BROWN LEES DEVELOPMENT

ENVIRONMENTAL SITE INVESTIGATION

FACTUAL AND INTERPRETATIVE REPORT

for

ADVANTAGE WEST MIDLANDS

IMC Consulting Engineers
PO Box 18
Common Road
Sutton-in-Ashfield
Nottinghamshire
NG17 2NS

D5249B **March 2001**

Prepared By	Checked By	Verified By	Status	Date	Issue No
SDC / DH			Draft		1

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The conclusions reached are those which can be reasonably determined from the sources of information referred to in the report and from our knowledge of current professional practice and standards. Any limitations resulting from the data are identified where possible but both these and our conclusions may require amendment should additional information become available. The report is only intended for use in the stated context and should not be used otherwise.

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1.0 INTRODUCTION

IMC Consulting Engineers (IMC) were instructed by Advantage West Midlands (AWM) to carry out a site investigation of the former Victoria Colliery, Biddulph. The site has been subject to opencast coal extraction as the 'Brownlees' site.

A Phase 1 desk study investigation, including a site inspection, has been undertaken and is reported as a separate volume. This study established site history including mining aspects, and assessed the environmental setting based on regulatory authority records and other sources.

Phase 2 intrusive site investigations were subsequently carried out, based on the Desk Study findings. The objectives of the investigation were :

- Excavation of trial pits on an approximate 50m centred grid, logged to BS5930:1999, and obtaining samples of soils and groundwater if encountered for contamination testing. Approximately 36 trial pits are anticipated.

- Selected soil and water samples to be tested for contamination, including loss on ignition and leachability testing to assess potential for combustion and groundwater pollution. Testing to be specified based on potential historical contamination and site observations.

- In situ CBR testing to be carried out at approximate 50 m intervals along the centre line of the proposed road

- Preparation of factual and interpretative reports, including recommendations for any necessary remedial works or building specification requirements.

- Further Phase 2 geotechnical and previous mining legacy investigations are to be undertaken. This will include the drilling of cable percussive and potentially rotary boreholes to assess the geotechnical conditions of the site and the presence of any unrecorded shallow mineworkings. During this investigation an assessment of any gas contamination should also be made.

2.0 SITE LOCATION

The site is located to the west of the A527 (Tunstall Road) and to the south of Brown Lees Road, south of Biddulph, Stoke on Trent. It is centred at National Grid Reference 387863 355465, as shown in Figure 1.

The area to the southeast, southwest and south is Adopted Green Belt Land under the City of Stoke-on-Trent Plan 2001, Staffordshire Moorlands Local Plan and the Newcastle-under-Lyme Local Plan.

3.0 SITE HISTORY AND CURRENT CONDITIONS

A detailed discussion of the site history and current conditions is contained in the IMC Desk Study on the site.

3.1 Site History

The detailed site history as given in the desk study report was compiled from historical Ordnance Survey maps as supplied by Landmark Information Group.

The earliest map of 1878 shows the site to already contain works which were part of the Biddulph Valley Coal and Iron Works. The site contained tipping in the north-east, east and the south along with rail tracks/tramways running through the site to tips, shafts and buildings.

The area surrounding the site in the late 1800's was scattered with old shafts, collieries and tipping. One area of tipping close to the site was the area north east of Brindley Ford which included rail tracks running from it to the site. Brown Lees colliery was shown to be 150m west of the site. The 1899 map showed the site to contain a Brick Kiln. This was no longer labelled after 1925.

Throughout the early twentieth century the site changed to include reservoirs and tanks, a decrease in the size of the tip within the eastern section of the site and the excavation of a quarry in the south. Outside the site, the area also changed within this period, an engineering works developed north of the site with rail tracks running from it through the site. The tipping north of Brindley Ford further extended during this period along with the tipping at Brown Lees Colliery. Quarries were developed south of the site, which were no longer shown after 1967.

By 1937, the site was labelled as Victoria Colliery with no reference to Iron Works.

Within the mid twentieth century an aerial cable haulage system was shown running from Victoria Colliery to the tip south of Brown Lees Colliery which had again further extended.

By 1955 the activities within the site had further changed. The quarry within the site was no longer shown and the tipping area in the southern section had decreased. However sludge beds had been constructed and another area of water was marked.

The site in 1976 contained a refuse tip, electricity substations, and a conveyor where the aerial ropeway was situated. Brown Lees Colliery was not labelled on the 1976 map however the tipping area close to Brown Lees had increased in size.

The colliery closed in 1982 and following a planning application work commenced to extract coal from the Brown Lees Opencast Coal site including washing the former tip from August 1988 to September 1994 (Scott Wilson Kirkpatrick 1997).

The map of 1992/93 showed no detail within the site. The area to the west of the site was shown as opencast workings.

The settlement of the open cast backfill has been monitored since May 1995 and reported on by SWK at the end of 2000.

3.2 Current Conditions

A site inspection was undertaken on 12 February 2001 and details of the condition of the site at the time of the inspection can be found in the IMC desk study of March 2001.

The site occupies an irregular shaped area, approximately 270m by 570m at its widest points. A track from Tunstall Road, opposite Bemersley Road allows access to the site area.

The ground surface was slightly uneven. The northern end of the site was fairly flat. Towards the southern end of the site, the ground slopes quite steeply in a south-westerly direction. The site was bounded by various types of fencing, predominantly wooden post and wire.

The site comprised of roughly vegetated land containing many stones and rocks. Most of the site was covered with grass or moss. Small deciduous trees and shrubs were visible in the northern end of the site, apparently healthy, however difficult to assess during winter.

Many watercourses were visible within the site. A main watercourse ran from the south east of the site to the northwest and exited in the northwest. The flowing water within the ditches appeared of good quality and no discolouring of the water was seen.

Even with the large amount of water ditches, the ground was very wet and waterlogged, showing poor drainage of the material underfoot. However, the visit followed heavy rainfall.

A ponded area was visible in the north east, containing domestic waste, wood, metal wiring and rocks. Small amounts of waste were seen within the site along with insulated cable, metal piping and wire ropes protruding from the ground.

Three boreholes (possibly monitoring boreholes) surrounded by a wooden fencing were seen within the site and another was visible outside the western boundary.

3.3 The Environs

The site is set within an area of old opencast workings and is bounded on the west by a track following the path of the dismantled London Midland Scottish Railway. The main residential area of Brown Lees is located approximately 150m to the north. Tunstall Road industrial estate is located immediately to the north of the site. The site drains into numerous ditches located on the site the majority of which appear to flow into the stream running from Brown Lees Farm to Brindley Ford. Water within this stream at the south of the site was visually assessed as of good quality, with no ochreous colouration. Fields are located to the west.

4.0 PREVIOUS INVESTIGATIONS

Geological information is available on the site from the prospecting boreholes for the open cast operations. No details of any environmental site investigations since the completion of the backfill of the opencast excavation are known to IMC or have been made available prior to writing this report.

5.0 FIELD INVESTIGATIONS

5.1 Site Investigation Design

The extent of the site investigation, together with the number and location of trial pits and in situ California Bearing Ratio tests (CBR), was determined by IMC following consultation with Staffordshire County Council with regard to their requirements for highway design . The locations of the trial pits is given in Figure 2 (IMC drawing No D5249/05). All exploratory excavations were logged on site to BS5930, 1999.

The field investigations were undertaken between the 20th and 23rd February 2001. All positions were set out on site prior to any invasive works by MS Surveys and the position of the settlement markers were marked on site by Staffordshire Moorland District Council. Prior to any invasive works, positions were checked against services plans and a check was made for unmarked services using a cable avoidance tool (CAT).

5.2 Trial Pits

Forty trial pits were excavated using a JCB 3CX. Soil samples were obtained from trial pit excavations for contamination testing. Routine samples were taken by the Site Engineer, in plastic snap top tubs of 1.0 litre capacity. Glass jars were available on site for sampling any materials where contamination by potentially volatile organic species was suspected.

Samples were taken to represent each visually discrete horizon within the trial pit, including made ground and natural materials. Sample locations within the excavation are shown in the trial pit logs. Photographs of the site and the trial pits are shown in Appendix C.

Details of each trial pit are shown on Figures 3 to 42.

5.3 California Bearing Ratio Tests

Twenty California Bearing Ratio (CBR) tests were carried out by Construction Materials Testing Ltd of Derby along the line of the proposed adopted access road into the site (see Figure 43, IMC Drawing No D5249/06). Additional CBR tests were also carried out in the service yards of the proposed development units.

The results of the testing are reported in Appendix B.

5.4 Geology

5.4.1 Made Ground

The whole site is currently vegetated and covered with between 0.1m (TP23) and 0.75m (TP2) of topsoil at an average thickness of 0.30 m. The topsoil is characteristically a soft to firm brown CLAY with some fine angular gravel of limestone, shale brick and quartz.

All trial pits encountered opencast backfill, mostly to their full depth except those listed in section 5.4.3. The opencast backfill is generally a dark grey to black CLAY with much

angular fine to coarse gravel and cobble size fragments of mudstone, sandstone, coal and shale. Occasional large boulders of backfill material was encountered at depth within the trial pits which could be not excavated with as JCB 3CX. Occasional deposits of some soft black clay of coal fines, ash and slag were also encountered in the trial pits along with "waste" material such as timber, concrete posts and plastic.

The distribution of the made ground was across the whole of the site and was not confined to the areas of excavation associated with the open cast operations. This would seem indicate that there has also been considerable reprofiling of the whole area during the life time of the colliery and the subsequent opencast excavation. Colliery spoil and open cast backfill has been used to change the natural ground level across the whole of the site to allow the ongoing development of the colliery.

5.4.2 Foundations

In situ foundations were encountered in TP39 with a red brick wall at 1.8 m in Face A of the trial pit (see photographs, Appendix C) and a concrete base at 3.50 m. This would seem to confirm the conclusions from the Desk Study that the demolition of the colliery took place with all walls and footings removed to 200 mm below ground level and that any underground structures were left insitu and filled.

The presence of former foundations remaining in situ should be investigated further as part of any geotechnical investigation into the site and the extent of any reclamation and remediation required will depend on the detailed design of the proposed developments.

5.4.3 Natural Ground

Natural superficial deposits were encountered in six trial pits (TP1, 2, 4, 7, 19 and 20). These trial pits are located in the northern and north eastern corner of the site. These trial pits indicate that the natural superficial deposits consist primarily of a soft to firm olive brown mottled sandy CLAY.

Bedrock was not encountered in any of the trial pits excavate and no investigation was carried out as part of this study for the presence of unrecorded shallow mineworkings that could be present in the north eastern corner of the site where the outcrop of the Bowling Alley and Holly Lane coal seams.

The presence of shallow mineworkings in these seams should be investigated further as part of any geotechnical investigation into the site and the extent of any reclamation and remediation required will depend on the detailed design of the individual units.

5.4.4 Soil Bund

Trial pits TP11 and TP16 were excavated in the flanks of a bund in the north eastern corner of the site. These trial pits were excavated to the existing ground level of the surrounding site and the pits indicate that the bund is constructed of approximately 0.4 m of topsoil overlying opencast backfill.

5.5 Groundwater

Groundwater was only encountered in nine of the forty trial pits excavated across the site. These water strikes are described as "seepages or slight seepages" and are considered to be localised perched water present within the fill.

6.0 LABORATORY TESTING

6.1 Chemical Testing

Analysis was carried out on behalf of IMC by Ecos Environmental. The laboratory has UKAS / NAMAS accreditation for tests related to soils and water for contamination and follows similar audit procedures for tests which are not included in this accreditation.

The general scope of the testing was indicated by AWM in their site investigation tender, although IMC were given freedom to vary the testing regime and selection of samples based on ground conditions encountered. Details of test suites and scheduling are shown in Table 2.

A total of 55 solids samples were scheduled for a routine inorganics test suite, suite A1. Samples which indicated some evidence of possible contamination by organic materials were also scheduled for Suite A2. Nine samples selected to be representative of the general material types encountered were subjected to leachability testing, using the 'NRA R&D Note 301 leachate extraction. Eight samples which indicated a range of residual coal content were tested for gross Calorific Value, used as a site-specific correlation with loss on ignition data to assess combustibility hazard.

Two water samples were obtained from trial pits, and these were also scheduled for analysis.

Analysis results supplied by Ecos are presented in Appendix B. Test methods used and the scope of NAMAS accreditation are included in their report.

7.0 CONTAMINATION INVESTIGATION : DESIGN AND PRINCIPLES

7.1 Investigation Design

The investigation was undertaken in accordance with the requirements of the AWM contract.

Figure 2 shows the locations of IMC trial pits and boreholes.

7.2 The Risk Assessment Approach

In March 2000 the Department of the Environment, Transport and the Regions issued a Circular (2/2000) entitled 'Contaminated Land: Environmental Protection Act 1990: Part IIA'. The Circular included as Annex 3 'Statutory Guidance on the Definition of Contaminated Land'.

The approach of the UK Government as presented in the Circular is that the definition and assessment of 'contaminated land' should be based on:-

a) a "suitable for use" approach

b) a risk assessment appraisal method

In order for a contaminant to present a risk, the presence of the following must be established:-

a) a contaminant, a substance which has the potential to cause harm or pollution of waters.

b) a receptor or target, something which may be adversely affected by the contaminant. This may include plants and animals (including man), building materials and controlled waters.

c) a pathway by which the receptor could be exposed to the contaminant.

The use of a risk-based assessment has several advantages over the use of generic 'trigger values' as has commonly been the practice in the past. It allows site-specific factors to be considered, and may therefore permit less conservative contaminant concentration criteria to be adopted. It is also more flexible, permitting re-evaluation should circumstances or knowledge change.

Adopting a risk assessment approach does not preclude the use of some form of threshold trigger concentrations as a first stage in the assessment. Such criteria should be chosen to reflect an acceptable level of risk associated with the particular contaminant. Where concentrations are below these "acceptable" levels, then there is no necessity to pursue the existence of valid pathways to the at-risk receptor.

In the context of this report, the identification of ‘contamination’ does not necessarily imply that the land falls within the statutory definition of ‘contaminated land’.

7.3 Pathways and Receptors Available

It is understood that proposals for the site include industrial units, with associated roadways, hardstanding and possible some landscaped areas.

Risks may exist to numerous receptors during the development works and subsequent use of the site. The more significant of these include:-

- Hazards to construction workers and other contractors due to skin contact, inhalation and/or ingestion of contaminated material.
- Hazards to users of the site post-development.
- Pollution of controlled waters by leaching of soluble contaminants or run-off water containing sediments.

- Hazards to persons outside the site, for example by airborne escape of material.
- Damage to building materials or services.
- Adverse effects on plant growth.

It is not to be inferred from the above that these risks are considered significant, merely that, given the presence of contaminants at concentrations above 'no effect' levels, these potential risks require assessment.

7.4 Preliminary Contamination Assessment Criteria

Site-specific contamination criteria were determined for the preliminary assessment of analytical results. These were derived from various sources, including the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) guidance notes and Building Research Establishment data. It should be noted that revised UK government 'Guideline Values' are anticipated in the near future, derived using a more rigorous risk-based assessment method than the existing ICRCL trigger concentrations.

The assessment criteria, and their derivation, are presented in Table 4.

7.5 Sensitivity of Controlled Waters

The geology, hydrology and hydrogeology of the site were described in the Desk Study report, and summarised as follows:

- A number of water courses / ditches exist within the site, one of which discharges southward toward Brindley Ford where it is classed as Grade D under the Environment Agency GQA scheme.
- The site is located on a minor aquifer, with overlying soils given the interim classification of High leaching potential. It is not within a Groundwater Protection Zone.
- No licensed surface water or groundwater abstractions are recorded within 500 metres of the site.

8.0 ASSESSMENT OF CONTAMINATION

8.1 Soils

Concentrations of phytotoxic metals (**copper** and **zinc**) were very rarely encountered at concentrations in excess of the ICRCL threshold trigger concentration (TTC). One of 55 samples exceeded the copper TTC, and two the zinc TTC. Maximum concentrations were less than a factor of three greater than the TTC. It is not considered that these results indicate any significant risk due of phytotoxicity.

Sulphate (water soluble) determinations were carried out on 55 samples. Twelve of the 55 exceeded the threshold specified in BRE Digest 363 for potential sulphate attack of concrete. Of these, 10 were within Class 2; 1 Class 3, and 1 Class 5. Guidance in the Digest suggests that the site should be classified based on the mean of the highest 20% of samples tested. The single result at Class 5 is however regarded as anomalous, and a site classification of Class 2 is considered suitable. The potential for sulphate attack is minimised due to the absence of groundwater encountered in most trial pits.

Correlation between **loss on ignition** (LoI) and **calorific value** (CV) data shows that the tentative 7MJ/kg threshold for potential combustibility included in ICRCL 61/84, 1986, is approximately equivalent to a LoI of 30%. Allowing a 5% LoI safety margin, 10 of 55 samples indicated a LoI in excess of 25%, and are consequently considered potentially combustible. One additional sample of a coal gravel horizon (TP15/3) was tested for CV only, and found to be potentially combustible at a CV of 12.9MJ/kg. In most cases, the trial pit logs indicate that the LoI is consistent with the presence of coal residues within the made ground. However, in two cases (TP4/2 and 25/3) the material is described as [road surface] scalpings, with some potential for combustibility due to the inclusion of tars. Sample TP20/3 comprised limestone chippings, the LoI result giving a false indication of combustibility in this case due to decomposition of the limestone on heating.

The material identified as being potentially combustible was located beneath a variable thickness of lower coal content cover. This was less than 1.0 metre thickness in places, but not less that 0.5m. At some locations (eg. TP15) the coal was present as horizons of clean coal. A combustion risk is therefore considered to exist in localised areas. Guidance in ICRCL 61/84 suggests that potentially combustible fill should be capped with about 1 metre of a non-combustible material, though a reduced thickness may suffice where the site will not be disturbed. The risk associated with residual coal in made ground is increased where the combustible matter may be subject to heating, for example by surface fires or overheating electrical services.

Removal of all combustible materials from the near-surface of the site to a depth of 1 metre may not be practicable. However, post-development, the likelihood of surface fires or major heat sources is small, and access of air to the combustible ground would be reduced due to hard cover surfaces. The 1 metre of non-combustible cover suggested in ICRCL 61/84 can include the thickness of floor slabs, hardstanding, road base material and other materials, which would be anticipated to be present post development. As a consequence, it is suggested that at least the upper 0.5m of ground within the development platform should comply with the 7MJ/kg criterion, risk being further reduced by compaction (exclusion of oxygen). Where services trenches encounter material which is suspected to contain a significant coal content, they should be excavated over-depth and backfilled with clean inert material to avoid close contact of the combustible material with potential heat sources. Any material dark grey to black in appearance should be regarded as potentially combustible.

Test results and trial pit logs do not indicate any instances where material proven to be combustible, or considered likely to be on the basis of inspection, occur within 0.5 metre of the existing ground level. However, if levels are changed during the development, it is possible that material presenting a greater combustion risk may become exposed. In this case, levels should be reduced by at least 0.5m below the platform level, and a capping of inert material placed and compacted.

Leachability test results have been compared with the Leachate Quality Threshold (LQT) specified in the Environment Agency 'Interim Guidance on the Disposal of "Contaminated Soils", 1997'. All results with the exception of a single leachable sulphate (TP20/2) were within the LQT criteria. No significant indication of potential for pollution of controlled waters was therefore indicated.

[NB- Sample TP25/4 was scheduled for Suite A2 organics analysis due to identification of a "tarry odour". Results are currently awaited]

8.2 Groundwater

Two samples of groundwater were recovered from trial pits (TP's 4 and 20) and tested for contamination. Results were compared with the maximum acceptable concentrations in the Water Supply (Water Quality) Regulations 1989.

All results with the exception of sulphate and conductivity for TP20 were within Water Supply standards for the parameters tested. Sulphate in TP20, at 1543mg/l, was within BRE Digest 363 Class 3 with regard to potential for sulphate attack of concrete. It is notable that 3 of 4 soil samples tested from TP20 indicated elevated sulphate concentrations at BRE Class 2, suggesting that groundwater at this location might be uncharacteristically high in sulphate. As groundwater was absent from all but two pits, it is not considered necessary to increase the sulphate protection class from the Class 2 proposed above.

8.3 Waste Classification

There is no generally applicable standard for acceptability of waste materials at disposal facilities, each site operating within specific conditions with regard to the types of waste acceptable. However, at sites licensed only to accept uncontaminated inert materials, the guidelines specified by the former GLC are commonly applied, only materials within the 'typical values for uncontaminated soils' being acceptable. Several results for cadmium, and less frequently mercury, pH, phenols and PAHs, were found to exceed these criteria. However, leachability results were almost all within the Environment Agency Leachate Quality Threshold specified in 'Interim Guidance on the Disposal of "Contaminated Soils"', and it is likely that should the disposal of material from site be required, most disposal sites would regard soils as uncontaminated.

An appropriate description of any materials for disposal should be supplied to the disposal site operator in accordance with the Duty of Care Regulations.

8.4 Surface Waters

No samples from surface water bodies were recovered during the investigation.

9.0 PAVEMENT DESIGN

Twenty in situ California Bearing Ratio Tests were carried out along the line of the proposed access road as indicated on Figure 2 at approximate 50 m intervals. The results of the tests are given in Appendix B. It is understood that Staffordshire County Council have already

carried out a detailed design of the road scheme for the site, however the exact details of the construction of the road are not known.

The CBR values for all the tests average at 2.3 % at an average moisture content of 15 % for all tests carried out along proposed adopted access road to the development. Therefore as a conservative design approach the CBR value used for the assessment of the construction of the road should be 2%. The DoT Design Manual for Roads and Bridges (HD 25/94) indicates that this CBR value would require a pavement design with a capping layer of either 600 mm or 350 mm with a 150 mm sub-base. If the road is be designed and constructed by another party other than the adopting authority, then the pavement design should be checked with them to ensure that this meets their individual specifications.

10.0 CONCLUSIONS

10.1 Contamination

- Significant contamination identified in made ground at the Brownlees site was restricted to moderately widespread sulphates, with potential for damage to concrete, and the presence of combustible material.

- Protection from sulphate attack should be included in the foundation specification, by the use of a concrete specification to BRE Class 2 requirements.

- Combustible material was identified at several locations, though no evidence of combustible ground within 0.5m of the existing ground level was identified. Post-development, the risk of external heat sources which might initiate combustion is considered small. It is suggested that a minimum cover thickness of 0.5 metres of inert fill is retained between any potentially combustible material and the development platform level, which would be anticipated to increase to 0.8 metres or more when floor slabs, hard cover, road base material and other surface materials are applied. This should be confirmed as acceptable by the local authority building control regulator before proceeding.

- No significant contamination of groundwater was identified, though elevated sulphate concentration at one location confirms the requirement for concrete protection.

- A gas risk investigation will be required.

10.2 Geological and Mining

- The trial pits confirmed the anticipated geology with the site comprising opencast backfill with natural superficial deposits encountered in only a few excavations. Localised perched water tables with minor flows of groundwater were encountered in several of the pits.

- The trial pits confirmed the presence of some in situ foundation remaining after the demolition of the Victoria Colliery Buildings.

- No investigation was carried out as part of this fieldwork for the presence of shallow mineworkings associated with the Holly Lane and Bowling Alley coal seams.

- The presence of former foundations remaining in situ and unrecorded shallow mineworkings should be investigated further as part of any geotechnical investigation into the site and the extent of any reclamation and remediation required will depend on the detailed design of the individual units.

10.3 Pavement Design

- The CBR tests indicate that a design CBR value to be used for the construction of the road should be 2%. The DOT Design Manual for Roads and Bridges (HD 25/94)

indicates that this CBR value would require a pavement design with a capping layer of either 600 mm or 350 mm with a 150 mm sub-base. If the road is be constructed by another party than the adopting authority then the pavement design should be checked with them to ensure that this meets their individual specifications.

11.0 REFERENCES

1. BS 5930 - Code of Practice for Site Investigations (1999).

TABLES

Table 1
Contamination Test Schedule

Sample i.d	Depth,m	Suite				
		A1	A2	A3	CV	Waters
Trial pits:						
1/2	0.9-1.0	*		*		
2/1	0.0-0.1	*				
3/2	0.35-0.7	*			*	
3/3	1.4-1.7	*				
4/2	0.5-0.7	*	*			
4/4	0.7					*
4/5	1.2-1.6	*				
5/2	0.3-1.3	*				
6/2	0.5-1.6	*		*		
7/3	0.35-0.5	*	*			
8/2	0.4-1.0	*				
9/2	0.3-1.3	*				
10/2	0.2-1.45	*				
10/3	1.45-1.65	*	*		*	
11/2	0.5-2.0	*				
12/2	0.2-0.75	*		*		
13/2	0.2-1.5	*				
14/2	0.2-1.3	*				
15/4	0.9-2.9	*				
15/3	0.8-1.1				*	
16/2	1.6-1.7	*			*	
17/2	0.2-1.1	*				
17/3	1.1-1.4	*				
18/2	0.2-1.0	*				
18/3	2.2-3.3	*				
19/2	0.2-1.7	*		*		
20/2	0.2-0.7	*	*	*		
20/3	0.7-1.1	*				
20/4	1.2-2.0	*			*	
20/5	2.1-2.2	*	*			
20/6	2.2					*
21/3	0.9-1.1	*				
22/2	0.2-0.65	*				
22/3	0.65-3.0	*			*	

Sample i.d	Depth,m	Suite				
		A1	A2	A3	CV	Waters
Trial pits:						
23/1	0.1-0.5	*				
23/3	0.5-1.2	*				
24/2	0.2-1.2	*				
25/3	0.55-0.9	*				
25/4	0.9-1.1	*	*			
26/2	0.2-1.6	*				
27/2	0.35-0.8	*				
28/2	0.2-0.9	*				
29/2	0.7-2.8	*	*	*	*	
30/2	0.4-1.0	*				
31/1	0.0-0.2	*				
31/2	0.3-0.9	*				
32/2	1.0-1.6	*	*	*		
32/3	1.7-2.0	*				
33/2	0.5-1.8	*				
34/2	0.4-1.5	*				
35/2	0.2-0.7	*				
36/2	0.3-2.0	*	*	*		
36/3	2.6-3.2	*				
37/2	0.6-2.0	*			*	
38/2	0.5-2.8	*				
39/2	0.35-0.8	*				
40/1	0.0-0.5	*				
40/2	0.6-1.2	*		*		
Total		55	9	9	8	2

Table 2

Analytical Suites

Suite A1: Metals (total) As, Cd, Cr, Pb, Hg, Cu, Ni, Zn. Sulphate water sol.(2:1 extract), pH, Loss on ignition at 815C, chloride

Suite A2: Phenol index, PAH (total), TPH (IR)

Suite A3: Leachate extraction (NRA R&D Note 301). Leachate analysis as water suite.

CV: Calorific Value (gross)

Water: Metals (dissolved): As, Cd, Cr, Pb, Hg, Cu, Ni, Zn, Fe. Sulphate, pH, conductivity, chloride, ammoniacal nitrogen

Table 3
Preliminary Contamination Assessment Criteria - Soils

Parameter	Criterion	Origin
pH	Minimum 5	1
Arsenic	40 mg/kg	1
Cadmium	15 mg/kg	1
Chromium (total)	1000 mg/kg	1
Mercury	20 mg/kg	1
Lead	2000 mg/kg	1
Copper	130 mg/kg	2
Nickel	70 mg/kg	2
Zinc	300 mg/kg	2
Sulphate (water soluble)	1.2 g/l SO_4	3
Total Petroleum Hydrocarbons	5000 mg/kg	4
Phenols (total)	5 mg/kg	1
PAH (total)	1000 mg/kg	1
Chloride	100 mg/kg	5
Loss on ignition	30%	6
Calorific Value	7MJ/kg	7

Origin Key:-

1 - ICRCL 59/83 2nd Edition, Threshold Trigger Concentration, open space / landscape
2 - ICRCL 59/83 2nd Edition, Threshold Trigger Concentration, where plants are to be grown.
3 - Building Research Establishment, Digest 363.
4 - Dutch Intervention Value, 'mineral oil'.
5 - German Gas and Water Association (in BRE Digest 255)
6 - Approximately equivalent to 7MJ/kg CV (see text)
7 - ICRCL 61/84, 1986

FIGURES

APPENDICES

APPENDIX A

Chemical Analysis Results

Ecos Environmental Report Nos.
R01/0621 Soils
R01/0628 Waters

APPENDIX B

CALIFORNIA BEARING RATIO TEST RESULTS

APPENDIX C

SITE AND TRIAL PIT PHOTOGRAPHS