conditions are such that the specified moisture content and density values cannot be achieved, the Contractor shall cease work until such time as the fill can be placed and compacted to meet specification requirements. Alternatively, measures to improve soil performance, such as soil stabilisation, may be required.

10.10 If the results of control tests (Section 11) indicate that the fill is being placed and compacted in such a way that the desired level of compaction is not being achieved, the Contractor shall further compact or, if necessary, shall excavate the affected work and replace with new fill, compacted to meet the specification requirements.

10.11 If the results of control tests (Section 11) indicate that antecedent weather conditions (such as frost or heavy rain) have caused the deterioration of finished work such that the work no longer meets with the specification, the Contractor shall, at his or her own cost, take such steps as are necessary to bring the fill to specification requirements.

11.0 Control of Compaction and Testing

11.1 Compaction will usually be controlled by visual supervision of the works by the Geotechnical Engineer and by testing.

11.2 Testing of end product compacted materials shall be in accordance with the schedule provided in Table 1, Appendix B and as follows:

- Moisture content and in-situ density determinations shall be performed as soon as it is practical after placement,
- Control tests shall be performed by the Geotechnical Engineer throughout the fill at such frequency and at such locations as shall be deemed necessary by the Geotechnical Engineer.
- The minimum frequency of testing shall be as indicated within Table 1. Extra testing will be required in visually doubtful areas or previously failed areas.

11.3 The method specification requirements shall be in accordance with the schedule provided in Table 1 and as follows:

- Moisture content determinations.
- The minimum frequency of testing shall be as shown within the schedule in Table 1. Extra testing will be required in visually doubtful areas or previously failed areas.
- Control tests shall be performed by the Geotechnical Engineer throughout the fill at such frequency and at such locations as shall be deemed necessary by the Geotechnical Engineer. In this instance, it is likely that method compaction shall be employed on granular cut materials. Control tests on method compacted fill shall comprise deformation type tests such as plate bearing tests (using minimum 600mm diameter plate) and TRL dynamic cone penetrometer tests.

11.4 For end product compaction, for example on cohesive materials, the Geotechnical Engineer shall make available a plot of in situ dry densities against in situ moisture content results. Should any results indicate inadequate compaction (i.e. >5% air voids or <95% relative compaction, the Contractor shall agree with the Geotechnical Engineer proposals for rectifying the existing situation and for improving future performance.

11.5 The compacted layer thickness shall be checked regularly by the Geotechnical Engineer.

11.6 The numbering system to be adopted for Quality Control testing shall be decided by the Geotechnical Engineer at the start of works. The system adopted shall enable the location of each test to be identified in the works i.e. plan location and level beneath final formation level. The date of the test shall also be included. e.g. Plot 24/1.2/25May would

indicate a test under Plot 24 at a depth of 1.2m below final formation level carried out on 25th May. The testing laboratory shall be informed of the number of each test they perform and shall report that number on the results sheet.

12.0 Monitoring of Fill Performance

12.1 If instructed by the Geotechnical Engineer, the Contractor shall make arrangements for monitoring the performance of the fill, once placed. Monitoring may take one or more of the following forms:

- Optical levelling of surface monuments.
- Standpipes or piezometers.
- Load tests.
- Other methods as directed by the Geotechnical Engineer.

12.2 The Contractor shall, within twenty-one working days of receiving notification of the Geotechnical Engineer's intention to monitor fill performance, arrange for the procurement and supply of the equipment to the Geotechnical Engineer's written specification and shall inform the Geotechnical Engineer of the date on which the equipment installation shall commence. The specification shall include:

- A full description of the nature and type of instrument and the purpose it fulfils.
- The number required and the locations and/or depths at which it is to be installed.
- The frequency, accuracy and duration for which any readings are to be taken.

APPENDIX A

SERIES 600 TABLES

Table 6/1: (05/04) **Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes)**

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirement on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
GENERAL GRANULAR FILL	1	A	-	Well graded granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) and (iv) in next column, shall not apply chalk), recycled aggregate	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	1	A	-
							(ii) uniformity coefficient	See Notes 5	10	-				
							(iii) mc	BS 1377: part 2	TBC	TBC				
	1	B	-	Uniformly graded granular material	General Fill	Any material, or combination of materials, other than chalk and material designated as Class 3 in the Contract, recycled aggregate	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	1	B	-
							(ii) uniformity coefficient	See Note 5	-	10				
							(iii) mc	BS 1377: part 2	TBC	TBC				
	1	C	-	Coarse granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) in next column, shall not apply chalk), recycled aggregate	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 5	1	C	-
							(ii) uniformity coefficient	See Note 5	5	-				
							(iii) Los Angeles coefficient	Clause 635	-	50				

Table 6/1: (05/04) **Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)**

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirement on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
GENERAL COHESIVE FILL	2	A	-	Well cohesive material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) (iii) lower limit and (iv) in the next column, shall not apply chalk)	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Method: Tab 6/4 Tab 2 End product: ≥95% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method) and a dry density corresponding to ≤5% air voids.	2	A	-
							(ii) Plastic limit (PL)	BS 1377: part 2	-	-				
							(iii) mc	BS 1377: part 2	PL – 4%	PL +4%				
							(iv) undrained shear strength of remoulded material	Clause 633	50 kN/m^2	-				
	2	B	-	Dry cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Method: Tab 6/4 Tab 2 End product: ≥95% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method) and a dry density corresponding to ≤5% air voids.	2	B	-
							(ii) Plastic limit (PL)	BS 1377: part 2	-	-				
							(iii) mc	BS 1377: part 2	PL – 4%	PL +4%				
							(iv) undrained shear strength of remoulded material	Clause 633	50 kN/m^2	-				
	2	C	-	Stony cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Method: Tab 6/4 Tab 2 End product: ≥95% of maximum dry density of BS 1377 : Part 4 (2.5 kg rammer method) and a dry density corresponding to ≤5% air voids.	2	C	-
							(ii) plastic limit (PL)	BS 1377: part 2	-	-				
							(iii) mc	BS 1377: part 2	App 6/1	App 6/1				
							(iv) Undrained shear strength of remoulded material	Clause 633	50 kN/m^2	-				

Table 6/1: (05/04) **Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued)**

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirement on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
SELECTED GRANULAR FILL	6	F	1	Selected granular graded material (fine grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil argillaceous rock and chalk. Recycled aggregate	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	1
	6	F	2	Selected granular graded material (coarse grading)	Capping	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock. (property (i) in next column shall not apply to chalk.) recycled aggregate	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	2

APPENDIX B

TESTING TO BE CARRIED OUT BY CONTRACTOR

APPENDIX B

EARTHWORKS TESTING TO BE CARRIED OUT BY THE CONTRACTOR AND REQUIREMENTS FOR CLAUSE 612 COMPACTION OF MATERIALS

1.0 Testing required by the Geotechnical Engineer (GE) to be carried out by the Contractor to assess compliance with the Sirius Specification for Engineered Fill is listed in this Appendix.

2.0 The Contractor shall allow in his rates for the testing listed. Where test certificates are identified these shall be produced prior to the incorporation of that item into the Works.

3.0 The base of the excavation shall be recorded accurately prior to placement of engineered fill and subsequent testing. The extents of any benching shall also be recorded accurately.

4.0 Each in situ geotechnical test location should also be accurately recorded by the GE.

5.0 Notes:

1 (U) indicates that a UKAS test report or certificate is required.

2 Unless otherwise shown in this Appendix tests and certificates for work, goods or materials as scheduled under any one Clause are required for all such work, goods or materials in the Works.

Table 1: Testing to be carried out by Contractor and requirements for Clause 612 compaction of materials

Clause	Work, Goods or Material		Test	Frequency of Testing	Test Certificate	Comments
601, 631 to 637, 640	Acceptable material					
	Class	General Description				
	1	General granular fill	Grading/uniformity coefficient (U)	1 every 2000m³	Required	UKAS Accredited Laboratory Results to be cross referenced by GE with Table 6/1 in Appendix A
			mc (natural) (U)			
		1C only	Los Angeles Coefficient (U) **OR** 10% fines value (U)	Each sub class of material		
	2	General cohesive fill	Grading (U)	1 per 2000m³	Required	UKAS Accredited Laboratory Results to be cross referenced by GE with Table 6/1 in Appendix A
			mc (natural) and LL & PL (U)			
			Undrained shear strength of remoulded material at natural moisture content	Each sub class of material		
			Dry density/mc relationship (2.5kg rammer) (U) Particle density (U)	Each sub class of material.		
	6F Graded	Selected granular fill	Grading (U)	1 every 2500m³	Required	UKAS Accredited Laboratory. Results to be cross referenced by GE with Table 6/1 in Appendix A

Note:- Should Class 6F graded fill be utilised within the construction of adoptable highways, then further testing may be required by Barnsley Metropolitan Borough Council's Highways Department.

Table 1: Testing to be carried out by the Contractor and Clause 612 compaction of materials (continued)

Clause	Work, Goods or Material		Test	Frequency of Testing	Test Certificate	Comments
612	Compaction of fills					
		Method compaction	Plate load tests using 600mm diam plate (U)	At approx. 25m centres along all adoptable highways and on completed infilled formation	Required	GE to review results relative to recorded settlement. Testing to be undertaken on highway formation and on completed infilled formation. CBR to be calculated for tests on highway formation
			TRL dynamic cone penetrometer	At an approx. rate of one per 900m^2 and on approx. every second layer. At approx. 25m centres along all adoptable highways and on completed infilled formation.		Tested in-situ by the GE (or his nominated appropriate person) after compaction. CBR to be calculated. Testing to be undertaken on highway formation and on completed infilled formation.
		End product compaction	Field dry density (U) (by calibrated nuclear density gauge, sand replacement test or core cutter as appropriate)	1 per 2,500m^2 and on every second layer.	Required	Results to be plotted by GE to establish relative compaction and air voids content
			Undrained shear strength (U) (cohesive only)	Daily hand vanes at a rate each lift of one per 500m^2.		Tested in-situ by GE after compaction
			Plate load tests using 600mm diam plate (U)	Approx. 25m centres along all adoptable highways.	Required	GE to review results relative to recorded settlement. Testing to be undertaken on highway formation. CBR to be calculated.
			TRL dynamic cone penetrometer	Approx. rate of one per 900m^2 and on approx. every second layer.		Tested in-situ by the GE (or his nominated appropriate person) after compaction. CBR to be calculated. Testing to be undertaken on highway formation and on completed infilled formation.

Note: Each in situ geotechnical test location should also be accurately recorded by the GE.

APPENDIX C

SIRIUS GAC VALUES

SIRIUS GENERIC ASSESSMENT CRITERIA

Context

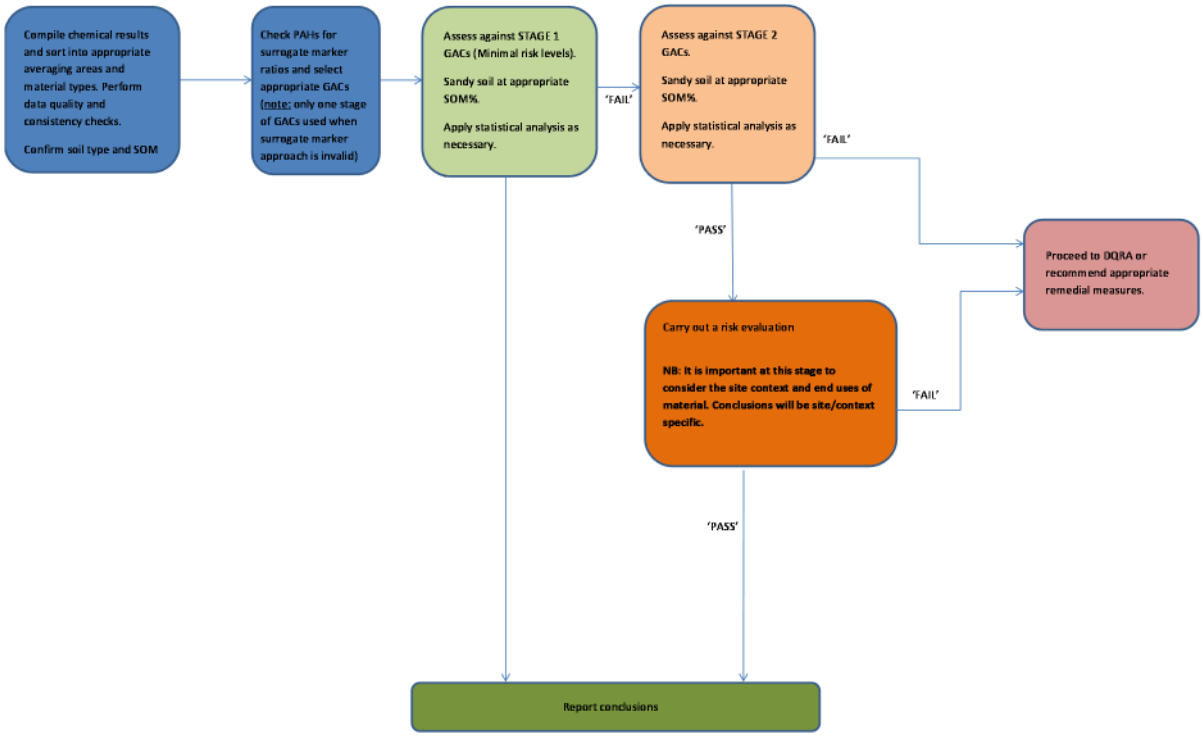
The framework for conducting site investigations, risk assessments and undertaking any necessary remedial works in the UK is provided by Environment Agency report CLR11 "Model Procedures for the Management of Contaminated Land". This presents a phased approach to risk assessment, involving: identification and qualitative assessment of potential pollutant linkages (source-pathway-receptor relationships) by means of a Conceptual Site Model; Generic Quantitative Risk Assessment (GQRA) of potentially significant pollutant links by comparing contaminant concentrations with appropriate Generic Assessment Criteria (GAC) values; and, if required, a Detailed Quantitative Risk Assessment (DQRA) based on site-specific conditions.

Assessment of Risk to Human Health

Introduction

A staged approach to GQRA has been adopted by Sirius for the evaluation of soil concentration data, as shown schematically in Figure 1.

Figure 1. GQRA Process.



The first stage of GQRA comprises assessment of the data against GAC values derived using toxicological parameter values based on "minimum risk". Any contaminants exceeding their GACs at this stage are further assessed against Stage 2 GACs, which have been derived using Low Level of Toxicological Concern (LLTC) criteria, where these are available.

With appropriate justification, a contaminant concentration that does not exceed the relevant Stage 2 GAC value may be considered to indicate that the land is "suitable for use". The appropriate use of LLTC-based criteria within the planning regime is considered reasonable by government agencies, as most recently highlighted in the letter (dated 3rd September 2014) to all local authorities from Lord de Mauley, Parliamentary Under Secretary at DEFRA.

A narrative "risk evaluation" must therefore accompany any Stage 2 assessment to justify the conclusions drawn. Where appropriate, this may provide a basis for eliminating from further consideration those contaminants whose concentrations do not exceed the applicable Stage 2 GAC value.

For the specific case of lead, the Category 4 Screening Level criteria given in CL:AIRE (2014)[1] have been adopted directly as GACs, as these are considered to be based on expert interpretation of current toxicological evidence.

In some areas, background concentrations of lead, other metals and metalloids, and/or individual PAHs may exceed their respective GACs and it may be appropriate to consider relative site and background concentration data as part of a more detailed assessment of the data.

Derivation of GACs

Except where otherwise stated, GACs have been derived by Sirius using CLEA version 1.071.

The GAC values have been derived for a sandy soil type, which will be conservative for the majority of soils (including made ground) encountered on historically contaminated sites. For organic contaminants of concern, criteria have been derived for a number of Soil Organic Matter (SOM) contents.

Genotoxic PAHs are assessed by the "Surrogate Method" using benzo(a)pyrene. Further information on this approach is given below.

Unless specifically stated, chemical properties and Health Criteria Values (HCVs) were obtained from:

- Environment Agency Science Report SC050021 series;
- Nathanail *et al*. (2009) "The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment", 2nd edition, Land Quality Press, Nottingham;
- CL:AIRE - AGS - EIC (2010) "Soil Generic Assessment Criteria for Human Health Risk Assessment". CL:AIRE, London.

GACs for arsenic, benzene, benzo(a)pyrene, cadmium and chromium (VI) have been derived using the

[1] CL:AIRE (2014) "Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination", Report SP1010, rev. 2.

Low Level of Toxicological Concern (LLTC) criteria given in CL:AIRE (2013). These criteria are considered a reasonable basis for assessment as they are still highly precautionary and definitely do not approach an intake level that could be defined as approaching Significant Possibility of Significant Harm to human health in the context of Part 2A of the Environmental Protection Act 1990. It must be further understood that the GACs derived will still incorporate a residual level of conservatism resulting from the exposure parameters used and the assumptions inherent in the model algorithms.

GACs for Genotoxic PAHs

Our approach to the assessment of genotoxic PAHs retains the use of benzo(a)pyrene as a surrogate marker. This approach for genotoxic PAHs is recommended by the HPA (2010)[2], which we consider to be the authoritative current guidance produced by a UK expert body and note that it was retained in the DEFRA Category 4 Screening Levels project (CL:AIRE, 2014).

The surrogate marker approach allows the assessment of the combined carcinogenic risk associated with all genotoxic PAHs[3] present as a mixture within soil, even though detailed toxicological information for many of the individual compounds may be lacking. The approach is based on determining the risk posed by the genotoxic PAH mixture using the concentration of benzo(a)pyrene present as an indicator.

To use the GAC for benzo(a)pyrene as a surrogate marker, a number of requirements must be met (HPA, 2010):

- Benzo(a)pyrene must be present in all soil samples containing genotoxic PAHs for which this method of assessment is being used;
- A similar profile of the genotoxic PAHs relative to benzo(a)pyrene should be present in all of the samples being assessed;
- The PAH profile of PAHs in the soil samples should be similar to that present in the pivotal toxicity study on which toxicological criterion for benzo(a)pyrene was based (Culp et al., 1998[4]). Table 1 provides the basis for defining the acceptable range.

Data indicate that contaminated soils in the UK generally meet these criteria[5] but the assessor must review their dataset before adopting this approach. If the above criteria are not met, then the surrogate marker approach must not be adopted and individual GAC or SSAC values are to be applied.

[2] HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5.

[3] The genotoxic PAHs included in the USEPA PAH 16 analysis reported by analytical labs are: benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, benzo(a)pyrene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene.

[4] Culp, S. *et al*. (1998) Carcinogenesis, 19, 117-124.

[5] Bull, S. & Collins, C. (2013) Environ. Geochem. Health, 31, 101-109.

Table 1. Profile of Genotoxic PAHs Relative to Benzo(a)pyrene that are Considered Acceptable for Application of Benzo(a)pyrene as a Surrogate Marker.

PAH	Acceptable Ratio of PAH Concentration to Benzo(a)pyrene for Application of Surrogate Marker Assessment	
	Lower Limit	Upper Limit
Benz[a]anthracene	0.12	12.43
Benzo[b]fluoranthene	0.11	10.85
Benzo[k]fluoranthene	0.04	3.72
Benzo[g,h,i]perylene	0.08	8.22
Chrysene	0.12	11.61
Dibenz[a,h]anthracene	0.01	1.38
Indeno[1,2,3-c,d]pyrene	0.07	7.27

For further information see: HPA (2010).

Soil Criteria Set for Purposes Other Than Human Health Protection

The Sirius GACs for sulphate, total organic carbon (TOC) and calorific value are set on basis of risks other than human health and their exceedance does not indicate a potential risk to future site users:

- The GAC for sulphate content is based on potential detrimental effects on buried concrete[6] and must be assessed with reference to the soil pH;
- The GAC for TOC content is provided for indicative assessment of disposal options if off-site landfill of soil were to be considered. This GAC is set at the 'Inert' waste threshold and should be considered as being applied for information purposes only;
- The GAC for calorific value is set to assist in an initial assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

Assessment criteria more stringent than those for human health may be set for specific purposes, for example, elimination of nuisance odours or ensuring that potentially mobile free-phase organic products are not present.

Controlled Waters

The Environment Agency's "Remedial Targets Methodology" (2006) provides a framework for assessing the potential for pollution of controlled waters and for deriving remedial target concentrations in soil and groundwater.

There are no generic groundwater or surface water quality standards that are applicable to all sites. Drinking Water Standards and Environmental Quality Standards (EQS) are used by Sirius as assessment criteria where they are appropriate to the contaminant linkages under consideration. Given that these standards apply at the receptor point, this is a conservative approach for samples collected at a source or along a transport pathway.

[6] BRE (2005) "Concrete in Aggressive Ground", Special Digest No. 1; 3rd Edition.

Soil Leachability

Sirius specifies that the analytical laboratory undertakes leachate preparation by BS EN 12475-2:2002. Where specific circumstances require a different method to be used, then this will be explained and justified within the report body text.

The results of leachate analysis are compared to the relevant GAC values for controlled waters.

The Sirius Group
Stage 1 Generic Assessment Criteria for Soils

Revision: 20th August 2015

Parameter	Residential (mg/kg, unless otherwise stated)						Commercial / Industrial (mg/kg, unless otherwise stated)			Note
	With Homegrown Produce			Without Homegrown Produce						
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
Metals/Metalloids										
Arsenic (inorganic)	37			40			630			[1]
Cadmium	11			85			190			[2]
Chromium (III)	910			4000			8600			
Chromium (VI)	6.0			6.1			33			[3]
Copper	200			7100			68000			[4]
Lead	200			310			2300			[5]
Mercury (inorganic)	40			56			1100			[6]
Nickel	130			180			980			[7]
Selenium	250			430			12000			
Vanadium	410			1200			9000			
Zinc	450			40000			750000			[4]
Other Inorganics										
pH	<5 or >9			<5 or >9			<5 or >9			
Total Sulphate	2400			2400			2400			[8]
Water-Soluble Sulphate	0.5 g/l			0.5 g/l			0.5 g/l			[8]
Free Cyanide	34			34			1400			[9]
Organics										
PAHs										
Acenaphthene	200	490	920	2000	3600	4900	75000	92000	100000	
Acenaphthylene	170	400	760	2000	3600	4900	76000	93000	100000	
Anthracene	2300	5300	9400	30000	34000	36000	520000	540000	540000	[10]
Benzo(a)anthracene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(a)pyrene	2.1	2.1	2.2	2.3	2.3	2.3	27	27	27	[11]
Benzo(b)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(k)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(g,h,i)perylene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Chrysene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Dibenzo(a,h)anthracene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Fluoranthene	280	560	820	1500	1600	1600	23000	23000	23000	
Fluorene	170	390	730	2200	3400	4000	60000	67000	70000	
Indeno(1,2,3-c,d)pyrene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Naphthalene	1.0	2.3	4.6	1.0	2.4	4.7	110	260	510	
Phenanthrene	95	220	380	1300	1400	1500	22000	22000	23000	
Pyrene	620	1200	1900	3700	3800	3800	54000	54000	54000	
BTEX and related										
Benzene	0.063	0.13	0.24	0.16	0.30	0.38	15	28	49	
Toluene	100	240	460	370	830	1100	33000	68000	110000	
Ethylbenzene	26	62	120	34	81	110	3200	7400	14000	
Xylenes (total)	28	67	130	33	78	110	3200	7700	15000	[12]
1,2,4-trimethylbenzene	0.22	0.53	1.1	0.24	0.58	1.2	39	93	170	
Iso-propylbenzene	6.6	16	32	6.8	17	33	1300	3100	6100	
Propylbenzene	21	51	100	23	57	110	3800	9100	17000	
Styrene	6.9	16	32	21	49	93	3100	6100	9500	
TPH										
Aliphatic EC 5-6	24	41	68	24	41	48	2400	4100	6900	
Aliphatic EC >6-8	53	110	210	53	110	150	5300	11000	21000	
Aliphatic EC >8-10	13	31	61	13	31	43	1300	3100	6000	
Aliphatic EC >10-12	62	150	300	62	150	220	6100	15000	28000	
Aliphatic EC >12-16	510	1200	2300	510	1200	1700	43000	72000	85000	
Aliphatic EC >16-35	41000	70000	90000	42000	70000	80000	>1E6	>1E6	>1E6	[13]
Aromatic EC >5-7	53	110	200	150	300	380	15000	28000	48000	
Aromatic EC >7-8	100	240	460	370	820	1100	33000	68000	110000	
Aromatic EC >8-10	20	48	94	22	54	75	2200	5200	9800	
Aromatic EC >10-12	63	150	290	120	290	400	11000	22000	30000	
Aromatic EC >12-16	140	320	570	1100	1900	2100	35000	37000	37000	
Aromatic EC >16-21	260	540	840	1800	1900	1900	28000	28000	28000	
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	28000	28000	28000	
Chlorinated Organics										
Chlorobenzene	0.19	0.44	0.86	0.19	0.45	0.87	31	71	140	
Dichloromethane (DCM)	0.47	0.78	1.2	1.2	1.7	2.4	250	340	470	
1,1-dichloroethane (DCA)	1.4	2.4	4.0	1.4	2.4	4.1	260	420	690	
1,2-dichloroethane (DCA)	0.0031	0.0048	0.0076	0.0035	0.0053	0.0084	0.34	0.51	0.81	
1,1-dichloroethene (DCE)	0.15	0.26	0.45	0.15	0.26	0.46	24	43	74	
cis -1,2-dichloroethene (DCE)	0.066	0.12	0.20	0.069	0.12	0.21	14	23	38	
trans -1,2-dichloroethene (DCE)	0.11	0.21	0.38	0.12	0.22	0.39	21	37	65	
Pentachlorophenol	0.21	0.52	1.0	27	30	31	400	400	400	
1,1,1,2-tetrachloroethane	0.56	1.3	2.6	0.63	1.5	2.9	59	140	270	
1,1,2,2-tetrachloroethane	0.98	2.1	4.0	1.6	3.4	6.3	150	310	570	

The Sirius Group
Stage 1 Generic Assessment Criteria for Soils

Parameter	Residential (mg/kg, unless otherwise stated)						Commercial / Industrial (mg/kg, unless otherwise stated)			Note
	With Homegrown Produce			Without Homegrown Produce						
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
Tetrachloroethene (PCE)	0.074	0.17	0.32	0.07	0.17	0.33	10	23	45	
Tetrachloromethane (CT)	0.011	0.024	0.046	0.011	0.024	0.046	1.6	3.6	6.9	
1,1,1-trichloroethane (TCA)	3.7	7.8	15	3.8	7.9	15	370	770	1400	
1,1,2-trichloroethane (TCA)	0.39	0.85	1.6	0.51	1.1	2.0	89	180	320	
Trichloroethene (TCE)	0.0070	0.015	0.028	0.0071	0.015	0.68	1.5	2.8	44	
Trichloromethane (CF)	0.43	0.80	1.4	0.48	0.89	53	98	170	300	
Vinyl Chloride	0.00034	0.00045	0.00062	0.00037	0.00048	0.00066	0.038	0.049	0.068	
Miscellaneous Organics										
Carbon disulphide	0.066	0.13	0.25	0.066	0.13	0.25	6.7	14	25	
Di-(2-ethylhexyl)-phthalate	290	660	1100	3900	4000	4100	85000	85000	8600	
MTBE	31	55	94	39	68	120	7400	12000	19000	
Phenol	110	190	330	420	440	440	440			[14]
Methylphenols (cresols), total	78	170	330	5600	8200	9900	160000	170000	18000	[15]
2,4-dimethylphenol (m-xylenol)	18	43	82	200	430	720	15000	23000	28000	
Other Parameters										
TOC	3% w/w			3% w/w			3% w/w			[16]
Calorific Value	2 MJ/kg			2 MJ/kg			2 MJ/kg			[17]
Asbestos	Fibres present			Fibres present			Fibres present			

All concentration-based criteria are rounded to 2 significant figures.

The criteria assume a sandy soil type, which will be conservative for the great majority of soils (including made ground) encountered on historically contaminated sites.

Except where otherwise stated, criteria have been derived by Sirius using CLEA version 1.06. Parameters for the land use cases are consistent with those given in Environment Agency (2009) "Updated Technical Background to the CLEA Model", report SC050021/SR3 but updated (where relevant) for respiration rate, exposure frequency for dermal contact outdoors, soil adherence factors for children, and plant uptake concentration factors given in CL:AIRE (2014) and Nathanail et al., (2015). No correction has been made for the "Top Two" crop types in the Residential with Homegrown Produce land use and the criteria will therefore be conservative in this regard.

Health Criteria Values (HCVs) and (except where specifically noted) chemical property data were obtained from:
- Environment Agency Science Report SC050021 Series;
- Nathanail et al. (2015);
- CL:AIRE-AGS-EIC (2010).

Footnotes

[1] Based on oral GAC as this is the lower GAC and reflects a cancer risk many orders of magnitude greater than for inhalation.

[2] Determined for lifetime exposure. Plant uptake concentration factors applied were as given in CL:AIRE (2014). The GAC values are based on data for soils having a pH value in the range 6-8; caution should be applied in applying them at pH values outside this range, especially at pH values <5.

[3] Both oral and inhalation HCVs are based on local toxicological effects and therefore the lowest (oral) GAC value is adopted.

[4] For the Residential with Homegrown Produce land use, the GAC values for Cu and Zn are based on potential phytotoxic effects and have been set at the maximum allowable concentrations for sewage sludge-amended soils presented in the "Sludge (Use in Agriculture) Regulations" (SI 1263/1989); these criteria may also be applied in any land use where plants are to be grown. The equivalent GAC values for human health protection in the Residential with Homegrown Produce land use are around an order of magnitude greater.

[5] The Category 4 Screening Levels for lead defined in CL:AIRE (2013) have been adopted directly to provide an acceptable basis for initial assessment of data. Where background concentrations of lead exceed the GAC value, then site-specific evaluation will be required.

[6] The SGV for mercury is based on inorganic mercury which represents the most common form encountered within the environment. This is considered appropriate for most sites as: "…the SGV for inorganic mercury can normally be compared with chemical analysis for total mercury content because the equilibrium concentrations of elemental and methylmercury compounds are likely to be very low" (Environment Agency report SC050021/Mercury SGV). Analysis and specific assessment for elemental or methylated forms of mercury will need to be considered if historical land use or site-specific factors indicate that these forms of mercury are likely to be present.

[7] Toxicological effects by inhalation are localised, therefore the lower of the GAC values for oral and inhalation HCVs have been adopted.

[8] BRE (2005). Sulphate is not considered to pose a potential risk to human health under normal circumstances – this GAC applies to construction cases only and is set at the upper limit for DS-1 Design Sulphate Class concrete.

[9] GAC calculated for acute risk. Further information can be provided upon request.

[10] The genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene) are routinely assessed using benzo(a)pyrene as a surrogate (HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5). Separate information on this approach is provided.

[11] Calculated using a 'minimum risk' oral index dose derived from the application of a 10,000x safety factor to the BMD10 presented in CL:AIRE (2014) for benzo(a)pyrene as a surrogate marker and the inhalation index dose specified in CL:ARE (2014) and Nathanail *et al*. (2015). As a conservative measure, the GAC is based on combined exposure pathways to account for systemic carcinogenic effects. Further information on the derivation can be provided upon request.

[12] For screening purposes, a single GAC has been set for total xylene. This is the lowest of the values calculated for the three individual xylene isomers.

[13] "No GAC" indicates that no value has been specified for this land use as the TDSI cannot be exceeded at achievable soil concentrations.

[14] 440mg/kg is the minimum concentration that is protective for direct skin contact with phenol (See Environment Agency SR050021/Phenol SGV) and is adopted where GACs for chronic exposure are higher.

[15] For screening purposes, a single GAC has been set for total methylphenol. This is the lowest of the values calculated for the three individual methylphenol isomers.

[16] The Hazardous Waste (England and Wales) Regulations 2005. TOC content in itself does not represent a potential risk to human health. This GAC is provided for indicative assessment of disposal options, in the case that off-site landfill of soil is undertaken. This GAC is specified at the 'Inert' waste threshold and should be considered as for information purposes only.

[17] ICRCL (1986) Guidance Note 61/84, 2nd Edition, Notes on the Fire Hazards of Contaminated Land. Calorific value is not an indication of direct human health risk but may be useful in assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

The Sirius Group
Stage 2 Generic Assessment Criteria for Soils

Revision: 20th August 2015

Parameter	Residential (mg/kg, unless otherwise stated)						Commercial / Industrial (mg/kg, unless otherwise stated)			Note
	With Homegrown Produce			Without Homegrown Produce						
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
Metals/Metalloids										
Arsenic (inorganic)	37			40			630			[1]
Cadmium	18			150			410			[2]
Chromium (III)	910			4000			8600			
Chromium (VI)	21			21			49			[3]
Copper	200			7100			68000			[4]
Lead	200			310			2300			[5]
Mercury (inorganic)	40			56			1100			[6]
Nickel	130			180			980			[7]
Selenium	250			430			12000			
Vanadium	410			1200			9000			
Zinc	450			40000			750000			[4]
Other Inorganics										
pH	<5 or >9			<5 or >9			<5 or >9			
Total Sulphate	2400			2400			2400			[8]
Water-Soluble Sulphate	0.5 g/l			0.5 g/l			0.5 g/l			[8]
Free Cyanide	34			34			1400			[9]
Organics										
PAHs										
Acenaphthene	200	490	920	2000	3600	4900	75000	92000	100000	
Acenaphthylene	170	400	760	2000	3600	4900	76000	93000	100000	
Anthracene	2300	5300	9400	30000	34000	36000	520000	540000	540000	[10]
Benzo(a)anthracene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(a)pyrene	4.9	4.9	4.9	5.3	5.3	5.3	76	76	76	[11]
Benzo(b)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(k)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Benzo(g,h,i)perylene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Chrysene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Dibenzo(a,h)anthracene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Fluoranthene	280	560	820	1500	1600	1600	23000	23000	23000	
Fluorene	170	390	730	2200	3400	4000	60000	67000	70000	
Indeno(1,2,3-c,d)pyrene	Assessed using benzo(a)pyrene as a surrogate marker									[10]
Naphthalene	1.0	2.3	4.6	1.0	2.4	4.7	110	260	510	
Phenanthrene	95	220	380	1300	1400	1500	22000	22000	23000	
Pyrene	620	1200	1900	3700	3800	3800	54000	54000	54000	
BTEX and related										
Benzene	0.13	0.27	0.50	0.37	0.71	1.30	15	29	51	[12]
Toluene	100	240	460	370	830	1100	33000	68000	110000	
Ethylbenzene	26	62	120	34	81	110	3200	7400	14000	
Xylenes (total)	28	67	130	33	78	110	3200	7700	15000	[13]
1,2,4-trimethylbenzene	0.22	0.53	1.1	0.24	0.58	1.2	39	93	170	
Iso-propylbenzene	6.6	16	32	6.8	17	33	1300	3100	6100	
Propylbenzene	21	51	100	23	57	110	3800	9100	17000	
Styrene	6.9	16	32	21	49	93	3100	6100	9500	
TPH										
Aliphatic EC 5-6	24	41	68	24	41	48	2400	4100	6900	
Aliphatic EC >6-8	53	110	210	53	110	150	5300	11000	21000	
Aliphatic EC >8-10	13	31	61	13	31	43	1300	3100	6000	
Aliphatic EC >10-12	62	150	300	62	150	220	6100	15000	28000	
Aliphatic EC >12-16	510	1200	2300	510	1200	1700	43000	72000	85000	
Aliphatic EC >16-35	41000	70000	90000	42000	70000	80000	>1E6	>1E6	>1E6	[14]
Aromatic EC >5-7	53	110	200	150	300	380	15000	28000	48000	
Aromatic EC >7-8	100	240	460	370	820	1100	33000	68000	110000	
Aromatic EC >8-10	20	48	94	22	54	75	2200	5200	9800	
Aromatic EC >10-12	63	150	290	120	290	400	11000	22000	30000	
Aromatic EC >12-16	140	320	570	1100	1900	2100	35000	37000	37000	
Aromatic EC >16-21	260	540	840	1800	1900	1900	28000	28000	28000	
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	28000	28000	28000	
Chlorinated Organics										
Chlorobenzene	0.19	0.44	0.86	0.19	0.45	0.87	31	71	140	
Dichloromethane (DCM)	0.47	0.78	1.2	1.2	1.7	2.4	250	340	470	
1,1-dichloroethane (DCA)	1.4	2.4	4.0	1.4	2.4	4.1	260	420	690	
1,2-dichloroethane (DCA)	0.0031	0.0048	0.0076	0.0035	0.0053	0.0084	0.34	0.51	0.81	
1,1-dichloroethene (DCE)	0.15	0.26	0.45	0.15	0.26	0.46	24	43	74	
cis -1,2-dichloroethene (DCE)	0.066	0.12	0.20	0.069	0.12	0.21	14	23	38	
trans -1,2-dichloroethene (DCE)	0.11	0.21	0.38	0.12	0.22	0.39	21	37	65	
Pentachlorophenol	0.21	0.52	1.0	27	30	31	400	400	400	
1,1,1,2-tetrachloroethane	0.56	1.3	2.6	0.63	1.5	2.9	59	140	270	
1,1,2,2-tetrachloroethane	1.0	2.1	4.0	1.6	3.4	6.3	150	310	570	
Tetrachloroethene (PCE)	0.074	0.17	0.32	0.074	0.17	0.33	10	23	45	
Tetrachloromethane (CT)	0.011	0.024	0.046	0.011	0.024	0.046	1.6	3.6	7	

The Sirius Group
Stage 2 Generic Assessment Criteria for Soils

Parameter	Residential (mg/kg, unless otherwise stated)						Commercial / Industrial (mg/kg, unless otherwise stated)			Note
	With Homegrown Produce			Without Homegrown Produce						
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
1,1,1-trichloroethane (TCA)	3.7	7.8	15	3.8	7.9	15	370	770	1400	
1,1,2-trichloroethane (TCA)	0.39	0.85	1.6	0.51	1.1	2.0	89	180	320	
Trichloroethene (TCE)	0.0070	0.015	0.028	0.0071	0.015	0.68	1.5	2.8	44	
Trichloromethane (CF)	0.43	0.80	1.4	0.48	0.89	53	98	170	300	
Vinyl Chloride	0.00034	0.00045	0.00062	0.00037	0.00048	0.00066	0.038	0.049	0.07	
Miscellaneous Organics										
Carbon disulphide	0.066	0.13	0.25	0.066	0.13	0.25	6.7	14	25	
Di-(2-ethylhexyl)-phthalate	290	660	1100	3900	4000	4100	85000	85000	8600	
MTBE	31	55	94	39	68	120	7400	12000	19000	
Phenol	110	190	330	420	440	440	440			[15]
Methylphenols (cresols), total	78	170	330	5600	8200	9900	160000	170000	18000	[16]
2,4-dimethylphenol (m-xylenol)	18	43	82	200	430	720	15000	23000	28000	
Other Parameters										
TOC	3% w/w			3% w/w			3% w/w			[17]
Calorific Value	2 MJ/kg			2 MJ/kg			2 MJ/kg			[18]
Asbestos	Fibres present			Fibres present			Fibres present			

All concentration-based criteria are rounded to 2 significant figures.

The criteria assume a sandy soil type, which will be conservative for the great majority of soils (including made ground) encountered on historically contaminated sites.

Except where otherwise stated, criteria have been derived by Sirius using CLEA version 1.06. Parameters for the land use cases are consistent with those given in Environment Agency (2009) "Updated Technical Background to the CLEA Model", report SC050021/SR3 but updated (where relevant) for respiration rate, exposure frequency for dermal contact outdoors, soil adherence factors for children, and plant uptake concentration factors given in CL:AIRE (2014) and Nathanail et al. (2015). No correction has been made for the "Top Two" crop types in the Residential with Homegrown Produce land use and the criteria will therefore be conservative in this regard.

Health Criteria Values (HCVs) and (except where specifically noted) chemical property data were obtained from:
- Environment Agency Science Report SC050021 Series;
- CL:AIRE (2014)
- Nathanail et al. (2015);
- CL:AIRE-AGS-EIC (2010).

Footnotes

[1] Determined using LLTC value and plant uptake concentration factors given in CL:AIRE (2014). The oral GAC is adopted as this is the lower value and reflects a cancer risk many orders of magnitude greater than for inhalation.

[2] Determined for lifetime exposure using the LLTC value and plant uptake concentration factors given in CL:AIRE (2014). The GAC values are based on data for soils having a pH value in the range 6-8; caution should be applied in applying them at pH values outside this range, especially at pH values <5.

[3] Determined using LLTC value and plant uptake concentration factors given in CL:AIRE (2014). Both oral and inhalation LLTCs are based on local toxicological effects and therefore the lowest (oral) GAC value is adopted.

[4] For the Residential with Homegrown Produce land use, the GAC values for Cu and Zn are based on potential phytotoxic effects and have been set at the maximum allowable concentrations for sewage sludge-amended soils presented in the "Sludge (Use in Agriculture) Regulations" (SI 1263/1989); these criteria may also be applied in any land use where plants are to be grown. The equivalent GAC values for human health protection in the Residential with Homegrown Produce land use are around an order of magnitude greater.

[5] The Category 4 Screening Levels for lead defined in CL:AIRE (2013) have been adopted directly to provide an acceptable basis for initial assessment of data. Where background concentrations of lead exceed the GAC value, then site-specific evaluation will be required.

[6] The SGV for mercury is based on inorganic mercury which represents the most common form encountered within the environment. This is considered appropriate for most sites as: "…the SGV for inorganic mercury can normally be compared with chemical analysis for total mercury content because the equilibrium concentrations of elemental and methylmercury compounds are likely to be very low" (SC050021/Mercury SGV). Analysis and specific assessment for elemental or methylated forms of mercury will need to be considered if historical land use or site-specific factors indicate that these forms of mercury are likely to be present.

[7] Toxicological effects by inhalation are localised, therefore the lower of the GAC values for oral and inhalation HCVs have been adopted.

[8] BRE (2005). Sulphate is not considered to pose a potential risk to human health under normal circumstances – this GAC applies to construction cases only and is set at the upper limit for DS-1 Design Sulphate Class concrete.

[9] GAC calculated for acute risk. Further information can be provided upon request.

[10] The genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene) are routinely assessed using benzo(a)pyrene as a surrogate (HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5). Separate information on this approach is provided.

[11] Determined using oral LLTC value (CL:AIRE, 2014) for assessment of all pathways to determine systemic carcinogenic effect; inhalation HCV and LLTC values are based on local pulmonary effects only and result in a less conservative GAC.

[12] Calculated using LLTC value (CL:AIRE, 2014).

[13] For screening purposes, a single GAC has been set for total xylene. This is the lowest of the values calculated for the three individual xylene isomers.

[14] "No GAC" indicates that no value has been specified for this land use as the TDSI cannot be exceeded at achievable soil concentrations.

[15] 440mg/kg is the minimum concentration that is protective for direct skin contact with phenol (See Environment Agency SR050021/Phenol SGV) and is adopted where GACs for chronic exposure are higher.

[16] For screening purposes, a single GAC has been set for total methylphenol. This is the lowest of the values calculated for the three individual methylphenol isomers.

[17] The Hazardous Waste (England and Wales) Regulations 2005. TOC content in itself does not represent a potential risk to human health. This GAC is provided for indicative assessment of disposal options, in the case that off-site landfill of soil is undertaken. This GAC is specified at the 'Inert' waste threshold and should be considered as for information purposes only.

[18] ICRCL (1986) Guidance Note 61/84, 2nd Edition, Notes on the Fire Hazards of Contaminated Land. Calorific value is not an indication of direct human health risk but may be useful in assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

The Sirius Group
Stage 1 Generic Assessment Criteria for Soils in Public Open Space Settings

Revision: 20th August 2015

Parameter	Informal POS in Residential Setting (mg/kg, unless otherwise stated)			Park POS (mg/kg, unless otherwise stated)			Note
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
Metals/Metalloids							
Arsenic (inorganic)	79			170			[1]
Cadmium	120			560			[2]
Chromium (III)	1500			33000			
Chromium (VI)	7.7			220			[3]
Copper	200			200			[4]
Lead	630			1300			[5]
Mercury (inorganic)	120			240			[6]
Nickel	230			800			[7]
Selenium	1100			1800			
Vanadium	2000			5000			
Zinc	450			450			[4]
Other Inorganics							
pH	<5 or >9			<5 or >9			
Total Sulphate	2400			2400			[8]
Water-Soluble Sulphate	0.5 g/l			0.5 g/l			[8]
Free Cyanide	34			34			[9]
Organics							
PAHs							
Acenaphthene	15000	15000	15000	30000	30000	30000	
Acenaphthylene	15000	15000	15000	30000	30000	30000	
Anthracene	74000	74000	74000	150000	150000	150000	[10]
Benzo(a)anthracene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(a)pyrene	4.2	4.2	4.2	10	10	10	[11]
Benzo(b)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(k)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(g,h,i)perylene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Chrysene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Dibenzo(a,h)anthracene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Fluoranthene	3100	3100	3100	6300	6300	6400	
Fluorene	9900	9900	9900	20000	20000	20000	
Indeno(1,2,3-c,d)pyrene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Naphthalene	3500	3800	4000	1300	1800	2400	
Phenanthrene	3100	3100	3100	6300	6300	6300	
Pyrene	7400	7400	7400	15000	15000	15000	
BTEX and related							
Benzene	71	72	72	94	100	110	
Toluene	55000	56000	56000	90000	97000	100000	
Ethylbenzene	23000	24000	24000	18000	23000	28000	
Xylenes (total)	38000	40000	41000	19000	26000	33000	[12]
1,2,4-trimethylbenzene	240	240	240	220	280	320	
Iso-propylbenzene	24000	24000	24000	14000	20000	24000	
Propylbenzene	24000	24000	25000	27000	33000	37000	
Styrene	3000	3000	3000	5600	5800	5900	
TPH							
Aliphatic EC 5-6	520000	550000	570000	120000	150000	200000	
Aliphatic EC >6-8	560000	580000	600000	170000	250000	330000	
Aliphatic EC >8-10	12000	12000	12000	16000	19000	22000	
Aliphatic EC >10-12	13000	13000	13000	22000	24000	24000	
Aliphatic EC >12-16	13000	13000	13000	25000	25000	26000	
Aliphatic EC >16-35	250000	250000	250000	470000	480000	490000	
Aromatic EC >5-7	55000	55000	55000	78000	87000	93000	
Aromatic EC >7-8	55000	55000	55000	89000	97000	100000	
Aromatic EC >8-10	5000	5000	5000	7700	8800	9300	
Aromatic EC >10-12	5000	5000	5000	9400	9800	10000	
Aromatic EC >12-16	5000	5000	5000	10000	10000	10000	
Aromatic EC >16-21	3800	3800	3800	7700	7800	7800	
Aromatic EC >21-35	3800	3800	3800	7800	7900	7900	
Chlorinated Organics							
Chlorobenzene	8800	10000	12000	1500	2200	3000	
Dichloromethane (DCM)	750	750	750	1400	1400	1400	
1,1-dichloroethane (DCA)	42000	43000	45000	11000	14000	17000	
1,2-dichloroethane (DCA)	28	28	28	22	25	28	
1,1-dichloroethene (DCE)	9200	9600	10000	1900	2500	3200	
cis-1,2-dichloroethene (DCE)	1200	1200	1300	390	490	610	
trans-1,2-dichloroethene (DCE)	3500	3700	3800	910	1200	1500	
Pentachlorophenol	180	180	180	250	270	280	
1,1,1,2-tetrachloroethane	1400	1400	1400	1600	1900	2100	
1,1,2,2-tetrachloroethane	1400	1400	1400	1900	2100	2300	
Tetrachloroethene (PCE)	1300	1400	1400	900	1200	1500	
Tetrachloromethane (CT)	790	850	890	210	310	410	
1,1,1-trichloroethane (TCA)	120000	130000	130000	63000	84000	100000	

The Sirius Group
Stage 1 Generic Assessment Criteria for Soils in Public Open Space Settings

Parameter	Informal POS in Residential Setting (mg/kg, unless otherwise stated)			Park POS (mg/kg, unless otherwise stated)			Note
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
1,1,2-trichloroethane (TCA)	960	970	980	760	950	1100	
Trichloroethene (TCE)	110	120	120	76	98	120	
Trichloromethane (CF)	2400	2500	2500	2700	2900	3100	
Vinyl Chloride	3.5	3.5	3.5	5.0	5.2	5.5	
Miscellaneous Organics							
Carbon disulphide	9000	10000	11000	1500	2100	2800	
Di-(2-ethylhexyl)-phthalate	9700	9700	9700	16000	16000	16000	
MTBE	73000	73000	73000	70000	81000	92000	
Phenol	440			440			[13]
Methylphenols (cresols), total	25000	25000	25000	47000	49000	50000	[14]
2,4-dimethylphenol (m-xylenol)	5000	5000	5000	8700	9200	9600	
Other Parameters							
TOC	3% w/w			3% w/w			[15]
Calorific Value	2 MJ/kg			2 MJ/kg			[16]
Asbestos	Fibres present			Fibres present			

The POS cases defined are based on the specific Conceptual Site Models given in CL:AIRE (2014). For these GACs to be applied, the relevant conceptual model must be valid for the site under assessment.

All concentration-based criteria are rounded to 2 significant figures.

The criteria assume a sandy soil type, which will be conservative for the great majority of soils (including made ground) encountered on historically contaminated sites.

Except where otherwise stated, criteria have been derived by Sirius using CLEA version 1.06. Parameters for the land use cases are consistent with those given in Environment Agency (2009) "Updated Technical Background to the CLEA Model", report SC050021/SR3 but updated (where relevant) for respiration rate, exposure frequency for dermal contact outdoors, soil adherence factors for children, and plant uptake concentration factors given in CL:AIRE (2014) and Nathanail et al. (2015). No correction has been made for the "Top Two" crop types in the Residential with Homegrown Produce land use and the criteria will therefore be conservative in this regard.

Health Criteria Values (HCVs) and (except where specifically noted) chemical property data were obtained from:
- Environment Agency Science Report SC050021 Series;
- Nathanail et al. (2015);
- CL:AIRE ASC TS2 (2010).

Footnotes

[1] Based on oral GAC as this is the lower GAC and reflects a cancer risk many orders of magnitude greater than for inhalation.

[2] Determined for lifetime exposure. Plant uptake concentration factors applied were as given in CL:AIRE (2014). The GAC values are based on data for soils having a pH value in the range 6-8; caution should be applied in applying them at pH values outside this range, especially at pH values <5.

[3] Both oral and inhalation HCVs are based on local toxicological effects and therefore the lowest (oral) GAC value is adopted.

[4] The GAC values for Cu and Zn are based on potential phytotoxic effects and have been set at the maximum allowable concentrations for sewage sludge-amended soils presented in the "Sludge (Use in Agriculture) Regulations" (SI 1263/1989); these criteria may also be applied in any land use where plants are to be grown. The GAC values for human health protection are significantly higher.

[5] The Category 4 Screening Levels for lead defined in CL:AIRE (2014) have been adopted directly to provide an acceptable basis for initial assessment of data. Where background concentrations of lead exceed the GAC value, then site-specific evaluation will be required.

[6] The SGV for mercury is based on inorganic mercury which represents the most common form encountered within the environment. This is considered appropriate for most sites as: "…the SGV for inorganic mercury can normally be compared with chemical analysis for total mercury content because the equilibrium concentrations of elemental and methylmercury compounds are likely to be very low" (Environment Agency report SC050021/Mercury SGV). Analysis and specific assessment for elemental or methylated forms of mercury will need to be considered if historical land use or site-specific factors indicate that these forms of mercury are likely to be present.

[7] Toxicological effects by inhalation are localised; consistent with the SGV for nickel, the lower of the GAC values for oral and inhalation HCVs have been adopted in each case.

[8] BRE (2005). Sulphate is not considered to pose a potential risk to human health under normal circumstances – this GAC applies to cases where concrete structures may be constructed within the soil and is set at the upper limit for DS-1 Design Sulphate Class concrete.

[9] GAC calculated for acute risk. Further information can be provided upon request.

[10] The genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene) are routinely assessed using benzo(a)pyrene as a surrogate (HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5). Separate information on this approach is provided.

[11] Calculated using a 'minimum risk' oral index dose derived from the application of a 10,000x safety factor to the BMD10 presented in CL:AIRE (2014) for benzo(a)pyrene as a surrogate marker and the inhalation index dose specified in CL:ARE (2014) and Nathanail et al. (2015). As a conservative measure, the GAC is based on combined exposure pathways to account for systemic carcinogenic effects. Further information on the derivation can be provided upon request.

[12] For screening purposes, a single GAC has been set for total xylene. This is the lowest of the values calculated for the three individual xylene isomers.

[13] 440mg/kg is the minimum concentration that is protective for direct skin contact with phenol (See Environment Agency SR050021/Phenol SGV) and is adopted where GACs for chronic exposure are higher.

[14] For screening purposes, a single GAC has been set for total methylphenol. This is the lowest of the values calculated for the three individual methylphenol isomers.

[15] The Hazardous Waste (England and Wales) Regulations 2005. TOC content in itself does not represent a potential risk to human health. This GAC is provided for indicative assessment of disposal options, in the case that off-site landfill of soil is undertaken. This GAC is specified at the 'Inert' waste threshold and should be considered as for information purposes only.

[16] ICRCL (1986) Guidance Note 61/84, 2nd Edition, Notes on the Fire Hazards of Contaminated Land. Calorific value is not an indication of direct human health risk but may be useful in assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

The Sirius Group
Stage 2 Generic Assessment Criteria for Soils in Public Open Space Settings

Revision: 20th August 2015

Parameter	Informal POS in Residential Setting (mg/kg, unless otherwise stated)			Park POS (mg/kg, unless otherwise stated)			Note
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
Metals/Metalloids							
Arsenic (inorganic)	79			170			[1]
Cadmium	220			840			[2]
Chromium (III)	1500			33000			
Chromium (VI)	23			250			[3]
Copper	200			200			[4]
Lead	630			1300			[5]
Mercury (inorganic)	120			240			[6]
Nickel	230			800			[7]
Selenium	1100			1800			
Vanadium	2000			5000			
Zinc	450			450			[4]
Other Inorganics							
pH	<5 or >9			<5 or >9			
Total Sulphate	2400			2400			[8]
Water-Soluble Sulphate	0.5 g/l			0.5 g/l			[8]
Free Cyanide	34			34			[9]
Organics							
PAHs							
Acenaphthene	15000	15000	15000	30000	30000	30000	
Acenaphthylene	15000	15000	15000	30000	30000	30000	
Anthracene	74000	74000	74000	150000	150000	150000	[10]
Benzo(a)anthracene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(a)pyrene	10	10	10	21	21	22	[11]
Benzo(b)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(k)fluoranthene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Benzo(g,h,i)perylene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Chrysene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Dibenzo(a,h)anthracene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Fluoranthene	3100	3100	3100	6300	6300	6400	
Fluorene	9900	9900	9900	20000	20000	20000	
Indeno(1,2,3-c,d)pyrene	Assessed using benzo(a)pyrene as a surrogate marker						[10]
Naphthalene	3500	3800	4000	1300	1800	2400	
Phenanthrene	3100	3100	3100	6300	6300	6300	
Pyrene	7400	7400	7400	15000	15000	15000	
BTEX and related							
Benzene	140	140	140	140	160	180	[12]
Toluene	55000	56000	56000	90000	97000	100000	
Ethylbenzene	23000	24000	24000	18000	23000	28000	
Xylenes (total)	38000	40000	41000	19000	26000	33000	[13]
1,2,4-trimethylbenzene	240	240	240	220	280	320	
Iso-propylbenzene	24000	24000	24000	14000	20000	24000	
Propylbenzene	24000	24000	25000	27000	33000	37000	
Styrene	3000	3000	3000	5600	5800	5900	
TPH							
Aliphatic EC 5-6	520000	550000	570000	120000	150000	200000	
Aliphatic EC >6-8	560000	580000	600000	170000	250000	330000	
Aliphatic EC >8-10	12000	12000	12000	16000	19000	22000	
Aliphatic EC >10-12	13000	13000	13000	22000	24000	24000	
Aliphatic EC >12-16	13000	13000	13000	25000	25000	26000	
Aliphatic EC >16-35	250000	250000	250000	470000	480000	490000	
Aromatic EC >5-7	55000	55000	55000	78000	87000	93000	
Aromatic EC >7-8	55000	55000	55000	89000	97000	100000	
Aromatic EC >8-10	5000	5000	5000	7700	8800	9300	
Aromatic EC >10-12	5000	5000	5000	9400	9800	10000	
Aromatic EC >12-16	5000	5000	5000	10000	10000	10000	
Aromatic EC >16-21	3800	3800	3800	7700	7800	7800	
Aromatic EC >21-35	3800	3800	3800	7800	7900	7900	
Chlorinated Organics							
Chlorobenzene	8800	10000	12000	1500	2200	3000	
Dichloromethane (DCM)	750	750	750	1400	1400	1400	
1,1-dichloroethane (DCA)	42000	43000	45000	11000	14000	17000	
1,2-dichloroethane (DCA)	28	28	28	22	25	28	
1,1-dichloroethene (DCE)	9200	9600	10000	1900	2500	3200	
cis-1,2-dichloroethene (DCE)	1200	1200	1300	390	490	610	
trans-1,2-dichloroethene (DCE)	3500	3700	3800	910	1200	1500	
Pentachlorophenol	180	180	180	250	270	280	
1,1,1,2-tetrachloroethane	1400	1400	1400	1600	1900	2100	
1,1,2,2-tetrachloroethane	1400	1400	1400	1900	2100	2300	
Tetrachloroethene (PCE)	1300	1400	1400	900	1200	1500	
Tetrachloromethane (CT)	790	850	890	210	310	410	
1,1,1-trichloroethane (TCA)	120000	130000	130000	63000	84000	100000	

The Sirius Group
Stage 2 Generic Assessment Criteria for Soils in Public Open Space Settings

Parameter	Informal POS in Residential Setting (mg/kg, unless otherwise stated)			Park POS (mg/kg, unless otherwise stated)			Note
	1% SOM	2.5% SOM	5% SOM	1% SOM	2.5% SOM	5% SOM	
1,1,2-trichloroethane (TCA)	960	970	980	760	950	1100	
Trichloroethene (TCE)	110	120	120	76	98	120	
Trichloromethane (CF)	2400	2500	2500	2700	2900	3100	
Vinyl Chloride	3.5	3.5	3.5	5.0	5.2	5.5	
Miscellaneous Organics							
Carbon disulphide	9000	10000	11000	1500	2100	2800	
Di-(2-ethylhexyl)-phthalate	9700	9700	9700	16000	16000	16000	
MTBE	73000	73000	73000	70000	81000	92000	
Phenol	440			440			[14]
Methylphenols (cresols), total	25000	25000	25000	47000	49000	50000	[15]
2,4-dimethylphenol (m-xylenol)	5000	5000	5000	8700	9200	9600	
Other Parameters							
TOC	3% w/w			3% w/w			[16]
Calorific Value	2 MJ/kg			2 MJ/kg			[17]
Asbestos	Fibres present			Fibres present			

The POS cases defined are based on the specific Conceptual Site Models given in CL:AIRE (2014). For these GACs to be applied, the relevant conceptual model must be valid for the site under assessment.

All concentration-based criteria are rounded to 2 significant figures.

The criteria assume a sandy soil type, which will be conservative for the great majority of soils (including made ground) encountered on historically contaminated sites.

Except where otherwise stated, criteria have been derived by Sirius using CLEA version 1.06. Parameters for the land use cases are consistent with those given in Environment Agency (2009) "Updated Technical Background to the CLEA Model", report SC050021/SR3 but updated (where relevant) for respiration rate, exposure frequency for dermal contact outdoors, soil adherence factors for children, and plant uptake concentration factors given in CL:AIRE (2014) and Nathanail et al. (2015). No correction has been made for the "Top Two" crop types in the Residential with Homegrown Produce land use and the criteria will therefore be conservative in this regard.

Health Criteria Values (HCVs) and (except where specifically noted) chemical property data were obtained from:
- Environment Agency Science Report SC050021 Series;
- CL:AIRE (2014);
- Nathanail et al. (2015);
- CL:AIRE-AGS-EIC (2010).

Footnotes

[1] Determined using LLTC value and plant uptake concentration factors given in CL:AIRE (2014). The oral GAC is adopted as this is the lower value and reflects a cancer risk many orders of magnitude greater than for inhalation.

[2] Determined for lifetime exposure using the LLTC value given in CL:AIRE (2014).

[3] Determined using LLTC value given in CL:AIRE (2014). Both oral and inhalation LLTCs are based on local toxicological effects and therefore the lowest (oral) GAC value is adopted.

[4] The GAC values for Cu and Zn are based on potential phytotoxic effects and have been set at the maximum allowable concentrations for sewage sludge-amended soils presented in the "Sludge (Use in Agriculture) Regulations" (SI 1263/1989); these criteria may also be applied in any land use where plants are to be grown. The GAC values for human health protection are significantly higher.

[5] The Category 4 Screening Levels for lead defined in CL:AIRE (2014) have been adopted directly to provide an acceptable basis for initial assessment of data. Where background concentrations of lead exceed the GAC value, then site-specific evaluation will be required.

[6] The SGV for mercury is based on inorganic mercury which represents the most common form encountered within the environment. This is considered appropriate for most sites as: "…the SGV for inorganic mercury can normally be compared with chemical analysis for total mercury content because the equilibrium concentrations of elemental and methylmercury compounds are likely to be very low" (SC050021/Mercury SGV). Analysis and specific assessment for elemental or methylated forms of mercury will need to be considered if historical land use or site-specific factors indicate that these forms of mercury are likely to be present.

[7] Toxicological effects by inhalation are localised; consistent with the SGV for nickel, the lower of the GAC values for oral and inhalation HCVs have been adopted in each case.

[8] BRE (2005). Sulphate is not considered to pose a potential risk to human health under normal circumstances – this GAC applies to cases where concrete structures may be constructed within the soil and is set at the upper limit for DS-1 Design Sulphate Class concrete.

[9] GAC calculated for acute risk. Further information can be provided upon request.

[10] The genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene) are routinely assessed using benzo(a)pyrene as a surrogate (HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5). Separate information on this approach is provided.

[11] Determined using oral LLTC value (CL:AIRE, 2014) for assessment of all pathways to determine systemic carcinogenic effect; inhalation HCV and LLTC values are based on local pulmonary effects only and result in a less conservative GAC.

[12] Calculated using LLTC value (CL:AIRE, 2014).

[13] For screening purposes, a single GAC has been set for total xylene. This is the lowest of the values calculated for the three individual xylene isomers.

[14] The GAC is based on the threshold protective for acute effects of skin contact with phenol (See SR050021/Phenol SGV). The chronic exposure GAC is significantly higher.

[15] For screening purposes, a single GAC has been set for total methylphenol. This is the lowest of the values calculated for the three individual methylphenol isomers.

[16] The Hazardous Waste (England and Wales) Regulations 2005. TOC content in itself does not represent a potential risk to human health. This GAC is provided for indicative assessment of disposal options, in the case that off-site landfill of soil is undertaken. This GAC is specified at the 'Inert' waste threshold and should be considered as for information purposes only.

[17] ICRCL (1986) Guidance Note 61/84, 2nd Edition, Notes on the Fire Hazards of Contaminated Land. Calorific value is not an indication of direct human health risk but may be useful in assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

APPENDIX D

STAGE 1 & 2 THRESHOLD CONCENTRATIONS FOR CLEAN COVER MATERIAL FOR USE IN GARDENS OF PRIVATE RESIDENTIAL PROPERTIES

The Sirius Group
Stage 1 Threshold Concentrations for Clean Cover Material for Use in Gardens of Private Residential Properties

Parameter	Threshold Concentration (mg/kg, unless otherwise stated)			Comment
	1% SOM*	2.5% SOM	5% SOM	
Metals/Metalloids				
Arsenic (inorganic)	37			
Cadmium	11			Soil pH 6-9
Chromium (III)	910			
Copper	200			Based on phytotoxic effect
Lead	200			
Mercury (inorganic)	40			
Nickel	130			
Selenium	250			
Zinc	450			Based on phytotoxic effect
Other Inorganics				
pH	<5 or >9			Must be in range 5-9
Water-Soluble Sulphate	0.5 g/l			
Organics				
PAHs**				
Total 16 PAHs	***100***	***100***	***100***	Professional judgement
Benzo(a)pyrene	2.1	2.1	2.2	Genotoxic surrogate
Naphthalene	1.0	2.3	4.6	
TPH†				
Sum of TPH fractions EC5-35	***500***	***500***	***500***	Professional judgement
Aliphatic EC 5-6	24	41	68	
Aliphatic EC >6-8	53	110	210	
Aliphatic EC >8-10	13	31	61	
Aliphatic EC >10-12	62	150	300	
Aliphatic EC >12-16	510	1200	2300	
Aliphatic EC >16-35	41000	70000	90000	
Aromatic EC >5-7	53	110	200	
Aromatic EC >7-8	100	240	460	
Aromatic EC >8-10	20	48	94	
Aromatic EC >10-12	63	150	290	
Aromatic EC >12-16	140	320	570	
Aromatic EC >16-21	260	540	840	
Aromatic EC >21-35	1100	1500	1700	
TPH Hazard Index (no units)	<1	<1	<1	
BTEX‡				
Benzene	0.063	0.13	0.24	
Miscellaneous Organics				
Phenol	110	190	330	
Other Parameters				
Asbestos	Unsuitable if any fibres present			

Based on sandy soil at a range of soil organic matter contents and assuming a standard residential with gardens land use. Alternative criteria may be specified for other soil types and SOM contents, for soils placed at depth, or for other land uses.

Notes:

* Soil organic matter; %SOM = 1.724 * %TOC.

** Soils must meet the specified criteria for each component AND the sum of 16 PAHs. The total is specified to prevent unsuitable materials being placed as cover. Where an individual PAH is not shown, then its criterion is greater than that for the sum or it is a genotoxic PAH assessed by using benzo(a)pyrene as a surrogate marker.

† Soils must meet the specified criteria for each component and the Hazard Index for TPH must be <1.0. The sum of TPH fractions must also be met to prevent unsuitable materials being placed as cover. Where an individual TPH fraction has a criterion greater than that for the sum of TPH fractions, the value is solely provided for the calculation of the Hazard Index.

‡ Components other than benzene are not genotoxic carcinogens and therefore assessed as part of the TPH mixture.

Soils must have no visual or olfactory evidence of contamination.

The Sirius Group
Stage 2 Threshold Concentrations for Clean Cover Material for Use in Gardens of Private Residential Properties

Parameter	Threshold Concentration (mg/kg, unless otherwise stated)			Comment
	1% SOM*	2.5% SOM	5% SOM	
Metals/Metalloids				
Arsenic (inorganic)	37			
Cadmium	18			Soil pH 6-9
Chromium (III)	910			
Copper	200			Based on phytotoxic effect
Lead	200			
Mercury (inorganic)	40			
Nickel	130			
Selenium	250			
Zinc	450			Based on phytotoxic effect
Other Inorganics				
pH	<5 or >9			Must be in range 5-9
Water-Soluble Sulphate	0.5 g/l			
Organics				
PAHs**				
Total 16 PAHs	***100***	***100***	***100***	Professional judgement
Benzo(a)pyrene	4.9	4.9	4.9	Genotoxic surrogate
Naphthalene	1.0	2.3	4.6	
TPH†				
Sum of TPH fractions EC5-35	***500***	***500***	***500***	Professional judgement
Aliphatic EC 5-6	24	41	68	
Aliphatic EC >6-8	53	110	210	
Aliphatic EC >8-10	13	31	61	
Aliphatic EC >10-12	62	150	300	
Aliphatic EC >12-16	510	1200	2300	
Aliphatic EC >16-35	41000	70000	90000	
Aromatic EC >5-7	53	110	200	
Aromatic EC >7-8	100	240	460	
Aromatic EC >8-10	20	48	94	
Aromatic EC >10-12	63	150	290	
Aromatic EC >12-16	140	320	570	
Aromatic EC >16-21	260	540	840	
Aromatic EC >21-35	1100	1500	1700	
TPH Hazard Index (no units)	<1	<1	<1	
BTEX‡				
Benzene	0.130	0.27	0.50	
Miscellaneous Organics				
Phenol	110	190	330	
Other Parameters				
Asbestos	Unsuitable if any fibres present			

Based on sandy soil at a range of soil organic matter contents and assuming a standard residential with gardens land use. Alternative criteria may be specified for other soil types and SOM contents, for soils placed at depth, or for other land uses.

Notes:

* Soil organic matter; %SOM = 1.724 * %TOC.

** Soils must meet the specified criteria for each component AND the sum of 16 PAHs. The total is specified to prevent unsuitable materials being placed as cover. Where an individual PAH is not shown, then its criterion is greater than that for the sum or it is a genotoxic PAH assessed by using benzo(a)pyrene as a surrogate marker.

† Soils must meet the specified criteria for each component and the Hazard Index for TPH must be <1.0. The sum of TPH fractions must also be met to prevent unsuitable materials being placed as cover. Where an individual TPH fraction has a criterion greater than that for the sum of TPH fractions, the value is solely provided for the calculation of the Hazard Index.

‡ Components other than benzene are not genotoxic carcinogens and therefore assessed as part of the TPH mixture.

Soils must have no visual or olfactory evidence of contamination.

APPENDIX E

SIRIUS SPECIFICATION FOR THE TREATMENT OF SHALLOW MINE WORKINGS

REPORT C6054-DG
MAY 2017

SPECIFICATION FOR THE TREATMENT OF SHALLOW MINEWORKINGS

of
BARUGH GREEN, BARNSLEY

prepared for
BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

REPORT NUMBER:	C6054-DG	**REPORT STATUS:**	FINAL
REPORT TYPE:	SPECIFICATION FOR THE TREATMENT OF SHALLOW MINEWORKINGS		
REPORT DATE:	MAY 2017		
SITE:	BARUGH GREEN, BARNSLEY		
PREPARED FOR:	BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD		
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SPECIFICATION FOR THE TREATMENT OF

SHALLOW MINEWORKINGS

for

BARUGH GREEN, BARNSLEY

prepared for

BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

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APPENDICES

APPENDIX A FIGURES AND DRAWINGS

Drawing No.	Title	Scale
C6054-RS/01	Site Location Plan	1:50,000
C6054-RS/02	Site Features Plan	Not to Scale
C6054-DG/04	Indicative Drill and Grout Layout	1:500 @ A1
R/1667/1B-1 Rev C (FDA Landscape)	Landscape Masterplan	1:500 @ A0

1. INTRODUCTION

Sirius Geotechnical Ltd (Sirius) has been commissioned by Barratt and David Wilson Homes (Yorkshire West) Ltd (BDWH) to prepare a specification for the treatment of shallow mineworkings at their development site at Barugh Green, Barnsley ('the site').

The site covers an area of approximately 9.9 hectares and is irregular in shape, measuring approximately 400m from east to west and approximately 380m from north to south. Ground levels generally slope downward from elevations of approximately 72m AOD in the south-west to approximately 55m AOD in the north-east.

The site is generally occupied by open fields, with waterlogged rough grassland located in the South east with a pond in the north-east. Land adjacent to the pond was also waterlogged. An embankment, generally ranging between 2m to 4m in height, is located in the south-east of the site. This embankment was recorded as being heavily vegetated with semi-mature trees and low lying shrubs.

An unoccupied residential property with a private garden (No.1 Claycliffe Road) and an adjoining gravel surfaced car park is located within the south-western corner of the site.

It is understood that BDWH are proposing to demolish the existing building on site and redevelop the property for a low-rise a residential end-use comprising 170 No. low-rise residential properties with private gardens and associated infrastructure.

It is understood that outline foundation proposals for the proposed development generally comprise strip / trench-fill foundations (reinforced within the area subject to treatment of shallow mine workings). This is on the basis that areas of identified deeper made ground in the north, south and south-west of the site, generally associated with infilled ponds, an infilled canal and former railway land, are located below areas of soft landscaping. However, should this not be the case, conventional spread foundations may not be feasible for residential properties within these areas due to the excessive depth required for excavation, and an alternative foundation solution, such as piles or vibro-replacement methods may be required.

Previous ground investigations have been undertaken on the site which have identified the presence of two coal seams at shallow depth below the site, namely the Top and Low Haigh Moor coal seams. Workings have only been encountered within the Top Haigh Moor coal seam, which may affect surface stability of the site.

The Top and Low Haigh Moor coal seams dip beneath the site to the north-east.

Evidence of shallow underground workings within the Top Haigh Moor coal seam were located in the southern-central part of the site at depths of between 7.80m and 10.80m bgl. This was consistent with the recorded extent of workings in the Top Haigh Moor coal seam from Barugh Colliery.

Based upon the current available information, it is recommended that within the southern-central part of site, the ground below all proposed buildings and adoptable highways be stabilised by drilling and grouting on an appropriate grid with treatment extending up to 3m beyond the building footprint. However, as the works progress, seam thicknesses, seam depths and the nature and form of the seams will be reviewed.

The object of the work is to identify and stabilise old mine workings beneath areas where insufficient competent rock cover has been identified; using appropriate treatment procedures comprising PFA/cement grout injection via boreholes.

All works shall be carried out in accordance with the Construction Design Management (CDM) Regulations and the Construction Phase Health and Safety Plan.

This specification is divided into two sections; the general site details including information on the site, previous investigations and their findings; the second part of this report is a general specification for the works to be undertaken. The specification may be reviewed and amended, at any point during the drilling and grouting works. Any amendments to the specification, as outlined below will be recorded.

On completion of the drill and grout programme, a validation report containing copies of borehole records, a borehole location plan, procedures followed during the works, the results of validation boreholes and pressure tests, and a record of any deviation from this specification will be produced and issued to the client and all other relevant parties.

This specification has been prepared for the sole use of Barratt and David Wilson Homes (Yorkshire West) Ltd. No other third party may rely upon or reproduce the contents of this report without the written approval of Sirius. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.

2. SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview

Location	The site is located to the south of Dearne Hall Road, within the village of Low Barugh, approximately 5km north-west of Barnsley town centre. A site location plan is included as Drawing No. C6054-RS/01 within Appendix A.
National Grid Reference	431690, 408730.
Topography and Features	The site covers an area of approximately 9.9 hectares and is irregular in shape, measuring c. 400m from east to west and c. 380m from north to south. Ground levels generally slope downward from elevations of approximately 72m AOD in the south-west to approximately 55m AOD in the north-east. The site is generally occupied by open fields, with waterlogged rough grassland located in the south-east and a pond in the north-east. Land adjacent to the pond was also waterlogged. An embankment, generally ranging between 2m to 4m in height, is located in the south-east of the site. This embankment was recorded as being heavily vegetated with semi-mature trees and low lying shrubs. A row of mature trees runs from east to west in the northern part of the site. Overhead power lines, generally aligned north-west to south-east and east to west, supported on electricity pylons and wooden poles, are present in the east and south of the site, respectively. These overhead lines cross the area of required shallow mine workings treatment and therefore may affect the works (e.g., angled boreholes may be required). An unoccupied residential property with private garden (No.1 Claycliffe Road) and an adjoining gravel-surfaced car park are located within the south-western corner of the site.
Site Boundaries	The boundary of the site is generally delineated by either barbed wire or wooden fencing. Land to the north and west of the site is occupied by residential properties and public highways. A railway embankment lies immediately east of the site. Land to the south of the site is occupied by an electrical substation and commercial / industrial premises.

Invasive Plant Species	Japanese knotweed is understood to be present in the south-western corner of the site, within the curtilage to No.1 Claycliffe Road.

3. GEOLOGICAL SETTING

A summary of available published geological information is provided in Table 3.1 below.

3.1. Recorded Geology

Sources of Information	The following sources of information have been referenced: • BGS 1:50,000 scale geological map (Sheet 87 Barnsley, Solid and Drift Edition). • BGS 1:10,000 scale geological map (SE 30 NW). • The Coal Authority (CA) Mining Report (Reference 51000094105001, dated 23rd May 2012). • BGS on-line borehole records.
Made Ground	Made ground is recorded on the published 1:10,000 scale geology sheet within the south-western part of the site, associated with an infilled railway cutting. Although not reported on the geological plans, areas of deep made ground are anticipated within the southern and northern parts of the site associated with infilled cooling ponds and canal / channel, respectively. Areas of made ground, annotated as 'domestic refuse' and 'industrial refuse and quarry debris on colliery waste' are shown immediately to the east and south-east of the site associated with a former reservoir and disused tips / slag heaps, respectively. An area of 'worked-out opencast coal-seam (backfilled) or backfilled quarry' is reported a short distance to the south-west of the site.
Drift Geology	Drift deposits are reported to be absent across the majority of the site with the exception of the northern part which is shown to be underlain by alluvium associated with the River Dearne.
Solid Geology	The site is reported to be underlain by Carboniferous Middle Coal Measures strata, dipping at approximately 3º to the north-east. The Haigh Moor Rock (sandstone) is shown below the majority of the site, with the exception of the south-east which is reported to be underlain by undifferentiated strata, comprising mudstone, siltstone, sandstone and coal.
Faults	An east/west orientated fault, downthrown to the north, is conjectured to underlie the northernmost section of the site.

BGS Borehole Records	Exploratory hole records provided by the BGS (available on-line) were examined and included four trial pits excavated by Norwest Holst in 1981, approximately 100m to the south-west of the site. The trial pit records indicate the area to the south-west of the site to be underlain by made ground to approximately 4.2m and 4.9m below ground level (bgl), which in turn is underlain by weathered grey mudstone to a maximum proven depth of 6.5m bgl. A borehole (SE 30 NW 24), drilled by the National Coal Board (dated October 1971) approximately 50m to the south-east of the site was also reviewed. This refers to an exploratory borehole drilled to a depth of c. 150m bgl. However only strata located below approximately 90m bgl was recorded. This generally comprised undifferentiated mudstone, siltstone, sandstone and seat earth, with the following coal seams recorded: Silkstone seam (c. 1.80m thick) at c. 90m bgl, the Black Band seam (c. 1.10m thick) at c. 137m bgl and the Whitmore seam (c. 1.18m thick) at c. 147m bgl.	
Mining and Quarrying	**Coal Seams:**	The Top Low Haigh Moor and Low Haigh Moor coal seams are conjectured to outcrop approximately 100m and 150m to the west of the site respectively, dipping to the north-east beneath the property. The Swallow Wood coal seam is conjectured to outcrop immediately to the east of the site. A review of the generalised vertical section provided with the 1:10,000 scale geological plan indicates the Top and Low Haigh Moor coal seams and the Swallow Wood coal seam to range in thickness between 0.69m to 1.19m; 0.43m to 1.02m; and 0.30m to 1.15m, respectively.
	Coal Mining:	The Coal Authority (CA) Report obtained for the site states that: • *'The property is in the likely zone of influence from past workings in four seams of coal at shallow to 170m depth, and last worked in 1984'.* • *'The property is not in the likely zone of influence of any present underground coal workings'.* • *'The property is not in an area for which the CA is determining whether to grant a license to remove coal using underground methods'.*

		Consultation with the CA at the time of the 2013 Sirius report confirmed the shallowest worked seam beneath the site to be the Top Haigh Moor coal seam. A copy of the CA abandonment plan for underground workings in the Top Haigh Moor coal seam confirmed the location and extent of the Barugh Colliery together with indicating that that underground mineworkings encroach into the central / southern part of the site.
	Mine Entries:	The CA record no known coal mine entries within, or within 20 metres of, the site.
	Quarries/ Opencast:	Historical maps do not indicate the presence of any pits or quarries within the site. However, an infilled sandstone quarry and backfilled opencast workings to the Low and Top Haigh Moor coal seams are annotated/reported on the 1:10,000 scale geological plan located a short distance to the south and south-west of the site, respectively.

4. PREVIOUS INVESTIGATIONS

The site has been subject to two phases of mineworkings investigation by Sirius. These are summarised within the Sirius Strategy for Remedial and Preparatory Works, with the pertinent findings in relation to shallow mining risk detailed below.

The ground investigations confirmed the presence of two coal seams across the site considered to be the Top and Low Haigh Moor coal seams.

The Top Haigh Moor coal seam was encountered at depths of between 5.45m and 18.20m bgl (approximately between 37.98m and 66.61m AOD) during previous investigations. Where found to be intact, the Top Haigh Moor coal seam was recorded to range in thickness from 0.30m to 1.60m.

Evidence of potential mineworkings, recorded as broken ground, were encountered at the anticipated depth of the Top Haigh Moor coal seam within rotary probeholes with the depth to the base of workings recorded as being between 9.00m and 9.50m bgl (generally from 53.03m AOD to 55.12m AOD).

The Low Haigh Moor coal seam was encountered at depths of between 16.20m and 23.20m bgl (34.85m AOD and 51.87m AOD). The Low Haigh Moor coal seam was recorded as ranging from 0.20m to 0.50m thick with no evidence of unrecorded mineworkings (voids, broken ground or soft push) identified.

Triangulation of borehole data indicates the Top and Low Haigh Moor coal seams dip approximately 3° to the north-east.

Rapid inflows of sub-artesian groundwater were recorded in rotary probeholes R14 and R16, located within the southern part of the site, at depths of 9.00m and 10.20m bgl, respectively. These inflows correlate with the voids/broken ground recorded within these probeholes, and are considered to be representative of flooded mineworkings.

Groundwater was encountered during the drilling of probeholes R1, R2, R4, R10 and R27 at depths of between 8.00m and 17.50m bgl.

Subsequent groundwater monitoring of the gas/groundwater monitoring wells installed within selected rotary probeholes and window sample boreholes indicated the groundwater level, where present, to be between 0.72m and 8.70m bgl.

For typical Coal Measures bedrock, it is generally accepted that there is a risk of surface instability where the thickness of competent bedrock above the worked coal seam is less than 10x the worked seam thickness. The average thickness of the Top Haigh Moor coal seam recorded by the Sirius site investigation was 1m. Based on a maximum recorded seam thickness of 1.60m for the Top Haigh Moor coal seam, a minimum rock cover of 16m would be required above the seam in order to mitigate the potential for surface subsidence. The ground investigation has confirmed that insufficient rock cover exists across the southern-central area of the site and, as such there is a risk of surface instability associated with underground mineworkings within the Top Haigh Moor coal seam.

Based on the intact and relatively thin nature of the Low Haigh Moor coal seam on site, it is considered that the risk from surface instability from this seam will be negligible.

No mine entries are known to exist on the site. However, the possibility of encountering unrecorded mine entries, including bell pits and crop workings and adits cannot not be discounted. It is therefore recommended that the footprints of all proposed plots and highways are stripped back to natural strata and examined for evidence of mine entries. If a mine entry / disturbed ground is suspected, advice regarding treatment / foundation precautions should be sought immediately from a suitably qualified geotechnical engineer or engineering geologist.

5. DRILLING AND GROUTING WORKS

The treatment of mineworkings will be to areas below plots, adoptable highways, and non-adoptable roads and parking areas, the requirements for each area will be as follows:

Site Strip

Prior to commencement of any drilling and grouting, a site wide strip should be completed to natural strata to help confirm the presence / absence of mine related features i.e. mine entries, bell pits, crop workings, adits, etc. If these features are found they should be appropriately treated in line with details provided in Section 6.8 of this Specification.

Plots

Boreholes will be drilled on a nominal 3m grid across building footprints, with the treatment extending up to 3m beyond the edge of the structures.

Adoptable Highways

Beneath adoptable highways the boreholes will be drilled on a primary staggered 6m grid and reducing to a 3m grid locally to boreholes encountering evidence of underground workings.

Car Parks / Non Adoptable Highways

The proposed site layout plan shows two areas of non-adopted roads within the area of recorded shallow mine workings, within the central and western extent.

Consideration should be given to mitigating the risk of crown hole formation within these areas by provision of suitable geogrid reinforcement within the pavement construction.

Confirmation from the Coal Authority should be sought prior to works commencing to determine their specific requirements for the treatment of these specific areas.

Overhead Powerlines

There are currently overhead powerlines crossing the area that requires drilling and grouting. It is understood that these are to be diverted underground as part of the proposed development of the site. If these works are not completed prior to the drilling and grouting works, then precautions will be required to mitigate the risk of contact with the lines, in accordance with Health and Safety

Executive (HSE) Guidance Note GS6, *Avoiding Danger from Overhead Power Lines* (2013), which may include the use of, e.g., angled borehole drilling.

Mineshaft Treatment

Whilst no known mineshafts are present within the site boundary, or located within investigatory works, if any are located during the remedial works, they shall be treated in accordance with approved procedures.

Ground Contamination

Previous site investigations carried out include information in relation to contamination risk assessment. However, in summary no significant ground contamination was identified during the previous site investigation works, apart from some localised arsenic contamination. Mitigation measures in respect to these are detailed within the Strategy for Remedial and Preparatory Works.

Groundwater

Measures should be put in place for the management of groundwater encountered / displaced by treatment of shallow coal mine workings.

6. GENERAL SPECIFICATION

6.1. Constituent Materials for Grouting

Water shall be from the mains supply or other source approved by the Engineer, supplied by the Principal Contractor.

Cement shall be CEM II 32.5 conforming to BS EN 197-1:2011

Pulverised fuel ash (PFA) complying with BS EN 12715:2000 shall be conditioned hopper ash, or dry powder ash, or a type suitable as a constituent for grout and obtained from an approved supplier.

Sand shall generally comply with BS882 and be of a grading suitable for use in the Contractor's plant and approved by the Engineer.

Pea gravel shall comply with BS882, and be of grading approved by the Engineer.

Thixotropic admixtures shall be bentonite or another admixture approved by the Engineer.

6.2. Storage and Use of Materials

Storage of materials shall be such as to prevent contamination and deterioration. Cement shall be kept in a dry location, and the sequence of deliveries recorded so that cement can be used in rotation.

PFA shall be delivered to site and stockpiled, if required it may be stored under impermeable covers which shall be weighted down to prevent dust nuisance and to retain moisture.

6.3. Grouting Plant

Grout will be mixed by loading hopper conditioned PFA and bagged OPC directly into a rotary paddle mixer. Water will then be added to the mix to produce grout of the correct consistency.

The grout will be mixed and injected under hydrostatic head using a 50mm diaphragm pump operating at around 100 psi (6.9 bar) and will be pumped via 50mm reinforced grout hoses into the boreholes.

The grout mixer will be capable of producing a homogenous mix, with all particles being thoroughly wetted and without segregation occurring.

6.4. Grout Mixes

With consideration to the future use of the area, the filling material shall generally consist of a PFA:cement grout which should be mixed in the proportions of up to 10:1 where water is present, but which may range up to 20:1 in dry conditions.

It is anticipated that a 12:1 mix will be utilised at this site although the exact proportion of the mix to be used at any one time shall be as instructed by the GE.

Where excessive lateral flow of grout is anticipated or when voids greater than 500mm are encountered, the addition of sand or pea gravel to the mix in accordance with CIRIA SP32 may be utilised if agreed with the GE. The specified grout mix shall have the minimum water content consistent with effective pumping.

The actual proportions to be used initially for the various grouts shall be agreed with the GE paying due regard of the conditions met in drilling and the results of any trial grouting carried out before work commences.

6.5. Grout Properties and Testing

With water / (cement and PFA) ratios generally in the range of 0.4 to 0.45, (including the moisture in the aggregates), the mixes proposed should produce pumpable grout with flowability readings of between 300 to 600mm, when measured in a meter of the “Colcrete” type.

The sample for the flowability test shall be obtained by the grouting Contractor at the point of injection i.e. from the end of the tremie pipe. A minimum of two flowability tests per week shall be performed by the Contractor.

High-bleed grouts shall be avoided. Bleed capacity should be limited to 5% maximum unless agreed otherwise.

A minimum of two bleed capacity tests shall be performed by the Contractor per shift. The sample of grout for the test shall be taken from the point of injection i.e. the end of the tremie pipe.

Bleed capacity shall be measured in a clear plastic or glass graduated cylinder which has an internal diameter not less than 50mm and with a volume of approximately 1000ml. After placing the grout, a cover shall be placed over the cylinder to avoid evaporation. Bleed capacity shall be read at hourly intervals for neat cement grout, and readings should continue for not less than 3 hours. For PFA:cement grouts readings should continue for not less than 6 hours.

The Contractor shall prepare two sets of test cubes of grout from one batch of grout per week.

Each cube shall be of 100mm side, and shall be taken from the grout at the point of injection i.e. the end of the tremie pipe.

At the instruction of the GE, the Contractor shall arrange for them to be tested by crushing at 7 and 28 days in accordance with BS1881. The testing shall be carried out by an independent laboratory.

The mixes shall produce cubes with crushing strengths of not less than 0.7MN/m^2 at 28 days (Note: the 7 day test is performed to indicate that the 28 day strength is achievable i.e. a 7 day value of about 0.4MN/m^2 would probably be considered on target).

If the GE considers the results of the test indicate that a change of mix proportions is required, the Contractor shall make such modifications as the GE may direct.

6.6. Drilling Procedures for Treatment of Shallow Mineworkings

Prior to works commencing on site a numbered borehole layout must be submitted to the GE for approval. Any deviations from this proposed layout including drilling of the additional secondary and tertiary holes shall be recorded by the Contractor and a revised borehole location plan provided to the Engineer.

All boreholes to be used for the injection of grout, including those which strike coal pillars, shall be drilled by rotary or rotary percussive techniques down to 0.5m beyond the base of the workings in the seams to be treated. The drilling system and flushing medium to be used shall be as instructed on the CA licence, and approved by the Engineer. The Contractor shall allow for the provision of appropriate dust suppression for those holes that are to be drilled near sensitive receptors (e.g. nearby houses, highways, active commercial properties, car parks and public footpaths).

If multiple workings within seams are encountered and flush is lost, the upper seam will require treatment, prior to drilling and grouting the lower seams.

All boreholes are to be cased through made ground and soft soils to prevent holes collapsing.

Water will be required as the flushing medium in boreholes within 50m of any receptor properties.

Boreholes drilled for the treatment of the plots will ensure the zone of consolidation extends beyond the building footprint, based upon anticipated grout flows

The minimum diameter of the holes shall be 75mm unless otherwise specified by the Engineer. When it is impracticable to drill at the minimum diameter for the full depth, the diameter of the borehole shall be increased in the upper lengths.

Boreholes shall be temporarily cased through superficial deposits down to the rockhead and if directed by the Engineer, down through the rock strata. The boreholes shall be kept open until grout injection into the workings and rock is complete.

Where a borehole proves abortive because it becomes obstructed, it shall be re-drilled in a suitable location as directed by the Engineer, at a larger diameter and re-cased.

During the course of the works, the Engineer will review the borehole records generated, and will review the potential for the presence of workings at shallow depth below rockhead elsewhere on the site. If so required, the Engineer shall instruct the Contractor to undertake supplemental investigation boreholes in areas out with the proposed drill and grout programme, to confirm the presence or otherwise of workings at shallow depth. If such workings are suspected or identified, the drill and grout programme shall be extended to treat such areas.

The Contractor is expected to recover all steel borehole casing employed in any hole and no payment will be made for any casing abandoned in any hole on completion of the Contract.

6.7. Grouting Procedures for Shallow Mineworkings

The aim of the stabilisation work is to substantially fill any old workings within the worked seams as well as any voids or broken ground found within the overlying strata in order to prevent the development of crown holes at the surface / foundation level.

Perimeter grout walls, if required, shall be installed by filling boreholes drilled at 1.5m centres with a viscous grout composed of appropriate proportions of cement, PFA, sand or pea gravel and water. The mix, proportions and method must be agreed with the Engineer.

Pressure need not be applied to the grout in perimeter boreholes unless required by the Engineer.

Unless specified otherwise, the section of the perimeter wall at the deepest part of the seam shall be constructed first.

Immediately prior to grouting each borehole, the Contractor shall check that it is unobstructed to the required depth to receive the tubing or tremie pipes for grout injection. Obstructions shall be dealt with as described in ‘drilling procedures’ above.

Grout shall be injected into each hole via an approved flexible tube, or series of steel tubes, placed to the base of the hole or to such other depth to receive the tubing or pipes for grout.

Grouting shall proceed upwards from the base of each borehole to the base of the surface deposits. It is not intended that, as a general rule, significant quantities of grout shall be injected into the surface deposits unless specified otherwise. This requirement will be subject to Engineer review.

The grout shall be injected at the approved rates until grout appears near the point of injection, when the borehole shall be deemed complete. If the criteria is reached quickly, the grout tubes shall be lifted to check that a local obstruction is not preventing flow of the grout into the strata.

Hydrostatic pressure shall be applied to the grout in every borehole. If grout has not appeared at the point of injection after five tonnes of grouting materials have been introduced then sand and / or pea gravel (gravel which passes through a 6.33mm sieve and is retained on a 2.36mm sieve) may be added to the mix or placed down the borehole.

Treatment of adoptable highways will generally be undertaken as per the plots although should a borehole within the highway accept more than 6 tonnes of grout, treatment within the hole will be suspended for 12 hours. Thereafter further grout will be injected in two tonne batches. If pressure has not been achieved or grout appeared after a total of 10 tonnes of grout has been placed then a review of the borehole grid spacing, grout mix and materials used will be undertaken.

6.8. Stabilisation Procedures for the Treatment of Mine Entries / Bell Pits

If any former mine shafts / bells pits / adits etc. are encountered on site these shall be stabilised in accordance with the recommendations given in the NCB handbook *'The Treatment of Disused Mine Shafts and Adits'* and CIRIA SP32.

All work on or about old mine shafts must be carried out from a safety platform of adequate dimensions that will span the potential collapse zone and support the crew and equipment should a catastrophic failure of the shaft occur.

Prior to work commencing the area will be inspected to ensure that the safe movement of heavy equipment can proceed. This will be carried out by a competent, experienced person who will be securely fastened to the surface by means of a full body harness anchored beyond the shafts.

If any shaft is found to be open from the surface, then it shall be backfilled with graded material. Any such material will be introduced directly into the shaft from the surface utilising equipment such as a 360 excavator or conveyor.

If the shaft is backfilled then reversed stage pressure grouting of the infill material will be undertaken. Such treatment is achieved by a combination of permeation grouting and low pressure compaction grouting of the infill material which forms an enhanced bond between the infill and the shaft lining / competent rock.

Treatment will therefore be undertaken in the following manner.

A rigid steel and wooden shaft frame will be then mounted over the shaft mouth to ensure that any slumping of the shaft infill will not jeopardise the stability of the drilling rig and the safety of the crew.

Once the safety frame is in place, the drill rig will be positioned over the shaft to allow the sinking of a centrally located borehole through fill material.

Treatment will involve the drilling of a single borehole to the base of the shaft and at least three metres in to natural strata. This is to ensure that no "staging" is present within the shaft and that the actual shaft base has been reached. Shaft staging would typically be encountered within the first 50m below ground within shafts although no hard or fast rules can be applied to this. Staging can be a problem if, over time, it deteriorates to such an extent that catastrophic failure of the infill material occurs.

On completion of the first borehole temporary steel casing will then be inserted into the borehole. This casing forms the basis of the reversed stage pressure grouting technique.

The grouting operation will commence on completion of the probehole and will involve direct injection down the borehole under pressure through the drill rods or casing in ascending 3m stages.

The grout will possess water: solids ratio of no more than 40% giving an approximate compressive strength at least 0.7N/mm^2 at 28 days.

Grout will be mixed by loading hopper conditioned PFA and bagged OPC directly into the mixer via a front loading shovel and by hand. Water supplied from the approved water source will be then be added to the mix to produce grout of the correct consistency.

The grout mixer will be capable of producing a homogenous mix, with all particles being thoroughly wetted without segregation occurring.

The grout will be mixed and injected using a 50mm diaphragm pump operating at around 100 psi and will be pumped via 50mm reinforced grout hoses into borehole. This will continue until either a

maximum pressure is reached or refusal of grout occurs. A length of casing will then be extracted, and the process repeated until the complete length of the shaft has been treated.

Should any significant thickness of permeable / granular fill be present on site, grouting may need to be terminated at the level of the base of such material.

If any significant voids are encountered during the operation, a grout / pea gravel mix will be introduced into the borehole to restrict excessive movement of grout. However, should any major mining feature such as roadways running off the shaft are suspected these will require investigation and treating separately from the shaft.

On completion of the treatment of any mineshafts, the shafts will need to have an appropriately designed reinforced concrete cap installed. The cap should be designed by an appropriately qualified structural engineer. The design should be approved by the regulators and appropriate warranty providers. If buildings are to be located above the shaft these will need to be adequately designed, with approval of the Coal Authority.

6.9. Services and Roads

The Contractor shall take all necessary precautions, including making all reasonable liaison with the Client, to ascertain the positions and depths of underground services and drains passing through the site, making full allowance for working around and protecting live services and drains.

The Contractor shall be responsible for maintaining close liaison with the Local Authority and statutory utilities undertakers so as to avoid any disruption of the existing services. The Contractor shall keep the public and private roads clear from all obstructions other than those permitted by the police and highway authority or the owners, and shall abide by all other police regulations.

When introducing grout into any borehole, the Contractor shall ensure by regular inspections throughout the day that the grout is not entering adjacent drains, services, culverts and ducts. In the event that any such leakage is detected the Contractor shall immediately suspend the grouting operations and commence to remove any accumulated grout.

6.10. In Situ Testing

When directed by the GE, the Contractor shall test the consolidated ground for permeability and strength.

Permeability by grout acceptance testing shall be checked by drilling test holes in positions to be selected by the GE and injecting grout at pressures appropriate to the depth, all in accordance with the requirements for infilling grouting. If the GE considers that the quantities of grout accepted are excessive, further holes shall be drilled and grouted at the rates and prices agreed.

After testing, boreholes shall be completed in accordance with the requirements for grouting infill holes.

In general, test holes will be undertaken below selected plots and along the adoptable highways adjacent to boreholes exhibiting grout taken in excess of 6 tonnes.

6.11. Records

The Contractor shall prepare and keep available for inspection on site, plans showing the positions of all boreholes, daily drilling records (see below), together with the total amounts of grout injected. Levels shall be given with reference to a datum to be confirmed by the GE.

The plans shall be updated daily in conformity with the Records noted below. On completion of the works, the Contractor shall give fair copies of the plans and sections to the GE within one week of completion of the programme of grouting.

As works proceed, the Contractor shall maintain separate daily records for drilling, for grouting and for materials and plant received in a form to be approved by the GE. The daily records signed by the Contractor's agent shall be submitted each day to the GE for his / her agreement. The Contractor shall provide one copy of the agreed record for the GE's retention and keep a further copy available for inspection on site.

Daily drilling records shall be provided for each borehole and contain the following information:

1. Job title and location
2. Borehole reference number
3. Date
4. Contractor's name
5. Plant in use, crew members and hours worked
6. Method of boring or drilling

7. Type, diameter and depth of casing used
8. Diameter and depth of hole at the beginning and end of each working day or shift
9. Loss of any flushing medium during drilling
10. Standing time, with reason, or time lost overcoming obstructions
11. Details of underground services located
12. Details of any settlement or ground heave
13. Daily and cumulative length drilled
14. Depth to each major change of stratum
15. Description, with identification, of the stratum and whether it is intact or broken
16. Each depth at which groundwater is encountered (if apparent), the depth to which it rose and any steps taken to stop the flow
17. Depths at which any samples are taken
18. Details and results of any permeability tests instructed by the RE
19. Details of any voids or suspected workings
20. Details of any emissions of gas, water, etc.
21. Depth of completed borehole

Daily grouting records shall be provided for each borehole and contain the following information:

1. Job title and location
2. Borehole reference number
3. Date
4. Contractor's name
5. Plant in use, crew members and hours worked

6. Details of type of injection grout-line dimensions and length of standpipes inserted
7. Type of grout mix and volumetric quantity injected including total quantity by weight by each type of grouting material introduced
8. Grout pressures recorded, with the corresponding depths
9. The results of all flow and bleed tests
10. Details of casing abandoned
11. Details of grouting materials delivered to the site and a running total of each of the materials delivered
12. The nature, frequency and results of all inspections of services to check for grout penetration
13. Details of all stoppages or delays and any other relevant information

The daily records of materials and plant received shall show in particular that day's quantities by weight of each type of material and cumulative quantities. With the daily records, the Contractor shall submit to the GE copies of receipts or invoices for all materials delivered and he shall keep them on site until the Works are complete.

Notwithstanding the information listed above, the Contractor shall provide any other information required by the GE.

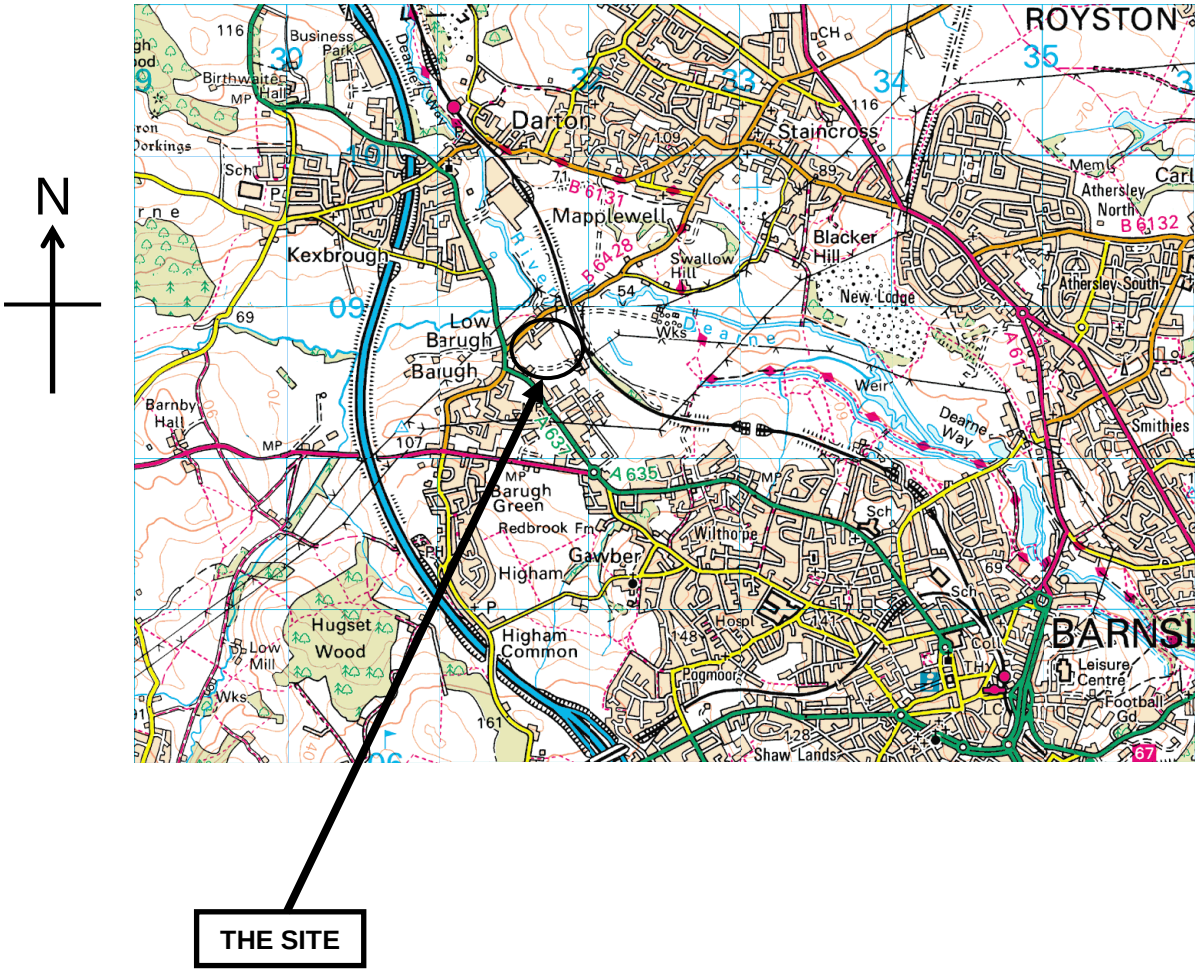
On completion of the drill and grout programme, the GE shall prepare a validation report containing copies of borehole records, a borehole location plan, procedures followed during the works, the results of validation boreholes and pressure tests, and a record of any deviation from this specification.

APPENDIX A

FIGURES AND DRAWINGS

Site Location Plan

Contract Number	**C6054**
Contract	**Barugh Green, Barnsley**
Client	**Barratt and David Wilson Homes (Yorkshire West) Ltd**



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Scale	1:50,000		
Drawn by	AMG	**Approved**	AMG
Drawing Number	C6054/RS/01		

N

Dearne River
Barugh House Farm
Water Mill Court
A 637
B 6428
Pylon
Drainage ditch
Electricity Substation
Fuel Suppliers / Sales (Coal)
BARNSLEY ROAD
DEARNE HALL ROAD
DEARNE HALL FOLD
Agricultural fields
Railway Line (Embankment)
Overhead Power Lines
Residential
Former Coalite works
ROYAL COURT
Royal Hotel
(PH)
Church
SHAW
Car Park
Residential dwelling and garden
Overhead Power Lines
Transformer Station (former Coke and By Product works and latterly a refuse tip)
MOT Garage
CLAYCLIFFE ROAD
LANGDALE ROAD
HOLMWOOD DRIVE
GRESHAM CROFT
DOVEDALE WAY
Distribution Centre
WHALEY ROAD


View of River Dearne to North


View to North


View to South West


View of waterlogged area - South


View to East - Car Park


MOT Garage (Off-site) - South


Transformer Station (Off-site) - East

NOTES

Current Features

- Area Investigated by Sirius in July 2006
- Site Boundary - Additional Areas (2012)
- Flow Direction
- Slope Direction
- Heavily Waterlogged
- Pond
- Heavily Vegetated (long grass, mature trees and low lying shrubs)
- Area of raised embankment
- Electricity substation

Historical Features

- Area of former railway cutting / embankment
- Location of former depot
- Former reservoir / infilled
- Former route of canal / infilled
- Former well
- Former pond features / infilled
- Former cooling ponds / infilled

All historical feature locations are approximate

REVISION		BY	DATE
0	For Information	AG	18/05/17
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

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FAX: 0113 264 9962

CLIENT

Barratt and David Wilson Homes (Yorkshire West) Ltd

SITE

Barugh Green, Barnsley

DRAWING TITLE

Site Features Plan

DRAWING NO.	REVISION NO.
C6054/RS/02	0
DRAWN BY: AG	APPROVED BY: AG
DATE: May 2017	SCALE: NTS	PAPER SIZE: A1

N

DEARNE

El Sub Sta

DEARNE HALL FOLD

39 2 82 1 12 24 9 22

boundary - mixed species

boundary - mixed species

5m maintenance access strip kept clear of scrub

YOUTH PROVISION

NEAP

JUNIOR PROVISION

dense undergrowth

ditch

mature oak trees

hawthorn/birch dense undergrowth

tarmac

overgrown area

tarmac

galvanised security fence

ditch

mature oak trees

wire fence

ditch

mature oak trees

hawthorn/birch dense undergrowth

tarmac

overgrown area

tarmac

galvanised security fence

marshy area with ponding

overhead power lines

overhead power lines

wire fence

stone track

galvanised security fence

wire fence

stone track

galvanised security fence

wire fence

stone track

Overhead power lines

Overhead power lines

Approximate extent of proven shallow mine workings

Garage

NOTES

- Drill and Grout Borehole for Plots (3m Grid Spacing)
- Drill and Grout Borehole for Roads (6m Initial Grid Spacing)

REVISION

0	>>
A	>>
B	>>
C	>>
D	>>

sirius

CLIENT

BARRATT AND DAVID WILSON HOMES (YORKSHIRE WEST) LTD

SITE

BARUGH GREEN, BARNSLEY

DRAWING TITLE

INDICATIVE DRILL AND GROUT LAYOUT

DRAWING NO.	REVISION NO.
C6054/DG/04	0

DRAWN BY	APPROVED BY
AMG	AMG

DATE	SCALE	PAPER SIZE
May 2017	1:500	A1

KEY

- Existing trees to be retained (refer to tree survey & report by JCA Ltd for details)
- Existing trees to be removed
- Existing grassland to be retained
- Proposed Extra heavy standard (14-16cm girth) tree
- Proposed heavy standard (12-14cm girth) tree
- Proposed selected standard (10-12cm girth) tree
- Proposed standard (8-10cm girth) tree
- Proposed light standard (6-8cm girth) tree
- Proposed Beech hedging
  Proposed evergreen flowering hedge (Escallonia)
  Proposed evergreen hedging (Laurel)
- Proposed photinia hedge
- Proposed native hedge
- Proposed mixed species native trees and shrubs
- Proposed mixed species native shrub planting
- Proposed ornamental shrub planting
- Proposed turf
- Proposed grass seed to rear gardens
- Proposed amenity grass seed
- Proposed wildflower grass seed
- Proposed 1800mm high close boarded timber fencing (detailed by others)
- Proposed 1800mm high brick wall / fence (detailed by others)
- Proposed division fence (detailed by others)
- Proposed 1100mm high vertical metal railing (detailed by others)
- Proposed 450mm high timber trip rail (detailed elsewhere)
- Proposed compacted stone footpath (detailed elsewhere)
- Proposed block paving (detailed by others)
- Proposed mounding (maximum 1.5m above prevailing ground levels)

NOTES

PROTECTION OF EXISTING VEGETATION

The majority of the existing trees and scrubby vegetation to the boundaries shall be retained and protected where necessary during the works by 2.3m high metal mesh fencing secured to a scaffold tube framework, all in accordance with BS 5837:2012. The protected area shall remain an exclusion area throughout the construction period and suitable signs shall be fixed to the fencing at no less than 10 metre intervals (or at any change in direction) stating that the area is a tree protection exclusion zone. The fencing shall remain fixed in place through out the construction period. No chemicals or building materials which may potentially contaminate the soil shall be stored within 5metres of the protected area and no bonfires shall be lit within 5m of the canopy spread. In the event that any excavation work is required within the protected area for the erection of garden fencing, for example, this shall be carried out by hand. Where retained vegetation needs to be cut back/ lifted to enable fencing to be erected, this shall be done in accordance with the requirements of BS3998:2010 by qualified and certified tree surgeons and overseen by the consultant Landscape Architect as required.

PROPOSED TREE PLANTING

In order to protect the rural character on the southern and western boundaries, at the new settlement edge, new tree planting will consist of predominantly mixed native species chosen to complement the existing composition as well as be in keeping with the scale of the garden areas. On the northern boundary with Yew Tree Lane, tree planting will be carried out within the front garden areas to the new dwellings to extend the retained line of trees to the south-eastern conner in front of proposed plots 1-3.

Within the site tree planting of ultimately large growing native tree species (or their cultivars) is proposed around the central area of open space. This will, in conjunction with the retained trees and new road frontage and rear garden planting, help to soften the built form and filter views into the site from the south, south-west and north. e, trees will be planted into front gardens to soften the building line and filter views of the development from this aspect.

Trees will be selected from the following indicative but not exhaustive list.

Species to be chosen from:

- Acer campestre (Ac)
- Acer campestre 'Streetwise' (AcS)
- Acer platanoides (Ap)
- Aesculus hippocastanum (Aeh)
- Alnus glutinosa (Ag)
- Alnus incana (Ai)
- Amelanchier lamarkii (Al)
- Betula pendula (Bp)
- Betula pubescens (Bpub)
- Carpinus betulus (Cb)
- Carpinus betulus 'Frans Fontaine' (ChFF)
- Corylus columa (Cc)
- Fagus sylvatica (Fs)
- Malus sylvestris (Ms)
- Pinus sylvestris (Psyl)
- Prunus padus (Ppad)
- Prunus padus 'Albertii' (PpA)
- Prunus serrula (Pse)
- Pyrus calleryana 'Chanticleer' (PyC)
- Quercus robur (Qr)
- Quercus rubra (Qrub)
- Sorbus aria (Sa)
- Sorbus aucuparia
- Sorbus 'Embley' (Se)
- Sorbus 'Joseph Rock' (Sj)
- Tilia cordata (Tc)
- Tilia cordata 'Greenspire' (TGs)
- Tilia x europaea (Txe)

Foundation design of new buildings shall accommodate proposed tree planting in accordance with NHBC guidelines.

LANDSCAPE PROPOSALS TO PUBLIC OPEN SPACE AREA

The proposed Public Open Space (POS) for this development runs around the eastern and southern boundaries of the residential area. This drawing shows the proposals for the whole of the POS southern boundary and part of the proposals for the eastern side of the development. For the remaining proposals on the eastern boundary please refer to FDA drawing nr. R/1667/2.

It is proposed that the existing grassland and woody vegetation be retained along the south and south-east of the POS since this part of the site can remain unaffected by the development. The proposals for the southern area area are ultimately to create a naturalistic landscape into which new blocks of native trees and shrubs are introduced along the residential road to soften the development and provide a transition between the open space and the built form. An informal compacted stone path will provide access though this linear space linking through to the larger area of open space to the east of the development. A mown edge to the footpath will define the route through the space and provide areas for passive leisure and seating. Beyond the mown edge any areas disturbed by the works will be sown with a wildflower meadow grass to complement the existing sward.

PROPOSED TREE PLANTING

In order to protect the rural character of this part of the development, new tree planting will consist of a relatively small palette of native species based on the composition of the existing cover together with a small number of additional native species to increase the biodiversity and habitat vaue of the area. Trees will be planted as either extra heavy standard or selected standard to provide a degree of instant maturity.

Trees will be selected from the following indicative but not exhaustive list.

- Acer campestre (Ac)
- Acer platanoides (Ap)
- Aesculus hippocastanum (Aeh)
- Alnus glutinosa (Ag)
- Alnus incana (Ai)
- Amelanchier lamarkii (Al)
- Betula pendula (Bp)
- Betula pubescens (Bpub)
- Carpinus betulus (Cb)
- Corylus columa (Cc)
- Crataegus monogyna (Cm)
- Fagus sylvatica (Fs)
- Malus sylvestris (Ms)
- Populus nigra (Pn)
- Prunus avium (Pa)
- Prunus padus (Ppad)
- Prunus padus 'Albertii' (PpA)
- Prunus serrula (Pse)
- Quercus robur (Qr)
- Quercus rubra (Qrub)
- Sorbus aria (Sa)
- Sorbus aucuparia
- Tilia cordata (Tc)
- Tilia cordata 'Greenspire' (TGs)
- Tilia x europaea (Txe)

For trees planted near proposed dwellings the foundation design of the new buildings shall accommodate proposed tree planting in accordance with NHBC guidelines.

Rev.C: Amended in line with technical layout G (SEL)	May 17
Rev.B: Amended to latest client layout Rev.E	Dec 15
Rev.A: Amended to latest client layout	Sep 15

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client: Barratt Homes Yorkshire West

project: Residential Development
Low Barugh, BARNSLEY

drawing title: LANDSCAPE MASTERPLAN

scale	date	drawn by	drawing
1:500	Dec. 2014	EW/JT	R/1667/1B-1

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