Earthworks
Conceptual Site Models

The Chiltern Railways (Bicester to Oxford Improvements) Order 2012

Version 1
November 2013

www.erm.com

The world's leading sustainability consultancy

ERM

Chiltern Railways

Earthworks Conceptual Site Models: *The Chiltern Railways (Bicester to Oxford Improvements) Order 2012*

November 2013

Prepared by: Emma Arnold and Claire Byrne

For and on behalf of
Environmental Resources Management

Approved by: Phil Crowcroft

Signed:

Position: Partner

Date: 12 November 2013

Environmental Resources Management Limited
Incorporated in the United Kingdom with registration number 1014622
Registered Office: 2nd Floor, Exchequer Crt, 33 St Mary Axe, London, EC3A 8AA

CONTENTS

FIGURES

TABLES

ANNEXES

1 INTRODUCTION

1.1 TERMS OF REFERENCE

The Chiltern Railway Company Ltd ('Chiltern Railways') assisted by Network Rail, has retained Environmental Resources Management Ltd ('ERM') to manage the discharge of planning conditions associated with improving the railway between Oxford and Bicester.

1.2 BACKGROUND TO THE SCHEME

In October 2012, the Secretary of State made the Chiltern Railways (Bicester to Oxford Improvements) Order 2012 ('the Order'). This Transport and Works Act Order authorises the construction and operation of an improved railway between Bicester and Oxford. The Order is accompanied by a planning direction (or 'deemed planning permission') granted by the Secretary of State, which is subject to a number of conditions.

The Order is being implemented by Chiltern Railways assisted by Network Rail.

1.3 PLANNING CONDITIONS RELATING TO LAND QUALITY

In relation to land quality/contaminated land, Condition 11 set out in Annex 1 of the deemed planning permission requires that:

'*No development shall commence…until a scheme to establish the presence or otherwise of, assess and, if necessary, remediate contamination at that location, which is likely to cause significant harm to persons, pollution of controlled waters or the environment within that section….*

It requires that a scheme of investigation be '…submitted to and approved in writing by the local planning authority, in consultation with the Environment Agency.'

The planning condition also notes that the scope of the scheme should include '*all of the potentially contaminated sites identified in Figures 15.1A to 15.1Q in Volume 3 of the Environmental Statement*' and specifically identifies the following areas of interest:

- Bicester Town, Islip, Water Eaton Parkway and Oxford station works; and
- sites of the proposed bridges, culverts or other below ground structures.

If the remediation of land contamination is required at any location, Condition 11 states that '*all remedial measures shall be undertaken before development at that location is commenced, unless agreed in writing with the local*

planning authority. Further, that a verification report is provided to demonstrate that the 'agreed remediation has been completed and that the necessary degree of decontamination has been achieved'.

In the event that previously unidentified contamination is encountered during development, '*no further construction shall be undertaken at that location ,unless otherwise agreed in writing with the local planning authority, until a scheme to assess and remediate that contamination… has been submitted to and approved in writing by the local planning authority, in consultation with the Environment Agency'.*

1.4 SCOPE AND OBJECTIVES OF THIS REPORT

The structures, earthworks and stations along the route that are to be newly constructed or redeveloped were assessed to identify the potential for them to be impacted by current or historical contaminative land uses. This assessment was presented in the Scheme of Investigation(1) that was previously submitted in support of the partial discharge of Planning Condition 11.

This report discusses the earthworks (embankments and cuttings) between Bicester Chord and Wolvercote Tunnel, but excluding Bicester Chord itself which is discussed in a separate report. After the initial assessment, those sections in which no historical or current potentially contaminative land uses were identified were discounted from further assessment, as they were considered unlikely to represent a significant risk to either human health or the environment. .

Further details of the sites with potential contamination are discussed in the relevant Sections of this report. The sections of earthworks carried forward comprise:

- Section B1 of approximate chainage 112100 to 111500
- Section D1 of approximate chainage 115440 to 115260
- Section D2 of approximate chainage 116380 to 116060
- Section E1 of approximate chainage 120720 to 120240
- Section H1 of approximate chainage 125960 to 125580

The locations of these earthworks along the route are presented in *Figure 1*. Bicester Chord, the stations (and any associated bridges), footbridges and overbridges, and other structures will be discussed in separate reports.

The objectives of this report are to:

- develop a desk-based preliminary conceptual site model for each of the sections of earthworks along the route that have potential to be impacted by current and historical contaminant sources.

(1) ERM '*Scheme of Investigation for Land Contamination: The Chiltern Railways (Bicester to Oxford Improvements) Order 2012'* for Chiltern Railways. Version 1, May 2013.

- determine the need, if any, for further intrusive investigation at each of the sections of earthworks, based on an evaluation of the likely exposure and its potential significance to identified receptors.

- propose a scope of further works for each of the sections of earthworks, where required.

1.5 REPORT STRUCTURE

Each Section of this report discusses an earthworks section and includes the following sub-sections:

- Site Location and Proposed Development
- Design of Structure
- Environmental Setting - including geology, hydrogeology and hydrology.
- Observed Impacts and Analytical Results
- Preliminary Conceptual Site Model – including quantitative risk assessment as appropriate.
- Conclusions and Recommendations

1.6 SOURCES OF INFORMATION AND ASSUMPTIONS

The sources of information that have been used in the production of this report are presented in *Table 1*.

Table 1 Data Sources for the Desk Study Assessment of Potential Contaminant Sources, Potential Contaminant Receptors and Exposure Pathways

Information	Data Source(s)
Site location and proposed development	Online aerial photography, OS mapping, EA WIYBY(1) (landfill and pollution data), site visits, engineering AIP(2) documents, communication with local authority contaminated land officer.
Design of structure	Engineering AIP documents
Site history	Historical OS maps from Envirocheck(3), EA WIYBY (historical landfill data), communication with local authority contaminated land officer.
Geology	BGS 1:50,000 geological maps Sheet 219 *'Buckingham'* Solid & Drift ed., Sheet 236 *'Witney'* Solid and Drift ed. and Sheet 237 '*Thame*' Solid & Drift ed., BGS logs, Atkins ground investigation data.
Hydrogeology	Abstraction information obtained from EA under licence, EA WIYBY (groundwater topics), Atkins ground investigation data.
Hydrology	OS mapping, online aerial photography, EA WIYBY,RBM plans, site visits, abstraction information obtained from EA.
Designated ecological sites	English Nature website, communication with ERM ecologists.

(1) EA WIYBY – Environment Agency *'What's In Your Back Yard'* online database
(2) AIP – Atkins *Approval In Principle Form F001* various documents dated December 2012
(3) - Envirocheck reports 27207959_1_1, 27207960_1_1 and 27207961_1_1 *'Chiltern Railways Project Evergreen 3'* 5 February 2009

A site visit was undertaken for Section E1 in the vicinity of Islip station on 8 May 2013 in order to clarify the site setting of the cutting in relation to the adjacent disused oil depot and to determine whether any seepages were visible in the cutting wall at this location. No other site visits were undertaken because the desk-based review was considered to be sufficient for the other locations.

The study areas used for the sites are the same as those used in the Environmental Statement[1] and are listed in *Table 2*.

Table 2 ***Study Areas Assessed in Desk Study Review***

Information	**Study Area**
Potential historical and current sources of contamination	500 m buffer from the centre line from Bicester South Junction and A41, and from Peartree Park & Ride to Oxford station. 100 m buffer from the centre line in the rural section between the urban ends (from A41 to Peartree Park & Ride)
Human neighbours	500 m radius from feature.
Geological strata	Within the Limit of Deviation* of the site.
Aquifer designation and groundwater vulnerability	Within the Limit of Deviation of the site.
Groundwater source protection zones	1 km distance either side of the centre line.
Surface water courses	500 m distance either side of the centre line.
Licensed surface water abstractions	500 m distance either side of the centre line.
Designated ecological sites	500 m buffer from the centre line from Bicester South Junction and A41, and from Peartree Park & Ride to Oxford station. 100 m buffer from the centre line in the rural section between the urban ends (from A41 to Peartree Park & Ride)

*Limit of Deviation - the horizontal limits of where construction may occur

(1) Environmental Resources Management Ltd. '*The Chiltern Railways (Bicester to Oxford Improvements) Order Environmental Statement*' ref. 0094441. December 2009.

2 EARTHWORKS SECTION B1

2.1 SITE LOCATION AND PROPOSED DEVELOPMENT

Earthworks Section B1 is located between project chainage 112100 m and 111500 m approximately 290 m south of the A41 (*Figure 2*). The site is currently an embankment which carries the current single track railway line between Oxford and Bicester. The embankment is reportedly in poor condition and to be settling and/or spreading. It is due to be improved and widened to accommodate a second track. This section of earthworks is located in a largely rural setting with the following neighbouring land uses:

- *North-East* – Langford Park Farm
- *East* – MOD sidings with MOD undeveloped land beyond
- *South* – rural land
- *South-West* – Nature Reserve
- *West* – Sewage Works with a retail park beyond

Immediately adjacent to each side of the existing embankment are wide water-filled ditches which were observed to be overgrown with trees and smaller vegetation. The Langford Brook runs from the east towards the sewage works and is culverted beneath the existing embankment at the northern extent of this section of earthworks. A pond may be present to the immediate south-west of earthworks Section B1 located between the main line and the MOD sidings, however, it was reported as 'not present' in the Environmental Statement.

2.2 EARTHWORKS DESIGN

The Approval In Principle report (AIP) for the Bicester to Oxford earthworks(1) states that the proposed earthworks for Section B1 will comprise areas of regrading, the installation of a steel sheet pile wall and the installation of toe drains. *Figure 3* reproduces the outline designs provided in that report. Ground disturbance activities associated with the proposed earthworks are as follows:

- Slope regrading will be achieved through a soft strip of the existing embankment and benching to allow placement of the additional fill on one or both sides of the existing embankment, depending on access. The AIP drawings indicate that a sub-formation layer may be included at the base of the widened areas. The depth of the layer has not yet been determined but appears to be less than 1 m on the outline design drawings.

(1) Atkins 'East-West Rail: *Bicester to Oxford Earthworks Form F001: Approval in Principle'* 5114534-ATK-EWRP1-GE-003 Revision A01, 17th December 2012.

- The sheet piling is required to support the embankment widening due to the presence of ditches and ponds. The water-filled ditches located adjacent to the embankment are planned to be backfilled with excavated material derived from earthworks cuttings further north of the line. The ditches have been assessed and are thought to have ecological potential. It is reported that the sheet piles will be installed into the shallow water-bearing drift deposits (Alluvium and/or River Terrace Deposits). In many locations the sheet piles may penetrate the full depth of these strata and key into the impermeable clay deposits beneath. If this is considered to increase the risk of flooding caused by groundwater mounding, sheets will either be perforated or some will be installed at a shallower depth to mitigate the risk.

- The toe drains will either be open ditch or piped filter drains depending on the available land take, with open ditches being the preferred option. Both options will require excavation of the ground adjacent to the existing embankment. The design and dimensions of the drains will be determined at the detailed design stage, but given the flat topography and shallow groundwater they may be required to be oversized.

2.3 *ENVIRONMENTAL SETTING*

2.3.1 *Site History*

The railway has been in existence since before 1881 when the surrounding area was rural. In addition to the current railway line, itself a possible source of historical contamination, sites with potential for historical contamination to be present nearby comprise:

- MOD sidings adjacent to the east, constructed in the mid-1960s and still in use today.

- Sewage tanks adjacent to the west, present from before 1881and supplied by a 'sewage pipe' from Bicester. Tanks replaced by a sewage works constructed in the late 1960s .

2.3.2 *Geology*

A thin layer of River Terrace Gravels (1 m thickness) are mapped as present within the southern footprint of the proposed earthworks, however they may be locally absent on site. The bedrock geology is of Jurassic age, comprising the Peterborough Member of the Oxford Clay Formation (<2.5 m thick)(1) underlain by the Kellaways Sand Member (<5 m thick). The Kellaways Clay Member mudstone (<4 m) underlies this which in turn is underlain by the

(1) BGS Borehole Logs SP52SE77, SP52SE81

Great Oolite Group: Cornbrash Member (1-4 m) underlain by Forest Marble Member (2-7 m) and then lower Great Oolite Group Members.

Atkins undertook ground investigation for geotechnical purposes in the locality of earthworks Section B1 in 2012 and 2013. The positions of the investigation locations and the logs, and the BGS logs, are attached in *Annex A*. In relation to earthworks Section B1, WS46 was positioned on the cess support of the existing railway embankment (approximately 0.5 m high) and BH190 and BH191 were both positioned at ground level; BH190 approximately 160 m north of the southern end of the earthworks section and BH191 on the southern extent of the earthworks at approximate chainage 112120 m.

WS46 was located on the crest of the existing railway embankment which is approximately 0.5 m in height in this area. At this location the embankment is constructed from 0.2 m of ballast overlying a sand and gravel sub-base of around 0.3 m thickness.

The underlying natural strata encountered beneath the embankment in WS46 comprised 1.5 m of soft to firm orange mottled grey gravelly weathered clay. This overlies 2.4 m of stiff browney grey clay containing bands of fine sandy silt with occasional selenite crystals observed at 2.9 m begl. Dark grey silty sand was proven to 6.0 m begl. ERM has interpretted the weathered clay to be the Peterborough Member of the Oxford Clay and the silty sand to be Kellaways Sand Member.

Made Ground was encountered at ground level in BH190 and BH191 to a maximum depth of 0.7m begl and comprised 0.3m of topsoil underlain by approximately 0.2 to 0.4 m of yellow brown clayey gravelly sand containing subrounded and subangular limestone, quartz and flint. This was underlain by approximately 1 m of gravels, interpreted by ERM to be a thin layer of River Terrace Gravels. Around 2.5 m of stiff grey clay underlay the gravels in BH190 interpreted to be the Peterborough Member of the Oxford Clay. Underlying this was the Kellaways Formation in the form of a 1.5 m thickness of clay containing bands of silt (Sand Member) and a very stiff grey silty clay proven to 10.0 m begl (Clay Member Mudstone).

The underlying natural strata in BH191 comprised soft to stiff grey clay proven to 6.45 m, with many shell fragments and selenite crystals observed from 3.80 begl. The full thickness of the Oxford Clay at this location was not proved but was >4.8 m.

2.3.3 Hydrogeology

The River Terrace Gravels drift deposits located in the southern vicinity of the proposed earthworks are designated as a Secondary A drift aquifer.

The Peterborough Member of the Oxford Clay Formation (approximately 4 m thick) is designated as unproductive strata which are underlain by Kellaways

Formation Sand Member (1.5 m), designated as a Secondary A bedrock aquifer. The underlying Kellaways Clay Member Mudstone is designated as unproductive strata.

The site is not located within a groundwater vulnerability zone or a groundwater source protection zone and there are no licensed groundwater abstractions within 1 km of the site.

A groundwater seepage was encountered in the River Terrace Gravels in BH191 at 0.8m begl, with no rise in water level recorded.

Groundwater was encountered in the Kellaways Formation Sands Member in WS46 at a depth of approximately 5 m begl (strike).

A groundwater seepage was also encountered during drilling in the Kellaways Formation Clay Member Mudstone in BH190 at 6.95 m begl (strike) and a resting water level of 5.5 m begl (after 5 minutes) indicating that the water within the formation is confined by the Peterborough Member above.

2.3.4 Hydrology

The nearest named surface water course is Langford Brook which runs from the east towards the sewage works and is culverted beneath the existing embankment at the northern extent of earthworks Section B1. The EA has assessed its current ecological status in the vicinity of the site to be Moderate and predicts that it will be unchanged by 2015, although the EA evaluates that there is a risk that this may not be achieved. It does not consider that chemical quality requires assessment.

Immediately adjacent to each side of the existing embankment are wide water-filled ditches. It is understood that these water filled ditches will be backfilled during the earthworks. A pond is reportedly present to the immediate south-west of earthworks Section B1 located between the main line and the MOD sidings, although recent observations indicated that the pond may be absent. .

There are no currently licensed surface water abstractions within 1 km of the site.

2.3.5 Hydrogeological Model

Groundwater was encountered in the River Terrace Gravels where the stratum was recorded as being present. Where this unit was not present, the uppermost geological unit was the Peterborough Member of the Oxford Clay. Where present, the River Terrace Gravels Secondary A aquifer is separated from the underlying Secondary A Kellaways Formation thin Sands Member by weathered Peterborough Member which is unproductive strata. As the Peterborough Member of the Oxford Clay is likely to be >2.5 m thick in the area, it is considered that the River Terrace Gravels and Kellaways Formation Sands Member are not hydraulically connected. The underlying Kellaways

Clay Member Mudstone is also designated as unproductive strata but groundwater was observed in the form of a seepage in BH190.

The sheet piling design will penetrate the shallow alluvium and/or River Terrace Gravels and may toe into the underlying Oxford Clay. As such connectivity between the drift aquifers and the Kellaways Sands Member will be avoided.

Groundwater was encountered at 5.5 m begl within the Kellaways Formation Sand Member at WS46. There is insufficient data to infer a groundwater flow direction, but based on the topography and location of the Langford Brook, it is inferred that regional groundwater flow direction in the River Terrace Gravels as well as the Kellaways Sand Member will be towards the west to south-west, i.e. contaminants could be leaching into shallow groundwater from off-site contaminant sources and migrating towards the footprint of the earthworks widening. Therefore, there is potential for saturated and capillary zone soils to be impacted by off-site contaminant sources within the areas that will be excavated during the proposed earthworks in the area.

2.3.6 Ecological Sites

Bicester Wetland Reserve County Wildlife Site (a non-statutory designation) is located approximately 75 m to the west of the earthworks. The site is a grazing marsh and reedbed with ornithological interest.

2.4 OBSERVED IMPACT AND ANALYTICAL RESULTS

No visual or olfactory evidence of impact was noted on the available logs other than occasional clinker in the top 0.2 m of Made Ground on the crest of the embankment. At the time of reporting there were no analytical results available for earthworks Section B1.

2.5 PRELIMINARY CONCEPTUAL SITE MODEL

2.5.1 Introduction

The preliminary conceptual site model (CSM) has been developed in accordance with industry good practice. It uses the information and data presented in *Sections 2.1, 2.2, 2.3* and *2.4* to identify plausible contaminant-pathway-receptor contaminant linkages in the context of the proposed earthworks for Section B1. The findings of the CSM are used to determine the potential risks associated with land quality in the context of likelihood of unacceptable exposure of sensitive receptors.

2.5.2 *Potential Primary Sources of Contamination*

On-Site

Section B1 is an existing railway embankment. The available information suggests that in this area the embankment comprises predominantly reworked natural deposits, however, given the age of the railway, there is potential for contaminated fill materials to be present. It is also possible that the fill materials could extend into the footprint where embankment widening and toe drain installation are proposed. Given the age of the construction there is potential for these fill materials to be impacted with contaminants associated with the origin of the fill materials and railway use including oils, diesel and other organic compounds.

Off-Site

The railway track ballast on the embankment and the adjacent MOD sidings has been replaced on an 'as needed' basis typically on 20 year cycles. There is potential for the track bed to be impacted historically by creosotes seeping from wooden sleepers, and from oils, greases and diesel fuel which could leak/drip from passing trains.

Other contaminants that may have impacted the ballast include: weedkillers such as atrazine, simazine, diuron and glyphosate which may have been used in track maintenance; antifreezes such as ethylene glycol; and pathogens associated with disposal of sanitary waste from passing trains. However, herbicides, ethylene glycol and sanitary waste contaminants are considered unlikely to be present at significant concentrations because they are not persistent in the environment.

In addition to the track bed, the MOD sidings has the potential to be impacted by contaminants such as oils, greases and fuel which may have leaked/dripped from passing and stalled trains. In addition, foundations could be made up of materials that have been sourced from locally-derived wastes such as foundry slag or steam locomotive ash which could result in a wide range of potential contaminants being present e.g. phenols, polyaromatic hydrocarbons (PAHs), metals, sulphates, etc.

The current sewage works located adjacent to the proposed earthworks is a potential source of heavy metals, organic and inorganic compounds and pathogens.

Langford Park Farm, located to the immediate east of earthworks Section B1, is a potential source of contaminants including oils, fuels, sewage and slurry, pesticides and fertilisers.

2.5.3 *Potential Receptors*

The following potential receptors of soil and/or groundwater impact were identified:

- Local employees in adjacent sewage works, farm and MOD sidings
- Local residents 100 m to east in Langford Park Farm
- Langford Brook at the northern extent of the proposed earthworks
- River Terrace Gravels Secondary A aquifer
- Bicester Wetland Reserve adjacent to west of the earthworks

Groundworkers are discounted from this assessment because they will be protected through health and safety systems and controls during the works. It is anticipated that procedures for worker protection will be covered by method statements which will be produced by the contractor.

Other human receptors are discounted from this assessment because the site is located in a rural setting. It is not expected that any member of the public would spend any prolonged periods of time being exposed to the ground surrounding the earthworks and therefore, significant exposure is considered unlikely.

Below ground structures are discounted from this assessment because the engineers (Atkins) are independently evaluating soil and groundwater chemical data in order to finalise detailed design requirements and to ensure that suitably chemically-resistant construction materials are used.

2.5.4 *Evaluation of Potential Contaminant Linkages*

Table 1 provides an evaluation of the potential contaminant linkages to determine which are considered to be plausible.

2.6 *CONCLUSIONS AND RECOMMENDATIONS FOR SECTION B1 EARTHWORKS*

The Code of Construction Practice (CoCP)(1) provides mitigation measures that remove the pathways from most of the identified potential contaminant linkages. The plausible linkages that remain theoretically possible are those associated with the potential to mobilise on- and off-site contaminants during the earthworks proposed for Section B1. The ultimate receptors for this mobilisation could be Langford Brook (on-site), the near-surface Secondary A aquifer (River Terrace Gravels) and Bicester Wetland Reserve.

The excavation works for the sub-formation layer and toe drain are likely to be shallow (<1 m) so vertical mobilisation into the underlying Kellaways Sand

(1) Environmental Resources Management Ltd. '*Chiltern Railways (Bicester to Oxford Improvements) Order Code of Construction Practice*' v.5. ref. TWA/10/APP/01/Oxford/ALL/C18/CoCP. April 2013.

Member Secondary A aquifer is not considered likely. The sheet piling will also be designed to prevent vertical migration.

No chemical data is available for earthworks Section B1, however, an evaluation of the available borehole logs on and around the existing embankment does not indicate that significant organic contamination is present derived from the embankment itself or the adjacent farm or MOD sidings (the sewage works is likely to be upgradient of the earthworks).

Taking into account the relatively thin layer of terrace gravel found over part of the embankment, and the underlying cohesive layers of soils, it is considered that the proposed earthworks are unlikely to significantly increase the mobilisation of any groundwater contamination that may be present. During excavation, any contamination that may be encountered will be removed as part of the redevelopment of the site, in effect remediating it through the SWMP. Based on the data available to date, it is not envisaged that contamination will require chasing out.

It is recommended that this information is provided to the construction contractor to ensure that an awareness for potential contamination to be present is communicated to all employees and sub-contractors working at the site.

3 SECTION D1 EARTHWORKS

3.1 SITE LOCATION AND PROPOSED DEVELOPMENT

Earthworks Section D1 is located between project chainage 115260 m and 115440 m approximately 1 km south-east of Wendlebury village and immediately south of the M40 (*Figure 4*). The site is currently an embankment which carries the current single track railway line between Oxford and Bicester. It is due to be improved and widened to accommodate a second track. This section of earthworks is located in a rural setting surrounded by agricultural land. Manor Farm landfill is located approximately 160 m to the north-west.

3.2 EARTHWORKS DESIGN

The AIP report states that the proposed earthworks for Section D1 will comprise areas of regrading and the installation of toe drains. *Figure 5* reproduces the outline designs provided in that report. Ground disturbance activities associated with the proposed earthworks are as follows:

- Slope regrading will be achieved through a soft strip of the existing embankment and benching to allow placement of the additional fill on one or both sides of the existing embankment, depending on access. The AIP drawings indicate that a sub-formation layer may be included at the base of the widened areas. The depth of the layer has not yet been determined but appears to be less than 1 m on the outline design drawings.

- The toe drains will either be open ditch or piped filter drains depending on the available land take, with open ditches being the preferred option. Both options will require excavation of the ground adjacent to the existing embankment. The design and dimensions of the drains will be determined at the detailed design stage, but given the low-lying, flat topography, they may be required to be oversized to accommodate the likely volume of surface run-off.

3.3 ENVIRONMENTAL SETTING

3.3.1 Site History

The railway has been in existence since before 1875 in a similar rural setting to today. In addition to the current railway line, itself a possible source of historical contamination, the only site with potential for historical contamination which is present nearby is Manor Farm Landfill, located approximately 160 m to the west of the site. EA records indicate that waste was first accepted in 1993 and although no end date is reported, no records were available to indicate that the site has a current Waste

Management Licence or Environmental Permit. The records indicate that the site accepted inert, industrial, commercial and household waste and also has a leachate control system in place.

3.3.2 Geology

Recent Alluvium and River Terrace gravels (<2 m thick combined) are mapped across the surrounding area of the proposed Section D1 earthworks. The bedrock geology is of Jurassic age, comprising the Peterborough Member of the Oxford Clay Formation (approximately 16 m thick in the vicinity of the site) underlain by 2- 5 m of Kellaways Sand Member(1).

Atkins undertook ground investigation for geotechnical purposes in the locality of the earthworks Section D1 in 2012, and there are five other borehole logs recorded by the BGS in the immediate vicinity. The position of the investigation location, the log, and the BGS logs, are attached in *Annex A*. In relation to the proposed earthworks location, WS66 was positioned in the cess (the area alongside the track) support at the crest of the existing embankment, which is approximately 0.7 - 1.0 m high in this area.

The embankment in this area is constructed with 0.2 m of ballast overlying a sand and gravel sub-base of around 0.5 m thickness.

Firm sandy clay was encountered beneath the embankment with a thickness of 2.3 m. ERM has correlated this with five BGS recorded borehole logs[2] in the immediate vicinity where Alluvium strata (up to 1.8 m thick) was identified. Two of the logs also interpret River Terrace Gravels up to 0.95 m thick In WS66 these drift deposits were underlain by stiff to very stiff silty clay with rare mudstone gravel and shell fragments, becoming laminated at 5.0 m begl. The full thickness of the clay at this location was not proved but was > 3.5 m (proven to end of hole at 6.45 m begl). Other boreholes in the vicinity have proven the thickness of this clay to be approximately 16 m, underlain by Kellaways Sand Member. ERM has interpreted this silty clay to be Peterborough Member of the Oxford Clay Formation.

3.3.3 Hydrogeology

The Recent Alluvium deposits and River Terrace Gravels (if present), within the area of the proposed earthworks are designated as a Secondary A drift aquifer.

The Peterborough Member of Oxford Clay Formation (approximately 16 m) is designated as unproductive strata which is underlain by the Kellaways Sand Member, designated as a Secondary A bedrock aquifer.

(1) BGS logs SP51NE72 and SP51NE73

[2] BGS logs SP51NE72, SP51NE73, SP51NE74, SP51NE156 and SP51NE157

The site is not located within a groundwater vulnerability zone or a groundwater source protection zone and there are no currently licensed groundwater abstractions within 1 km of the site.

No groundwater was encountered in WS66 during drilling and the well was not installed so resting water level data is not available. The drift strata were seen to be partially saturated in two of the five BGS borehole records in the immediate vicinity, indicating that the near-surface Secondary A drift aquifer may be present as an ephemeral, perched water body developed over the Oxford Clay.

3.3.4 Hydrology

The nearest surface water feature to the proposed Section D1 earthworks is a pond located approximately 370 m to the north within the Wendlebury Ponds County Wildlife Site (CWS). Three additional ponds in the CWS are approximately 450 m from the earthworks.

An unnamed tributary of the Langford Brook flows southwards from the village of Wendlebury, passing at its nearest point approximately 400 m to the north and east of the site of the proposed earthworks. Its current ecological and chemical status has not been assessed by the EA.

Two ponds are located approximately 450 m south-west of the proposed Section D1 earthworks within the Wendlebury Meads and Mansmoor Close SSSI.

There are no currently licensed surface water abstractions within 1 km of the site.

3.3.5 Hydrogeological Model

Groundwater was not encountered during the ground investigation undertaken by Atkins in 2012, however it was encountered at approximately 2.25 m begl in the Alluvium and also in the Peterborough Member of the Oxford Clay at 2.25m and 8.5 m begl (1) at the northern extent of Section D1 in 1986.

There is insufficient data from Atkins or BGS records with which to infer a regional groundwater flow direction, but based on the topography and location of the Wendlebury tributary of the Langford Brook, it is inferred that regional groundwater flow direction could be to the east/south-east. This indicates that any dissolved phase leachate plume that might be released from Manor Farm landfill may migrate towards the site of the proposed earthworks. However, as shallow groundwater in the vicinity of the site is ephemeral or absent, there is little potential for soil and groundwater impacted by off-site sources to be encountered during redevelopment.

(1) BGS Log SP51NE157

3.3.6 Ecological Sites

Wendlebury Meads and Mansmoor Close SSSI is located 240 m to the south of the proposed earthworks redevelopment. A medium meta-population of great crested newts (GCN) are supported in two ponds located within 450 m south-west of the proposed earthworks.

Wendlebury Ponds CWS (a non-statutory designation) is located 400 m to the north-east of the proposed Section D1 earthworks. A small population of GCN are supported in a pond 370 m north of the site, located within the boundary of Wendlebury Ponds CWS. A meta-population of GCN is also supported in three other ponds in the CWS, approximately 450 m of the proposed earthworks.

3.4 OBSERVED IMPACT AND ANALYTICAL RESULTS

The ballast that the trackbed and embankment were constructed from was observed to be 'black' and 'dirty' on the available log containing fine to coarse ash. An organic odour was recorded to an approximate depth of 2.0 m begl in WS66 within the natural sandy clay. No other visual or olfactory evidence of impact was noted on the available log.

The analytical results for samples from this earthworks section are presented in *Annex B* with the relevant samples for Section D1 Earthworks highlighted. Soil analytical data is available for a Made Ground sample taken from WS66 0.3-0.5 m. Results for the samples analysed are indicative of natural and uncontaminated concentrations, with low levels of metals and organic compounds largely below detection limits. No asbestos was identified in the Made Ground sample taken from WS66.

3.5 PRELIMINARY CONCEPTUAL SITE MODEL

3.5.1 Introduction

The preliminary conceptual site model (CSM) has been developed in accordance with industry good practice. It uses the information and data presented in *Sections 3.1, 3.2, 3.3* and *3.4* to identify plausible contaminant-pathway-receptor contaminant linkages in the context of the proposed earthworks for Section D1. The findings of the CSM are used to determine the potential risks associated with land quality in the context of likelihood of unacceptable exposure of sensitive receptors.

3.5.2 Potential Primary Sources of Contamination

On-Site

Section D1 is an existing railway embankment. The available information suggests that in this area the embankment comprises predominantly reworked natural deposits, however, given the age of the railway, there is potential for contaminated fill materials to be present. It is also possible that the fill materials could extend into the footprint where embankment widening and toe drain installation are proposed. Given the age of the construction there is potential for these fill materials to be impacted with contaminants associated with the origin of the fill materials and railway use including oils, diesel and other organic compounds.

Off-Site

The railway track ballast on the embankment has been replaced on an 'as needed' basis typically on 20 year cycles. There is potential for the track bed to be impacted historically by creosotes seeping from wooden sleepers, and from oils, greases and diesel fuel which could leak/drip from passing trains.

Other contaminants that may have impacted the ballast include: weedkillers such as atrazine, simazine, diuron and glyphosate which may have been used in track maintenance; antifreezes such as ethylene glycol; and pathogens associated with disposal of sanitary waste from passing trains. However, herbicides, ethylene glycol and sanitary waste contaminants are considered unlikely to be present at significant concentrations because they are not persistent in the environment. In addition, soil samples taken in the area do not indicate that gross contamination is present.

A landfill is present approximately 160 m to the west of the proposed Section D1 earthworks which has reportedly accepted inert, industrial, commercial and household waste. The available information indicates that the landfill has a leachate control system but further details of the site use and history are not available so there is considered to be a potential for the release of leachate to the surrounding area.

Sources Discounted from Further Assessment

Landfill gases could be released from the landfill. The landfill is located between the embankment and the farmhouses located to the south-east and south-west of the earthworks. Therefore, if gas is migrating from the landfill, the impact from any ground disturbance associated with the embankment widening is considered to be less significant than the linkage directly between the farms and the landfill. Given the clayey nature of the Alluvium and the presence of low permeability Oxford Clay in the area, significant migration of gases towards the embankment is not considered likely.

3.5.3 Potential Receptors

The following potential receptors of soil and/or groundwater impact were identified:

- Recent Alluvium Secondary A aquifer
- Wendlebury Meads and Mansmoor Close SSSI 240 m south
- Wendlebury Ponds CWS containing great crested newts (nearest approximately 370 m north)
- Tributary of the Langford Brook approximately 400 m to the north and east, flowing south
- Local residents and farm employees 300 m south-east (Starveall Farm) and 340 m south-west at Field Barn farm facilities

Groundworkers are discounted from this assessment because they will be protected through health and safety systems and controls during the works. It is anticipated that procedures for worker protection will be covered by method statements which will be produced by the contractor.

Other human receptors are discounted from this assessment because it is considered that the ground surrounding the earthworks would only be accessed infrequently, or for short regular durations by members of the public and therefore, significant exposure is considered unlikely.

Below ground structures are discounted from this assessment because the engineers (Atkins) are independently evaluating soil and groundwater chemical data in order to finalise detailed design requirements and to ensure that suitably chemically-resistant construction materials are used.

3.5.4 Evaluation of Potential Contaminant Linkages

Table 2 provides an evaluation of the potential contaminant linkages to determine which are considered to be plausible.

3.6 CONCLUSIONS AND RECOMMENDATIONS FOR SECTION D1 EARTHWORKS

None of the potential contaminant linkages set out in Table 2 are considered plausible. The CoCP provides mitigation measures that remove the pathways for deposition of soil particles to air and water from the identified potential contaminant linkages. Table 3 provides a comparison of soil data available with suitable screening criteria to be protective of human health. Justification for the selection of criteria is provided at footnotes to Table 3.

As significant amounts of groundwater were not encountered, the potential contaminant linkages associated with the potential to mobilise on- and off-site contaminants during the earthworks proposed for Section D1 are not considered to be plausible.

The excavation works for the sub-formation layer and toe drain are likely to be shallow (<1 m) so vertical mobilisation into the underlying Kellaways Sand Member Secondary A aquifer is not considered likely. Further mitigating factors may include:

- that the landfill 160 m to the west is recent and records indicate it has sufficient lining and leachate control in place, and is therefore far less likely to be a source.

- Chemical data available for the existing embankment fill materials in Section D1 indicate natural and uncontaminated concentrations.

Taking into account the relatively thin layer of alluvium found over the embankment, and the underlying cohesive layers of soils it is considered that the proposed earthworks are unlikely to significantly increase the mobilisation of any contaminants that may be present. During excavation, any contamination that may be encountered will be removed as part of the redevelopment of the site, in effect remediating it through the SWMP. Based on the data available to date, it is not envisaged that contamination will require chasing out.

It is recommended that this information is provided to the construction contractor to ensure that an awareness for potential contamination to be present is communicated to all employees and sub-contractors working at the site.

4 SECTION D2 EARTHWORKS

4.1 SITE LOCATION AND PROPOSED DEVELOPMENT

Earthworks Section D2 is located between project chainage 116380 m and 116060 m approximately 2.5 km south-east of Weston-on-the-Green and 810 m south of the M40 (*Figure 6*). The site is currently an embankment which carries the current single track railway line between Oxford and Bicester. It is due to be improved and widened to accommodate a second track. This section of earthworks is located in a rural setting surrounded by agricultural land with Holts Farm adjacent to the east and additional farm storage facilities 350 m to the south-east of the proposed redevelopment.

4.2 EARTHWORKS DESIGN

The AIP report states that the proposed earthworks for Section D2 will comprise areas of regrading, the installation of cess (the area alongside the track) walls and the installation of toe drains. *Figure 7* reproduces the outline designs provided in that report. Ground disturbance activities associated with the proposed earthworks are as follows:

- Slope regrading will be achieved through a soft strip of the existing embankment and benching to allow placement of the additional fill on one or both sides of the existing embankment, depending on access. The AIP drawings indicate that a sub-formation layer may be included at the base of the widened areas. The depth of the layer has not yet been determined but appears to be less than 1 m on the outline design drawings.

- The cess wall is required where the current embankment is sufficiently wide to accommodate a second track, but not wide enough to allow for an adequate cess. In these instances a cess wall will be constructed which is likely to toe into the existing embankment. However, there is a possibility that piling may be required into the underlying natural strata. The wall will support well graded granular walkway fill and drainage weep holes will be installed into the face of the cess wall to prevent water build up.

- The toe drains will either be open ditch or piped filter drains depending on the available land take, with open ditches being the preferred option. Both options will require excavation of the ground adjacent to the existing embankment. The design and dimensions of the drains will be determined at the detailed design stage, but given the low-lying, flat topography they may be required to be oversized to accommodate the likely volume of surface run-off.

4.3 ENVIRONMENTAL SETTING

4.3.1 Site History

In addition to the current railway line which was constructed before 1881, itself a possible source of historical contamination, sites with potential for historical contamination to be present nearby include Charlton Halt station which was constructed in the early 1900s on the site of Holts Farm located adjacent to the west. The site of the halt was redeveloped as the farm sometime between the 1950s and 1970s.

4.3.2 Geology

A thin layer of Recent Alluvium is mapped across the area of proposed earthworks (< 3 m), but locally may be absent. The bedrock geology is the Peterborough Member of the Oxford Clay Formation (at least 16 m thick) underlain by 2-5 m of the Kellaways Sand Member, both of Jurassic age(1).

Atkins undertook ground investigation for geotechnical purposes in the locality of earthworks Section D2 in 2012. The positions of the investigation locations and the logs are attached in *Annex A*. CPT152 and WS68a were located on a low embankment (approximately 0.3 m high) within earthworks Section D2; CPT152 was advanced within the four feet of the current railway track.

The embankment in this area is constructed with 0.3 m of ballast or sand overlying sand and gravel sub-base of up to 0.4 m begl with a reworked layer of gravelly/sandy clay alluvium beneath proven to 1.2m begl. It is not possible to distinguish the boundary between this reworked material and natural alluvium (if present). Stiff to very stiff clay with occasional sandy silty bands was proved to end of one borehole at 6.0 m begl.

ERM has interpreted the stiff clay strata to be the Peterborough Member of the Oxford Clay.

4.3.3 Hydrogeology

The Recent Alluvium deposits located within the area of the proposed earthworks are designated as a Secondary A drift aquifer, although at the site are extremely thin and contained no groundwater in the boreholes advanced at site.

The Oxford Clay is designated as unproductive strata and the underlying Kellaways Formation Sand Member is designated as a Secondary A bedrock aquifer.

(1) BGS log SP51NE73

The site is not located within a groundwater vulnerability zone or a groundwater source protection zone and there are no currently licensed groundwater abstractions within 1 km of the site.

4.3.4 Hydrology

A drainage ditch is located approximately 100 m to the north of the site of proposed earthworks redevelopment which runs south to meet the Langford Brook to the east.

Three ponds, each approximately 15 m long and 10 m wide, supporting medium-sized population of great crested newts (GCN) are located within one pond adjacent to the east of the site and within two ponds located approximately 60 m to the north.

There are no named surface water courses within 500 m of the site and there are no currently licensed surface water abstractions within 1 km of the site.

4.3.5 Hydrogeological Model

Groundwater was not encountered in the shallow and thin Recent Alluvium deposits or the underlying Peterborough Member of the Oxford Clay in the sampling locations advanced within the area of the proposed earthworks for Section D2. A borehole location advanced by Atkins in the wider area recorded a groundwater seepage at greater depths in the Oxford Clay[1] (4.9m begl), although this stratum is discounted as a groundwater pathway due to the great thickness of the clay at this site.

The Peterborough Member of the Oxford Clay is a low permeability stratum classified as unproductive strata, greater than 19 m thick in the area, overlying the Kellaways Formation Secondary A aquifer. It is considered likely that the aquifer will be isolated from any near surface contaminants that may be present by the presence of the low permeability clays.

There is insufficient data to infer a groundwater flow direction, but based on the surrounding low gradient topography and location of Langford Brook, it is inferred that the regional groundwater flow direction in the drift and upper bedrock strata, where water is present, will be towards the east/south-east, broadly towards the Langford Brook located approximately 1 km to the east.

The Peterborough Member of the Oxford Clay is a low permeability stratum classified as unproductive strata, approximately 16 m thick in the area, overlying the Kellaways Formation Secondary A aquifer. Although it is likely the groundwater encountered in the deeper parts of the Oxford Clay is probably in continuity with the underlying Kellaways, the thick unsaturated

[1] Atkins Borehole Log WS71a

zone and low permeability of the intervening clays will allow attenuation of any potential contaminants on the site.

Given the great thickness of the unsaturated zone at the site, it is anticipated that there is limited potential for contaminants that may be leaching into groundwater from off-site contaminant sources (rail track bed, historical Charlton Halt station, Holts Farm) to migrate towards the footprint of the embankment widening. Therefore, there is little potential for saturated and capillary zone soils to be impacted by off-site contaminant sources within the areas that will be excavated during the proposed earthworks in this area.

The construction of the cess wall in Section D2 may include piling into the natural strata. However, as no groundwater was encountered by Atkins in the Peterborough Member in this area, and that the clay is low permeability, the potential to create pathways for vertical migration of contaminants into underlying groundwater is considered to be extremely limited.

The two ponds 60 m to the north of the proposed earthworks are not down-gradient and therefore, there is no potential for shallow groundwater to recharge these ponds with contaminated groundwater that could potentially be mobilised from the excavation of the earthworks redevelopment.

The pond adjacent to the east is not likely to be in continuity with the adjacent shallow drift aquifer, if present. Additionally, groundwater is not likely to be encountered during excavation, so mobilisation of potential contaminants and migration towards the pond is not considered likely.

4.3.6 Ecological Sites

Wendlebury Meads and Mansmoor Close Site of Special Scientific Interest (SSSI), is located adjacent to the north and west of the proposed Section D2 earthworks.

A pond that supports a medium-sized population of GCN is located adjacent to the east of the proposed redevelopment, adjacent to Holts Farm crossing and within two ponds located 60 m north of the redevelopment site.

4.4 OBSERVED IMPACT AND ANALYTICAL RESULTS

The 0.4 m thickness of ballast that the trackbed and embankment were constructed from was observed to be 'dirty' on the WS68a log. No other visual or olfactory evidence of impact was noted on the logs.

The analytical results are presented in *Annex B* with the relevant samples for Section D2 Earthworks highlighted. Soil and soil leachate analytical data is available for WS68a in both Made Ground and natural deposits within 3 m begl. Results for the samples analysed are indicative of natural and uncontaminated concentrations, with low levels of metals and organic

compounds largely below detection limits. No asbestos was identified in the samples taken. No groundwater samples were taken from the locations in the vicinity of the proposed embankment redevelopment in this area.

4.5 PRELIMINARY CONCEPTUAL SITE MODEL

4.5.1 Introduction

The preliminary conceptual site model (CSM) has been developed in accordance with industry good practice. It uses the information and data presented in *Sections 4.1, 4.2, 4.3* and *4.4* to identify plausible contaminant-pathway-receptor contaminant linkages in the context of the proposed earthworks for Section D2. The findings of the CSM are used to determine the potential risks associated with land quality in the context of likelihood of unacceptable exposure of sensitive receptors.

4.5.2 Potential Primary Sources of Contamination

On-Site

Section D2 is an existing railway embankment. The available information suggests that in this area the embankment comprises predominantly reworked natural deposits, however, given the age of the railway there is potential for contaminated fill materials to be present. It is also possible that the fill materials could extend into the footprint where embankment widening and toe drain installation are proposed. Given the age of the construction there is potential for these fill materials to be impacted with contaminants associated with the origin of the fill materials and railway use including oils, diesel and other organic compounds.

Off-Site

The railway track ballast on the embankment has been replaced on an 'as needed' basis typically on 20 year cycles. There is potential for the track bed to be impacted historically by creosotes seeping from wooden sleepers, and from oils, greases and diesel fuel which could leak/drip from passing trains.

Other contaminants that may have impacted the ballast include: weedkillers such as atrazine, simazine, diuron and glyphosate which may have been used in track maintenance; antifreezes such as ethylene glycol; and pathogens associated with disposal of sanitary waste from passing trains. However, herbicides, ethylene glycol and sanitary waste contaminants are considered unlikely to be present at significant concentrations because they are not persistent in the environment. In addition, soil and soil leachate samples taken in the area do not indicate that gross contamination is present.

A small station, Charlton Halt, was historically present adjacent to the proposed earthworks redevelopment. Constructed in the 1900s, there is potential for the surrounding land to be historically impacted from oils,

greases and fuel which may have leaked/dripped from passing and stalled trains. In addition, the Halt foundations could have been sources from locally-derived wastes such as foundry slag or steam locomotive ash which could result in a wide range of potential contaminants being present e.g. phenols, polyaromatic hydrocarbons (PAHs), metals, sulphates, etc. The historical presence of a Halt is considered sufficient to highlight as a potential source, however the likelihood of significant contamination being present is considered to be limited, and this is supported by the data collected to date.

The current Holts Farm, located adjacent and to the west of the proposed earthworks, is a potential source of contaminants including oils, fuels, sewage and slurry, pesticides and fertilisers, although the data collected to date does not indicate gross contamination to be present.

4.5.3 Potential Receptors

The following potential receptors of soil and/or groundwater impact were identified:

- Local residents adjacent to east (Holts Farm)
- Local employees at Holts Farm
- Wendlebury Meads and Mansmoor Close SSSI

Controlled waters including drift and bedrock aquifers, the drainage ditch and the ponds are discounted based on the hydrogeological model presented in *Section 4.3.5.*

Groundworkers are discounted from this assessment because they will be protected through health and safety systems and controls during the works. It is anticipated that procedures for worker protection will be covered by method statements which will be produced by the contractor.

Other human receptors are discounted from this assessment because it is considered that the ground surrounding the earthworks would only be accessed infrequently, or for short regular durations by members of the public and therefore, significant exposure is considered unlikely.

Below ground structures are discounted from this assessment because the engineers (Atkins) are independently evaluating soil and groundwater chemical data in order to finalise detailed design requirements and to ensure that suitably chemically-resistant construction materials are used.

4.5.4 Evaluation of Potential Contaminant Linkages

Table 4 provides an evaluation of the potential contaminant linkages to determine which are considered to be plausible.

The table includes an evaluation of soil and soil leachate data taken from the existing embankment in terms of determining both the potential presence of

contamination associated with the former halt and current farm, and also the potential for contaminants to leach and migrate from the existing embankment onto the footprint of the proposed earthworks. *Tables 5, 6a* and *6b* provide a comparison of the data with suitable screening criteria to be protective of human health and controlled waters.

4.6 CONCLUSIONS AND RECOMMENDATIONS FOR SECTION D2 EARTHWORKS

None of the potential contaminant linkages set out in Table 5 are considered plausible.

The possible contaminant linkages associated with the potential to mobilise contaminants derived from on- and off-site sources into shallow groundwater during earthworks in Section D2 were not considered to be plausible. Information available from recent ground investigations undertaken by by Atkins has shown that there was no groundwater present to 6 m begl in the area of the proposed earthworks redevelopment. Due to the presence of the unproductive strata of Oxford Clay at this location, it is highly unlikely that groundwater will be encountered during the proposed earthworks redevelopment at this location in the form of slope regrading, embankment widening and installation of toe drains, so there is no potential for mobilisation of contaminants.

The CoCP provides mitigation measures that remove the pathways from all the other identified plausible contaminant linkages. In addition, no evidence of significant organic contamination was observed in the field at the ground investigation locations or within the analytical results of the soil samples that were analysed.

During excavation, any contamination that may be encountered will be excavated as part of the redevelopment of the site, in effect remediating it through the SWMP. Based on the data available to date, it is not envisaged that contamination will require chasing out.

It is recommended that this information is provided to the construction contractor to ensure that awareness for potential contamination to be present is communicated to all employees and sub-contractors working at the site.

5 EARTHWORKS SECTION E1

5.1 SITE LOCATION AND PROPOSED DEVELOPMENT

Earthworks Section E1 is located between project chainage 120720 m and 120240 m on the northern edge of the village of Islip adjacent to Islip station (*Figure 8*). The site is currently a combination of embankment and cutting which carries the current single track railway line between Oxford and Bicester. The cutting between chainage 120553 m to 120473 m on the west side of the track is reportedly in poor condition due to weathering and unravelling of the cut face. The embankment and cutting are due to be improved and widened to accommodate a second track. This section of earthworks is located in a predominantly rural setting with the following neighbouring land uses:

- *North-West* –Former railways sidings and Islip Oil Depot (disused)
- *North*– Agricultural land and residential properties
- *East* – Agricultural land
- *South* – Islip station with field, Manor Farm and residential properties beyond
- *South-West* – residential properties

The nearest residential properties are immediately adjacent to the southwest and to the north of the site.

The ES refers to a Government Pipelines and Storage System (GPSS) oil pipeline which runs along the northern side of the track and is understood to dog-leg and then pass over the railway towards the south-east contained within B4027 the road bridge.

5.2 EARTHWORKS DESIGN

The AIP report states that the proposed earthworks for Section E1 will comprise areas of embankment regrading, rock cutting stabilisation, possibly cutting widening and regrading in places, and the installation of crest and toe drains. *Figure 8* reproduces the outline design provided in that report. Ground disturbance activities associated with the proposed earthworks are as follows:

- Slope regrading will be achieved through a soft strip of the existing embankment and benching to allow placement of the additional fill on one or both sides of the existing embankment, depending on access. The AIP drawings indicate that a sub-formation layer may be included at the base of the widened areas. The depth of the layer has not yet been determined but appears to be less than 1 m on the outline design drawings.

- The rock cutting will be stabilised by the removal of loose material and overhanging rock blocks. The face will then be protected with layers of geotextile filter and steel mesh with an aesthetic stone or 'green' face which will be secured into competent rock with rock bolts / soil nails. Close to existing ground level a bench will be formed a minimum of 1m wide and the residual soil material above will be battered back.

- Where space is available, and the rock cutting is considered to be stable, conventional earthworks regrading may be adopted through excavation of additional material from the full height of the existing cutting slope.

- The crest drains will either be open ditch or piped filter drains depending on the available land take, with open ditches being the preferred option. Both options will require excavation of the ground adjacent to the existing embankment. The toe drains will be piped filter drains. The design and dimensions of the drains will be determined at the detailed design stage, but given the flat topography of the area and shallow groundwater they may be required to be oversized.

5.3 ENVIRONMENTAL SETTING

5.3.1 Site History

The railway, including the adjacent Islip station, has been in existence since before 1896 in what remains a largely rural area on the outskirts of Islip village.

In addition to the current railway line, itself a possible source of historical contamination, sites with potential for historical contamination to be present nearby comprise:

- Islip Oil Depot – present on the maps between the 1920s and 1940s. Known to be present to the current day, although recently disused (and does not appear on the historical maps from the 1980s onwards).

- A small goods yard was present to the north of the station from the end of the 19th Century until the 1970s.

- Former railway sidings to the north of the site.

5.3.2 Geology

Section E1 is underlain by two different bedrock deposits due to the nature of the fault underlying the site to the southwest near Overbridge OXD42 (Bletchingdon Road Roadbridge). For the purpose of this report the geology section is subdivided into the area between the two bridges and the area to the north-east of Overbridge OXD42.

Area between Roadbridges OXD43 and OXD42

No drift geology is mapped regionally in the area between the two roadbridges. The bedrock geology is mapped as a faulted area of the Cornbrash Member (up to 3 m thick) of the Jurassic Greater Oolite Group underlain by the Forest Marble Member and the White Limestone Formation of the Greater Oolite Group(1). In this area the Forest Marble Member is further subdivided to include Limestone Beds, typically 5 to 10 m thick, within the sequence. Together, these strata comprise various shelly, oolitic, massive or flaggy limestones interbedded with mudstones. The fault structures are mainly east-west orientated, and are likely to influence groundwater flow direction and vertical permeability, locally increasing the fracture porosity in these brittle bedrocks. Overall the outcropping bedrock at and around the site is likely to be characterised by dual porosity, having both matrix and fracture porosity.

The track bed is located in a cutting which is approximately 1.5 m lower than the surrounding ground level. The base of the cutting appears to be underlain by approximately 1.0 to 1.5 m of stiff yellow grey clay which could be interpreted as foundations for the railway, particularly as this deposit was not encountered on either side of the cutting.

Area north-east of OXD42 Roadbridge

The published geology indicates superficial drift deposits, (River Terrace Sands and Gravels) overlying the Oxford Clay Formation and West Walton Formation, described as a Mudstone to the north east of the OXD42 Roadbridge

According to borehole 162 excavated at ground level at the base of the cutting, the track bed appears to be located directly onto the Oxford Clay formation. Boreholes 164, 160, 163 and 159 were all located on the embankment and indicated alternating bands of sands, clays and gravels. Given the presence of clay horizons recorded above the sands and gravels, it is suspected that the embankment materials may in part comprise reworked Oxford Clay overlying the River Terrace Deposits, with the river terrace deposits being thickest to the north of the track.

The Oxford Clay formation is mainly brownish-grey, fissile, organic-rich (bituminous) mudstones which includes shell beds and several bands of cementstone nodules and concretions

(1) BGS log SP51SW3

5.3.3 Hydrogeology

Area between Roadbridges OXD43 and OXD42

The Greater Oolite Forest Marble Member is designated a Secondary A bedrock aquifer. Limestone Beds within the Forest Marble, present at the site from 1.2 m begl, are designated as a Principal Aquifer. Historical records indicate these Limestone Beds served as the primary water supply for Islip with an abstraction well (13 m deep) approximately 400 m to the north-west, active until at least the late 1950s.

Area north-east of Roadbridge OXD42

The Oxford Clay is designated as unproductive strata by the EA. Where present, the drift deposits of River Terrace Gravels are classified as a Secondary A aquifer, comprising permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The majority of the earthworks site is located within a Minor Aquifer High groundwater vulnerability zone. The groundwater vulnerability zone is absent at the sites of rock cutting and stabilisation located to the north of Overbridge OXD42 and adjacent Islip Oil Depot. There are no currently licensed and active groundwater abstractions within 1 km of the site.

5.3.4 Hydrology

The nearest named surface water courses are the River Ray located 400 m to the south and Gallos Brook located approximately 490 m to the north-east. The Environment Agency has assessed the current ecological status in the vicinity of the site to be Poor for the River Ray and Moderate for Gallos Brook and predicts that status of both will remain unchanged by 2015. It does not consider that chemical quality requires assessment for these surface water courses.

There are no currently licensed surface water abstractions within 1 km of the site.

5.3.5 Hydrogeological Model

Area between Roadbridges OXD43 and OXD42

Shallow groundwater was encountered within the near-surface deposits in the vicinity of the development footprint, and confined within limestone beds both beneath the track bed (approximately 5.0 m begl), and to the north of the cutting (approximately 13.5 m begl) where it was recorded as artesian. It is likely that the groundwater is connected to, and part of, the Limestone Beds Principal Aquifer of the Forest Marble Member.

Area north-east of OXD42 Roadbridge

Shallow groundwater is encountered within the River Terrace deposits at approximately 0.4m below the track bed to the north, where the superficial deposits appear to be thickest
There is insufficient data to determine a local groundwater flow direction, but based on the topography and location of the River Ray, it is inferred to be towards the south. However, this should be regarded with caution as the faulting in the area (to the north), the railway cutting and quarries, and the artesian conditions encountered could alter the flow direction in the local area. In addition, the shallow groundwater encountered in the locations drilled in 2013 indicate that, on a highly localised scale, the water appears to be flowing towards and underneath the cutting. These shallow and artesian groundwater conditions may explain the presence of a clay foundation to the track bed which may have the purpose of preventing groundwater ingress into the cutting as well as being a construction foundation.

ERM considers that there is the potential for impacted groundwater to be present to the northwest of the railway line down gradient from the former oil depot and former railway sidings. There is potential for this groundwater to become present in toe and crest drains that are within the proposed design. The potentially impacted groundwater is likely to be present within the Sand and Gravels to the north of the track and could migrate towards the Gallos Brook.

On the basis of the currently available data, it is possible that shallow groundwater within Forest Marble may be in continuity with the Sands and Gravels and could migrate towards the River Ray to the south, although at a local scale the groundwater may be flowing towards and underneath the cutting. If exposed, the aquifer in the Forest Marble could be artesian and form surface water bodies that, if left un-managed, may connect through drains to the Ray and to Gallos Brook, and a surface water body was noted along the southern side of the tracks supporting this assumption.

5.3.6 Designated Ecological Sites

There are no designated ecological sites within 500 m of the site. Two badger setts have been recorded within the embankment in the area of the Section E1 earthworks.

5.4 OBSERVED IMPACT AND ANALYTICAL RESULTS

The ballast that the track bed and embankment were constructed from at locations CPT17, WS159 and WS161 were observed to be 'black' and 'dirty' on the available logs. A diesel odour was noted in the Made Ground at WS159. No other visual or olfactory evidence of impact was noted.

The analytical results are presented in Annex B with the relevant samples for Section E1 Earthworks highlighted. Soil analytical data is available for WS163 and WS164, soil leachate data is available for WS163 and groundwater data is available for WS162 and WS163.

The soil analytical results indicate low level detections of metals (WS163 and WS164), TPH and PAHs in the shallow soils (<1m), none of the detections exceed the screening criteria for railway landuse.

The groundwater results from WS163 (screened within the Clay) present elevated concentrations above the Screening Criteria (Surface Water EQS's) for Zinc in the groundwater sample. Sulphate also exceeded the screening criteria in WS162. Aromatic hydrocarbons (C16-C35) are also detected in WS162 below the screening criteria where they are available.

The groundwater results also indicate exceedances of the Drinking Water Standards (DWS), for Sulphate in both groundwater samples from WS162 and WS163. However, based on State of the Aquifer Report[1], which relates to the nearby Greater Oolite Limestone Members and Forest Members (but Jurassic geology), sulphate can occur naturally up to 180 mg/l. Furthermore, in areas when the limestone aquifer becomes more confined, the natural levels of sulphate ions increase in the water.

WS162 is located at track level to the north of the railway track, assumed down gradient of the former oil depot and former railway sidings. It is not conclusive whether the elevated concentrations detected in the groundwater are from one specific source or a combination of sources.

Asbestos (in the form of chrysotile) was identified in the Made Ground sample taken from 0.5 m deep in WS164 which was located to the north of the railway track northeast of Roadbridge OXD42. This location is adjacent to the residential properties.

Carbon dioxide and Carbon monoxide are noted in the Gas Monitoring results from WS160, WS162 and WS163. A maximum concentration of Carbon Dioxide was noted in WS163 in May 2013 (Round 4) of 6.4% and a maximum concentration of Carbon Monoxide of 2.0ppm in April 2013 (Round 2).

5.5 PRELIMINARY CONCEPTUAL SITE MODEL

5.5.1 Introduction

The preliminary conceptual site model (CSM) has been developed in accordance with industry good practice. It uses the information and data presented in *Sections 5.1*, *5.2, 5.3* and *5.4* to identify plausible contaminant-

[1] Jurassic Limestone (Bristol Avon),Groundwater Monitoring Unit, Environment Agency,(April 2005)

pathway-receptor contaminant linkages in the context of the proposed earthworks. The findings of the CSM are used to determine the potential risks associated with land quality in the context of likelihood of unacceptable exposure of sensitive receptors.

5.5.2 *Potential Primary Sources of Contamination*

On-Site

The railway track ballast within the cutting has been replaced on an 'as needed' basis typically on 20 year cycles. There is potential for the track bed to be impacted historically by creosotes seeping from wooden sleepers, and from oils, greases and diesel fuel which could leak/drip from passing trains.

Other contaminants that may have impacted the ballast include: weedkillers such as atrazine, simazine, diuron and glyphosate which may have been used in track maintenance; antifreezes such as ethylene glycol; and pathogens associated with disposal of sanitary waste from passing trains. However, herbicides, ethylene glycol and sanitary waste contaminants are considered unlikely to be present at significant concentrations because they are not persistent in the environment.

It is possible that fill materials could extend into the footprint where embankment widening and toe and crest drain installations are proposed. Given the age of the construction there is potential for these fill materials to be impacted with contaminants associated with the origin of the fill materials and railway use including oils, diesel and other organic compounds.

Off-Site

The railway track ballast on the embankment adjacent to where widening will take place will be similar in nature to that described above within the section of cutting.

The adjacent disused oil depot and GPSS pipeline are potential sources of petroleum hydrocarbons. The oil depot is listed as disused, but was operational from the 1930's when it was used for fuel storage during the war. Following the war it was operated by ESSO until 1969 when it was linked to RAF Upper Heyford. While operational Jet A-1fuel and Diesels[1] were stored onsite and are considered a potential source of contamination.

5.5.3 *Potential Receptors*

The following potential receptors of soil and/or groundwater impact were identified:

[1] http://www.derelictplaces.co.uk/main/showthread.php?t=7741 date viewed 26th September 2013

- Local residents adjacent to the southwest and north and in general surrounding area
- Local employees at Manor Farm and in general surrounding area
- River Ray 400 m to the south
- Gallos Brook located 490 m to the north-east
- Principal aquifer Limestone Beds in the Forest Marble Member in the upper 10 m at site, and adjacent Secondary A aquifers in the Cornbrash, Forest Marble Members and the Sands and Gravels.

Groundworkers are discounted from this assessment because they will be protected through health and safety systems and controls during the works. It is anticipated that procedures for worker protection will be covered by method statements which will be produced by the contractor.

Below ground structures are discounted from this assessment because the engineers (Atkins) are independently evaluating soil and groundwater chemical data in order to finalise detailed design requirements and to ensure that suitably chemically-resistant construction materials are used.

5.5.4 Evaluation of Potential Contaminant Linkages

The disused oil depot is considered to be a potential source of contamination of dissolved phase TPH, which may have a pathway to reach the Sands and Gravels, and in turn the surface water courses. This contaminant linkage is also considered to be plausible in relation to potential contamination from the former railway sidings to the north of the railway track.

The only potential onsite contaminant source is considered to be the possible presence of Made Ground associated with railway construction, although no significant impact was observed in the soil analysis from the investigations undertaken to date.

Soil Gas is recorded in the monitoring data available. ERM anticipate that there is no current receptor as the gas will vent to ambient air. It is recommended that this contaminant linkage is considered during the assessments of the new stations, as gas migration measures may need to be considered in the final design.

Table 7 provides an evaluation of the potential contaminant linkages to determine which are considered to be plausible.

The table includes an evaluation of soil, soil leachate and groundwater data taken from WS160, WS162, WS163 and WS164 in terms of determining both the potential presence of contamination from onsite and offsite sources including GPSS pipeline, disused oil depot and track bed within the cutting. *Tables 8*, *9a*, *9b*, *10a* and *10b* provide a comparison of the data with suitable screening criteria to be protective of human health and controlled waters. Justification for the selection of criteria is provided as footnotes to *Tables 8*, *9a*, *9b*, *10a* and *10b*.

5.6 *CONCLUSIONS AND RECOMMENDATIONS FOR SECTION E1 EARTHWORKS*

The CoCP provides mitigation measures that remove the pathways from most of the identified potential contaminant linkages.

The plausible linkages that remain are associated with the potential offsite sources associated with the historic oil depot, associated pipeline and former railway sidings located to the north of the track. There is a theoretical possibility that groundwater may be contaminated off site from these sources, which if present may be flowing in the general direction of the earthworks. It is considered theoretically possible that the introduction of toe and crest drains associated with the earthworks may potentially create a preferential pathway for contaminant migration.

The ultimate receptors would be the River Ray and Gallos Brook (through lateral migration) and the River Terrace Sands and Gravels and the Limestone (through vertical leaching). In order to prevent the ingress of potentially contaminated groundwater from the oil depot into the drainage network and ultimately the River Ray and Gallos Brook, we would recommend the provision of an impermeable barrier on the northwest (oil depot) side of the toe drains.

Construction of the new cutting and regrading of the slope will include a Materials Management Plan which will control the quality of materials used within the construction of the embankments to help ensure that they are suitable for use and do not pose a risk to human health or the environment.

It is recommended that this information is provided to the construction contractor to ensure that awareness for potential contamination and artesian conditions is communicated to all employees and sub-contractors working at the site.

6 SECTION H1 EARTHWORKS

6.1 SITE LOCATION AND PROPOSED DEVELOPMENT

Earthworks Section H1 is located between project chainage 125960 m and 125580 m immediately to the north of the Wolvercote Tunnel (*Figure 10*). The section is known as Wolvercote Cutting North which forms the approach to Wolvercote Tunnel and carries the current single track railway line between Oxford and Bicester. It is reportedly in poor condition between chainage 125823 m to 125533 m. It is due to be stabilised and widened to accommodate a second track, and the track level lowered in the tunnel to accommodate faster running speeds and possible future electrification. This section of earthworks is located on the edge of the residential area of Wolvercote and has the following neighbouring land uses:

- *North* – residential properties and Pear Tree Park & Ride
- *East* – residential properties and a former clay pit, now Linkside Lake
- *South-East* – residential properties
- *South* –residential properties
- *South-West* – hotel and residential properties
- *West* – petrol filling station and residential properties (at the southern extent) with car showroom beyond (approximately 330 m from the earthworks), and fields (further north)

Linkside Lake is designated as a Site of Importance for Nature Conservation (SINC).

6.2 EARTHWORKS DESIGN

The AIP report states that the proposed earthworks for Section H1 will comprise lowering, stabilisation and widening of the cutting either through the installation of gabion walls or the use of soil nails with counterfort drains. In the outer areas of the approach where lowering is not required, cutting widening will be achieve by regrading, or possibly through the installation of gabion walls. Crest and toe drains will be installed under all options. *Figure 11* reproduces the outline design provided in the AIP report. Ground disturbance activities associated with the proposed earthworks are as follows:

- Gabion wall option: Regrading of the slope to accommodate the proposed widening and lowering cannot be achieved within the available space so gabion gravity retaining walls could be utilised. Granular backfill would be placed between the rock face and the gabions.

- Soil nail and counterfort drainage option: The lower portion of the existing slope would be cut at a steeper gradient with which to accommodate the widened, lowered profile without affecting the crest

line. Soil nails and a geotextile and mesh reinforced face would provide the support for this option and would be finished with an aesthetic stone or 'green' face. Regularly spaced counterfort drains in the upper slopes of the existing cutting would be extending from the crest drain to the toe drain in order to reduce pore water pressure in the Oxford Clay strata to prevent land slips.

- Where space is available, and the clay cutting is considered to be stable, conventional earthworks regrading may be adopted through excavation of additional material from the full height of the existing cutting slope.

- An alternative approach to regrading (for example where there are space constraints or a desire to limit the extent of vegetation clearance) would be to install a <1.5 m retaining wall constructed of rock-filled gabion baskets.

- The crest drains will either be open ditch or piped filter drains depending on the available land take, with open ditches being the preferred option. Both options will require excavation of the ground adjacent to the existing embankment. The toe drains will be piped filter drains. The design and dimensions of the drains will be determined at the detailed design stage, but given the flat topography and shallow groundwater they may be required to be oversized.

6.3 *ENVIRONMENTAL SETTING*

6.3.1 Site History

The railway has been in existence since before 1876 in what was a largely rural area. The area of Wolvercote developed residentially from the north-west towards the tunnel and rail line progressively throughout the late 19th Century and early 20th Century.

In addition to the current railway line, itself a possible source of historical contamination, sites with potential for historical contamination to be present nearby comprise:

- A clay pit and brickworks located 70 m to the east of earthworks Section H1, which had been in existence before 1876 and was last mapped in 1938. The clay pit had an approximate diameter of 150 m when it was last mapped. The depression of the clay pit is now a lake, designated as a SINC.

- The historic brickworks site and land immediately to the south of the clay pit was redeveloped as residential properties in the mid to late 1930s , and these are still in existence.

- The petrol filling station and car showroom have been in existence since the 1980s.

- Pear Tree Park & Ride was developed from greenfield land during the 1970s/1980s.

6.3.2 Geology

Published geological information indicates the Wolvercote Sand and Gravel Member is not present along the line of the cutting to the north of the Wolvercote Tunnel, however based on mapping it may be present at the top of the cutting to the east and west. The bedrock geology is mapped as Oxford Clay Formation and West Walton Formation, described as a mudstone.

Atkins undertook ground investigation for geotechnical purposes along the line of the cutting. Three boreholes were located in the area of interest; WS110, WS109 located in the eastern wall of the cutting and WS108 located in the western wall of the cutting. The positions of the investigation locations and the logs are attached in *Annex A*. Multiple boreholes were drilled at each location, at the base of the cutting (borehole suffixes A) and at the midpoint of the cutting (boreholes suffixes B,C,D).

The track bed is located in a cutting which is approximately 5 m lower than the surrounding ground level. Information from the borehole logs indicates the base of the cutting is underlain by 0.5 to 0.9 m of Made Ground comprising ballast and a fine to coarse sand and gravel (with flint, sandstone, quartzite, clinker), interpreted to be the track bed. This overlies stiff slightly gravelly clay, which grades to a very stiff laminated clay by approximately 2 m below the base of the cutting, both of which are interpreted to represent the natural Oxford Clay Formation.

Boreholes drilled at the midpoint of the cutting wall indicate a thin veneer of Made Ground (generally <0.4 m) on the banks of the cutting, comprising predominantly sands and gravels. As with the base of the cutting, the Made Ground overlies slightly gravelly clay which grades into very stiff laminated clay, interpreted to be the Oxford Clay.

Deeper Made Ground was recorded on the eastern cutting wall nearest to the Wolvercote cutting, up to 1.45 m depth half way up the cutting wall, also comprising sand and gravel.

6.3.3 Hydrogeology

The Oxford Clay and West Walton Formation are designated as unproductive strata by the EA. Where present, the drift deposits are classified as a Secondary A aquifer, comprising permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The site is not located within a groundwater vulnerability zone or a groundwater source protection zone and there are no currently licensed groundwater abstractions within 1 km of the site.

With the exception of WS110A, no groundwater seepages were recorded at any of the borehole locations. Groundwater was observed during drilling at 0.3m below the base of the cutting at WS110A.

6.3.4 Hydrology

The nearest named surface water course is the Oxford Canal located 500 m to the south of the proposed cutting works. The EA has assessed its current ecological status in the vicinity of the site to be Good and predicts that its status will remain unchanged by 2015. It does not consider that chemical quality requires assessment.

The Linkside Lake located adjacent to the north east of the cutting has been identified as a Site of Important Nature Conservation (SINC).

There are no currently licensed surface water abstractions within 1 km of the site.

6.3.5 Hydrogeological Model

The underlying Oxford Clay and West Walton Formation are low permeability strata, and as such a consistent body of groundwater is not anticipated beneath the site, and overall has not been recorded during site investigation works undertaken by Atkins.

However, shallow bands of sands and gravels have been recorded within the uppermost 2-3 m of the Oxford Clay beneath the base of the cutting, and therefore localised groundwater seepages cannot be discounted within the more permeable bands, which may be indicative of the groundwater encountered in WS110.

6.3.6 Designated Ecological Sites

Linkside Lake is located adjacent and to the north-east of the proposed earthworks in Section H1 and is designated as a Site of Importance for Nature Conservation (SINC).

6.4 OBSERVED IMPACT AND ANALYTICAL RESULTS

The ballast that the trackbed is constructed from at locations WS109 and WS110 were observed to be 'black' and 'dirty' on the available logs and contained fine to coarse ash. No other visual or olfactory evidence of impact was noted. At the time of reporting there were no analytical results available for earthworks Section H1.

6.5 PRELIMINARY CONCEPTUAL SITE MODEL

6.5.1 Introduction

The preliminary conceptual site model (CSM) has been developed in accordance with industry good practice. It uses the information and data presented in *Sections 6.1*, *6.2, 6.3* and *6.4* to identify plausible contaminant-pathway-receptor contaminant linkages in the context of the proposed earthworks for Section H1. The findings of the CSM are used to determine the potential risks associated with land quality in the context of likelihood of unacceptable exposure of sensitive receptors.

6.5.2 Potential Primary Sources of Contamination

On-Site

Section H1 is an existing railway cutting. The available information suggests that the track bed is a 0.5-0.9 m thickness of fill and the cutting walls are predominantly <0.4 m of fill materials, but up to 1.45 m in places. Given the age of the railway, there is potential for the fill materials to be impacted with contaminants associated with the origin of those materials and railway use including oils, diesel and other organic compounds. It is possible that fill materials could extend into the footprint where cutting widening and crest drain installation are proposed.

The railway track ballast in the cutting has been replaced on an 'as needed' basis typically on 20 year cycles. There is potential for the track bed to be impacted historically by creosotes seeping from wooden sleepers, and from oils, greases and diesel fuel which could leak/drip from passing trains.

Other contaminants that may have impacted the ballast include: weedkillers such as atrazine, simazine, diuron and glyphosate which may have been used in track maintenance; antifreezes such as ethylene glycol; and pathogens associated with disposal of sanitary waste from passing trains. However, herbicides, ethylene glycol and sanitary waste contaminants are considered unlikely to be present at significant concentrations because they are not persistent in the environment.

Off-Site

The former brickworks and clay pit adjacent to the north-east of earthworks Section H1 are potential sources of contaminants. In the area of the brick works itself, contaminants that could be present include, for example, fuels and oils associated with machinery used for brick manufacture, and the kilns for brick-making. Given the age of the residential properties now located on the area of the brickworks, remediation cannot be assumed to have occurred. The majority of the area of the clay pit has become a lake, however, areas around the periphery could have been infilled with waste, and contaminants that could be present include, but are not limited to: heavy metals, asbestos,

organic compounds e.g. oils, inorganic compounds e.g. ammoniacal nitrogen and chloride, and ground gases (largely methane and carbon dioxide).

The current petrol filling station adjacent to the west, car showroom 330 m to the west are potential sources of petroleum hydrocarbons.

6.5.3 Potential Receptors

The following potential receptors of soil and/or groundwater impact were identified:

- Local residents adjacent to east and in general surrounding area
- Local employees adjacent to the south-west and west
- Linkside Lake (SINC) adjacent to north-east

Controlled waters including drift and bedrock aquifers, the Oxford Canal and Linkside Lake are discounted based on the hydrogeological model presented in *Section 6.3.5.* The lake is retained as a potential receptor in the context of its designation as a SINC.

Groundworkers are discounted from this assessment because they will be protected through health and safety systems and controls during the works. It is anticipated that procedures for worker protection will be covered by method statements which will be produced by the contractor.

Below ground structures are discounted from this assessment because the engineers (Atkins) are independently evaluating soil and groundwater chemical data in order to finalise detailed design requirements and to ensure that suitably chemically-resistant construction materials are used.

6.5.4 Evaluation of Potential Contaminant Linkages

Table 10 provides an evaluation of the potential contaminant linkages to determine which are considered to be plausible. In practice, none of the linkages were found to be plausible, primarily due to the low permeability nature of the subsoil and the distance to residential receptors.

6.6 CONCLUSIONS AND RECOMMENDATIONS FOR SECTION H1 EARTHWORKS

The possible contaminant linkages associated with the potential to mobilise contaminants derived from on- and off-site sources into controlled waters during cutting widening and lowering in Section H1 are not considered plausible. Information available from publicly available sources and recent ground investigations has shown that, other than occasional seepages encountered in the sands and gravels within the uppermost 2-3 m of the Oxford Clay beneath the base of the cutting, there is little or no contamination

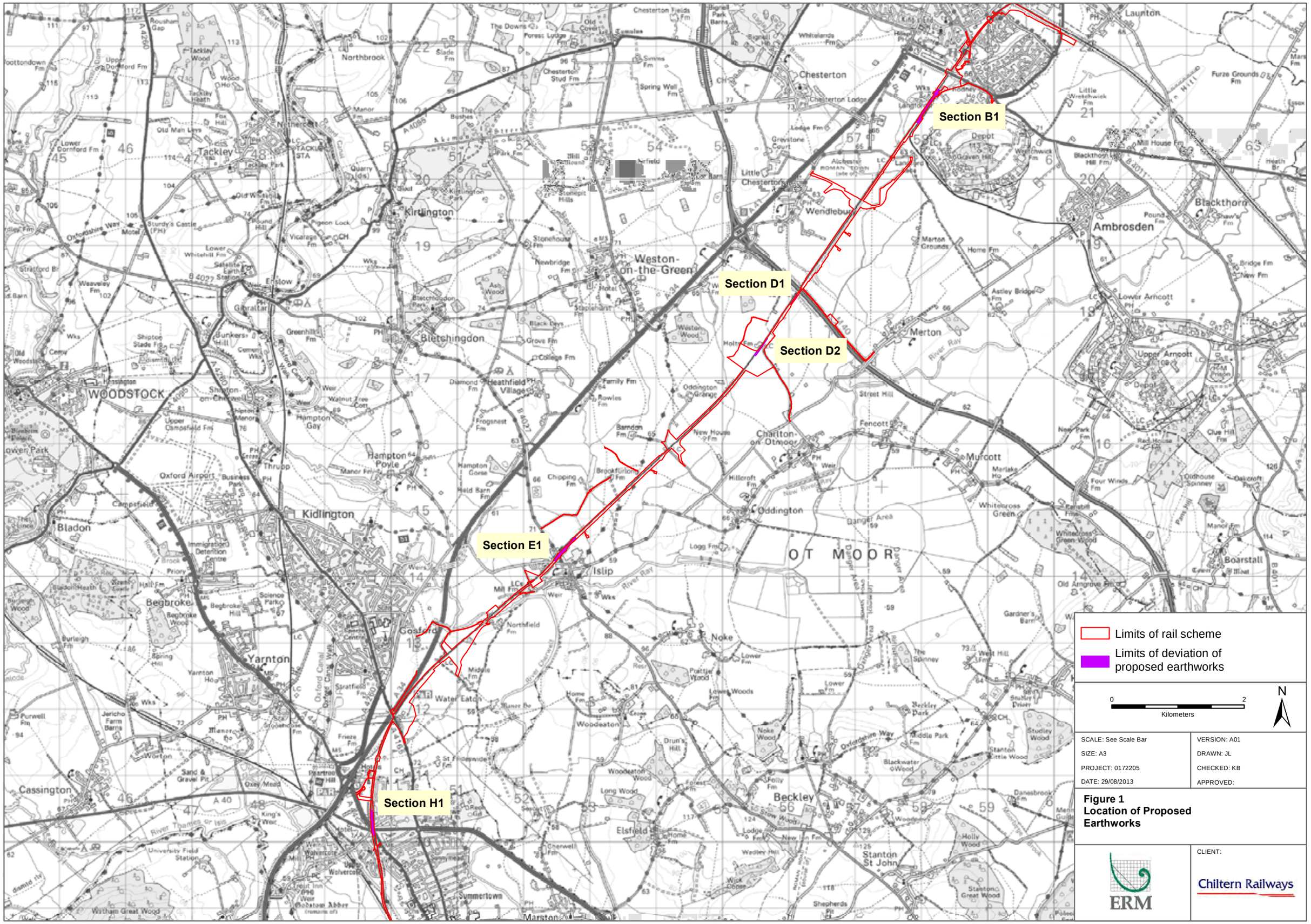
present. Therefore, there is minimal potential for mobilisation of contaminants during and after the earthworks.

The CoCP provides mitigation measures that remove the pathways from all the identified potential contaminant linkages. In addition, no evidence of gross contamination was observed in the field at the ground investigation locations.

It is considered that the proposed earthworks are unlikely to significantly increase the mobilisation of any contaminants that may be present. During excavation, any contamination that may be encountered will be removed as part of the cutting widening and lowering activities, in effect remediating it through the SWMP. Based on the information available to date, it is not envisaged that contamination will require chasing out

It is recommended that this information is provided to the construction contractor to ensure that an awareness for potential contamination to be present is communicated to all employees and sub-contractors working at the site.

Figures



SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: JL
PROJECT: 0172205	CHECKED: KB
DATE: 29/08/2013	APPROVED:

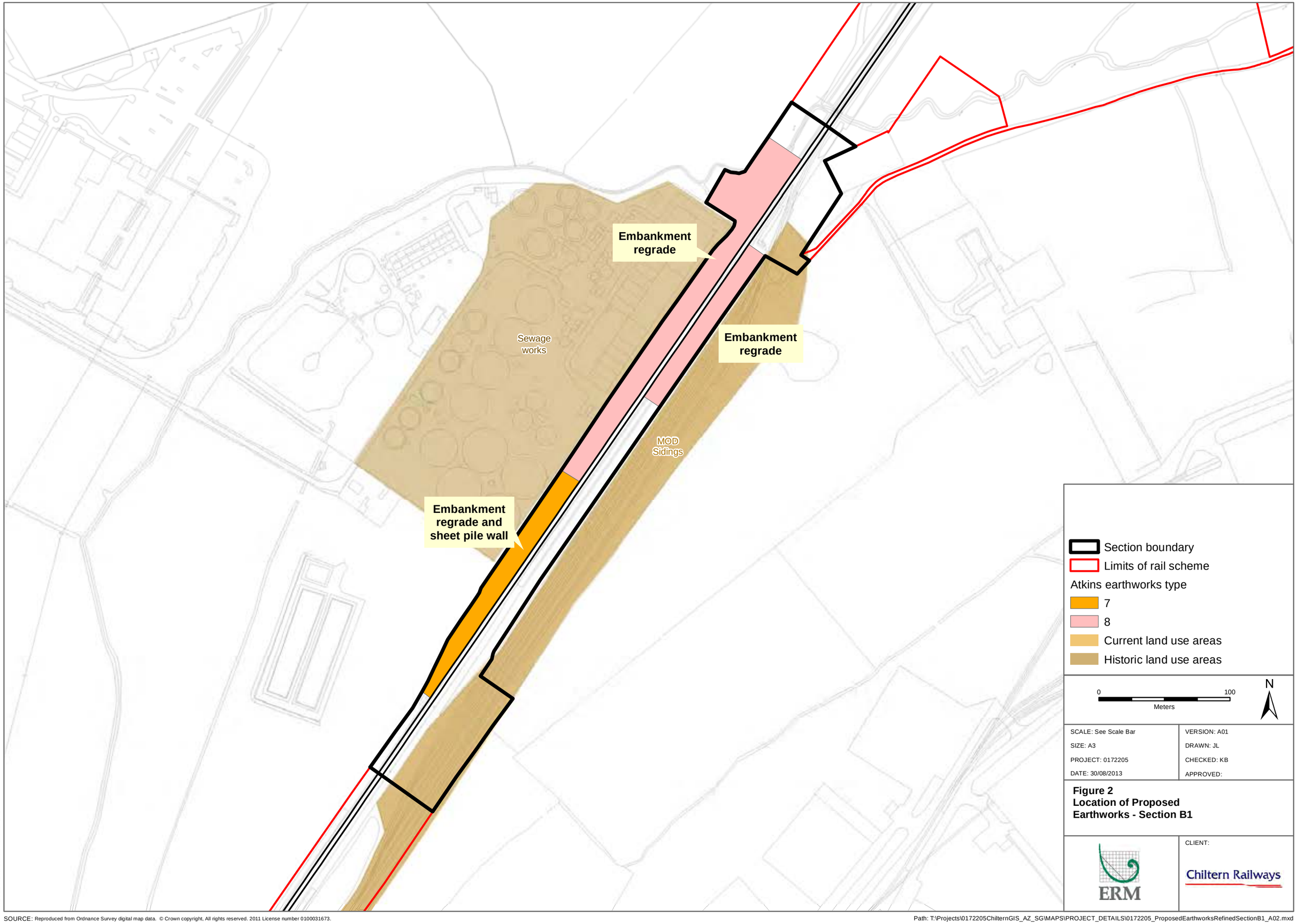
Figure 1
Location of Proposed Earthworks

CLIENT: Chiltern Railways

ERM

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedOverview_A01.mxd



SCALE: See Scale Bar | VERSION: A01
SIZE: A3 | DRAWN: JL
PROJECT: 0172205 | CHECKED: KB
DATE: 30/08/2013 | APPROVED:

Figure 2
Location of Proposed Earthworks - Section B1

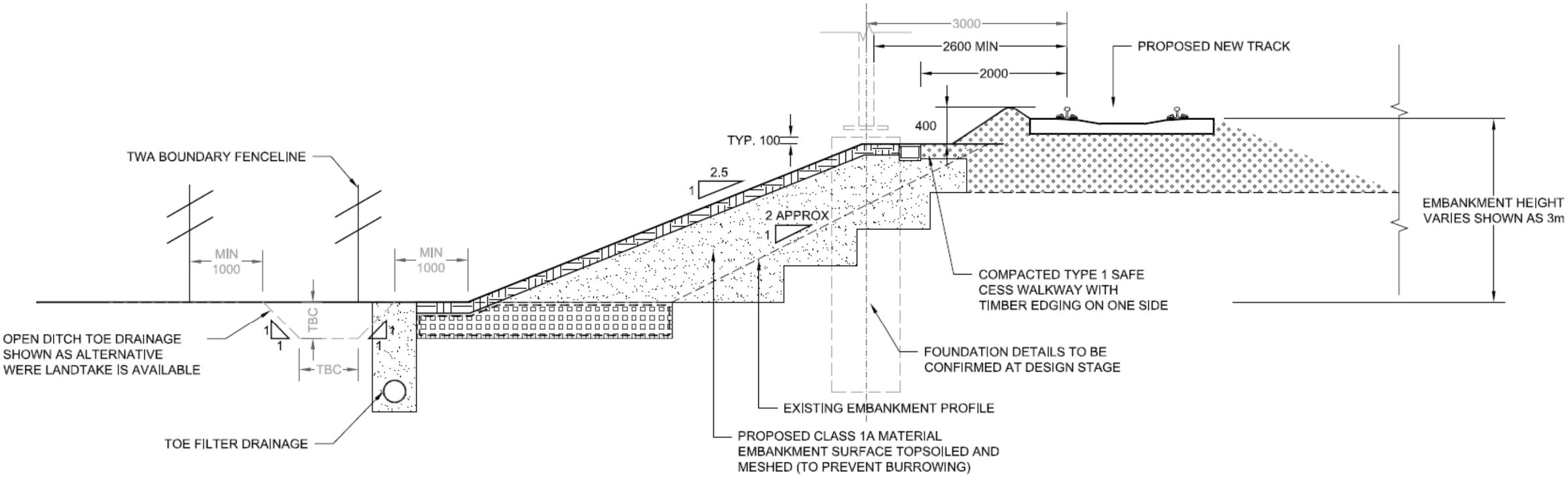
ERM

CLIENT: Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedSectionB1_A02.mxd

Section B1 Earthworks (a)
Figure 3



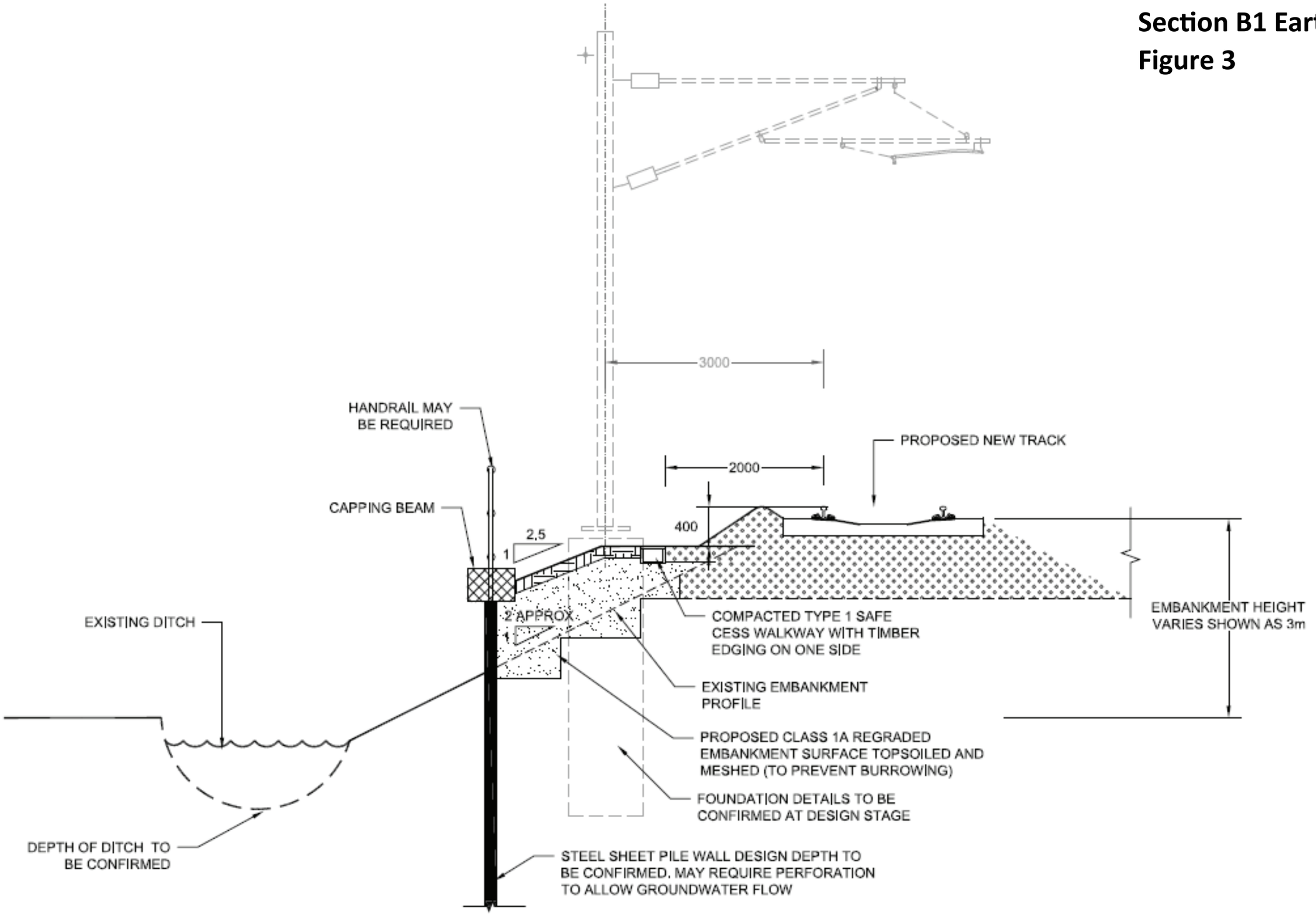
ASSET 8:EMBANKMENT WORKS (WIDENING-REGRADE)

1;50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- EXISTING TRACKS ARE BEING SLEWED OR NEW TRACK IS BEING LAID CLOSE TO EXISTING EMBANKMENT EDGE WHICH COULD LEAD TO INSTABILITY
- SUFFICIENT LAND IS AVAILABLE TO REGRADE

Section B1 Earthworks (b)
Figure 3

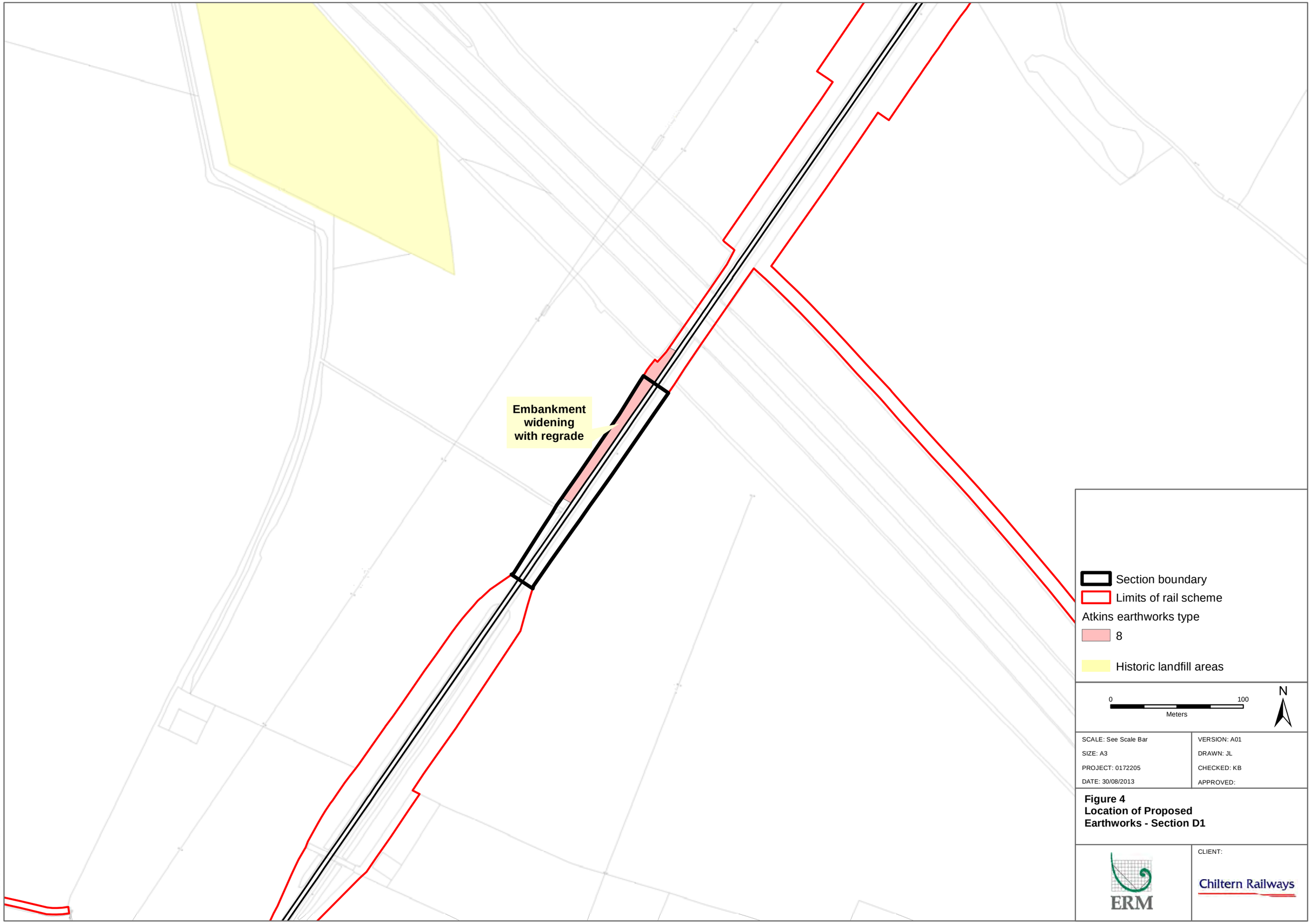


ASSET 7: EMBANKMENT WORKS (WIDENING-REGRADE AND SHEET PILE WALL)

1:50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- EXISTING TRACKS ARE BEING SLEWED OR NEW TRACK BEING LAID CLOSE TO EMBANKMENT EDGE WHICH COULD LEAD TO INSTABILITY
- PONDS/LARGE DITCHES PRESENT AT TOE



Section boundary

Limits of rail scheme

Atkins earthworks type

8

Historic landfill areas

0 100

Meters

N

SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: JL
PROJECT: 0172205	CHECKED: KB
DATE: 30/08/2013	APPROVED:

Figure 4
Location of Proposed Earthworks - Section D1

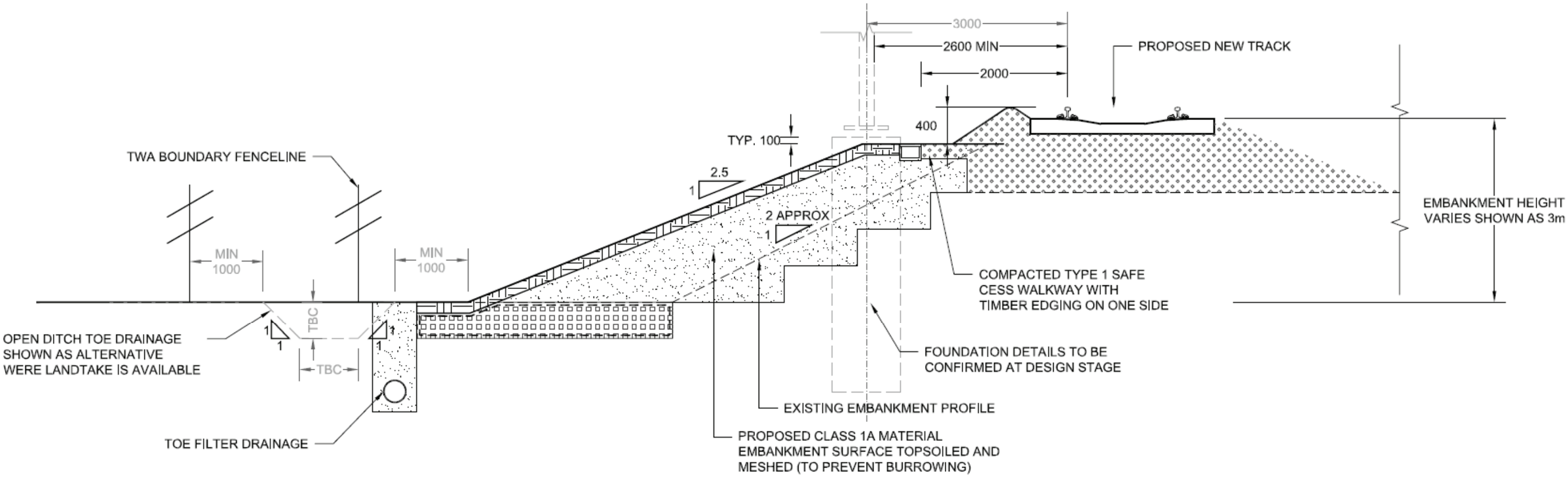
ERM

CLIENT: Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedSectionD1_A02.mxd

Section D1 Earthworks
Figure 5

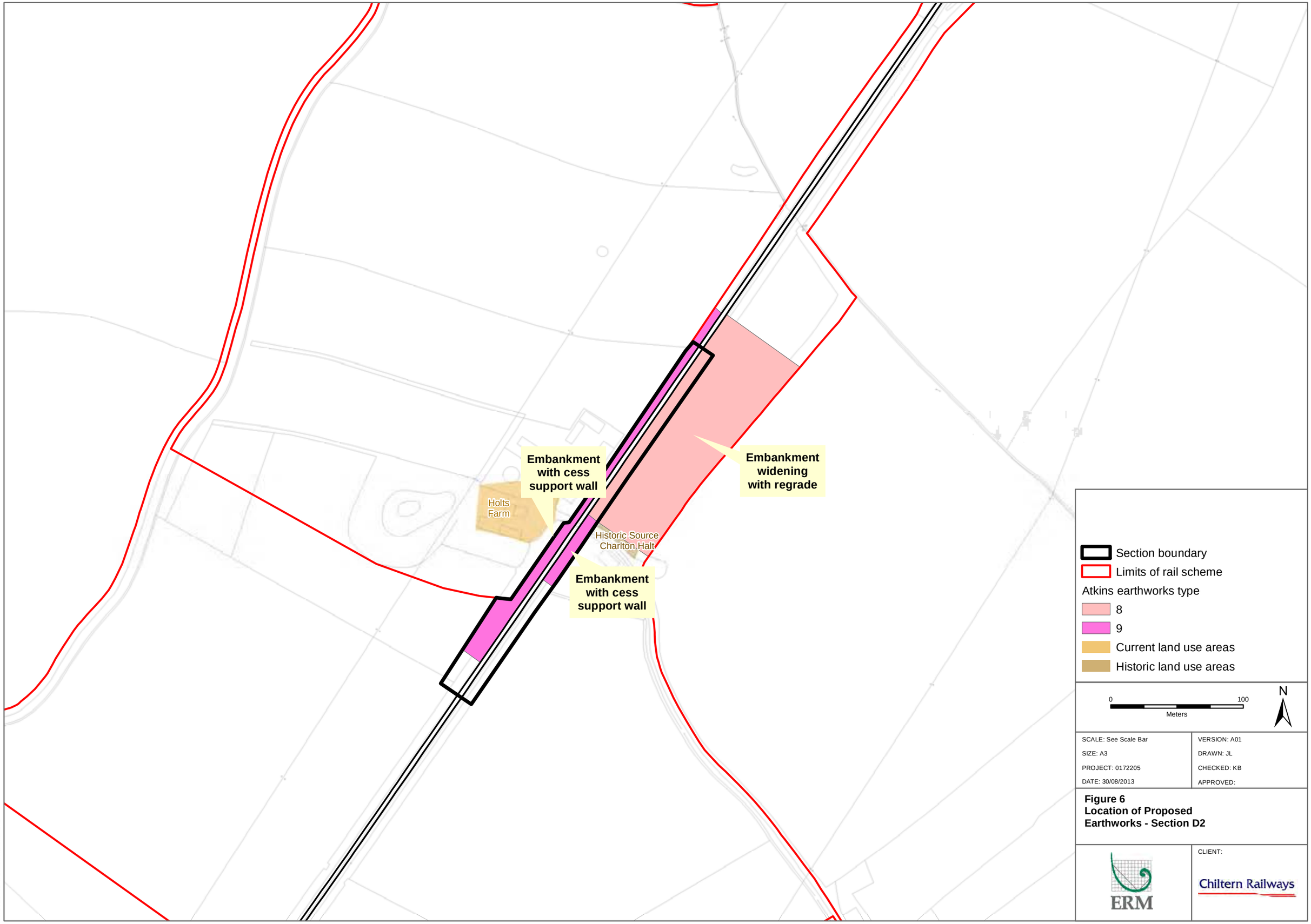


ASSET 8:EMBANKMENT WORKS (WIDENING-REGRADE)

1;50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- EXISTING TRACKS ARE BEING SLEWED OR NEW TRACK IS BEING LAID CLOSE TO EXISTING EMBANKMENT EDGE WHICH COULD LEAD TO INSTABILITY
- SUFFICIENT LAND IS AVAILABLE TO REGRADE



SCALE: See Scale Bar | VERSION: A01
SIZE: A3 | DRAWN: JL
PROJECT: 0172205 | CHECKED: KB
DATE: 30/08/2013 | APPROVED:

Figure 6
Location of Proposed Earthworks - Section D2

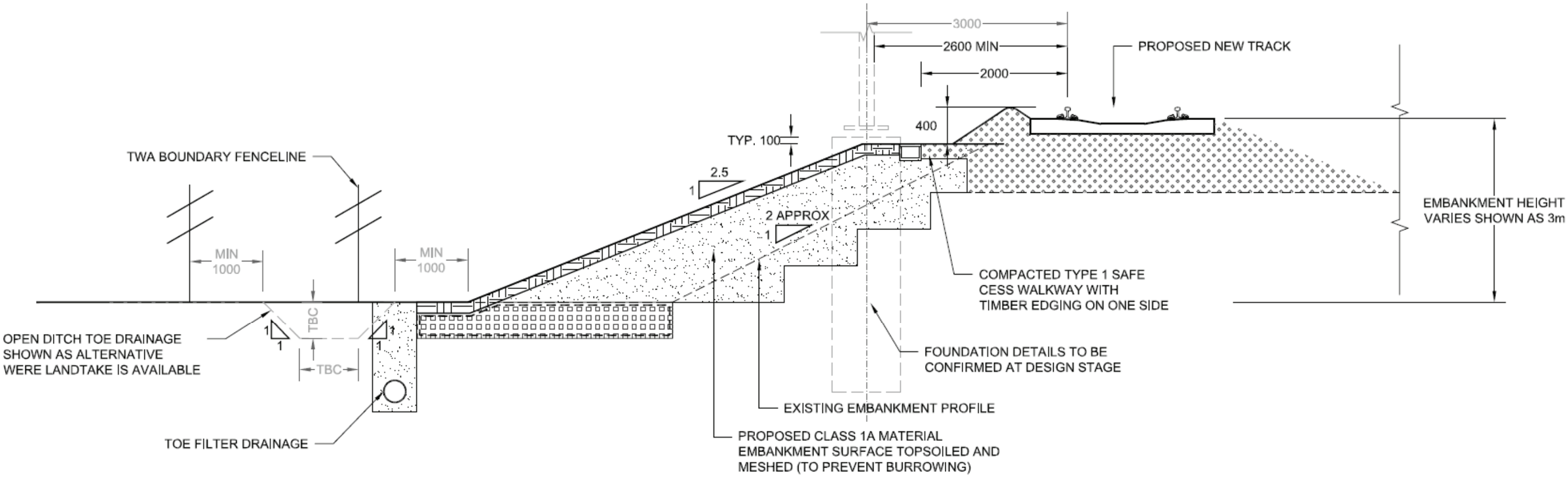
ERM

CLIENT: Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedSectionD2_A02.mxd

Section D2 Earthworks (a)
Figure 7



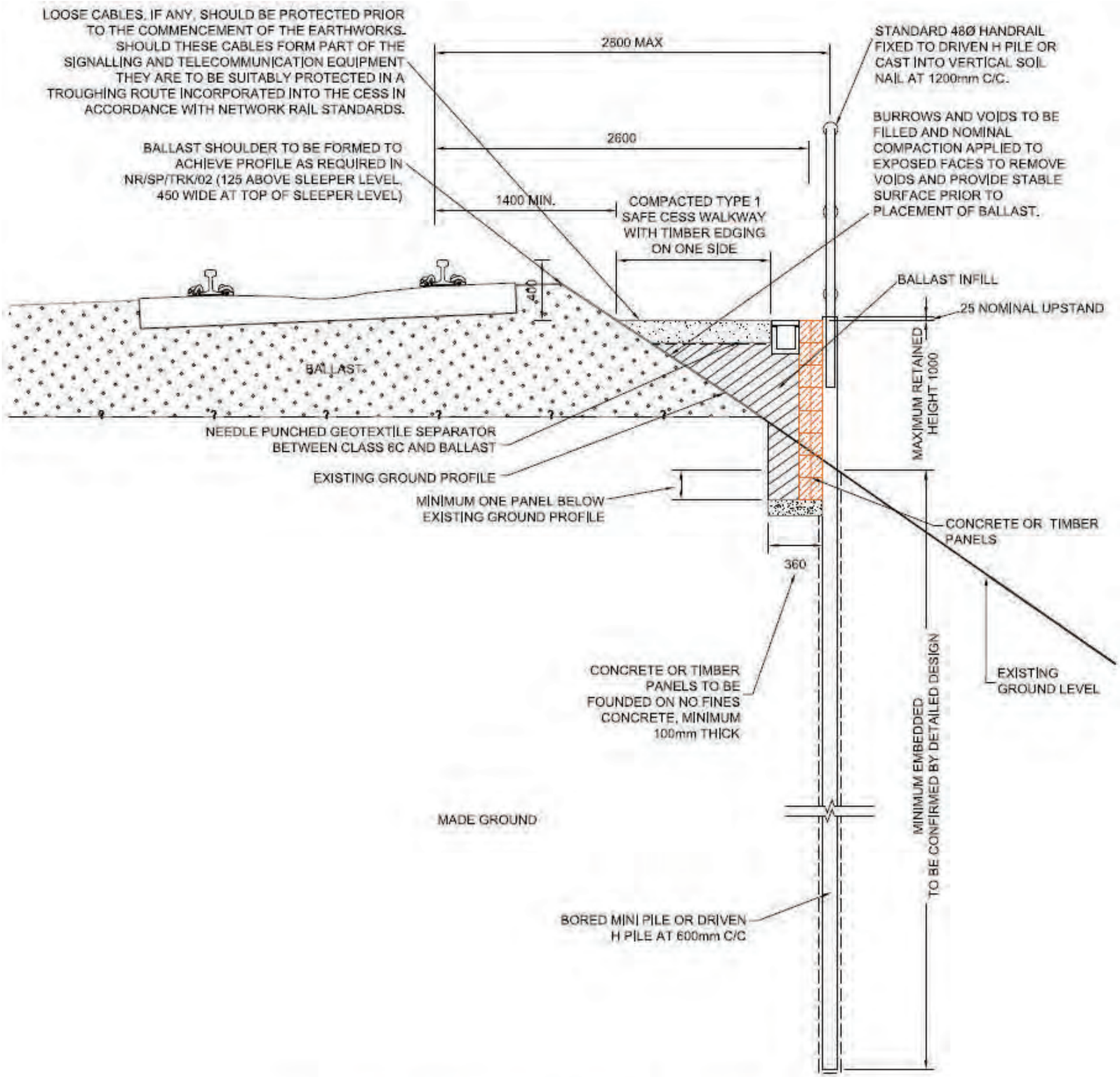
ASSET 8:EMBANKMENT WORKS (WIDENING-REGRADE)

1;50

LOCATIONS WHERE:

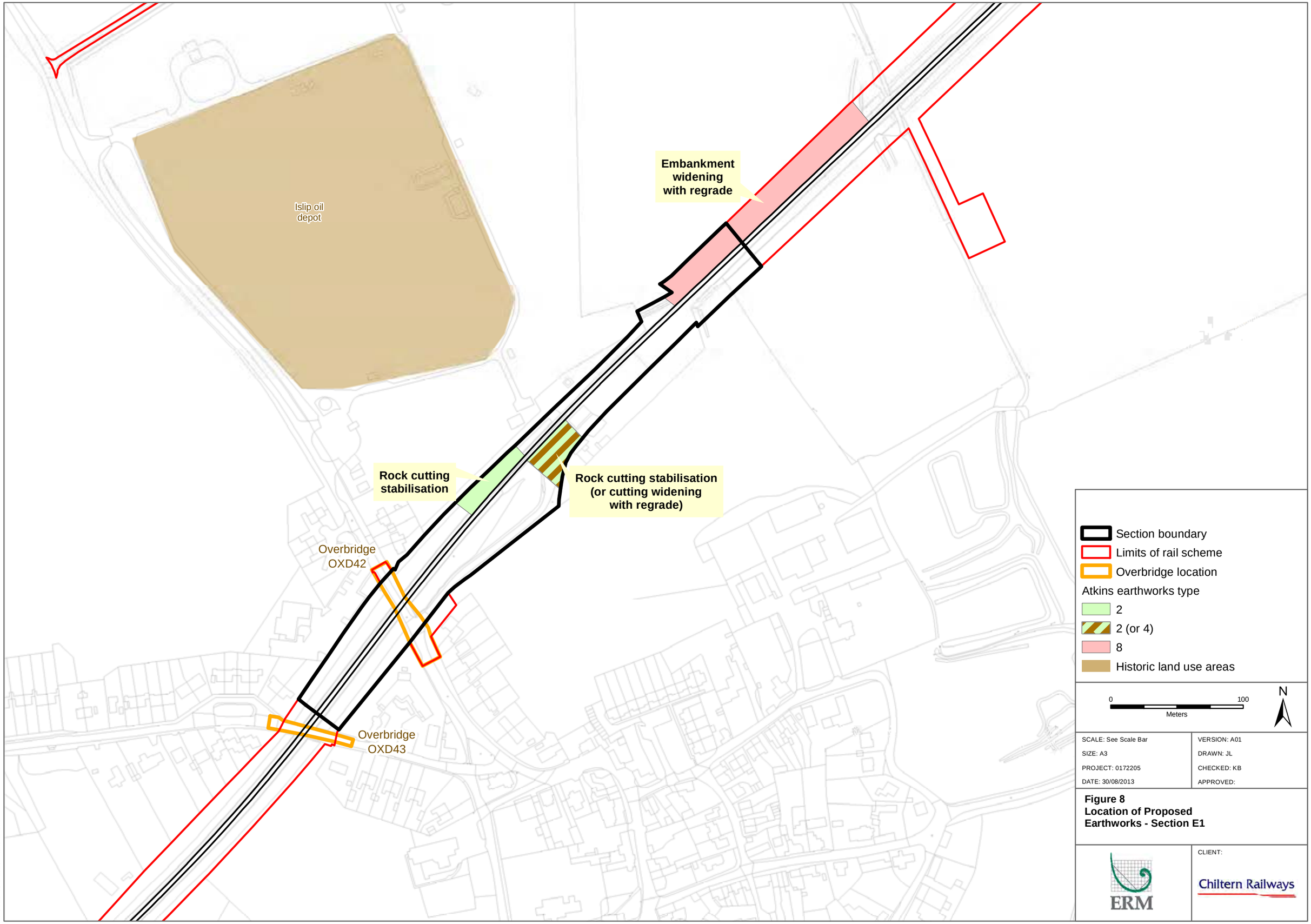
- THERE IS NOTABLY INSUFFICIENT CESS
- EXISTING TRACKS ARE BEING SLEWED OR NEW TRACK IS BEING LAID CLOSE TO EXISTING EMBANKMENT EDGE WHICH COULD LEAD TO INSTABILITY
- SUFFICIENT LAND IS AVAILABLE TO REGRADE

Section D2 Earthworks (b)
Figure 7



ASSET 9: EMBANKMENT WORKS (CESS WALL DETAIL)

1:25



SCALE: See Scale Bar | VERSION: A01
SIZE: A3 | DRAWN: JL
PROJECT: 0172205 | CHECKED: KB
DATE: 30/08/2013 | APPROVED:

Figure 8
Location of Proposed Earthworks - Section E1

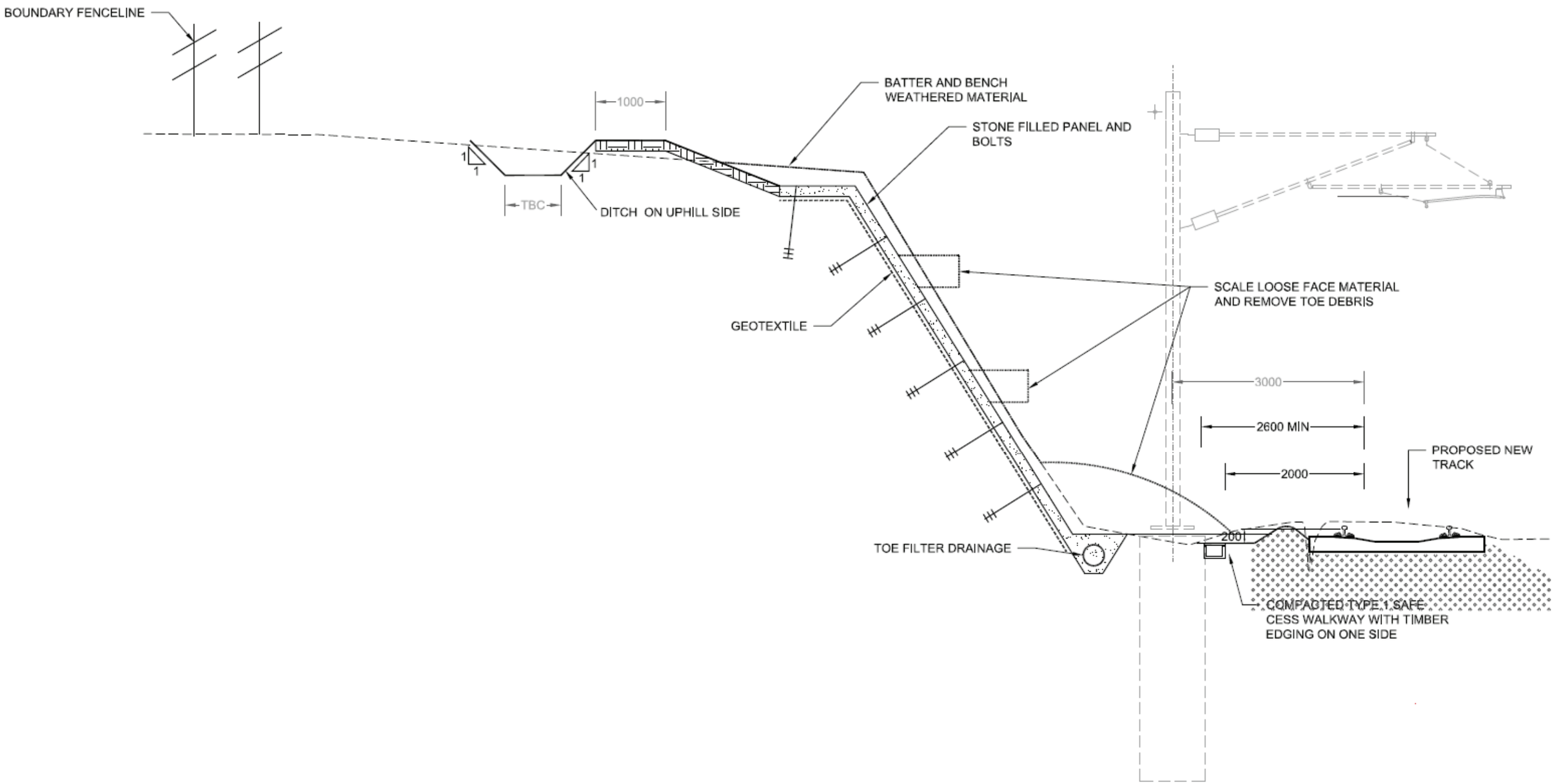
ERM

CLIENT: Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedSectionE1_A02.mxd

Section E1 Earthworks (a)
Figure 9



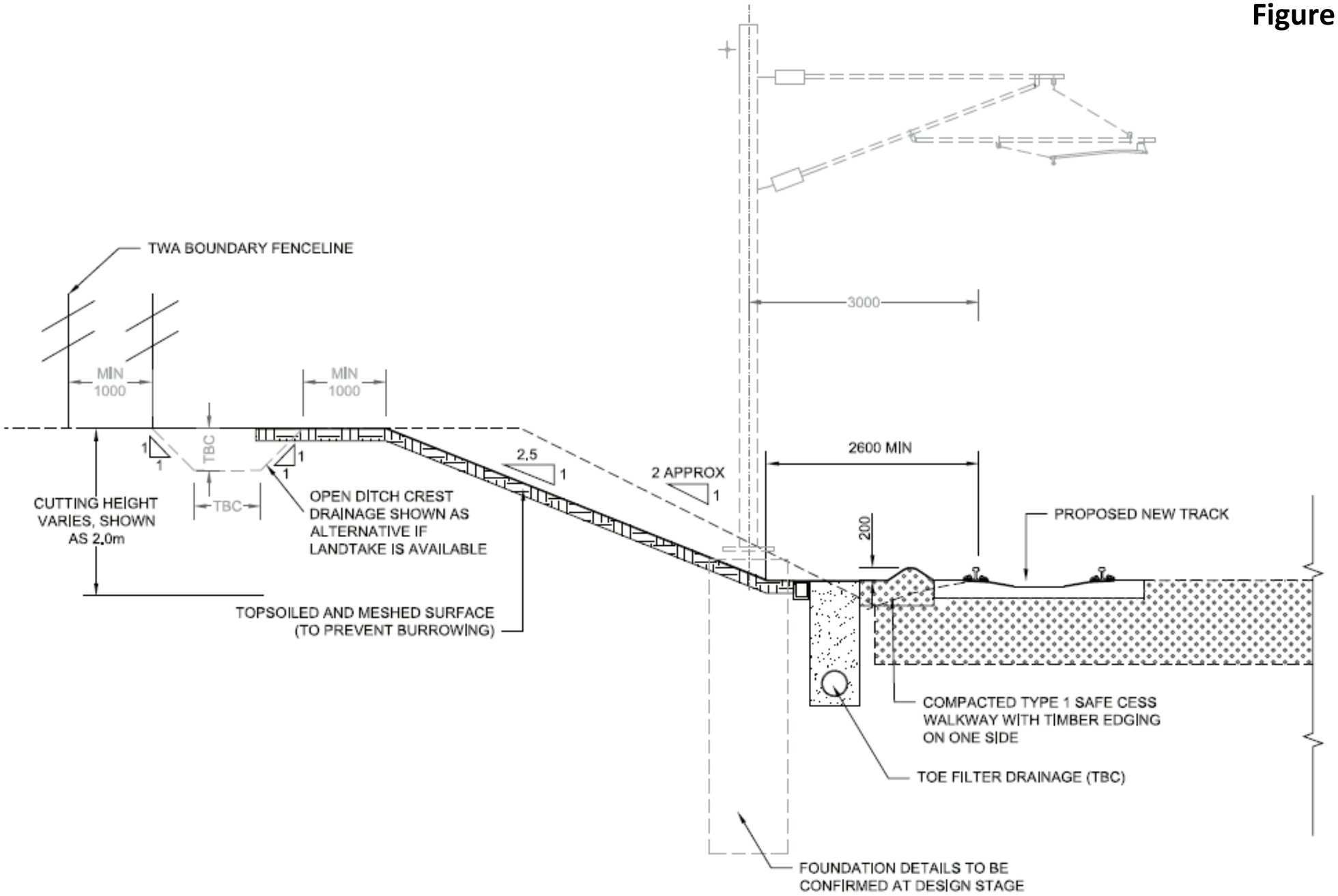
ASSET 2: CUTTING WORKS (ISLIP WIDENING AND STABILISATION)

1:50

LOCATIONS WHERE:

- LOOSE ROCK IN CUTTING FACE.
- ROCK CUTTING WITH IN SUFFICIENT SPACE FOR SHALLOW REGRADE

Section E1 Earthworks (b)
Figure 9



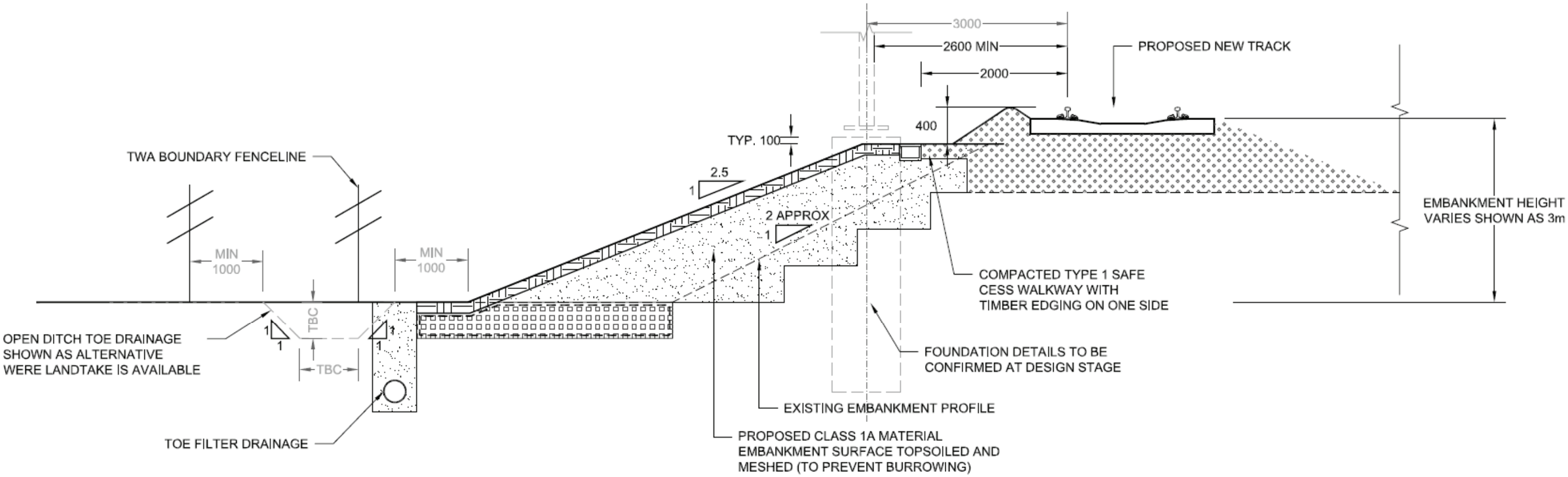
ASSET 4: CUTTING WORKS (WIDENING)

1:50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- SURFACE MATERIAL FROM CUTTING HAS WEATHERED AND 'SLOUGHED' INTO CESS,
- MINOR FORMATION WIDENING IS REQUIRED

Section E1 Earthworks (c) Figure 9



ASSET 8:EMBANKMENT WORKS (WIDENING-REGRADE)

1;50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- EXISTING TRACKS ARE BEING SLEWED OR NEW TRACK IS BEING LAID CLOSE TO EXISTING EMBANKMENT EDGE WHICH COULD LEAD TO INSTABILITY
- SUFFICIENT LAND IS AVAILABLE TO REGRADE

Cutting widening with regrade (or with Gabion wall)

Cutting widening with regrade (or with Gabion wall)

Lake & Residential

Clay pit and brick works 1887

Oxford Clay cutting stabilisation with either Gabion wall or Soil nails with counterfort drains

Oxford Clay cutting stabilisation with either Gabion wall or Soil nails with counterfort drains

Petrol Station & Garage

Section boundary

Limits of rail scheme

Atkins earthworks type

1 or 1a

4 (or 3)

Current land use areas

Historic land use areas

Historic landfill areas

0 100

Meters

N

SCALE: See Scale Bar

SIZE: A3

PROJECT: 0172205

DATE: 30/08/2013

VERSION: A01

DRAWN: JL

CHECKED: KB

APPROVED:

Figure 10
Location of Proposed Earthworks - Section H1

CLIENT:

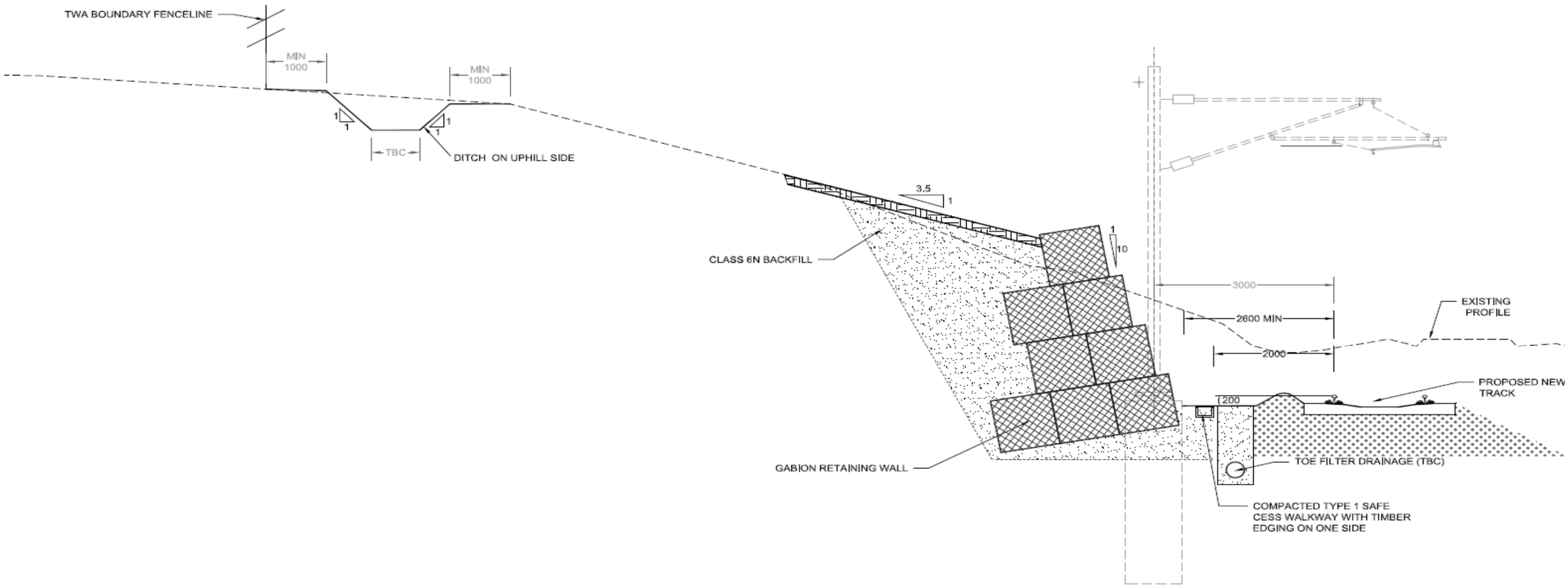
Chiltern Railways

ERM

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_ProposedEarthworksRefinedSectionH1_A02.mxd

Section H1 Earthworks Figure 11

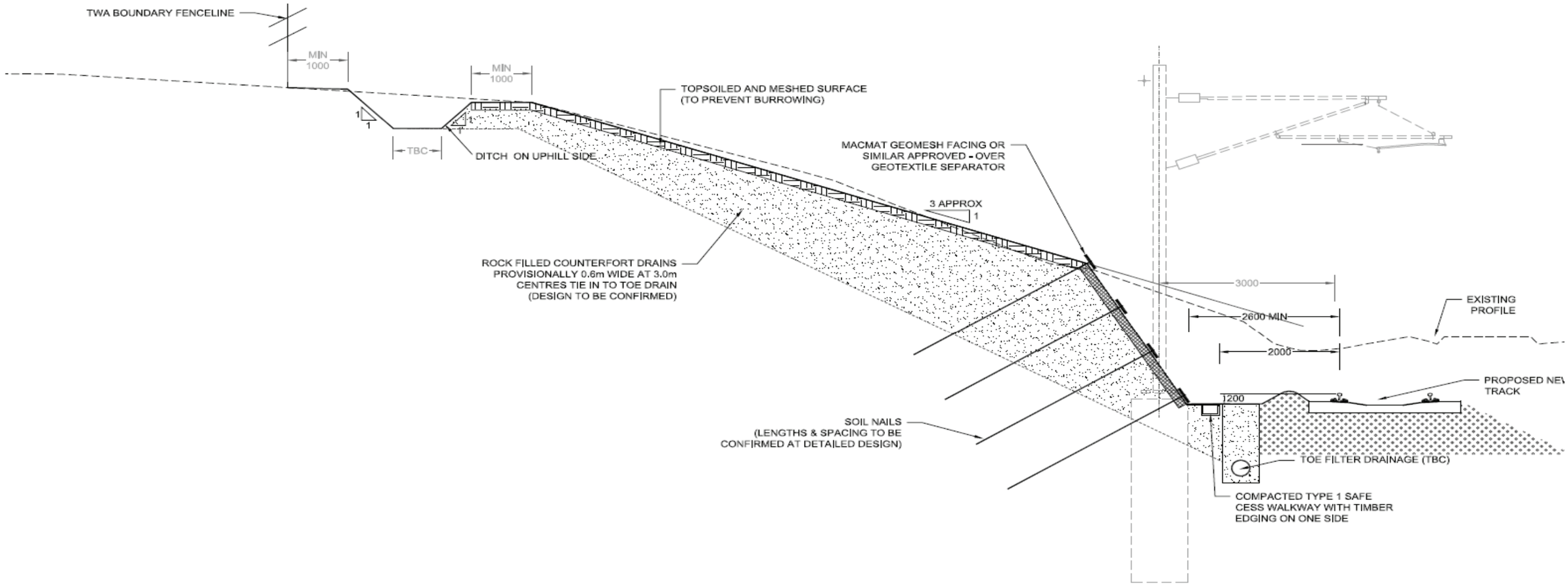


ASSET 1: CUTTING WORKS STABILISATION WITH GABION WALL

1:50

LOCATIONS WHERE:

- ROUTE WIDENING AND LOWERING ARE REQUIRED IN WOLVERCOT CUTTING.
- STABILISATION OF EXISTING WOLVERCOT CUTTING SLOPE.



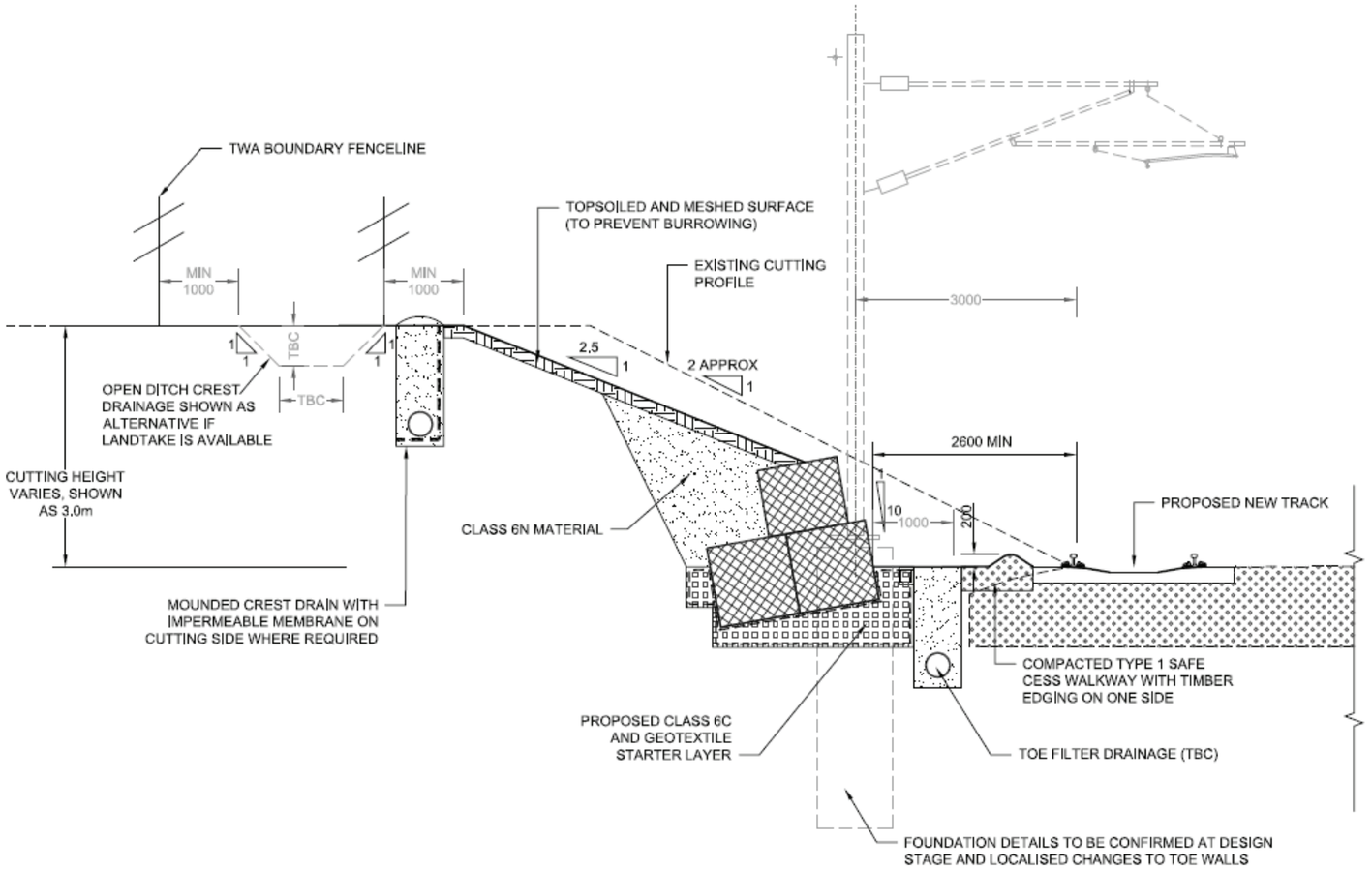
ASSET 1A (ALTERNATIVE): CUTTING WORKS STABILISATION WITH SOIL NAIL & COUNTERFORT DRAINS

1:50

LOCATIONS WHERE:

- ROUTE WIDENING AND LOWERING ARE REQUIRED IN WOLVERCOT CUTTING.
- STABILISATION OF EXISTING WOLVERCOT CUTTING SLOPE.
- ALTERNATIVE TO ASSET 1.

Section H1 Earthworks Figure11

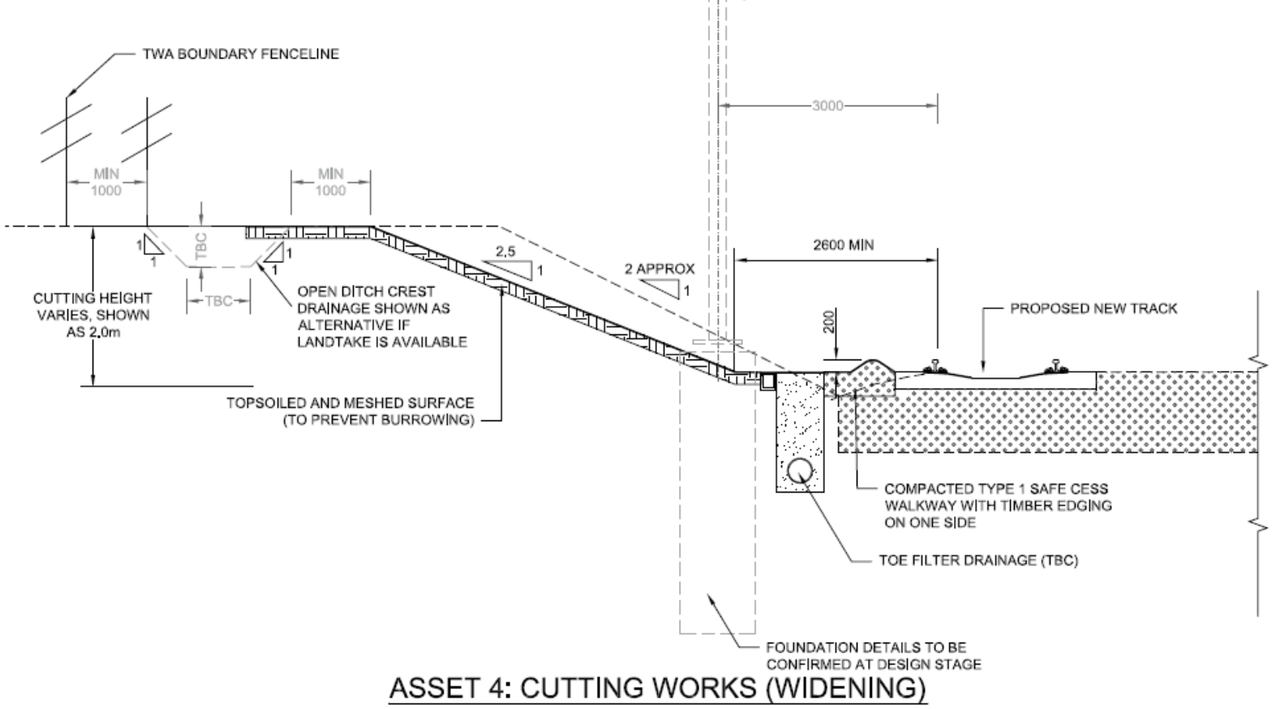


ASSET 3: CUTTING WORKS (WIDENING AND GABION TOE WALL)

1:50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS AND A RETAINING WALL IS REQUIRED
- SIGNIFICANT FORMATION WIDENING IS REQUIRED



ASSET 4: CUTTING WORKS (WIDENING)

1:50

LOCATIONS WHERE:

- THERE IS NOTABLY INSUFFICIENT CESS
- SURFACE MATERIAL FROM CUTTING HAS WEATHERED AND 'SLOUGHED' INTO CESS,
- MINOR FORMATION WIDENING IS REQUIRED

Tables

Table 1: Evaluation of Potential Contaminant Linkages – Section B1 Earthworks

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
All contaminants	• Langford Brook (on-site)	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
		Deposition of water-borne soil.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
		Lateral migration in groundwater or NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	Theoretically possible

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
	• Secondary A aquifer (near surface)	Leaching from sorbed phase and dissolution from NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction. Enhanced vertical migration considered unlikely post-construction given the likely shallow depth of the sub-formation layer and toe drain, and given the proposed construction of the sheet piles. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	Theoretically possible
	• Bicester Wetland Reserve	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater flow direction is towards the nature reserve.	No
		Lateral migration in groundwater or NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater flow direction is towards the nature reserve.	Theoretically possible
	• Local employees • Local residents	Dermal contact and ingestion of soil particles (on-site)	Construction	CoCP states that work sites will be secured to prevent unauthorised access during construction (Section 4). Exposure frequency and duration post-construction expected to be short term and ad hoc, plus CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8) and access will be limited by railway security.	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Dermal contact, ingestion and inhalation of soil particles (off-site)	Construction Post-construction	Dust suppression and prevention measures during construction are included in the CoCP (Sections 4 and 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
Volatile compounds	• Local employees • Local residents	Vapour inhalation	Construction Post-construction	No odours recorded. CoCP states requirement for suitable monitoring and mitigation during construction where the potential for VOC emissions exists. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

CoCP – Code Of Construction Practice

Table 2: Evaluation of Potential Contaminant Linkages – Section D1 Earthworks

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
All contaminants	• Secondary A aquifer (near surface)	Leaching from sorbed phase and dissolution from NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction. Enhanced vertical migration considered unlikely post-construction given the likely shallow depth of the sub-formation layer and toe drain, and the lack of a laterally continuous shallow groundwater, present in only 2 of 6 borehole records. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
	• Wendlebury Ponds County Wildlife Site • Tributary of the Langford Brook	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater unlikely to be encountered and would not flow towards the water bodies at their nearest points to the earthworks.	No
		Lateral migration in groundwater or NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction, but groundwater unlikely to be encountered and would not flow towards the water bodies at their nearest points to the earthworks.	No
	• Wendlebury Meads and Mansmoor Close SSSI	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater unlikely to be encountered.	No
		Lateral migration in groundwater or NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction, but groundwater unlikely to be encountered.	No
	• Local employees • Local residents	Dermal contact and ingestion of soil particles (on-site)	Construction Post-construction	CoCP states that work sites will be secured to prevent unauthorised access during construction (Section 4). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil analytical results.	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Dermal contact, ingestion and inhalation of soil particles (off-site)	Construction Post-construction	Dust suppression and prevention measures during construction are included in the CoCP (Sections 4 and 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil analytical results.	No
Volatile compounds	• Local employees • Local residents	Vapour inhalation	Construction Post-construction	No odours recorded. CoCP states requirement for suitable monitoring and mitigation during construction where the potential for VOC emissions exists. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

CoCP – Code Of Construction Practice

Table 3: Quantitative Evaluation of Soil Chemical Data - Section D1 Earthworks

Parameter	Units	Screening Criteria		WS 66
		Residential (No Veg Uptake)	Commercial	0.3-0.5
Metals				
Arsenic (total)	$mgkg^{-1}$	35	640	8.0
Boron (water soluble)	$mgkg^{-1}$	NRP	NRP	1.3
Cadmium (total)	$mgkg^{-1}$	85	330	<0.2
Chromium (VI)	$mgkg^{-1}$	38	330	<1
Copper (total)	$mgkg^{-1}$	6,500	72,775	14
Lead (total)	$mgkg^{-1}$	359	6,406	88
Mercury (total)	$mgkg^{-1}$	238	3,600	0.6
Nickel (total)	$mgkg^{-1}$	130	1,800	24
Selenium (total)	$mgkg^{-1}$	596	13,000	<0.3
Zinc (total)	$mgkg^{-1}$	40,432	702,236	68
Inorganics				
pH	units	n.v.	n.v.	8.1
Chloride (2:1 water soluble)	mg/l	NRP	NRP	4.0
Sulphate (total)	$mgkg^{-1}$	NRP	NRP	642
Sulphide	$mgkg^{-1}$	NRP	NRP	<10
Cyanide (free)	$mgkg^{-1}$	59	14,049	<2
Asbestos	-	Detection	Detection	NAD
Other Organics				
Organic matter content (OMC)	% w/w	n.v.	n.v.	2.37

Assumptions for GAC calculations are presented in Annex C
NRP- No risk predicted
n.v - No value
NAD - no asbestos detected

- present above detection limit
- exceeds residential GAC/SGV
- exceeds residential and commercial GAC/SGV

Table 4: Evaluation of Potential Contaminant Linkages – Section D2 Earthworks

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
All contaminants	• Wendlebury Meads and Mansmoor Close SSSI	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
		Lateral migration in groundwater or NAPL.	Construction Post-construction	No evidence of NAPL in logs. Contaminants derived from site not considered to be significant based on evidence from logs. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater unlikely to be encountered and would not flow towards SSSI.	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
	• Local residents • Local employees	Dermal contact and ingestion of soil particles (on-site)	Construction Post-construction	CoCP states that work sites will be secured to prevent unauthorised access during construction (Section 4). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil analytical results.	No
		Dermal contact, ingestion and inhalation of soil particles (off-site)	Construction Post-construction	Dust suppression and prevention measures during construction are included in the CoCP (Sections 4 and 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil analytical results.	No
Volatile compounds	• Local residents Local employees	Vapour inhalation	Construction Post-construction	No odours recorded. No indication of significant on-site impact from available soil VOC analytical results. CoCP states requirement for suitable monitoring and mitigation during construction where the potential for VOC emissions exists. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

CoCP – Code Of Construction Practice

Table 5: Quantitative Evaluation of Soil Chemical Data - Section D2 Earthworks

Parameter	Units	Screening Criteria		WS 68a	WS 68a	WS 68a
		Residential (No Veg Uptake)	Commercial	0.50	1.00	2.00-3.00
Metals						
Arsenic (total)	$mgkg^{-1}$	35	640	12	9.6	7.5
Boron (water soluble)	$mgkg^{-1}$	NRP	NRP	0.5	2.7	5.3
Cadmium (total)	$mgkg^{-1}$	85	330	<0.2	<0.2	<0.2
Chromium (total)	$mgkg^{-1}$	3,872	33,830	14	41	51
Chromium (VI)	$mgkg^{-1}$	38	330	<1	<1	<1
Copper (total)	$mgkg^{-1}$	6,500	72,775	19	13	13
Lead (total)	$mgkg^{-1}$	359	6,406	9.9	8.2	9.5
Mercury (total)	$mgkg^{-1}$	238	3,600	0.6	0.5	0.7
Nickel (total)	$mgkg^{-1}$	130	1,800	18	28	36
Selenium (total)	$mgkg^{-1}$	596	13,000	<0.3	1.1	1.5
Zinc (total)	$mgkg^{-1}$	40,432	702,236	12	16	13
Inorganics						
pH	units	n.v.	n.v.	8.8	8.4	8.1
Chloride (2:1 water soluble)	mg/l	NRP	NRP	1.1	2.1	36
Sulphate (total)	$mgkg^{-1}$	NRP	NRP	533	910	52,410
Sulphide	$mgkg^{-1}$	NRP	NRP	<10	<10	<10
Cyanide (free)	$mgkg^{-1}$	59	14,049	<2	<2	<2
Asbestos	-	Detection	Detection	NAD	NAD	NAD
PAHs						
Naphthalene	$mgkg^{-1}$	16	31,046	<0.1	<0.1	<0.1
Acenaphthylene	$mgkg^{-1}$	4,830	109,163	<0.1	<0.1	<0.1
Acenaphthene	$mgkg^{-1}$	4,834	109,142	<0.1	<0.1	<0.1
Fluorene	$mgkg^{-1}$	3,223	72,763	<0.1	<0.1	<0.1
Phenanthrene	$mgkg^{-1}$	1,001	22,703	<0.1	<0.1	<0.1
Anthracene	$mgkg^{-1}$	24,206	545,841	<0.1	<0.1	<0.1
Fluoranthene	$mgkg^{-1}$	1,007	22,734	0.3	<0.1	<0.1
Pyrene	$mgkg^{-1}$	2,419	54,575	0.2	<0.1	<0.1
Benzo(a)anthracene	$mgkg^{-1}$	10	146	<0.1	<0.1	<0.1
Chrysene	$mgkg^{-1}$	111	1,485	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	$mgkg^{-1}$	10	146	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	$mgkg^{-1}$	26	365	<0.1	<0.1	<0.1
Benzo(a)pyrene	$mgkg^{-1}$	1.0	15	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	$mgkg^{-1}$	10	146	<0.1	<0.1	<0.1
Dibenz(ah)anthracene	$mgkg^{-1}$	1.0	15	<0.1	<0.1	<0.1
Benzo(ghi)perylene	$mgkg^{-1}$	48	681	<0.1	<0.1	<0.1
PAH (total)	$mgkg^{-1}$	n.v.	n.v.	<5	<5	<5
Petroleum Hydrocarbons						
MTBE	$mgkg^{-1}$	101	10,952	<0.01	<0.01	<0.01
Benzene	$mgkg^{-1}$	0.3	28	<0.01	<0.01	<0.01
Toluene	$mgkg^{-1}$	607	419,194	<0.01	<0.01	<0.01
Ethylbenzene	$mgkg^{-1}$	167	184,722	<0.01	<0.01	<0.01
m & p-Xylene	$mgkg^{-1}$	53	305,338	<0.01	<0.01	<0.01
o-Xylene	$mgkg^{-1}$	60	314,550	<0.01	<0.01	<0.01
TPH Aromatic EC5-EC7	$mgkg^{-1}$	260	405,675	<0.01	<0.01	<0.01
TPH Aromatic EC7-EC8	$mgkg^{-1}$	555	418,711	<0.01	<0.01	<0.01
TPH Aromatic EC8-EC10	$mgkg^{-1}$	42	33,128	<0.01	<0.01	<0.01
TPH Aromatic EC10-EC12	$mgkg^{-1}$	230	37,607	<1	<1	<1
TPH Aromatic EC12-EC16	$mgkg^{-1}$	1,578	38,065	<1	<1	<1
TPH Aromatic EC16-EC21	$mgkg^{-1}$	1,328	28,562	<1	<1	<1
TPH Aromatic EC21-EC35	$mgkg^{-1}$	1,335	28,563	<1	<1	<1
TPH Aromatic EC35-EC44	$mgkg^{-1}$	1,335	28,563	<1	<1	<1
TPH Aliphatic EC5-EC6	$mgkg^{-1}$	35	NRP	<0.1	<0.1	<0.1
TPH Aliphatic EC6-EC8	$mgkg^{-1}$	90	NRP	<0.1	<0.1	<0.1
TPH Aliphatic EC8-EC10	$mgkg^{-1}$	25	92,563	<0.1	<0.1	0.1
TPH Aliphatic EC10-EC12	$mgkg^{-1}$	2,862	94,990	1	2	1
TPH Aliphatic EC12-EC16	$mgkg^{-1}$	4,322	95,267	3	5	2
TPH Aliphatic EC16-EC35	$mgkg^{-1}$	89,023	NRP	16	14	9
TPH Aliphatic EC35-EC44	$mgkg^{-1}$	89,023	NRP	<1	<1	<1
Other Organics						
Phenols (total)	$mgkg^{-1}$	310	3,200	<0.5	<0.5	<0.5
Organic matter content (OMC)	% w/w	n.v.	n.v.	0.84	0.42	0.21

Assumptions for GAC calculations are presented in Annex C
NRP- No risk predicted
n.v - No value
NAD - no asbestos detected

- present above detection limit
- exceeds residential GAC/SGV
- exceeds residential and commercial GAC/SGV

Tables 6a and 6b: Quantitative Evaluation of Leachate Data - Section D2 Earthworks

Protection of surface waters

				Location:	WS 68a	WS 68a	WS 68a
				Depth:	0.50	1.00	2.00-3.00
Parameter	**Units**	**Screening Criteria / µgl^{-1}**					
		Value	**Source**				
Arsenic (dissolved)	mg/l	0.05	EQS		0.002	0.001	0.002
Boron (dissolved)	mg/l	2	non-stat EQS		<0.03	0.06	0.21
Cadmium (dissolved)	mg/l	0.00025	EQS		<0.001	<0.001	<0.001
Chromium (dissolved)	mg/l	n.v.			<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	mg/l	0.0034	EQS		<0.01	<0.01	<0.01
Copper (dissolved)	mg/l	0.028	EQS		<0.004	<0.004	<0.004
Lead (dissolved)	mg/l	0.0072	EQS		<0.009	<0.009	<0.009
Mercury (dissolved)	mg/l	0.00005	EQS		<0.001	<0.001	<0.001
Nickel (dissolved)	mg/l	0.02	EQS		<0.003	<0.003	<0.003
Selenium (dissolved)	mg/l	n.v.			0.002	<0.001	<0.001
Zinc (dissolved)	mg/l	0.125	EQS		<0.020	<0.020	<0.020
Ammoniacal Nitrogen as N	mg/l	n.v.			0.08	0.19	0.15
Chloride	mg/l	250	non-stat EQS		<1	<1	7.5
Nitrate as NO_3	mg/l	n.v.			<1	<1	<1
Sulphate as SO_4	mg/l	400	non-stat EQS		<10	30	1852
Cyanide (free)	mg/l	0.001	EQS		<0.02	<0.02	<0.02
Total Organic Carbon	mg/l	n.v.			2.3	3.1	2.2

Protection of Secondary A Aquifer

				Location:	WS 68a	WS 68a	WS 68a
				Depth:	0.50	1.00	2.00-3.00
Parameter	**Units**	**Screening Criteria / µgl^{-1}**					
		Value	**Source**				
Arsenic (dissolved)	mg/l	0.01	DWS		0.002	0.001	0.002
Boron (dissolved)	mg/l	1	DWS		<0.03	0.06	0.21
Cadmium (dissolved)	mg/l	0.005	DWS		<0.001	<0.001	<0.001
Chromium (dissolved)	mg/l	0.05	DWS		<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	mg/l	n.v.			<0.01	<0.01	<0.01
Copper (dissolved)	mg/l	2	DWS		<0.004	<0.004	<0.004
Lead (dissolved)	mg/l	0.01	DWS		<0.009	<0.009	<0.009
Mercury (dissolved)	mg/l	0.001	DWS		<0.001	<0.001	<0.001
Nickel (dissolved)	mg/l	0.02	DWS		<0.003	<0.003	<0.003
Selenium (dissolved)	mg/l	0.01	DWS		0.002	<0.001	<0.001
Zinc (dissolved)	mg/l	3	WHO		<0.020	<0.020	<0.020
Ammoniacal Nitrogen as N	mg/l	0.389	DWS		0.08	0.19	0.15
Chloride	mg/l	250	DWS		<1	<1	7.5
Nitrate as NO_3	mg/l	50	DWS		<1	<1	<1
Sulphate as SO_4	mg/l	250	DWS		<10	30	1852
Cyanide (free)	mg/l	n.v.			<0.02	<0.02	<0.02
Total Organic Carbon	mg/l	n.v.			2.3	3.1	2.2

Surface Water Heirarchy:

1. EQS - Environmental Quality Standard defined in The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010

2. non-stat EQS - non-statutory EQS (UK) defined in DoE Circular 7/89, EA Horizontal Guidance H1 2011, SEPA Supporting Guidance WAT-SG-53 April 2013

Aquifer Heirarchy:

1. DWS - UK Drinking Water Standard

2. WHO - World Health Organisation DWS 4th ed. 2011

Assumptions:

Hardness dependent EQS (for Cd, Cu, Zn) assume hardness as $CaCO_3$ >250 mgl^{-1} because the typology of surface water courses in the catchment have been defined by the EA as Calcareous.

Key:

n.v. - no value | - present above limit of detection | - exceeds surface water screening criteria | - exceeds aquifer screening criteria

Table 7: Evaluation of Potential Contaminant Linkages – Section E1 Earthworks

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
All contaminants	• Secondary A aquifer (near surface) • Principal Aquifer (Limestone)	Leaching from sorbed phase and dissolution or NAPL.	Construction Post-construction	A number of exceedances of EQSs and DWS screening criteria within the groundwater samples Detections of PAHs, Metals and TPH in soils. Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction. Enhanced vertical migration considered likely post-construction given the shallow depth of the sub-formation layer and toe drain, and the presence of shallow groundwater. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	Yes
	• River Ray • Gallos Brook	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater likely to be encountered and would flow towards the water bodies at their nearest points to the earthworks.	Yes
		Lateral migration in groundwater.	Construction Post-construction	Exceedances of Metals, Chloride and Sulphate in groundwater. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Mobilisation of contaminants in groundwater derived from off-site sources possible during and post-construction, and groundwater likely to be encountered and would flow towards the water bodies at their nearest points to the earthworks.	Yes
	• Local employees • Local residents	Dermal contact and ingestion of soil particles (on-site)	Construction Post-construction	CoCP states that work sites will be secured to prevent unauthorised access during construction (Section 4). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Only shallow soil sample data available, not sufficient to make an assessment.	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Dermal contact, ingestion and inhalation of soil particles (off-site)	Construction Post-construction	Dust suppression and prevention measures during construction are included in the CoCP (Sections 4 and 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Only shallow soil sample data available, not sufficient to make an assessment.	No
Volatile compounds	• Local employees • Local residents	Vapour inhalation	Construction Post-construction	No odours recorded. CoCP states requirement for suitable monitoring and mitigation during construction where the potential for VOC emissions exists. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Only shallow soil sample data available, not sufficient to make an assessment.	No

CoCP – Code Of Construction Practice

Table 8: Quantitative Evaluation of Soil Chemical Data - Section E1 Earthworks

Parameter	Units	Screening Criteria Residential (No Veg Uptake)	Screening Criteria Commercial	WS 163 0.30	WS 163 1.00	WS 164 0.50	WS 164 1.00
Metals							
Arsenic (total)	$mgkg^{-1}$	35	640	18	7.6	16	5.2
Boron (water soluble)	$mgkg^{-1}$	NRP	NRP	<0.3	1.0	0.3	0.9
Cadmium (total)	$mgkg^{-1}$	85	330	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	$mgkg^{-1}$	38	330	<1	<1	<1	<1
Copper (total)	$mgkg^{-1}$	6,500	72,775	29	24	27	19
Lead (total)	$mgkg^{-1}$	359	6,406	21	11	14	12
Mercury (total)	$mgkg^{-1}$	238	3,600	0.7	0.7	0.6	<0.5
Nickel (total)	$mgkg^{-1}$	130	1,800	20	23	17	10
Selenium (total)	$mgkg^{-1}$	596	13,000	<0.3	<0.3	<0.3	<0.3
Zinc (total)	$mgkg^{-1}$	40,432	702,236	68	66	49	57
Inorganics							
pH	units	n.v.	n.v.	8.6	8.1	8.6	7.3
Chloride (2:1 water soluble)	mg/l	NRP	NRP	<1	<1	<1	1.8
Sulphate (total)	$mgkg^{-1}$	NRP	NRP	442	616	651	27,700
Sulphide	$mgkg^{-1}$	NRP	NRP	<10	<10	<10	<10
Cyanide (free)	$mgkg^{-1}$	59	14,049	<2	<2	<2	<2
Asbestos	-	n.v.	n.v.	NAD	NAD	Chrysotile	NAD
PAHs							
Naphthalene	$mgkg^{-1}$	16	31,046	<0.1	<0.1	-	-
Acenaphthylene	$mgkg^{-1}$	4,830	109,163	<0.1	<0.1	-	-
Acenaphthene	$mgkg^{-1}$	4,834	109,142	<0.1	<0.1	-	-
Fluorene	$mgkg^{-1}$	3,223	72,763	<0.1	<0.1	-	-
Phenanthrene	$mgkg^{-1}$	1,001	22,703	0.2	0.1	-	-
Anthracene	$mgkg^{-1}$	24,206	545,841	<0.1	<0.1	-	-
Fluoranthene	$mgkg^{-1}$	1,007	22,734	0.2	<0.1	-	-
Pyrene	$mgkg^{-1}$	2,419	54,575	0.2	<0.1	-	-
Benzo(a)anthracene	$mgkg^{-1}$	10	146	<0.1	<0.1	-	-
Chrysene	$mgkg^{-1}$	111	1,485	<0.1	<0.1	-	-
Benzo(b)fluoranthene	$mgkg^{-1}$	10	146	<0.1	<0.1	-	-
Benzo(k)fluoranthene	$mgkg^{-1}$	26	365	<0.1	<0.1	-	-
Benzo(a)pyrene	$mgkg^{-1}$	1.0	15	<0.1	<0.1	-	-
Indeno(123cd)pyrene	$mgkg^{-1}$	10	146	<0.1	<0.1	-	-
Dibenz(ah)anthracene	$mgkg^{-1}$	1.0	15	<0.1	<0.1	-	-
Benzo(ghi)perylene	$mgkg^{-1}$	48	681	<0.1	<0.1	-	-
PAH (total)	$mgkg^{-1}$	n.v.	n.v.	<5	<5	-	-
Petroleum Hydrocarbons							
MTBE	$mgkg^{-1}$	101	10,952	<0.01	<0.01	-	-
Benzene	$mgkg^{-1}$	0.3	28	<0.01	<0.01	-	-
Toluene	$mgkg^{-1}$	607	419,194	<0.01	<0.01	-	-
Ethylbenzene	$mgkg^{-1}$	167	184,722	<0.01	<0.01	-	-
m & p-Xylene	$mgkg^{-1}$	53	305,338	<0.01	<0.01	-	-
o-Xylene	$mgkg^{-1}$	60	314,550	<0.01	<0.01	-	-
TPH Aromatic EC5-EC7	$mgkg^{-1}$	260	405,675	<0.1	<0.1	-	-
TPH Aromatic EC7-EC8	$mgkg^{-1}$	555	418,711	<0.1	<0.1	-	-
TPH Aromatic EC8-EC10	$mgkg^{-1}$	42	33,128	0.1	0.1	-	-
TPH Aromatic EC10-EC12	$mgkg^{-1}$	230	37,607	<1	<1	-	-
TPH Aromatic EC12-EC16	$mgkg^{-1}$	1,578	38,065	<1	<1	-	-
TPH Aromatic EC16-EC21	$mgkg^{-1}$	1,328	28,562	<1	<1	-	-
TPH Aromatic EC21-EC35	$mgkg^{-1}$	1,335	28,563	<1	<1	-	-
TPH Aromatic EC35-EC44	$mgkg^{-1}$	1,335	28,563	<1	<1	-	-
TPH Aliphatic EC5-EC6	$mgkg^{-1}$	35	NRP	<0.01	<0.01	-	-
TPH Aliphatic EC6-EC8	$mgkg^{-1}$	90	NRP	<0.01	<0.01	-	-
TPH Aliphatic EC8-EC10	$mgkg^{-1}$	25	92,563	<0.01	<0.01	-	-
TPH Aliphatic EC10-EC12	$mgkg^{-1}$	2,862	94,990	<1	<1	-	-
TPH Aliphatic EC12-EC16	$mgkg^{-1}$	4,322	95,267	<1	<1	-	-
TPH Aliphatic EC16-EC35	$mgkg^{-1}$	89,023	NRP	2	<1	-	-
TPH Aliphatic EC35-EC44	$mgkg^{-1}$	89,023	NRP	<1	<1	-	-
Other Organics							
Phenols (total)	$mgkg^{-1}$	310	3,200	<0.5	<0.5	-	-
Organic matter content (OMC)	% w/w	n.v.	n.v.	0.45	0.60	0.88	1.63

Assumptions for GAC calculations are presented in Annex C

NRP- No risk predicted

n.v - No value

NAD - no asbestos detected

- present above detection limit

- exceeds residential GAC/SGV

- exceeds residential and commercial GAC/SGV

Tables 9a and 9b: Quantitative Evaluation of Leachate Data - Section E1 Earthworks

Protection of surface waters

Parameter	Units	Screening Criteria Value	Screening Criteria Source	Location: WS 163 Depth: 0.30	Location: WS 163 Depth: 1.00
Arsenic (dissolved)	ug/l	50	EQS	<0.001	<0.001
Boron (dissolved)	ug/l	2,000	non-stat EQS	<0.03	<0.03
Cadmium (dissolved)	ug/l	0.25	EQS	<0.001	<0.001
Chromium (dissolved)	ug/l	n.v.		<0.003	<0.003
Chromium (VI) (dissolved)	ug/l	3.4	EQS	<0.01	<0.01
Copper (dissolved)	ug/l	28	EQS	<0.004	<0.004
Lead (dissolved)	ug/l	7.2	EQS	<0.009	<0.009
Mercury (dissolved)	ug/l	0.05	EQS	<0.001	<0.001
Nickel (dissolved)	ug/l	20	EQS	<0.003	<0.003
Selenium (dissolved)	ug/l	n.v.		0.002	0.004
Zinc (dissolved)	ug/l	125	EQS	<0.020	<0.020
Hardness (by calculation)	mg/l	n.v.		35	64
Ammoniacal Nitrogen	mg/l	n.v.		0.07	0.04
Chloride	mg/l	250	non-stat EQS	<1	<1
Nitrate	mg/l	n.v.		<1	<1
Sulphate	mg/l	400	non-stat EQS	<10	12
Cyanide (free)	mg/l	0.001	EQS	<0.02	<0.02
Total Organic Carbon	mg/l	n.v.		3.4	2.3

Protection of Secondary A aquifer

Parameter	Units	Screening Criteria Value	Screening Criteria Source	Location: WS 163 Depth: 0.30	Location: WS 163 Depth: 1.00
Arsenic (dissolved)	ug/l	10	DWS	<0.001	<0.001
Boron (dissolved)	ug/l	1,000	DWS	<0.03	<0.03
Cadmium (dissolved)	ug/l	5	DWS	<0.001	<0.001
Chromium (dissolved)	ug/l	50	DWS	<0.003	<0.003
Chromium (VI) (dissolved)	ug/l	n.v.		<0.01	<0.01
Copper (dissolved)	ug/l	2,000	DWS	<0.004	<0.004
Lead (dissolved)	ug/l	10	DWS	<0.009	<0.009
Mercury (dissolved)	ug/l	1	DWS	<0.001	<0.001
Nickel (dissolved)	ug/l	20	DWS	<0.003	<0.003
Selenium (dissolved)	ug/l	10	DWS	0.002	0.004
Zinc (dissolved)	ug/l	3,000	WHO	<0.020	<0.020
Hardness (by calculation)	mg/l	n.v.		35	64
Ammoniacal Nitrogen	mg/l	0.389	DWS	0.07	0.04
Chloride	mg/l	250	DWS	<1	<1
Nitrate	mg/l	50	DWS	<1	<1
Sulphate	mg/l	250	DWS	<10	12
Cyanide (free)	mg/l	n.v.		<0.02	<0.02
Total Organic Carbon	mg/l	n.v.		3.4	2.3

Surface Water Heirarchy:

1. EQS - Environmental Quality Standard defined in The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010

2. non-stat EQS - non-statutory EQS (UK) defined in DoE Circular 7/89, EA Horizontal Guidance H1 2011, SEPA Supporting Guidance WAT-SG-53 April 2013

Aquifer Heirarchy:

1. DWS - UK Drinking Water Standard

2. WHO - World Health Organisation DWS 4th ed. 2011

Assumptions:

Hardness dependent EQS (for Cd, Cu, Zn) assume hardness as $CaCO_3$ >250 mgl^{-1} because the typology of Langford Brook has been defined by the EA as Calcareous and the groundwater data is >250 mgl^{-1}.

Key:

n.v. - no value

- present above limit of detection

- exceeds surface water screening criteria

- exceeds aquifer screening criteria

Tables 10a and 10b: Quantitative Evaluation of Groundwater Data - Section E1 Earthworks

Protection of surface waters

Parameter	Units	Screening Criteria Value	Screening Criteria Source	Location: WS162	WS163
Arsenic, Dissolved	ug/l	50	EQS	0.38	0.33
Total Cadmium	ug/l	0.25	EQS	1.4	1.0
Chromium, Dissolved	ug/l	n.v.		< 0.25	< 0.25
Hexavalent Chromium	ug/l	3.4	EQS	< 1.0	< 1.0
Copper, Dissolved	ug/l	28	EQS	5.5	< 0.40
Lead, Dissolved	ug/l	7.2	EQS	0.70	< 0.090
Mercury, Dissolved	ug/l	0.05	EQS	< 0.010	< 0.010
Nickel, Dissolved	ug/l	20	EQS	18	4.2
Selenium, Dissolved	ug/l	n.v.		2.0	1.1
Vanadium, Dissolved	ug/l	60	non-stat EQS	< 0.60	< 0.60
Total Zinc	ug/l	125	EQS	230	110
Alkalinity as $CaCO_3$	mg/l	n.v.		380	430
Chloride	mg/l	250	non-stat EQS	130	12
Boron Total	ug/l	2,000	non-stat EQS	950	120
Cyanide total	ug/l	n.v.		< 40	< 40
Cyanide free	ug/l	1	EQS	< 10	< 10
Cyanide complex	ug/l	n.v.		< 40	< 40
Hardness	mg/l	n.v.		1700	728
Ammoniacal Nitrogen as N	mg/l	n.v.		0.26	0.029
Nitrate as N	mg/l	n.v.		0.27	2.4
Sulphate as SO_4	mg/l	400	non-stat EQS	2100	340
Total Organic Carbon	mg/l	n.v.		44	39
Petroleum Hydrocarbons					
Benzene	ug/l	10	EQS	< 1.0	< 1.0
Ethylbenzene	ug/l	20	non-stat EQS	< 1.0	< 1.0
Toluene	ug/l	50	EQS	< 1.0	< 1.0
Xylene	ug/l	30	EQS	< 1.0	< 1.0
Aliphatic C5-C6	ug/l	15,000	WHO	< 0.1	< 0.1
Aliphatic C6-C8	ug/l			< 0.1	< 0.1
Aliphatic C8-C10	ug/l			< 0.1	< 0.1
Aliphatic C10-C12	ug/l	300	WHO	< 1.0	< 1.0
Aliphatic C12-C16	ug/l			< 1.0	< 1.0
Aliphatic C16-C21	ug/l	6,000	WHO	< 1.0	< 1.0
Aliphatic C21-C35	ug/l			< 1.0	< 1.0
Aromatic C5-C7	ug/l	10	EQS[a]	< 0.1	< 0.1
Aromatic C7-C8	ug/l	50	EQS[b]	< 0.1	< 0.1
Aromatic C8-C10	ug/l	20	EQS[c]	< 0.1	< 0.1
Aromatic C10-C12	ug/l	100	WHO	< 1.0	< 1.0
Aromatic C12-C16	ug/l			< 1.0	< 1.0
Aromatic C16-C21	ug/l	90	WHO	1.9	< 1.0
Aromatic C21-C35	ug/l			60	< 1.0
Aliphatic C5-C35	ug/l	n.v.		< 10	< 10
Aromatic C5-C35	ug/l	n.v.		62	< 10
TPH Ali/Aro	ug/l	n.v.		62	< 10
Total PAH (USEPA Priority 16)	ug/l	n.v.		0.29	0.75
Phenol - Monohydric	ug/l	7.7	EQS	< 0.5	< 0.5

Protection of Secondary A Aquifer

Parameter	Units	Screening Criteria Value	Screening Criteria Source	Location: WS162	WS163
Arsenic, Dissolved	ug/l	10	DWS	0.38	0.33
Total Cadmium	ug/l	5	DWS	1.4	1.0
Chromium, Dissolved	ug/l	50	DWS	< 0.25	< 0.25
Hexavalent Chromium	ug/l	n.v.		< 1.0	< 1.0
Copper, Dissolved	ug/l	2,000	DWS	5.5	< 0.40
Lead, Dissolved	ug/l	10	DWS	0.70	< 0.090
Mercury, Dissolved	ug/l	1	DWS	< 0.010	< 0.010
Nickel, Dissolved	ug/l	20	DWS	18	4.2
Selenium, Dissolved	ug/l	10	DWS	2.0	1.1
Vanadium, Dissolved	ug/l	n.v.		< 0.60	< 0.60
Total Zinc	ug/l	3,000	WHO	230	110
Alkalinity as $CaCO_3$	mg/l	n.v.		380	430
Chloride	mg/l	250	DWS	130	12
Boron Total	ug/l	1,000	DWS	950	120
Cyanide total	ug/l	50	DWS	< 40	< 40
Cyanide free	ug/l	n.v.		< 10	< 10
Cyanide complex	ug/l	n.v.		< 40	< 40
Hardness	mg/l	n.v.		1700	728
Ammoniacal Nitrogen as N	mg/l	0.389	DWS	0.26	0.029
Nitrate as N	mg/l	50	DWS	0.27	2.4
Sulphate as SO_4	mg/l	250	DWS	2100	340
Total Organic Carbon	mg/l	n.v.		44	39
Petroleum Hydrocarbons					
Benzene	ug/l	1	DWS	< 1.0	< 1.0
Ethylbenzene	ug/l	300	WHO	< 1.0	< 1.0
Toluene	ug/l	700	WHO	< 1.0	< 1.0
Xylene	ug/l	500	WHO	< 1.0	< 1.0
Aliphatic C5-C6	ug/l	15,000	WHO	< 0.1	< 0.1
Aliphatic C6-C8	ug/l			< 0.1	< 0.1
Aliphatic C8-C10	ug/l			< 0.1	< 0.1
Aliphatic C10-C12	ug/l	300	WHO	< 1.0	< 1.0
Aliphatic C12-C16	ug/l			< 1.0	< 1.0
Aliphatic C16-C21	ug/l	6,000	WHO	< 1.0	< 1.0
Aliphatic C21-C35	ug/l			< 1.0	< 1.0
Aromatic C5-C7	ug/l	1	EQS[a]	< 0.1	< 0.1
Aromatic C7-C8	ug/l	700	EQS[b]	< 0.1	< 0.1
Aromatic C8-C10	ug/l	300	EQS[c]	< 0.1	< 0.1
Aromatic C10-C12	ug/l	100	WHO	< 1.0	< 1.0
Aromatic C12-C16	ug/l			< 1.0	< 1.0
Aromatic C16-C21	ug/l	90	WHO	1.9	< 1.0
Aromatic C21-C35	ug/l			60	< 1.0
Aliphatic C5-C35	ug/l	n.v.		< 10	< 10
Aromatic C5-C35	ug/l	n.v.		62	< 10
TPH Ali/Aro	ug/l	n.v.		62	< 10
Total PAH (USEPA Priority 16)	ug/l	n.v.		0.29	0.75
Phenol - Monohydric	ug/l			< 0.5	< 0.5

Surface Water Heirarchy:

1. EQS - Environmental Quality Standard defined in The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010

2. non-stat EQS - non-statutory EQS (UK) defined in DoE Circular 7/89, EA Horizontal Guidance H1 2011, SEPA Supporting Guidance WAT-SG-53 April 2013

3. WHO - World Health Organisation TPH 2005 used for petroleum hydrocarbons as secondary screening values.

Aquifer Heirarchy:

1. DWS - UK Drinking Water Standard

2. WHO - World Health Organisation DWS 4th ed. 2011

Assumptions and Justifications

Hardness dependent EQS use >250 mgl^{-1} $CaCO_3$ banding based on analytical results.

Key:

n.v. - no value | - present above limit of detection | - exceeds surface water screening criteria | - exceeds aquifer screening criteria

Table 11: Evaluation of Potential Contaminant Linkages – Section H1 Earthworks

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
All contaminants	• Linkside Lake (SINC)	Deposition of air-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent air-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8).	No
		Deposition of water-borne soil particles.	Construction Post-construction	CoCP states that precautions will be taken to prevent water-borne dusts from entering any bodies of water during construction (Section 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Groundwater unlikely to be encountered.	No
	• Local residents • Local employees	Dermal contact and ingestion of soil particles (on-site)	Construction Post-construction	CoCP states that work sites will be secured to prevent unauthorised access during construction (Section 4). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil borehole logs..	No

Potential Contaminant	Receptors	Pathways	Phase When Pathway Is Relevant	Evaluation	Plausible Contaminant Linkage?
		Dermal contact, ingestion and inhalation of soil particles (off-site)	Construction Post-construction	Dust suppression and prevention measures during construction are included in the CoCP (Sections 4 and 7). CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). No indication of significant on-site impact from available soil borehole logs.	No
Volatile compounds	• Local employees • Local residents	Vapour inhalation	Construction Post-construction	No odours recorded. CoCP states requirement for suitable monitoring and mitigation during construction where the potential for VOC emissions exists. CoCP states that materials re-use criteria will ensure post-construction suitability for use (Section 8). Low permeability clays will minimise the migration of vapours.	No

CoCP – Code Of Construction Practice

Annex A

Atkins and BGS Geological Logs

Section B1 Earthworks

Embankment regrade

Embankment regrade

Embankment regrade and sheet pile wall

WS46

WS190

WS191

Section boundary

Limits of rail scheme

Rail centreline

Atkins earthworks type

7

8

Approximate ground investigation location

0 100

Meters

N

SCALE: See Scale Bar

SIZE: A3

PROJECT: 0172205

DATE: 04/09/2013

VERSION: A01

DRAWN: JL

CHECKED: KB

APPROVED:

Figure A1
Approximate Atkins Ground Investigation Locations - Section B1

ERM

CLIENT:

Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_AtkinsGroundInvestigationLocationsSectionB1_A01.mxd

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336777 : BGS Reference: SP52SE77
British National Grid (27700) : 458270,221380
Report an issue with this borehole

Boring method: Shell and Auger	Boring diameter (mm): 150 to 7.20m	Record of BOREHOLE 421/3	
Boring equipment: Pilcon Wayfarer	Casing diameter (mm): 150 to 6.80m		
Location: See Site Plan	Orientation: Vertical	Ground level (m O D): 66.25	Date commenced: 13.6.86

Samples and in situ tests: Depth (m)	Type	Casing depth (m)	Water depth (m)	Date and Depth (m)	Description of Strata	O D Level (m O D)	Legend
					SP52SE 77 5827 - 2138		
0.25	Dj			13/6	FILL (Topsoil sandy silty clay and pieces of concrete)		
0.50	U100	None		0.50		65.75	
0.95	Dj				Stiff friable brown with blue-grey pockets sandy and silty CLAY with rootlets (possibly fill)		
1.25	Dj			1.50		64.75	
1.50	U100	1.50			Grey slightly clayey very silty fine SAND with pockets of sandy silt		
1.95	Dj			2.30		63.95	
2.30	Dj		GWs 2.90 1.70	2.50	Soft to firm sandy silty CLAY	63.75	
2.50	U100	2.50		2.90			
2.90	GWs	2.80					
2.95	Dj		1.70	14/6	Dark grey slightly clayey very sandy SILT with roots		
3.85	Dj			3.85		62.40	
4.00	U100	3.00			Stiff fissured fissile dark grey silty CLAY with occasional shell debris, silt partings and pyrite		
4.45	Dj						
4.75	Dj						
5.00	U100	3.00					
5.45	Dj						
5.75	Dj						
6.00	U100	3.00					
6.45	Dj			6.45		59.80	
6.70	C(>50) Db	6.80	GWs 6.80	6.70	Very stiff dark grey calcareous silty CLAY with much shell debris	59.55	
6.70					Dark grey coarse crystalline LIMESTONE, moderately strong		
				7.20	END OF BOREHOLE	59.05	

Remarks: Ground-water was encountered at 2.90m; level rose to 1.70m in 30 minutes. Ground-water was also encountered at 6.70m; level rose to 1.80m in 30 minutes.
The borehole was advanced by chiselling between 6.70m and 7.20m.
On completion of boring, borehole was backfilled as follows: Sand from 7.20m to 6.40m; bentonite pellets from 6.40m to 5.90m; bentonite grout from 5.90m to 3.20m; bentonite pellets from 3.20m to 2.90m; sand from 2.90m to 1.90m; bentonite pellets from 1.90m to 1.60m; bentonite grout from 1.60m to 1.00m; bentonite pellets from 1.00m to 0.50m; concrete from 0.50m to ground-level. Standpipe piezometers were installed at depths of 6.80m and 2.50m, the installations were protected at ground level by a stop-box cover.

WIMPEY LABORATORIES

BOREHOLE RECORD
Scale 1 : 50
For explanation of symbols and abbreviations see Key Sheet

Lab Ref No S/24347

T.W.A.-BICESTER SEWAGE TREATMENT WORKS

Fig. 3

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336781 : BGS Reference: SP52SE81
British National Grid (27700) : 458270,221380
Report an issue with this borehole

Boring method: Shell and Auger	Boring diameter (mm): 150 to 10.20m	Record of BOREHOLE 421/7	
Boring equipment: Pilcon Wayfarer	Casing diameter (mm): 150 to 9.00m	(Sheet 1 of 1)	
Location: See Site Plan	Orientation: Vertical	Ground level (m O D): 67.50	Date commenced: 10.6.86

SP52SE 81 5827-2138

Samples and in situ tests: Depth (m)	Type	Casing depth (m)	Water depth (m)	Date and Depth (m)	Description of Strata	O D Level (m O D)	Legend
0.25	Dj			10/6 0.25	TOPSOIL	67.25	
0.50	U100	None		0.70	Firm to stiff brown with grey-brown patches slightly sandy silty CLAY with occasional gravel and closely spaced rootlets	66.80	
1.00	Dj				Firm to stiff green with orange-brown patches sandy silty CLAY with occasional calcareous nodules and closely spaced rootlets		
1.25	Dj						
1.50	U100	None		1.60		65.90	
2.00	Dj				Firm to stiff grey with orange-brown patches silty CLAY with occasional pockets and layers of sandy clay		
2.25	Dj						
2.50	U100	2.00					
3.00	Dj			3.00		64.50	
3.25	Dj				Firm to stiff fissured brown-green with yellow patches sandy silty CLAY		
3.50	U100	3.00					
3.75	GMs		GMs 3.75	3.70		63.80	
4.00	Dj						
4.25	Dj		GMc 4.00				
4.50	S(37)	4.00					
4.50	Dj	4.00	Dry	5.00	Dense dark grey slightly clayey silty SAND with layers of silty fine sand and occasional shell debris		
5.25	Dj		2.40				
5.50	C(>50)	4.50					
5.50	Db		⧖				
6.25	Dj		GMc 6.20	6.20		61.30	
6.50	U100	6.00					
7.00	Dj						
7.25	Dj				Stiff fissured fissile dark grey silty CLAY with occasional shell debris		
7.50	U100	7.00					
8.00	Dj						
8.25	Dj						
8.50	U100	8.50		8.80		58.70	
9.00	Dj				Very stiff dark grey calcareous silty CLAY with much shell debris		
				9.30		58.20	
9.50	C(>50)	9.00			Dark grey coarse crystalline LIMESTONE moderately strong		
9.50	Db						
				10.20	END OF BOREHOLE	57.30	

Remarks: Ground-water was encountered at a depth of 3.75m; level rose to 3.30m in 30 minutes.
Ground-water was also encountered at the start of shift 11.6.86 at a depth of 2.40m.
Ground-water was sealed off by lining casings between 4.00m and 5.00m; also between 6.20m and 10.20m.
Borehole was advanced by chiselling between 9.30m and 10.20m.
On completion of boring the borehole was backfilled as follows: Bentonite grout from 10.20m to 6.30m; bentonite pellets between 6.30m and 6.00m; sand from 6.00m to 5.00m; bentonite pellets between 4.50m and 5.00m; bentonite grout between 4.50m and 1.50m; bentonite pellets from 1.50m to 1.00m; cement from 1.00m to ground level.
A standpipe piezometer was installed at a depth of 5.80m. The installation was protected at ground level by a stop box cover.

WIMPEY LABORATORIES

BOREHOLE RECORD
Scale 1 : 50
For explanation of symbols and abbreviations see Key Sheet

Lab Ref No S/24347

T.W.A.-BICESTER SEWAGE TREATMENT WORKS

Fig. 7

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS46**
Job No: J11631	Date: 10-10-12 10-10-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

Depth (m)	Readings (blows/100mm)	Diagram (Blow Count)	Torque (Nm)	Remarks
1	0 0			
	0 0			
2	0 0			
	0 0			
3	0 0			
	1 1			
4	1 1			
	2 2			
5	3 4			
	7 9			
6	5 7			
	8 13			
7	10 8			
	17 16			
	26 26			
	23 18			
	17 26			
	50			

Diagram (Blow Count) scale: 5, 10, 15, 20, 25, 30; 50 blows recorded at 7.00 m.

Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client: Atkins	Method/ Plant Used: Dart Competitor Rig	Logged By: NY

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS46**
Job No: J11631	Date: 10-10-12 10-10-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV	Field Test kPa PP	Instrument/ Backfill
0.10-0.20	B					0.20	BALLAST: Dark brown silty very sandy angular to subangular fine to coarse gravel. Occasional clinker and some rootlets.			
0.30	D					0.50	Beige and orange silty gravelly fine to coarse SAND. Gravel is angular to subangular fine to medium flint and sandstone.			
0.30	ES					(0.70)	Soft to firm slightly friable orange mottled grey CLAY with occasional rootlets.			
0.90-1.20	B					1.20				
1.00	D									
1.00	ES					1.35	Firm dark grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is angular to subangular fine to coarse sandstone. Rare roots.			
1.20-1.35	B								125	
1.35-2.00	B					(0.65)	Firm light brown mottled grey and orange medium to high strength slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse sandstone and mudstone. Small bands of orange sand. Rare roots.			
						2.00			42	
2.00-2.90	B					(0.90)	Stiff dark brown mottled cream high strength CLAY with occasional selenite crystals.		132	
						2.90				
2.90	D						Stiff grey high locally very high strength CLAY. Some bands of fine sandy silt. Becoming more silty and sandy with depth.	62	190	
3.00-3.30	U							88	150	
									165	
4.00-6.00	B					(2.50)			92	
									122	
5.00-5.40	D					5.40				
5.40-5.60	D		1 ▼				Medium dense dark grey silty SAND. Sand is fine to medium locally slightly clayey.			
5.60-6.00	D					(0.60)				
						6.00				

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
10-10-12	1.20	DRY		
10-10-12	5.60	5.6		

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By NY

NICHOLLS COLTON GEOTECHNICAL

BOREHOLE RECORD - BH190

(Cable Percussion)

Site
East West Rail Phase 1 - Off Track Investigation

Client
Atkins Limited

Boring diameter:
150 mm to 10.00m

Casing diameter:

Project No.:
G13066

Logged by: PP

Ground Level:

Date: 10/04/2013

Location: -

Scale: 1:50

Samples & In situ Tests			Water	Level (mAOD)	Depth (m)	Strata Description	Legend	Backfill
Ref:	Depth (m)	SPT N						
B1	0.00-0.30					TOPSOIL.		
B2	0.30-0.70				0.30	Brown and grey slightly clayey slightly gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to medium quartz.		
B3	0.70-1.20				0.70			
S	1.20	N=6				Loose yellow brown gravelly fine to coarse SAND. Gravel is angular to sub rounded fine to coarse limestone and quartz and flint.		
D5	1.70-2.00				1.70	... no soil sample recovered from SPT at 1.20m.		
S	2.00	N=6				Soft grey CLAY.		
D7	2.00-2.45				2.20			
B8	2.20-3.00					Stiff locally very stiff grey CLAY.		
U9	3.00-3.45	(19)						
D10	3.50							
B11	3.50-4.00							
S	4.00	N=18			4.00			
D13	4.00-4.45					Stiff locally very stiff grey CLAY with bands of grey silt.		
B14	4.50-5.00							
S	5.00	N=50						
D16	5.00-5.45							
B17	5.50-6.50		▼		5.50	Stiff locally very stiff grey silty CLAY.		
S	6.50	N=34						
D19	6.50-6.95							
D20	7.00-8.00		▽					
S	8.00	N=35						
D22	8.00-8.45							
D23	8.50-9.50							
						(continued next sheet)		

Remarks and Water Observations

1. Hand dug starter pit to 1.20m to check for services.
2. Groundwater seepages were encountered at 6.95m (casing at 2.50m) rising to stand at 5.50m after 5 minutes during boring operations.
3. On completion the borehole was backfilled with spoil arisings.

NICHOLLS COLTON GEOTECHNICAL

BOREHOLE RECORD - BH190

(Cable Percussion)

Site
East West Rail Phase 1 - Off Track Investigation

Client
Atkins Limited

Boring diameter:
150 mm to 10.00m

Casing diameter:

Project No.:
G13066

Logged by: PP

Ground Level:

Date: 10/04/2013

Location: -

Scale: 1:50

Samples & In situ Tests			Water	Level (mAOD)	Depth (m)	Strata Description	Legend	Backfill
Ref:	Depth (m)	SPT N						
S D25 D26	9.50 9.50-9.95 9.50-10.00	N=31				Stiff locally very stiff grey silty CLAY.		
					10.00	*End of Borehole at 10.00 m*		

Remarks and Water Observations

1. Hand dug starter pit to 1.20m to check for services.
2. Groundwater seepages were encountered at 6.95m (casing at 2.50m) rising to stand at 5.50m after 5 minutes during boring operations.
3. On completion the borehole was backfilled with spoil arisings.

NICHOLLS COLTON GEOTECHNICAL

BOREHOLE RECORD - BH191

(Window Sampler)

Site
East West Rail Phase 1 - Off Track Investigation

Client
Atkins Limited

Boring diameter:
148 mm to 4.00m

Casing diameter:

Project No.:
G13066

Logged by: PP

Ground Level:

Date: 10/04/2013

Location: -

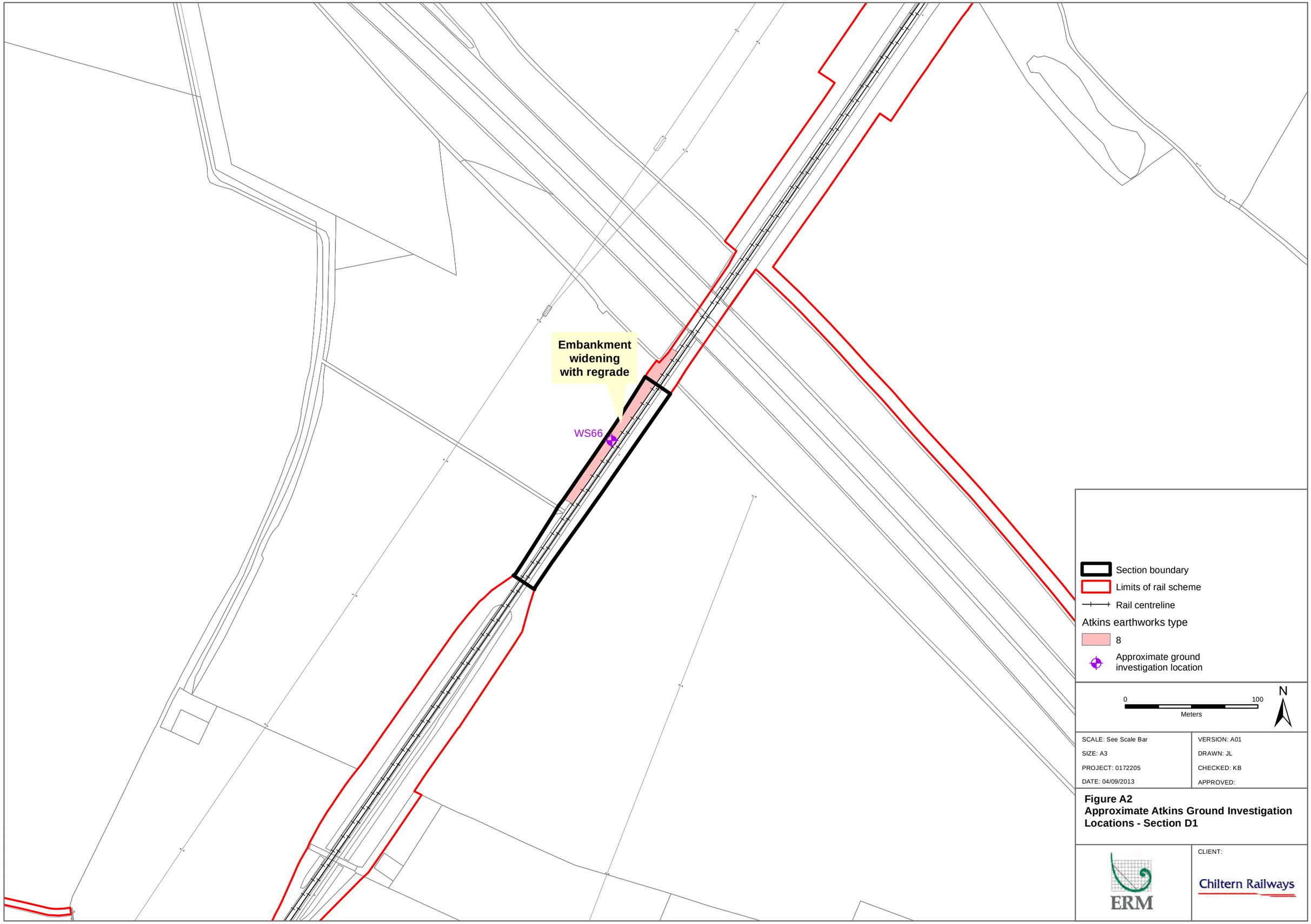
Scale: 1:50

Samples & In situ Tests Ref:	Depth (m)	SPT N	Water	Level (mAOD)	Depth (m)	Strata Description	Legend	Backfill
B1	0.00-0.30					TOPSOIL.		
B2	0.30-0.50				0.30			
B3	0.50-1.00				0.50	Brown clayey gravelly fine to coarse SAND. Gravel is angular to sub angular fine to coarse limestone and quartz.		
S	1.20	N=7				Yellow brown gravelly fine to coarse SAND. Gravel is angular to sub angular fine to medium quartz and flint.		
B4	1.20-1.60							
B5	1.60-2.00				1.60			
S	2.00	N=17				Stiff locally very stiff dark grey CLAY.		
D6	2.00-2.45							
B7	2.00-3.00							
S	3.00	N=25						
D8	3.00-3.45							
B9	3.00-3.80							
D10	3.80-4.00				3.80			
S	4.00	50/85mm				Hard grey CLAY with many shell fragments and selenite crystals.		
S	5.00	50/230mm						
S	6.00	N=19						
					6.45	*End of Borehole at 6.45 m*		

Remarks and Water Observations

1. Hand dug starter pit to 1.20m to check for services.
2. Slight groundwater seepage at 0.80m, the water level did not rise.
3. Borehole completed at 6.45m and a groundwater monitoring standpipe installed to the base of the hole.

Section D1 Earthworks



SCALE: See Scale Bar | VERSION: A01
SIZE: A3 | DRAWN: JL
PROJECT: 0172205 | CHECKED: KB
DATE: 04/09/2013 | APPROVED:

Figure A2
Approximate Atkins Ground Investigation Locations - Section D1

CLIENT: Chiltern Railways

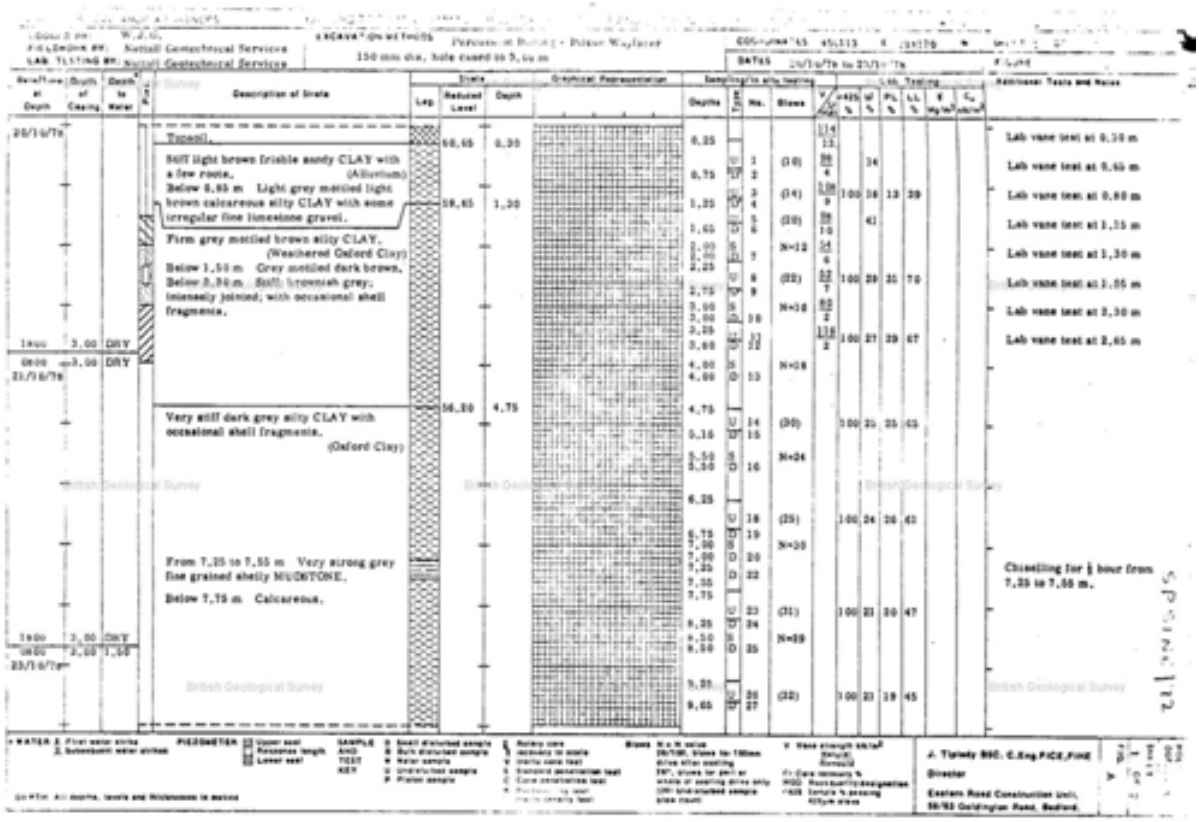
PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_AtkinsGroundInvestigationLocationsSectionD1_A01.mxd

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 335928 : BGS Reference: SP51NE72
British National Grid (27700) : 456113,218170
Report an issue with this borehole

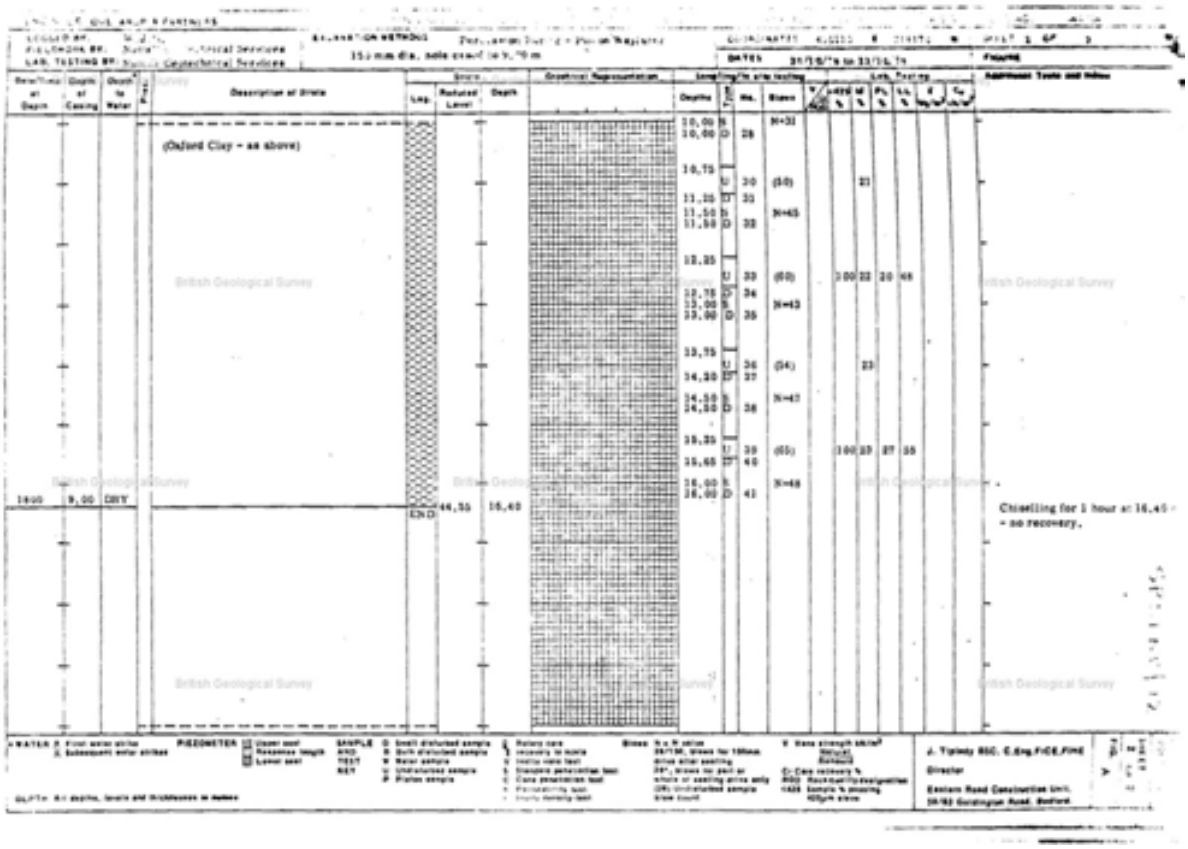
<< < Prev Page 1 of 2 Next > >>

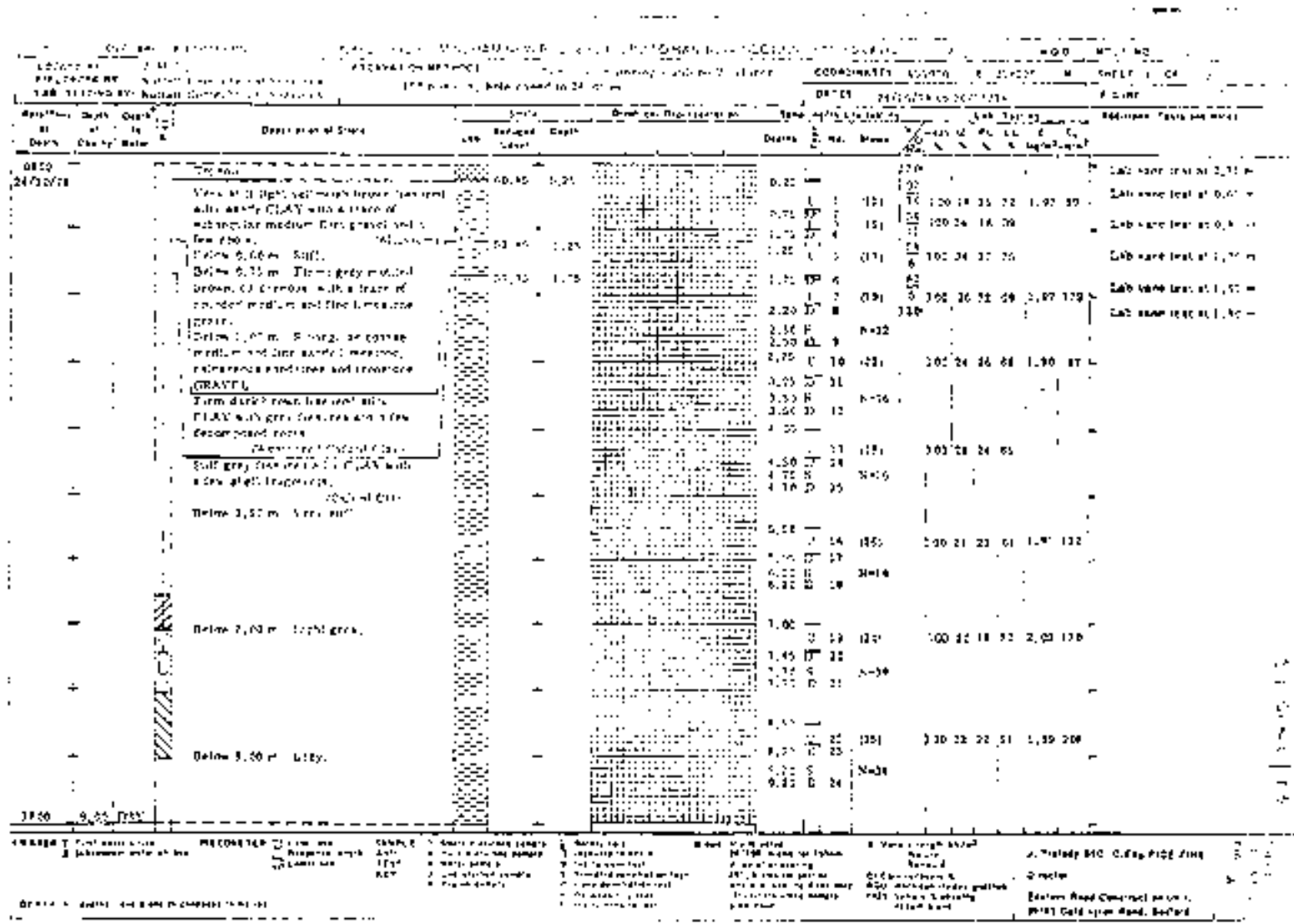


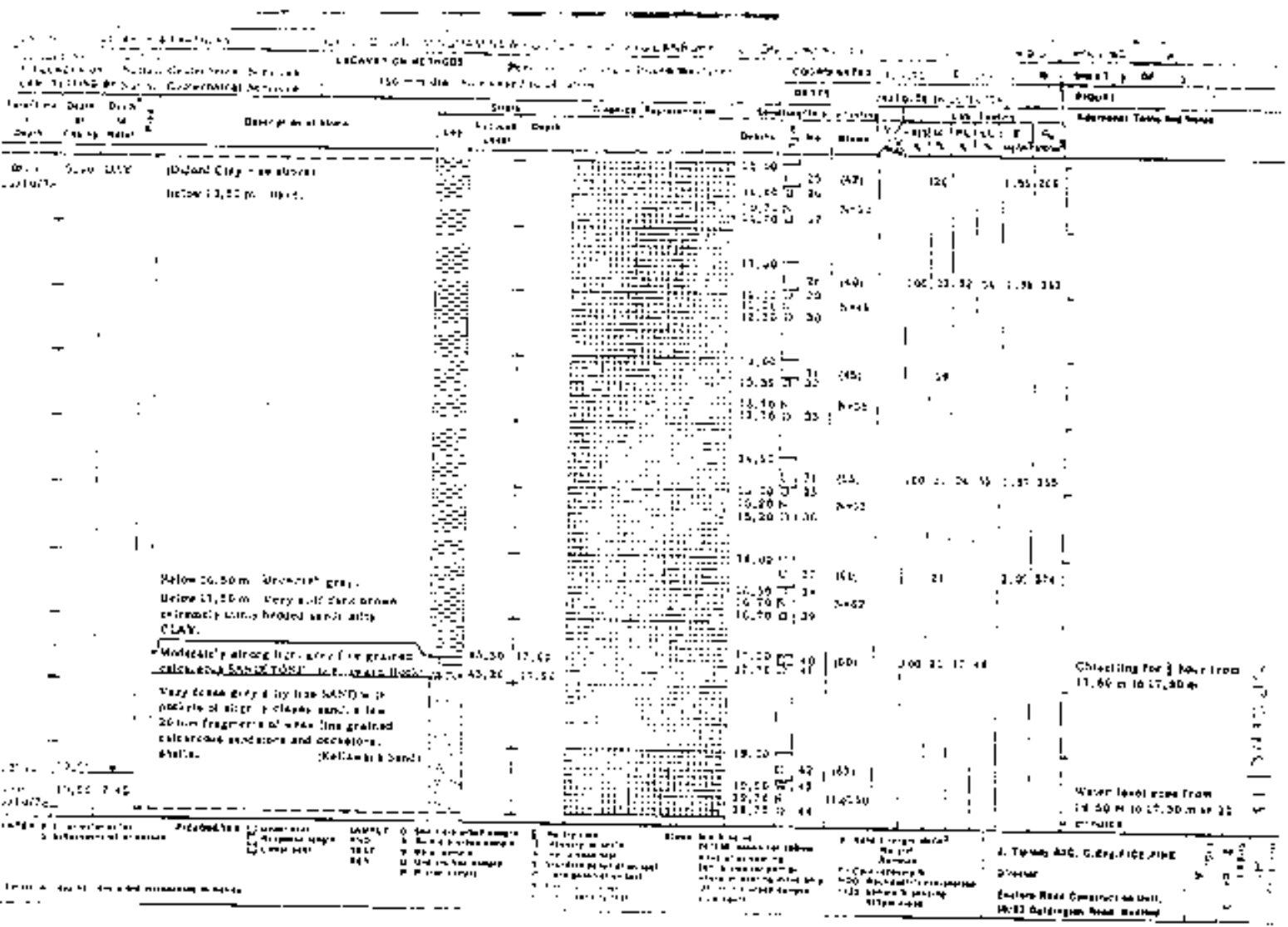
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

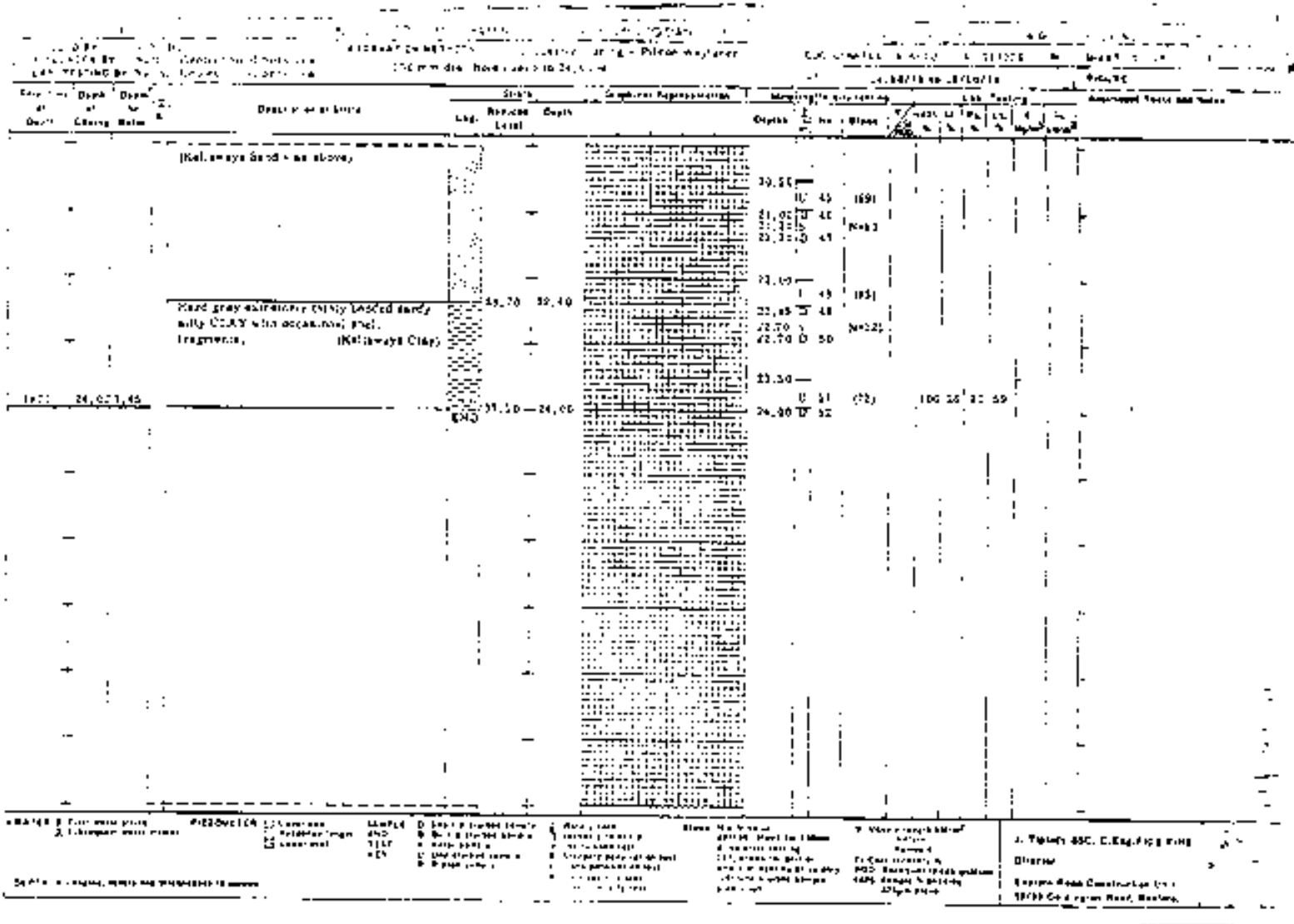
BGS ID: 335928 : BGS Reference: SP51NE72
British National Grid (27700) : 456113,218170
Report an issue with this borehole

<< < Prev Page 2 of 2 Next > >>





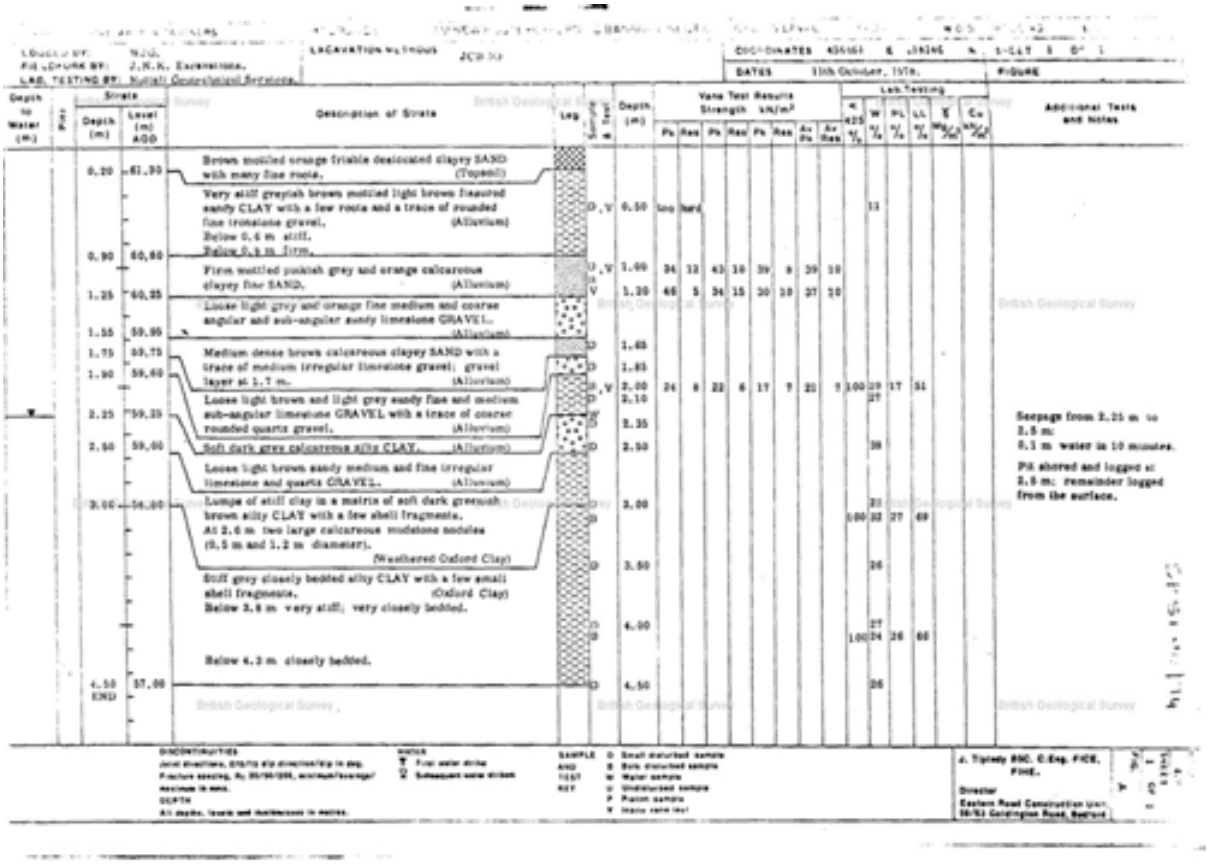




British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 335930 : BGS Reference: SP51NE74
British National Grid (27700) : 456051,218246
Report an issue with this borehole

<< < Prev Page 1 of 1 Next > >>



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336012 : BGS Reference: SP51NE156
British National Grid (27700) : 456160,218260
Report an issue with this borehole

SP 51 NE 156
5616 1826

Sampling

Depth	Type	Cu kPa	Wt%	SPT N
0.40	B			
0.50-0.95	B(42)		23	
1.00	DW			
1.20-1.65	SD			25
1.20-1.70	B			
1.80	B			
1.90-2.75	B(57)	40	40	
			33	
2.40	D			
2.60	D			50*
2.65-2.70	SW			
2.65-2.80	D			25
3.00-3.45	U(66)	80	26	
			27	
3.50	D			
4.25	D			
4.50-4.95	SD			25
5.50	D			
6.00-6.45	U(76)	>120	26	
6.50	D			
7.25	D			
7.50	SD			30
8.75	D			
9.00-9.45	U(120)	150	21	
			20	
9.50	D			
10.00	D			

Strata

Description	Depth	Level	Legend
TOPSOIL.	G.L.	64.74	
Firm yellow brown slightly sandy silty CLAY with occasional sub-rounded fine to coarse gravel and rootlets. (ALLUVIUM)	0.25	64.49	
	(0.65)		
Medium dense yellow brown very clayey medium to coarse SAND and sub-rounded fine to coarse GRAVEL. (RIVER GRAVELS)	0.90	63.84	
	(0.95)		
Firm extremely closely fissured dark greenish grey silty CLAY with many shells. (LOWER WEATHERED LOWER OXFORD CLAY)	1.85	62.89	
	(0.8)		
2.40 - 2.60m Very shelly band	2.65	62.09	
	(0.15)		
Strong grey slightly weathered thinly bedded/nodules fine grained argillaceous LIMESTONE.	2.80	61.94	
Very stiff fissured shaley dark grey silty CLAY with many bivalves and ammonites. (LOWER OXFORD CLAY)			
	(15.2)		
(Continued over from 10.00m)	10.00	54.74	

Drilling

Type	From	To	Size	Fluid
S & A Dando 150	G.L.	10.00	0.15	

Ground Water

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
0.90	Seepage increasing with depth	1.85	6.5.86	G.L.	NIL	NIL
2.70	Slow ingress rising to 2.50m in 20 minutes	3.00	7.5.86	5.00	3.10	NIL
			7.5.86	25.20	3.10	1.10

Remarks Chiselled 2.65m - 2.80m (45 mins). Average hourly depth achieved 2.00m/hr.
* Seating Blows only.

Borehole Record

exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680

Borehole 240
Sheet 1 of 3

FX1

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336012 : BGS Reference: SP51NE156
British National Grid (27700) : 456160,218260
Report an issue with this borehole

<< < Prev Page 2 of 3 Next > >>

SP 51 NE 156
5616 1826

Sampling

Depth	Type
10.40–10.85	SD
11.50	D
12.00–12.45	U(126)
12.50	D
13.00	D
13.50–13.95	SD
14.50	D
15.00–15.45	U(130)
15.50	D
16.00	D
16.50–16.95	SD
17.50	D
18.00–18.45	U(150)
18.50	D
19.00	D
19.50–19.95	SD

Properties

Cu kPa	W%	SPT N
		43
>120	24	
		38
>260	16	
		48
270	17	
		49

Strata

Description	Depth	Level	Legend
(Continued from 10.00m) Very stiff shaley grey silty CLAY with many bivalves and ammonites. (LOWER OXFORD CLAY)	10.00	54.74	
Very stiff fissured shaley dark grey fine sandy silty CLAY with many shells. (LOWER OXFORD CLAY)	18.00	46.74	
(Continued over from 20.00m)	20.00	44.74	

(15.2)
(2.5)

Drilling

Type	From	To	Size	Fluid
S & A Dando 150	10.00	20.00	0.15	

Ground Water

Struck	Behaviour	Sealed	Date	Hole	Cased	Water

Remarks

Borehole Record

exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680

Borehole 240
Sheet 2 of 3

FY1

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336012 : BGS Reference: SP51NE156
British National Grid (27700) : 456160,218260
Report an issue with this borehole

SP 51 NE 156
5616 1826

Sampling		Properties			Strata			
Depth	Type	Cu kPa	W%	SPT N	Description	Depth	Level	Legend
20.50					(Continued from 20.00m)	20.00 (2.5)	44.74	
20.60–21.05	DW U(116)				Very stiff shaley grey silty CLAY with many bivalves and ammonites. (LOWER OXFORD CLAY)	20.50	44.24	
21.10	D				Grey slightly clayey silty fine to medium SAND. (KELLAWAY BEDS)	(1.25)		
21.75	D				Very stiff very closely fissured dark grey fine sandy silty CLAY. (KELLAWAY BEDS)	21.75	42.99	
22.00–22.45	U(140)	>260	20					
22.50	D							
23.00	D							
23.50–23.95	U(145)	240	23			(3.45)		
24.00	D							
24.50	D							
24.70–25.15	U(150)	>260						
25.20	D				End of Borehole	25.20	39.54	

Drilling					Ground Water						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
S & A Dando 150	20.00	25.20	0.15		20.50	Slow ingress rose to 20.10m in 20 minutes.					

Remarks

Borehole Record

exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680

Borehole 240
Sheet 3 of 3

EX1

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336013 : BGS Reference: SP51NE157
British National Grid (27700) : 456160,218310
Report an issue with this borehole

SP 51 NE 157
5616 1831

Sampling		Properties			Strata			
Depth	Type	Cu kPa	W%	SPT N	Description	Depth	Level	Legend
					TOPSOIL.	G.L.	60.98	
0.40-0.85	U(37)				Firm orange brown mottled light grey slightly sandy silty CLAY with rootlets and occasional grey silty clay lenses. (ALLUVIUM)	0.30	60.68	
0.90	D		41					
1.10-1.55	U(46)	60	42 38 42			(1.55)		
1.60	D							
1.90-2.40	B(54)	>260			Firm extremely closely fissured dark brown mottled grey silty CLAY with many bivalves. (WEATHERED LOWER OXFORD CLAY)	1.85 (0.45)	59.13	
2.45	D					2.30	58.68	
2.60-3.05	U(55)	85	18 17		Firm to stiff extremely closely fissured dark greenish grey silty CLAY. 2.30 - 2.80m - very shelly band. (WEATHERED LOWER OXFORD CLAY)	(1.3)		
3.10	D							
3.60	D				Firm to stiff becoming stiff to very stiff shaley dark grey silty CLAY with many bivalves and occasional ammonites. Fissured in parts. (LOWER OXFORD CLAY)	3.60	57.38	
4.00-4.45	U(58)	75	27					
4.50	D							
5.00	D							
5.50-5.45	SD			23				
6.50	D							
7.00-7.45	U(76)	190	25			(12.1)		
7.50	D							
8.00 8.10	B							
8.50-8.95	SD			37				
9.50	D							
					(Continued over from 10.00m)	10.00	50.98	

Drilling

Type	From	To	Size	Fluid
S & A Dando 150	G.L.	10.00	0.15	

Ground Water

Struck	Behaviour	Sealed	Date	Hole	Cased	Water
8.10	Seepage		8.5.86	G.L.	NIL	NIL
			8.5.86	25.00	3.00	20.10

Remarks Average hourly rate achieved 2.50m/hour. Chiselled 15.70 - 15.80m (30 mins). Piezometer tip installed at 9.15m.

Borehole Record
exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680
Borehole 241
Sheet 1 of 3

EX1

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336013 : BGS Reference: SP51NE157
British National Grid (27700) : 456160,218310
Report an issue with this borehole

SP 51 NE 157
5616 1831

Sampling		Properties			Strata			
Depth	Type	Cu kPa	W%	SPT N	Description	Depth	Level	Legend
10.00-10.45	U(87)	>120	20		(Continued from 10.00m) Very stiff shaley dark grey silty CLAY with many bivalves and ammonites. Fissured in parts. (LOWER OXFORD CLAY)	10.00	50.98	
10.50	D							
11.00	D							
11.50-11.95	SD			38				
						(12.1)		
12.50	D							
13.00-13.45	U(111)	100	26					
13.50	D							
14.00	D							
14.50-14.95	SD			42				
15.50	D				Strong grey slightly weathered very thinly bedded/nodule argillaceous LIMESTONE. (LOWER OXFORD CLAY)	15.70	45.28	
15.70-15.80	D					15.80	45.18	
16.00-16.95	U(138)	>120	26					
16.50	D				Very stiff shaley dark grey fine sandy silty CLAY with some bivalves. (LOWER OXFORD CLAY)			
17.00	D							
17.50-17.95	SD			49		(3.0)		
18.50	D							
19.00-19.45	U(125)	>260				18.80	42.18	
19.50	D				Grey very clayey silty fine to medium SAND. (KELLAWAYS BEDS)	(2.6)		
19.75	D							
					(Continued over from 20.00m)	20.00	40.98	

Drilling

Type	From	To	Size	Fluid
S & A Dando 150	10.00	20.00	0.15	

Ground Water

Struck	Behaviour	Sealed	Date	Hole	Cased	Water

Remarks

Borehole Record

exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680

Borehole 241
Sheet 2 of 3

FY1

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

BGS ID: 336013 : BGS Reference: SP51NE157
British National Grid (27700) : 456160,218310
Report an issue with this borehole

SP 51 NE 157
SU16 1831

Sampling		Properties			Strata			
Depth	Type	Cu kPa	W%	SPT N	Description	Depth	Level	Legend
20.00-20.45	U(160)			18	(Continued from 20.00m)	20.00	40.98	
20.10	W							
20.50	D				Grey very clayey silty fine to medium SAND. (KELLAWAY BEDS)	(2.6)		
21.00	D							
21.50-21.95	U(165)	>260			Very stiff closely fissured dark grey silty CLAY with fine sand partings. (KELLAWAY BEDS)	21.40	39.58	
22.00	D							
22.50	D							
23.00-23.35	U(170)	200	22			(3.6)		
23.40	D							
24.00	D							
24.60-24.95	U(170)	>260						
25.00	D				End of Borehole	25.00	35.98	

Drilling					Ground Water						
Type	From	To	Size	Fluid	Struck	Behaviour	Sealed	Date	Hole	Cased	Water
S & A Dando 150	20.00	25.00	0.15		20.10	Very slow ingress					

Remarks

Borehole Record

exploration associates

Project
Department of Transport
M40 Waterstock to Wendlebury
Ground Investigation

Contract E5680

Borehole 241
Sheet 3 of 3

EX1

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS66**
Job No: J11631	Date: 19-11-12 19-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.20	Black dirty BALLAST of igneous rock. Fines are granular fine to coarse ash.		
0.20-0.70	B					(0.50)	MADE GROUND: Yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse quartzite and sandstone.		
0.30-0.50	B					0.70			
0.50	D						Firm dark greenish brown locally black low strength locally high strength slightly sandy CLAY. Sand is fine to medium becoming fine to coarse from 2.0m. Organic odour up to 2.0m.		
1.20-1.80	B								
1.20-1.65	S	N0							
1.80-3.20	B					(2.30)			
2.00-2.45	S	N5							
						3.00		68	
3.00-3.45	S	N9					Stiff dark grey high strength to very high strength CLAY. Rare angular to subangular medium to coarse mudstone gravel and shell fragments. Becoming laminated from 5.0m.		
3.20-4.00	B								
4.00-6.00	B								
4.00-4.45	S	N38				(3.45)			
5.00-5.45	S	N26						>220	
6.00-6.45	S	N27							
						6.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
19-11-12	1.20	DRY	N/A	N/A
19-11-12	2.00	DRY	87	100
19-11-12	3.00	DRY	77	100
19-11-12	4.00	DRY	67	100
19-11-12	5.00	DRY	57	100
19-11-12	6.00	DRY	45	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Section D2 Earthworks

CPT152

Embankment with cess support wall

WS68a

Embankment with cess support wall

Embankment widening with regrade

Section boundary

Limits of rail scheme

Rail centreline

Atkins earthworks type

8

9

Approximate ground investigation location

0 100

Meters

N

SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: JL
PROJECT: 0172205	CHECKED: KB
DATE: 04/09/2013	APPROVED:

Figure A3
Approximate Atkins Ground Investigation Locations - Section D2

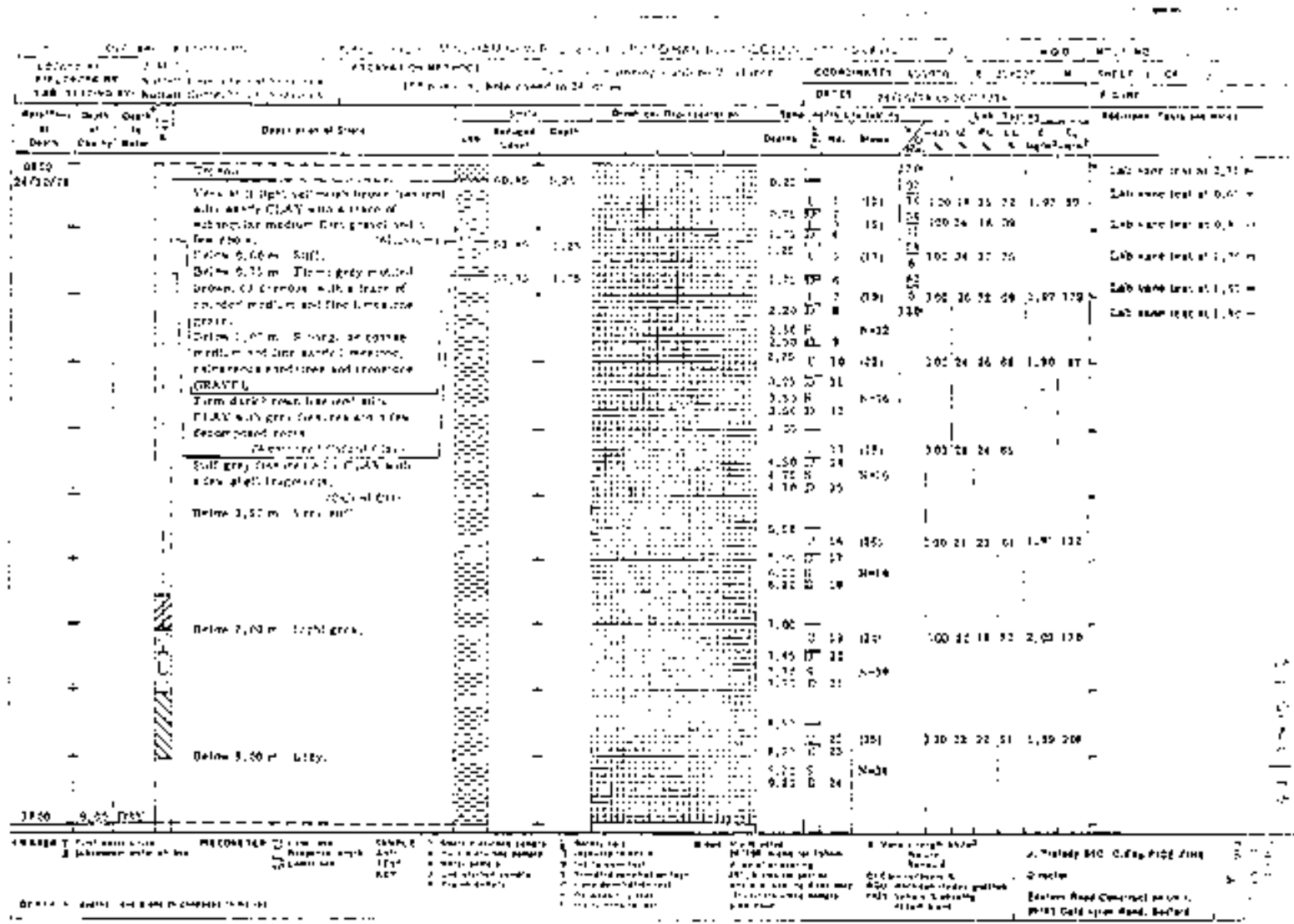
ERM

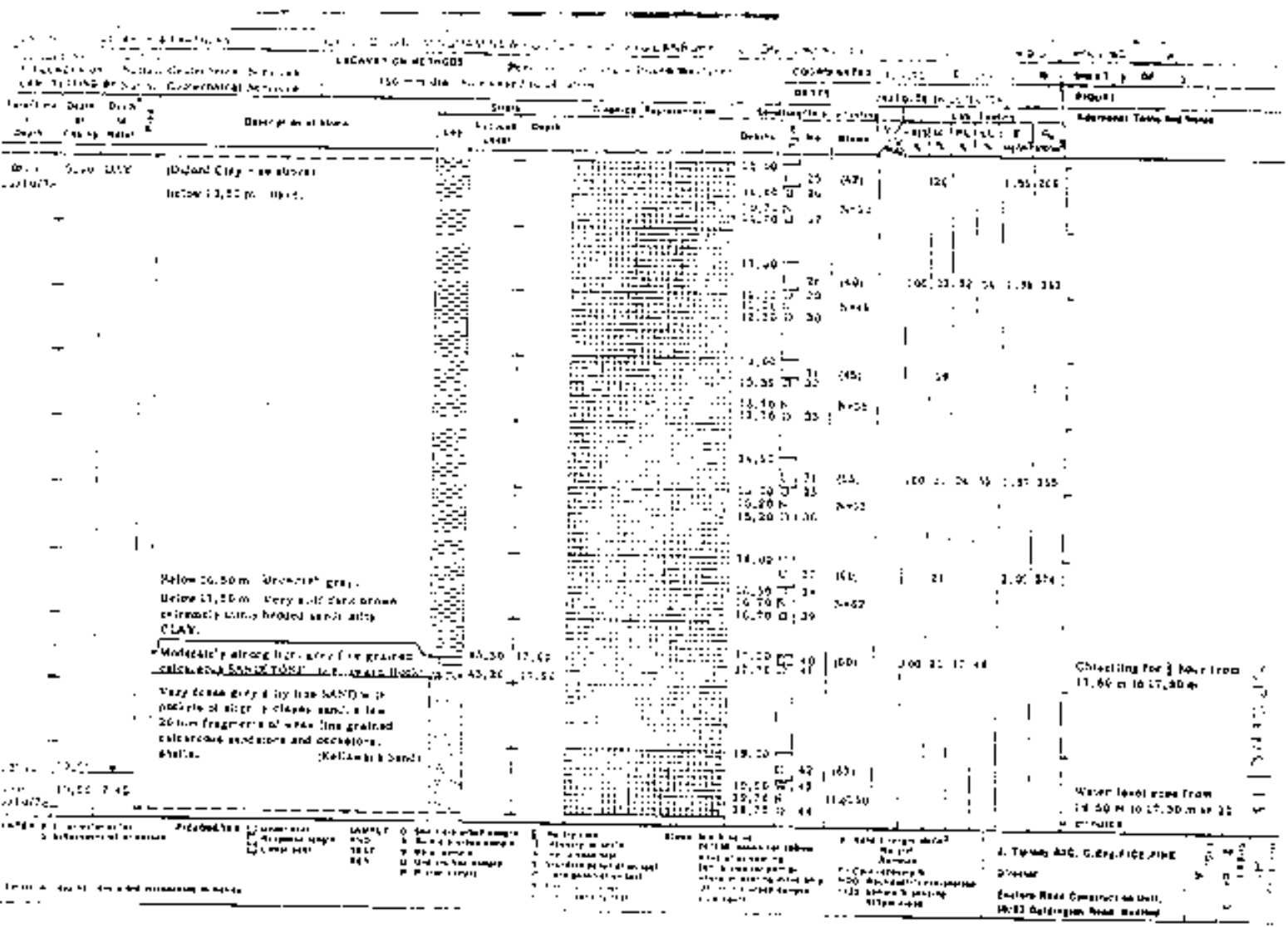
CLIENT:

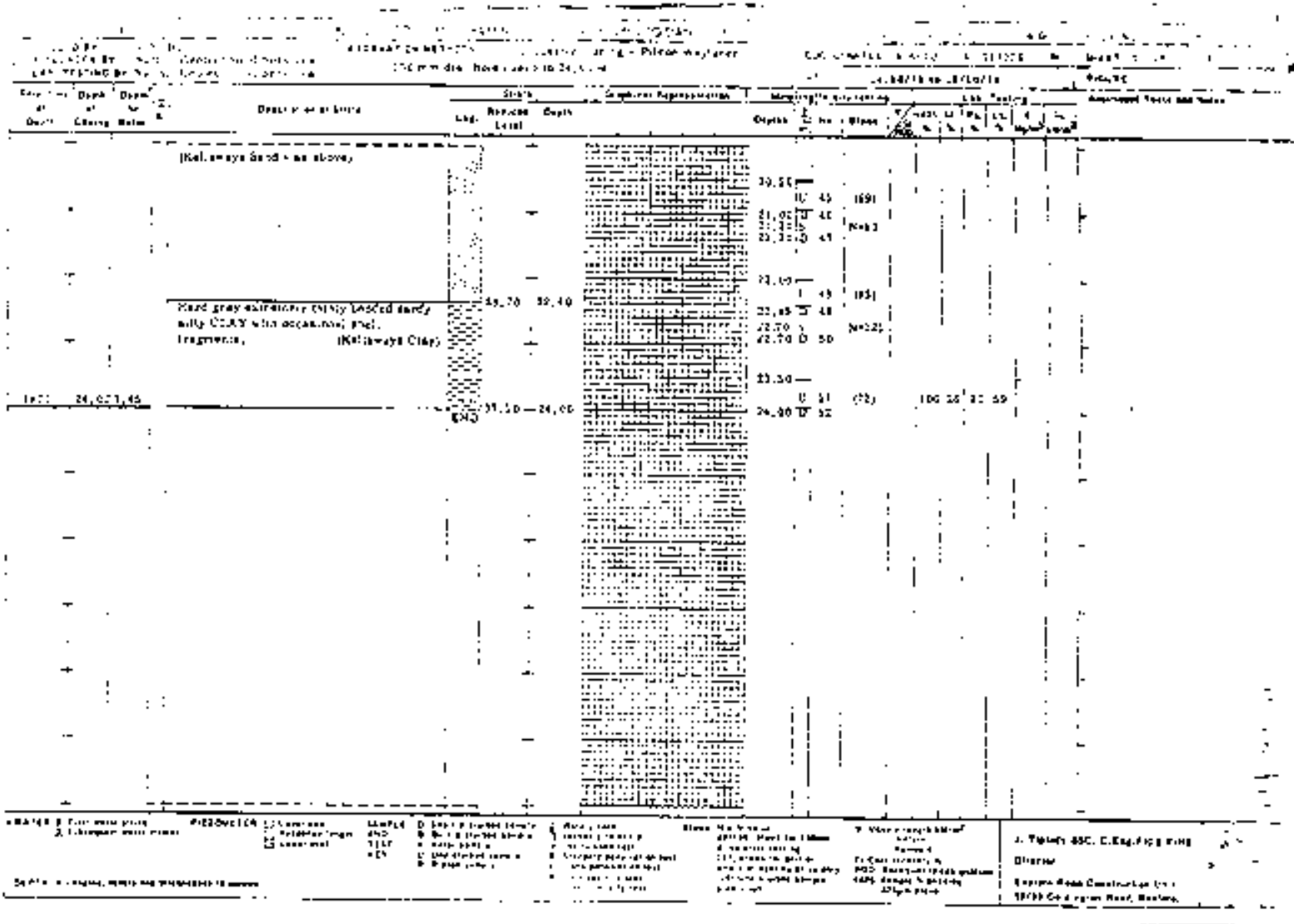
Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_AtkinsGroundInvestigationLocationsSectionD2_A01.mxd



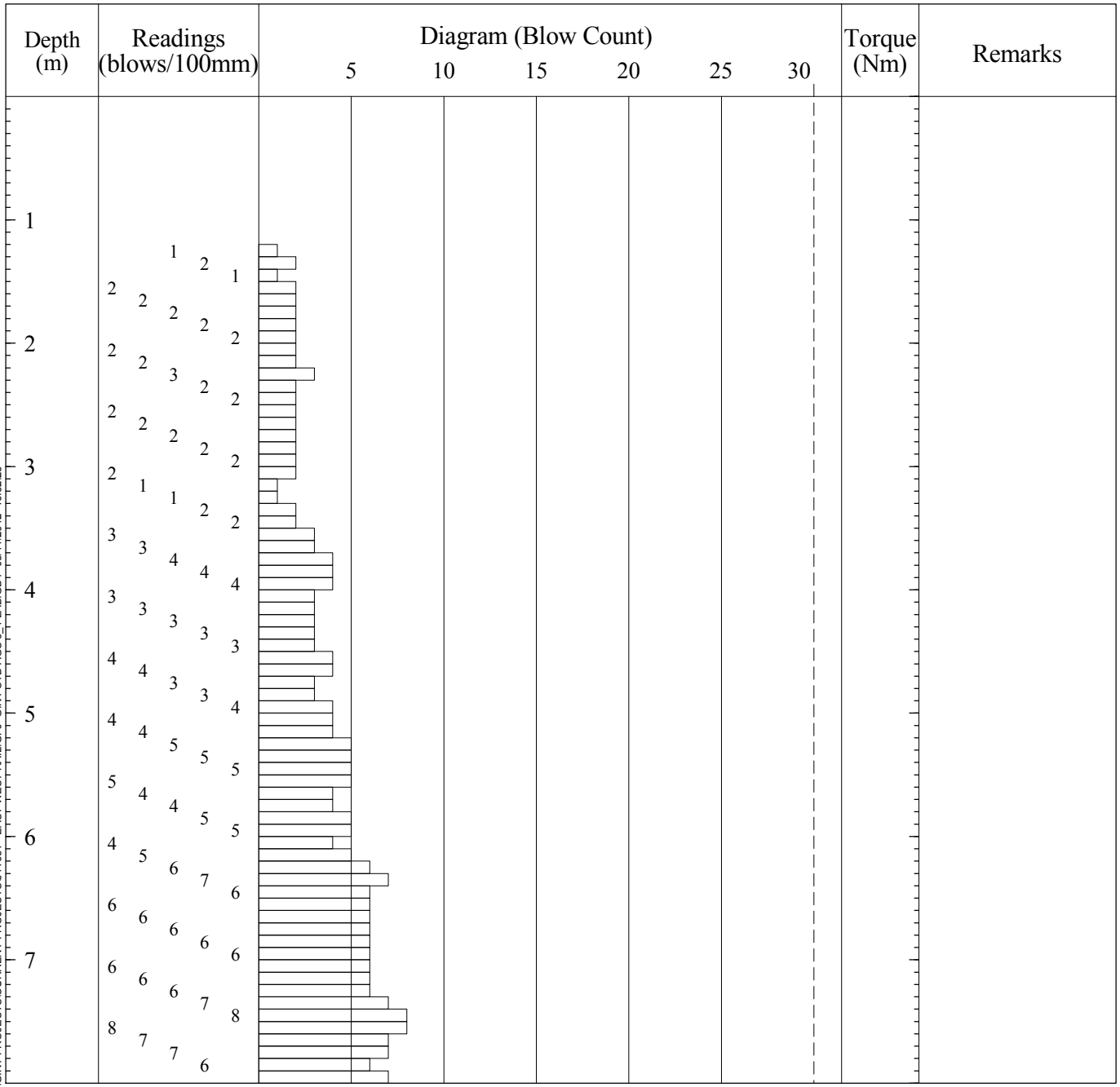




Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS68A**
Job No: J11631	Date: 29-10-12 29-10-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 2



Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client: Atkins	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

GINT STD AGS 3_1 LAB.GLB DCLP K:\SITE INVESTIGATION\GINT PROJECTS\CURRENT PROJECTS\J11631 - EAST WEST RAIL.GPJ GINT STD AGS 3_1 LAB.GDT 08/11/2012 16:32:25

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS68A**
Job No: J11631 / Date: 29-10-12, 29-10-12	Ground Level (m)	Co-Ordinates ()	
Contractor: Bridgeway Consulting			Sheet: 2 of 2

Depth (m)	Readings (blows/100mm)	Diagram (Blow Count)	Torque (Nm)	Remarks
9	6 7 8 8 7 / 8 8 6 8 / 9 12 13 15 14 / 13 11 10 11 12	5 10 15 20 25 30		
10				
11				
12				
13				
14				
15				

Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client: Atkins	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS68A**
Job No: J11631 / Date: 29-10-12, 29-10-12	Ground Level (m)	Co-Ordinates ()	
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.30	Dirty BALLAST of angular to subangular fine to medium granite. Fines are black granular fine to coarse ash.		
0.30-0.70	B					(0.40)	Yellow clayey fine to coarse SAND and GRAVEL. Gravel is angular to subrounded fine to medium sandstone, flint and quartz.		
0.50	D					0.70			
0.50	ES								
0.70-1.20	B					(0.50)	Stiff to very stiff blue mottled yellow CLAY with pockets of yellow fine to coarse sand.		
1.00	D					1.20			
1.00	ES						Stiff brown high becoming very high strength grey CLAY.		
1.20-2.00	B							98	
2.00-3.00	B						Between 2.00 and 3.00m, slightly sandy, sand is fine to coarse.	147	
3.00-4.00	B					(4.80)		135	
4.00-5.00	B							147	
5.00-6.00	B							196	
						6.00			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
29-10-12	1.20	DRY	N/A	N/A
29-10-12	2.00	DRY	87	
29-10-12	3.00	DRY	77	
29-10-12	4.00	DRY	67	
29-10-12	5.00	DRY	57	
29-10-12	6.00	DRY	45	

GENERAL REMARKS

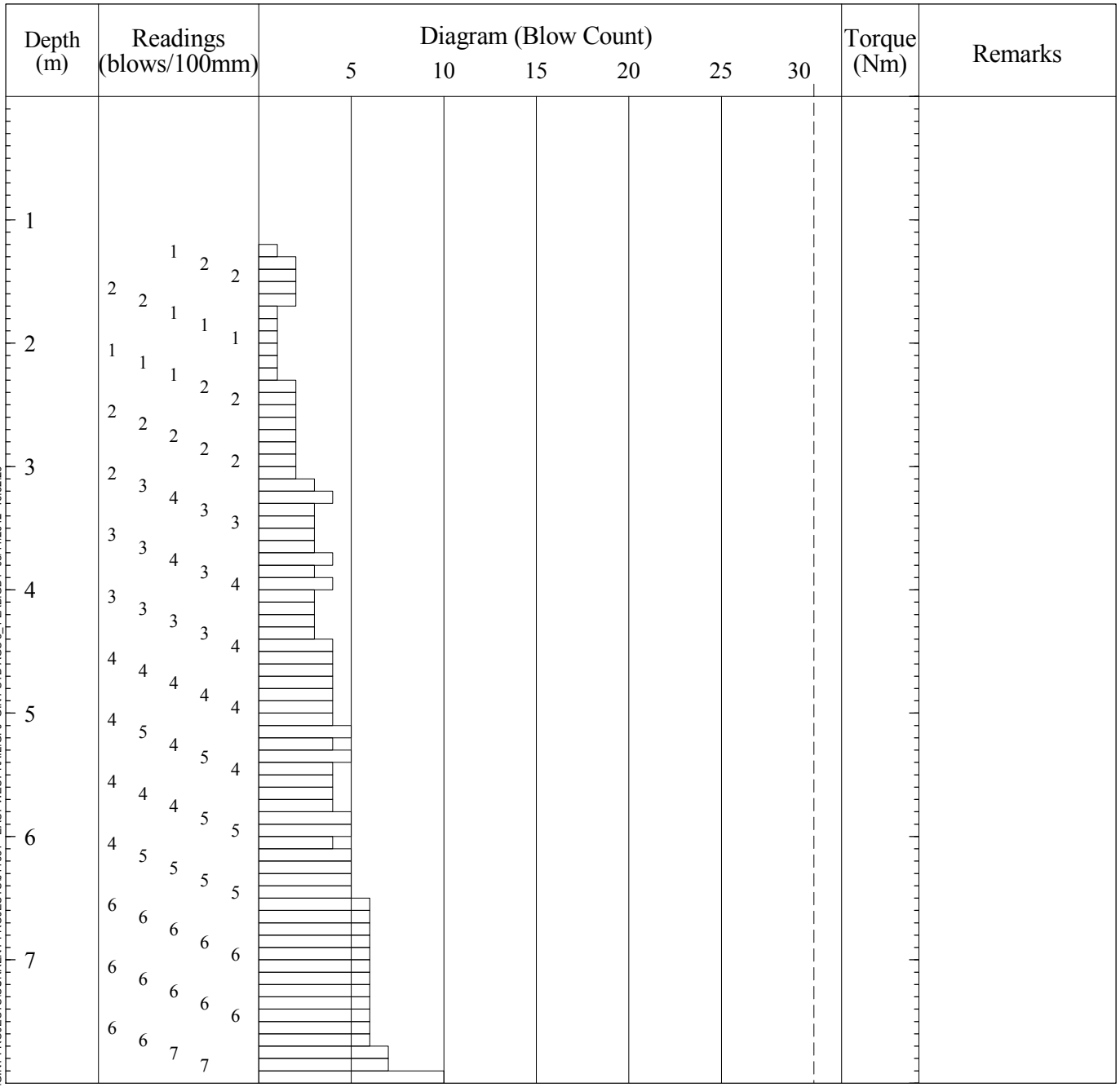
1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS71A**
Job No: J11631	Date: 30-10-12 30-10-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 2



Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client: Atkins	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS71A**
Job No: J11631 / Date: 30-10-12 30-10-12	Ground Level (m)	Co-Ordinates ()	
Contractor: Bridgeway Consulting			Sheet: 2 of 2

Depth (m)	Readings (blows/100mm)	Diagram (Blow Count) 5 10 15 20 25 30	Torque (Nm)	Remarks
	10			
9				
10				
11				
12				
13				
14				
15				

Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS71A**
Job No: J11631	Date: 30-10-12 30-10-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.30	Slightly dirty BALLAST of angular to subangular granite. Fines are granular fine to coarse ash.		
0.50	D		1			(0.40) 0.70	Yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to medium sandstone, flint and quartz.		
0.50	ES								
0.70-1.20	B					(0.50) 1.20	Blue mottled yellow CLAY with pockets of fine to coarse sand.		
1.00	D								
1.00	ES								
1.20-2.00	B					(0.80) 2.00	Stiff brown mottled grey high strength slightly sandy CLAY. Sand is fine to medium.	100	
2.00-3.00	B						Stiff brown mottled grey high strength locally medium strength CLAY. No recovery from 5.0-6.0m.	88	
3.00-3.90	B							150	
4.00-4.90	B					(4.00) 6.00		63	

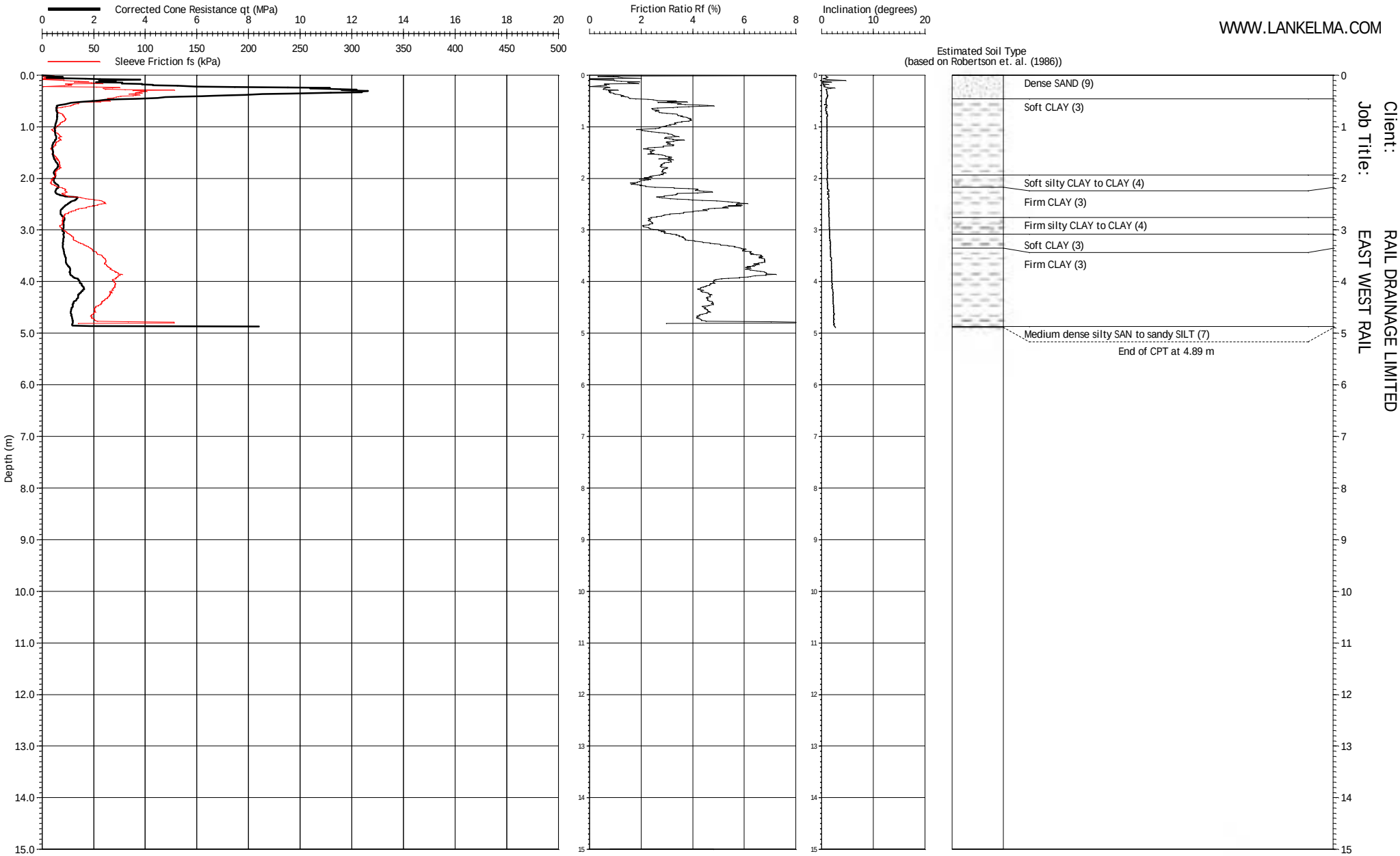
Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
30-10-12	1.20	0.7	N/A	N/A
30-10-12	2.00	1.4	87	80
30-10-12	3.00	2.00	77	100
30-10-12	4.00	3.00	67	90
30-10-12	5.00	4.20	57	90
30-10-12	6.00	4.90	45	N/R

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD



WWW.LANKELMA.COM

Client: RAIL DRAINAGE LIMITED

Job Title: EAST WEST RAIL

Location: ISLIP

Coordinates: -

Ground Level: -

Cone & Rig Used: S15-CFIP.843 - Andrew Hewitt

Remarks:

Date of Test: 04/12/2012

Date of Plot: 19/12/2012

File Name: 105595 - CPT 152

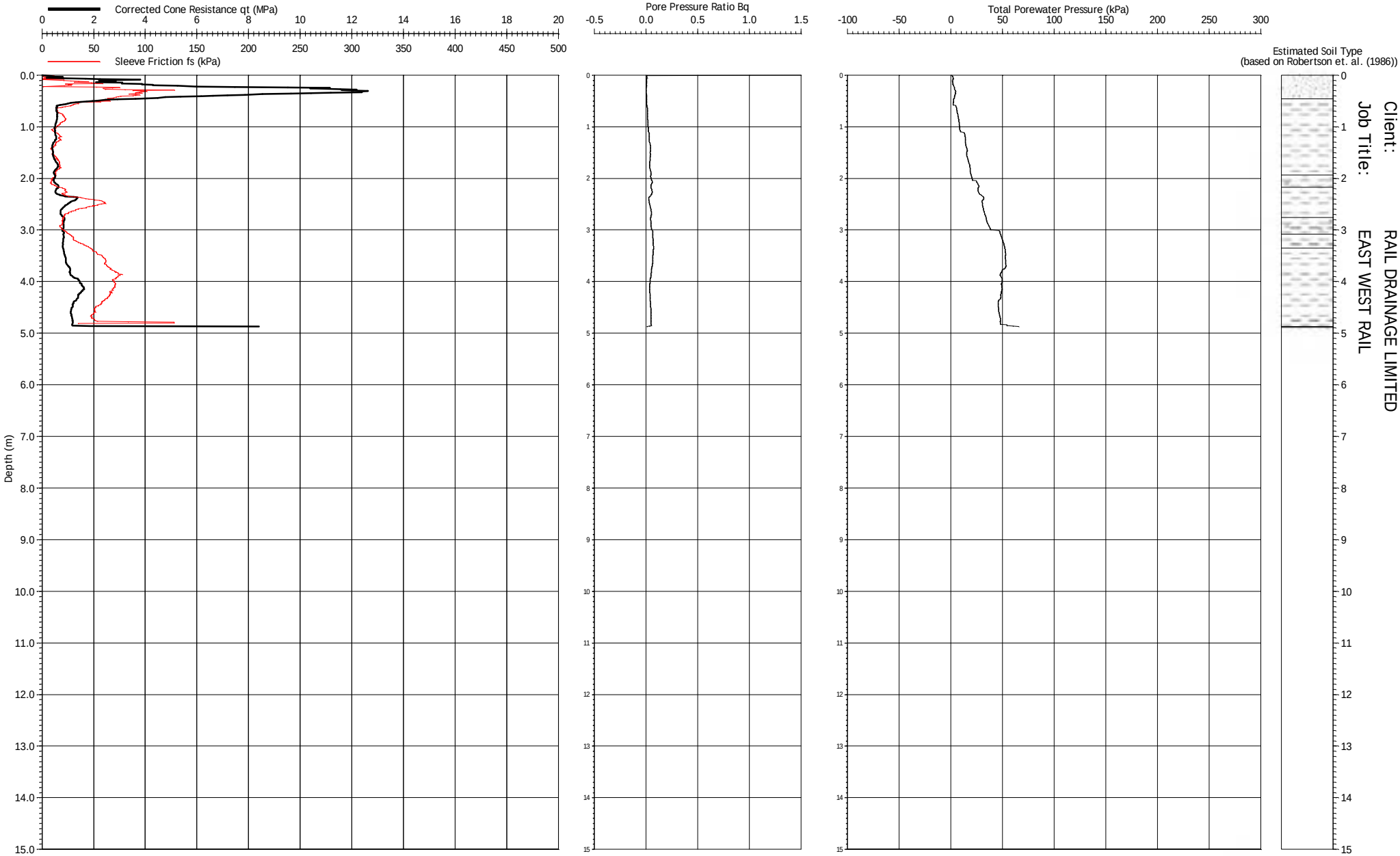
Checked By:

CONE PENETRATION TEST CPT 152

LANKELMA CPT LTD

LANKELMA

Form: CPT_201_20MPa



Client: RAIL DRAINAGE LIMITED

Job Title: EAST WEST RAIL

Location: ISLIP

Coordinates: -

Ground Level: -

Cone & Rig Used: S15-CFIP.843 - Andrew Hewitt

Remarks:

Date of Test: 04/12/2012

Date of Plot: 19/12/2012

File Name: 105595 - CPT 152

Checked By:

CONE PENETRATION TEST CPT 152

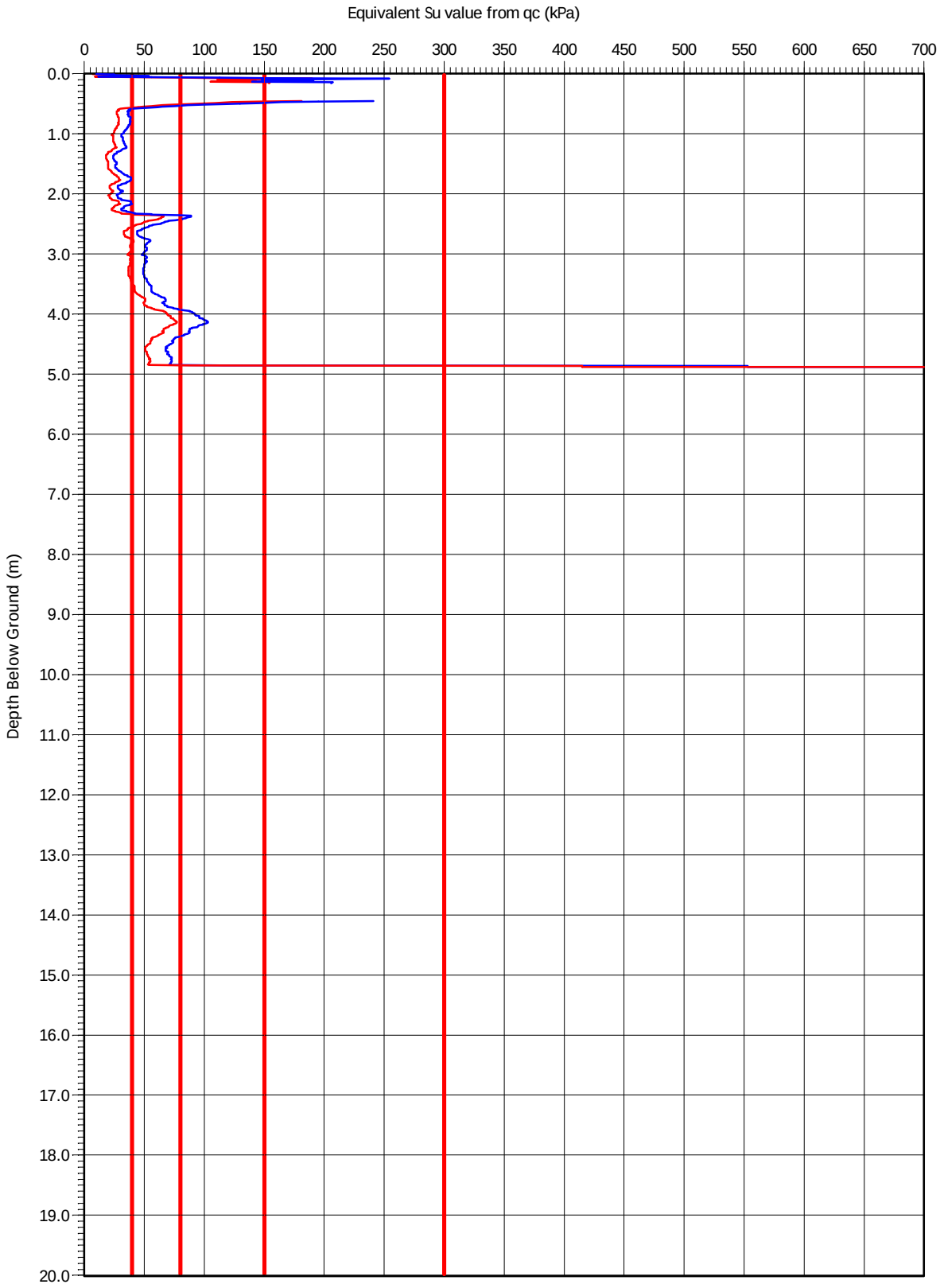
LANKELMA CPT LTD

LANKELMA

Form: CPT_303_Bq2

Client: RAIL DRAINAGE LIMITED

Project: EAST WEST RAIL



SHEAR STRENGTH PROFILE
Test No.: CPT 152
Report No.: 105595
Checked:

Su calculated from qc using Lunne et. al. (1981).

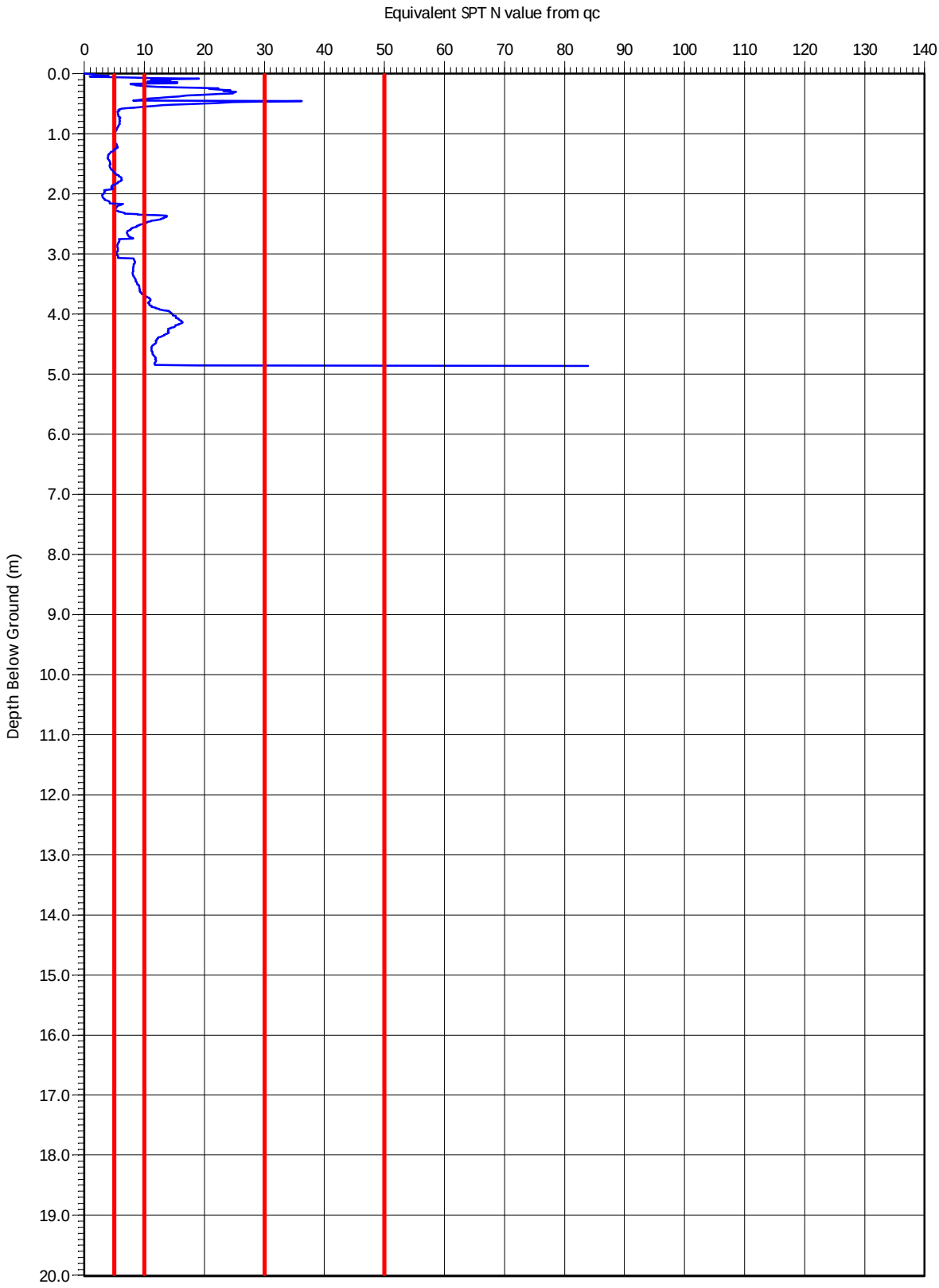
Su=qc-SIGMAvo/Nk

Highest Estimate: Nk = 15

Best Estimate: Nk = 20

Client: RAIL DRAINAGE LIMITED

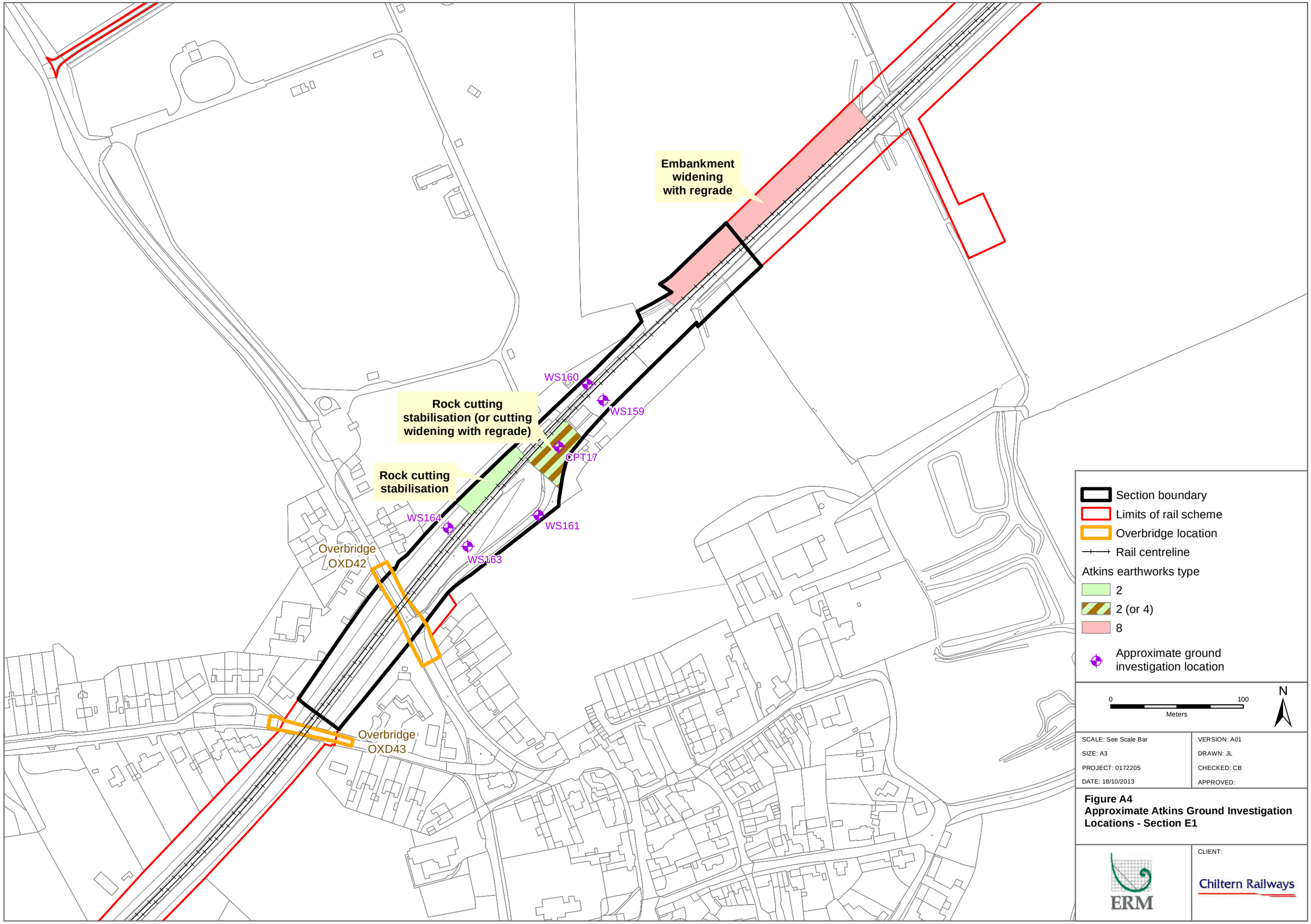
Project: EAST WEST RAIL



'N' VALUE PROFILE
Test No.: CPT 152
Report No.: 105595
Checked:

SPT Energy Ratio N60
derived from Robertson et. al.
(1986)

Section E1 Earthworks



SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: JL
PROJECT: 0172205	CHECKED: CB
DATE: 18/10/2013	APPROVED:

Figure A4
Approximate Atkins Ground Investigation Locations - Section E1

CLIENT: Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_AtkinsGroundInvestigationLocationsSectionE1_A01.mxd

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS159 - Wk35**
Job No: J11631	Date: 25-11-12 25-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.00-0.70	B					0.25	Black DIRTY BALLAST of igneous rock. Fines are granular fine to coarse sand.		
0.40	D					(0.45) 0.70	MADE GROUND: Cream silty very sandy GRAVEL. Gravel is angular to subrounded fine to coarse flint and quartzite.		
0.70	B						Soft to firm extremely low strength blueish grey and yellow slightly sandy CLAY. Sand is fine.		
0.70	D								
1.20-1.65	S	N2				(0.90) 1.60			
1.60-1.70	D					(0.40) 2.00	Firm extremely low strength blackish blue grey mottled red slightly sandy CLAY. Sand is fine to medium. Some roots.		
2.00-2.10	D						Firm high strength yellowish blue CLAY.		
2.00	S	N20	1			(0.50) 2.50			
2.50-2.60	D					2.80	Medium dense yellowish orange slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse sandstone and flint.		
3.00-3.45	S	N10	1				Firm medium to high strength yellowish blue slightly sandy CLAY. Sand is fine.		
						(1.65)			
4.00	S	N19				4.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
25-11-12	1.20	DRY	N/A	N/A
25-11-12	2.00	DRY	87	95
25-11-12	3.00	2.5	77	100
25-11-12	4.00	2.5	67	0

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 22m 50ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: MR

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS160**
Job No: J11631	Date: 06-12-12 06-12-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.00-0.20	B					0.20	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse mudstone, sandstone and ballast of granite. Some roots.		
0.10	D								
0.20-0.60	B					(0.60)			
0.20	D						Brown and light brown slightly clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse sandstone, mudstone and quartzite.		
0.50	D					0.80			
						(0.40)			
1.00-1.20	B					1.20	Stiff blue mottled green and yellow gravelly CLAY. Gravel is angular to subrounded fine to medium sandstone, mudstone and quartzite.		
1.20-2.00	B								
1.20-1.65	S	N5	1			(0.80)	Firm greenish brown medium strength CLAY.	74	
						2.00			
2.00-3.60	B						Orange brown clayey very gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse sandstone, quartzite and flint.		
2.00-2.45	S	N13							
3.00-3.45	S	N17				(2.45)			
						4.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
06-12-12	1.20	DRY	N/A	N/A
06-12-12	2.00	1.8	87	90
06-12-12	3.00	1.8	77	80
06-12-12	4.00	1.8	67	60

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS161 - Wk35**
Job No: J11631	Date: 24-11-12, 25-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						(0.40) 0.40	Black VERY DIRTY BALLAST of igneous rock. Fines are granular fine to coarse sand and ash and gravel of subangular to subrounded fine to coarse coal and granite. Some rootlets.		
0.40-1.00	B								
0.60	D					(0.60) 1.00	MADE GROUND: Light yellowish brown gravelly SAND. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium flint and sandstone. Occasional shell fragments. Some roots.		
						1.20			
1.10	D					1.30	Very soft greyish blue mottled yellow sandy CLAY. Sand is fine to medium. Some rootlets.		
1.20-1.30	B								
1.20-1.65	S	N6					Very soft low strength brownish blue and grey gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint and sandstone.		
1.30-2.50	B					(1.20)			
2.00-2.10	D						Very soft low strength brownish blue and grey mottled red sandy CLAY. Sand is fine to coarse.		
2.00-2.45	S	N6				2.50			
2.50-5.50	B						Firm medium becoming high strength blueish grey slightly sandy CLAY with some selenite crystals. Sand is fine to medium.		
3.00-3.10	D								
3.00-3.45	S	N12							
4.00-4.10	D								
4.00-4.45	S	N13				(3.95)			
5.00-5.45	S	N20							
5.50-5.60	D								
6.00-6.45	S	N20				6.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
25-11-12	1.20	DRY	N/A	N/A
25-11-12	2.00	DRY	87	100
25-11-12	3.00	DRY	77	100
25-11-12	4.00	DRY	67	100
25-11-12	5.00	DRY	57	100
25-11-12	6.00	DRY	45	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 23m 18ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: MR

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS162 - Wk36**
Job No: J11631	Date: 01-12-12 01-12-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.30	Black DIRTY BALLAST of granite. Fines are granular fine ash.		
0.30-0.70	B					(0.40)	POSSIBLE MADE GROUND: Yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to medium sandstone, mudstone and flint.		
0.50	D					0.70			
						(0.50)	Blue gravelly CLAY. Gravel is angular to subrounded fine to medium sandstone, mudstone and flint.		
1.00	D					1.20			
1.20-2.00	B						Firm medium locally high strength brown and grey mottled orange slightly sandy CLAY. Sand is fine to coarse. Some gypsum crystals from 2.0m.		
1.20-1.65	S	N7						74	
2.00-3.00	B								
2.00-2.45	S	N13						88	
						(3.40)			
3.00-4.60	B								
3.00-3.45	S	N8							
4.00-4.45	S	N7						63	
						4.60			
4.60-6.00	B						Stiff medium becoming very high strength laminated dark grey CLAY with rare shells fragments.		
5.00-5.45	S	N30							
						(1.85)		>225	
6.00-6.45	S	N54							
						6.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
01-01-12	4.00	DRY	77	100
01-12-12	1.20	DRY	N/A	N/A
01-12-12	2.00	DRY	87	100
01-12-12	3.00	DRY	87	100
01-12-12	5.00	DRY	67	90
01-12-12	6.00	DRY	57	90

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 23m 70ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS163 - Wk35**
Job No: J11631	Date: 26-11-12, 27-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.25	Black SLIGHTLY DIRTY BALLAST of granite. Fines are granular fine to coarse sand and ash.		
0.25-0.40	B					0.40			
0.30	D						MADE GROUND: Brownish yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to medium quartzite, sandstone and mudstone.		
0.40	D					(0.40)			
						0.80			
0.80-1.20	B						Yellowish brown BOULDERS of sandstone.		
1.00	D					(0.40)			
						1.20	Firm blue mottled brown slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse sandstone and some shell fragments.		
1.20-1.65	S	N7				(0.40)			
			1.1			1.60	Grey low strength very gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse sandstone.		
						(0.40)			
						2.00	Firm low strength dark orangey brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse flint. Rare rootlets.	25	
2.00	S	N0				(0.40)			
						2.40	Very loose orangey brown very sandy GRAVEL. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse sandstone and quartzite.		
							Stiff high locally low strength dark grey CLAY with some shell fragments.	63	
3.00-3.45	S	N9							
								125	
4.00-4.45	S	N30							
						(4.05)		113	
5.00-5.45	S	N27							
								113	
6.00-6.45	S	N7							
						6.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
26-11-12	1.20	DRY	N/A	N/A
26-11-12	2.00	1.7	101	100
26-11-12	3.00	1.67	101	70
26-11-12	4.00	1.67	101	100
26-11-12	5.00	1.67	86	90
26-11-12	6.00	1.67	76	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 24m 50ch East.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS164 - Wk35**
Job No: J11631	Date: 27-11-12, 28-12-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.30	Black SLIGHTLY DIRTY BALLAST of igneous rock. Fines are granular fine to coarse sand and ash.		
0.30-0.50	B					(0.50)	MADE GROUND: Yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is subangulalr to subrounded fine to coarse sandstone. Occasional sandstone cobbles.		
0.50	ES					0.80			
0.80-1.20	B					(0.40)	Blue gravelly CLAY. Gravel is angular to subangular fine to medum sandstone.		
1.00	D					1.20			
1.00	ES						Loose dark brown clayey SAND with rare rootlets. Sand is fine to medium.		
1.20-1.60	D								
1.20-1.65	S	N9				(0.80)			
1.60-2.00	D								
						2.00			
2.00-3.80	B						Medium dense locally dense orangey brown slightly clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse sandstone and flint.		
2.00-2.45	S	N26							
						(1.80)			
3.00-3.45	S	N28							
						3.80			
3.80-6.00	B						Stiff to very stiff high to very high strength laminated CLAY with some shell fragments.		
4.00-4.45	S	N19							
5.00-5.45	S	N31				(2.65)		188	
6.00-6.45	S	N32							
						6.45			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
27-11-12	1.20	N/A	N/A	N/A
27-11-12	2.00	DRY	101	80
28-11-12	3.00	2.73	101	100
28-11-12	4.00	2.73	101	100
28-11-12	5.00	2.73	86	100
28-11-12	6.00	2.73	76	100

GENERAL REMARKS

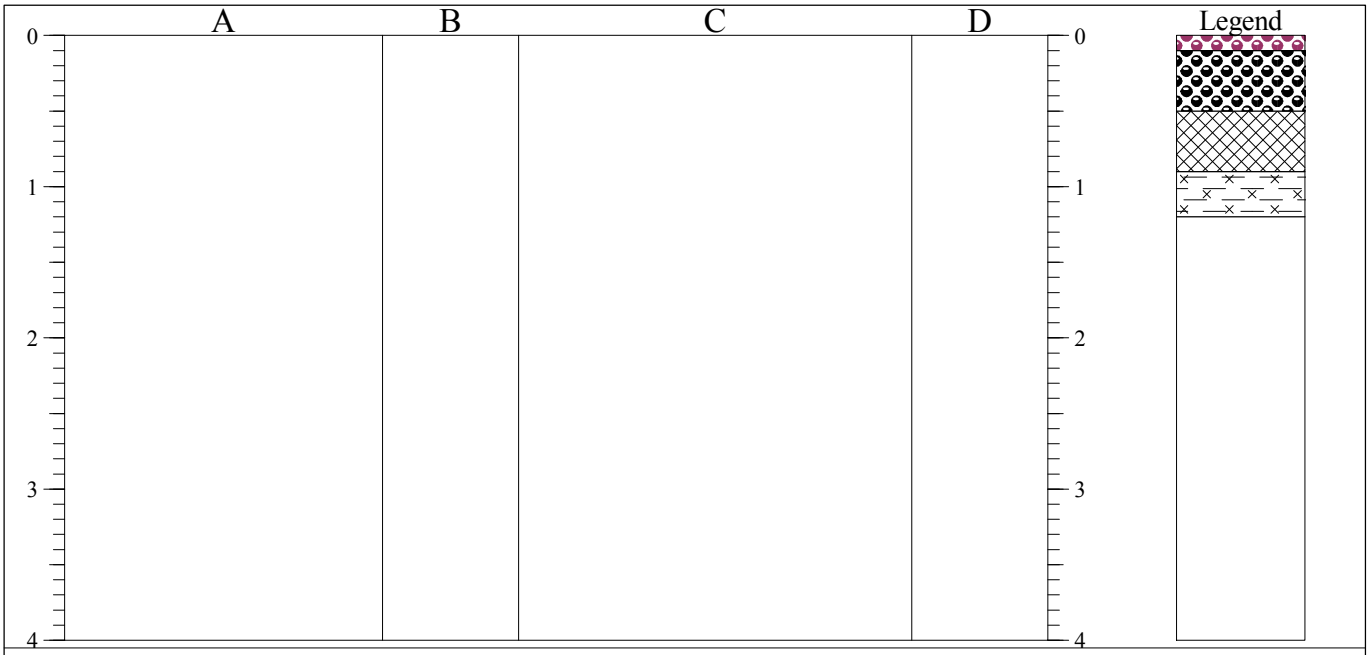
1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 24m 60ch East.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

TRIAL PIT LOG

Project	Site	Consultant	TRIAL PIT No
East West Rail		Atkins	**CPT17C**
Job No: J11631	Date: 27-08-12 27-08-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

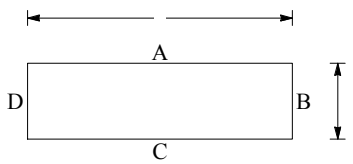


STRATA

SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.10		Pink grey clean BALLAST of igneous rock			
0.10-0.50		Very dirty brown BALLAST with roots and rootlets. Fines are silty of ash sand and angular fine to coarse gravel of igneous rock.			
0.50-0.90		MADE GROUND: Light brown silty very sandy angular fine to medium gravel of limestone. Sand is fine to coarse. Angular cobbles below 0.80m. Diesel Odour.	0.50-0.70	B	
0.90-1.20		Soft grey mottled brown silty CLAY.	1.00	D	

Shoring/Support:
Stability:



GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole Drilled at 25m 35ch Down.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Hand Tools	Logged By NY

Section H1 Earthworks

Cutting widening with regrade (or with Gabion wall)

Cutting widening with regrade (or with Gabion wall)

WS108/A/C/D

WS109/A/B/D

Oxford Clay cutting stabilisation with either Gabion wall or Soil nails with counterfort drains

Oxford Clay cutting stabilisation with either Gabion wall or Soil nails with counterfort drains

WS110/A/B/D

Section boundary

Limits of rail scheme

Rail centreline

Atkins earthworks type

1 or 1a

4 (or 3)

Approximate ground investigation location

0 100

Meters

N

SCALE: See Scale Bar	VERSION: A01
SIZE: A3	DRAWN: JL
PROJECT: 0172205	CHECKED: KB
DATE: 04/09/2013	APPROVED:

Figure A5
Approximate Atkins Ground Investigation Locations - Section H1

ERM

CLIENT:

Chiltern Railways

PROJECTION: British National Grid

Path: T:\Projects\0172205ChilternGIS_AZ_SG\MAPS\PROJECT_DETAILS\0172205_AtkinsGroundInvestigationLocationsSectionH1_A01.mxd

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS108A -Wk26**
Job No: J11631	Date: 22-09-12 22-09-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.30-0.90	B					(0.90)	MADE GROUND: Brown SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, sandstone and quartzite.		
0.50	D								
0.50	ES					0.90			
0.90-1.20	B						Very stiff to stiff blueish grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium flint, sandstone and quartzite.		
1.00	D					1.20			
1.00	ES						Very stiff blueish grey mottled yellow CLAY.		
						(0.80)			
						2.00		183	
							Very stiff to hard very high strength blueish grey CLAY. Occasional pockets of sand and silt.	221	
4.00-5.00	B					(4.00)		225	
								225	
						6.00		225	

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
22-09-12	1.20	DRY	N/A	N/A
22-09-12	2.00	DRY	87	100
22-09-12	3.00	DRY	87	100
22-09-12	4.00	DRY	77	80
22-09-12	5.00	DRY	67	80
22-09-12	6.00	DRY	57	60

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 5ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: EK

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS108C - Wk36**
Job No: J11631	Date: 04-12-12 04-12-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.10-1.20	D					0.10	MADE GROUND: Brown SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, sandstone and quartzite.		
						(1.10)	Firm to stiff blueish grey slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium flint, sandstone and quartzite.		
1.20-2.00	B					1.20	Firm to stiff high to very high strength laminated dark greenish grey and brown CLAY. Rare rootlets and gypsum crystals.	100	
2.00-2.60	B					(1.40)		175	
						2.60			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
04-12-12	1.20	DRY	N/A	N/A
04-12-12	2.00	DRY	76	80
04-12-12	2.60	DRY	66	60

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 45ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: GD

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS108D - Wk48**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.10	MADE GROUND: Brown SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, sandstone and quartzite.		
						(2.80)	Soft becoming stiff from 1.8m brownish grey CLAY. Rare angular to subangular fine mudstone and sandstone gravel. Rare gypsum crystals and wood fragments. Some black staining and sulphur odour at 1.3m. Rare rootlets. Becoming fissured from 2.4m.	44 78 168 170 121 127	
2.60-2.90	D					2.90			

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.90	DRY	101	70
24-02-13	2.60	DRY	86	70
24-02-13	2.90	DRY	76	30

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 45ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: ZS

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS109A - Wk33**
Job No: J11631	Date: 13-11-12 13-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS				STRATA					
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						(0.40) 0.40	Dark grey DIRTY BALLAST of granite. Fines are granular fine to coarse black sand and ash.		
						0.70	MADE GROUND: Yellow SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subangular clinker, sandstone and quartzite.		
0.70-1.20	B						Stiff very high strength dark grey slightly gravelly CLAY. Gravel is subrounded fine to medium sandstone and quartzite.		
1.00	D								
1.20-2.00	B							188	
						(2.30)			
2.00-3.00	B							200	
						3.00			
3.00-3.80	B						Very stiff very high strength laminated dark grey CLAY with rare shells.	220	
						(1.75)			
						4.75		>220	

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
13-11-12	1.20	DRY	N/A	N/A
13-11-12	2.00	DRY	87	100
13-11-12	3.00	DRY	77	100
13-11-12	4.00	DRY	67	80
13-11-12	4.75	DRY	57	75

GENERAL REMARKS

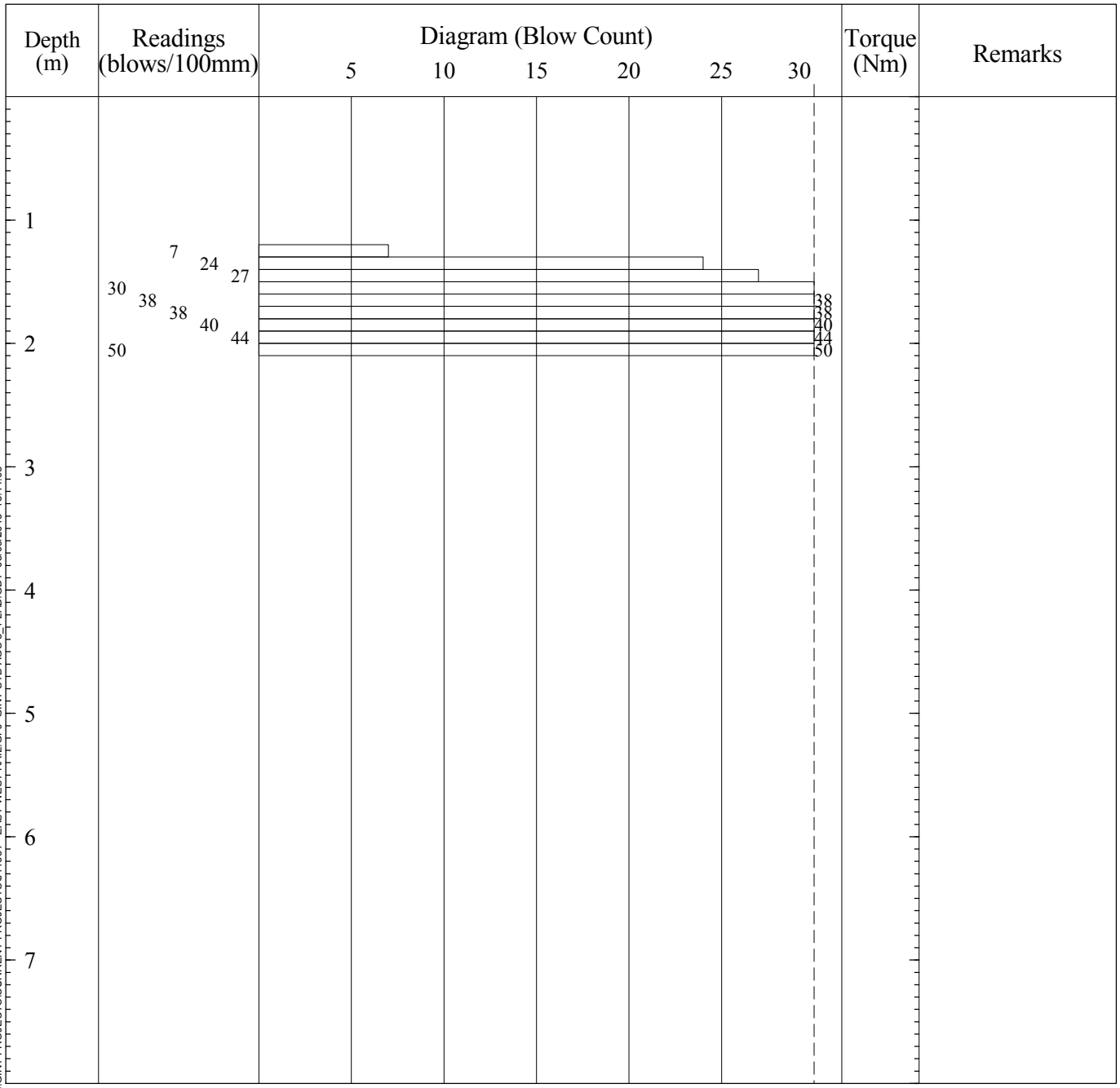
1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 49ch East.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS109A (M)**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1



Hammer Wt (kg)	10
Hammer Drop (mm)	
Cone Dia (mm)	35
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 49ch Down.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: MR

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS109A (M)**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						(0.40) 0.40	MADE GROUND: Dark brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse sandstone. some roots.		
0.40-0.50	B					0.70	Firm to stiff brown sandy CLAY. Sand is fine to coarse.		
0.90-1.00	B					(0.90) 1.60	Stiff to very stiff grey mottled yellow slightly sandy CLAY. Sand is fine to coarse.		

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.40	DRY	87	100
24-02-13	1.60	DRY	67	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 49ch Down.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: MR

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS109B - Wk48**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						(0.40) 0.40	MADE GROUND: Dark brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse sandstone. Some roots.		
0.40-0.50	B					0.70	Firm to stiff brown sandy CLAY. Sand is fine to coarse.		
0.90-1.00	B					(0.90) 1.60	Stiff to very stiff grey mottled yellow slightly sandy CLAY. Sand is fine to coarse.		

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.40	DRY	87	100
24-02-13	1.60	DRY	67	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 49ch East.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: MR

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS110A**
Job No: J11631	Date: 14-11-12 14-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
			1			(0.50) 0.50	Slightly dirty BALLAST. Gravel is angular to subangular medium to coarse granite. Fines are granular medium to coarse black sand and ash.		
0.50-1.20	B					(0.70) 1.20	Blue slightly gravelly CLAY. Gravel is angular to subrounded fine to medium sandstone and quartz.		
1.00	D								
1.00	ES								
1.20-2.00	B					(0.80) 2.00	Firm to stiff dark grey and brown high strength slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subronded fine to medium quartz.		
2.00-3.60	B					(3.30) 5.30	Firm to stiff laminated dark grey high strength CLAY. Rare shell fragments.	125 125 100 88	
3.60-4.00	B								
4.00-5.30	B								

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
14-11-12	1.20	0.3	N/A	N/A
14-11-12	2.00	0.3	87	100
14-11-12	3.00	0.3	77	100
14-11-12	4.00	0.3	67	60
14-11-12	5.00	0.3	57	90
14-11-12	5.30	0.3	45	100

GENERAL REMARKS

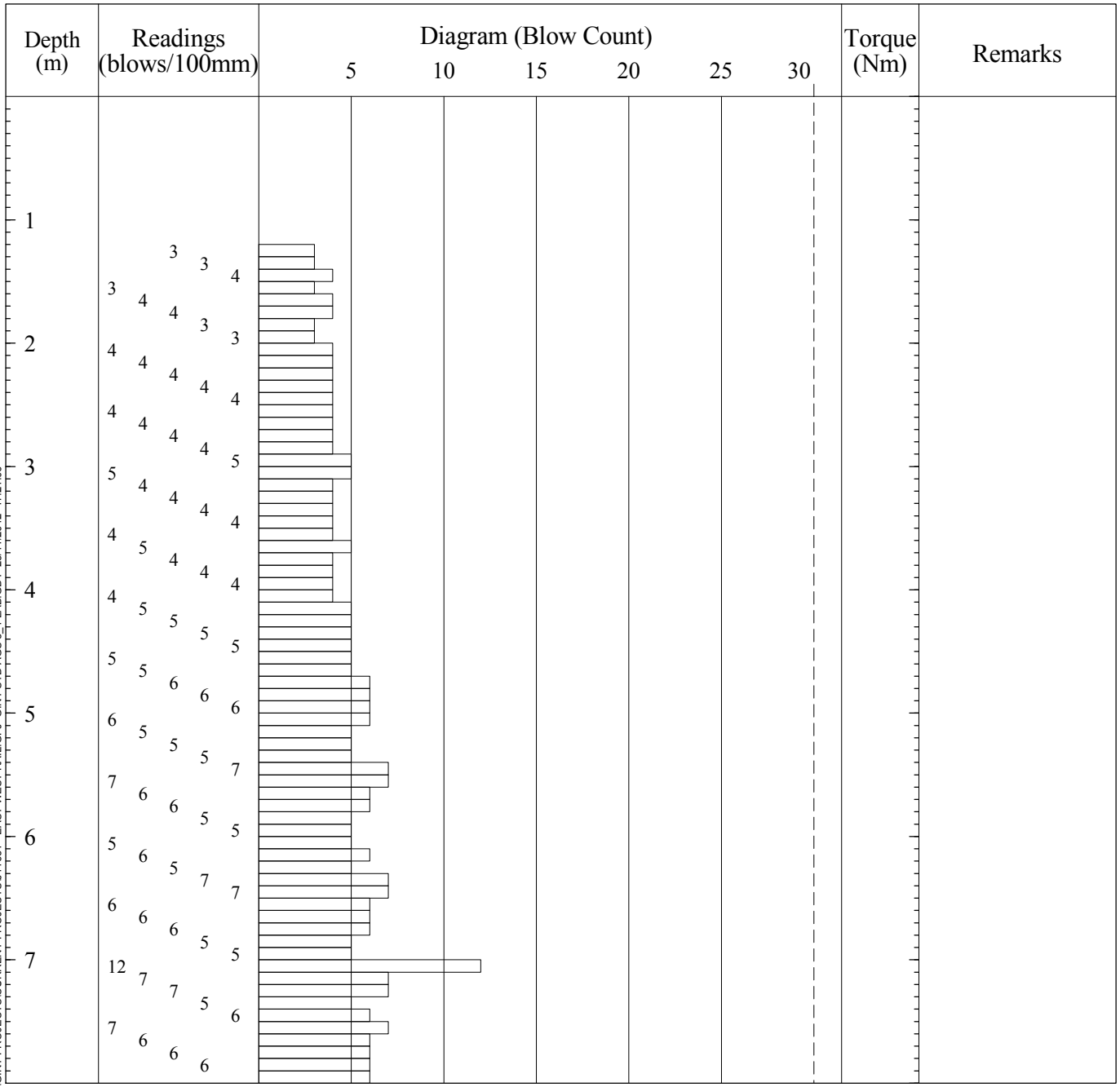
1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS110A**
Job No: J11631	Date: 14-11-12 14-11-12	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 2



Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

All dimensions in metres Scale 1:50	Client Atkins	Method/ Plant Used Dart Competitor Rig	Logged By GD

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS110A**
Job No: J11631 / Date: 14-11-12, 14-11-12	Ground Level (m)	Co-Ordinates ()	
Contractor: Bridgeway Consulting			Sheet: 2 of 2

Depth (m)	Readings (blows/100mm)	Diagram (Blow Count) 5 10 15 20 25 30	Torque (Nm)	Remarks
9	6 6 7 6 6 / 6 6 6 7 7 / 7 8 8 8 8 / 8 9 9 9 9			
10				
11				
12				
13				
14				
15				

Hammer Wt (kg)	63
Hammer Drop (mm)	760
Cone Dia (mm)	50
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.

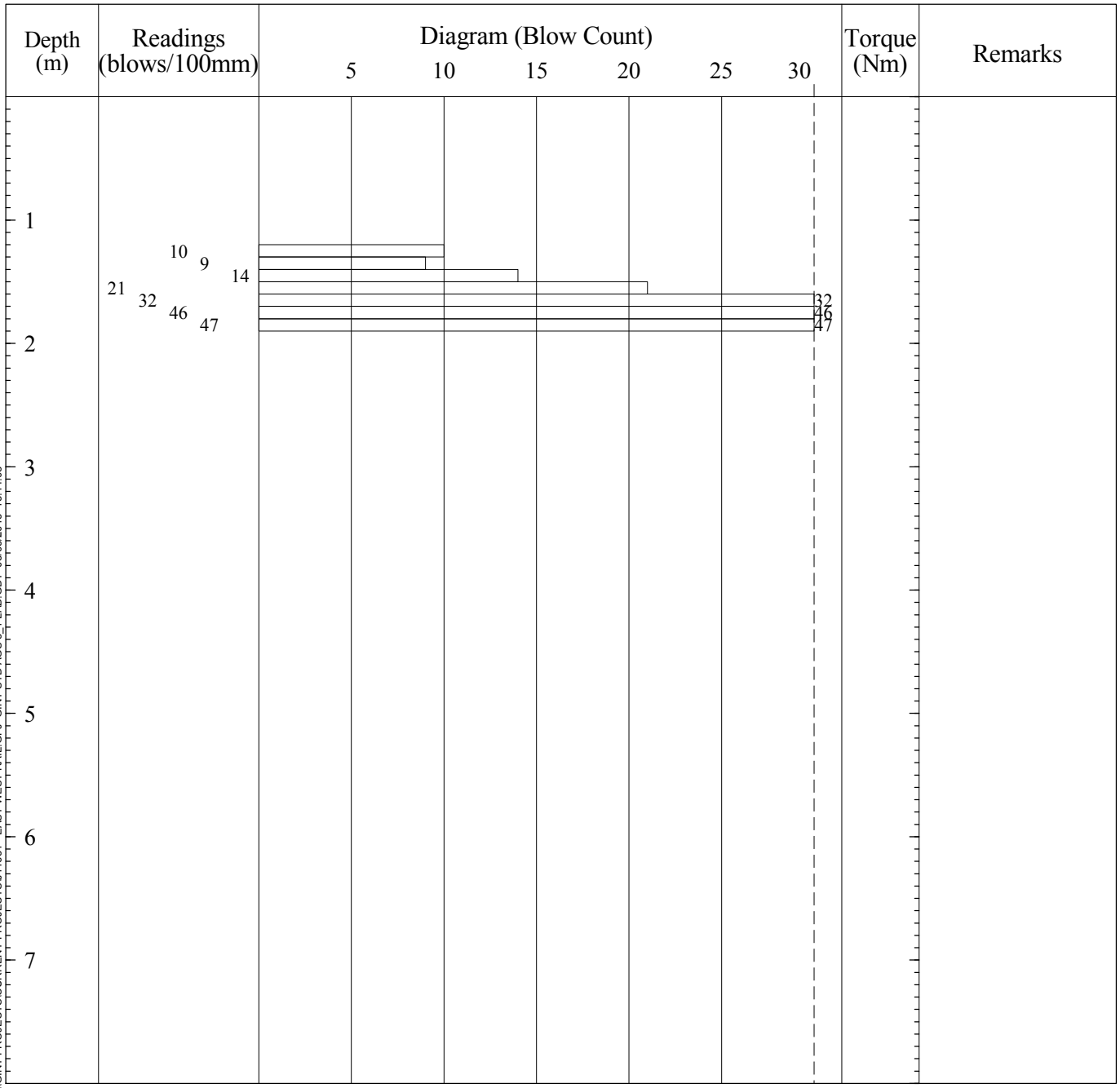
All dimensions in metres Scale 1:50	Client: Atkins	Method/ Plant Used: Dart Competitor Rig	Logged By: GD

GINT STD AGS 3_1 LAB.GLB DCLP K:\SITE INVESTIGATION\GINT PROJECTS\CURRENT PROJECTS\J11631 - EAST WEST RAIL.GPJ GINT STD AGS 3_1 LAB.GDT 23/11/2012 17:21:06

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive,
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

DYNAMIC PROBE LOG

Project	Site	Consultant	PROBE No
East West Rail		Atkins	**WS110A (M)**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1



Hammer Wt (kg)	10
Hammer Drop (mm)	
Cone Dia (mm)	35
Cone Type	Sacrificial
Damper	

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 59ch Down.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: ZS

Bridgeway Consulting Ltd
Beeston Business Park, Technology Drive
Nottingham. NG9 1LA
Telephone: 0115 919 1111
Fax: 0115 919 1112

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS110A (M)**
Job No: J11631 / Date: 24-02-13, 24-02-13	Ground Level (m)	Co-Ordinates ()	
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.60	D					(1.20) 1.20	MADE GROUND: Brown gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick and sandstone.		
1.20-1.45	D					1.45	MADE GROUND: Brownish orange clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to subangular fine flint and mudstone and medium to coarse brick. Some roots and rootlets and gypsum crystals. Some pockets of firm dark grey clay.		
1.45-1.90	B					(0.45) 1.90		117 158 200	
							Stiff high to very high strength dark grey mottled greyish brown CLAY. Some dark red staining at 1.6m. Occasional decaying roots and rootlets. Slightly silty from 1.85m Rare selenite crystals.		

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.90	DRY	77	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 59ch Down.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: ZS

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS110B - Wk47**
Job No: J11631	Date: 21-02-13, 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
						0.05	Dark brown clayey SAND. Sand is fine to coarse.		
							Blue CLAY. Some roots.		
0.40	D								
0.40	ES					(1.15)			
1.00	D					1.20			
1.00	ES					1.40	Soft to firm high strength grey CLAY. Occasional roots some selenite crystals and small pockets of dark brown sandy clay and yellowish orange coarse sand.	74	
1.20-1.40	D							132	
1.40-1.50	D								
1.50-1.60	D					(0.50)			
1.60-1.90	D					1.90	Hard dark grey CLAY. Occasional weak angular to subangular fine to coarse mudstone gravel. Some selenite crystals and orange staining.		

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.60	DRY	77	100
24-02-13	1.90	DRY	67	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 59ch West.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: ZS

Bridgeway Consulting Ltd
Bridgeway House, Technology Drive
NG9 1LA
Telephone: 01159191111

WINDOWLESS SAMPLER LOG

Project	Site	Consultant	EXPLORATORY HOLE No
East West Rail		Atkins	**WS110D - Wk48**
Job No: J11631	Date: 24-02-13 24-02-13	Ground Level (m)	Co-Ordinates ()
Contractor: Bridgeway Consulting			Sheet: 1 of 1

SAMPLES & TESTS			STRATA						
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Field Test kPa HSV PP	Instrument/ Backfill
0.60	D					(1.20) 1.20	MADE GROUND: Brown gravelly slightly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick and sandstone.		
1.20-1.45	D					1.45	MADE GROUND: Brownish orange clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to subangular fine flint and mudstone and medium to coarse brick. Some roots and rootlets and gypsum crystals. Some pockets of firm dark grey clay.		
1.45-1.90	B					(0.45) 1.90	Stiff high to very high strength dark grey mottled greyish brown CLAY. Some dark red staining at 1.6m. Occasional decaying roots and rootlets. Slightly silty from 1.85m Rare selenite crystals.	117 158 200	

Progress and Water Observations

Date	Depth	Water Dpt	Dia. mm	% Rec
24-02-13	1.20	DRY	N/A	N/A
24-02-13	1.90	DRY	77	100

GENERAL REMARKS

1. Position scanned with CAT & genny prior to excavation.
2. Inspection pit excavated to 1.20mbgl prior to drilling.
3. Hole drilled at 28m 59ch East.

All dimensions in metres Scale 1:50	Client: Chiltern Railways Ltd	Method/ Plant Used: HHWS	Logged By: ZS

Annex B

Laboratory Analytical Data

Section D1 Earthworks

2531

ANALYTICAL TEST REPORT

Contract no: 47627

Contract name: EWR

Client reference: PSL13/0364

Clients name: Professional Soils Laboratory

Clients address: 5-7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 14 March 2013

Analysis started: 14 March 2013

Analysis completed 21 March 2013

Report issued: 22 March 2013

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by:

Karan Campbell
Director

John Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are exclusive of stones.

Lab ref	Sample id	Depth (m)	Soil description passing 2mm sieve	Description of material retained on 2mm sieve	% Retained on 2mm sieve	Moisture (%)
47627-1	WS 45B	0.00-1.20	Clay	Gravel	23.0	18.0
47627-2	WS 57B	0.60	Sand	Gravel	20.4	22.2
47627-3	WS 58B	0.60	Loamy Clay	Gravel	15.2	20.9
47627-4	WS 64A	0.20-0.75	Sandy Clay	Gravel	25.0	12.5
47627-5	WS 66	0.30-0.50	Clay	Gravel	14.7	19.3
47627-6	WS 106C	0.25	Clay	N/A	<1	18.4
47627-7	WS 163	0.30	Sand	Stones & Gravel	40.8	8.1
47627-8	WS 163	1.00	Clay	Gravel	5.3	15.9
47627-9	WS 164	0.50	Sandy Clay	Gravel	32.1	8.1
47627-10	WS 164	1.00	Clay	N/A	<1	22.8
47627-11	WS 166	0.80	Clay	Gravel	11.0	20.6
47627-12	WS 181	0.70	Clay	N/A	<1	14.8
47627-13	WS 701	1.00	Sandy Clay	Gravel	9.9	10.1
47627-14	WS 703	0.50	Sand	Gravel	20.4	7.0
47627-15	WS 703	1.40-1.60	Loam	Gravel	10.5	26.4
47627-16	WS 703	3.80-4.00	Sandy Clay	Gravel	31.2	17.0
47627-17	WS 705	0.90	Clay	N/A	<1	17.5
47627-18	WS 705	1.80-2.00	Loam	Gravel	10.0	30.0
47627-19	WS 706	0.50	Sand	Gravel	10.5	9.5
47627-20	WS 706	2.00	Clay	N/A	<1	22.5
47627-21	WS 708	0.50	Sandy Clay	Stones & Gravel	38.0	8.9
47627-22	WS 708	1.00	Clay	Stones & Gravel	10.9	17.5
47627-23	WS 708	2.00-2.50	Clay	N/A	<1	23.7
47627-24	WS 709	0.80	Clay	Gravel	7.6	13.2

Chemtech Environmental Limited

SOILS

Lab number			47627-1	47627-2	47627-3	47627-4	47627-5	47627-6
Sample id			WS 45B	WS 57B	WS 58B	WS 64A	WS 66	WS 106C
Depth (m)			0.00-1.20	0.60	0.60	0.20-0.75	0.30-0.50	0.25
Date sampled			-	21/11/2012	21/11/2012	-	-	03/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	7.1	23	9.1	13	8.0	12
Boron (water soluble)	CE063 M	mg/kg B	1.1	1.6	3.3	<0.3	1.3	2.1
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	14	172	82	19	14	18
Lead (total)	CE054 M	mg/kg Pb	84	34	17	13	88	11
Mercury (total)	CE054	mg/kg Hg	0.7	<0.5	0.7	0.7	0.6	0.7
Nickel (total)	CE054 M	mg/kg Ni	21	40	19	19	24	32
Selenium (total)	CE054 M	mg/kg Se	<0.3	0.6	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	59	56	51	58	68	67
pH	CE004 M	units	8.2	8.0	8.4	8.7	8.1	8.3
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	4.6	12	13	<1	4.0	6.8
Sulphate (total)	CE062 M	mg/kg SO_4	690	956	942	289	642	590
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	-	-	<0.5	-	-
Organic matter content (OMC)	CE005 M	% w/w	2.16	7.40	3.42	0.23	2.37	0.84
PAH								
Naphthalene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Acenaphthylene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Acenaphthene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Fluorene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Phenanthrene	CE087	mg/kg	0.2	-	-	0.1	-	-
Anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Fluoranthene	CE087	mg/kg	0.2	-	-	0.1	-	-
Pyrene	CE087	mg/kg	0.1	-	-	0.1	-	-
Benzo(a)anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Chrysene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	-	-	0.1	-	-
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(a)pyrene	CE087	mg/kg	<0.1	-	-	0.1	-	-
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(ghi)perylene	CE087	mg/kg	<0.1	-	-	0.1	-	-
PAH (total)	CE087	mg/kg	<5	-	-	<5	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Benzene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Toluene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Ethylbenzene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
m & p-Xylene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-1	47627-2	47627-3	47627-4	47627-5	47627-6
Sample id			WS 45B	WS 57B	WS 58B	WS 64A	WS 66	WS 106C
Depth (m)			0.00-1.20	0.60	0.60	0.20-0.75	0.30-0.50	0.25
Date sampled			-	21/11/2012	21/11/2012	-	-	03/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.1	-	-	<0.1	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.1	-	-	<0.1	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	0.1	-	-	<0.1	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	1	-	-	<1	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	15	-	-	5	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	-	-	<1	-	-
Subcontracted analysis								
Asbestos	$	-	Chrysotile	NAD	NAD	Amosite	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-7	47627-8	47627-9	47627-10	47627-11	47627-12
Sample id			WS 163	WS 163	WS 164	WS 164	WS 166	WS 181
Depth (m)			0.30	1.00	0.50	1.00	0.80	0.70
Date sampled			-	-	26/11/2012	26/11/2012	27/11/2012	03/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	18	7.6	16	5.2	4.0	11
Boron (water soluble)	CE063 M	mg/kg B	<0.3	1.0	0.3	0.9	1.7	3.7
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	29	24	27	19	23	13
Lead (total)	CE054 M	mg/kg Pb	21	11	14	12	12	13
Mercury (total)	CE054	mg/kg Hg	0.7	0.7	0.6	<0.5	<0.5	0.7
Nickel (total)	CE054 M	mg/kg Ni	20	23	17	10	17	32
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	68	66	49	57	106	47
pH	CE004 M	units	8.6	8.1	8.6	7.3	8.3	7.8
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	<1	<1	<1	1.8	1.4	4.8
Sulphate (total)	CE062 M	mg/kg SO_4	442	616	651	27700	832	60810
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	0.45	0.60	0.88	1.63	2.06	0.26
PAH								
Naphthalene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Acenaphthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Fluorene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Phenanthrene	CE087	mg/kg	0.2	0.1	-	-	-	-
Anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Fluoranthene	CE087	mg/kg	0.2	<0.1	-	-	-	-
Pyrene	CE087	mg/kg	0.2	<0.1	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Chrysene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
PAH (total)	CE087	mg/kg	<5	<5	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Benzene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Toluene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-7	47627-8	47627-9	47627-10	47627-11	47627-12
Sample id			WS 163	WS 163	WS 164	WS 164	WS 166	WS 181
Depth (m)			0.30	1.00	0.50	1.00	0.80	0.70
Date sampled			-	-	26/11/2012	26/11/2012	27/11/2012	03/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.1	<0.1	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.1	<0.1	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	0.1	0.1	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	2	<1	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	<1	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	Chrysotile	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-13	47627-14	47627-15	47627-16	47627-17	47627-18
Sample id			WS 701	WS 703	WS 703	WS 703	WS 705	WS 705
Depth (m)			1.00	0.50	1.40-1.60	3.80-4.00	0.90	1.80-2.00
Date sampled			11/12/2012	11/12/2012	16/01/2013	16/01/2013	11/12/2012	20/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	9.5	9.4	5.6	6.2	12	7.9
Boron (water soluble)	CE063 M	mg/kg B	0.7	<0.3	1.5	1.8	1.5	2.9
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	3.5	<0.3	<0.3
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	33	31	21	16	15	17
Lead (total)	CE054 M	mg/kg Pb	26	9.5	12	9.7	9.7	15
Mercury (total)	CE054	mg/kg Hg	0.7	0.7	0.8	0.6	0.6	<0.5
Nickel (total)	CE054 M	mg/kg Ni	16	15	16	30	33	26
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	69	44	35	339	56	75
pH	CE004 M	units	8.5	8.9	8.0	8.0	8.5	7.7
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	1.5	<1	4.0	5.7	1.8	3.4
Sulphate (total)	CE062 M	mg/kg SO_4	758	388	1739	1580	477	1802
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	-	-	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	2.17	0.44	4.59	3.06	0.54	6.12
PAH								
Naphthalene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthylene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthene	CE087	mg/kg	-	-	-	-	-	-
Fluorene	CE087	mg/kg	-	-	-	-	-	-
Phenanthrene	CE087	mg/kg	-	-	-	-	-	-
Anthracene	CE087	mg/kg	-	-	-	-	-	-
Fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Pyrene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	-	-	-	-	-	-
Chrysene	CE087	mg/kg	-	-	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	-	-	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	-	-	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	-	-	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	-	-	-	-	-	-
PAH (total)	CE087	mg/kg	-	-	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	-	-	-	-	-	-
Benzene	CE057 U	mg/kg	-	-	-	-	-	-
Toluene	CE057 U	mg/kg	-	-	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	-	-	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	-	-	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-13	47627-14	47627-15	47627-16	47627-17	47627-18
Sample id			WS 701	WS 703	WS 703	WS 703	WS 705	WS 705
Depth (m)			1.00	0.50	1.40-1.60	3.80-4.00	0.90	1.80-2.00
Date sampled			11/12/2012	11/12/2012	16/01/2013	16/01/2013	11/12/2012	20/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 [U]	mg/kg	-	-	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-19	47627-20	47627-21	47627-22	47627-23	47627-24
Sample id			WS 706	WS 706	WS 708	WS 708	WS 708	WS 709
Depth (m)			0.50	2.00	0.50	1.00	2.00-2.50	0.80
Date sampled			17/12/2012	07/01/2013	17/12/2012	17/12/2012	-	18/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	14	11	12	11	12	61
Boron (water soluble)	CE063 M	mg/kg B	<0.3	3.4	0.4	1.3	1.5	0.6
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	28	20	12	12	13	13
Lead (total)	CE054 M	mg/kg Pb	12	12	8.5	11	11	17
Mercury (total)	CE054	mg/kg Hg	0.6	0.7	0.9	0.6	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	17	41	22	31	30	38
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	17	41	22	31	30	66
pH	CE004 M	units	8.8	7.6	8.9	8.2	7.9	8.4
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	1.1	2.2	<1	<1	2.0	<1
Sulphate (total)	CE062 M	mg/kg SO_4	290	12400	962	271	338	399
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	-	-	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	0.53	0.37	0.37	0.52	1.20	0.90
PAH								
Naphthalene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthylene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthene	CE087	mg/kg	-	-	-	-	-	-
Fluorene	CE087	mg/kg	-	-	-	-	-	-
Phenanthrene	CE087	mg/kg	-	-	-	-	-	-
Anthracene	CE087	mg/kg	-	-	-	-	-	-
Fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Pyrene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	-	-	-	-	-	-
Chrysene	CE087	mg/kg	-	-	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	-	-	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	-	-	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	-	-	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	-	-	-	-	-	-
PAH (total)	CE087	mg/kg	-	-	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	-	-	-	-	-	-
Benzene	CE057 U	mg/kg	-	-	-	-	-	-
Toluene	CE057 U	mg/kg	-	-	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	-	-	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	-	-	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-19	47627-20	47627-21	47627-22	47627-23	47627-24
Sample id			WS 706	WS 706	WS 708	WS 708	WS 708	WS 709
Depth (m)			0.50	2.00	0.50	1.00	2.00-2.50	0.80
Date sampled			17/12/2012	07/01/2013	17/12/2012	17/12/2012	-	18/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	-	-	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	Amosite	NAD	Amosite	NAD	NAD	NAD

Chemtech Environmental Limited

LEACHATES

Lab number			47627-1L	47627-4L	47627-7L	47627-8L	47627-14L	47627-15L
Sample id			WS 45B	WS 64A	WS 163	WS 163	WS 703	WS 703
Depth (m)			0.00-1.20	0.20-0.75	0.30	1.00	0.50	1.40-1.60
Test	**Method**	**Units**						
Arsenic (dissolved)	CE055	mg/l As	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Boron (dissolved)	CE063	mg/l B	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.002	0.002	0.002	0.004	0.002	0.004
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Hardness (by calculation)	CE055	mg/l $CaCO_3$	50	28	35	64	27	55
pH	CE004	units	8.1	8.0	8.3	8.4	8.7	8.1
Ammoniacal Nitrogen	CE012 U	mg/l N	0.02	0.06	0.07	0.04	0.08	0.01
Chloride	CE049 U	mg/l Cl	1.1	<1	<1	<1	<1	<1
Nitrate	CE049 U	mg/l NO_3	3.4	<1	<1	<1	<1	1.2
Sulphate	CE049 U	mg/l SO_4	<10	<10	<10	12	<10	<10
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	5.6	2.8	3.4	2.3	2.8	6.1

Chemtech Environmental Limited

LEACHATES

Lab number			47627-16L	47627-17L	47627-18L	47627-19L	47627-20L
Sample id			WS 703	WS 705	WS 705	WS 706	WS 706
Depth (m)			3.80-4.00	0.90	1.80-2.00	0.50	2.00
Test	**Method**	**Units**					
Arsenic (dissolved)	CE055	mg/l As	<0.001	<0.001	<0.001	0.001	<0.001
Boron (dissolved)	CE063	mg/l B	0.03	<0.03	0.03	<0.03	0.07
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	0.007	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.002	0.003	0.002	0.003	0.003
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020
Hardness (by calculation)	CE055	mg/l $CaCO_3$	108	44	30	30	1651
pH	CE004	units	7.7	8.0	7.6	8.7	7.8
Ammoniacal Nitrogen	CE012 U	mg/l N	0.04	0.01	0.03	0.08	0.62
Chloride	CE049 U	mg/l Cl	<1	<1	1.0	<1	<1
Nitrate	CE049 U	mg/l NO_3	<1	<1	2.9	<1	1.4
Sulphate	CE049 U	mg/l SO_4	66	<10	<10	<10	1384
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	2.4	2.7	10.2	3.9	5.1

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE054	Arsenic (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.3	mg/kg B
CE054	Cadmium (total)	Aqua regia digest, ICP-OES	Dry	M	0.2	mg/kg Cd
CE050	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE054	Copper (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cu
CE054	Lead (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Pb
CE054	Mercury (total)	Aqua regia digest, ICP-OES	Dry		0.5	mg/kg Hg
CE054	Nickel (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Ni
CE054	Selenium (total)	Aqua regia digest, ICP-OES	Dry	M	0.3	mg/kg Se
CE054	Zinc (total)	Aqua regia digest, ICP-OES	Dry	M	3	mg/kg Zn
CE055	Hardness (by calculation)	ICP-OES		1	mg/l $CaCO_3$	
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	M	100	mg/kg SO_4
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE005	Organic matter content (OMC)	Based on BS 1377, Colorimetry	Dry	M	0.01	% w/w
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.1	mg/kg
CE087	PAH (total)	Solvent extraction, GC-MS	Wet		5	mg/kg
CE057	BTEX & MTBE	Headspace GC-FID	Wet	U	0.01	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C5-C10)	Headspace GC-FID	Wet		0.01-0.1	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C10-C44)	Solvent extraction, GC-FID	Wet		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE055	Arsenic (dissolved)	ICP-OES		0.001	mg/l As
CE063	Boron (dissolved)	ICP-OES		0.03	mg/l B
CE055	Cadmium (dissolved)	ICP-OES	U	0.001	mg/l Cd
CE055	Chromium (dissolved)	ICP-OES	U	0.003	mg/l Cr
CE050	Chromium VI (dissolved)	Colorimetry		0.01	mg/l CrVI
CE055	Copper (dissolved)	ICP-OES	U	0.004	mg/l Cu
CE055	Lead (dissolved)	ICP-OES	U	0.009	mg/l Pb
CE055	Mercury (dissolved)	ICP-OES		0.001	mg/l Hg
CE055	Nickel (dissolved)	ICP-OES	U	0.003	mg/l Ni
CE055	Selenium (dissolved)	ICP-OES		0.001	mg/l Se
CE055	Zinc (dissolved)	ICP-OES	U	0.020	mg/l Zn
CE004	pH	Based on BS 1377, pH Meter		-	units
CE012	Ammoniacal Nitrogen	Colorimetry	U	0.01	mg/l N
CE049	Chloride	Ion Chromatography	U	1	mg/l Cl
CE049	Nitrate	Ion Chromatography	U	1	mg/l NO_3
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO_4
CE077	Cyanide (free)	Distillation, Colorimetry		0.02	mg/l CN
CE071	Total Organic Carbon	TOC analyser		1	mg/l C

Section D2 Earthworks

2531

ANALYTICAL TEST REPORT

Contract no: 46741

Contract name: East-West Rail

Client reference: PSL12/4199

Clients name: Professional Soils Laboratory

Clients address: 5-7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 30 November 2012

Analysis started: 30 November 2012

Analysis completed 10 December 2012

Report issued: 10 December 2012

Notes:

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

BTEX compounds are identified by retention time only and may include interference from co-eluting compounds.

This report shall not be reproduced except in full, withour prior written approval.

Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:

U UKAS accredited test

M MCERTS & UKAS accredited test

$ Test carried out by an approved subcontractor

I/S Insufficient sample to carry out test

N/S Sample not suitable for testing

NAD No Asbestos Detected

Approved by:

K Campbell

Karan Campbell
Director

John Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are exclusive of stones.

Lab ref	Sample id	Depth (m)	Soil description passing 2mm sieve	Description of material retained on 2mm sieve	% Retained on 2mm sieve	Moisture (%)
46741-1	WS 45a	1.80-2.00	Sandy Clay	Gravel	38.3	17.1
46741-2	WS 52a	0.80	Sand	Stones	66.8	5.9
46741-3	WS 54	0.70	Silty Clay	Gravel	24.4	21.7
46741-4	WS 55	0.50	Sand	Stones	49.3	7.4
46741-5	WS 55	1.00	Silty Clay	Gravel	27.4	19.6
46741-6	Ws 59a	0.70	Clayey Sand	Gravel	46.5	10.1
46741-7	WS 68a	0.50	Sandy Clay	Gravel and Stones	70.2	8.1
46741-8	WS 68a	1.00	Clay	Gravel	19.4	17.4
46741-9	WS 68a	2.00-3.00	Clay	Gravel	35.8	19.5
46741-10	WS 72	1.00	Clay	Gravel	26.6	21.6
46741-11	WS 73a	0.50	Clayey Sand	Gravel and Stones	56.4	7.4
46741-12	WS 73a	1.00	Clay	Gravel and Stones	48.5	16.6
46741-13	WS 73a	3.00-4.00	Clay	Gravel	44.0	18.7
46741-14	WS 73b	1.00	Clay	Gravel	46.8	24.3
46741-15	WS 74a	0.50	Clayey Sand	Stones	61.4	8.7
46741-16	WS 74b	1.00	Clay	Gravel	40.5	20.4
46741-17	WS 81	0.70	Clay	Gravel and Stones	55.3	14.5
46741-18	WS 87	0.00-0.30	Loamy Sand	Gravel and Stones	46.5	12.6
46741-19	WS 98	0.70	Clayey Sand	Gravel and Stones	47.0	10.1
46741-20	WS 102a	1.20-2.00	Clay	Gravel	31.5	18.3
46741-21	WS 107a	0.50	Sand	Gravel and Stones	42.2	6.7
46741-22	WS 108a	0.50	Sand	Gravel and Stones	43.9	9.5

Chemtech Environmental Limited

SOILS

Lab number			46741-1	46741-2	46741-3	46741-4	46741-5	46741-6
Sample id			WS 45a	WS 52a	WS 54	WS 55	WS 55	Ws 59a
Depth (m)			1.80-2.00	0.80	0.70	0.50	1.00	0.70
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	8.8	5.8	6.0	4.0	9.1	6.4
Boron (water soluble)	CE063 M	mg/kg B	0.8	<0.3	1.6	<0.3	0.7	0.6
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	0.3	<0.2	<0.2	<0.2	<0.2
Chromium (total)	CE054 M	mg/kg Cr	26	10	31	8.6	25	14
Chromium (VI)	CE050 U	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	12	13	15	8.6	8.1	5.7
Lead (total)	CE054 M	mg/kg Pb	14	7.5	11	4.7	8.9	6.0
Mercury (total)	CE054	mg/kg Hg	<0.5	0.6	0.6	0.5	0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	16	8.5	17	7.8	19	13
Selenium (total)	CE054 M	mg/kg Se	1.1	<0.3	1.8	<0.3	1.5	<0.3
Zinc (total)	CE054 M	mg/kg Zn	57	38	44	21	35	20
pH	CE004 M	units	7.6	8.9	8.4	8.9	8.2	8.7
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	3.5	<1	1.2	<1	1.2	7.9
Sulphate (total)	CE062 M	mg/kg SO_4	317	300	828	248	4910	244
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	-	<0.5	<0.5	<0.5	<0.5	<0.5
Organic matter content (OMC)	CE005 M	% w/w	0.75	0.64	2.88	0.18	2.68	0.21
PAH								
Naphthalene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	CE087	mg/kg	-	0.4	<0.1	<0.1	<0.1	<0.1
Anthracene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	CE087	mg/kg	-	2.0	0.2	0.3	<0.1	<0.1
Pyrene	CE087	mg/kg	-	1.8	0.2	0.4	<0.1	<0.1
Benzo(a)anthracene	CE087	mg/kg	-	0.2	<0.1	<0.1	<0.1	<0.1
Chrysene	CE087	mg/kg	-	0.5	<0.1	<0.1	<0.1	<0.1
Benzo(b)fluoranthene	CE087	mg/kg	-	0.5	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	CE087	mg/kg	-	0.2	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	CE087	mg/kg	-	0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(ah)anthracene	CE087	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	CE087	mg/kg	-	0.1	<0.1	<0.1	<0.1	<0.1
PAH (total)	CE087	mg/kg	-	5.8	<5	<5	<5	<5
BTEX & TPH								
MTBE	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01

Chemtech Environmental Limited

SOILS

Lab number			46741-1	46741-2	46741-3	46741-4	46741-5	46741-6
Sample id			WS 45a	WS 52a	WS 54	WS 55	WS 55	Ws 59a
Depth (m)			1.80-2.00	0.80	0.70	0.50	1.00	0.70
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
m & p-Xylene	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	CE057 U	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC5-EC7	CE068	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC7-EC8	CE068	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC8-EC10	CE068	mg/kg	-	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC10-EC12	CE068	mg/kg	-	<1	<1	<1	<1	<1
TPH Aromatic EC12-EC16	CE068	mg/kg	-	<1	<1	<1	<1	<1
TPH Aromatic EC16-EC21	CE068	mg/kg	-	4	<1	<1	<1	<1
TPH Aromatic EC21-EC35	CE068	mg/kg	-	2	<1	<1	<1	<1
TPH Aromatic EC35-EC44	CE068	mg/kg	-	<1	<1	<1	<1	<1
TPH Aliphatic EC5-EC6	CE068	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC6-EC8	CE068	mg/kg	-	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC8-EC10	CE068	mg/kg	-	<0.1	0.1	0.1	0.1	<0.1
TPH Aliphatic EC10-EC12	CE068	mg/kg	-	<1	<1	<1	<1	<1
TPH Aliphatic EC12-EC16	CE068	mg/kg	-	2	<1	2	2	1
TPH Aliphatic EC16-EC35	CE068	mg/kg	-	59	8	15	7	4
TPH Aliphatic EC35-EC44	CE068	mg/kg	-	<1	<1	<1	<1	<1
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			46741-7	46741-8	46741-9	46741-10	46741-11	46741-12
Sample id			WS 68a	WS 68a	WS 68a	WS 72	WS 73a	WS 73a
Depth (m)			0.50	1.00	2.00-3.00	1.00	0.50	1.00
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	12	9.6	7.5	12	16	13
Boron (water soluble)	CE063 M	mg/kg B	0.5	2.7	5.3	2.2	<0.3	1.4
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (total)	CE054 M	mg/kg Cr	14	41	51	33	12	30
Chromium (VI)	CE050 U	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	19	13	13	14	17	14
Lead (total)	CE054 M	mg/kg Pb	9.9	8.2	9.5	13	8.8	9.5
Mercury (total)	CE054	mg/kg Hg	0.6	0.5	0.7	<0.5	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	18	28	36	23	18	25
Selenium (total)	CE054 M	mg/kg Se	<0.3	1.1	1.5	0.5	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	12	16	13	53	45	42
pH	CE004 M	units	8.8	8.4	8.1	7.7	8.6	8.2
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	1.1	2.1	36	1.9	1.8	1.4
Sulphate (total)	CE062 M	mg/kg SO_4	533	910	52410	6795	495	612
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Organic matter content (OMC)	CE005 M	% w/w	0.84	0.42	0.21	2.00	0.37	0.43
PAH								
Naphthalene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Fluorene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	CE087	mg/kg	0.3	<0.1	<0.1	<0.1	0.5	0.5
Pyrene	CE087	mg/kg	0.2	<0.1	<0.1	<0.1	0.4	0.3
Benzo(a)anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Chrysene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
PAH (total)	CE087	mg/kg	<5	<5	<5	<5	<5	<5
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Chemtech Environmental Limited

SOILS

Lab number			46741-7	46741-8	46741-9	46741-10	46741-11	46741-12
Sample id			WS 68a	WS 68a	WS 68a	WS 72	WS 73a	WS 73a
Depth (m)			0.50	1.00	2.00-3.00	1.00	0.50	1.00
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
m & p-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC8-EC10	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	<1	<1	<1	1	<1
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC8-EC10	CE068	mg/kg	<0.1	<0.1	0.1	0.2	<0.1	0.1
TPH Aliphatic EC10-EC12	CE068	mg/kg	1	2	1	1	1	1
TPH Aliphatic EC12-EC16	CE068	mg/kg	3	5	2	4	3	2
TPH Aliphatic EC16-EC35	CE068	mg/kg	16	14	9	18	17	10
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	<1	<1	<1	<1	<1
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			46741-13	46741-14	46741-15	46741-16	46741-17	46741-18
Sample id			WS 73a	WS 73b	WS 74a	WS 74b	WS 81	WS 87
Depth (m)			3.00-4.00	1.00	0.50	1.00	0.70	0.00-0.30
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	9.7	10	14	7.5	9.0	21
Boron (water soluble)	CE063 M	mg/kg B	4.3	2.2	<0.3	2.2	0.7	1.0
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	0.3
Chromium (total)	CE054 M	mg/kg Cr	31	49	15	53	19	14
Chromium (VI)	CE050 U	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	12	21	9.8	19	12	73
Lead (total)	CE054 M	mg/kg Pb	6.4	13	7.5	9.9	8.7	44
Mercury (total)	CE054	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	23	23	17	32	16	22
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	3.5	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	35	58	32	63	32	199
pH	CE004 M	units	7.9	8.3	8.8	8.3	8.4	8.2
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	18	11	<1	20	2.6	4.4
Sulphate (total)	CE062 M	mg/kg SO_4	134600	2614	455	455	880	1750
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Organic matter content (OMC)	CE005 M	% w/w	0.44	1.77	0.76	0.21	2.84	0.22
PAH								
Naphthalene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	CE087	mg/kg	0.2	<0.1	0.2	<0.1	<0.1	0.8
Pyrene	CE087	mg/kg	0.1	<0.1	0.2	<0.1	<0.1	1.0
Benzo(a)anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Chrysene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.9
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Benzo(a)pyrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.3
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	CE087	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
PAH (total)	CE087	mg/kg	<5	<5	<5	<5	<5	<5
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Chemtech Environmental Limited

SOILS

Lab number			46741-13	46741-14	46741-15	46741-16	46741-17	46741-18
Sample id			WS 73a	WS 73b	WS 74a	WS 74b	WS 81	WS 87
Depth (m)			3.00-4.00	1.00	0.50	1.00	0.70	0.00-0.30
Date sampled			-	-	-	-	-	-
Test	**Method**	**Units**						
m & p-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC8-EC10	CE068	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	<1	<1	<1	<1	2
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	<1	<1	<1	<1	3
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	<1	<1	<1	<1	<1
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TPH Aliphatic EC8-EC10	CE068	mg/kg	0.1	0.2	<0.1	0.2	0.1	0.1
TPH Aliphatic EC10-EC12	CE068	mg/kg	1	1	1	1	1	2
TPH Aliphatic EC12-EC16	CE068	mg/kg	2	2	2	4	5	8
TPH Aliphatic EC16-EC35	CE068	mg/kg	5	4	8	9	9	94
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	<1	<1	<1	<1	3
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			46741-19	46741-20	46741-21	46741-22
Sample id			WS 98	WS 102a	WS 107a	WS 108a
Depth (m)			0.70	1.20-2.00	0.50	0.50
Date sampled			-	-	-	-
Test	**Method**	**Units**				
Arsenic (total)	CE054 M	mg/kg As	24	10	16	49
Boron (water soluble)	CE063 M	mg/kg B	0.5	1.7	0.3	<0.3
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2
Chromium (total)	CE054 M	mg/kg Cr	23	40	15	16
Chromium (VI)	CE050 U	mg/kg CrVI	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	32	9.3	9.9	57
Lead (total)	CE054 M	mg/kg Pb	20	10	7.7	19
Mercury (total)	CE054	mg/kg Hg	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	19	17	12	18
Selenium (total)	CE054 M	mg/kg Se	<0.3	0.4	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	53	54	34	76
pH	CE004 M	units	8.2	8.0	8.4	8.5
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	2.0	1.2	1.5	<1
Sulphate (total)	CE062 M	mg/kg SO_4	1165	1392	116	255
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	-	-
Organic matter content (OMC)	CE005 M	% w/w	1.46	0.70	0.60	0.21
PAH						
Naphthalene	CE087	mg/kg	<0.1	<0.1	-	-
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	-	-
Acenaphthene	CE087	mg/kg	<0.1	<0.1	-	-
Fluorene	CE087	mg/kg	<0.1	<0.1	-	-
Phenanthrene	CE087	mg/kg	<0.1	<0.1	-	-
Anthracene	CE087	mg/kg	<0.1	<0.1	-	-
Fluoranthene	CE087	mg/kg	0.5	<0.1	-	-
Pyrene	CE087	mg/kg	0.5	<0.1	-	-
Benzo(a)anthracene	CE087	mg/kg	<0.1	<0.1	-	-
Chrysene	CE087	mg/kg	<0.1	<0.1	-	-
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-
Benzo(a)pyrene	CE087	mg/kg	<0.1	<0.1	-	-
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	-	-
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	-	-
Benzo(ghi)perylene	CE087	mg/kg	<0.1	<0.1	-	-
PAH (total)	CE087	mg/kg	<5	<5	-	-
BTEX & TPH						
MTBE	CE057 U	mg/kg	<0.01	<0.01	-	-
Benzene	CE057 U	mg/kg	<0.01	<0.01	-	-
Toluene	CE057 U	mg/kg	<0.01	<0.01	-	-
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	-	-

Chemtech Environmental Limited

SOILS

Lab number			46741-19	46741-20	46741-21	46741-22
Sample id			WS 98	WS 102a	WS 107a	WS 108a
Depth (m)			0.70	1.20-2.00	0.50	0.50
Date sampled			-	-	-	-
Test	**Method**	**Units**				
m & p-Xylene	CE057 [U]	mg/kg	<0.01	<0.01	-	-
o-Xylene	CE057 [U]	mg/kg	<0.01	<0.01	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.01	<0.01	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.01	<0.01	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	<0.01	<0.01	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	<1	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	<1	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	1	<1	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	<1	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	<1	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.1	<0.1	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.1	<0.1	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	0.1	0.2	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	1	1	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	2	4	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	12	6	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	<1	-	-
Subcontracted analysis						
Asbestos	$	-	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

LEACHATES

Lab number			46741-1L	46741-2L	46741-4L	46741-5L	46741-6L	46741-7L
Sample id			WS 45a	WS 52a	WS 55	WS 55	Ws 59a	WS 68a
Depth (m)			1.80-2.00	0.80	0.50	1.00	0.70	0.50
Test	**Method**	**Units**						
Arsenic (dissolved)	CE055	mg/l As	0.004	0.002	0.003	<0.001	0.001	0.002
Boron (dissolved)	CE063	mg/l B	0.04	<0.03	<0.03	<0.03	<0.03	<0.03
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050 U	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.005	0.003	0.002	0.002	0.003	0.002
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	CE004	units	7.7	8.3	8.4	7.7	8.3	7.8
Ammonia	CE012 U	mg/l N	0.55	0.09	0.06	0.09	0.07	0.08
Chloride	CE049 U	mg/l Cl	<1	<1	1.1	<1	2.0	<1
Nitrate	CE049 U	mg/l NO_3	12	<1	<1	<1	<1	<1
Sulphate	CE049 U	mg/l SO_4	<10	<10	<10	2250	<10	<10
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	10.8	2.5	2.2	2.3	2.8	2.3

Chemtech Environmental Limited

LEACHATES

Lab number			46741-8L	46741-9L	46741-10L	46741-11L	46741-12L	46741-13L
Sample id			WS 68a	WS 68a	WS 72	WS 73a	WS 73a	WS 73a
Depth (m)			1.00	2.00-3.00	1.00	0.50	1.00	3.00-4.00
Test	**Method**	**Units**						
Arsenic (dissolved)	CE055	mg/l As	0.001	0.002	0.004	0.003	0.004	0.003
Boron (dissolved)	CE063	mg/l B	0.06	0.21	0.05	<0.03	0.04	0.12
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050 U	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	<0.001	<0.001	<0.001	0.001	0.003	0.002
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	CE004	units	7.8	7.3	7.6	8.6	8.1	7.6
Ammonia	CE012 U	mg/l N	0.19	0.15	3.35	0.05	1.95	0.25
Chloride	CE049 U	mg/l Cl	<1	7.5	<1	<1	<1	4.5
Nitrate	CE049 U	mg/l NO_3	<1	<1	<1	<1	2.0	<1
Sulphate	CE049 U	mg/l SO_4	30	1852	2074	<10	<10	2925
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	3.1	2.2	5.7	1.9	3.3	2.0

Chemtech Environmental Limited

LEACHATES

Lab number			46741-14L	46741-17L	46741-18L	46741-19L	46741-20L	46741-21L
Sample id			WS 73b	WS 81	WS 87	WS 98	WS 102a	WS 107a
Depth (m)			1.00	0.70	0.00-0.30	0.70	1.20-2.00	0.50
Test	**Method**	**Units**						
Arsenic (dissolved)	CE055	mg/l As	0.003	0.002	0.002	<0.001	0.001	0.002
Boron (dissolved)	CE063	mg/l B	0.03	<0.03	0.05	0.06	0.07	<0.03
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050 U	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	<0.001	0.003	0.001	<0.001	<0.001	0.004
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
pH	CE004	units	7.7	8.1	7.7	8.1	7.8	8.3
Ammonia	CE012 U	mg/l N	0.02	0.07	0.06	0.07	0.04	0.06
Chloride	CE049 U	mg/l Cl	1.5	<1	<1	<1	<1	<1
Nitrate	CE049 U	mg/l NO_3	2.2	<1	<1	<1	<1	<1
Sulphate	CE049 U	mg/l SO_4	25	<10	365	15	110	<10
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	5.2	2.7	1.8	2.8	3.0	4.0

Chemtech Environmental Limited

LEACHATES

Lab number			46741-22L
Sample id			WS 108a
Depth (m)			0.50
Test	**Method**	**Units**	
Arsenic (dissolved)	CE055	mg/l As	<0.001
Boron (dissolved)	CE063	mg/l B	<0.03
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003
Chromium (VI) (dissolved)	CE050 U	mg/l CrVI	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.003
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020
pH	CE004	units	8.5
Ammonia	CE012 U	mg/l N	0.07
Chloride	CE049 U	mg/l Cl	<1
Nitrate	CE049 U	mg/l NO_3	<1
Sulphate	CE049 U	mg/l SO_4	<10
Cyanide (free)	CE077	mg/l CN	<0.02
Total Organic Carbon	CE071	mg/l C	2.8

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE054	Arsenic (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.3	mg/kg B
CE054	Cadmium (total)	Aqua regia digest, ICP-OES	Dry	M	0.2	mg/kg Cd
CE054	Chromium (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cr
CE050	Chromium (VI)	Acid extraction, Colorimetry	Dry	U	1	mg/kg CrVI
CE054	Copper (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cu
CE054	Lead (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Pb
CE054	Mercury (total)	Aqua regia digest, ICP-OES	Dry		0.5	mg/kg Hg
CE054	Nickel (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Ni
CE054	Selenium (total)	Aqua regia digest, ICP-OES	Dry	M	0.3	mg/kg Se
CE054	Zinc (total)	Aqua regia digest, ICP-OES	Dry	M	3	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	M	100	mg/kg SO_4
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE005	Organic matter content (OMC)	Based on BS 1377, Colorimetry	Dry	M	0.01	% w/w
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.1	mg/kg
CE087	PAH (total)	Solvent extraction, GC-MS	Wet		5	mg/kg
CE057	BTEX & MTBE	Headspace GC-FID	Wet	U	0.01	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C5-C10)	Headspace GC-FID	Wet		0.01-0.1	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C10-C44	Solvent extraction, GC-FID	Wet		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE055	Arsenic (dissolved)	ICP-OES		0.001	mg/l As
CE063	Boron (dissolved)	ICP-OES		0.03	mg/l B
CE055	Cadmium (dissolved)	ICP-OES	U	0.001	mg/l Cd
CE055	Chromium (dissolved)	ICP-OES	U	0.003	mg/l Cr
CE050	Chromium VI (dissolved)	Colorimetry	U	0.01	mg/l CrVI
CE055	Copper (dissolved)	ICP-OES	U	0.004	mg/l Cu
CE055	Lead (dissolved)	ICP-OES	U	0.009	mg/l Pb
CE055	Mercury (dissolved)	ICP-OES		0.001	mg/l Hg
CE055	Nickel (dissolved)	ICP-OES	U	0.003	mg/l Ni
CE055	Selenium (dissolved)	ICP-OES		0.001	mg/l Se
CE055	Zinc (dissolved)	ICP-OES	U	0.020	mg/l Zn
CE004	pH	Based on BS 1377, pH Meter		-	units
CE012	Ammonia	Colorimetry	U	0.01	mg/l N
CE049	Chloride	Ion Chromatography	U	1	mg/l Cl
CE049	Nitrate	Ion Chromatography	U	1	mg/l NO_3
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO_4
CE077	Cyanide (free)	Distillation, Colorimetry		0.02	mg/l CN
CE071	Total Organic Carbon	TOC analyser		1	mg/l C

Section E1 Earthworks

2531

ANALYTICAL TEST REPORT

Contract no: 47627

Contract name: EWR

Client reference: PSL13/0364

Clients name: Professional Soils Laboratory

Clients address: 5-7 Hexthorpe Road
Doncaster
DN4 0AR

Samples received: 14 March 2013

Analysis started: 14 March 2013

Analysis completed 21 March 2013

Report issued: 22 March 2013

Notes:
Opinions and interpretations expressed herein are outside the UKAS accreditation scope.
Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.
Methods, procedures and performance data are available on request.
Results reported herein relate only to the material supplied to the laboratory.
This report shall not be reproduced except in full, withour prior written approval.
Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

Key:
U UKAS accredited test
M MCERTS & UKAS accredited test
$ Test carried out by an approved subcontractor
I/S Insufficient sample to carry out test
N/S Sample not suitable for testing
NAD No Asbestos Detected

Approved by:

Karan Campbell
Director

John Campbell
Director

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

All results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.
Analytical results are exclusive of stones.

Lab ref	Sample id	Depth (m)	Soil description passing 2mm sieve	Description of material retained on 2mm sieve	% Retained on 2mm sieve	Moisture (%)
47627-1	WS 45B	0.00-1.20	Clay	Gravel	23.0	18.0
47627-2	WS 57B	0.60	Sand	Gravel	20.4	22.2
47627-3	WS 58B	0.60	Loamy Clay	Gravel	15.2	20.9
47627-4	WS 64A	0.20-0.75	Sandy Clay	Gravel	25.0	12.5
47627-5	WS 66	0.30-0.50	Clay	Gravel	14.7	19.3
47627-6	WS 106C	0.25	Clay	N/A	<1	18.4
47627-7	WS 163	0.30	Sand	Stones & Gravel	40.8	8.1
47627-8	WS 163	1.00	Clay	Gravel	5.3	15.9
47627-9	WS 164	0.50	Sandy Clay	Gravel	32.1	8.1
47627-10	WS 164	1.00	Clay	N/A	<1	22.8
47627-11	WS 166	0.80	Clay	Gravel	11.0	20.6
47627-12	WS 181	0.70	Clay	N/A	<1	14.8
47627-13	WS 701	1.00	Sandy Clay	Gravel	9.9	10.1
47627-14	WS 703	0.50	Sand	Gravel	20.4	7.0
47627-15	WS 703	1.40-1.60	Loam	Gravel	10.5	26.4
47627-16	WS 703	3.80-4.00	Sandy Clay	Gravel	31.2	17.0
47627-17	WS 705	0.90	Clay	N/A	<1	17.5
47627-18	WS 705	1.80-2.00	Loam	Gravel	10.0	30.0
47627-19	WS 706	0.50	Sand	Gravel	10.5	9.5
47627-20	WS 706	2.00	Clay	N/A	<1	22.5
47627-21	WS 708	0.50	Sandy Clay	Stones & Gravel	38.0	8.9
47627-22	WS 708	1.00	Clay	Stones & Gravel	10.9	17.5
47627-23	WS 708	2.00-2.50	Clay	N/A	<1	23.7
47627-24	WS 709	0.80	Clay	Gravel	7.6	13.2

Chemtech Environmental Limited

SOILS

Lab number			47627-1	47627-2	47627-3	47627-4	47627-5	47627-6
Sample id			WS 45B	WS 57B	WS 58B	WS 64A	WS 66	WS 106C
Depth (m)			0.00-1.20	0.60	0.60	0.20-0.75	0.30-0.50	0.25
Date sampled			-	21/11/2012	21/11/2012	-	-	03/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	7.1	23	9.1	13	8.0	12
Boron (water soluble)	CE063 M	mg/kg B	1.1	1.6	3.3	<0.3	1.3	2.1
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	14	172	82	19	14	18
Lead (total)	CE054 M	mg/kg Pb	84	34	17	13	88	11
Mercury (total)	CE054	mg/kg Hg	0.7	<0.5	0.7	0.7	0.6	0.7
Nickel (total)	CE054 M	mg/kg Ni	21	40	19	19	24	32
Selenium (total)	CE054 M	mg/kg Se	<0.3	0.6	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	59	56	51	58	68	67
pH	CE004 M	units	8.2	8.0	8.4	8.7	8.1	8.3
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	4.6	12	13	<1	4.0	6.8
Sulphate (total)	CE062 M	mg/kg SO_4	690	956	942	289	642	590
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	-	-	<0.5	-	-
Organic matter content (OMC)	CE005 M	% w/w	2.16	7.40	3.42	0.23	2.37	0.84
PAH								
Naphthalene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Acenaphthylene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Acenaphthene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Fluorene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Phenanthrene	CE087	mg/kg	0.2	-	-	0.1	-	-
Anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Fluoranthene	CE087	mg/kg	0.2	-	-	0.1	-	-
Pyrene	CE087	mg/kg	0.1	-	-	0.1	-	-
Benzo(a)anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Chrysene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	-	-	0.1	-	-
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(a)pyrene	CE087	mg/kg	<0.1	-	-	0.1	-	-
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	-	-	<0.1	-	-
Benzo(ghi)perylene	CE087	mg/kg	<0.1	-	-	0.1	-	-
PAH (total)	CE087	mg/kg	<5	-	-	<5	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Benzene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Toluene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
Ethylbenzene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
m & p-Xylene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-1	47627-2	47627-3	47627-4	47627-5	47627-6
Sample id			WS 45B	WS 57B	WS 58B	WS 64A	WS 66	WS 106C
Depth (m)			0.00-1.20	0.60	0.60	0.20-0.75	0.30-0.50	0.25
Date sampled			-	21/11/2012	21/11/2012	-	-	03/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.1	-	-	<0.1	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.1	-	-	<0.1	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	0.1	-	-	<0.1	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	<0.01	-	-	<0.01	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	<1	-	-	<1	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	1	-	-	<1	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	15	-	-	5	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	-	-	<1	-	-
Subcontracted analysis								
Asbestos	$	-	Chrysotile	NAD	NAD	Amosite	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-7	47627-8	47627-9	47627-10	47627-11	47627-12
Sample id			WS 163	WS 163	WS 164	WS 164	WS 166	WS 181
Depth (m)			0.30	1.00	0.50	1.00	0.80	0.70
Date sampled			-	-	26/11/2012	26/11/2012	27/11/2012	03/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	18	7.6	16	5.2	4.0	11
Boron (water soluble)	CE063 M	mg/kg B	<0.3	1.0	0.3	0.9	1.7	3.7
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	29	24	27	19	23	13
Lead (total)	CE054 M	mg/kg Pb	21	11	14	12	12	13
Mercury (total)	CE054	mg/kg Hg	0.7	0.7	0.6	<0.5	<0.5	0.7
Nickel (total)	CE054 M	mg/kg Ni	20	23	17	10	17	32
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	68	66	49	57	106	47
pH	CE004 M	units	8.6	8.1	8.6	7.3	8.3	7.8
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	<1	<1	<1	1.8	1.4	4.8
Sulphate (total)	CE062 M	mg/kg SO_4	442	616	651	27700	832	60810
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	0.45	0.60	0.88	1.63	2.06	0.26
PAH								
Naphthalene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Acenaphthylene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Acenaphthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Fluorene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Phenanthrene	CE087	mg/kg	0.2	0.1	-	-	-	-
Anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Fluoranthene	CE087	mg/kg	0.2	<0.1	-	-	-	-
Pyrene	CE087	mg/kg	0.2	<0.1	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Chrysene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	<0.1	<0.1	-	-	-	-
PAH (total)	CE087	mg/kg	<5	<5	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Benzene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Toluene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-7	47627-8	47627-9	47627-10	47627-11	47627-12
Sample id			WS 163	WS 163	WS 164	WS 164	WS 166	WS 181
Depth (m)			0.30	1.00	0.50	1.00	0.80	0.70
Date sampled			-	-	26/11/2012	26/11/2012	27/11/2012	03/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	<0.1	<0.1	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	<0.1	<0.1	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	0.1	0.1	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	<0.01	<0.01	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	<1	<1	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	2	<1	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	<1	<1	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	Chrysotile	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-13	47627-14	47627-15	47627-16	47627-17	47627-18
Sample id			WS 701	WS 703	WS 703	WS 703	WS 705	WS 705
Depth (m)			1.00	0.50	1.40-1.60	3.80-4.00	0.90	1.80-2.00
Date sampled			11/12/2012	11/12/2012	16/01/2013	16/01/2013	11/12/2012	20/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	9.5	9.4	5.6	6.2	12	7.9
Boron (water soluble)	CE063 M	mg/kg B	0.7	<0.3	1.5	1.8	1.5	2.9
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	3.5	<0.3	<0.3
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	33	31	21	16	15	17
Lead (total)	CE054 M	mg/kg Pb	26	9.5	12	9.7	9.7	15
Mercury (total)	CE054	mg/kg Hg	0.7	0.7	0.8	0.6	0.6	<0.5
Nickel (total)	CE054 M	mg/kg Ni	16	15	16	30	33	26
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	69	44	35	339	56	75
pH	CE004 M	units	8.5	8.9	8.0	8.0	8.5	7.7
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	1.5	<1	4.0	5.7	1.8	3.4
Sulphate (total)	CE062 M	mg/kg SO_4	758	388	1739	1580	477	1802
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	-	-	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	2.17	0.44	4.59	3.06	0.54	6.12
PAH								
Naphthalene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthylene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthene	CE087	mg/kg	-	-	-	-	-	-
Fluorene	CE087	mg/kg	-	-	-	-	-	-
Phenanthrene	CE087	mg/kg	-	-	-	-	-	-
Anthracene	CE087	mg/kg	-	-	-	-	-	-
Fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Pyrene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	-	-	-	-	-	-
Chrysene	CE087	mg/kg	-	-	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	-	-	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	-	-	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	-	-	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	-	-	-	-	-	-
PAH (total)	CE087	mg/kg	-	-	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	-	-	-	-	-	-
Benzene	CE057 U	mg/kg	-	-	-	-	-	-
Toluene	CE057 U	mg/kg	-	-	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	-	-	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	-	-	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-13	47627-14	47627-15	47627-16	47627-17	47627-18
Sample id			WS 701	WS 703	WS 703	WS 703	WS 705	WS 705
Depth (m)			1.00	0.50	1.40-1.60	3.80-4.00	0.90	1.80-2.00
Date sampled			11/12/2012	11/12/2012	16/01/2013	16/01/2013	11/12/2012	20/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 [U]	mg/kg	-	-	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	NAD	NAD	NAD	NAD	NAD	NAD

Chemtech Environmental Limited

SOILS

Lab number			47627-19	47627-20	47627-21	47627-22	47627-23	47627-24
Sample id			WS 706	WS 706	WS 708	WS 708	WS 708	WS 709
Depth (m)			0.50	2.00	0.50	1.00	2.00-2.50	0.80
Date sampled			17/12/2012	07/01/2013	17/12/2012	17/12/2012	-	18/12/2012
Test	**Method**	**Units**						
Arsenic (total)	CE054 M	mg/kg As	14	11	12	11	12	61
Boron (water soluble)	CE063 M	mg/kg B	<0.3	3.4	0.4	1.3	1.5	0.6
Cadmium (total)	CE054 M	mg/kg Cd	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE054 M	mg/kg Cu	28	20	12	12	13	13
Lead (total)	CE054 M	mg/kg Pb	12	12	8.5	11	11	17
Mercury (total)	CE054	mg/kg Hg	0.6	0.7	0.9	0.6	<0.5	<0.5
Nickel (total)	CE054 M	mg/kg Ni	17	41	22	31	30	38
Selenium (total)	CE054 M	mg/kg Se	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zinc (total)	CE054 M	mg/kg Zn	17	41	22	31	30	66
pH	CE004 M	units	8.8	7.6	8.9	8.2	7.9	8.4
Chloride (2:1 water soluble)	CE049 U	mg/l Cl	1.1	2.2	<1	<1	2.0	<1
Sulphate (total)	CE062 M	mg/kg SO_4	290	12400	962	271	338	399
Sulphide	CE079	mg/kg S^{2-}	<10	<10	<10	<10	<10	<10
Cyanide (free)	CE077	mg/kg CN	<2	<2	<2	<2	<2	<2
Phenols (total)	CE078	mg/kg PhOH	-	-	-	-	-	-
Organic matter content (OMC)	CE005 M	% w/w	0.53	0.37	0.37	0.52	1.20	0.90
PAH								
Naphthalene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthylene	CE087	mg/kg	-	-	-	-	-	-
Acenaphthene	CE087	mg/kg	-	-	-	-	-	-
Fluorene	CE087	mg/kg	-	-	-	-	-	-
Phenanthrene	CE087	mg/kg	-	-	-	-	-	-
Anthracene	CE087	mg/kg	-	-	-	-	-	-
Fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Pyrene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)anthracene	CE087	mg/kg	-	-	-	-	-	-
Chrysene	CE087	mg/kg	-	-	-	-	-	-
Benzo(b)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(k)fluoranthene	CE087	mg/kg	-	-	-	-	-	-
Benzo(a)pyrene	CE087	mg/kg	-	-	-	-	-	-
Indeno(123cd)pyrene	CE087	mg/kg	-	-	-	-	-	-
Dibenz(ah)anthracene	CE087	mg/kg	-	-	-	-	-	-
Benzo(ghi)perylene	CE087	mg/kg	-	-	-	-	-	-
PAH (total)	CE087	mg/kg	-	-	-	-	-	-
BTEX & TPH								
MTBE	CE057 U	mg/kg	-	-	-	-	-	-
Benzene	CE057 U	mg/kg	-	-	-	-	-	-
Toluene	CE057 U	mg/kg	-	-	-	-	-	-
Ethylbenzene	CE057 U	mg/kg	-	-	-	-	-	-
m & p-Xylene	CE057 U	mg/kg	-	-	-	-	-	-

Chemtech Environmental Limited

SOILS

Lab number			47627-19	47627-20	47627-21	47627-22	47627-23	47627-24
Sample id			WS 706	WS 706	WS 708	WS 708	WS 708	WS 709
Depth (m)			0.50	2.00	0.50	1.00	2.00-2.50	0.80
Date sampled			17/12/2012	07/01/2013	17/12/2012	17/12/2012	-	18/12/2012
Test	**Method**	**Units**						
o-Xylene	CE057 U	mg/kg	-	-	-	-	-	-
TPH Aromatic EC5-EC7	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC7-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC16-EC21	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC21-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aromatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC5-EC6	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC6-EC8	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC8-EC10	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC10-EC12	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC12-EC16	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC16-EC35	CE068	mg/kg	-	-	-	-	-	-
TPH Aliphatic EC35-EC44	CE068	mg/kg	-	-	-	-	-	-
Subcontracted analysis								
Asbestos	$	-	Amosite	NAD	Amosite	NAD	NAD	NAD

Chemtech Environmental Limited

LEACHATES

Lab number			47627-1L	47627-4L	47627-7L	47627-8L	47627-14L	47627-15L
Sample id			WS 45B	WS 64A	WS 163	WS 163	WS 703	WS 703
Depth (m)			0.00-1.20	0.20-0.75	0.30	1.00	0.50	1.40-1.60
Test	**Method**	**Units**						
Arsenic (dissolved)	CE055	mg/l As	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Boron (dissolved)	CE063	mg/l B	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.002	0.002	0.002	0.004	0.002	0.004
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Hardness (by calculation)	CE055	mg/l $CaCO_3$	50	28	35	64	27	55
pH	CE004	units	8.1	8.0	8.3	8.4	8.7	8.1
Ammoniacal Nitrogen	CE012 U	mg/l N	0.02	0.06	0.07	0.04	0.08	0.01
Chloride	CE049 U	mg/l Cl	1.1	<1	<1	<1	<1	<1
Nitrate	CE049 U	mg/l NO_3	3.4	<1	<1	<1	<1	1.2
Sulphate	CE049 U	mg/l SO_4	<10	<10	<10	12	<10	<10
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	5.6	2.8	3.4	2.3	2.8	6.1

Chemtech Environmental Limited

LEACHATES

Lab number			47627-16L	47627-17L	47627-18L	47627-19L	47627-20L
Sample id			WS 703	WS 705	WS 705	WS 706	WS 706
Depth (m)			3.80-4.00	0.90	1.80-2.00	0.50	2.00
Test	**Method**	**Units**					
Arsenic (dissolved)	CE055	mg/l As	<0.001	<0.001	<0.001	0.001	<0.001
Boron (dissolved)	CE063	mg/l B	0.03	<0.03	0.03	<0.03	0.07
Cadmium (dissolved)	CE055 U	mg/l Cd	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (dissolved)	CE055 U	mg/l Cr	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (VI) (dissolved)	CE050	mg/l CrVI	<0.01	<0.01	<0.01	<0.01	<0.01
Copper (dissolved)	CE055 U	mg/l Cu	<0.004	0.007	<0.004	<0.004	<0.004
Lead (dissolved)	CE055 U	mg/l Pb	<0.009	<0.009	<0.009	<0.009	<0.009
Mercury (dissolved)	CE055	mg/l Hg	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel (dissolved)	CE055 U	mg/l Ni	<0.003	<0.003	<0.003	<0.003	<0.003
Selenium (dissolved)	CE055	mg/l Se	0.002	0.003	0.002	0.003	0.003
Zinc (dissolved)	CE055 U	mg/l Zn	<0.020	<0.020	<0.020	<0.020	<0.020
Hardness (by calculation)	CE055	mg/l $CaCO_3$	108	44	30	30	1651
pH	CE004	units	7.7	8.0	7.6	8.7	7.8
Ammoniacal Nitrogen	CE012 U	mg/l N	0.04	0.01	0.03	0.08	0.62
Chloride	CE049 U	mg/l Cl	<1	<1	1.0	<1	<1
Nitrate	CE049 U	mg/l NO_3	<1	<1	2.9	<1	1.4
Sulphate	CE049 U	mg/l SO_4	66	<10	<10	<10	1384
Cyanide (free)	CE077	mg/l CN	<0.02	<0.02	<0.02	<0.02	<0.02
Total Organic Carbon	CE071	mg/l C	2.4	2.7	10.2	3.9	5.1

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE054	Arsenic (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	M	0.3	mg/kg B
CE054	Cadmium (total)	Aqua regia digest, ICP-OES	Dry	M	0.2	mg/kg Cd
CE050	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE054	Copper (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Cu
CE054	Lead (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Pb
CE054	Mercury (total)	Aqua regia digest, ICP-OES	Dry		0.5	mg/kg Hg
CE054	Nickel (total)	Aqua regia digest, ICP-OES	Dry	M	1	mg/kg Ni
CE054	Selenium (total)	Aqua regia digest, ICP-OES	Dry	M	0.3	mg/kg Se
CE054	Zinc (total)	Aqua regia digest, ICP-OES	Dry	M	3	mg/kg Zn
CE055	Hardness (by calculation)	ICP-OES		1	mg/l $CaCO_3$	
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE049	Chloride (2:1 water soluble)	Aqueous extraction, IC-COND	Dry	U	1	mg/l Cl
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	M	100	mg/kg SO_4
CE079	Sulphide	Extraction, Continuous Flow Colorimetry	Wet		10	mg/kg S^{2-}
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	Wet		2	mg/kg CN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	Wet		0.5	mg/kg PhOH
CE005	Organic matter content (OMC)	Based on BS 1377, Colorimetry	Dry	M	0.01	% w/w
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.1	mg/kg
CE087	PAH (total)	Solvent extraction, GC-MS	Wet		5	mg/kg
CE057	BTEX & MTBE	Headspace GC-FID	Wet	U	0.01	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C5-C10)	Headspace GC-FID	Wet		0.01-0.1	mg/kg
CE068	TPH Aliphatic/Aromatic fractions (C10-C44)	Solvent extraction, GC-FID	Wet		1	mg/kg
$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

Chemtech Environmental Limited

METHOD DETAILS

METHOD	LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
CE055	Arsenic (dissolved)	ICP-OES		0.001	mg/l As
CE063	Boron (dissolved)	ICP-OES		0.03	mg/l B
CE055	Cadmium (dissolved)	ICP-OES	U	0.001	mg/l Cd
CE055	Chromium (dissolved)	ICP-OES	U	0.003	mg/l Cr
CE050	Chromium VI (dissolved)	Colorimetry		0.01	mg/l CrVI
CE055	Copper (dissolved)	ICP-OES	U	0.004	mg/l Cu
CE055	Lead (dissolved)	ICP-OES	U	0.009	mg/l Pb
CE055	Mercury (dissolved)	ICP-OES		0.001	mg/l Hg
CE055	Nickel (dissolved)	ICP-OES	U	0.003	mg/l Ni
CE055	Selenium (dissolved)	ICP-OES		0.001	mg/l Se
CE055	Zinc (dissolved)	ICP-OES	U	0.020	mg/l Zn
CE004	pH	Based on BS 1377, pH Meter		-	units
CE012	Ammoniacal Nitrogen	Colorimetry	U	0.01	mg/l N
CE049	Chloride	Ion Chromatography	U	1	mg/l Cl
CE049	Nitrate	Ion Chromatography	U	1	mg/l NO_3
CE049	Sulphate	Ion Chromatography	U	10	mg/l SO_4
CE077	Cyanide (free)	Distillation, Colorimetry		0.02	mg/l CN
CE071	Total Organic Carbon	TOC analyser		1	mg/l C

Certificate of Analysis

2139

Date: 06/06/2013

Certificate Number: 13-82108

Client:	Professional Soils Laboratory Ltd 5/7 Hexthorpe Road Hexthorpe DN4 0AR
Our Reference:	13-82108
Client Reference:	PSL13/1880
Contract Title:	EWR Testing
Description:	20 water samples
Date Received:	30 May 2013
Date Started:	31 May 2013
Date Completed:	06 June 2013
Test Procedures:	Identified by prefix DETSn, details available upon request.
Notes:	Observations and interpretations are outside the scope of UKAS accreditation
Approved By:	Rob Brown, Business Manager

Information in Support of the Analytical Results

Analysis

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425um sieve, in accordance with BS1377.
Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28oC +/-2oC.

Key

*	Denotes test not included in laboratory scope of accreditation
#	Denotes test that holds MCERTS accreditation, however, MCERTS accreditation is only implied if the report carries the MCERTS logo
$	Denotes tests completed by an approved subcontractor
I/S	Denotes insufficient sample to carry out test
U/S	Denotes that the sample is not suitable for testing

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
Soils - 1 month
Liquids - 2 weeks
Asbestos (test portion) - 6 months

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518665	518666	518667	518668	518669
			Sample ID	WS163	WS701	WS160	WS72	WS708
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	29/05/2013	29/05/2013	29/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Arsenic, Dissolved	ug/l	DETSC 2306	0.16	0.33	1.1	1.6	0.71	0.35
Total Cadmium	ug/l	DETSC 2306*	0.03	1.0	0.22	8.8	0.49	1.1
Chromium, Dissolved	ug/l	DETSC 2306	0.25	< 0.25	< 0.25	< 0.25	0.40	< 0.25
Copper, Dissolved	ug/l	DETSC 2306	0.4	< 0.40	2.4	1.2	2.5	3.6
Lead, Dissolved	ug/l	DETSC 2306	0.09	< 0.090	< 0.090	0.41	0.39	0.34
Mercury, Dissolved	ug/l	DETSC 2306	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nickel, Dissolved	ug/l	DETSC 2306	0.5	4.2	2.6	4.8	1.1	5.7
Selenium, Dissolved	ug/l	DETSC 2306	0.25	1.1	2.7	1.3	15	1.5
Vanadium, Dissolved	ug/l	DETSC 2306	0.6	< 0.60	1.3	< 0.60	< 0.60	< 0.60
Total Zinc	ug/l	DETSC 2306*	1.25	110	63	550	140	190
Alkalinity as CaCO3 (Automated)	mg/l	DETS 030	10	430	340	280	210	310
Chloride	mg/l	DETSC 2055	0.1	12	6.6	15	4.7	44
Boron Total	ug/l	DETSC 2306*	12	120	54	96	79	120
Cyanide total	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Cyanide free	ug/l	DETSC 2130	20	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
Cyanide complex	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Hardness	mg/l	DETSC 2303*	0.1	728	339	314	232	349
Hexavalent Chromium	ug/l	DETSC 2203	10	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	mg/l	DETSC 2207	0.015	0.029	< 0.015	0.037	0.031	0.067
Nitrate as N	mg/l	*	0.1	2.4	2.0	0.94	2.4	2.9
Sulphate as SO4	mg/l	DETSC 2076*	0.01	340	29	100	120	59
Total Organic Carbon	mg/l	DETSC 2033	2	39	18	180	14	26
pH		DETSC 2008		7.1	7.7	7.3	7.5	7.3
Aliphatic C5-C6	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C6-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	9.5	9.3	< 1.0
Aliphatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	32	< 1.0	< 1.0
Aliphatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	52	< 1.0	< 1.0
Aromatic C5-C7	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C7-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	3.9	< 1.0	< 1.0
Aromatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	23	6.1	3.2
Aromatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	48	110	120
Aliphatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	94	< 10	< 10
Aromatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	75	120	120
TPH Ali/Aro	ug/l	DETSC 3072*	10	< 10	< 10	170	130	120
Acenaphthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.01	0.05	< 0.01	< 0.01	< 0.01	0.01

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518665	518666	518667	518668	518669
			Sample ID	WS163	WS701	WS160	WS72	WS708
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	29/05/2013	29/05/2013	29/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Benzo(a)anthracene	ug/l	DETS 074*	0.01	0.04	< 0.01	< 0.01	< 0.01	0.02
Benzo(a)pyrene	ug/l	DETS 074*	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	0.01	0.09	< 0.01	< 0.01	< 0.01	0.08
Dibenzo(a,h)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	0.19	< 0.01	< 0.01	< 0.01	0.14
Fluorene	ug/l	DETS 074*	0.01	0.04	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.01	0.05	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	0.01	0.19	< 0.01	< 0.01	< 0.01	0.08
Pyrene	ug/l	DETS 074*	0.01	0.09	< 0.01	< 0.01	< 0.01	0.08
PAH	ug/l	DETS 074*	0.2	0.75	< 0.20	< 0.20	< 0.20	0.42
Benzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phenol - Monohydric	ug/l	DESTC 2130	100	< 100.0	< 100.0	< 100.0	< 100.0	< 100.0

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518670	518671	518672	518673	518674
			Sample ID	WS98	WS180	WS162	WS800	WS73A
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	29/05/2013	29/05/2013	29/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Arsenic, Dissolved	ug/l	DETSC 2306	0.16	1.6	0.43	0.38	1.9	1.7
Total Cadmium	ug/l	DETSC 2306*	0.03	3.2	1.6	1.4	2.5	0.26
Chromium, Dissolved	ug/l	DETSC 2306	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Copper, Dissolved	ug/l	DETSC 2306	0.4	5.7	4.7	5.5	2.0	1.0
Lead, Dissolved	ug/l	DETSC 2306	0.09	1.0	1.4	0.70	1.1	0.21
Mercury, Dissolved	ug/l	DETSC 2306	0.01	< 0.010	< 0.010	< 0.010	0.015	< 0.010
Nickel, Dissolved	ug/l	DETSC 2306	0.5	20	13	18	2.7	4.5
Selenium, Dissolved	ug/l	DETSC 2306	0.25	0.36	1.8	2.0	0.51	1.4
Vanadium, Dissolved	ug/l	DETSC 2306	0.6	< 0.60	< 0.60	< 0.60	< 0.60	< 0.60
Total Zinc	ug/l	DETSC 2306*	1.25	200	120	230	1500	92
Alkalinity as CaCO3 (Automated)	mg/l	DETS 030	10	320	640	380	300	280
Chloride	mg/l	DETSC 2055	0.1	36	340	130	10	6.6
Boron Total	ug/l	DETSC 2306*	12	460	3700	950	100	75
Cyanide total	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Cyanide free	ug/l	DETSC 2130	20	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
Cyanide complex	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Hardness	mg/l	DETSC 2303*	0.1	689	1440	1700	358	233
Hexavalent Chromium	ug/l	DETSC 2203	10	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	mg/l	DETSC 2207	0.015	0.57	1.2	0.26	8.1	2.6
Nitrate as N	mg/l	*	0.1	1.6	0.39	0.27	1.1	< 0.10
Sulphate as SO4	mg/l	DETSC 2076*	0.01	680	2500	2100	24	27
Total Organic Carbon	mg/l	DETSC 2033	2	38	22	44	280	20
pH		DETSC 2008		7.0	7.2	7.2	7.3	7.2
Aliphatic C5-C6	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C6-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	1.4	< 1.0
Aliphatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	180	< 1.0
Aromatic C5-C7	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C7-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C16-C21	ug/l	DETSC 3072*	1	5.5	2.2	1.9	24	10
Aromatic C21-C35	ug/l	DETSC 3072*	1	170	60	60	270	220
Aliphatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	< 10	180	< 10
Aromatic C5-C35	ug/l	DETSC 3072*	10	170	62	62	290	230
TPH Ali/Aro	ug/l	DETSC 3072*	10	170	62	62	480	230
Acenaphthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	0.02	0.01	< 0.01

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518670	518671	518672	518673	518674
			Sample ID	WS98	WS180	WS162	WS800	WS73A
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	29/05/2013	29/05/2013	29/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Benzo(a)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	0.02	0.03	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	0.09	0.08	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	0.13	0.10	0.04
Fluorene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	0.11	< 0.01
Pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	0.04	0.03	0.01
PAH	ug/l	DETS 074*	0.2	< 0.20	< 0.20	0.29	0.36	< 0.20
Benzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phenol - Monohydric	ug/l	DESTC 2130	100	< 100.0	< 100.0	< 100.0	< 100.0	< 100.0

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518675	518676	518677	518678	518679
			Sample ID	WS179	WS702	WS707	WS706	WS703
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	28/05/2013	28/05/2013	28/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Arsenic, Dissolved	ug/l	DETSC 2306	0.16	1.3	0.71	0.33	0.32	0.80
Total Cadmium	ug/l	DETSC 2306*	0.03	0.40	4.1	0.18	0.59	1.5
Chromium, Dissolved	ug/l	DETSC 2306	0.25	0.59	< 0.25	< 0.25	< 0.25	< 0.25
Copper, Dissolved	ug/l	DETSC 2306	0.4	9.2	2.4	2.7	1.6	0.90
Lead, Dissolved	ug/l	DETSC 2306	0.09	0.56	0.75	0.71	0.33	0.41
Mercury, Dissolved	ug/l	DETSC 2306	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nickel, Dissolved	ug/l	DETSC 2306	0.5	87	4.9	3.3	4.5	3.0
Selenium, Dissolved	ug/l	DETSC 2306	0.25	2.6	19	3.0	< 0.25	0.47
Vanadium, Dissolved	ug/l	DETSC 2306	0.6	< 0.60	1.4	< 0.60	< 0.60	< 0.60
Total Zinc	ug/l	DETSC 2306*	1.25	86	1700	41	95	150
Alkalinity as CaCO3 (Automated)	mg/l	DETS 030	10	500	350	350	360	360
Chloride	mg/l	DETSC 2055	0.1	110	14	34	36	67
Boron Total	ug/l	DETSC 2306*	12	1100	110	760	200	78
Cyanide total	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Cyanide free	ug/l	DETSC 2130	20	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
Cyanide complex	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Hardness	mg/l	DETSC 2303*	0.1	1370	286	756	805	354
Hexavalent Chromium	ug/l	DETSC 2203	10	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	mg/l	DETSC 2207	0.015	0.77	0.035	0.079	0.49	0.35
Nitrate as N	mg/l	*	0.1	0.29	2.6	0.75	0.54	< 0.10
Sulphate as SO4	mg/l	DETSC 2076*	0.01	1700	88	630	650	24
Total Organic Carbon	mg/l	DETSC 2033	2	52	71	11	25	49
pH		DETSC 2008		7.1	7.5	7.5	7.4	7.6
Aliphatic C5-C6	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C6-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	17	< 1.0
Aliphatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	18	< 1.0
Aliphatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C5-C7	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C7-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C21-C35	ug/l	DETSC 3072*	1	4.4	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	< 10	35	< 10
Aromatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	< 10	< 10	< 10
TPH Ali/Aro	ug/l	DETSC 3072*	10	< 10	< 10	< 10	35	< 10
Acenaphthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518675	518676	518677	518678	518679
			Sample ID	WS179	WS702	WS707	WS706	WS703
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	29/05/2013	29/05/2013	28/05/2013	28/05/2013	28/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Benzo(a)anthracene	ug/l	DETS 074*	0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	0.01	< 0.01	0.05	< 0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	0.03	0.02	< 0.01	< 0.01	< 0.01
Fluorene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	0.01	< 0.01	0.09	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	ug/l	DETS 074*	0.01	0.02	0.04	< 0.01	< 0.01	< 0.01
PAH	ug/l	DETS 074*	0.2	< 0.20	0.23	< 0.20	< 0.20	< 0.20
Benzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phenol - Monohydric	ug/l	DESTC 2130	100	< 100.0	< 100.0	< 100.0	< 100.0	< 100.0

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518680	518681	518682	518683	518684
			Sample ID	WS55	WS54	WS46	WS45a	WS44
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	28/05/2013	28/05/2013	28/05/2013	28/05/2013	28/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Arsenic, Dissolved	ug/l	DETSC 2306	0.16	0.96	3.6	0.79	0.39	0.25
Total Cadmium	ug/l	DETSC 2306*	0.03	1.4	0.94	0.92	0.73	0.88
Chromium, Dissolved	ug/l	DETSC 2306	0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Copper, Dissolved	ug/l	DETSC 2306	0.4	1.4	0.93	4.2	1.8	56
Lead, Dissolved	ug/l	DETSC 2306	0.09	0.45	0.33	0.44	0.42	0.29
Mercury, Dissolved	ug/l	DETSC 2306	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Nickel, Dissolved	ug/l	DETSC 2306	0.5	2.8	7.2	16	3.6	2.0
Selenium, Dissolved	ug/l	DETSC 2306	0.25	0.77	0.46	1.2	0.43	0.33
Vanadium, Dissolved	ug/l	DETSC 2306	0.6	< 0.60	< 0.60	< 0.60	< 0.60	< 0.60
Total Zinc	ug/l	DETSC 2306*	1.25	180	120	130	280	200
Alkalinity as CaCO3 (Automated)	mg/l	DETS 030	10	270	390	240	300	300
Chloride	mg/l	DETSC 2055	0.1	29	34	25	19	17
Boron Total	ug/l	DETSC 2306*	12	88	97	200	120	110
Cyanide total	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Cyanide free	ug/l	DETSC 2130	20	< 20.0	< 20.0	< 20.0	< 20.0	< 20.0
Cyanide complex	ug/l	DETSC 2130	40	< 40	< 40	< 40	< 40	< 40
Hardness	mg/l	DETSC 2303*	0.1	274	434	1180	380	599
Hexavalent Chromium	ug/l	DETSC 2203	10	< 10	< 10	< 10	< 10	< 10
Ammoniacal Nitrogen as N	mg/l	DETSC 2207	0.015	0.45	1.1	0.10	< 0.015	< 0.015
Nitrate as N	mg/l	*	0.1	< 0.10	< 0.10	< 0.10	0.72	0.15
Sulphate as SO4	mg/l	DETSC 2076*	0.01	30	64	1200	120	370
Total Organic Carbon	mg/l	DETSC 2033	2	37	19	30	16	27
pH		DETSC 2008		7.7	7.4	7.2	7.5	7.6
Aliphatic C5-C6	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C6-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aliphatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	15	< 1.0	13	18
Aliphatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	15	< 1.0	8.6	19
Aliphatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C5-C7	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C7-C8	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C8-C10	ug/l	DETSC 3322	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Aromatic C10-C12	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic C12-C16	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	6.1
Aromatic C16-C21	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	4.4
Aromatic C21-C35	ug/l	DETSC 3072*	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic C5-C35	ug/l	DETSC 3072*	10	< 10	30	< 10	21	38
Aromatic C5-C35	ug/l	DETSC 3072*	10	< 10	< 10	< 10	< 10	11
TPH Ali/Aro	ug/l	DETSC 3072*	10	< 10	30	< 10	21	48
Acenaphthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Summary of Chemical Analysis
Water Samples

Our Ref: 13-82108
Client Ref: PSL13/1880
Contract Title: EWR Testing

			Lab No.	518680	518681	518682	518683	518684
			Sample ID	WS55	WS54	WS46	WS45a	WS44
			Depth					
			Sample Ref					
			Sample Type					
			Sampling Date	28/05/2013	28/05/2013	28/05/2013	28/05/2013	28/05/2013
			Sampling Time					
Test	**Units**	**DETSxx**	**LOD**					
Benzo(a)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	ug/l	DETS 074*	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	ug/l	DETS 074*	0.01	0.04	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	ug/l	DETS 074*	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	ug/l	DETS 074*	0.01	0.03	< 0.01	< 0.01	< 0.01	< 0.01
PAH	ug/l	DETS 074*	0.2	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene	ug/l	DETSC 3322	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phenol - Monohydric	ug/l	DESTC 2130	100	< 100.0	< 100.0	< 100.0	< 100.0	< 100.0

Sample Comments

DETS cannot be held responsible for the integrity of sample(s) received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating.

Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note "Guidance on Deviating Samples".

All samples received are listed below. However, those samples that have additional comments in relation to hold time and/or inappropriate containers are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations.

If no sampled date (soils) or date/time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters), this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Lab No.	Sample ID	Date Sampled	Containers Received	Deviating due to holding time being exceeded for test(s)	Deviating due to inappropriate container for test(s)	Deviating due to headspace presence in container for test(s)
518665	WS163 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518666	WS701 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518667	WS160 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518668	WS72 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518669	WS708 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518670	WS98 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518671	WS180 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518672	WS162 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518673	WS800 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518674	WS73A WATER	29/05/2013	Glass Jar 500ml (500ml)			
518675	WS179 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518676	WS702 WATER	29/05/2013	Glass Jar 500ml (500ml)			
518677	WS707 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518678	WS706 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518679	WS703 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518680	WS55 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518681	WS54 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518682	WS46 WATER	28/05/2013	Glass Jar 500ml (500ml)			
518683	WS45a WATER	28/05/2013	Glass Jar 500ml (500ml)			
518684	WS44 WATER	28/05/2013	Glass Jar 500ml (500ml)			

Annex C

Human Health Quantitative Risk Assessment Methodology

1.1 GENERAL RATIONALE

ERM GAC have been developed in general accordance with the guidance published by the Environment Agency for undertaking the assessment of chronic risks to human health from land contamination collectively commonly referred to as the 'CLEA framework' as contained in the following documents:

- Updated technical background to the CLEA model (SR3), Environment Agency, January 2009;
- Human health toxicological assessment of contaminants in soil (SR2), Environment Agency, January 2009;
- Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values (SR7), November 2008; and
- CLEA software (version 1.06) and handbook (SR4 version 1.05), Environment Agency, September 2009.

During 2009, the Environment Agency published a number of Soil Guideline Values (SGVs) using the 'CLEA Framework'. The SGVs are an example of authoritative generic assessment criteria used in the preliminary evaluation of the risk to human health from long term exposure to chemicals in soil. However, only a limited number of SGVs have been published to date, (As, Cd, Hg, Ni, Se, benzene, toluene, ethylbenzene, phenol, Dioxins/Furans & Dioxin like PCB's).

Environment Agency document "*Using Soil Guideline Values*" published in March 2009 states that in the absence of an SGV the simplest option might be to derive a generic assessment criterion using (where appropriate) the generic models used to define SGVs, and based on appropriately sourced physical-chemical and toxicity data.

Due to the limited number of published SGVs, ERM has developed an expanded set of Generic Assessment Criteria (GACs) in accordance with the techniques and protocols set out in the CLEA Framework of publications detailed above. The intention is that these GACs are used in an equivalent way to SGVs in terms of being applicable to the majority of sites and a means of undertaking a generic assessment of chronic risks to human health and help refine any requirement for further DQRA.

The SGVs and ERMs GACs are considered to represent "cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health" (1). SGVs and GACs are not levels which indicate a significant possibility of **significant harm or levels which describe the boundary between categories 3 and 4, as detailed** within the statutory Guidance (1), neither are they indicators of levels of contamination above which detailed risk assessment would automatically be required under Part 2a. SGV's and GAC do however describe levels of contamination which are comfortably within category 4 of the statutory guidance.

The CLEA framework does not currently include specific guidance for assessing the potential risks to human health via the inhalation of groundwater-derived vapours. In the absence of UK specific guidance ERM has followed the spirit of the methodology to derive a set of GAC_{GW} for groundwater adopting where applicable the same standard land use assumptions detailed within SR3 and the fate and transport algorithms adopted within the software RISC V4.5.

The SGVs and GACs rely on predicting the concentration of vapours within the unsaturated zone using partitioning equations. However, due to the inherent uncertainty with estimating vapour partitioning there is growing international consensus that when assessing vapour inhalation risks from land contamination less reliance is placed on predicting contaminant partitioning and greater emphasis on directly measured soil vapour concentrations. Therefore, ERM has also produced Soil Vapour GACs (GAC_{SV}) with respect to assessing the vapour

(1) Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance, DEFRA, April 2012.

inhalation pathway. The GAC_{SV} have been based on the standard land use assumptions detailed within SR3 and modelling the migration of vapours through the unsaturated zone and subsequent flow inside buildings and into ambient air. The GAC_{SV} enable a tiered approach to assessing vapour inhalation to be adopted involving an initial assessment based on calculating partitioning from soil and groundwater phases, supplemented where appropriate by the assessment of directly measured soil vapour concentrations. This tiered approach to the assessment of vapour inhalation is consistent with the approach suggested within DEFRA way forward publication CLAN 6/06 and CIRIA C682 (The VOC Handbook).

1.2 *Conceptual Exposure Model*

Harmful effects from exposure to hazardous substances may occur as a result of either short-term exposure (acute effects) or long-term exposure (chronic effects). Generally for the vast majority of contaminants the long-term exposure to relatively low levels of the substance is of greatest concern since short-term effects generally occur at much higher concentrations. Any assessment based on the effects of long-term exposure is also likely to be overly protective with respect to the effects from short-term exposure. The assessment of risks to human health for the vast majority of the contaminants of concern is, therefore, based on the assessment of chronic exposure. However, free cyanide may elicit harmful effects from short-term exposure at relatively low concentrations. Therefore, GAC for free cyanide have been derived for both chronic and acute exposure.

The land use behaviour will significantly influence the exposure of end users to soil contaminants and should be reflected in any site specific assessment of those contaminants which represent a hazard as a result of chronic exposure. Influencing factors include: the age and gender of site users; the number of visits to the site; the duration of each visit; and the likely activities that could bring about contact with soil contamination. In the derivation of ERM's GACs three types of 'generic' land use have been included:

- Residential including Consumption of Home-grown Vegetables;
- Residential excluding the Consumption of Home-grown Vegetables; and
- Commercial/Industrial.

The generic land use conceptual exposure models presented within SR3 have been adopted in the derivation of the GAC. *Table 1* presents the exposure pathways included in the derivation of ERMs GAC for each land use.

Table 1 Exposure Pathways Included For Land Use

	Residential Land Use with Gardens	Residential Land Use without Gardens	Commercial Land Use
GAC_{Soil} - Exposure from Substances Present in Soils			
Ingestion of Soil and Dust	✓	✓	✓
Ingestion of Home grown Vegetables	✓	-	-
Ingestion of Soil Attached to Vegetables	✓	-	-
Inhalation of Fugitive Dust – Indoors	✓	✓	✓
Inhalation of Fugitive Dust – Outdoors	✓	✓	✓
Inhalation of Vapours – Indoors	✓	✓	✓
Inhalation of Vapours – Outdoors	✓	✓	✓
Dermal contact – Indoors	✓	✓	✓
Dermal contact – Outdoors	✓	✓	✓
GAC_{GW} - Exposure from Substances Present in Groundwaters			
Inhalation of Vapours – Indoors	✓	✓	✓
Inhalation of Vapours – Outdoors	✓	✓	✓
GAC_{SV} - Exposure from Substances Present in Soil Vapours			
Inhalation of Vapours – Indoors	✓	✓	✓
Inhalation of Vapours – Outdoors	✓	✓	✓

The generic human exposure assumptions and building parameters detailed within SR3 for each standard land use have been adopted in the derivation of the GAC.

1.3 CONTAMINANT SPECIFIC PROPERTIES

Toxicological Parameters

Health criteria values (HCV) used to benchmark exposure have been compiled from a review of the scientific and technical literature. Where several health criteria values have been identified, preference has been given to authoritative UK sources where available, as per SR2. In the absence of any appropriate authoritative UK sources, the selection of the most appropriate value has been made with consideration of the following hierarchy:

1. Authoritative UK Sources (e.g. Environment Agency TOX reports, UK Drinking Water Inspectorate, UK Air Quality Strategy);
2. European/International Authoritative Sources (e.g. WHO Drinking Water Guidelines (underlying toxicological data), WHO Air Quality Guidelines for Europe, International Programme on Chemical Safety (IPCS) Environmental Health Criteria Monographs (EHC), IPCS Concise International Chemical Assessment Documents (CICADs));
3. Other National Organisations (e.g. USEPA, RIVM)

In deriving HCVs for non threshold substances, preference was given to the use of an Index Dose (ID) where these were available. Where ID were not available slope factors have been used and amended by multiplying by an appropriate level of excess lifetime cancer risk. SR2 states that, when using human data, the ID is based on estimates of the daily dose corresponding to an excess lifetime cancer risk of 1 in 100,000. This has been used, where required for slope factors in the absence of an ID.

In the absence of appropriate dermal or inhalation HCVs, extrapolated oral values have been adopted as described within SR2. Where available, the dermal absorption fractions presented within SR3 have been adopted. In their absence the default approach adopted within the CLEA model, as outlined within SR3, has been adopted (0.1 for all organic chemicals and zero for inorganic chemicals).

Where required, inhalation HCVs have been converted from reference concentrations quoted in mg/m^{-3} unit risk factors by assuming a 70kg adult typically inhales $20m^3$ of air per day.

Where available, the mean daily intakes (MDI) have been sourced from UK diet studies and the Food Standard Agency. In the absence of any UK sources, the IPCS EHC and CICADs have been reviewed to help determine potential background exposure. In accordance with SR2, if no data or information on background information are available, background exposure is considered to be negligible and MDI set to zero for all age groups. If qualitative information is available suggesting background exposure may significantly contribute to overall exposure the pragmatic default outlined within SR2, that land should be allowed to contribute at least half the tolerable daily intake (TDI), has been applied.

Toxicological Equivalents

For non threshold PAHs the index dose has been calculated from published(1) estimated relative potencies to benzo(a)pyrene, and calculated from the ID for benzo(a)pyrene detailed within the DEFRA/EA toxicity report.

Polychlorinated Biphenyls (PCBs) have been assessed according to the Toxicity Equivalency Factor (TEF) approach(2) for dioxin-like PCBs (the PCBs considered to represent the greatest health risk). Each of the PCBs toxicity is related to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-

(1) Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. USEPA, July 1993

(2) Environment Agency 'Contaminants In Soil: Updated collation of toxicological data and intake values for humans. Dioxins, furans and dioxin-like PCBs'. SC050021/TOX 12. September 2009.

TCDD), which is considered to be the most carcinogenic dioxin, using a multiplication factor (the TEF). The concentration of each PCB is multiplied by its respective TEF giving a 2,3,7,8-TCDD toxic equivalent (TEQ). The total TEQ for the mixture is compared with the GAC for 2,3,7,8-TCDD.

The toxicity assumptions presented within the TPH Criteria Working Group have been adopted in the derivation of the GAC for aliphatic and aromatic TPH fractions. The TPH fractions are therefore protective of threshold human health effects and indicator compounds are used to assess non-threshold health effects (in line with Environment Agency publication on assessing petroleum hydrocarbons). An attenuation factor of 10 has been adopted for petroleum hydrocarbons in accordance with the recommendations contained within SR3.

Physico-chemical Parameters

Physico-chemical properties have been compiled from a review of the scientific and technical literature. Where available, the physico-chemical properties have been adopted from the Environment Agency Report SR7 (1). In their absence, parameters have been sourced from the references detailed within SR7, where available.

Many of the references present a range of values from numerous scientific studies, with the same studies being presented within each reference. Based upon the values presented within the studies and their own professional expertise, Mackay et al (2) provide recommended values for many parameters and have been adopted where available.

Where a range of values have been sourced, consideration has been given to the selection hierarchy detailed within SR7:

1. If all values the same, select this value;
2. Select Value from consistent range;
3. Central value from consistent range;
4. Newest value (if there is no consistent range or no single central value)

Where available, parameters have been sourced at 10^0C, which is the assumed annual average temperature of UK soils (SR3) and required for the CLEA model.

Where chemical data was unavailable in the literature, or adjustments needed for temperature (i.e. literature source not at 10^0C), property estimation methods and adjustment calculations detailed within SR7 have been used.

1.4 SOIL PROPERTIES

ERM GAC have been developed using a generic set of soil properties which are considered to represent a reasonable conservative scenario. SR3 states that although the sand soil type represents the most conservative choice for modelling diffusion and advection transport processes, it is not geographically widespread. Most common UK sandy soils are closer to a sandy loam and it is this default soil type that is used in the derivation of SGVs by the Environment Agency and has been adopted in the derivation of ERM GAC.

In deriving SGVs, the Environment Agency, have adopted a soil organic matter content of 6%. ERM do not consider this value to be sufficiently conservative for the production of GAC. Therefore, a SOM of 1% (or TOC 0.58%) has been adopted in the derivation of ERM GAC.

(1) Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values (SR7). Environment Agency, November 2008.
(2) Handbook of Physical-Chemical Properties and Environmental fate for Organic Chemicals. 2nd edition. Mackay et al, 2006.

1.5 *MODELLING APPROACH*

In deriving human health GAC for soils, ERM have adopted the CLEA software version 1.06, which implements the modelling approach detailed within SR3 and is used by the Environment Agency to derive Soil Guideline Values.

The ERM soil vapour GAC (GAC_{SV}) have been back calculated from the indoor and outdoor vapour inhalation soil criteria derived using the CLEA software using the soil to soil vapour partioning approach detailed within Section 5 of SR3. The results have been directly compared to the soil gas media concentration provided within the CLEA outputs when running the model for vapour inhalation pathways only, to ensure parity.

The ERM GAC for groundwater derived vapours (GAC_{GW}) have been calculated using the groundwater vapour transport algorithms developed by the ASTM (E1739), used by RISC V4.05 and outlined within Appendix E of the RISC user manual. Where applicable the standard CLEA receptor, soil and building properties have been utilised.

For acute exposure to free cyanide the conceptual exposure model assumes a one off ingestion of 2000mg of soil by a 1 to 2 year old female child using the algorithms presented by Beck et al 2006 (1) and SNIFFER 2000 (2) .

1.6 *ESTIMATING COMBINED EXPOSURE FROM ALL RELEVANT PATHWAYS*

For some chemicals, intake and/or uptake via different routes (via the nose, mouth, or through the skin) may lead to different local effects or may affect different organs. People using a contaminated site may be exposed to the same chemical via all three routes of exposure. If the contaminant exhibits systemic toxicity (i.e. reaches the main blood circulation system unchanged following absorption), each route of exposure may contribute to an aggregate total systemic load that results in adverse systemic effects. The ERM GAC takes this possible effect into account by automatically adopting the methodology used by the CLEA software and the Environment Agency, and combining the reciprocal from each relevant exposure pathway. This helps ensure that the assessment criteria is set at a concentration where the total risk via all relevant routes of entry into the body is mathematically no greater than the risk due to exposure by any single route of entry. The only exception is where an Environment Agency Soil Guideline Value (SGV) report identifies that a single exposure route is more appropriate for an individual contaminant, in such cases the same exposure routes used by the Environment Agency in deriving the SGV have been adopted by ERM in deriving the GAC for the same contaminant.

Environment Agency report SR4, states that an important assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved, and vapour phases. The theoretical upper boundaries to this behaviour are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. Environment Agency report SR3 presents equations for using these chemical properties to estimate the saturated soil concentrations where these limits are reached. These boundaries are important when considering vapour phase transport of chemicals into ambient and indoor air.

The CLEA software uses a traffic-light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous or vapour based saturation limit.

In instances where the combined assessment criteria of all relevant pathways outputted from the CLEA software is highlighted green or amber and the vapour pathway is not an important contributor, these have been adopted as ERM GAC.

(1) Human Health Risk Assessment of Cyanide in Water and Soil. Beck et al. *Published in Cyanide in water and Soil, Chemistry Risk and Management, Dzombak et al 2006.*
(2) Framework for Deriving Numeric Targets to Minimise the Adverse Human Health Effects of Long-term Exposure to Contaminants in Soil. SR99(02)F. SNIFFER April 2000.

Where the combined assessment criteria exceeds the theoretical saturation limits (aqueous or vapour based) and the vapour pathway is an important contributor to exposure, the methodology detailed within the CLEA Software Handbook for such circumstances has been adopted:

1. Determining the relevant inhalation ADE/HCV ratio at the lower saturation limit;
2. Estimate relevant contribution required from other pathways by subtracting this value by 1 (since the contribution from the vapour pathway is capped at the saturation limit);
3. Determine the soil concentration at which the relevant combined HCV/ADE ratio is equal to the value calculated in (2) without the vapour inhalation pathways.

1.7 Assessing Mixtures

Knowledge about the toxicology of a chemical comes, in the main, from studies involving the exposure of relatively large doses to a single substance. In contrast, an individual may be exposed to many different chemicals every day, including priority soil contaminants. The possibility exists, therefore, that the mixture of chemicals to which any one individual may be exposed may have a greater cumulative effect on health than that predicted by toxicological risk assessment of individual chemicals. Environment Agency report SR2 states that 'where there is evidence for chemical interaction, this should be taken into account: when such evidence is not available, each chemical should be assumed to be acting independently. SR2 goes on to identify that interactions between chemicals are however unlikely at exposures below the HCVs.

Environment Agency Guidance does however identify two groups of similar substances where additive affects should be considered:

1.7.1 Dioxins Furans & Dioxin Like PCBs

The assessment of Dioxin like PCB's assumes the effect from exposure to any individual dioxin like PCB will potentially be additive to exposure to other dioxin like PCB's (as well as similarly acting dioxins/furans) and therefore when assessing risks to human health the 12 congeners should be considered as a mixture rather than isolated substances (1) . The assessment of the PCB mixture is undertaken by calculating the Hazard Quotient (HQ) for each individual congener (ratio of soil concentration and congener specific GAC) and summing the individual HQ to derive a Hazard Index (HI) for the mixture. Where the HI for the mixture is greater than 1 a potentially significant risk may arise and further investigation and or assessment is likely to be required.

1.7.2 Petroleum Hydrocarbons

When assessing the significance of petroleum hydrocarbon mixtures the assessment should consider both indicator compounds and petroleum fractions. Environment Agency report P5-080/TR3 (2) identifies 16 Petroleum Hydrocarbon fractions for use in UK human health risk assessments based on equivalent carbon numbers corresponding to the 13 fractions proposed by the TPHCWG (3) up to EC35 but with the addition of 3 further heavier hydrocarbon fractions (pending further review/evaluation). When assessing petroleum hydrocarbon fractions P5-080/TR3 also identifies the potential for additivity across fractions and that a Hazard Index approach should be adopted for fractions exhibiting similar toxicological properties and that further guidance would be published on this issue. The TPHCWG identified 6 toxicological fractions between C5 - C35 and pending the release of the further guidance ERM

(1) Environment Agency, October 2009. Soil Guideline values for dioxins, furans and dioxin like PCBs in soil. Science Report SC050021/Dioxins SGV.
(2) Environment Agency, February 2005. The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils. Science Report P5-080/TR3.
(3) Total Petroleum Hydrocarbon Criteria Working Group Series Volumes 1 to 5.

approach to Petroleum Hydrocarbon mixtures will be to treat the 13 TPH fractions as essentially 6 Petroleum Hydrocarbon mixtures based on the 6 toxicological fractions.

The assessment of each Petroleum Hydrocarbon mixture is undertaken by calculating the Hazard Quotient (HQ) for each individual fraction (ratio of soil concentration and fraction specific GAC) and summing the relevant individual HQ within each mixture to derive a Hazard Index (HI) for each mixture. Where the HI for the mixture is greater than 1 a potentially significant risk may arise and further investigation and or assessment is likely to be required.

1.8 UNCERTAINTY

As with any form of modelling of the interaction between humans and the wider environment, there is a substantial amount of uncertainty involved. This relates both to the way in which the interaction is modelled (the pathway algorithms) and the input parameters defining the substances, the pathways and the receptors. The CLEA model is deterministic, meaning that in any calculation a single value is assigned to each variable. Many of these values are assigned on the basis of average or conservative (the most health protective) measurements and by expert judgement.

Historically, in dealing with parameter uncertainty and variability in a deterministic model, it has been good practice to select values representative of a worst case exposure scenario. This has the assumed comfort of being more protective against an unforeseen situation or risks to sensitive individuals. However, the problem with this approach can be that such choices, however defensible individually, tend to be implausible collectively.

Over the recent years there has been an increasing desire on the part of authoritative bodies to move away from modelling a worst case individual to more realistic or reasonable exposure scenarios. This is the approach adopted by the CLEA model and takes into account not only the degree of conservatism from individual choices, but also the collective effect of these choices.

It should be noted that ERM's GACs are not a static set of values, but are reviewed on a regular basis and reissued as more guidance is made available by the Environment Agency, or when improved knowledge of toxicity is published.