woodford CONSULT

Yorkshire Office
Marian House, 3 Colton [illegible]
Bullerthorpe Lane, Leeds [illegible]

Tel: 0113 397 5802
Fax: 0113 397 5801

www.woodfordgroup.com

DOCUMENT ISSUE RECORD

Engineering Documents

Document Title: **Completion Report**

Project Reference: **896: Wombwell, Wombwell Mills**

Purpose of Issue: **Information to Client**

Originator / Author	Reviewer	Approver
Steven Taylor	Robert Lingard	Tim Smith
BSc., MSc.	BSc., EurChem., CChem., MRSC., SiLC.	MA., MSc., FGS., CGeol.
[redacted]		
30/5/07	31/5/07	30/5/2007

Total number of pages

Text 23 Drawings 10 Appendices 7

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CERTIFICATE OF COMPLETION

Former Perfecta Beds Site, Barnsley Road, Wombwell ("the Site")

In accordance with clause 5 of the Schedule of Services ("the Schedule of Services") to an appointment made between Woodford Consulting Engineers Limited ("Consult") and Woodford Land Limited dated 20 January 2006 ("the Appointment"), Consult certifies that:

1 The Remediation Works are practically complete;

2 The Remediation Works and any other reclamation works which are required pursuant to the Remediation Contract have been carried out in accordance with the requirements and recommendations of Consult and any Relevant Authorities and in accordance with any other statutory requirements prevailing at the time in relation to ground conditions and their suitability for residential development; and

3 Provided that the Developer complies strictly with the Post Remediation Constraints specified in the Completion Report ("the Post Remediation Constraints") the Site is suitable for residential development in accordance with the Planning Consent so far as this relates to the Remediation Works specified in the Remediation Statement prepared by Consult;

with all defined terms having the meanings ascribed to them in the Appointment.

This Certificate does not in any way increase Consult's duties beyond those agreed under the Appointment.

The Certificate is for the sole benefit of Elite Homes Limited ("the Developer") and applies to the condition of the Property at the date hereof. For the avoidance of doubt Consult shall not be liable to the Developer (or its assignees) for any Harm at the Site which is directly or indirectly caused following the date of this Certificate by the Developer and/or its assignees and/or its/their sub-contractors, employees and invitees failing to comply with the Post Remediation Constraints. The Developer shall be entitled to assign without Consult's prior written consent to the first person acquiring the interest of the Developer in the Development or any part of it or any subordinate interest all of its rights under this Certificate and in this certificate references to the Developer shall where the context so admits include its assignees. Notice of any such assignment shall be given

to Consult as soon as reasonably practicable and no rights will be transferred until such notification occurs.

D W Rix Esq, BSc, MSc, CEng, MICE, MCIArb
For and on behalf of Woodford Consulting Engineers Limited

24 May 2007

woodford
ENVIRONMENTAL

Head Office/North West Office
Gordon House, Sceptre Way,
Bamber Bridge, Preston PR5 6AW

Tel: 01772 318 552
Fax: 01772 318 744

www.woodfordgroup.com

To Whom it May Concern

Re: 896 ~ former Perfecta Beds Site ~ Wombwell (S73 8EA)

It is confirmed for and on behalf of Woodford Environmental Limited (Environmental) that the works described in this Completion Report were undertaken by Environmental or by sub-contractor's on behalf of Environmental and under Environmental's direct supervision.

It is also confirmed that Environmental have read the Completion Report and that this is a true record of the works which have been carried out at the Site in accordance with the Remediation Contract made between Woodford Land and Woodford Environmental Ltd.

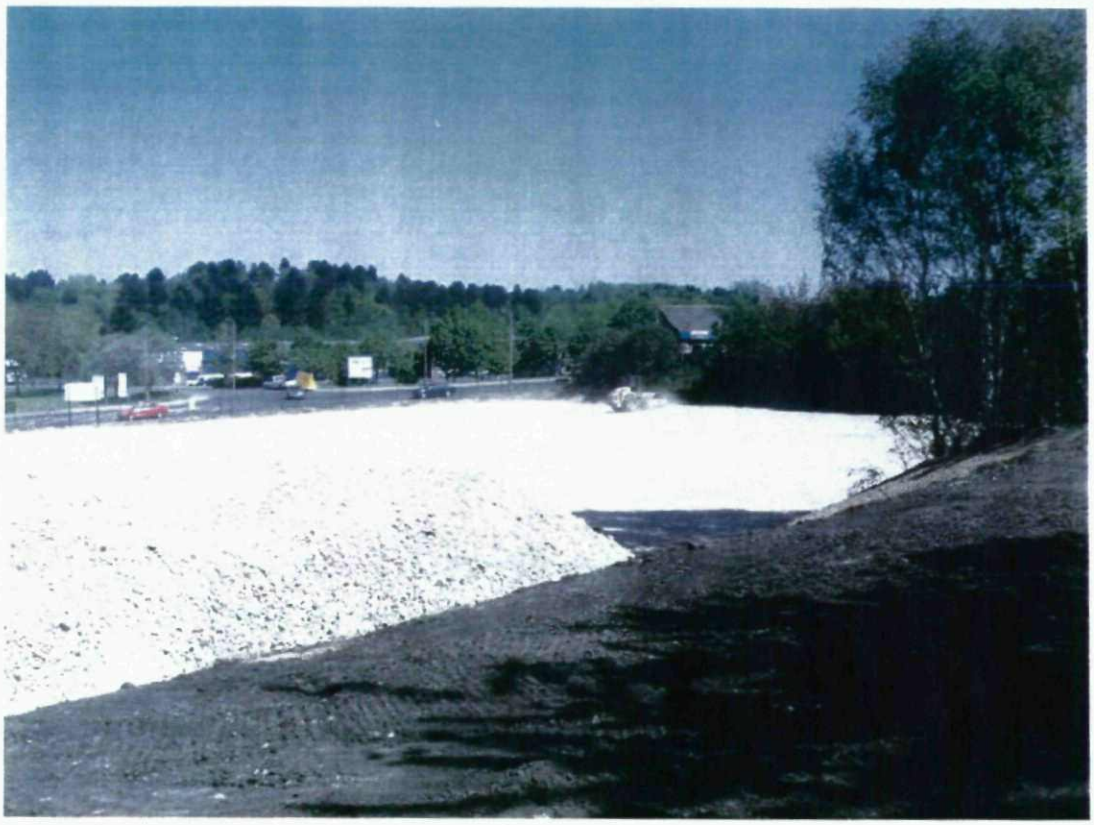
Signed..

John Bamforth

Regional Director

Dated..... May 2007

WOMBWELL
WOMBWELL MILLS



COMPLETION REPORT

MAY 2007

WOODFORD CONSULTING ENGINEERS LIMITED
Marian House
3 Colton Mill
Bullerthorpe Lane
Leeds
LS15 9JN

896/04

WOMBWELL MILLS
WOMBWELL

COMPLETION REPORT

MAY 2007

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1. INTRODUCTION

This completion report covers the geotechnical and environmental aspects of the project to remediate the site at the former Wombwell Mills, Wombwell (W896/01) for a residential end use.

The report should be read in accordance with the disclaimer appended to the Quality Assurance sheet at the start of this report. This report on land potentially affected by contamination has been carried out by or under the direction of a suitably qualified competent person as defined in PPS23.

The four stages of a site remediation project are:

- Study (investigations, risk assessments and consultations)
- Remediation Statement
- Execution (site works)
- Completion and Verification

This document follows the successful completion of the remediation works by Woodford Environmental Limited. It is for the benefit of Woodford Land, Barnsley Metropolitan District Borough Council, the Environment Agency and NHBC.

It incorporates details and verification of the remediation works undertaken at the property to render the ground conditions at the site suitable for residential development in accordance with an outline planning consent, reference 2006/1172.

Section 2 of this report provides information about the site's environmental setting. Section 3 briefly summarises the Previous Investigations. Section 4 summarises the pre-remediation objectives. Section 5 provides a summary of the remediation strategy and Section 6 describes the work undertaken to achieve the objectives set out in the remediation strategy. Section 7 describes the testing undertaken by Consult to verify that the works had been completed satisfactorily. Section 8 describes the post remediation conceptual site model. Section 9 provides a summary of the post-remediation development constraints including any additional works required by the developer to fulfil Planning Conditions (e.g. placement of subsoil and topsoil).

All remediation work was undertaken in accordance with the Construction (Design Management) Regulations (CDM) 1994 (as amended). The Woodford Group Health and Safety Manager was the Planning Supervisor and Woodford Environmental Limited was the Principal Contractor. The Health and Safety Executive was informed of the works in accordance with the legal framework. The Health & Safety File will be produced in due course.

Where referenced, the earthworks specification is the current Specification for Highway Works, Series 600, Earthworks.

The information contained in this report is protected by disclosure under Part

3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of Woodford Consulting Engineers Limited.

2. SITE SETTING AND SUMMARY OF PREVIOUS SITE INVESTIGATIONS

2.1. Site Location and Description

The site is located on Barnsley Road, Wombwell at Ordnance Survey Grid Reference 438890, 404160 (Drawing W896-01). The site is approximately 5 acres (2.02 hectares) in size and is approximately rectangular in shape.

The site formerly comprised a large factory building that covered the majority of the site. A site plan is presented in Drawing No W896-02, which shows the on site features before the remediation works.

2.2. Site Setting

The site is located approximately four miles south-east of Barnsley Town Centre at national grid reference 438890, 404160.

The site is bound by residential areas to the south-west and south-east. Playing fields are located beyond the southern boundary. Aldham House Lane runs adjacent to the western boundary with both residential and industrial units beyond. Barnsley Road (A633) is located adjacent to the north-east boundary with industrial units beyond (Aldham Industrial Estate).

2.3. Previous Investigation Works

A desk study was undertaken by Consult for Woodford Land Ltd. in November 2005 and can be found on a CD attached to this report as *Final Desk Study Report, Wombwell, Wombwell Mills November 2005.*

Consult also completed and issued a site investigation report to Woodford Land Ltd in October 2006 as *Site Investigation Report, Wombwell, Wombwell Mills October 2006.* These have been included on the CD attached as Appendix A.

To Consult's knowledge, no other investigations have been undertaken on this site.

2.4. Site History

The available historical maps show the site has been developed as a warehouse / factory since the late 1960's. It is understood that the only use of the factory was to assemble and distribute beds. Prior to development as a factory the site is shown to be undeveloped.

2.5. Ground Conditions

The British Geological Survey shows that no drift geology is present on the site. The solid geology comprises Oaks Rock of the Middle Coal Measures, which is described as sandstone of significant thickness.

2.6. Hydrogeology

The Environment Agency's Groundwater Vulnerability Map (Sheet 11, South Pennines), shows the underlying Middle Coal Measures to be classified as a minor aquifer. Minor aquifers do not produce large quantities of water for abstraction, but are important for local supplies and in supplying base flow to rivers.

The soils in the area are given a high leaching potential classification. This is based on a worst case scenario due to fewer observations being undertaken in urban environments.

The site has not been found to be within a Groundwater Source Protection Zone, although, there is one licensed groundwater abstraction within 1km (approx 900m) of the site.

The site is located at the base of the east west running valley of the River Dove, which is approximately 140m to the north of the site. It is anticipated, given the surrounding topography, that groundwater is likely to flow in a north or north-west direction towards the River Dove.

2.7. Waste

There are no registered operational landfill sites within 1km of the site boundary. Three previously licensed sites are located to the north-west of the site with the closest 520m from the site. There are no British Geological Society (BGS) recorded landfills present within 1km of the site. The Environment Agency did not hold any more records of landfills in the area.

There are no registered waste transfer sites or waste treatment/disposal sites within 1km of the site.

2.8. Proximity to Surface Waters

The closest watercourse is the River Dove located 140m to the north of the site. Historically the Dearne and Dove Canal was located approximately 50m north of the site but this has since become disused and infilled.

The site is considered by the Environment Agency to not be within a natural indicative fluvial floodplain from the River Dove.

3. SUMMARY OF SITE INVESTIGATIONS, RISK ASSESSMENT AND CONCEPTUAL MODEL

A summary of the site investigations, risk assessment and conceptual model can be found in the site investigation report No. 896/02 which is included on CD in Appendix A. No further investigations or risk assessment were carried out as part of the remediation works.

The generic screening criteria used in the report were utilised to assess the suitability of site won materials for re-use within the works and these are tabulated below.

ANALYTE	SCREENING VALUE (mg/kg)	ANALYTE	SCREENING VALUE (mg/kg)
Arsenic	20*	Toluene	3*
Cadmium (pH 6)	1*	Ethylbenzene	9*
Cadmium (pH 7)	2*	o Xylene	42.22⊕
Cadmium (pH 8)	8*	Aliphatics C_5-C_6	24.78⊕
Chromium	130*	Aliphatics >C_6-C_8	50.05⊕
Copper pH 5.0-5.5	80§	Aliphatics >C_8-C_{10}	9.82⊕
Copper pH 5.5-6.0	100§	Aliphatics >C_{10}-C_{12}	50.23⊕
Copper pH 6.0-7.0	135§	Aliphatics >C_{12}-C_{16}	209.21⊕
Copper pH >7	200§	Aliphatics >C_{16}-C_{21}	36,425⊕▲
Lead	2.65 (log450)	Aliphatic >C_{21}-C_{35}	36,425⊕▲
Mercury	8*	Aromatics C_6-C_7	0.17⊕
Nickel	50*	Aromatics >C_7-C_8	3 (SGV Toluene)
Zinc <pH7	200§	Aromatics >C_8-C_{10}	9.46⊕
Zinc >pH7	300§	Aromatics >C_{10}-C_{12}	24.55⊕
Phenol	78*	Aromatics >C_{12}-C_{16}	55.59⊕
Naphthalene	17.18⊕	Aromatics >C_{16}-C_{21}	122.34⊕▲
Benzo(a)pyrene	1.14⊕▲	Aromatics >C_{21}-C_{35}	373.83⊕▲
Benzene	0.16⊕		

* CLEA SGV for Residential With Plant Uptake End Use, where appropriate 1%SOM, Sand Soil.

§ The SNIFFER model is not designed for use with phytotoxic or acutely human toxic substances. CLR 8 Table 2.1 illustrates that the phytotoxic risk is greater than that for human health for copper and zinc. Screening concentrations for phytotoxic risks used (See Section 8.8) MAFF "Code of good agricultural practice for the protection of soil" October 1998).

⊕ SNIFFER framework Site Specific Assessment Criterion. Residential with plant uptake exposure route assuming 1% SOM and sandy soil.

▲ Where dermal pathway active, dermal exposure has been calculated in accordance with CLR10 and CLEA briefing Note 1. Resultant Dermal pathway and SNIFFER SSAC integrated to achieve SUV in accordance with CLEA briefing Note 4.

4. REMEDIATION OBJECTIVES

The aim of the remediation is to ensure that the site can be developed in a way that is fit for its proposed residential end use and to facilitate this by undertaking enabling works that add value. The following objectives were identified to meet this aim:-

- Remove all impediments to the proposed development, except those agreed to be dealt with by the developer;
- Confirm the conceptual site model assumed in the Risk Assessment; and
- Create a landform suitable for proposed development.

5. SUMMARY OF REMEDIATION STATEMENT

5.1. Scope of Works to be undertaken by Woodford Environmental

The following is an outline of the works that were to be undertaken by Woodford Environmental :

- General site clearance including surface vegetation, and the installation of measures to protect trees covered by TPOs;
- The disconnection of any redundant services on site, and the protection of any services to be retained;
- Demolition and removal of superstructure;
- The breakout and crushing of all surface concrete including and former building foundations;
- Removal of any impediments to the proposed development; and,
- Provide a landform for proposed development.

It was noted that the existing substation required protection throughout the works until an alternative substation is provided by the developer.

5.2. Constraints to the final development

The developer of the site will need to take account of the following constraints to the proposed development (full details are provided in Section 9) -:

- Clean imported soils will be required for the cover layer in gardens and landscape areas and as backfill to service trenches;
- Chemical validation will be required for clean imported soils; and
- Design and installation of appropriate foundations.

5.3. Further Investigations

No further investigations of ground, groundwater or ground gas conditions were required by the remediation statement. The remediation statement did, however, require investigation of the position and status of a public sewer and electricity supply to the existing substation.

5.4. Protection of Controlled Waters

Groundwater samples tested during the site investigation indicated that contamination present within the boreholes is minimal. Because of this the groundwater on site is considered to not pose a significant risk to controlled waters either underlying or close to the site and no particular remediation is required.

5.5. Validation Testing

Previous site investigations have been reasonably extensive given the context of the historic development of the site. Furthermore the risk assessment undertaken as part of the Phase II investigation has shown that the in situ soils would require a cover layer to be employed in garden and landscaped areas to break potential pollutant pathways that could affect end users and therefore additional chemical analysis to validate the conceptual model was not considered necessary.

However, visual and olfactory inspection of the excavated materials was to be undertaken during the works. If any ground is suspected to contain levels hydrocarbons or volatile contaminants significantly beyond those previously encountered at the site, additional samples would be taken for analysis. The local authority would be informed if the results showed that the conceptual model required revision.

It was proposed that plate loading tests were undertaken on the proposed road footprints to demonstrate that material is compacted to achieve an equivalent CBR of 3.0%. In addition inspections and records were to be undertaken to demonstrate compaction has been carried out in accordance with the relevant method specification from Series 600 of the Specification of Highway Works (SHW).

As built surveys are to be provided that show areas where impediments to proposed development have been removed, depths to natural ground, where encountered, and the finished levels post remediation works.

The Developer will be required to undertake further chemical validation for any soils brought onto the site to be used as subsoil or topsoil or backfill to service trenches. These materials will need to comply with the acceptance criteria set out in Section 5.6.

5.6. Acceptance Criteria

Validation testing analysis will endeavour to show that the material brought onto site is considered safe to use in garden areas. The testing suite undertaken on every sample will reflect a broad range of contaminants of concern as stated in Table 1. All samples are to contain concentrations less than the stated acceptance guideline in the table.

Table 1: Imported Material Acceptance Guidelines

ANALYTE	Soil	Acceptance Guideline
Asbestos Presence	✓	None detected
Total Ammonia (ionized plus unionized)		0.5mg/l
Arsenic	✓	20mg/kg
Cadmium	✓	1mg/kg
Chromium	✓	130mg/kg
Copper	✓	200mg/kg[1]
Cyanide (Total)	✓	None detected
Lead	✓	450mg/kg
Mercury	✓	8mg/kg
Nickel	✓	50mg/kg
Selenium	✓	35mg/kg
pH	✓	6-8
Phenol	✓	78 mg/kg
PAH (USEPA 16)	✓	0.7 mg/kg BaP 7mg/kg naphthalene Total PAH <10mg/kg
Zinc	✓	300mg/kg[1]
Gasoline Range Organics (inc BTEX & MTBE)	✓	None Detected
Diesel Range Organics	✓	100mg/kg
PCBs (7 congeners)	✓	None Detected

Notes:
[1] Zinc and copper acceptance criteria assume soil pH>7. More stringent acceptance criteria may apply to soil with pH<7.

5.7. Controlled Water Testing

The remediation statement did not require any monitoring of controlled waters as part of the remediation.

5.8. Other Monitoring

No specific monitoring of gas, dust, air quality etc was required by the remediation statement.

5.9. Landform

An indication of the proposed levels following works by Woodford Environmental is shown on Drawing W896/06B. It is noted in the remediation statement that proposed contours/levels may need to be varied given actual ground conditions found during site works.

6. REMEDIAL WORKS UNDERTAKEN

6.1. General

The remediation works that were undertaken by Woodford commenced in February 2007 and were completed in May 2007. The works were undertaken in general accordance with the proposals set out in the remediation statement prepared by Woodford Consult (*reference* 896/03).

The extent of excavation works was extended beyond that required by the remediation statement, as part of the contractors method of working, so that all made ground within the former factory area was excavated, inspected, unsuitable materials removed and re-compacted. This provided the opportunity for a more extensive inspection of the in situ soils and identified one unexpected area of impacted soils (see section 6.8.1).

No waste management licensing exemptions were required. Relevant correspondence with the Environment Agency regarding waste management is provided in Appendix B.

6.2. Site Management

Woodford Environmental was employed by Woodford Land to act as Principal Contractor and to manage the remedial works on a full time basis.

6.3. Site Security

The existing site fencing was replaced with chain link fencing as part of the works undertaken by Woodford Environmental. Personnel were present on a 24 hour a day basis during the works and therefore no additional security was provided.

6.4. Disconnection / Retention of Existing Services

Service disconnections were undertaken as shown illustratively on drawing W896/10/A. The water supply from Barnsley Road was retained and the water supply from Aldham House Lane was disconnected. The substation, connections to it, and the public sewer that passes through the site were retained at completion of the works.

6.5. Retention of Preserved Trees

The trees protected by tree preservation orders, shown indicatively on drawing W896/09, were retained during and at completion of the works.

6.6. Demolition Works

An asbestos strip of the buildings was undertaken prior to any demolition works. Details of the location of Asbestos Containing Materials (ACM) are provided in Appendix C.

Concrete forming the super-structure of the building, the building's floor slab and the surrounding reinforced concrete hardstanding was processed through a crusher to the grading of Class 6F2 as defined by the SHW.

Materials from the crusher were held in stockpiles of approximately 500 m^3 whilst physical and chemical validation of the material was undertaken. Steel from the superstructure and that recovered from the crushing process was removed from site for resale.

The Environment Agency was consulted regarding waste licensing exemptions before using any crushed material in the works. The Environment Agency advised that processing of the crushed material on-site did not fall within the Waste Management Framework and therefore no exemption was required as long as the processed arisings (crushed concrete) were for immediate reuse. A copy of an email from the Environment Agency setting out their position can be found within Appendix B.

All chemical test results from validation samples of crushed concrete were considered against the generic human health criteria used in the Phase II Site Investigation and which are presented in Section 3 of this report. All concentrations were below the screening criteria. Therefore, all of the site won crushed concrete was considered suitable for re-use as part of the proposed cover layer.

Some of the suitable crushed concrete was used as part of the cover system. It was placed and compacted in accordance with the SHW.

6.7. Vegetation Strip

The works required only a small amount of vegetation clearance and this was limited to a very narrow strip of mature shrubs behind the eastern retaining wall and removal of weeds occupying the land across the southern boundary.

No invasive species were encountered or treated as part of the works.

6.8. Removal of Chemically Unsuitable Arisings

6.8.1. Soils

The remediation statement did not identify any soil that required removal to satisfy the remediation objectives. However, it did require inspection of the in situ materials encountered in excavations and further testing of potentially impacted soils.

One area of potentially impacted soils (approx $50m^3$) was encountered during the works. The location of this area is shown on drawing W896/12. This material had a visible silvery sheen and hydrocarbon odour. All the suspect material was excavated, stockpiled and bunded on tarpaulin whilst samples were analysed.

The sample (referenced WAC1) was analysed for concentrations of GRO (C4 - C10), GRO (C10 - C12), BTEX, PAH and Mineral Oil. Concentrations of all the determinands, with the exception of mineral oil, (there is no directly comparative screening value for mineral oil) were below the screening values used to protect human health that are quoted in the Phase II Site Investigation on CD. However, the concentration of mineral oil recorded (1500 mg/kg) suggested that the impacted soil may be harmful to human health if left on site.

The contractor disposed of the impacted material (approx $50m^3$) at Highmoor Landfill in Oldham.

Following excavation of this material two soil samples (WVS11 & WVS12) were taken from the base of the excavation and submitted for chemical analysis to confirm that all impacted material had been removed. These samples both returned results below the human health screening criteria used in the Phase II site investigation for the all the TPH equivalent carbon bands.

All chemical testing results can be found within Appendix D.

6.8.2. Groundwater

The works did not encounter any groundwater and the remediation statement did not require the removal or treatment of any groundwater.

6.9. Ground Improvement and Removal of Geotechnically Unsuitable Arisings

All materials encountered on site or processed from the demolished buildings were considered to be physically suitable for inclusion in the works.

The site won materials that were re-used in the works fall into three classifications based on their grading curves- :

- Coal measures sandstone, which after excavation complied with the grading requirements of Class 1C material as defined in SHW;
- Made ground present beneath floor slabs and hard standing areas, which complied with the grading requirements of Class 2C as defined in the SHW;
- Crushed concrete, which after processing and removal of reinforcement complied with the grading requirements of Class 6F2 as defined in the SHW.

6.10. Mineworkings

The remediation statement did not require any specific work to be undertaken relating to grouting of mine workings and no evidence of unexpected mine workings were encountered during the remediation works.

6.11. Landform

The as built landform is illustrated on Drawing W 896/14.

The make-up of the landform comprised re-compacted site won made or natural ground, cut from the embankment, topped with a 200mm thick layer of crushed concrete won from the demolition of buildings and excavation of existing hardstanding.

7. VALIDATION TESTING

The following section describes the data that has been gathered to demonstrate that the remediation objectives identified in Section 4 have been fulfilled. The following sections refer to the evidence that has been collected to demonstrate that the remediation objectives have been achieved.

7.1. Removal of Impediments to Proposed Development

Removal of impediments to proposed development was undertaken by excavating to natural ground and removing all impediments to proposed development encountered in the excavation. The excavation was backfilled in accordance with the SHW.

The base of the excavation, described above, and hence the level of natural ground, is shown on drawing W896/13. The level, at the base of the excavation, and the formation material was confirmed by the Woodford Environmental site manager and an Engineer from Woodford Consult. The dates of excavation and the names of the personnel who accepted the work are provided in Appendix F.

7.2. Compliance with the Specification for Earthworks

The remediation statement required that re-compaction of the excavated material be undertaken in accordance with the relevant method specification from Series 600 of the Specification of Highway Works.

Laboratory and in situ testing was undertaken to demonstrate compliance with the requirements of this specification. Test certificates are provided in Appendix E and the location of the tests are shown on drawing W896/12. The laboratory and in situ test results are supported by the field observations undertaken by Woodford Environmental site manager. These observations are documented in the compaction records that are reproduced in Appendix F.

Plate loading tests were undertaken in the proposed highway areas to demonstrate, at the level handed over as formation to the developer, that equivalent CBR values of greater than 3% were achieved. The locations of the plate bearing tests are shown on drawing W896/12 and the test certificates are provided in Appendix E.

7.3. *Compliance with the Conceptual Site Model*

Soils

The remediation statement required sampling for chemical analysis to be undertaken on the in situ soils, where required by Woodford Consult, based on visual assessment.

The visual assessment was undertaken on a daily basis by the Site Manager. In addition, Consult undertook observations to verify that backfill materials were visually acceptable.

The remediation statement stated that any visual signs of contamination would be analysed to determine their significance. One area that was considered to be impacted was identified (see section 6.8.1). This was assumed to be unsuitable and removed from the works.

The site won crushed material was placed in stockpiles of approximately 500m^3 and one sample was taken from each stockpile. The samples were analysed by Alcontrol's laboratory in Chester.

Analysis certificates for the site won crushed material (referenced WVS4, WVS6, WVS8, WVS10, WVS13 to WVS16, WVS20 to WVS22 and WVS30 and WVS31) are provided in Appendix D.

The concentrations recorded within the samples for these determinands were below the screening values for the protection of human health used in the Phase II Site Investigation Report.

No soils were imported to the site during the course of the works.

Groundwater and Surface Water Monitoring

The remediation statement did not require any groundwater or surface monitoring.

7.4. Validation of Excavation Depth, Capping Thickness and Levels

Validation of excavation depth is discussed in Section 7.1 and shown on drawing W896/13.

The remediation works undertaken by Woodford Environmental does not include for the import of garden soils. This is to be undertaken by the future developer.

8 POST-REMEDIATION (HUMAN HEALTH AND CONTROLLED WATERS) RISK ASSESSMENT

The only observations from the works and validation testing that differ from the Conceptual Site Model, as described in the Phase II Site Investigation and the Remediation Statement, are - :

1. The presence of elevated concentrations of mineral oil that was removed during the works; and
2. Concentrations of Aliphatic C12 - C16 hydrocarbons of one validation sample (WVS27) of made ground above the corresponding screening value used in the Phase II Site Investigation.

Anecdotal evidence suggests that the source of the contaminated soils is likely to have been a car dismantler's yard that used an area of the site for a short period. Evidence suggests that this was likely to be some time between 1966 and 1970, as site neighbours describe the yard operating immediately prior to the site being developed by Perfecta Beds. The historic ordnance survey map for 1966 shows no development whilst the 1970 map shows the site developed by Perfecta. The conjectured position, based on anecdotal information, of the dismantler's yard is shown on drawing W896/12.

The soils with elevated concentrations of mineral oils were removed as part of the works and therefore do not affect the conceptual site model.

Statistical analysis shows that the slightly elevated concentration (220 mg/kg) of Aliphatic C12 - C16 recorded in WVS27 is a statistical outlier and is a potential hotspot. The concentration slightly exceeds the screening value used in the Phase II Investigation (209 mg /kg) and could be considered a potential risk to human health if no remedial measures were proposed. However, a cover layer will be provided in garden areas and therefore direct exposure pathways will not operate. The screening value derived for the Phase II Investigation assumes that direct exposure and volatile pathways operate, which is conservative given the proposed remedial measures. When the direct exposure pathways are removed from the conceptual exposure model, the CLEA UK beta computer model, which was used to derive the generic screening criteria, determines that the aliphatic C12-C16 banding is not sufficiently volatile to present a significant risk. The model shows that the remedial target concentration would need to be greater than the residual saturation value of the soil and therefore such a concentration would not be capable of posing a vapour risk.

Therefore, the concentration recorded in WVS27 would not present a significant risk to human health taking the revised conceptual model into account. Other samples taken from within the conjectured extent of the dismantler's yard (WVS28 and WVS29) all returned concentrations below the screening values used in the Phase II Investigation. It is therefore not considered that any of the observations recorded during the site works affect the Conceptual Site Model proposed in the Remediation Statement.

As discussed above, the risk assessment undertaken as part of the Phase II Site Investigation concluded that a cover layer should be employed in all garden areas to break all potential pollutant linkages, which is still considered to be valid. The following section considers the potential for source - pathway - receptor pollutant linkages to operate following the proposed development of the site and including the remedial measures.

Based on the Conceptual Site Model set out in previous reports the following pathways could operate and are considered worthy of discussion.

1. Ingestion, dermal contact with contaminants in soils;
2. Inhalation of contaminated dust from soils;
3. Ingestion of contaminated home grown vegetables grown in site derived soils;
4. Exposure to contaminants that have migrated via services buried within contaminated materials, e.g. water supply;
5. Infiltration of surface water through the made ground above the saturated zone and leaching of contaminants into the groundwater beneath the site;
6. Migration of contaminated groundwater impacting on off site receptors.

The mitigation measures that, together with the proposed development, form the remediation strategy are shown schematically in drawing W896/08. The potential for harm to occur via each pathway is discussed below, in light of the proposed remediation strategy.

The potential for harm is discussed in terms of chronic risk. The potential for short term risk to site workers, maintenance workers and site visitors is not covered by this assessment. This will be covered by workplace health and safety legislation and guidance.

1. *Ingestion, dermal contact with contaminants*
   Future residents and their children will be separated from the existing on-site soils by a clean cover layer. Woodford has placed a 200mm thick hard to dig (biotic) layer of validated clean crushed material from the buildings. Through the presence of a hard to dig layer any impacted ground beneath the cover does not represent a significant risk to future residents through all direct uptake pathways.

In addition, it is recommended that details of the cover layer and the soils below it are included in future sales documentation, to further minimise the risk of future residents excavating the existing on-site soils.

2. *Inhalation or ingestion of Dust*
The completed development will comprise surface areas that are either covered with buildings, impermeable surfacing, or the clean cover layer.

The potential for exposure of future site users to dust from soils below the cover layer will therefore be severely restricted by the hard to dig layer.

3. *Ingestion of Home Grown Vegetables*
The 200mm layer of crushed concrete covers the entire site and has been placed in accordance with the Specification for Highway Works 600 series with max 10% air voids. It can therefore be considered a biotic layer.

The biotic layer prevents downward rooting of plants into impacted soil and prevents burrowing animals from entering the impacted soil. The application of a biotic layer also eliminates the potential phytotoxicity pollutant linkage.

4 *Migration of contaminants via services buried within contaminated materials, e.g. water supply;*
The remediation strategy includes provision that all service will be backfilled in clean imported soils thus eliminating this potential pollutant linkage.

5 *Infiltration of surface water through the made ground and leaching into groundwater beneath the site;*
There is no evidence of leachable concentrations of contaminants impacting on the groundwater sampled during the Phase II Investigation. The only recorded contaminants in the groundwater were hydrocarbons. The identified source of the hydrocarbons contamination, soils in the area of the dismantler's yard, have been removed as part of the works undertaken and therefore no significant risk of ongoing contamination is considered from this pathway.

6 *Migration of Contaminated Groundwater Impacting on Off Site Receptors;*
A limited number of off site receptors have been identified. The closest groundwater abstraction is approximately 900m from the site. The most sensitive controlled water is considered to be the River Dove, which is 140m north of the site.

The single exceedance of the hydrocarbon UKDWS was found on the first sampling occasion in WR02. A second round of analysis recorded no traces of any hydrocarbons above the laboratories detection limit. It is considered that these contamination concentrations are not a significant risk to the River Dove.

9 POST REMEDIATION CONSTRAINTS

The works undertaken by Woodford Group are based on outline planning application (reference 2006/1172) and its dependent drawings. The validity of the remedial works undertaken should be reviewed in light of any changes to this layout.

The future developer will be responsible for any additional design and survey works that are required to achieve a full planning consent and any changes to the physical works that result from any additional design and survey works.

The following summarises the post remediation constraints that are known to apply to the proposed development.

9.1 Foundations

It is envisaged that foundations for the proposed residential development will be in the form of strip or deep trench foundations with formations in the natural ground. The level of natural ground encountered during the remediation works is shown on Drawing W896/13. However, the Purchaser is responsible for ensuring the design of suitable foundations and that formations are inspected and approved by a suitably qualified geotechnical engineer.

The disposal of material removed from foundation trenches is the responsibility of the developer.

9.2 Roads and Car Parking Areas

Plate test results have demonstrated the equivalent CBR values of greater than 3% at the as built surface, however, the developer should anticipate that deterioration may occur of the surface, from to surface water ingress, between the completion of remediation works and surfacing of the road areas and should therefore make an allowance when determining the appropriate thickness of pavement construction.

9.3 Impediments to Proposed Development

All known near surface impediments to proposed development have been removed with the exception of the retained services as described in Section 9.6. However impediments to proposed development may be present that have not been identified by the investigations to date.

9.4 Cover Layer

The developer is required to provide and place a cover layer of 450mm in garden and landscaped areas to break any pollution linkages. This is to comprise 300mm of subsoil followed by 150mm of topsoil. Imported soils are to be validated chemically in accordance with Section 5.5.

A 200mm thick hard to dig layer has already been placed across the site.

9.5 Developable Area

Tree preservation orders are present on the trees located in two areas along the southern boundary of the site restricting proposed development in this area.

9.6 Services

The services that remain live are shown on drawing W896/10A. The developer is responsible for diversion or retention of these services within their proposed development scheme.

All new service trenches shall be backfilled with imported soils that comply with the acceptability criteria specified in Section 5.5 of this report.

9.7 Potential for Presence of Asbestos

There have been no recorded observations of asbestos containing materials (ACM) during the remediation works, however, given the prevalence of asbestos containing materials within the built environment in general, there will always remain the potential for ACMs to be present in man made soils.

It is our view that the level of asbestos contamination will be no greater than should be anticipated on any Brownfield site but, it is appreciated that there is no Soil Guideline Value for asbestos in soils and, therefore, no official "safe" level. Because there is no official guidance on what level of asbestos contamination constitutes a hazard and because of the duty of care that the Control of Asbestos at Work regulations (CAW) places on Employers, it will be prudent to adopt appropriate precautions during the site works.

9.8 Boundary Slopes

Slopes adjacent to the site boundaries have been retained at angles considered safe. The Developer should undertake his own stability assessment prior to undertaking any works to amend this slope.

REFERENCES

Reports

1. Desk Study Report, Wombwell, Wombwell Mills, November 2005, Woodford Consult ref 896/01
2. Site Investigation Report, Wombwell, Wombwell Mills October 2006, Woodford Consult ref 896/02
3. Remediation Statement, Wombwell, Wombwell Mills, December 2006, Woodford Consult ref 896/03

British Standards and Codes of Practice

1. BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.
2. BS 5930: 1999: Code of practice for site investigation. British Standards Institution.
3. BS10175 :2001: Investigation of potentially contaminated sites - Code of practice

Publications

CLR 11 Model procedures for the management of land contamination, DEFRA/ Environment Agency 2004.