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14 December 2007

Our Ref: FSE96914A\D\3\L
KKINSEY 071214

Dear Kevin

BEDWAS COLLIERY RECLAMATION SCHEME

Parsons Brinckerhoff (PB) was commissioned by Caerphilly County Borough Council (CCBC) to provide the following: -

- A review of the Supplementary Ground Investigation Report (May 2003) Vols 1 & 2 and the conclusions contained there in the context of current legislation.
- Preliminary concept design for remediation measures to produce a site fit for the following two after uses:
  - Residential use
  - Public open space / country park
- Budget cost estimates for remediation measures for both of the above identified after uses

Overview

PB commenced with a review of the last report to assess changes in the light of legislation updates. PB has prepared risk assessments for the new proposed uses for human health criteria. The controlled waters risk assessment remains the same as nothing has changed in the output. Future work will require the P20 to be slightly updated to fit the forms for the November 2007 modified reporting spreadsheets. A preliminary concept design has determined volumes for remediation and two drawings detailing the spatial extents. Budget cost estimates for remediation measures were based on being suitable to produce a site for the two potential future uses (residential use and public open space/country park). A costing exercise has been based on recent remediation quotes, SPONS 2007, recent contractor's rates, and current known framework remediation rates. No time frame for remediation is proposed therefore a 5 year span of cost prediction has been formulated. The final output cost could be significantly modified by potential future impacts of landfill tax removal and to a lesser extent inflationary pressures.

Site Summary

Name of Site	Former Bedwas Colliery
Address of Site	Former Bedwas Colliery, Caerphilly, Mid Glamorgan
Location	2.5 km north east of Caerphilly NGR ST 176 893. Drawing: Figure 1
Site Ownership	The site is owned by Caerphilly County Borough Council, Powerscreen International, Forest Enterprise and Railways Paths Limited.
Site Occupation	The site is unsecured, vacant and derelict. A public footpath runs through the site.
Area of Site	31.6 Ha (78.1 acres)
Plan of Site	Drawing: Figure 3

The site is shown on the site location map, Figure No. 1. The study area comprises a series of plateau areas on the lower flanks of Mynydd y Craig above the village of Trethomas. The site topography comprises a southerly sloping hillside falling from 150m to 75m AOD across the site. The River Rhymney is present offsite at around 50m AOD in the valley bottom.

Details of the site history are included in previous reports prepared by PB as referenced below. Bedwas Navigation Colliery Company commenced mining on site in 1909 with two shafts. British Benzol and Coal Distillation Ltd formed a coke and by-products plant on site in 1929. The plant covered 2.37 hectares with 35 coke ovens and 53 ovens. The pit was nationalised in 1947. In 1984-5 the shafts were filled and capped. The resultant discard of colliery spoil was tipped on the hillside northwards for two miles and then re-profiled in the 1980's for safety reasons. A redundant transformer station and two former fuel storage locations were associated with the colliery.

Following cessation of production in 1984, the site was demolished. The demolition rubble and limited tar deposits were placed in a COPA licensed 0.93 ha. landfill during a 12 year period of infilling, which was designed to operate as a 'dilute and disperse' facility. A total of 2,500m3 was licensed for disposal.

The former Bedwas Colliery occupied the central plateau area of the site, with the former coking ovens, Benzol and by-products plant to the east. Old railway lines and rail sidings run west to east across the site. Anecdotal evidence proves the tanks and pipe works to have been above ground and that five culverts outfall to the River Rhymney. Asbestos products were part of the plant and placed in the tip. A tunnel walkway exists for former employees to gain access to the plant from Llanfabon Drive.

The buildings associated with the colliery, coking works and by-product plant have largely been demolished, although some retaining walls, structure bases and foundations still remain. Surficial materials are mainly soft cover with approximately 5% hard cover. Overhead power lines, gas mains and other services cross the site.

The surrounding area includes colliery tips, residential properties, allotments and farmland.

Post 2003 Report Correspondence

The P20 groundwater risk assessment contained within the PB Supplementary Ground Investigation Report (May 2003) was designed to be protective of the River Rhymney. The following reports were subsequently

produced by PB in response to the Environment Agency recommendation that any remediation would need to be protective of groundwater resources in the underlying aquifer rather than the River Rhymney:

- Parsons Brinckerhoff Ltd, Former Bedwas Colliery, Controlled Waters Risk Assessment, BEN45321A. February 2004;
- Parsons Brinckerhoff Ltd, Bedwas Colliery Reclamation Scheme, Letter report *(initial budget cost estimates for remediation, estimated developable land values and funding options)* BEN45321A. March 2004;
- Parsons Brinckerhoff Ltd, Bedwas Colliery Reclamation Scheme, Emailed report *(budget cost estimates for potential remediation strategies)*, BEN45321A. September 2004;

Review of 2003 report - Legislation

PB has reviewed the May 2003 report in the context of legislation that has come into effect since that time. The report presented a risk assessment based on the results of intrusive ground investigations that were completed in March 2003, then went on to provide conclusions and recommendations including potential remediation strategies for a current ' commercial' site use and for a residential development. The intended land use was mixed use, but no masterplan had been developed by that stage.

Potential risks were assessed in the March 2003 report based upon the following guidance and legislation:

- The statutory Part 2A framework provided within the Environmental Protection Act (1990), Environment Act 1995, Waste Management Licensing Regulations 1994, and the Water Resources Act 1991.
- Soil site specific action levels were generated using the Contaminated Land exposure Assessment (CLEA) model in line with non-statutory technical guidance (DEFRA R&D Publication CLR 7 and references therein) intended to meet the requirements of Part 2A.
- Additional soil screening values were obtained from risk-based criteria produced by RIVM (Dutch Human Toxicological Values) and Dutch Intervention Values (designed to be protective of both human and ecological receptors).

Changes to Statutory Regime

Part 2A of EPA 1990 is still in force as the statutory legislation in terms of contaminated land assessment, however in 2006 the contaminated land regime was extended to cover radioactivity.

Implications to Bedwas Colliery risk assessment and recommendations:

- No changes required at this time due to Part 2A.

Water Act 2003

The Water Act 2003 built upon existing legislation to advance the sustainable use of water resources, strengthen the voice of water consumers, increase the opportunity for competition in the supply of water and promote water conservation.

Implications to Bedwas Colliery risk assessment and recommendations:

- No changes required at this time due to Water Act 2003.

The Environmental Protection (Duty of Care) (Amendment) (Wales) Regulations 2003

These Regulations amend the Environmental Protection (Duty of Care) Regulations 1991 (as amended in 1996, 2000 and 2002), to allow waste collection authorities to serve a notice requiring a person to provide, within a specified period of time, written descriptions of waste and transfer notes as are specified in that notice.

Implications to Bedwas Colliery risk assessment and recommendations:

- No changes required at this time due to EP Duty of Care amendment.

Waste Regulations

The UK developed the Landfill (England and Wales) Regulations 2002 to implement the changes set out in the Landfill Directive (1999/31/EC). Subsequent amendments have been made to the 2002 regulations to implement European Council Decisions. These have been implemented in 2004 and 2005. Further changes were applied in 2007.

The Landfill (England and Wales) Regulations introduced fundamental changes in the handling, classification and disposal of waste. Government policy moved away from land filling to concentrate on minimisation, reuse, re-cycling or recovery options. The following constraints were implemented:

1. The banning of certain types of wastes from landfill e.g. liquids;
2. Separation of landfills into three groups, inert, non-hazardous and hazardous;
3. Prohibiting mixing or blending of waste;
4. Requirement to treat most waste prior to landfill unless
    a. it is inert waste for which treatment is not technically feasible; or
    b. it is waste other than inert waste and treatment would not reduce its quantity or the hazards which it poses to human health or the environment;
5. The introduction of WAC (Waste Acceptance Criteria); and
6. Landfills were to obtain IPPC permits no later than 31st March 2007

The requirements for pre-treatment applied to hazardous waste from 16 July 2004 and to non-hazardous waste from 30 October 2007. The pre-treatment will need to satisfy the requirements of a 'three point test' and therefore must fulfil all three of the following criteria:

1. It must be a physical/thermal/chemical or biological process including sorting.
2. It must change the characteristics of the waste.
3. It must do so in order to:
    a. reduce its volume, or
    b. reduce its hazardous nature, or
    c. facilitate its handling, or
    d. Enhance its recovery.

On 16 July 2005 the Hazardous Waste (England and Wales) Regulations and the List of Wastes (Wales) regulations came into force, replacing the Special Waste Regulations. Their aim was to harmonise the definition of waste across Europe and set out the correct management of such wastes.

The Hazardous Waste Directive, (which brought in the Regulations) sought to determine which wastes are hazardous. This was undertaken by the development of 14 hazardous properties that can be displayed by a waste.

The implementation of these new laws resulted in a decline of hazardous waste landfills, an increase in waste classified as hazardous and the requirement to pre-treat hazardous waste. The new regime includes a requirement for most producers of hazardous waste to notify their premises to the Environment Agency.

Implications to Bedwas Colliery risk assessment and recommendations:

- Gate prices for disposal at landfills have increased in cost since the implementation of these new laws. As such, potential remediation strategies that include disposal of waste to landfill must be re-evaluated;
- The new requirement to separate waste has the implication that encapsulation of contaminated soils in a single on site waste tip is no longer an appropriate remediation option;
- Disposal of asbestos must be within separate landfill cells that only receive asbestos (mono-cells). Such cells will be permitted in either hazardous or non-hazardous waste sites but always physically separate from other waste and no future drilling work or landfill gas extraction system can be placed into the cell;
- An IPPC permit will be required if the decision is made to create a new landfill.

The Control of Asbestos Regulations 2006

The Control of Asbestos Regulations 2006 (the "Asbestos Regulations") revokes and replaces the following three sets of Regulations:

- The Control of Asbestos Regulations 2002;
- The Asbestos (Licensing) Regulations 1993 (as amended); and
- The Asbestos (Prohibitions) Regulations 1992 (as amended).

The Asbestos Regulations include amendments regarding asbestos removal such that decisions on licensing requirements are now determined by risk rather than by what the particular asbestos material is. The amendments strengthen requirements to protect workers and others likely to be exposed to asbestos fibres arising from work with materials containing asbestos.

Implications to Bedwas Colliery risk assessment and recommendations:

- All site works must be undertaken in a safe manner giving consideration to the Asbestos Regulations amendments. No significant alterations to the proposed remediation options are required.

Changes to Non-Statutory Technical Guidance

In 2004 DEFRA and the EA published the Model Procedures for the Management of Contaminated Land (CLR 11), which is held as Best Practice at the current time.

The EA also released revised guidance in 2006 pertaining to risk assessment methodology for protection of controlled waters, the Remedial Targets Methodology (EA R&D Publication 20, 2006). This guidance replaced the 1999 Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources, and is designed for use as a tool in implementation of CLR 11.

CLR 11 Model Procedures for the Management of Contaminated Land

The contaminated land report 11 provides the technical framework for structured decision-making about land contamination. The CLR technical framework stipulates that the results of the site investigation must be assessed in terms of Generic Risk Assessment followed by a Detailed Quantitative Risk Assessment. In addition the CLR technical framework stipulates that the assessments are based upon a conceptual site model of the site presented in terms of pollutant linkages composed of a source, pathway and receptor.

Implications to Bedwas Colliery risk assessment and recommendations:

- In line with CLR11, the risk assessments contained within the PB 2003 report took the approach of a Generic Risk Assessment followed by a Detailed Quantitative Risk Assessment based upon a conceptual site model presented as potential pollutant linkages. Therefore, it is considered acceptable to update the detailed human health risk assessments using the new CLEA model (CLEA UK) to generate assessment criteria for the two potential future site uses;

CLAN 6/06 Soil Guidance Values – The Way Forward

The original Soil Guideline Values (SGVs) were thought to represent the situation at which there was a 'significant possibility of significant harm' (SPOSH). However by 2007 it has been demonstrated by groups such as the Environmental Industries Commission that there are flawed assumptions in the generation of the SGV's and they do not in fact represent a point where SPOSH is reached. As a consequence DEFRA produced the CLAN 6/06 note which describes the issues relating to the production of SGV's and the emerging conclusions, termed The Way Forward'. One such conclusion is that it is appropriate for exposure frequency and duration parameters to be based upon reasonable worst case.

Implications to Bedwas Colliery risk assessment and recommendations:

- The new Human Health Assessment Criteria may be generated using reasonable worst case parameters for exposure frequency and for duration, appropriate to the designated land use. This ensures that the minimal remediation is required based on the suitable for use approach.

EA Laboratory Monitoring Certification Scheme (MCERTS) 2003

The EA introduced MCERTS, Performance Standards for Laboratories Undertaking Chemical Testing of Soils, in 2003. This scheme requires that in order to gain MCERTS accreditation, a laboratory must satisfy the EA that BS EN ISO/IEC 17025:2000 is specifically applied to chemical testing of soils.

Implications to Bedwas Colliery risk assessment and recommendations:

- Laboratory data used for risk assessment are not MCERTS-accredited but methodologies, detection limits, and quality control appear to meet the substantive requirements of MCERTS.

EA Hydrogeological Risk Assessment for Land Contamination - 2006

The Environment Agency's Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination superseded the Environment Agency's R&D Publication 20.

Implications to Bedwas Colliery risk assessment and recommendations:

- The changes to the EA Hydrogeological Risk Assessment methodology are not anticipated to alter the remedial objectives presented above.

Future Pertinent Environmental Legislation

Water Framework Directive 2000/60/EC

Requires the EA to prepare and publish 10 river basin management plans by 2009 to promote the concept of sustainable water management:

- To safeguard the sustainable use of water;
- To reduce groundwater pollution; and
- To help mitigate the effects of floods and droughts

Implications to Bedwas Colliery risk assessment and recommendations:

- No changes required at this time due to Water Framework Directive;
- Once implemented, will not likely require any changes.

Soil Framework Directive

European Commission adopted the Thematic Strategy for Soil Protection, including proposals for a Framework Directive for Soils. The proposed Directive lays down a framework for the protection and sustainable use of soil based on the principles of integration of soil issues into other policies, preservation of soil functions within the context of sustainable use, prevention of threats to soil and mitigation of their effects, as well as restoration of degraded soils to a level of functionality consistent at least with the current and approved future use of the land.

Implications to Bedwas Colliery risk assessment and recommendations:

No changes required at this time due to the Soil Framework Directive;
Once the Soil Framework Directive is effective, may require changes in land use inputs to risk assessment calculations.

Overall Impact of changes

The implications of changes to legislation and guidance, with respect to the May 2003 report, are summarised below: -

- Disposal based remedial strategies have increased in cost since the implementation of the waste legislation. As such, potential remediation strategies that include disposal of waste to landfill must be re-evaluated. This has also meant that new technologies are now more cost effective versus landfilling. Since the previous report there are now more mobile thermal units and soil washing units in the UK and hub sites are more prevalent. Some of the previous costings were based on trans frontier shipments, which are now difficult to achieve;
- The new requirement to separate waste means that the option of encapsulation of contaminated soils in a single on site waste tip is no longer achievable. Two separate landfills would be required to house hazardous and non hazardous materials;

- Disposal of asbestos must be within separate landfill cells that only receive asbestos (mono-cells). Such cells will be permitted in either hazardous or non-hazardous waste sites but always physically separate from other waste and no future drilling work or landfill gas extraction system can be placed into the cell;
- An IPPC permit would be required if the decision was made to create a new landfill on site.
- The latest version of the Environment Agency's human health risk assessment tool (CLEA UK) is now in place. These have been utilised for the risk assessment process;
- In line with CLR11, the risk assessments contained within the PB 2003 report took the approach of a Generic Risk Assessment followed by a Detailed Quantitative Risk Assessment based upon a conceptual site model presented as potential pollutant linkages. Therefore, it is considered acceptable to update the detailed human health risk assessments using the new CLEA model (CLEA UK) to generate assessment criteria for the two potential future site uses;
- In accordance with the CLAN 6/06 new human health risk assessment criteria can be generated using reasonable worst case parameters for exposure frequency and duration appropriate to the designated land use. This ensures minimal remediation costs.
- The laboratory data (from 2003) used for the current risk assessments are not MCERTS - accredited but methodologies, detection limits, and quality control appear to meet the substantive requirements of MCERTS. The EA should accept pre-MCERTS data, rather than insisting on new testing on site.
- Waste acceptance criteria testing will be required for disposal options.

Risk Assessment

Human Health - Soils

In 2003 risk-based assessment utilised qualitative and quantitative methodologies, including the use of generic guideline values, modelling of soil vapours within the subsurface, and contaminant transport and degradation in the saturated zone. Where available, the results were compared against CLEA guideline values and other risk-based guidelines. A 'suitable for use' approach was adopted, in line with the proposed mixed-use development for the study site. An assessment was made of the degree of contamination present and the likelihood of there being a 'significant pollutant linkage' in accordance with the Environmental Protection Act 1990.

The 2003 assessment determined the risks of hazards present on site affecting receptors via pathways for the following generic uses:

- Existing use and future commercial use; and
- Future residential use.

The results of the site investigations at Bedwas have been re-assessed using the updated CLEA model (CLEA UK). Seeing as a Generic Risk Assessment was conducted in 2003 it is considered acceptable, in terms of CLR11 guidance, to produce a single Detailed Risk Assessment using CLEA UK.

To screen for the protection of human health, Site Specific Action Criteria (SSAC) based on the CLEA UK model were derived as a function of the following uses:

- Proposed public open space / country park end use; and
- Proposed residential end use.

SSAC derived from the CLEA UK model are only applicable for the top 1m of soil.

Full descriptions of the assumptions used in CLEA UK for the SSAC derivation are presented in Appendix 1 along with justifications for the toxicology used and the relevant physicochemical data.

As part of any assessment which is based on non-targeted sampling, a statistical analysis is required. However the sampling at Bedwas targeted particular areas of the sites production and therefore any statistics will be biased towards certain results. Accordingly, and in line with current guidance, statistical analysis has not been undertaken on the data set.

A summary of the analytical results for soils are presented in Appendix 1.

Controlled waters

Groundwater assessments were undertaken by PB in 2003 and amended in 2004. The assessments were undertaken in a tiered approach in accordance with Environment Agency R&D Publication 20 ("Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources").

Groundwater quality was been initially screened with reference to both Environmental Quality Standards (EQS) for salmonid fish and EC Drinking Water Standards for comparative purposes due to the proximity of the Afon (River) Rhymney and the presence of a Minor Aquifer beneath the site.

The 2003 risk assessment derived the following remedial objectives for the key contaminants to be protective off the River Rhymney:

Protective of the Afon Rhymni	SOILS	WATERS
TPH	5000mg / kg	10.0mg / l
PAH	1000mg / kg	1.0mg / l
BTEX	100mg / kg	5.0mg / l

The risk assessment was revised by PB in 2004 following the recommendation from the Environment Agency that any remediation would need to be protective of groundwater resources in the underlying aquifer. The 2004 risk assessment derived the following remedial objectives for the key contaminants to be protective of the aquifer:

Protective of the Aquifer	SOILS	WATERS
TPH	5000 mg / kg	0.5 mg / l
PAH	100 mg / kg	0.05 mg / l
BTEX	10 mg / kg	1.0 mg / l

Remediation Volumes

Soils requiring remedial action for country park end use and residential end use are identified on Figure 3 and Figure 4 respectively. The total volume of soil requiring remediation for these two future site uses and for existing commercial use are shown in the following table:

Site Use	Total volume of soil requiring remediation (m^3)
Future Country Park Use	88,000
Future Residential Use	94,000

Initial estimates indicate that 27% of the soil requiring remediation is hazardous waste, with 16% of this volume potentially failing the Waste Acceptance Criteria (WAC) due to elevated loss on ignition. Waste

Acceptance Criteria testing has not been undertaken to assist in defining the proportions of hazardous and non- hazardous material and will be better defined at the remediation stage.

Budget Cost Estimates

Suitable Remediation Strategies

Previous site experience, technical literature and information from remediation contractors were used in order to reject unsuitable remediation options. The primary reason for rejection of an option was the inability to treat contaminants present.

All selected remediation strategies include NAPL removal as well as pump and treat water clean up.

The selected remediation strategies allow for the asbestos containing soils to either be taken offsite for landfill disposal or encapsulated on site in a suitably constructed landfill.

The initial volume estimates of non- hazardous material (Non Haz), hazardous material (Haz) and WAC failing hazardous material (Haz WAC failing) were used as a basis for selecting suitable combinations of remediation technologies.

Thermal desorption is suitable for all contaminants of concern (excluding Asbestos) and is likely to achieve the greatest reduction in contamination of all the remediation techniques. A treatability study would be required to confirm the achievable reduction in contaminants and additional testing of the soil would be required prior to treating. A site licence would be required for the on site thermal desorption options.

Bioremediation treatment requires a large site area and would require a trial to be undertaken. Bioremediation treatment is not suitable for treating cyanide, metals and grossly hydrocarbon contaminated soils. Initial estimates indicate that 60% of the non- hazardous material would achieve the remedial target values if treated by bioremediation. A site licence would be required.

Landfill disposal off site and encapsulation on site would require detailed classification of the soils and WAC testing. The costs of these landfill options are highly sensitive to whether a landfill tax exemption is obtained.

Encapsulation on site would require maintenance and monitoring for an indefinite period of time. A long term liability would be associated with the site and there may be a public perception of blight. If a landfill were created on site the future use of the landfill area would be limited. In addition, a PPC permit would be required for the creation of an on site landfill.

The following eight remediation strategy combinations for the treatment of contaminated soils were evaluated for costings (in no particular order):

1. Disposal to landfill off site for asbestos material, combined with thermal desorption off site for hazardous (& WAC failing) and non hazardous materials, product (NAPL) recovery and dissolved phase groundwater treatment;
2. Disposal to landfill off site for asbestos material, combined with mobile thermal desorption on site for hazardous (& WAC failing) and non hazardous materials, product (NAPL) recovery and dissolved phase groundwater treatment;
3. Disposal to landfill off site for asbestos material, bioremediation on site of non hazardous combined with thermal desorption off site for hazardous (& WAC failing) materials, product (NAPL) recovery and dissolved phase groundwater treatment;

4. Disposal to landfill off site for asbestos material, bioremediation on site of non hazardous combined with mobile thermal desorption on site for hazardous (& WAC failing) materials, product (NAPL) recovery and dissolved phase groundwater treatment;
5. Disposal to landfill off site for asbestos material, non hazardous and hazardous waste combined with thermal desorption off site for hazardous WAC failing materials, product (NAPL) recovery and dissolved phase groundwater treatment;
6. Disposal to landfill off site for asbestos material and non hazardous waste combined with mobile thermal desorption on site for hazardous and WAC failing materials, product (NAPL) recovery and dissolved phase groundwater treatment;
7. Encapsulation in new landfills on site for asbestos materials, non hazardous & hazardous waste combined with mobile thermal desorption on site of hazardous WAC failing material product (NAPL) recovery and dissolved phase groundwater treatment;
8. Encapsulation in new landfills on site for asbestos materials & hazardous waste) combined with disposal to landfill of non hazardous waste, mobile thermal desorption on site of hazardous WAC failing material, product (NAPL) recovery and dissolved phase groundwater treatment.

Remediation Costs

Cost estimates are presented in Appendix 2 for two sets of eight strategy combinations of feasible remediation techniques to leave the site suitable for the following future uses:

- Residential use; and
- Country park use.

The costs exclude landfill tax, assuming that no remediation notice is served. However, it is possible that the Government will remove the contaminated land landfill tax exemption in the near future. Landfill tax would currently add £42 per m^3 for active waste, increasing to £48 per m^3 in April 2008, and then escalating by £16 per m^3 each subsequent year until 2010.

There is no allowance for service diversion of gas mains through remedial areas. Knowledge of line and level of the gas mains precludes costing.

The most cost effective remedial strategy (Option 6) would be a combination of offsite disposal to landfill, soil treatment using on site mobile thermal desorption methods combined with product removal and groundwater treatment. The cost estimates using this combination of remediation techniques are presented below for the designated two future land uses (Inflation has been added for up to 5 years hence):

- Residential Use **£5.4 – 6.2M**
- Country Park Use **£5.1 – 5.9M**

Initially, excavation and disposal methods would remove the non-hazardous soils and the asbestos containing soils from site to a suitably licensed landfill. The hazardous soils would be subject to thermal desorption using a site license for treatment plant on site. The treated soils should be suitable for re-use as fill material, subject to validation. A site licence would be required for this operation. This strategy would be more sustainable by reducing the export to landfill. It would further reduce the amount of lorry movements to and from this area on congested local roads.

Product Non aqueous Phase recovery (NAPL) recovery and dissolved phase groundwater treatment. Further treatment areas are yet to be defined.

Services diversions of the gas mains require assessment of line and level followed by feasibility design and diversion in the summer low demand period.

The remediation estimates are based on the premise the re-use of surrounding colliery spoil is required.

An amount of separation to remove metal objects, asbestos and other materials will be required. Concrete is available in foundations to be re-used as fill materials following on-site crushing.

After validation of the excavated area, the areas will be left prior to re-profiling using colliery spoil.

Future monitoring of the site is not a requirement as source removal and thermal treatment verification negates this requirement, for soils and ground waters.

Future Issues

The Contaminated Land Capital Fund (WCLCF), operated by the Welsh Assembly Government, provides support to local authorities and the EA in Wales for investigation and remediation of contaminated land sites under Part 2A. The funding available for 2007-08, for which the deadline for submission has passed (April 2007), was £2 million. The funding available for 2008-2009 is yet to be announced.

In order to be eligible for this funding the applications to WCLCF must be formally determined as contaminated land under Part 2A. The WCLCF may provide support where the authority is acting in default of an "appropriate person", where there is an orphan liability, or where imposing statutory liabilities on an "appropriate person" would cause hardship. A local authority may also be eligible for WCLCF support where it owns the land to which the remediation project relates.

In addition to the capital support fund, £2 million per year was built into the baseline of the Revenue Support Grant for 2000-01 to assist local authorities in meeting their revenue expenditure needs under Part 2A.

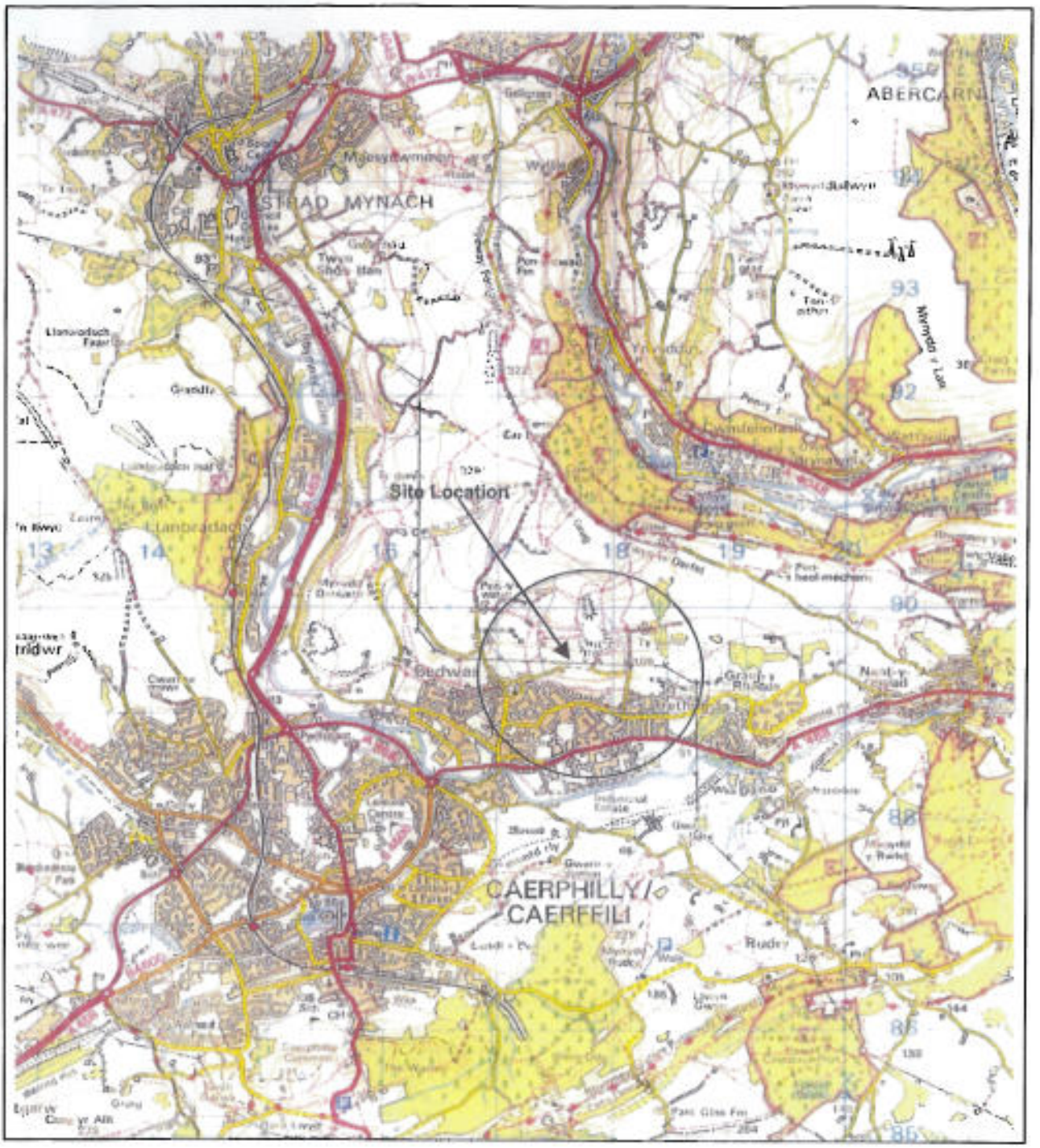
I trust the above meets your requirements.

Yours sincerely
Parsons Brinckerhoff

TOMOS KIDD
Remediation Engineer

NIGEL SNEDKER
Remediation Director

cc D Whetter (CCBC)
Enc Figure 1 - Site Location
Figure 2 - Conceptual Site Model
Figure 3 - Indicative Remediation for Country Park Use
Figure 4 - Indicative Remediation for Residential Use
Appendix 1 - Human Health Risk Assessment
Appendix 2 - Budget Cost Estimates for Residential Use & Country Park Use



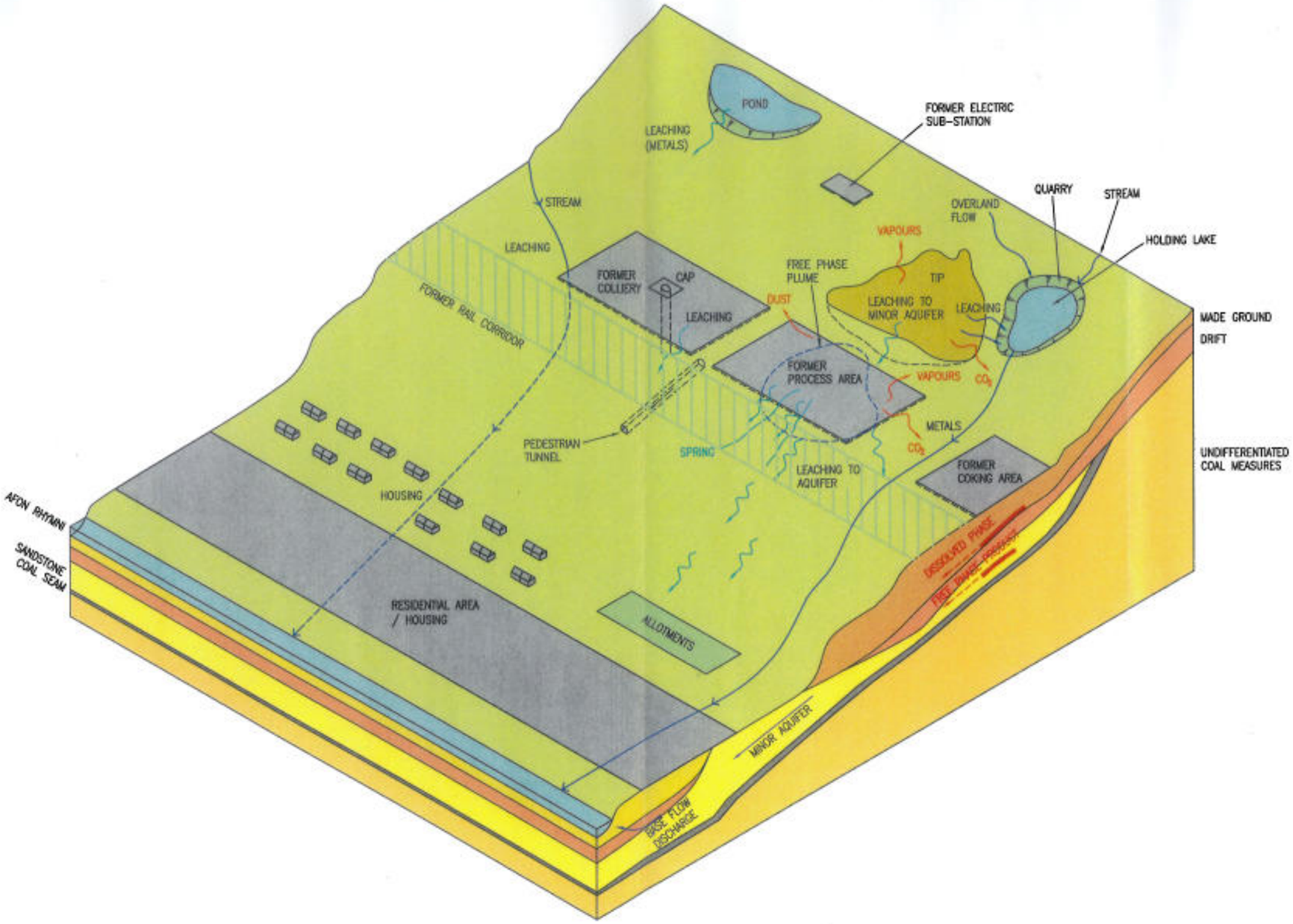
Parsons Brinckerhoff Ltd

Caerphilly County Borough Council

Bedwas Colliery

Figure 1: Site Location Plan

Project No: FSE96914A	Scale: 1:50,000
	Drawn By: TK



REV	DATE	DESCRIPTION	BY	CHKD	APPD

• NOTES

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PB PARSONS BRINCKERHOFF

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• CLIENT/PROJECT
CAERPHILLY CAERFFILI

BEDWAS COLLIERY

• TITLE
CONCEPTUAL SITE MODEL

• DATE 10/10/2007
• SCALE NTS
• CAD REF \FSE\969\14A\Z\1\FSE969814A-F02.DWG

DRAWN BY CEW
PRODUCED BY CEW
CHECKED TK
APPROVED NS

• DRAWING NUMBER
FIGURE 2

N

100m³ – REMEDIATE TO 1m DEPTH AVERAGE

3000m³ – REMEDIATE TO 3m DEPTH AVERAGE

4200m³ – REMEDIATE TO 1.5m DEPTH AVERAGE

400m³ – REMEDIATE TO 3m DEPTH AVERAGE

400m³ – REMEDIATE TO 1m DEPTH AVERAGE

18700m³ – REMEDIATE TOTAL TIP

Disused Quarry

WASTE TIP

32300m³ – REMEDIATE TO 2m DEPTH AVERAGE

1600m³ REMEDIATE TO 1.5m DEPTH AVERAGE

FORMER PROCESS AREA

FORMER RAILWAY CORRIDOR

4700m³ REMEDIATE TO 1.5m DEPTH AVERAGE

900m³ REMEDIATE TO 1m DEPTH AVERAGE

500m³ REMEDIATE TO 1m DEPTH AVERAGE

2700m³–REMEDIATE TO 1.5m DEPTH AVERAGE

2200m³ – REMEDIATE TO 3m DEPTH AVERAGE

7700m³ REMEDIATE TO 3m DEPTH AVERAGE

2300m³ – REMEDIATE TO 3m DEPTH AVERAGE

6300m³ REMEDIATE TO 3.5m DEPTH AVERAGE

REV	DATE	DESCRIPTION	BY	CHKD	APPD

* KEY

SOIL REMEDIATION

GROUNDWATER REMEDIATION

TOTAL REMEDIATION VOLUME
88000m³ (approx.)

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* CLIENT/PROJECT

CAERPHILLY CAERFFILI

BEDWAS COLLIERY

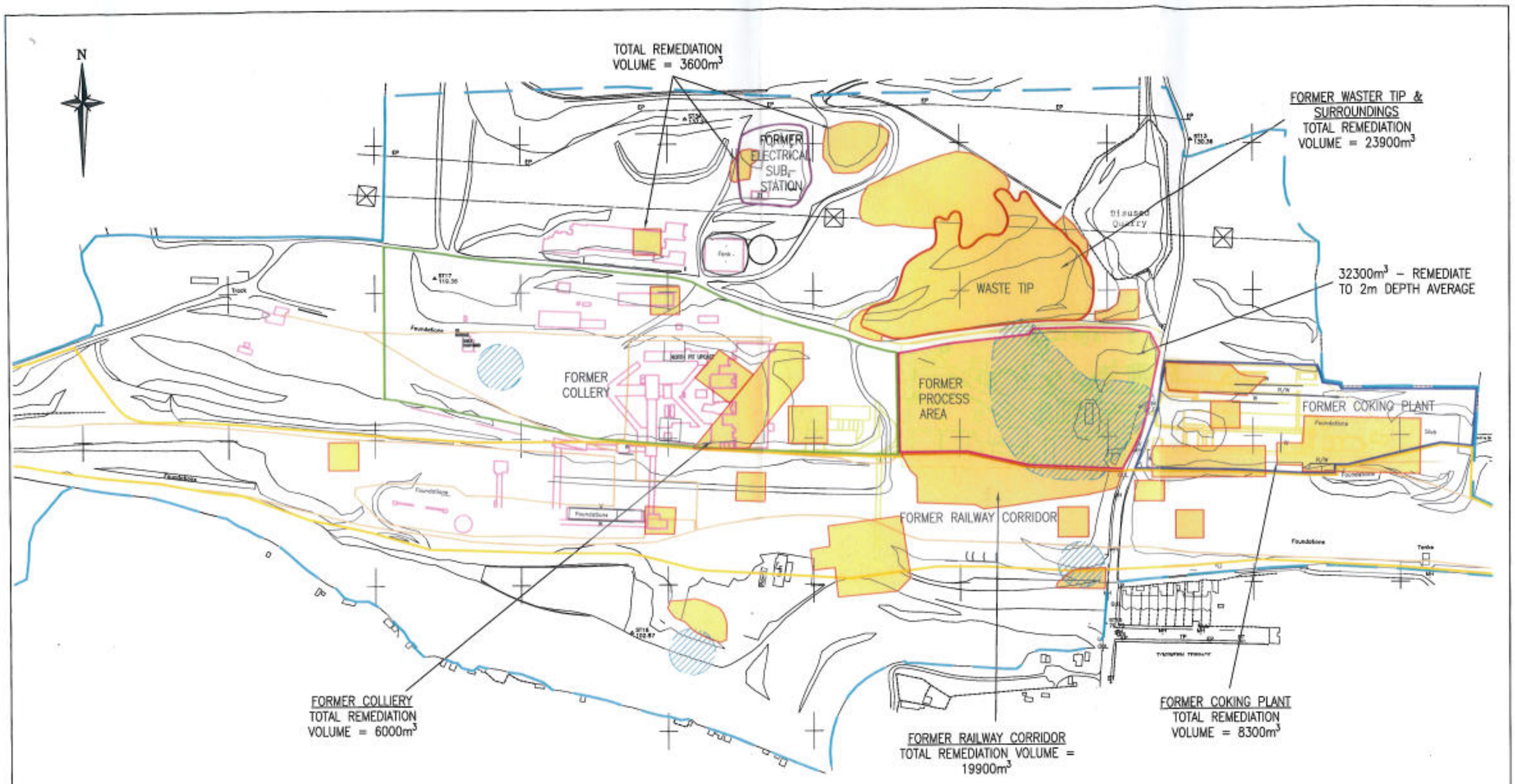
* TITLE

INDICATIVE REMEDIATION FOR COUNTRY PARK USE

* DATE	10/10/2007
* SCALE	1:2500
* CAD REF	\FSE\969\14A\2\1\ FSE96914A-F03
DRAWN BY	CEW
PRODUCED BY	JSDS
CHECKED	TK
APPROVED	NS

* DRAWING NUMBER

FIGURE 3



REV	DATE	DESCRIPTION	BY	CHKD	APPD

* KEY

SOIL REMEDIATION

GROUNDWATER REMEDIATION

TOTAL REMEDIATION VOLUME
94000m3 (approx.)

THIS DRAWING WAS PRODUCED USING AUTOCAD AND SHOULD ON NO ACCOUNT BE AMENDED BY HAND

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* CLIENT/PROJECT

CAERPHILLY CAERFFILI

BEDWAS COLLIERY

* TITLE

INDICATIVE REMEDIATION FOR RESIDENTIAL USE

* DATE	10/10/2007
* SCALE	1:2500
* CAD REF	\FSE\969\144\Z\1\ FSE96914A-F04
DRAWN BY	CEW
PRODUCED BY	JSDS
CHECKED	TK
APPROVED	NS

* DRAWING NUMBER

FIGURE 4

APPENDIX 1

QUANTITATIVE RISK ASSESSMENT

Context and Objectives

In accordance with CLR11 the results of the site investigation at Bedwas need to be assessed in terms of a Generic Risk Assessment and then a Detailed Quantitative Risk Assessment. However seeing as the results have previously been assessed in 2003 it is considered acceptable to produce a single risk assessment using CLEA UK. The justifications for the toxicology used and the relevant physicochemical data are presented in the attached sheets titled 'CLEA UK – Justifications'. Where more detailed risk assessment has been performed, these are explained as part of the main text.

As part of any assessment which is based on non-targeted sampling, a statistical analysis is required. However the sampling at Bedwas was undertaken at targeting particular areas of the sites production and therefore any statistics will be bias towards certain results. Accordingly, and in line with current guidance, statistical analysis has not been undertaken on the data set.

This section makes use of the site investigation findings, as described in the previous sections, to evaluate further the identified potential pollutant linkages. A combination of qualitative and quantitative techniques is used, as described below.

Numerical Assessment Criteria - Soils

Various numerical assessment criteria have been used to interpret the chemical testing results, as described in this section. These criteria are generally set to be highly conservative and in the event that they are exceeded a further level of analysis is typically required.

The assessment criteria used for the screening of determinands within soils are identified within Table 1.0. Details of input parameters are given within the footers to Tables 3.28 – 3.34.

Table .1:0 Selected Assessment Criteria – Contaminants in Soils

Substance Group	Determinand(s)	Assessment Criteria Selected
Organic Substances		
Volatile Organic Compounds (VOC's)	Toluene, Ethylbenzene	CLEA UK
	Benzene, Xylenes	CLEA UK
Non-halogenated hydrocarbons	Total Phenols, cresols	CLEA UK
	Total Petroleum Hydrocarbons (TPHCWG banded), trimethyl benzene, PCBs	CLEA UK
Polycyclic Aromatic Hydrocarbons (PAH's)	Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene	CLEA UK (beta) Altering Excessive Life Time Cancer Risk for BAP (see below)
Inorganic Substances		
Heavy metals and metalloids	Arsenic, Cadmium, Lead, Nickel, Selenium, Mercury, Chromium	CLEA UK
	Copper, Zinc	CLEA UK
Cyanides	Total Cyanide.	CLEA UK

CLEA UK – Human Health Risk

In November 2005 the Environment Agency released CLEA UK, the updated version of the original CLEA software. The CLEA model and supporting documentation were originally released by the Department of Environment, Food and Rural Affairs (DEFRA) to provide a scientifically based framework for assessing chronic risks to human health posed by land contamination within the United Kingdom.

The CLEA UK software is still at the beta test stage at the time of writing. As such, analytical results for soils will be compared against published SGV's where available. SGV reports for benzene and xylenes are currently in consultation.

All remaining contaminants are to be screened against criteria derived using the CLEA UK model. All assumptions and input parameters (both toxicological and fate & transport) for these contaminants, in addition to full CLEA UK report summaries.

CLEA UK Input Criteria

Residential With Plant Uptake

The input criteria used for the development of Assessment Criteria within CLEA UK is shown below:

Table 1.1a: CLEA UK Input Criteria – Residential with Plant Uptake

Input Details	Value
Land Use	Residential with plant uptake
Building Type	Typical House
Receptor	Female
Age Class	1 – 6
Exposure Duration	6 years
Averaging Time	6 years
Oral	Direct Soil Ingestion
	Direct Soil Derived Indoor Dust Ingestion
	Consumption of Site Grown Vegetables
	Consumption of Soil Attached to Site Grown Vegetables
Dermal	Skin Contact with Soil Derived Indoor Dust
	Skin Contact with Soil
Inhalation	Inhalation of Soil Derived Indoor Dust
	Inhalation of Soil Derived Outdoor Dust
	Inhalation of Soil Vapours Indoors
	Inhalation of Soil Vapours Outdoors
Soil Type	Loam
pH	8
Soil Organic Matter	2.5%

A pH value of '8' as it is considered to be representative of the prevailing soil conditions across the site. This value has been obtained by converting all pH values to hydrogen ion concentrations, averaging them, and then using the product to complete the average pH.

Communal Areas

CLEA UK Input Criteria – Country Park

Input Details	Value
Land Use	Country Park – Open Space
Building Type	No Building
Receptor	Female
Age Class	1 – 6
Exposure Duration	2 weeks
Averaging Time	6 years

CLEA UK Input Criteria – Country Park

Input Details	Value
Oral	Direct Soil Ingestion
	Direct Soil Derived Outdoor Dust Ingestion
Dermal	Skin Contact with Soil Derived Outdoor Dust
	Skin Contact with Soil
Inhalation	Inhalation of Soil Derived Outdoor Dust
Soil Type	Loam
pH	8
Soil Organic Matter	2.5%

In the area of open park it is considered that the maximum exposure for a human in the park will relate to the use for communal activities such as camping. In such circumstances it is estimated that the maximum time a single person could occupy a discrete area of the park would be 2 weeks out of the year. During this time it is assumed a female child will breath actively for 7.5hrs outdoors and 16.5 passively outdoors. Accordingly the risk associated with this has been calculated.

Benzo(a)pyrene

Background

For non-threshold contaminants, health criteria values (HCV's) are based upon excess lifetime cancer risks (ELCR). The ECLR is the additional risk of developing cancer, due to exposure to a toxic substance over an individual's lifetime (i.e. an upper bound estimate of the probability of developing cancer due to exposure to a particular substance). The HCV for benzo(a)pyrene recommended by the EA for SSGV calculation is in the region of 10^{-5}.

The CLEA UK model and its inputs are based on calculating an acceptable or minimum level of risk from pollutants within soil. However, in order to satisfy the legal definition of contaminated land, an unacceptable level of risk must be established. This can be achieved by increasing the ELCR on which the benzo(a)pyrene HCV is based. There is no set mechanism for choosing an ELCR, it is intangible, a scientific and political choice.

The toxicological data for benzo(a)pyrene recommended within DEFRA Tox Report 2 is based upon the WHO Drinking Water Standard (DWS) of 700 ng/L, which relates to an ELCR of $1x10^{-5}$. Whilst the WHO selected guideline values based on an upper bound ELCR of 10^{-5}, they also considered concentrations associated with ELCR of 10^{-4} and 10^{-6}, suggesting that such values may be acceptable for the derivation of DWS.

Sword et. al. undertook an extensive literature review, including information sourced from the USEPA (United States Environmental Protection Agency), the National Institute of Public Health and the Environment in the Netherlands, the New Zealand Ministry for the Environment and the HSE. They concluded that the lower bound or minimal risk levels for benzo(a)pyrene are generally in the region of $1x10^{-6}$ and $1x10^{-5}$, whilst upper bound risk levels are more difficult to equate.

Many countries and organisations use an ELCR of $1x10^{-4}$ as an upper bound level of 'acceptable risk', and guidance from the EA also suggests that there may be some consensus in using this risk level where it is determined appropriate. The use of an ELCR of $1x10^{-3}$ is generally regarded as unacceptable, and therefore the risk range of $1x10^{-5}$ to $1x10^{-4}$ may be regarded as representing a tolerable risk region.

There are large uncertainty factors currently applied in the drinking water and air quality standards used to derive the Index Doses presented within the TOX 2 Report (in particular the factors of safety as detailed in section 3.32). This, coupled with the acknowledgement that $1X10^{-4}$ is used by countries outside the UK, makes this ELCR a reasonable choice for inclusion as part of the assessment.

The assessment has not taken into account the additive effects of polyaromatic hydrocarbons.

Lead

The residential with plant uptake SGV for lead (450 mg/kg) is based upon the model derived by SEGH (Society for Environmental Geochemistry and Health 1993, within DEFRA R&D Publication SGV 10). The SGV depends upon;

- The target blood lead concentration and the degree of compliance within the overall population;
- The blood lead attributable to sources other than on site soil exposure; and
- The slope of empirical relationship between blood lead concentration and soil lead concentration (δ value).

SEGH considered that the reasonable range of δ values was between 2 and 5 µg/dL per 1,000 µg/g, but that this value should be adjusted in light of particular knowledge about a given situation ('site specific considerations').

DEFRA have selected a default value for δ of 5 µg/dL per 1,000 µg/g for the derivation of the published SGV (5 is the most conservative value within the 'reasonable range' of δ values reported by SEGH).

Selected δ Value	Calculated Tier 2 SSAC (mg/kg)	Log(SSAC)
4	577	2.761
3	770	2.886
2	1,155	3.063

SSAC have been calculated using δ values of 2, 3 and 4 (above). For this site the δ value is reduced to 3 (still within the 'reasonable range of δ values' as reported by SEGH)

Cyanide

Assessment of Chronic Exposure to Cyanides - Overview

Generic assessment criteria have been derived using CLEA UK (beta) for inorganic cyanide (free cyanide). Input parameters are pH 7 and SOM 2.5 %.

Oral / dermal pathway: 159 mg/kg
Inhalation pathway: 142,000 mg/kg
Integrated criteria: **159 mg/kg**

In the absence of DEFRA toxicity data for complex cyanide, this value is also used for assessing chronic risks to complex cyanide.

Acute Exposure

The TDI's for inorganic cyanide (taken from DEFRA Tox. Report 5) are derived for chronic (long term) exposure to free cyanide. Tox. Report 5 states that 'cyanide has high acute toxicity, and short term exposure is an important consideration when assessing the risks from soils contaminated with cyanide'. CLR10 states that 'the risk from acute exposure to free and simple cyanides are higher than the risks from chronic exposure'.

Assessment of Acute Exposure to Free Cyanide

The lowest reported fatal oral dose for humans is 0.56 mg/kg bw^{-1} (Tox Rpt 5). Cyanide toxicity results from inhibition of cytochrome oxidase, limiting the absorption of oxygen at the cellular level.

The approach taken by Massachusetts Department of Environmental Protection (MADEP, 1992) has been followed. A safety factor of 50 has been applied to the lowest reported absorbed lethal dose (in humans), to allow for LOAEL to NOAEL extrapolation, and for the varying sensitivity between different humans:

Lowest reported absorbed lethal dose	0.56 mg/kg bw^{-1}
LOAEL to NOAEL	UF of 5
Human to sensitive human	UF of 10

Estimated No Adverse Effect Absorbed Dose (sensitive human) = **0.0112 mg/kg bw^{-1}**

$$SSAC_{Acute} = \frac{\text{Estimated no effect dose x body weight of child}}{\text{Mass of soil ingested}}$$

Body weight has been selected for a 5 to 6 year old child (**20 kg**).

As stated within CLR10 (para. 6.21), 'where separate short term effects from exposure to contamination are known, it may be advisable to consider a one-off high soil ingestion rate, when deriving site specific assessment criteria'. Soil pica data (*deliberately high soil ingestion rate*) has been sourced from the USEPA (2002). The USEPA state that 'information on the amount of soil ingested by children with abnormal soil ingestion behaviour is limited. However, some evidence suggests that a rate on the order of 10 g/day may not be unreasonable'. This value (**10 g**) has therefore been taken as an upper bound (most conservative) estimate for pica amongst children.

Using these values, an assessment criteria for acute exposure to free cyanide of **22.4 mg/kg** is derived. This value is derived using a very conservative value for pica amongst children.

Assessment of Acute Exposure to Complex Cyanide

Whilst complex cyanides are not acutely toxic, they may release free cyanides under certain environmental conditions. Until DEFRA release complex cyanide toxicity information, an assessment criteria for complex cyanide has been derived based upon predicting the potential concentrations of free cyanide that may be liberated, and assessing the risks these concentrations may pose to human health.

This approach is based upon a method outlined within the SNIFFER framework (2000):

$$SSAC_{(complex)} = SSAC_{(free)} \times (K_d + 1)$$

We have selected a K_d value of 9.9 cm^3/g, sourced from the USEPA database. Based upon an SSAC for acute exposure to free cyanide of 22.4 mg/kg, this results in an SSAC for acute exposure to complex cyanide of **244 mg/kg**.

Summary

Determinand	Chronic Exposure		Acute exposure	
	Residential	Commercial/ Industrial	Residential	Commercial/ Industrial
Inorganic (free) Cyanide	*Derive using CLEA UK (beta), for inorganic cyanide*		22.4 mg/kg	N/A [A]
Complex Cyanide			244 mg/kg	N/A [A]

[A] Acute risks arise from a one-off high soil ingestion rate, by a child, & therefore are not applicable to this land use scenario.

It should be noted that no free cyanide analyses in the original assessment exceeded 4mg/kg and therefore the above is included for completeness as it will not alter the overall assessment.

References

MADEP (1992) 'Background Documentation for the Development of an "Available Cyanide" Benchmark Concentration' (http://www.mass.gov/dep/toxics/cn_soil.htm);

SNIFFER Framework (2000) Framework for Deriving Numeric Targets to Minimise the Adverse Human Health Effects of Long-term Exposure to Contaminants in Soil. Final Report No. SR 99(02);

USEPA (2002) 'Child Specific Exposure Factors Handbook'; and

DEFRA (2002) Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Inorganic Cyanide. R & D Publication TOX 5.

Determinand	Units	Number of samples tested		SSAC Residential With Plant Uptake		Number of Exceedances	
		Made Ground	Drift	Made Ground	Drift	Made Ground	Drift
Arsenic	mg/kg	174	21	19.4	19.5	6	0
Cadmium	mg/kg	174	21	7.84	7.84	0	0
Chromium	mg/kg	174	21	120	130	0	0
Lead	mg/kg	174	21	770	770	2	0
Mercury	mg/kg	174	21	6.79	6.79	2	0
Nickel	mg/kg	174	21	52.1	53.6	3	0
Copper	mg/kg	174	21	237	237	1	0
Zinc	mg/kg	174	21	286	286	8	0
Selenium	mg/kg	174	21	33.6	33.6	0	0
Acute Cyanide	mg/kg	167	20	22.4	22.4	0	0
Total Monohydric Phenols [B]	mg/kg	175	21	38100	38100	0	0
Cresols	mg/kg	166	20	3740	3740	0	0
Benzene	mg/kg	35	2	0.877	0.877	2	1
Toluene	mg/kg	35	2	80.8	80.8	0	0
Ethyl Benzene	mg/kg	35	2	401	401	0	0
Xylenes [C]	mg/kg	35	2	194	194	1	0
Naphthalene	mg/kg	165	20	8.58	8.58	64	5
Acenaphthylene	mg/kg	166	20	9.53	9.53	18	1
Acenaphthene	mg/kg	166	20	19.6	19.6	6	0
Fluorene	mg/kg	165	20	92.5	92.5	6	0
Phenanthrene	mg/kg	166	20	227	227	5	0
Anthracene	mg/kg	166	20	1640	1640	2	0
Fluoranthene	mg/kg	166	20	920	920	3	0
Pyrene	mg/kg	166	20	929	929	2	0
Benzo(a)anthracene	mg/kg	166	20	10.0	10.0	22	1
Chrysene	mg/kg	166	20	5.55	5.55	52	3
Benzo(b)fluoranthene	mg/kg	166	20	11.0	11.0	28	2
Benzo(k)fluoranthene	mg/kg	166	20	11.7	11.7	16	1
Benzo(a)pyrene	mg/kg	166	20	11.4	11.4	22	1
Indeno(123-cd)pyrene	mg/kg	166	20	11.7	11.7	17	0
Dibenz(ah)anthracene [A]	mg/kg	166	20	11.4	11.4	10	0
Benzo(ghi)perylene	mg/kg	166	20	6.44	6.44	22	1
Aliphatic EC 5-6	mg/kg	0	0	4.58	4.58	-	-
Aliphatic EC 6-8	mg/kg	0	0	11.8	11.8	-	-
Aliphatic EC 8-10	mg/kg	101	32	4.1	4.1	101*	32*
Aliphatic EC 10-12	mg/kg	101	32	24.2	5.65	13	32*
Aliphatic EC 12-16	mg/kg	101	32	97.6	7.72	9	32*
Aliphatic EC 16-35	mg/kg	0	0	25300	25300	-	-
Aromatic EC 5-7	mg/kg	0	0	1.33	1.33	-	-
Aromatic EC 7-8	mg/kg	0	0	1.47	1.47	-	-
Aromatic EC 8-10	mg/kg	101	32	3.17	3.17	101*	32*
Aromatic EC 10-12	mg/kg	101	32	5.65	5.65	101*	32*
Aromatic EC 12-16	mg/kg	101	32	7.72	7.72	101*	32*
Aromatic EC 16-21	mg/kg	101	32	190	190	19	5
Aromatic EC 21-35 [C]	mg/kg	101	32	257	257	23	2
Trimethyl Benzene [B]	mg/kg	35	2	1.87	1.87	2	1
PCB – Total 7 Congeners	mg/kg	17	4	0.14	0.14	1	0

Determinand	Units	Number of samples tested		SSAC Country park		Number of Exceedances	
		Made Ground	Drift	Made Ground	Drift	Made Ground	Drift
Arsenic	mg/kg	174	21	25.7	25.7	1	0
Cadmium	mg/kg	174	21	38.9	38.9	0	0
Chromium	mg/kg	174	21	217	217	0	0
Lead	mg/kg	174	21	770	770	2	0
Mercury	mg/kg	174	21	18.8	18.8	0	0
Nickel	mg/kg	174	21	87.2	87.2	0	0
Copper	mg/kg	174	21	5910	5910	1	0
Zinc	mg/kg	174	21	8810	8810	0	0
Selenium	mg/kg	174	21	300	300	0	0
Acute Cyanide	mg/kg	167	20	22.4	22.4	0	0
Total Monohydric Phenols [B]	mg/kg	175	21	41900	41900	0	0
Cresols	mg/kg	166	20	3800	3800	0	0
Benzene	mg/kg	35	2	19.5	19.5	0	0
Toluene	mg/kg	35	2	13800	13800	0	0
Ethyl Benzene	mg/kg	35	2	6970	6970	0	0
Xylenes [C]	mg/kg	35	2	12300	12300	0	0
Naphthalene	mg/kg	165	20	1360	1360	6	0
Acenaphthylene	mg/kg	166	20	1420	1420	2	0
Acenaphthene	mg/kg	166	20	1420	1420	0	0
Fluorene	mg/kg	165	20	2800	2800	1	0
Phenanthrene	mg/kg	166	20	1420	1420	3	0
Anthracene	mg/kg	166	20	2800	2800	1	0
Fluoranthene	mg/kg	166	20	1420	1420	2	0
Pyrene	mg/kg	166	20	1420	1420	2	0
Benzo(a)anthracene	mg/kg	166	20	14.2	14.2	17	1
Chrysene	mg/kg	166	20	14.2	14.2	25	1
Benzo(b)fluoranthene	mg/kg	166	20	14.2	14.2	22	2
Benzo(k)fluoranthene	mg/kg	166	20	14.2	14.2	16	0
Benzo(a)pyrene	mg/kg	166	20	14.2	14.2	18	1
Indeno(123-cd)pyrene	mg/kg	166	20	14.2	14.2	15	0
Dibenz(ah)anthracene [A]	mg/kg	166	20	14.2	14.2	8	0
Benzo(ghi)perylene	mg/kg	166	20	7.0	7.0	1	0
Aliphatic EC 5-6	mg/kg	0	0	67100	67100	-	-
Aliphatic EC 6-8	mg/kg	0	0	67100	67100	-	-
Aliphatic EC 8-10	mg/kg	101	32	1440	1440	1	0
Aliphatic EC 10-12	mg/kg	101	32	1440	1440	1	0
Aliphatic EC 12-16	mg/kg	101	32	1440	1440	1	0
Aliphatic EC 16-35	mg/kg	0	0	28800	28800	-	-
Aromatic EC 5-7	mg/kg	0	0	2870	2870	-	-
Aromatic EC 7-8	mg/kg	0	0	2870	2870	-	-
Aromatic EC 8-10	mg/kg	101	32	575	575	1	0
Aromatic EC 10-12	mg/kg	101	32	575	575	6	0
Aromatic EC 12-16	mg/kg	101	32	575	575	5	0
Aromatic EC 16-21	mg/kg	101	32	431	431	15	1
Aromatic EC 21-35 [C]	mg/kg	101	32	431	431	17	1
Trimethyl Benzene [B]	mg/kg	35	2	703	703	0	0
PCB – Total 7 Congeners	mg/kg	17	4	0.14	0.14	1	0

A	Has a TEF of 1.0 with regard to BAP and therefore set as the same SSAC
B	Uses 1 3 5 trimethy benzene as has a lower SSAC than 1 2 4 trimethyl benzene
C	Uses p-Xylene as most conservative
*	Limit of detection for TPH bands (10mg/kg) is greater than the SSAC

CLEA UK - Justifications

Aliphatic EC 5-6

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended from 18,400 µg/m^3 to 5,122 µg/kg bw/day, to account for UK adult body weight and inhalation rate (based on a 70 kg adult inhaling 20 m^3 of air a day). Oral and Inhalation MDI assumed to be 0.8 TDI.

Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aliphatic EC 6-8

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended to account for UK adult body weight and inhalation rate (method as per Aliphatic EC 5-6). Oral and Inhalation MDI assumed to be 0.8 TDI.

Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aliphatic EC 8-10

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended to account for UK adult body weight and inhalation rate (method as per Aliphatic EC 5-6). Oral and Inhalation MDI assumed to be 0.8 TDI.

Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aliphatic EC 10-12

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended to account for UK adult body weight and inhalation rate (method as per Aliphatic EC 5-6). Oral and Inhalation MDI assumed to be 0.8 TDI.

Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aromatic EC 10-12

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended to account for UK adult body weight and inhalation rate (method as per Aliphatic EC 5-6). Oral and Inhalation MDI assumed to be 0.8 TDI.

Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aromatic EC 12-16

Toxicity data from TPHCWG, Volume 5 (1999). Inhalation TDI amended to account for UK adult body weight and inhalation rate (method as per Aliphatic EC 5-6). Oral and Inhalation MDI assumed to be 0.8 TDI.

Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aromatic EC 16-21

Toxicity data from TPHCWG, Volume 5 (1999). Oral MDI assumed to be 0.8 TDI.

Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Aromatic EC 21-35

Toxicity data from TPHCWG, Volume 5 (1999). Oral MDI assumed to be 0.8 TDI.

Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as EC fraction deemed to be lipophillic.

Fate & transport data taken from TPHCWG, Volume 4 (1997). Data converted to CLEA UK required format using USEPA (2001) equations, where required.

Benzo(a)pyrene

Toxicity information taken from DEFRA toxicology report. Fate and transport information taken from draft EA technical report P5-079/TR1.

Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as deemed to be lipophillic.

Naphthalene

Toxicity information taken from DEFRA toxicology report. Fate and transport information taken from draft SGV report.

Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used as deemed to be (marginally) lipophillic.

Phenanthrene
Index dose amended from benzo(a)pyrene value, using TEF of 0.001 (Malcolm & Dobson 1994). Fate and transport information taken from draft EA technical report P5-079/TR1.
Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as deemed to be lipophillic.

Fluoranthene
Index dose amended from benzo(a)pyrene value, using TEF of 0.001 (Malcolm & Dobson 1994). Fate and transport information taken from draft EA technical report P5-079/TR1.
Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as deemed to be lipophillic.

Pyrene
Index dose amended from benzo(a)pyrene value, using TEF of 0.001 (Malcolm & Dobson 1994). Fate and transport information taken from draft EA technical report P5-079/TR1.
Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as deemed to be lipophillic.

Chrysene
Index dose amended from benzo(a)pyrene value, using TEF of 0.1 (McClure & Schoeny 1995). Fate and transport information taken from draft EA technical report P5-079/TR1.
Numeric soil to plant concentration factors used, as log Kow > 4.5. Trapp & Matthies model (1995) used to estimate plant uptake to leafy tissues. Travis & Arms model (1988) used to estimate root uptake. Dust enrichment factors used as deemed to be lipophillic.

Benz(a)anthracene
Index dose amended from benzo(a)pyrene value, using TEF of 0.1 (McClure & Schoeny 1995). Fate and transport information taken from draft EA technical report P5-079/TR1.
Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used to estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors used as deemed to be lipophillic.

Zinc
Toxicity data (oral TDI) taken from Dutch RIVM toxicity report (711701025). Solubility taken from BPRisc database. Kd from USEPA. Numeric soil to plant concentration factors from USEPA.

Inorganic Cyanide
Toxicity information taken from DEFRA toxicology report. Solubility and Kd taken from USEPA database and BPRisc database. Numeric soil to plant concentration factors from BPRisc database.

Barium
Oral and inhalation TDI data taken from USEPA RfD's. Oral MDI taken from published Dutch RIVM data (derived from UK estimate), inhalation MDI assumed to be 0.8 TDI. Kd from USEPA. Numeric soil to plant concentration factors from USEPA.

Vanadium
Oral TDI data taken from BPRisc database (sourced from USEPA Oral RfD). No MDI data available, therefore oral MDI assumed to be 0.8 TDI.
Solubility data from USEPA, Kd value from BPRisc database. Numeric soil to plant concentration factors from USEPA.

MTBE
Inhalation TDI taken from BPRisc database (sourced from USEPA Inhalation RfD). No MDI data available, therefore inhalation MDI assumed to be 0.8 TDI.
Fate and transport information taken from BPRisc database (boiling point from USEPA database). Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors not used, as contaminant deemed to not be lipophillic.

Thiocyanate
Toxicity data (oral TDI) taken from Dutch RIVM toxicity report (711701025).
Fate and transport information taken from USEPA database. Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors not used, as contaminant deemed to not be lipophillic.

Chlorobenzenes (total)
Toxicity data taken from Dutch RIVM toxicity report (711701025). MDI derived using Dutch background information. Fate and transport data taken from USEPA database. Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors not used, as contaminant deemed to not be lipophillic.

1,2,4-Trimethylbenzene
Toxicity data taken from USEPA database (sourced from USEPA RfD's). No MDI data available, therefore oral MDI assumed to be 0.8 TDI. Fate and transport data taken from USEPA database. Briggs model used for soil to plant concentration factors, as Log Kow < 4.5. Dust enrichment factors used, as contaminant deemed to be (marginally) lipophillic.

2,3,7,8-TetraCDD
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

1,2,3,7,8,9-HexaCDD
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

OctaCDD
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

2,3,7,8-TetraCDF
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

1,2,3,7,8-PentaCDF
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

2,3,4,7,8-PentaCDF
Toxicity information (oral TDI and MDI) taken from DEFRA tox report.
Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

PCB's (sum of 7 indicator congeners)
Toxicity information (oral and inhalation TDI, and MDI) taken from Dutch RIVM toxicity report (711701025). Fate and transport information obtained from USEPA database. Numeric soil to plant concentration factors used, as log Kow > 4.5. Travis & Arms model (1988) used to estimate plant uptake to leafy tissues. Briggs model used estimate root uptake (with EA reduction factor of 0.01). Dust enrichment factors selected.

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APPENDIX 2

Badwas Colliery Reclamation Scheme					
Estimates of remediation technologies and Landfill Directive waste differentiation					
Strategy;	**Residential Use**				
Waste Material Type;	Well graded very sandy gravel - Colliery Spoil overlying sandy gravel				
Key drivers;	Soil contaminants leaching to Controlled Waters, NAPL's in minor / major aquifer,				
	Carbon dioxide gas concentrations, contaminant content in lagoon fines and surface				
	combustible material and unlicensed tip 15,000m 3.				
Constraints;	Gas mains, 150,000 kv & 10,000kv electric transmission, culverts, public right of way,				
	No TPO's, some archaeological interest in conveyor structures, and public relations				
Planning Permission;	None granted				
Land ownerships	Tarmac, Forestry Enterprise, CCBC, Railway Paths Ltd				
Total Remediation Area (m^2)	**50000**				
Total Remediation Permimeter (m)	**6500**				
Volume of hard material	**5,000**				
Disposal Classification	Pre screening volume (m^3)	Estimated soil > RBC (m^3)			
WAC tailing	15000	14200			
Hazardous	10,000	9,500			
Non Hazardous	69,000	65,300			
Total Volume	**94,000**	**89,000**			
	m 3				
NAPL recovery volume	**50**				
Dissolved phase clean up volume	**8000**				
SUMMARY					
All options include NAPL removal / pump & treat water clean up	**Cost Exc. VAT, Consultancy Fees and Landfill tax**	**2008**	**2009**	**2010**	**2011**
	Estimated inflation rate	4.0	4.0	3.0	3.0
Option 1					
Landfill disposal **off site** (Asbestos soils)/ Thermal desorption **off site** (Haz & Non Haz soils)	£27,365,300	£28,460,712	£29,619,040	£30,508,539	£31,423,795
Option 2					
Landfill disposal **off site** (Asbestos soils)/ Thermal desorption **on site** (Haz & Non Haz soils)	£10,568,350	£11,022,284	£11,463,175	£11,807,071	£12,161,283
Option 3					
Landfill disposal **off site** (Asbestos soils)/ Bioremediation **on site** (Non Haz soils)/ Thermal desorption **off site** (Haz soils)	£10,682,890	£11,110,206	£11,554,614	£11,901,252	£12,258,290
Option 4					
Landfill disposal **off site** (Asbestos soils)/ Bioremediation **on site** (Non Haz soils)/ Thermal desorption **on site** (Haz soils)	£6,240,850	£6,490,276	£6,749,887	£6,952,384	£7,160,955
Option 5					
Landfill disposal **off site** (Asbestos, Non Haz & bulk Haz soils) /Thermal desorption **off site** (Haz WAC tailing soils)	£8,459,700	£8,803,448	£9,186,786	£9,462,389	£9,746,261
Option 6					
Landfill disposal **off site** (Asbestos & Non Haz) /Thermal desorption **on site** (Haz soils)	£5,419,000	£5,635,760	£5,861,190	£6,037,026	£6,218,137
Option 7					
Thermal desorption **on site** (Haz WAC tailing soils)/ Encapsulation **on site** (Asbestos, Non Haz & Bulk Haz soils)	£7,549,000	£7,850,960	£8,164,998	£8,409,948	£8,662,247
Option 8					
Landfill disposal **off site** (Non Haz soils) / Thermal desorption on site (Haz WAC tailing soils)/ Encapsulation **on site** (Asbestos & Bulk Haz soils)	£5,750,900	£5,980,296	£6,229,908	£6,416,805	£6,609,309
Landfill tax					
	Standard Rate for Active Waste (£/tonne)	Standard Rate for Active Waste (£/m^3)			
April 2006-07	21	42			
April 2007-08	24	48			
April 2008-09	32	64			
April 2009-10	40	80			
April 2010-11	48	96			

Strategy:	Residential Use						
Option 1	Volume	Duration	Rate			Cost	
Landfill **off site** (Asbestos soils)/ Thermal desorption **off site** (bulk soils)/ NAPL removal / pump & treat water clean up.	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General Items for Excavate & Replace		40		8000		£320,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (bulk soils)	86,300				300	£25,890,000	
Total						**£27,385,300**	**£291.33**
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption **off** site (Bulk soils)	86,300
TOTAL	89000

Strategy:	Residential Use						
Option 2	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Thermal desorption on site (bulk soils) / NAPL removal / pump & treat water clean up.	m3	Weeks	£/Item	£/week	£/m3		
CLASS A - General Items for Thermal Treatment On Site		83.0		22750		£1,888,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Thermal	86,300		13000			£13,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	86,300				2	£172,600	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk soils)	86,300				84	£7,249,200	
Total						£10,598,350	£112.75
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption on site (Bulk soils)	86,300
TOTAL	89000

Strategy:	Residential Use						
Option 3	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Bioremediation on site (Non-Haz soils)/ Thermal desorption off site (Bulk Haz soils) / NAPL removal / pump & treat water clean up.	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General Items for Bioremediation On Site		7.0		15,000		£105,000	
CLASS A - General Items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Bioremediation	66,300		187000			£187,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,020				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	65,300				2	£130,600	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Haulage & disposal at Non Haz Landfill (soils unsuitable for Bio	26120				27	£692,180	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (bulk Haz soil	21000				300	£6,300,000	
CLASS E - Bioremediation treatment set up			15000			£15,000	
CLASS E - Bioremediation treatment on site (Non-Haz soils)	39,180				42	£1,645,560	
Total						£10,682,890	£113.65
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Disposal off site at Non Haz Landfill (Non Haz soils unsuitable for Bio_40%)	26120
Bioremediation treatment on site (Non-Haz soils suitable for Bio_60%)	39,180
Thermal desorption off site (Bulk Haz soils)	21,000
TOTAL	89000

Strategy:	Residential Use						
Option 4	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Bioremediation on site (Non-Haz soils) / Thermal desorption on site (bulk Haz soils) / NAPL removal / pump & treat water clean up.	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General items for Bioremediation On Site		7.0		15,000		£105,000	
CLASS A - General items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Bioremediation	65,300		187000			£187,000	
CLASS C - Treatment testing for Thermal	21,000		4000			£4,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	60,180				2	£120,360	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos contaning soils)	2700				119	£321,300	
CLASS E - Haulage & disposal at Non Haz Landfill (soils unsuitable for Bio)	26120				27	£692,180	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	21000				84	£1,764,000	
CLASS E - Bioremediation treatment set up			15000			£15,000	
CLASS E - Bioremediation treatment on site (Non-Haz soils)	39,180				42	£1,645,560	
Total						£6,240,650	£66.39
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos contaning soils)	2700
Disposal off site at Non Haz Landfill (Non Haz soils unsuitable for Bio_40%)	26120
Bioremediation treatment on site (Non-Haz soils suitable for Bio_60%)	39,180
Thermal desorption on site (Bulk Haz soils)	21,000
TOTAL	89000

Strategy	Residential Use						
Option 5	Volume	Duration		Rate		Cost	
Landfill off site (Non Haz & bulk Haz soils) /Thermal desorption off site (Haz WAC failing soils) /NAPL removal (pump & treat water clean up	m3	Weeks	£/Item	£/week	£/m3		
CLASS A - General Items for Excavate & Replace		27.0		8000		£216,000	
CLASS A - General Items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	74,800		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	0				2	£0	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	65300				27	£1,730,450	
CLASS E - Haulage & disposal at Haz Landfill (Non WAC failing Haz soils including asbestos containing soils)	9500				119	£1,130,500	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (WAC failing Haz soils)	14,200				300	£4,260,000	
Total						£8,493,700	£96.36
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Non Haz Landfill	65,300
Disposal off site at Haz Landfill (Non WAC failing Haz soils including asbestos containing soils)	9,500
Thermal desorption off site (WAC failing Haz soils)	14,200
TOTAL	89000

Strategy	Residential Use						
Option 6	Volume	Duration	Rate			Cost	
Landfill off site (Non Haz & Asbestos containing soils) /Thermal desorption on site (Bulk Haz soils)/ NAPL removal /pump & treat water clean up.	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General items for Excavate & Replace		21.0		8000		£168,000	
CLASS A - General items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	68,000		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	21,000				2	£42,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	65300				27	£1,730,450	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	21000				84	£1,764,000	
Total						£5,418,000	£57.65
							All in
							rate per m3

Soil Treatment Breakdown

	Volume (m^3)
Disposal off site at Non Haz Landfill	65,300
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption on site (Bulk Haz soils)	21,000
TOTAL	89000

Strategy:	Residential Use						
Option 7	Volume	Duration		Rate		Cost	
Thermal desorption on site (haz-WAC failing soils)/ Encapsulation on site (Bulk soils)/ NAPL removal / pump & treat water clean up	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS A - Outline Landfill Design			10,000			£10,000	
CLASS A - Environmental Impact Assessment			50,000			£50,000	
CLASS A - Detailed Landfill Design			20,000			£20,000	
CLASS A - Apply for PPC landfill permit			50,000			£50,000	
CLASS A to E - Construction Cost (Haz landfill with separate cells for Asbestos waste & Non-Haz	74,800				64	£4,787,200	
CLASS A - Supervision			50,000			£50,000	
CLASS A - Long term aftercare and environmental monitoring (10 years inc only)			250,000			£250,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill disposal	74,800		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	89,000				1	£89,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	94,000				2	£188,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	89,000				2	£178,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,900		250,000			£250,000	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	14200				84	£1,192,800	
Total						£7,549,000	£80.31
							All in
							rate per m3

Soil Treatment Breakdown

	Volume (m^3)
Encapsulation in on site Landfill (Bulk soils)	74,800
Thermal desorption on site (Haz WAC failing soils)	14,200
TOTAL	89000

Strategy:	Residential Use						
Option 8	Volume	Duration		Rate		Cost	
Landfill off site (Non Haz soils) / Thermal desorption on site (Haz WAC failing soils)/ Encapsulation on site (Bulk Haz soils including Asbestos soils)/ NAPL removal / pump & treat water clean up	m3	Weeks	£/Item	£/week	£/m3		
CLASS A - General Items for Excavate & Replace		25		8000		£200,000	
CLASS A - General Items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS A - Outline Landfill Design			10,000			£10,000	
CLASS A - Environmental Impact Assessment			50,000			£50,000	
CLASS A - Detailed Landfill Design			20,000			£20,000	
CLASS A - Apply for PPC landfill permit			50,000			£50,000	
CLASS A to E - Construction Cost (Haz landfill with separate cells for Asbestos waste)	9,500				96	£962,500	
CLASS A - Supervision			50,000			£50,000	
CLASS A - Long term aftercare and environmental monitoring (10 years inc only)			250,000			£250,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill disposal	74,800		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	69,000				1	£69,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	14,000				9	£168,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Mixing treated material on site	23,700				2	£47,400	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	65,800				27	£1,730,450	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (Haz WAC failing soils)	14200				84	£1,192,800	
Total						£5,755,900	£61.28
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Non Haz Landfill	65,300
Encapsulation in on site Landfill (Bulk Haz soils including Asbestos soils)	9,500
Thermal desorption on site (Haz WAC failing soils)	14,200
TOTAL	89,000

Bedwas Colliery Reclamation Scheme					
Estimates of remediation technologies and Landfill Directive waste differentiation					
Strategy:	**Country Park Use**				
Waste Material Type:	Well graded very sandy gravel - Colliery Spoil overlying sandy gravel				
Key drivers:	Soil contaminants leaching to Controlled Waters, NAPL's in minor / major aquifer, transmission of contaminants via culverts to R Rhymney.				
	Carbon dioxide gas concentrations, contaminant content in lagoon fines and surface water pond.				
	combustible material and unlicensed tip 15,000m 3.				
Constraints:	Gas mains, 150,000 kv & 10,000kv electric transmission, culverts, public right of way, buried pedestrian tunnel, access, vandalism.				
	No TPO's, some archaeological interest in conveyor structures, and public relations.				
Planning Permission:	None granted				
Land ownerships	Tesco, Forestry Enterprise, CCBC, Railway Paths Ltd				
Total Remediation Area (m^2)	**41000**				
Total Remediation Perimmeter (m)	**2800**				
Volume of hard material	**5,000**				
Disposal Classification	Pre screening volume (m^3)	Estimated soil = RBC (m^3)			
WAC failing	14000	13000			
Hazardous	10,000	9,900			
Non Hazardous	64,000	59,500			
Total Volume	**88,000**	**82,000**			
	m 3				
NAPL recovery volume	**50**				
Dissolved phase clean up volume	**8000**				
SUMMARY					
All options include NAPL removal / pump & treat water clean up	**Cost Exc. VAT, Consultancy Fees and Landfill tax**	**2008**	**2009**	**2010**	**2011**
	Estimated inflation rate	4.0	4.0	3.0	3.0
Option 1					
Landfill disposal **off site** (Asbestos soils)/ Thermal desorption **off site** (Haz & Non Haz soils)	£25,266,300	£26,276,952	£27,328,030	£28,147,871	£28,992,307
Option 2					
Landfill disposal **off site** (Asbestos soils)/ Thermal desorption **on site** (Haz & Non Haz soils)	£9,977,360	£10,376,444	£10,791,502	£11,115,247	£11,448,704
Option 3					
Landfill disposal **off site** (Asbestos soils)/ Bioremediation **on site** (Non Haz soils)/ Thermal desorption **off site** (Haz soils)	£10,084,650	£10,488,036	£10,907,557	£11,234,784	£11,571,828
Option 4					
Landfill disposal **off site** (Asbestos soils)/ Bioremediation **on site** (Non Haz soils)/ Thermal desorption **on site** (Haz soils)	£5,903,850	£6,140,004	£6,385,604	£6,577,172	£6,774,487
Option 5					
Landfill disposal **off site** (Asbestos, Non Haz & bulk Haz soils) /Thermal desorption **off site** (Haz WAC failing soils)	£7,661,000	£8,279,440	£8,610,618	£8,868,936	£9,135,004
Option 6					
Landfill disposal **off site** (Asbestos & Non Haz) Thermal desorption **on site** (Haz soils)	£5,143,100	£5,348,824	£5,562,777	£5,729,660	£5,901,550
Option 7					
Thermal desorption **on site** (Haz WAC failing soils)/ Encapsulation **on site** (Asbestos, Non Haz & Bulk Haz soils)	£7,044,000	£7,325,760	£7,618,790	£7,847,354	£8,082,775
Option 8					
Landfill disposal **off site** (Non Haz soils) / Thermal desorption on site (Haz WAC failing soils)/ Encapsulation **on site** (Asbestos & Bulk Haz soils)	£5,484,000	£5,703,360	£5,931,494	£6,109,439	£6,292,722
Landfill tax					
	Standard Rate for Active Waste (£/tonne)	Standard Rate for Active Waste (£/m^3)			
April 2006-07	21	42			
April 2007-08	24	48			
April 2008-09	32	64			
April 2009-10	40	80			
April 2010-11	48	96			

Strategy:	Country Park Use						
Option 1	Volume	Duration	Rate			Cost	
Landfill **off site** (Asbestos soils)/ Thermal desorption **off site** (bulk soils)/ NAPL removal / pump & treat water clean up.	m3	Weeks	£/Item	£/week	£/m3		
CLASS A - General Items for Excavate & Replace		40		8000		£320,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (bulk soils)	79,300				300	£23,790,000	
Total						**£25,266,300**	**£287.12**
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption **off** site (Bulk soils)	79,300
TOTAL	82000

Strategy:	Country Park Use						
Option 2	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Thermal desorption **on** site (bulk soils) / NAPL removal / pump & treat water clean up.	m3	Weeks	£/ton	£/week	£/m3		
CLASS A - General Items for Thermal Treatment On Site		83.0		22750		£1,888,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Thermal	79,300		13000			£13,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	79,300				2	£158,600	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk soils)	79,300				84	£6,661,200	
Total						£8,977,350	£113.38
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption **on** site (Bulk soils)	79,300
TOTAL	82000

Strategy:	Country Park Use						
Option 3	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Bioremediation on site (Non-Haz soils)/ Thermal desorption off site (Bulk Haz soils) / NAPL removal / pump & treat water clean up.	**m3**	**Weeks**	**£/item**	**£/week**	**£/m3**		
CLASS A - General items for Bioremediation On Site		7.0		15,000		£105,000	
CLASS A - General items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Bioremediation	59,500		187000			£187,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	59,500				2	£119,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Haulage & disposal at Non Haz Landfill (soils unsuitable for Bio)	23800				27	£630,700	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (bulk Haz soil	19800				300	£5,940,000	
CLASS E - Bioremediation treatment set up			15000			£15,000	
CLASS E - Bioremediation treatment on site (Non-Haz soils)	35,700				42	£1,499,400	
Total						**£10,084,650**	**£114.60**
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Disposal off site at Non Haz Landfill (Non Haz soils unsuitable for Bio_40%)	23800
Bioremediation treatment on site (Non-Haz soils suitable for Bio_60%)	35,700
Thermal desorption **off** site (Bulk Haz soils)	19,800
TOTAL	82000

Strategy:	Country Park Use						
Option 4	Volume	Duration	Rate			Cost	
Landfill off site (Asbestos soils) / Bioremediation on site (Non-Haz soils) / Thermal desorption **on** site (bulk Haz soils) / NAPL removal / pump & treat water clean up.	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General Items for Bioremediation On Site		7.0		15,000		£105,000	
CLASS A - General Items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	2700		3000			£3,000	
CLASS C - Treatment testing for Bioremediation	59,500		157000			£167,000	
CLASS C - Treatment testing for Thermal	19,800		4000			£4,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	55,500				2	£111,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Haulage & disposal at Non Haz Landfill (soils unsuitable for Bio)	23800				27	£630,700	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	19800				84	£1,663,200	
CLASS E - Bioremediation treatment set up			15000			£15,000	
CLASS E - Bioremediation treatment on site (Non-Haz soils)	35,700				42	£1,499,400	
Total						**£5,903,850**	**£67.09**
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Haz Landfill (Asbestos containig soils)	2700
Disposal off site at Non Haz Landfill (Non Haz soils unsuitable for Bio_40%)	23800
Bioremediation treatment on site (Non-Haz soils suitable for Bio_60%)	35,700
Thermal desorption **on** site (Bulk Haz soils)	19,800
TOTAL	82000

Strategy:	Country Park Use						
Option 5	Volume	Duration	Rate			Cost	
Landfill off site (Non Haz & bulk Haz soils) /Thermal desorption off site (Haz WAC failing soils) /NAPL removal (pump & treat water clean up)	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General Items for Excavate & Replace		27.0		8000		£216,000	
CLASS A - General Items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	69,000		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	0				2	£0	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	59500				27	£1,576,750	
CLASS E - Haulage & disposal at Haz Landfill (Non WAC failing Haz soils including asbestos containing soils)	9500				119	£1,130,500	
CLASS E - Haulage to Middlesbourogh & Thermal Treatment (WAC failing Haz soils)	13,000				300	£3,900,000	
Total						£7,961,800	£96.47
							All in
							rate per m3

Soil Treatment Breakdown	Volume (m^3)
Disposal off site at Non Haz Landfill	59,500
Disposal off site at Haz Landfill (Non WAC failing Haz soils including asbestos containing soils)	9,500
Thermal desorption off site (WAC failing Haz soils)	13,000
TOTAL	82000

Strategy:	Country Park Use						
Option 9	Volume	Duration	Rate			Cost	
Landfill off site (Non Haz & Asbestos containing soils) /Thermal desorption on site (Bulk Haz soils)/ NAPL removal (pump & treat water clean up	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General items for Excavate & Replace		21.0		9000		£189,000	
CLASS A - General items for Thermal Treatment On Site		19.0		22750		£432,250	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill offsite	62,200		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	62,000				1	£62,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	19,800				2	£39,600	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	59500				27	£1,576,750	
CLASS E - Haulage & disposal at Haz Landfill (Asbestos containing soils)	2700				119	£321,300	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	19800				64	£1,267,200	
Total						£5,143,100	£58.44
							All in
							rate per m3

Soil Treatment Breakdown

	Volume (m^3)
Disposal off site at Non Haz Landfill	59,500
Disposal off site at Haz Landfill (Asbestos containing soils)	2700
Thermal desorption on site (Bulk Haz soils)	19,800
TOTAL	82000

Strategy	Country Park Use						
Option 7	Volume	Duration	Rate			Cost	
Thermal desorption on site (Haz WAC failing soils)/ Encapsulation on site (Bulk soils)/ NAPL removal / pump & treat water clean up	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General Items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS A - Outline Landfill Design			10,000			£10,000	
CLASS A - Environmental Impact Assessmet			50,000			£50,000	
CLASS A - Detailed Landfill Design			20,000			£20,000	
CLASS A - Apply for PPC landfill permit			50,000			£50,000	
CLASS A to E - Construction Cost (Haz landfill with separate cells for Asbestos waste & Non-Ha	69,000				64	£4,416,000	
CLASS A - Supervision			50,000			£50,000	
CLASS A - Long term aftercare and environmental monitoring (10 years inc only)			250,000			£250,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill disposal	69,000		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	82,000				2	£164,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	5,000		250,000			£250,000	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (bulk Haz soils)	13000				84	£1,092,000	
Total						£7,944,000	£93.85
							All in
							rate per m3

Soil Treatment Breakdown

	Volume (m³)
Encapsulation is on site Landfill (Bulk soils)	69,000
Thermal desorption on site (Haz WAC failing soils)	13,000
TOTAL	82000

Strategy:	Country Park Use						
Option 8	Volume	Duration	Rate			Cost	
Landfill off site (Non Haz soils) / Thermal desorption on site (Haz WAC failing soils)/ Encapsulation on site (Bulk Haz soils including Asbestos soils)/ NAPL removal / pump & treat water clean up	m3	Weeks	£/item	£/week	£/m3		
CLASS A - General items for Excavate & Replace		25		8000		£200,000	
CLASS A - General items for Thermal Treatment On Site		13.0		22750		£295,750	
CLASS A - Outline Landfill Design			10,000			£10,000	
CLASS A - Environmental Impact Assessment			50,000			£50,000	
CLASS A - Detailed Landfill Design			20,000			£20,000	
CLASS A - Apply for PPC landfill permit			50,000			£50,000	
CLASS A to E - Construction Cost (Haz landfill with separate cells for Asbestos waste)	9,500				95	£902,500	
CLASS A - Supervision			50,000			£50,000	
CLASS A - Long term aftercare and environmental monitoring (10 years in) only)			250,000			£250,000	
CLASS C - Groundwater testing			45000			£45,000	
CLASS C - Excavation validation testing			57000			£57,000	
CLASS C - Testing for Landfill disposal	69,000		10000			£10,000	
CLASS D - Demolition & Site Clearance			12000			£12,000	
CLASS E - Excavate soft material	82,000				1	£82,000	
CLASS E - Excavate hard material	5,000				12	£60,000	
CLASS E - Screening excavated materials	88,000				2	£176,000	
CLASS E - Crushing site won material	5,000				15	£75,000	
CLASS E - Moving treated material on site	22,500				2	£45,000	
CLASS E - NAPL recovery	50		75,000			£75,000	
CLASS E - Dissolved phase clean up	8,000		250,000			£250,000	
CLASS E - Haulage & disposal at Non Haz Landfill	99500				27	£1,578,750	
CLASS E - Thermal set up			100000			£100,000	
CLASS E - Thermal treatment on site (Haz WAC failing soils)	13000				84	£1,092,000	
Total						£5,484,000	£62.32
							All in
							rate per m3

Soil Treatment Breakdown

	Volume (m^3)
Disposal off site at Non Haz Landfill	69,500
Encapsulation in on site Landfill (Bulk Haz soils including Asbestos soils)	9,500
Thermal desorption on site (Haz WAC failing soils)	13,000
TOTAL	82,000