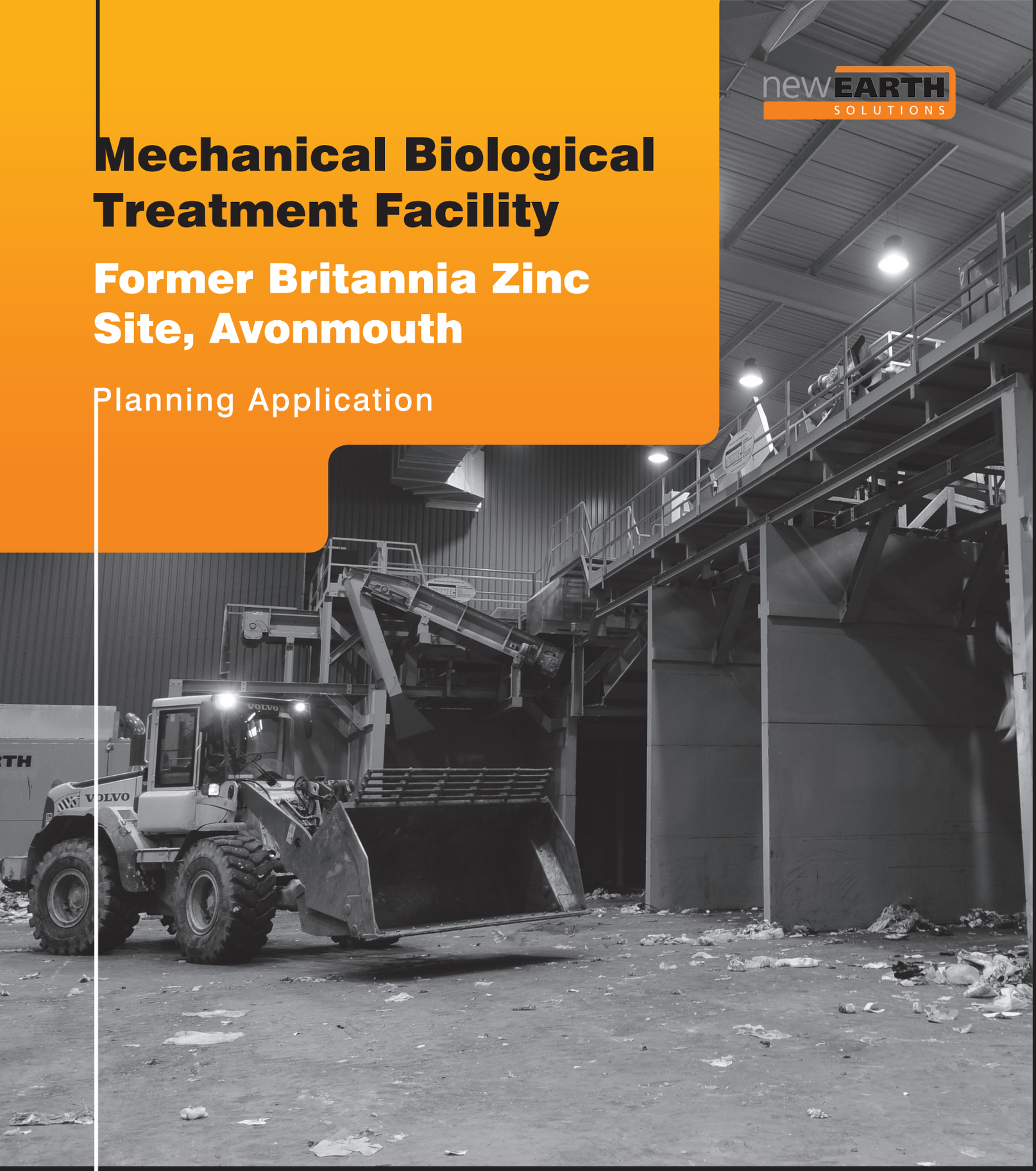
Mechanical Biological Treatment Facility

Former Britannia Zinc Site, Avonmouth

Planning Application



REMEDIATION STRATEGY

Remediation Strategy

July 09

New Earth Solutions Mechanical Biological Treatment Facility

Remediation Strategy

July 2009

Notice

Halcrow Group Ltd has been appointed by St Modwen Developments Limited to provide a Remediation Strategy to accompany a joint planning application between St Modwen Developments Limited and New Earth Solutions for a Mechanical Biological Treatment facility in Avonmouth.

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Halcrow Group Limited

Document History

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Contents

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1. Introduction

Halcrow Group Limited has been commissioned to provide a Remediation Strategy (RS) to accompany a full planning application for a Mechanical Biological Treatment (MBT) facility in Avonmouth.

The MBT facility will be operated by New Earth Solutions (NES) Group Ltd who have won a contract from the West of England Partnership (Bath & North East Somerset Council, Bristol City Council, North Somerset Council and South Gloucestershire Council) to treat 120,000 tonnes per annum (tpa) of municipal waste from the South West of England. The facility will be able to take 200,000 tpa of waste in total and will therefore have the capacity to treat 80,000 tpa of 'merchant' waste outside of the West of England Contract.

Construction is proposed to start in March 2010 and the facility will be operational by April 2011. Once the facility is fully operational it will reduce the amount of bio-degradable municipal waste (within the partnership area) going to landfill by 75%.

The MBT facility will be accommodated on part of the Access 18 site (former Britannia Zinc works), located within the Avonmouth Industrial Area.

The MBT occupies part of Area A as defined within Halcrow's Conceptual Model Report dated May 2005.

2. The Site

2.1 Site description

The proposed development site within Area A of the Access 18 site is centred at National Grid Reference 352100 E 179400 N (Figure 1 refers), on the former mudflats of the Severn Estuary, which is located approximately 1 kilometre to the west of the site. Chemical manufacturers Rhodia Organique Fine Ltd are situated to the north, albeit that the site ceased operations during the latter part of 2008; Yara, formally the Fisons Fertiliser plant now used for fertilizer storage and distribution, to the west. To the south of Area A is the Kings Weston Landfill. The northerly section of the Kings Weston Landfill is a modern commercial landfill which received construction waste from offsite sources, referred to as the Northern Extension which is in the process of being closed. It was constructed with a lined base and with leachate management. The closure will comprise the installation of an engineered cap with associated gas management system. The remainder of the landfill is older and is unlined, having been constructed during the lifetime of the smelting works. Further to the south are other industrial units. A sewage treatment works and agricultural land occupy the area to the east of the site (outside St Modwen ownership).

The site was used for the smelting of metals since the 1920's with smelting operations ceasing in February 2003. The works have recently been dismantled with the whole site proposed for redevelopment.

The overall Access 18 site occupies an area of approximately 95 hectares and comprises former works areas, agricultural land and a landfill, comprising both an above ground slag-heap and an engineered cell. The overall Access 18 site is traversed by a number of drainage channels (Rhines) that encourage surface water drainage. The overall Access 18 site (other than the landfill) has a relatively flat topography and the ground level lies at an elevation of between 6 metres and 8 metres AOD. The top of the adjacent landfill reaches an elevation of approximately 26 metres AOD.

Area A forms the north-western area of the overall Access 18 site and is where the initial smelting works were located. These works were subsequently dismantled and the area was then used for the uncovered storage of feed and recycled materials from the smelting/refining processes. Caesium contaminated material was temporarily stored in the north-west section, which was partially remediated during the early 1990's. This is discussed in Section 4.3.

2.2 Hydrology

Surface water drainage at the site is controlled by a series of drains and Rhines. The Rhines have been variously buried, blocked, placed in culvert and redirected during the expansion of the industrial works. The engineered drainage system is thought to substantially control the natural hydrology of the area. The water levels within the Rhines are not controlled and fluctuate naturally. The Kings Weston Rhine (West) runs along the northern boundary of Area A. There are a number of inlets into the Rhine that are considered to be acting as pathways for contaminated perched water to infiltrate the Rhine. The Kings Weston Rhine (West) eventually discharges into the Severn Estuary approximately 1km to the west of the proposed application site.

The rhine network and their interactions is shown in Figure 2.

2.3 Ground Conditions

2.3.1 Geology

Published Geological information suggests that the site is underlain by considerable thicknesses of Made Ground used to reclaim the land from the tidal flats, which in turn is underlain by Tidal Flat deposits comprising clay and silt, coarsening to a silty fine sand with depth. A thin layer of peat is occasionally present below the sand. The superficial deposits are underlain by Mercia Mudstone Group deposits comprising red, calcareous mudstone (marl), interbedded with sandstone and gypsum horizons to depths of up to 50m bgl (below ground level).

2.3.2 Hydrogeology

Three principal groundwater regimes have been identified at the site; a shallow perched groundwater within the Made Ground, groundwater within the Tidal Flat deposits and deeper apparently isolated groundwater within the Mercia Mudstone Group deposits. Groundwater flow within the Tidal Flat deposits and Mercia Mudstone Group appears to be generally in a westerly direction towards the Avonmouth Docks, the Severn Estuary and possibly the River Avon and is probably tidally influenced.

2.4 Existing Access 18 remediation strategy

In anticipation of developing the former process area which lies within the eastern part of the overall Access 18 site, a remediation strategy was devised which would sever the identified pollutant pathways. The site-wide remediation strategy was approved by Bristol City Council Environmental Health Officers and by the Environment Agency. That remediation strategy however, excluded the proposed application site which, at the time of the overall Access 18 remediation strategy, was proposed for use as a landfill.

Risk assessment identified the following pathways and receptors at the overall Access 18 site:

- Human health – soil ingestion
- Human health – gas inhalation/asphyxiation
- Controlled waters – groundwater and surface water
- Structures and services – gas risk
- Structures and services – aggressive ground conditions

In order to mitigate the risks associated with the site during and following its development for an industrial end-use, the measures described in the following sections were put in place to mitigate the effects. Figures 3 and 4 also refer.

2.4.1 Protection of human health – soil ingestion

A 450mm layer of “clean cover” has been provided to prevent exposure to contaminated in-situ Made Ground. The 450mm includes the pavement and floor slab construction. A marker layer of non-woven geotextile has been used to separate the “clean cover” material from the in-situ Made Ground and Made Ground that has been turned over. An orange coloured Terram-type material has been used for this demarcation purpose elsewhere within the Access 18 development site.

Service trenches have been lined with a similar separator material, and the resulting void backfilled with “clean” granular material.

2.4.2 Protection of human health – gas inhalation/asphyxiation

Elevated concentrations of methane have been encountered, which require the installation of measures to protect the development from the effect of gases originating from the organic soils underlying the site. Whilst the gas monitoring undertaken has demonstrated that a passive system would be appropriate for the concentrations and flow rates of gas which have been recorded active Clean Air Blanket systems has been adopted elsewhere within the Access 18 development.

2.4.3 Protection of controlled water

Ground investigations and groundwater risk assessment has demonstrated that the shallow perched groundwater (i.e. water which is within the Made Ground, perched on top of the naturally occurring clay material), is impacting on the water quality within the rhines which are in turn impacting upon the water quality within the Severn Estuary.

In order to minimise the input of contaminants into the Severn Estuary via the existing rhine system, the remediation philosophy that has been adopted has been to intercept contaminated perched water and collect in a shallow drain. The drain runs from the northern boundary, along the east boundary and along the southern boundary of the former process area, and currently terminates at a recently constructed pumping chamber. Captured water is then conveyed to, and treated at, a new effluent treatment plant (ETP) before being discharged to the Severn Estuary via Kings Weston Rhine (West).

It is intended that a cut-off wall will be installed around the western and southern boundaries of the landfill site. The cut-off along the south of the landfill will tie in to the recently constructed pumping chamber, allowing perched water within the landfill to be conveyed to the ETP.

In order to reduce the recharge of perched water within the former process area, rainfall run-off is controlled by roofs, hardstanding and drains. Clean rainwater is conveyed to a new clean-water rhine, referred to as the East Rhine. The East Rhine, which is present along parts of the northern and eastern part of the former process area, comprises a vegetated channel lined with a geo-composite liner (GCL). The liner prevents ingress of contaminated perched water into the rhine.

In order to protect the deep-lying groundwater, the piling technique adopted for new buildings comprises the installation of driven pre-cast concrete piles, which are cast with tapered leading sections, or are fitted with a sacrificial steel cone at their base. The purpose of the tapered leading section is to promote the lateral displacement of contaminated material thereby reducing the risk of advancing potentially contaminated materials ahead of the pile.

3. Ground investigations

3.1 Introduction

Area A has been subject to previous phases of investigation as part of the 2004 and 2005 site-wide investigations. Further targeted investigation was undertaken during May 2009, designed on the basis of the proposed development.

The borehole and trial pit records for each of exploratory holes undertaken within the confines of the NES site are shown in Figure 5, and the logs for the exploratory holes are appended (Appendix A).

3.2 Previous investigations

Area A has been previously investigated by Ian Farmer Associates (IFA) in May 2004 (Report ref 2624) and March 2005 (Report ref 2780). Those investigations were procured by Halcrow on behalf of St Modwen

An earlier investigation was undertaken by Geotechnical Engineering in December 2001, procured by Hyder Consulting Limited on behalf of Britannia Zinc.

3.3 May 2009 investigation

A site-specific investigation was undertaken by Structural Soils Limited within the confines of the proposed NES site during May 2009. That investigation was procured by Halcrow on behalf of St Modwen.

4. Geo-environmental Assessment

4.1 Introduction

The Made Ground in the vicinity of the proposed NES development site has been shown to contain concentrations of heavy metals, particularly cadmium, lead and arsenic, exposure to which needs to be limited to mitigate the risk of harm to human health and controlled waters. In addition, caesium has been identified within the Made Ground in a localised area within the Eastern portion of the application site.

The results of the chemical testing of soil and groundwater samples are appended in Appendix B.

4.2 Risk assessment

Tier 1 risk assessment have been undertaken to assess the significance of concentrations of contaminants in soil and groundwater in terms of the risk to identified sensitive receptors; occupants of the proposed development and controlled waters. Assessment criteria have been derived from SGV and Generic Assessment Criteria (GAC) developed using the now replaced CLEA UK model for assessing risks to human health and published EQS for assessing risks to controlled waters.

Risks to human health posed during maintenance and construction operations will be short term and controlled using standard health and safety mitigation measures for construction activities.

4.2.1 Human Health

The EA withdrew the Contaminated Land Exposure Assessment (CLEA) model and associated Soil Guideline Values (SGV) in August 2008. A new CLEA Model, version 1.04, was published in mid January 2009 and updated SGV are being published by the Environment Agency on an ongoing basis and to date only a limited number of new standards have been published. Where SGV's have not yet been published, in particular for phytotoxic elements and a number of metals (chromium, copper, lead and zinc) Halcrow will continue to use the original SGV's produced by the previous CLEA model as screening vales to assess the significance of soil contaminant concentrations in relation to risks to human health.

The proposed development of the site corresponds with the CLEA model for a Commercial/Industrial site.

Table 4.1 Summary of exceedences of soil assessment criteria

Determinant	Units	Screening Value	Max (mg/kg)	Mean (mg/kg)	Count	Number exceeding Screening value	% exceeding Screening value
Arsenic	mg/kg	640[#]	5500	912	34	16	47
Cadmium	mg/kg	230[#]	18000	1733	34	22	65
Lead	mg/kg	750*	55000	17447	34	29	85

Current SGV

* Based on previously published SGV"s, derived using the previous version of the CLEA model

Based on Table 4.1, it can be shown that the site, in its current form, poses a risk of harm to human health from arsenic, cadmium and lead. Zinc was not encountered above the site specific assessment criterion of 180,000mg/kg.

Appendix B presents the results of all available soils analysis undertaken and the adopted assessment criteria.

4.2.2 Controlled Waters

Risk to Controlled Waters has been assessed using Environmental Quality Standards (EQS) (Coastal and Estuarine standards). Where EQS values are not available for certain substances UK Drinking Water Standards (DWS) have been used.

Table 4.2 summarises those substances which have been encountered at concentrations in exceedence of the screening value. Groundwater analysis has shown total and dissolved concentrations of various metals in the groundwater to be above the Coastal and Estuarine EQS.

4.2.3 Table 4.2 Summary of exceedences of groundwater assessment criteria

Determinant	Units	Screening Value	Max (µg/l)	Mean (µg/l)	Count	Number exceeding Screening value	% exceeding Screening value
Zinc (total)	µg/l	40	98,000	32,375	11	11	100
Zinc (dissolved)	µg/l	-	16,000	4,529	-	-	-
Arsenic (dissolved)	µg/l	25	1,200	224	8	6	75
Cadmium (dissolved)	µg/l	2.5	1,800	337	8	7	88
Chromium (dissolved)	µg/l	15	16	9	3	1	33
Copper (dissolved)	µg/l	5	230	47	7	5	71
Lead (dissolved)	µg/l	25	9.300	1,408	8	5	63
Mercury (dissolved)	µg/l	0.3	1	0.4	6	3	50

Appendix B presents the results of all available groundwater analysis undertaken and the adopted assessment criteria.

Sediment within Kings Weston Rhine (West) has been shown to contain significant concentrations of heavy metals, specifically cadmium, zinc, lead and arsenic.

The most significant and direct pathway for contaminated groundwater from the application site to impact the Severn Estuary is likely to be via Kings Weston Rhine (West) which forms the northern boundary of the proposed application site, and eventually discharges to the Severn Estuary. There is historical and ongoing impact of the Rhine with zinc and other heavy metals. However, off-site monitoring of drainage features has demonstrated that Kings Weston Rhine (West) is not the principal source of zinc entering the Severn Estuary. The remediation strategy that has, to date, been partially implemented for the overall Access 18 site has been designed to sever that pollutant linkage. There are a number of remaining but redundant outlets into the Kings Weston Rhine (West) from Area A, some of which are thought to be linked with the drainage system from the original smelter complex. These drains are likely to be acting as pathways between the perched water in Area A and the Kings Weston Rhine (West). In addition, perched groundwater could flow directly into Kings Weston Rhine (West), although the flow of perched water appears to be restricted by the presence of buried obstructions such as remnant foundations.

4.2.4 Ground Gas

Ground gas has been encountered across the entire Access 18 site, typically as Characteristic Situation 2 (CS2) in accordance with CIRIA publication C665 (2007). However, a gas pocket was encountered within the alluvial deposits during the drilling of borehole BHNES06. Periodic monitoring has been undertaken on two occasions. During the first round of monitoring, a peak gas flow rate of 21.7l/hr was recorded with a peak concentration of 69% (volume in air) of methane, resulting in a GSV of 14.97, which characterises the site as CS4. However, the flow rate rapidly (within 5 seconds) dropped to zero, with a methane concentration of 40%, resulting in a GSV of 0.4, which characterises the site as CS1. The presence of other such isolated pockets of ground gas should not be discounted.

The results of the available gas monitoring data are appended (Appendix B)

4.3 Caesium 137

Part of the proposed application site was formerly used for the stockpiling of zinc-rich metaliferous bi-products imported from other industrial facilities. One such consignment of by-product, which was imported from Irish Steel during the late 1980's or early 1990's, was subsequently found to contain a small amount of the man-made radioactive isotope caesium-137 (Cs^{137}). The Irish Steel Stockpile area was remediated by Rolls Royce Nuclear Engineering Services Limited (RRNESL) during 1993; the remediation comprised to removal of the stockpiled material which was returned to Irish Steel, and the excavation of the Made Ground underlying the stockpile. The excavated material was monitored for radioactivity and segregated for appropriate disposal. During the course of that operation, an area of impenetrable concrete was encountered. The concern was that some radioactive contamination may have leached from the stockpile and migrated beneath the concrete. As a precautionary measure, it was agreed between Britannia Zinc Limited and the then Her Majesty's Inspectorate of Pollution (HMIP) that a 225mm thick concrete slab be cast across the area to cap and mitigate the risk of residual contamination. The location of the potential caesium contamination and the concrete slab constructed as a mitigation measure is shown in Figure 6.

RRNESL expressed the opinion that the impenetrable concrete might contain asbestos; however analytical testing certificates to substantiate this have not been made available. In order to address this issue and to inform subsequent "safe systems of work" for the

breaking out of the concrete which would be necessary during the pre-construction enabling works, St Modwen procured an investigation during June 2009 to recover cores of the concrete which were then subject to asbestos screening. Asbestos was not identified in any of the samples tested. The findings of that investigation are presented in Annex 1 of this report.

That investigation was undertaken under the observation of Aurora, a specialist supplier of Health Physics services. Field monitoring of radiological activity was undertaken by Aurora. Readings above the normal background of 5-6 cps were not recorded, prior to breaking the concrete. During the excavation works a drain was uncovered and direct monitoring with the probe indicated an increased level above background (20 cps compared to a background of 5-6 cps). Aurora identified that this increase could be due to naturally occurring radioactive material (NORM) in ceramics or brick in the drain construction materials. However, a sample of sludge from within the drain was collected for subsequent laboratory testing.

Health physics monitoring was also conducted before and during drilling operations for concrete core samples. Readings above background levels were not detected. On completion of the work all equipment was monitored by direct probe and smear sample and radiological contamination was not identified.

The sludge sample from the drain was subsequently analysed by high resolution gamma spectroscopy to determine if radioactive contamination was present. The sample identified the presence of Cs^{137}, which recorded a concentration of 530 (± 30) Bq/kg (0.56Bq/g). The significance of this value is assessed in Section 4.3.1 below.

4.3.1 Risk Assessment

Human health

A Tier 1 radiological risk assessment has been undertaken using the EA's Radioactively Contaminated Land Exposure Assessment (RCLEA) methodology. Table B contained within the EA's CLR-13 (October 2006) provides a Soil Guideline Value (SGV) of 20,000Bq/kg (20Bq/g) for Cs^{137} for a Commercial/Industrial land use, with respect to radioactivity in soil and human health. CLR-13 states that "harm" should be regarded as being caused where lasting exposure gives rise to doses that exceed one or more of the following criteria:

- An effective dose of 3 mSv/y (milisieverts per annum)
- An equivalent dose to the lens of the eye of 15 mSv/y; or
- An equivalent dose to the skin of 50 mSv/y.

CLR-13 also states that it is highly unlikely that the criterion for the lens of the eye would be exceeded without the other criteria also being exceeded.

A site specific assessment criterion (SSAC) has been calculated using the RCLEA methodology, which produced a Guideline Value for Cs^{137} of 90,000 Bq/kg, based on an industrial setting, concrete and brick construction, and worst case sex and age of receptor. This is calculated to produce a total dose of 0.019 mSv/y.

An investigation is ongoing to demonstrate that materials exceeding the SSAC are not present at the site, and this will be reported under separate cover. Provided that this is

the case, it is considered that the presence of former radioactive contamination will have no detrimental effect on the proposed development.

The Environment Agency has concurred that the use of RCLEA is appropriate under the particular circumstances of the proposed application site.

Controlled waters

The installation of the cut-off barriers and the associated carrier drains will sever potential linkages to Kings Weston Rhine (West), hence further consideration of risks to controlled waters area not required.

5. Remediation Options Appraisal

5.1 Identified Existing Pollutant Linkages

With regard to human health, the active pathways to end users of the site are those identified for a commercial/industrial end use as defined in the former CLR10 for people working onsite;

- Oral pathways
- Dermal contact
- Indoor and outdoor vapour
- Indoor and outdoor dust

The end use of Area A will necessitate predominantly hard cover in the form of buildings, hardstanding and access roads.

The most significant and direct pathway for contaminated groundwater from Area A to impact the Severn Estuary is likely to be the Kings Weston Rhine West which form the northern boundary of Area A and eventually discharges to the Severn Estuary. There is historical and ongoing impaction of the Rhine with zinc the remediation strategy that has partially been installed for the whole of the site has been designed to sever that important contaminant linkage. There are approximately 19 outlets into the Kings Weston Rhine from Area A and the Rhodia site, some of which are thought to be linked with the drainage system from the original smelter complex. These drains are likely to be acting as pathways between the perched water in Area A and the Kings Weston Rhine. In addition, perched groundwater could flow directly into Kings Weston Rhine.

In addition the deep groundwater within the Tidal Flats deposits flowing westwards across the site has been calculated to take approximately 18.4 years to reach the Avonmouth Docks (500m) and approximately 36.7 years to reach the Severn Estuary (1000m). This is seen as a less important pollutant linkage than the perched groundwater which is likely to be providing base flow to the Rhine system and impacting the Severn Estuary.

5.2 Remediation Options

Where a plausible pollutant linkage has been identified, (i.e. a source-pathway-receptor relationship) or a plausible linkage has been proven actions for removing the linkage include removal of the source, severing the pathway or removing/managing the receptors. In this case it is considered that both the human and controlled water targets are permanent features and therefore either removal of the source or management of severance of the pathway will be required to break the pollutant linkage. Since the source is generally the heavy-metal rich Made Ground, source removal is not a feasible option, neither financially nor in terms of its sustainability.

The remediation options which are anticipated for the proposed application site are complimentary to the remediation measures which have been previously approved by the EA and BCC for the Access 18 development site, which lies to the east of the proposed application site. A remediation options appraisal table for Area A is presented below;

Table 5.1: Remediation Options – Area A

Potential Issues	Potential Linkages	Action	Associated Remediation	Validation Required	Notes
Area wide heavy metals in Made Ground and upper horizons of Tidal Flat deposits	Perched water / groundwater / direct contact	Remove obstructions, reduce infiltration	Cover to be provided in the form of the building and hardstanding. Clean sub-base to be imported to provide a 450mm clean cover Mitigate recharge of perched water by provision of impermeable hard surfacing and separating clean rainwater from contaminated perched water.	Yes if removed (monitoring wells to be installed around landfill construction)	Provision of lined clean water conveyance systems
Heavy metals in perched water	Groundwater migration offsite via rhine network	Containment	Shallow groundwater interception via barriers and carrier drains within Area A to capture contaminated perched water from Area A and convey to on-site ETP	Yes	
Heavy metals within wind blown dust	Airborne	Cover	Provide areas not occupied by building or hardstanding with inert cover. Total cover not to be less than 450mm	Yes, testing of cover (quality, thickness etc)	Material to by approved prior to placement
Presence of underground drains / pipe outlets to Kings Weston Rhine	Groundwater / perched water / surface water	Remove redundant pipe work during a pre-construction enabling works contract	Remove or grout up any underground drains and inlets encountered during pre-construction enabling work contract.	Yes	Monitor Kings Weston Rhine (West)
Heavy metals in perched water	Migration of perched water to deeper-lying water bodies via piled foundations	Containment	Hard cover leading to reduction of infiltration of rainwater and generation of perched water.	Yes	Pile specification to be in line with EA guidance document
Heavy metals in surface water	Off-site migration of contaminated surface water from Kings Weston Rhine (West)	Source removal	Dredge sediment from Kings Weston Rhine (West)	Yes	Chemical testing of removed sediment and of samples collected from invert of rhine following sludge removal

5.3 Proposed Remediation

The construction of the proposed development will reduce the pollutant linkages to end users by providing a cover above the Made Ground over a significant proportion of Area A. The associated control of rainfall will significantly reduce the surface infiltration of rain water, reducing the leachate loading on the perched groundwater beneath the site.

5.3.1 Enabling works

Prior to construction of the proposed development, the existing derelict concrete structures (such as pile caps, floor slabs and redundant drainage runs) will be generally removed to a level of 1.5m below existing ground level during a pre-construction enabling works contract, with ground levels reduced to formation level. Any obstructions which remain in the ground following this exercise will be surveyed and their locations noted to inform the design of below ground works.

5.3.2 Clean cover

Outside of the footprint of the proposed building, it is proposed to provide a 450mm thick clean cover using a suitable fill material, however, this 450mm includes the pavement and floor slab construction in paved areas. This material should be suitable for use within an industrial/commercial setting. A minimum of one sample per 500m^3 of imported material should be tested, for an appropriate suite of determinants. However, materials imported to site that have been produced in accordance with the Waste Resource Action Plan (WRAP) Quality Protocol (QP). The suite of contaminants tested for should reflect the use of the land the material was sourced from and a suitable human health risk assessment should be carried out so as to be compliant with current UK Guidance to demonstrate that the material placed is suitable for use.

5.3.3 Cut-off drain

Following discussions with the Environment Agency it is proposed at this stage to deal with the shallow perched groundwater pathway which is likely to be impacting the Rhine system around the site. The presence of shallow groundwater is due to surface water infiltration and the relatively impermeable nature of the near surface Tidal Flat Deposits. Whilst the placement of the proposed development will significantly reduce the infiltration of surface water and together with the removal of the existing discharges into the Kings Weston Rhine, will significantly reduce this potential linkage, it is recommended that a shallow groundwater interceptor drain be installed. This is likely to comprise a relatively shallow trench, terminated within the tidal flat deposits. The off-site face of the trench (i.e. the face towards Kings Weston Rhine) will be lined with either an impermeable liner, either HDPE or a geocomposite clay liner (GCL). A perforated pipe would be installed within the base of the trench to act as a carrier drain, and the remainder of the trench backfilled with suitable granular pipe bedding. The carrier drain would convey water to the south or southeast corner of the NES site, where a pumping station would be constructed. Intercepted perched water would then be conveyed to the ETP, likely via the carrier drain which is proposed as part of the landfill cut-off wall. A schematic cross-section of the proposed remediation is shown as Figure 7 and a schematic plan of the proposed remediation is shown as Figure 8.

5.4 Construction considerations

5.4.1 Unexpected contamination

Areas of unexpected contamination, if encountered, should be segregated and stockpiled within the confines of the overall Access 18 site. Representative samples of the material would be sampled and the fate of the material determined, subject to the findings of the laboratory analysis. Subject to the findings of appropriate testing and where necessary, risk assessment, the material would be re-used as engineering fill.

5.4.2 Control of perched water

During construction works, there is a risk that excavation and removal of underground obstructions might alter the near surface groundwater regime and may in turn mobilise contamination, potentially causing impact to the adjacent Kings Weston Rhine (West). To mitigate the risks, excavation works will be kept to a minimum. Where perched water is encountered during excavation operations, it will be pumped to the ETP for treatment prior to its discharge to the Kings Weston Rhine (West).

5.4.3 Soil gas

A suspected pocket of soil gas was encountered during the recent ground investigation. An appropriate gas risk assessment should be undertaken prior to the commencement of piling operations. Notwithstanding this, vigilance will be required during piling operations for other pockets of soil gas, and should soil gas be encountered, site operations should be suspended pending monitoring of the work space and appropriate dynamic risk assessment.

6. Validation Requirements

6.1 Clean Cover

The thickness of imported clean cover placed will be controlled by New Earth Solution's groundwork contractor with both pre and post placement surveys. Third party confirmation will be provided by the Engineer via the excavation of shallow inspection pits at regular intervals across the site.

A demarcation layer will be placed between the in-situ Made Ground and the imported/site derived clean cover material by New Earth Solution's groundworks contractor prior to beginning any other works following the earthworks exercise undertaken by St Modwen.

6.2 Protection of Kings Weston Rhine (West)

Following construction of the peripheral cut-off and the removal/capping of the redundant drainage and pipe work, the existing monitoring strategy will be continued. Should successive surveys indicate that zinc levels have not reduced then consideration shall be given to the dredging of Kings Weston Rhine (West) as part of the overall Access 18 site-wide remediation strategy.

6.3 Perched Groundwater

The proposed development and the removal of redundant drainage which formerly discharged into Kings Weston Rhine will effectively cut the identified pollutant linkage via the shallow perched groundwater. To validate this it is proposed to install a number of permanent and semi-permanent shallow groundwater monitoring wells on the development site side of the cut-off drain. These will be monitored on a regular (monthly) basis as part of the monitoring of the whole of the Britannia Zinc site.

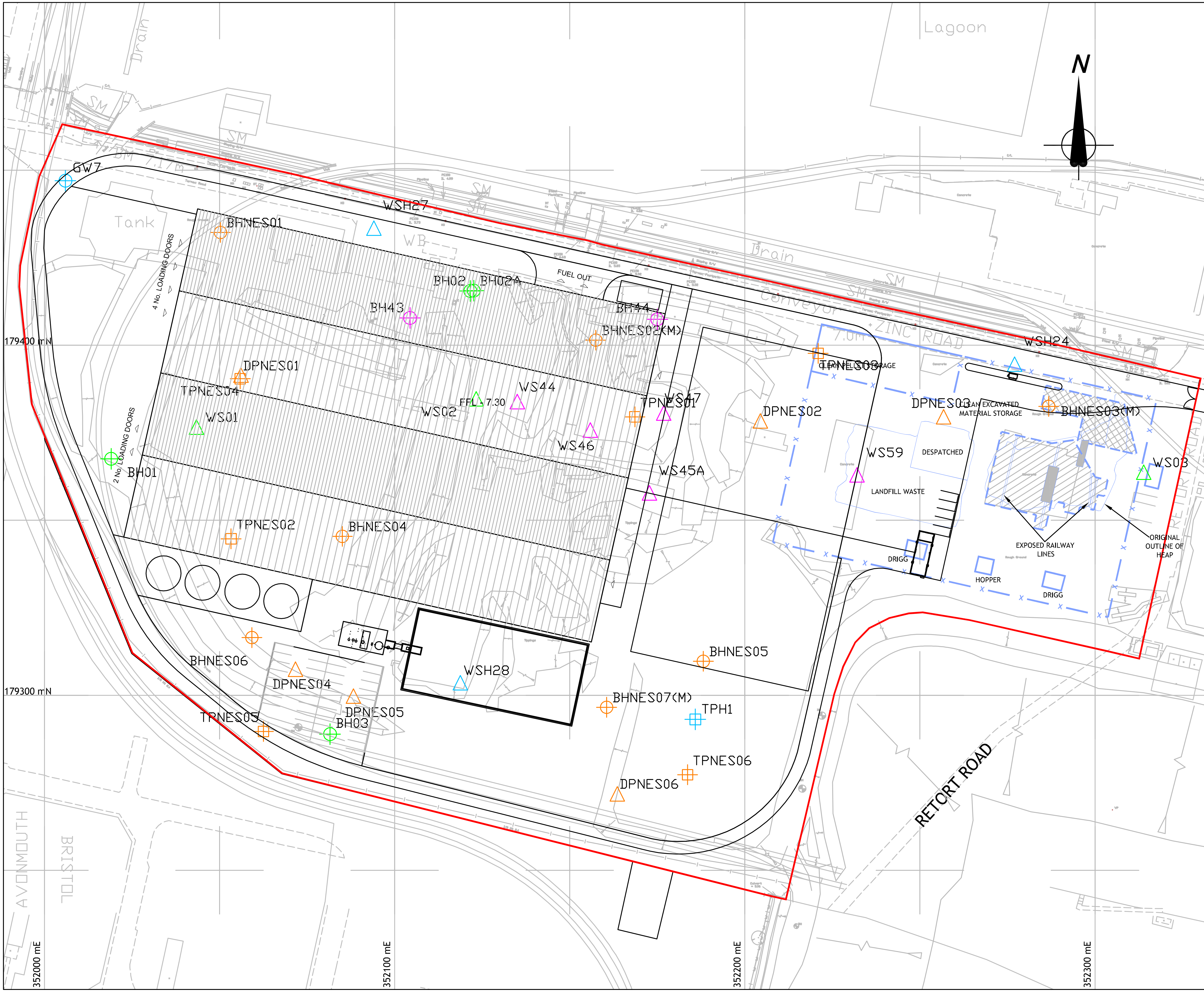
6.4 Validation Report

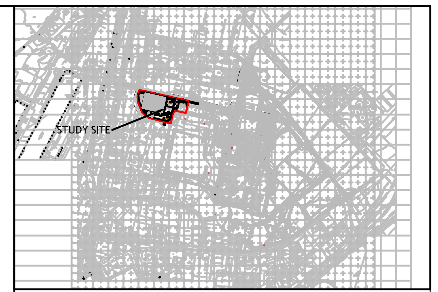
On completion of the St Modwen earthworks contract to remove underground obstructions, sever drainage linkages and install the cut-off wall, a partial Validation report will be produced by Halcrow Group Ltd, detailing the work carried out to date. Once New Earth Solutions (NES) take possession of the site, they will be responsible for placing the demarcation layer and then confirming the source and suitability of clean material prior to importation, the thickness of clean cover placed, and the results of the ongoing Kings Weston Rhine surface water surveys.

NES will be responsible for completing the validation exercise which will include construction of the required hard-paved impermeable areas, installation of the gas protection regime and other items required to complete the remediation strategy.

The Validation Report should be submitted to the Environment Agency and Local Authority for sign off of the regulatory process and discharge of planning conditions.

Annex 1





Key plan scale 1:50,000

Key:

- SITE BOUNDARY
- EXISTING FEATURE / SLABED AREA

IAN FARMER ASSOCIATES MAY 2004 GI, BRITANNIA ZINC, AVONMOUTH (REF 2624)

- BH1 — BOREHOLE LOCATIONS
- WS1 — WINDOW SAMPLE BOREHOLES

IAN FARMER ASSOCIATES MARCH 2005 GI, BRITANNIA ZINC LTD - PHASE 2 (REF 2780)

- BH1 — BOREHOLE LOCATIONS
- WS1 — WINDOW SAMPLE BOREHOLES

HYDER CONSULTING LTD, DECEMBER 2001 IPPC PHASE 2 ASSESSMENT (GI UNDERTAKEN BY GEOTECHNICAL ENGINEERING)

- WSH1 — WINDOW SAMPLE BOREHOLES
- TPH1 — TRIAL PIT
- GW7 — BOREHOLE LOCATIONS

PROPOSED EXPLORATORY HOLE LOCATIONS

- BHNES03 — BOREHOLE LOCATIONS
- TPNES03 — TRIAL PIT LOCATIONS
- DPNES03 — WINDOW SAMPLE BOREHOLES LOCATIONS
- (M) — MONITORING STANDPIPE
- AREA 2 TO BE EXCAVATED TO 1.5m
- AREA 1 TO BE EXCAVATED TO 300mm
- AREAS TO BE EXCAVATED TO 700mm

NOTES:

1. LAYOUT OF PROPOSED STRUCTURE IS BASED ON ROBERTSLIMBRICK DRAWING NO. 6138/PL02B DATED APRIL 2009.
2. EXISTING FEATURES ARE TAKEN FROM PHASE 3 PROGRESS REPORT, REPORT NO. WMU 093/170

Rev	By	Chkd	Apprvd	Date	Description

Client

ST.MODWEN

Halcrow Group Limited
One Kingsway Cardiff CF10 3AN
Tel +44 (0)29 2072 0920 Fax +44 (0)29 2072 0880
www.halcrow.com

Halcrow

Project

ACCESS 18
AVONMOUTH

Drawing

HISTORICAL RADIOACTIVITY
(IRISH STEEL STOCKPILE)

Drawn by: ADW Date: 11.05.2009
Checked by: NJC Date: 11.05.2009
Approved by: NJC Date: 11.05.2009

Drawing No. PIHASM/SK/011 Revision 0

Drawing Scale: 1:1000 at A3

Drawing file path & name :
Xreference file path

Halcrow Group Limited
One Kingsway Cardiff CF10 3AN Wales
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www.halcrow.com

Halcrow

Technical note

Project	Access 18, Avonmouth New Earth Solutions	**Date**	29 July 2009
Note	Preliminary investigation - potential asbestos-containing concrete – Rev 1	**Ref**	PIHNES/22.3/002 Rev1
Author	Nathan Cummins		

1. Introduction

In 1990, the current Access 18 development site was subjected to a radiological survey of the entire property. That survey identified two areas of radioactivity; subsequently referred to as the RTZ hotspot and the Irish Steel hotspot. The locations of those areas of contamination are shown on Figure PI/HASM/SK011.

The RTZ hotspot area was cleared in 1993 and a Radiological Clearance Certificate issued. This area is not believed to pose a constraint to development, and further monitoring is not required.

The entire Irish Steel Stockpile area was part-treated by Rolls Royce Nuclear Engineering Services Limited (RRNESL) during 1993 and a Radiological Clearance Certificate for Areas 1 and 2 within the Irish Steel Stockpile was issued on 15 June 1993. However, the RRNESL report also identified areas of suspected asbestos-containing concrete within Area 1 of the Irish Steel Stockpile; however this can not be substantiated since analytical testing certificates were not appended within reports. A concrete slab was cast over the suspected areas of radioactive and asbestos containing material by RRNESL as part of their remediation, approved by the then Her Majesty's Inspectorate of Pollution (HMIP).

The location of the concrete slab is within the demise of the proposed New Earth Solutions site, as such the concrete will be a constraint to the development and is likely to require partial or complete removal.

A preliminary investigation was undertaken during June 2009 to confirm the location of the asbestos-containing concrete and establish whether it contained asbestos, and thereby inform safe systems of work required for subsequent phases of investigation and development.

Analytical testing of concrete cores did not identify asbestos. As a result specific precautions will not be required to protect site operatives in respect to exposure to asbestos during breaking out the concrete. It is recommended however, that a precautionary approach to further work is adopted, particularly when excavating along the edged of the concrete as asbestos cement sheeting may have been used as temporary shuttering.

It will be necessary for a specialist radiological surveyor to be present on site during the breaking out of the concrete to undertake field measurements of radiological activity and take appropriate samples should suspected radiological contaminated sediment be encountered, either beneath the concrete slab or within any redundant drainage pipes or services trenches which may be present.

2. Preliminary investigation of potential asbestos-containing concrete

Ian Farmer Associates (IFA) was appointed to carry out the preliminary works to determine whether the concrete slab contained asbestos. These works involved excavating a trench approximately 25m long by 1m wide across the concrete slab cast by RRNESL in an east-to-west direction to expose the underlying potentially asbestos-containing concrete (Plates 1 and 2 refer). Once the concrete slab was exposed, IFA cored four concrete samples at approximately 6m intervals along the trench with a water flush to provide mitigation against the generation of dust (Plates 3 and 4 refer).

The concrete cores were sub sampled and subjected to laboratory analysis for the presence of asbestos. None of the 13 sub samples which were analysed reported that asbestos was present.

Table 1 – Laboratory results

Sample Ref	Depth (m)	Material	Result
CC1	0.30-0.53	Concrete	NAD
CC1	0.53-1.35	Concrete	NAD
CC1	1.35-1.42	Concrete	NAD
CC1	1.42-1.71	Concrete	NAD
CC2	0.30-1.34	Concrete	NAD
CC3	0.30-0.43	Concrete	NAD
CC3	0.43-0.49	Concrete	NAD
CC3	0.49-1.06	Concrete	NAD
CC3	1.06-1.39	Concrete	NAD
CC3	1.39-1.79	Concrete	NAD
CC4	0.30-0.92	Concrete	NAD
CC4	0.92-0.98	Concrete	NAD
CC4	0.98-1.28	Concrete	NAD

* NAD – No asbestos detected

Specific precautions will not be required to protect site operatives in respect to exposure to asbestos as a result the concrete slab within the New Solutions footprint can be broken out using conventional techniques. A precautionary approach to further work will be required, particularly when excavating along the edged of the concrete, as the potential for asbestos cement sheeting to have been used as temporary shuttering cannot be discounted.

3. Further radiological investigation

The concrete will require removal from within the development site, to allow piling operations or other construction activities from being constrained by buried obstructions. During the breaking out of the concrete, it will be necessary for a specialist radiological surveyor to be present on site to undertake field

measurement of radiological activity. The input of the radiological surveyor on site will be dependant upon a number of issues, such as the quantity of concrete to be broken out and the rate at which it is being broken-out.

Aurora has advised that based on the findings of RRNESL's investigations, the levels of activity anticipated would necessitate personal protective equipment (PPR) limited to disposable gloves and Tyvex-type disposable overalls. Should the field monitoring identify levels of activity of the order of 10's of Bq/g, the PPE requirements would be increased to include disposable half-face masks.

The survey stage of any work is not notifiable however if the levels are detected greater than 10Bq/g or the total activity exceeds 10kBq then the HSE will need to be informed 28 days before remediation work starts.

Investigation Photographs

Plate 1 – Area of works

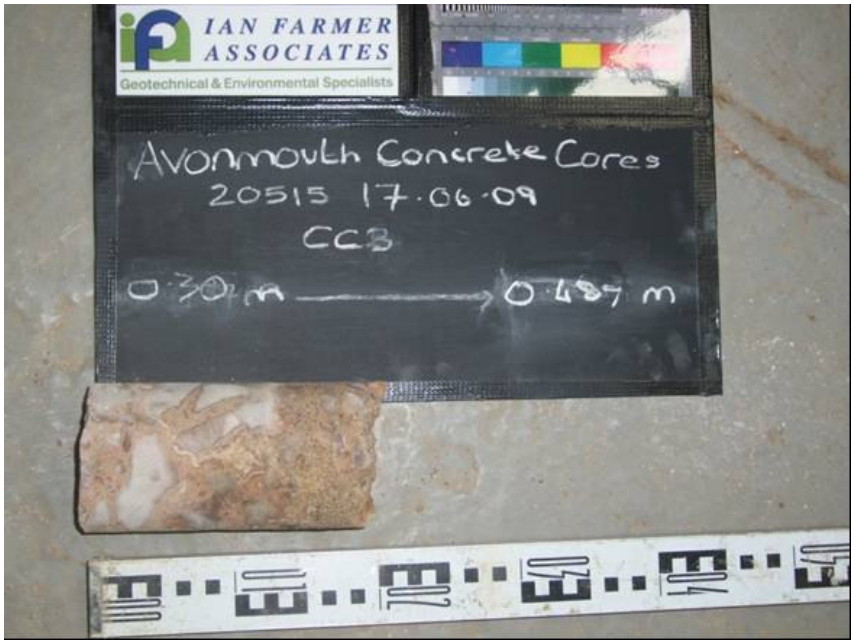
Plate 2 – Trench dug to expose potential asbestos containing concrete

Plate 3 – Concrete coring

Plate 4 – Concrete cores recovered

Concrete core photographs


IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC4
0.30 m
1.284 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC3
0.30 m
0.484 m

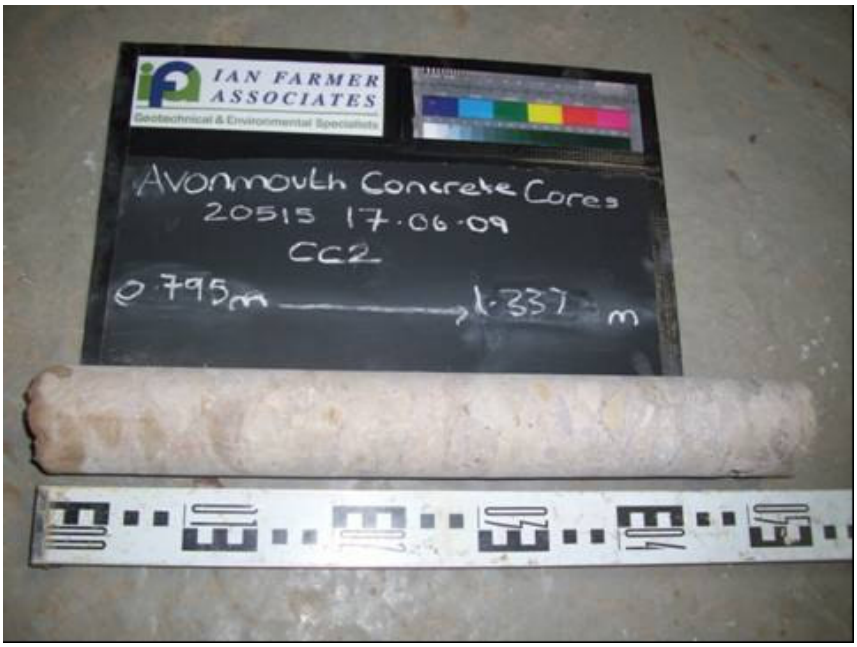

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC3
0.487m
1.06 m

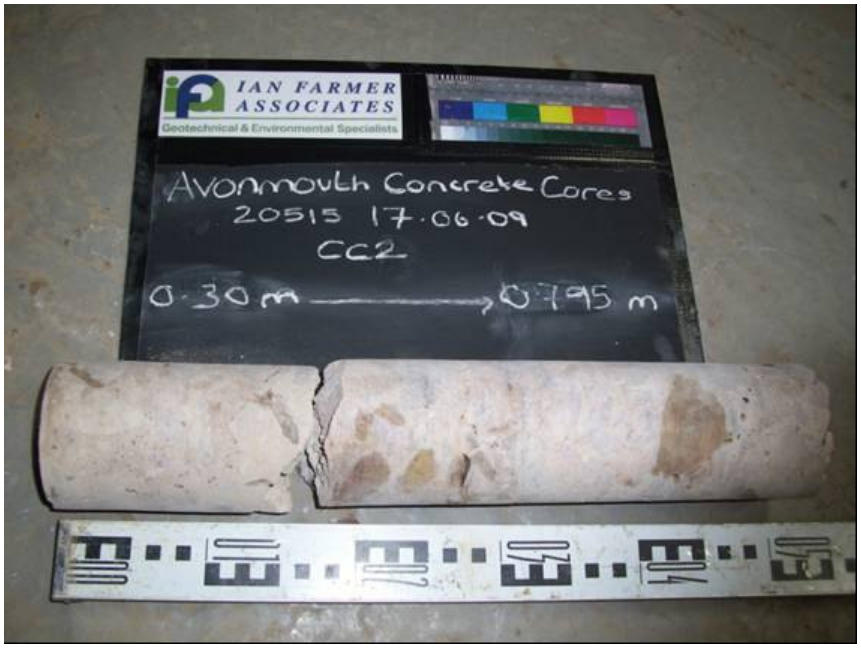

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC3
1.06 m
1.38 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC3
1.385 m
1.785 m

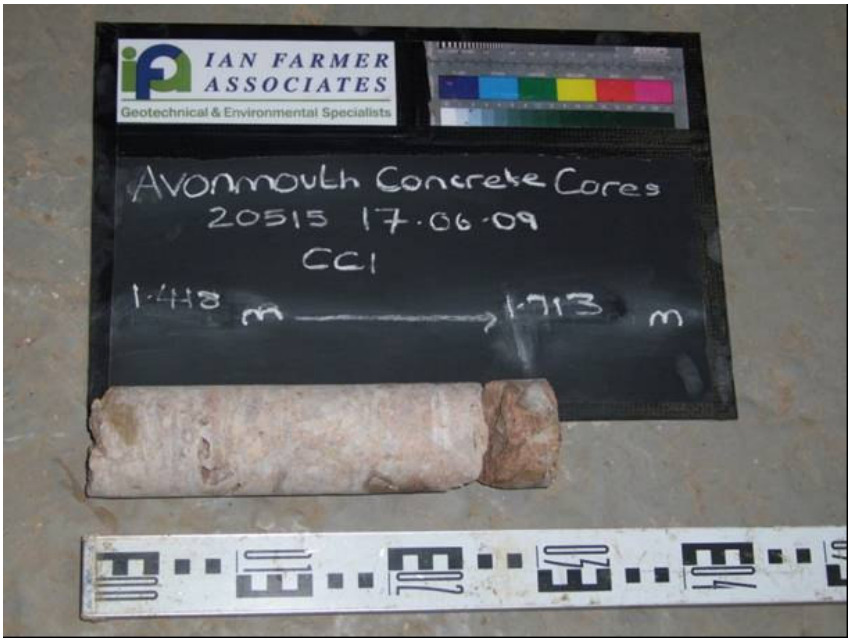

IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC3
1.085 m
1.785 m

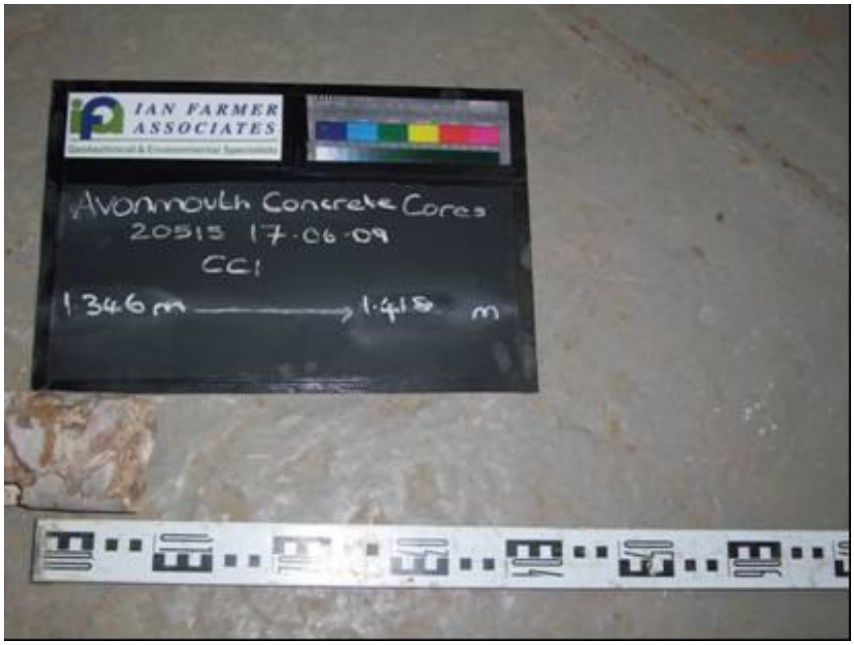

IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC3
0.30m
1.00 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC2
0.795m
1.337 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC2
0.30 m
0.795 m

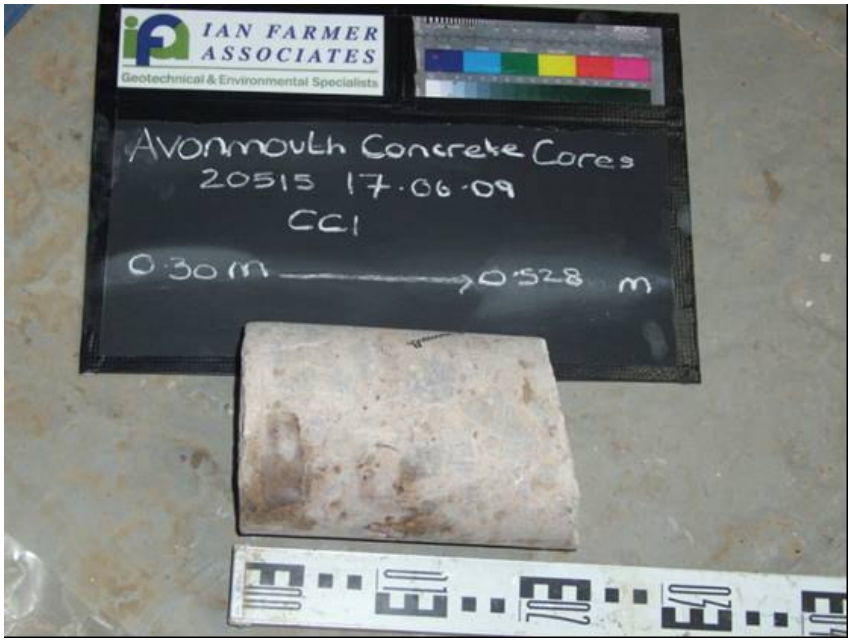

IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC2
0.30 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC1
1.413 m
1.713 m


IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC1
1.346 m
1.415 m


IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC1
0.528 m
1.346 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC1
0.30 m
0.528 m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC1
0.30m
0.528 m


IAN FARMER ASSOCIATES
Avonmouth Concrete Cores
20515 17.06.09
CC1
0.903m
1.713m


IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists
Avonmouth Concrete Cores
20515 17.06.09
CC1
0.30m
0.903m

Key:

Whole Access 18, Avonmouth site boundary

Application site boundary

CLIENT: newEARTH SOLUTIONS

PROJECT: ACCESS 18, AVONMOUTH

DRAWING TITLE: LOCATION PLAN

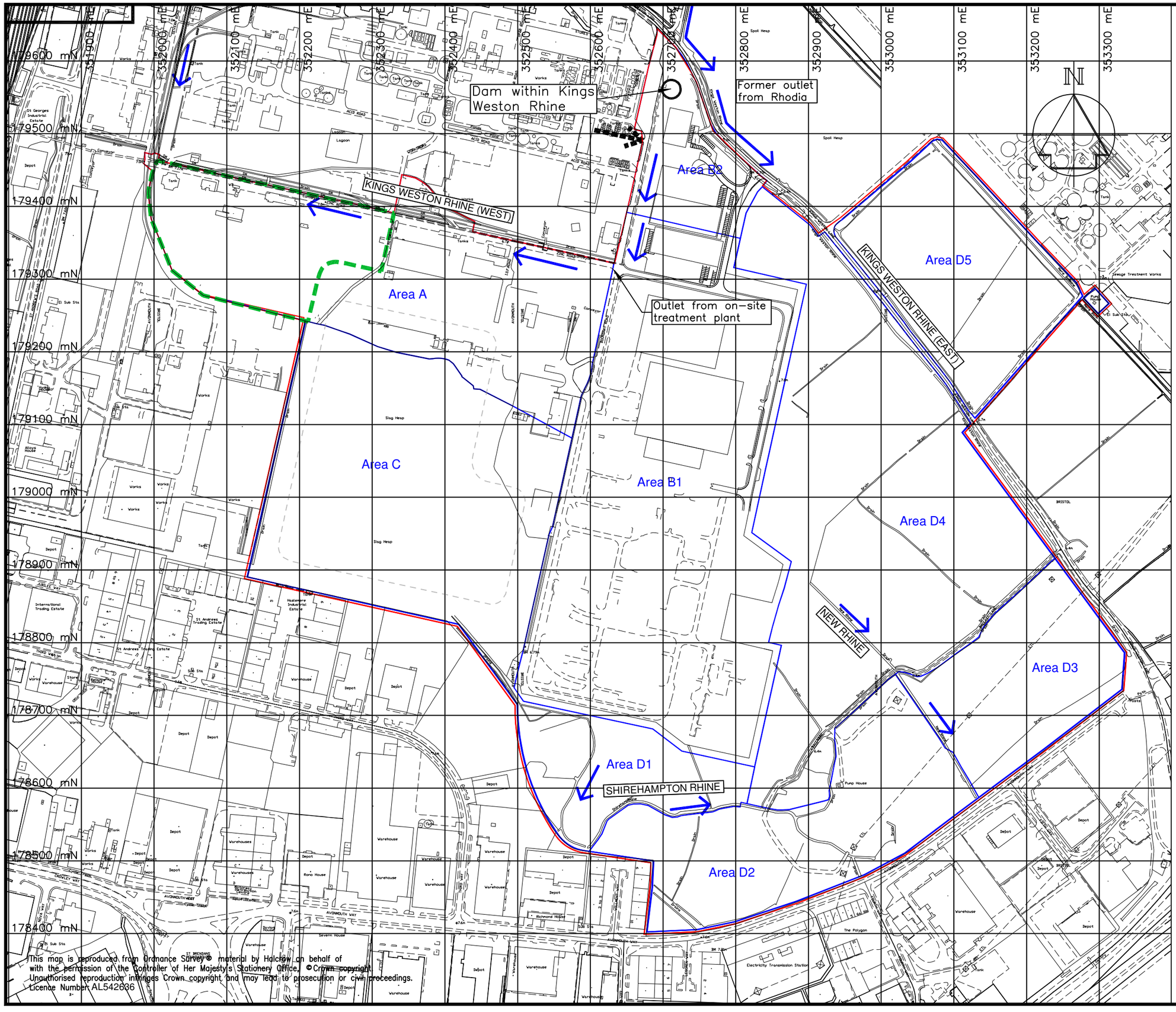
Sheet Size: A4

SCALE: 1:50,000

PURPOSE OF ISSUE	Rev.	Auth'd	Date	REVISIONS	Drawn	Chkd.	Date
Plot Date: 17/07/09		Cad Ref:			-		

DRAWING NO: FIGURE 1

REV: -



Key:

- Whole Access 18, Avonmouth site boundary
- Access 18, Avonmouth area boundaries
- Application site boundary
- Direction of flow
- Approx location of former Rhodia discharge

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

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ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

DRAWING TITLE
EXISTING RHINE NETWORK

SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:5000	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09
0	SHEET A3	PLOT DATE 24/07/09	

DRAWING NO
FIGURE 2

REV
—

Application site

vinyl pile cut-off wall (Proposed)

LANDFILL

ACCESS 18 DEVELOPMENT SITE

Shallow groundwater collection system and rhine

Existing ETP

Landfill cut off wall (Proposed)

Shallow groundwater pumping station

Shallow groundwater collection system

Key:

- Whole Access 18, Avonmouth site boundary
- Application site boundary

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

newEARTH SOLUTIONS

ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

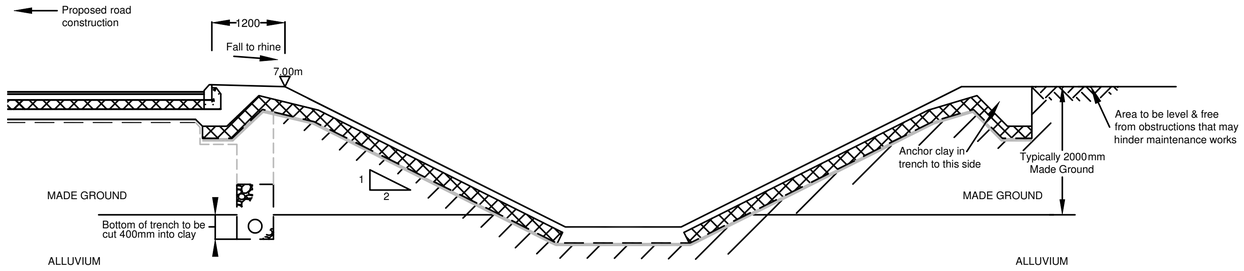
DRAWING TITLE
PLAN OF SITEWIDE REMEDIATION

SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:5000	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

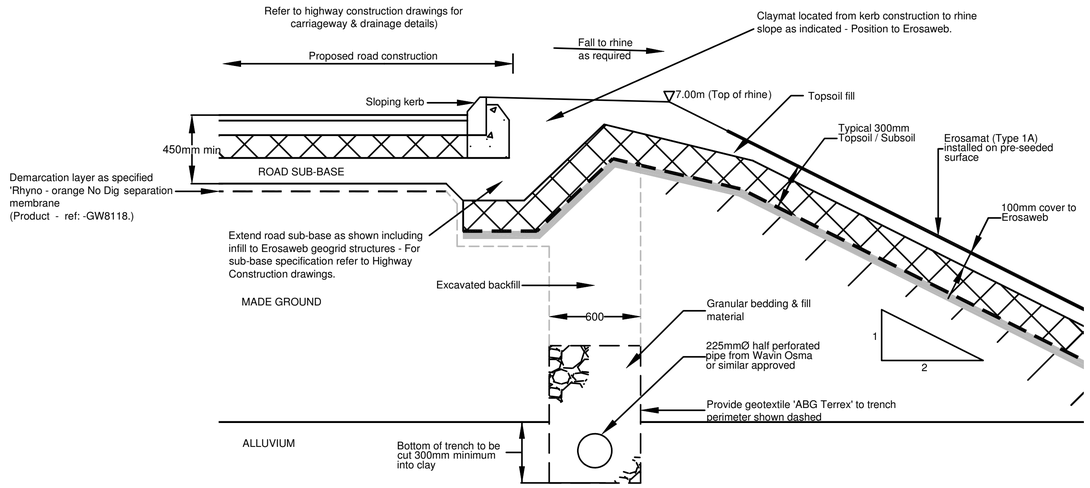
SHEET	PLOT DATE
A3	24/07/09

DRAWING NO
FIGURE 3

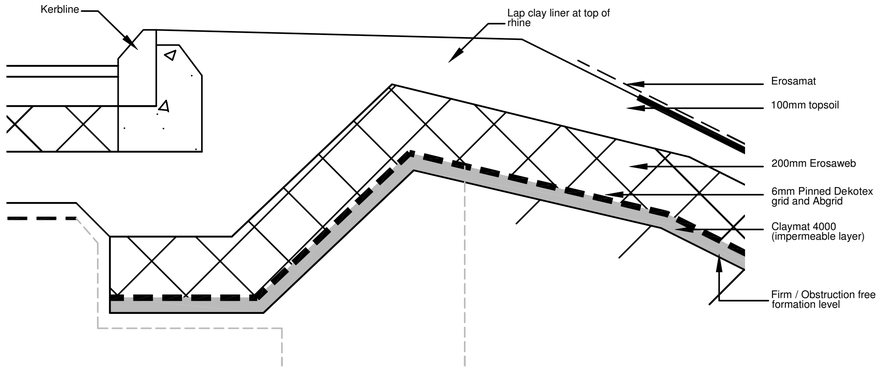
REV
—



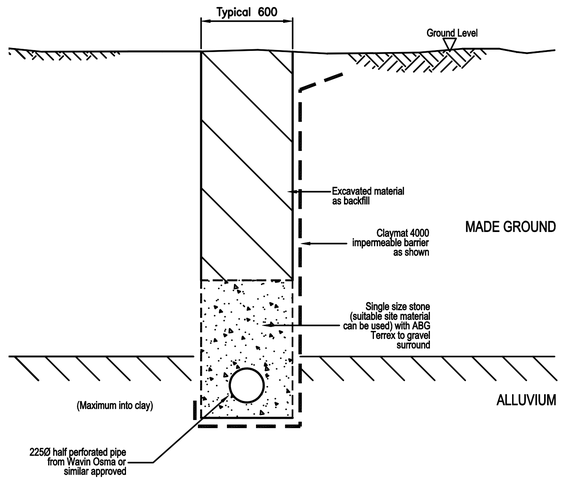
TYPICAL CROSS SECTION THROUGH SHALLOW GROUNDWATER COLLECTION SYSTEM & RHINE



DETAIL OF COLLECTION DRAIN / RHINE



DETAIL OF CONSTRUCTION OF TYPICAL ANCHOR TRENCH DETAIL TO TOP OF RHINE



TYPICAL DETAIL OF SHALLOW GROUNDWATER COLLECTION SYSTEM

RHINE LINER MATERIAL SPECIFICATION (IN SEQUENCE OF CONSTRUCTION)

Layer	Specification & roll size
Claymat 4000 Fibre reinforced geosynthetic clay liner	(Impermeable) - 300mm soil cover Roll size 4.85m x 50m (Dia 0.7m - weight =975kg)
ABGRID PP20/20 (Geogrid)	Polymer grid - Apertures 20x20 Roll size 4.75x100m
Dekotex (Geogrid)	Glass fibre/PVC - Apertures 7-10mm (Roll size 1m x 50m)
Erosaweb (GW200/300) 1m wide	Honeycomb expandable structure -HDPE to be pinned using typically 8mmx400mm steel pins- Expanded size - 6.0mx1.0m - 4.0m - Honeycombs to be backfilled with topsoil - Starting at Bottom of rhine working upwards - IMPORTANT.
Erosamat (Type 1A)	Soil erosion protector - Biodegradable Jute fibres Roll size 4.15m x 200m - Rolled on tubes - 150kg each (needs pinning) Surface to be pre-seeded

Notes

ABG Geosynthetic material & products specified for rhine construction & cut off wall. Similar approved to be verified & confirmed by engineer prior to installation. Refer to ABG's manufacturers data sheets as regarding material specification handling, installation and performance .

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

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newEARTH SOLUTIONS

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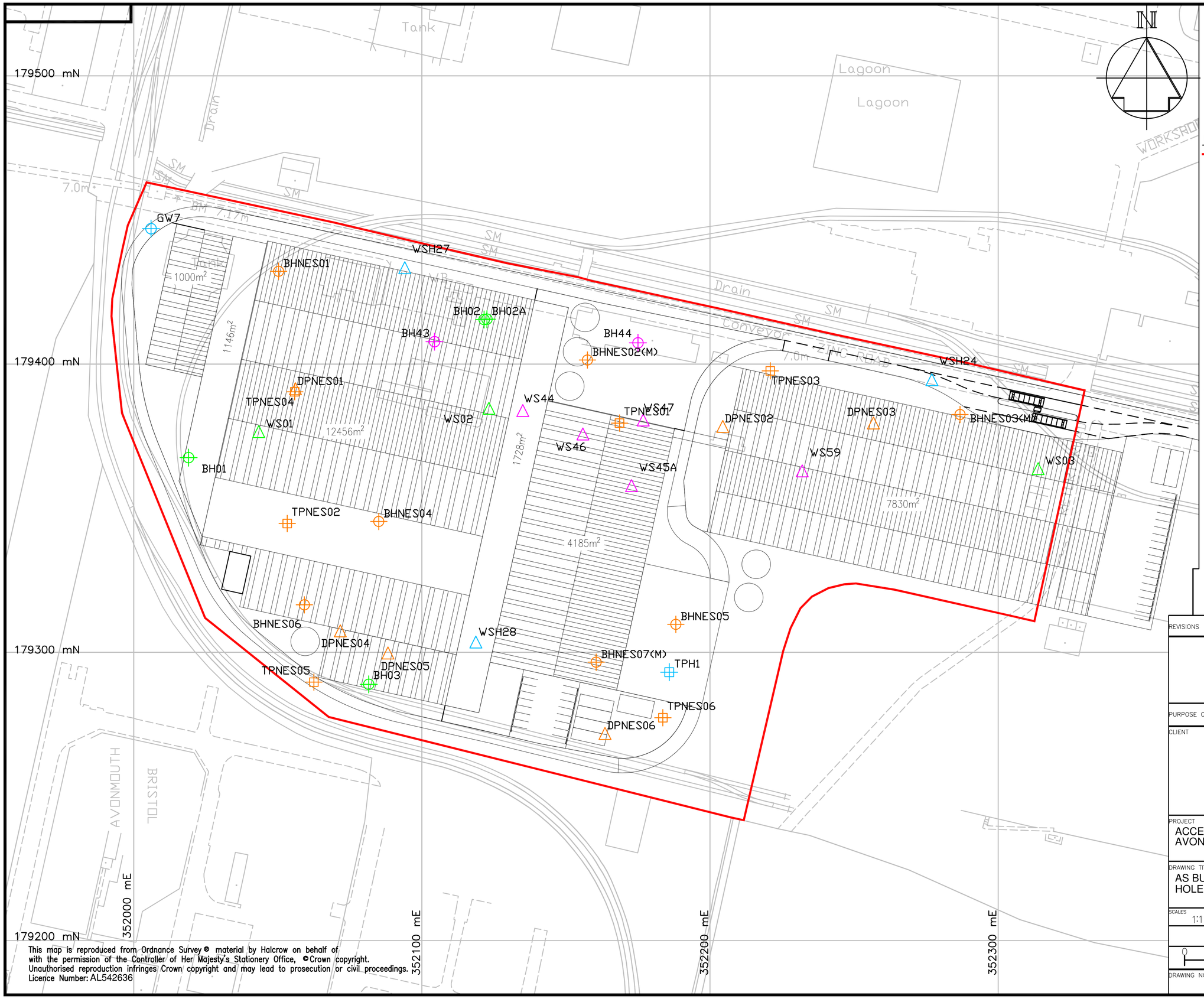
PROJECT
ACCESS 18
AVONMOUTH

DRAWING TITLE
TYPICAL CONSTRUCTION
LINED RHINE AND SHALLOW GROUNDWATER
COLLECTION SYSTEM

SCALES	DRAWN	CHECKED	CO-ORD CHECK
AS SHOWN	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

0 50m | SHEET A1 | PLOT DATE 24/07/09

DRAWING NO FIGURE 4 | REV —



Key plan scale 1:50,000

Key:

Application boundary

IAN FARMER ASSOCIATES MAY 2004 GI, BRITANNIA ZINC, AVONMOUTH (REF 2624)

- BH1 — Borehole locations
- WS1 — Window sample boreholes

IAN FARMER ASSOCIATES MARCH 2005 GI, BRITANNIA ZINC LTD – PHASE 2 (REF 2780)

- BH1 — Borehole locations
- WS1 — Window sample boreholes

HYDER CONSULTING LTD, DECEMBER 2001 IPPC PHASE 2 ASSESSMENT (GI UNDERTAKEN BY GEOTECHNICAL ENGINEERING)

- WSH1 — Window sample boreholes
- TPH1 — Trial pit
- GW7 — Borehole locations

STRUCTURAL SOILS LTD, MAY 2009, ACCESS 18, AREA A GROUND INVESTIGATION

- BHNES03 — Borehole locations
- TPNES03 — Trial pit locations
- DPNES03 — Window sample boreholes locations
- (M) — Monitoring standpipe

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

newEARTH SOLUTIONS

ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

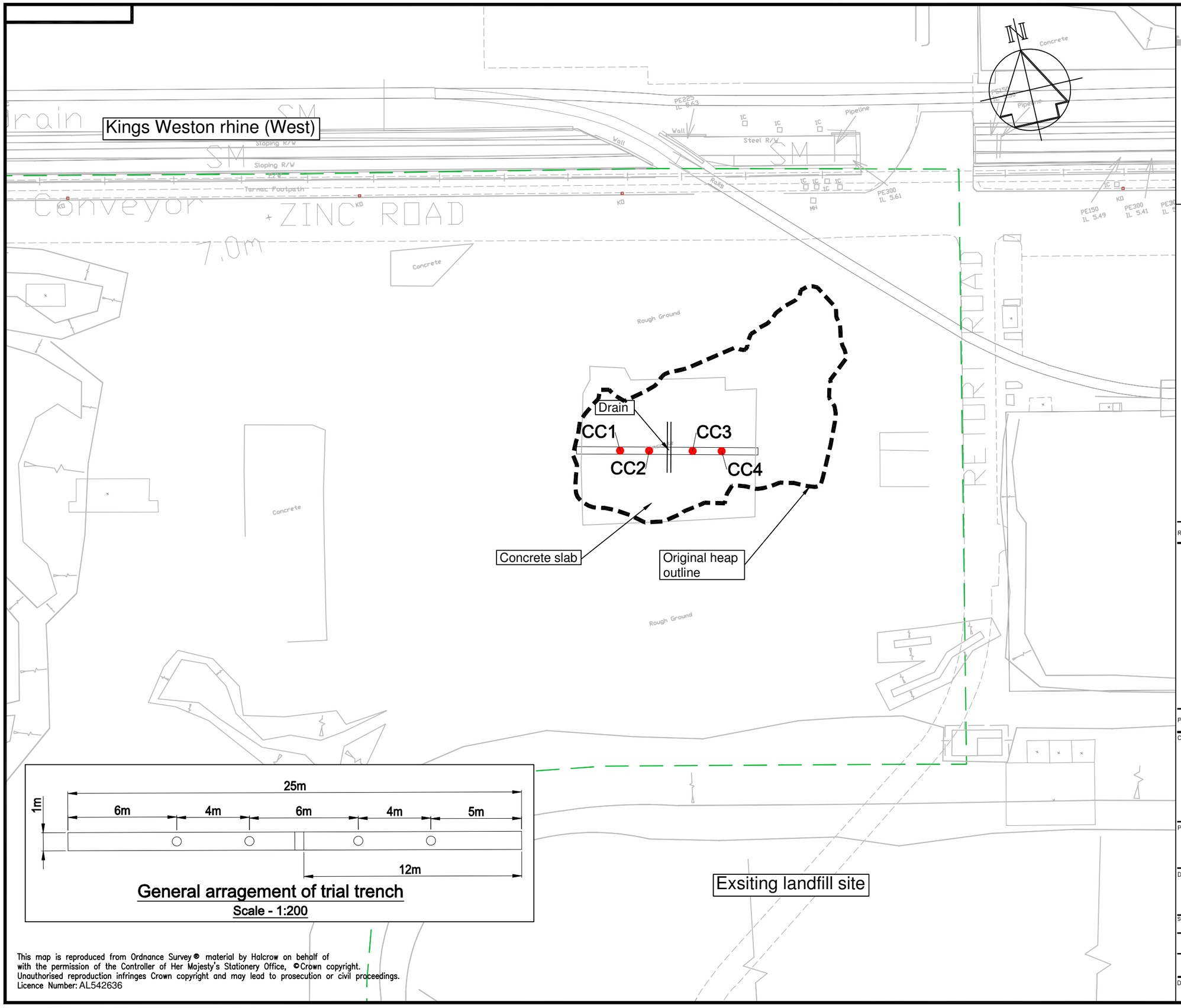
DRAWING TITLE
AS BUILT EXPLORATORY HOLE LOCATIONS

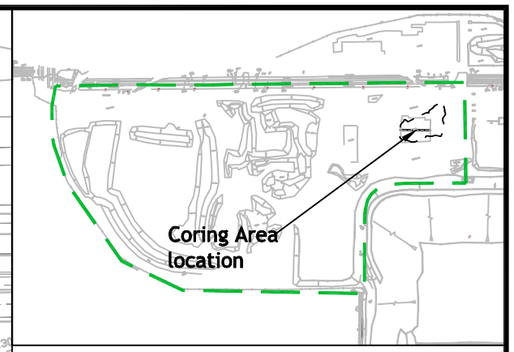
SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:1250	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

0 | SHEET A3 | PLOT DATE 24/07/09

DRAWING NO
FIGURE 5

REV -





Key

Proposed application site boundary

CC3 Location of core sample

General arragement of trial trench

Scale - 1:200

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

newEARTH SOLUTIONS

ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

DRAWING TITLE
CONCRETE CORING LOCATION PLAN

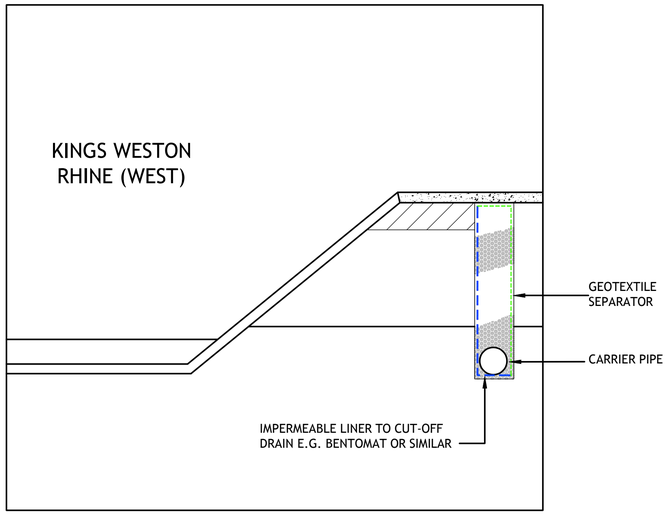
SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:500	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

0

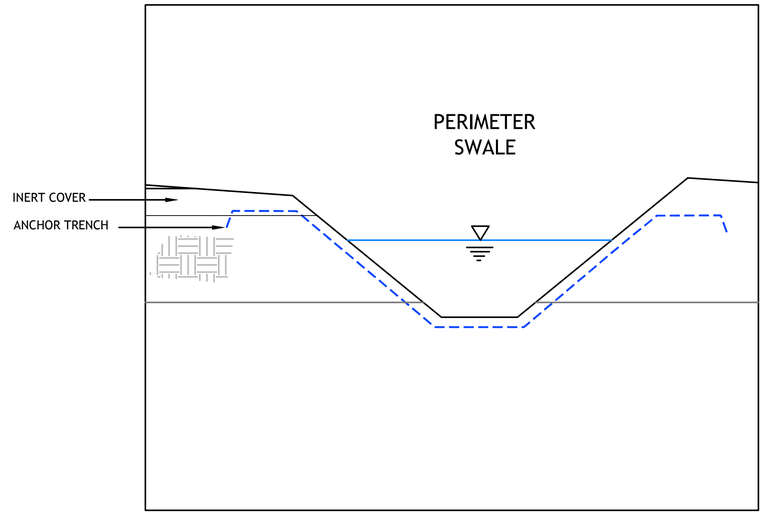
SHEET	PLOT DATE
A3	24/07/09

DRAWING NO
FIGURE 6

REV
-



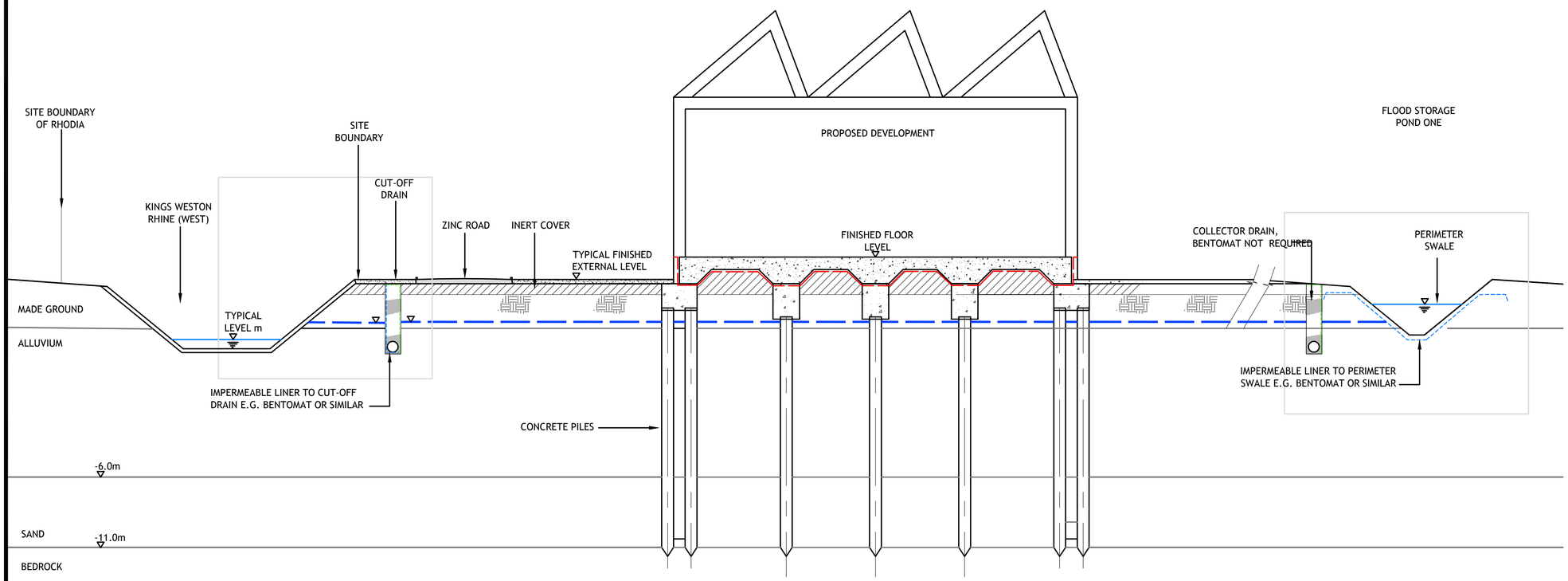
ENLARGED VIEW



ENLARGED VIEW

Key:

- Gas protection barrier
- Perched groundwater
- Bentomat or similar
- Geotextile separator



REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

newEARTH SOLUTIONS

ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

DRAWING TITLE
PROPOSED REMEDIATION
SCHEMATIC CROSS-SECTION

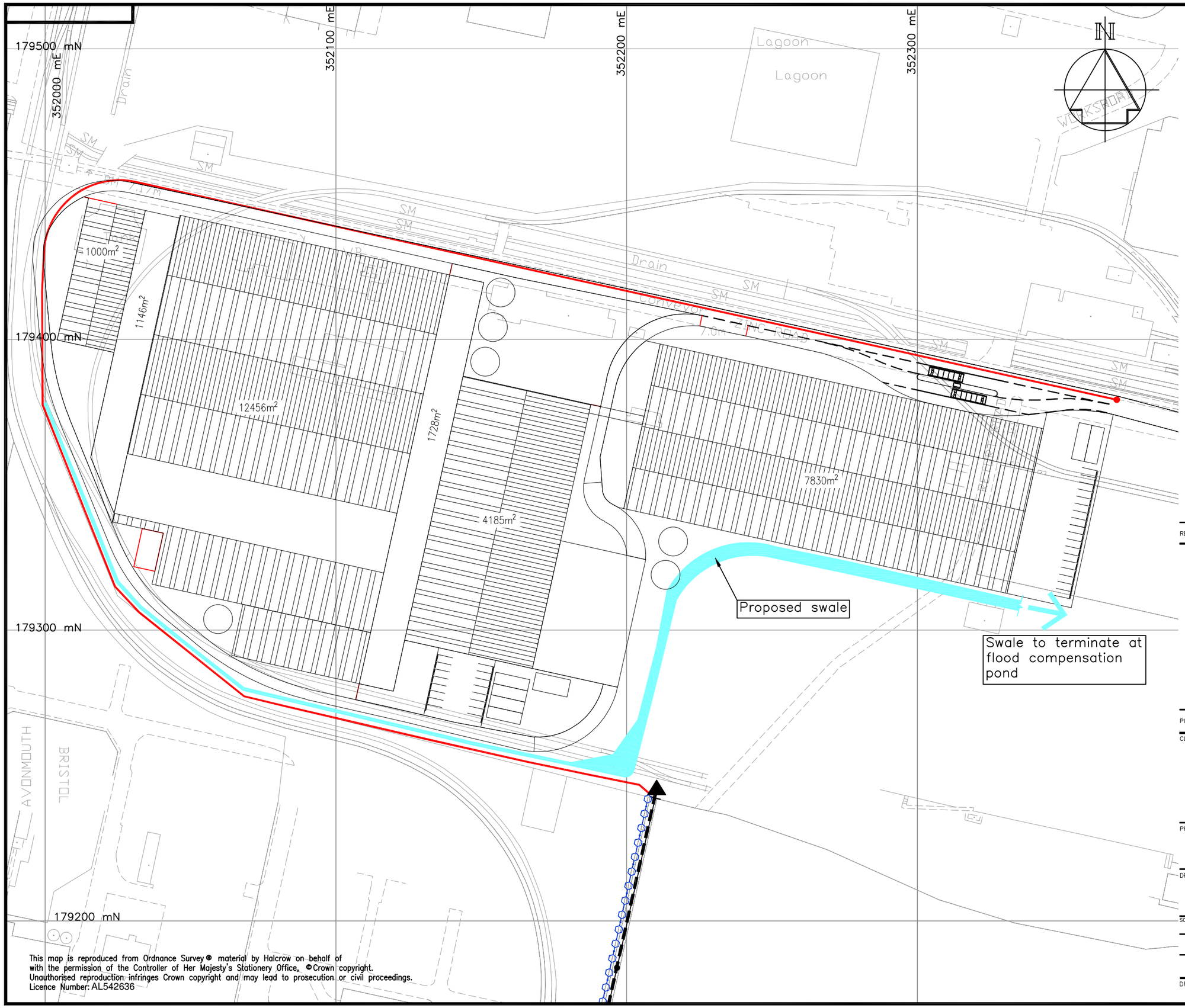
SCALES	DRAWN	CHECKED	CO-ORD CHECK
#:NTS	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

0

SHEET	PLOT DATE
A3	24/07/09

DRAWING NO
FIGURE 7

REV
-



Key

- Peripheral site cut–off to tie–in with proposed landfill cut–off wall and drain.
- Proposed landfill cutt–off wall
- Proposed pumping station (Location to be determined)
- Temporary pumping line to ETP

REVISIONS	Drawn By	Checked By	Date

PURPOSE OF ISSUE	Rev.	Authorised for issue	Date

CLIENT

newEARTH SOLUTIONS

ST.MODWEN

PROJECT
ACCESS 18
AVONMOUTH

DRAWING TITLE
PROPOSED REMEDIATION
SCHEMATIC PLAN

SCALES	DRAWN	CHECKED	CO–ORD CHECK
1:1250	ADW	NJC	NJC
	DATE JUL 09	DATE JUL 09	DATE JUL 09

0

SHEET	PLOT DATE
A3	28/07/09

DRAWING NO
FIGURE 8

REV
-

Mechanical Biological Treatment Facility

Former Britannia Zinc Site, Avonmouth

Remediation Strategy

APPENDIX A

Exploratory Hole Logs

July 2009

newEARTH SOLUTIONS

Mechanical Biological Treatment Facility

Former Britannia Zinc Site, Avonmouth

Remediation Strategy

APPENDIX B

Testing of Soil and Groundwater Samples

July 2009

newEARTH SOLUTIONS

IAN FARMER ASSOCIATES

od cussion	Diameter 150mm cased to 20.20m	Ground Level (mOD) 7.50	Site Britannia Zinc Limited, Avonmouth	Borehole Number BH1
	Location 352019.1 E 179367.5 N	Dates 30/01/2004-02/02/2004	Client St Modwen Developments Limited	Job Number 2624
			Engineer Halcrow Group Limited	Sheet 1/3

Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
B1					(0.60)	MADE GROUND:- Light brown sand over compacted brick, concrete and ash fill			
B2				6.90	0.60	MADE GROUND:- Compact, black, sandy, ashy, fine to coarse, angular to subangular gravel, of slag and clinker			
CPT N=4 B3		DRY	1/,1,2,1	6.40	(0.50) 1.10	Soft, grey mottled brown CLAY (possible MADE GROUND)			
CPT N=5 B4		MOIST	1/1,1,2,1	5.35	(1.05) 2.15	Soft, brown mottled grey CLAY, with occasional roots			
D1 U1	2.50	DRY	23 blows						
D2					(2.25)				
SPT N=5 D3 B5	3.60	DRY	1,2/1,2,1,1						
				3.10	4.40	Uncompact, grey SILT, with occasional traces of peat			
D4					(1.10)				
U2	4.70	DRY	16 blows						
D5				2.00	5.50	Uncompact, grey and black SILT			
D6									
SPT N=3 D7 B6	6.25	DRY	1/1,,1,1						
D8									
U3	7.75	DRY	12 blows						
D9									
D10									
SPT N=2 D11 B7	9.25	DRY	1/,1,,1						

Scale (approx): 1:50

Logged By: AO

Figure No. 2624.BH1

ng from 0.00m to 1.20m for 1 hour.

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH1

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.20m	7.50	St Modwen Developments Limited	2624
	Location	**Dates**	**Engineer**	Sheet
	352019.1 E 179367.5 N	30/01/2004-02/02/2004	Halcrow Group Limited	2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(6.20)				
10.60	D12									
11.00-11.45	U4	10.70	DRY	12 blows						
11.45-11.60	D13						Silt is grey below 11.45m			
					-4.20	11.70				
11.80	D14	10.70					Uncompact, grey, sandy SILT, with bands of fine grey sand. Becoming less sandy with depth			
12.40-12.85	SPT N=2			1/1,,1						
12.40-12.85	D15									
12.40-13.00	B8									
									▼2	
13.50	D16									
						(4.50)				
14.05-14.50	U5	13.70		21 blows						
14.50-14.65	D17									
15.10	D18									
15.55-16.00	SPT N=3	15.15	MOIST	1,1/1,,1,1						
15.55-16.00	D19									
15.55-16.10	B9									
16.30	D20			Water strike(1) at 16.30m, rose to 8.60m in 20 mins, sealed at 19.80m.	-8.70	16.20	Loose, greyish brown, slightly silty, fine to coarse SAND		▽1	
16.30	W1	16.10	8.60							
16.45-16.90	D21									
16.65-17.00	B10									
16.45-16.90	SPT N=7			/1,1,2,3						
						(2.55)				
17.50	D22									
18.00-18.45	SPT N=18	17.70	11.75	1,2/3,4,5,6			Below 18.00m: Medium dense			
18.00-18.45	D23									
18.00-18.50	B11									
18.80	D24				-11.25	18.75	Uncompact, grey SILT, with traces of peat			
						(0.45)				
18.95-19.40	SPT N=15	18.60	17.90	1,2/3,4,3,5						
18.95-19.40	D25									
18.95-19.50	B12				-11.70	19.20	Firm, reddish brown, sandy CLAY, with traces of peat. Sand is fine			
						(0.80)				
					-12.50	20.00				

Remarks

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH1

IAN FARMER ASSOCIATES

Site: Britannia Zinc Limited, Avonmouth				Number: BH1
g Method: ble Percussion	Diameter: 150mm cased to 20.20m	Ground Level (mOD): 7.50	Client: St Modwen Developments Limited	Job Number: 26[illegible]
	Location: 352019.1 E 179367.5 N	Dates: 30/01/2004-02/02/2004	Engineer: Halcrow Group Limited	Sheet: 3/3

epth m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.00 0	D26 W2	19.50	13.20	Water strike(2) at 20.00m, rose to 13.20m in 20 mins. 100 blows		(1.00)	Very stiff, reddish brown CLAY, with pockets of bluey grey, medium to coarse sand and coarse, angular, limestone gravel		▽2	
.0-20.50 .50-20.55 20.55-20.77	U6 D27 SPT 25*/145 50/70			8,17/50						
55-20.70 00-21.15	D28 SPT 25*/70 56/75	20.20	15.20	25/56	-13.50	21.00	Complete at 21.00m			
1.00-21.15	D29									

Remarks
Chiselling from 20.50m to 21.00m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH1

IAN FARMER ASSOCIATES

Site: Britannia Zinc Limited, Avonmouth				Borehole Number: BH2
g Method: ble Percussion	Diameter: 150mm cased to 3.20m	Ground Level (mOD): 6.95	Client: St Modwen Developments Limited	Job Number: 2624
	Location: 352121.6 E 179415.5 N	Dates: 02/02/2004	Engineer: Halcrow Group Limited	Sheet: 1/1

pth n)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
1.20	B1					(1.75)	MADE GROUND:- Very dense, brownish grey, sandy, slightly clayey, medium to coarse, angular to suangular gravel, of slag, concrete and clinker. Sand is fine to coarse		
20-1.37	CPT 25*/100 50/70			11,14/50					
20-1.50	B2		DRY		5.20	1.75	Firm, grey mottled brown CLAY (possible MADE GROUND). Faint hydrocarbon odour		
00-2.45	CPT N=13			1,2/1,2,3,7					
.00-2.45	B3								
-3.50	CPT N=10			1,3/2,1,4,3					
-3.50	B4					(3.75)			
-4.45	U1 N/R			89 blows			Below 4.00m: Stiff		
00-4.45	B5								
5.00-5.45	SPT N=23			1,2/4,5,6,8					
5.00-5.45	D1	3.20	DRY		1.45	5.50	Complete at 5.50m		

Remarks
ished large obstruction to 5.50m, unable to clear; aborted and moved rig.
disturbed sample at 4.00m was placed in a bulk bag (B5).
Chiselling from 1.25m to 1.75m for 1/2 hour. Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH2

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH2A

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 19.00m	6.95	St Modwen Developments Limited	2624
	Location	**Dates**	**Engineer**	**Sheet**
	352122.6 E 179416.6 N	03/02/2004-04/02/2004	Halcrow Group Limited	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10-1.20	B1					(1.55)	MADE GROUND:- Medium dense, greyish brown, sandy, fine to coarse, angular to subangular gravel of slag and clinker. Sand is fine to coarse Concrete fragments present below 1.25m			
1.20-1.65	CPT N=14		DRY	3,4/7,4,2,1						
1.20-1.65	B2				5.40	1.55	Firm, brown mottled grey CLAY			
1.70	D1									
2.00-2.45	U1	1.70	DRY	25 blows		(0.90)				
2.45-2.60	D2				4.50	2.45	Uncompact, grey and black SILT			
3.10-3.55	SPT N=2	2.80	MOIST	1/,1,,1						
3.10-3.55	D3									
3.10-3.70	B3									
4.15-4.60	U2	3.85		9 blows						
4.60-4.75	D4									
5.05-5.50	SPT N=1	4.70	MOIST	1/,,1						
5.05-5.50	D5									
5.05-5.60	B4									
6.05	D6									
6.60-7.05	U3	6.25		8 blows					▼1	
7.05-7.20	D7									
7.60	D8									
8.05-8.50	SPT N=0	7.75	MOIST	/						
8.05-8.50	D9									
8.05-8.55	B5									
9.00	D10									
9.45-9.90	U4	8.70		14 blows						
9.90-10.05	D11									

Remarks
Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH2A

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH2A

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 19.00m	6.95	St Modwen Developments Limited	2624

Location	Dates	Engineer
352122.6 E 179416.6 N	03/02/2004-04/02/2004	Halcrow Group Limited

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(9.65)				
10.10	D12									
11.00-11.45	SPT N=1	10.70	MOIST	1/,,1						
11.00-11.45	D13									
11.00-11.60	B6									
					-5.15	12.10	Uncompact, grey sandy SILT with occasional shell fragments. Sand is fine			
12.20	D14				-5.30	12.25				
12.40	D15				-5.50	12.45	Soft, dark brown, fibrous PEAT			
12.55-13.00	U5	12.15		15 blows		(0.20)				
							Uncompact, grey sandy SILT with occasional shell fragments. Sand is fine			
13.00-13.05	D16					(1.35)				
13.55	D17									
13.80	W1	13.65	6.70	Water strike(1) at 13.80m, rose to 6.70m in 20 mins.	-6.85	13.80	Medium dense, grey, slightly silty, medium to coarse SAND, with thin bands of peat and grey clay		▽1	
14.00	D18									
14.10-14.55	SPT N=19	13.80		1,2/3,4,6,6						
14.10-14.55	D19									
14.10-14.60	B7									
15.00	D20									
15.50-15.95	SPT N=10	16.00	7.10	1/2,3,2,3						
15.55-16.00	B8					(3.90)				
15.55-16.00	D21									
16.50	D22	16.00	4.20							
16.95-17.40	SPT N=12			1/2,3,3,4						
16.95-17.40	B9									
16.95-17.40	D23									
17.80	D24				-10.75	17.70	Soft, dark brown, fibrous PEAT			
17.90-18.25	U6	17.70	7.80	100 blows		(0.30)				
					-11.05	18.00	Stiff, very light grey SILT with root traces			
18.25-18.30	D25					(0.75)				
18.50-18.95	U7	18.25	9.10	125 blows						
					-11.80	18.75	Very stiff, reddish brown, sandy CLAY, with root traces. Sand is fine			
						(0.25)				
18.95-19.00	D26				-12.05	19.00				
19.00-19.35	SPT 50/200	18.80	12.25	7,9/13,21,16			Very stiff, reddish brown, sandy CLAY. Sand is fine			
19.00	W2									
19.00-19.38	D27					(1.00)				
20.00-20.35	SPT 50/200	19.00	15.20	6,11/17,21,12	-13.05	20.00				

Remarks
Chiselling from 19.40m to 20.00m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH2A

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH2A

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 19.00m	6.95	St Modwen Developments Limited	2624

Location	Dates	Engineer	Sheet
352122.6 E 179416.6 N	03/02/2004-04/02/2004	Halcrow Group Limited	3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
20.00-20.38	D28									

Remarks

Scale (approx)	Logged By
1:50	AO

Figure No.
2624.BH2A

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH3

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.50m	8.41	St Modwen Developments Limited	2624

Location	Dates	Engineer	Sheet
352081.6 E 179288.9 N	28/01/2004-29/01/2004	Halcrow Group Limited	1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10-0.50	B1					(0.50)	MADE GROUND:- Light brown, fine to coarse sand and whole brick fill			
0.50-1.20	B2				7.91	0.50	MADE GROUND:- Black, sandy, fine to coarse, angular to subangular gravel, ash, slag and clinker.			
						(0.80)				
1.20-1.65	CPT N=4		DRY	2,3/1,1,1,1	7.11	1.30	MADE GROUND:- Soft, brown mottled grey, gravelly CLAY. Gravel is fine to coarse, angular to subangular, of ash slag and clinker			
1.20-1.65	B3					(0.50)				
1.85	D1				6.61	1.80	Soft, light grey mottled brown CLAY, with small peat lenses and occasional fine, angular gravel (possible MADE GROUND)			
2.00-2.45	U1	1.70	DRY	14 blows		(1.05)				
2.45-2.60	D2									
2.90	D3				5.56	2.85	Soft, brown, slightly sandy CLAY with traces of peat and roots. Sand is fine			
3.00-3.45	SPT N=4	2.65	DRY	1/1,1,1,1		(0.25)				
3.00-3.45	D4				5.31	3.10	Soft, grey mottled brown, slightly sandy CLAY. Sand is fine			
3.00-3.60	B4									
3.85	D5						Becoming firm by 4.00m			
4.00-4.45	U2	3.70	DRY	57 blows						
4.45-4.60	D6					(3.10)				
5.00-5.45	SPT N=5	4.75	DRY	1/1,1,2,1			Becoming soft by 5.00m			
5.00-5.45	D7									
5.00-5.60	B5									
6.00	D8	4.75	DRY							
6.30	D9				2.21	6.20	Uncompact, light grey SILT			
6.50-6.95	U3	6.20	DRY	13 blows		(0.75)				
6.95-7.10	D10				1.46	6.95	Uncompact, grey and black SILT, with traces of peat			
7.50	D11									
8.00-8.45	SPT N=4	7.70	DRY	1/1,1,1,1						
8.00-8.45	D12									
8.00-8.60	B6									
9.10	D13									
9.50-9.95	U4	9.15	DRY	19 blows						

Remarks
Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No.
2624.BH3

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH3

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.50m	8.41	St Modwen Developments Limited	2624
	Location	**Dates**	**Engineer**	**Sheet**
	352081.6 E 179288.9 N	28/01/2004-29/01/2004	Halcrow Group Limited	2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
9.95-10.10	D14					(5.90)			
10.60	D15								
11.10-11.55	SPT N=3	10.80	DRY	1/1,,1,1					
11.10-11.55	D16								
11.10-11.70	B7								
12.15	D17								
12.40-12.85	U5	12.10	DRY	21 blows					
12.85-13.00	D18				-4.44	12.85	Uncompact grey SILT		
13.55	D19								
13.90-14.35	SPT N=6	13.60	MOIST	1,2/1,2,1,2		(1.85)			
13.90-14.35	D20								
13.90-14.50	B8								
14.80	W1	14.60	8.60	Water strike(1) at 14.80m, rose to 8.60m in 20 mins.	-6.29	14.70	Loose to medium dense, light brown and grey, fine to coarse SAND		▽1
14.90	D21								
15.05-15.50	D22								
15.05-15.50	SPT N=9	14.70		1/1,2,3,3					
15.05-15.60	B9								
16.05	D23								
16.40-16.85	SPT N=16	16.10		1,2/3,4,5,4			Below16.40m: Medium dense		
16.40-16.85	D24								
16.40-17.00	B10					(4.50)			
17.45	D25								
17.90-18.35	SPT N=14	17.65		1/2,3,4,5					
17.90-18.35	D26								
17.90-18.50	B11								
19.00	D27								
19.30	D28				-10.79	19.20	Uncompact grey SILT with thin peat bands		
19.45-19.90	U6	19.25	6.35	81 blows		(0.80)			
19.90-20.05	D29				-11.59	20.00			

Remarks

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH3

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH3

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.50m	8.41	St Modwen Developments Limited	2624
	Location	**Dates**	**Engineer**	**Sheet**
	352081.6 E 179288.9 N	28/01/2004-29/01/2004	Halcrow Group Limited	3/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend
						(0.25)	Soft, dark brown, fibrous PEAT	
					-11.84	20.25	Very stiff, reddish brown, sandy CLAY. Sand is fine	
20.40	D30							
20.50-20.95	SPT N=45	20.25	8.90	4,8/9,10,12,14				
20.50-20.95	D31							
20.50-21.50	B12					(1.25)		
21.50-21.95	SPT N=51	20.50	11.10	6,7/10,12,14,15	-13.09	21.50	Complete at 21.50m	
21.50-21.95	D32							

Remarks
Chiselling from 20.80m to 21.50m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No.
2624.BH3

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH8

Boring Method	Diameter	Ground Level (mOD)	Client	Job
Cable Percussion	150mm cased to 20.50m	9.01	St Modwen Developments Limited	[illegible] 2624

Location	Dates	Engineer	Sheet
352202.2 E 179166.3 N	27/01/2004-28/01/2004	Halcrow Group Limited	1/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10-1.20	B1					(1.55)	MADE GROUND:- Very loose, black, fine to coarse sand and fine to coarse, angular to subangular gravel of slag, brick and limestone, with grey lenses of clay, and occasional subangular, limestone cobbles			
1.20-1.65	CPT N=2		DRY	1/1,,,1						
1.20-1.65	B2		DRY		7.46	1.55	Soft, grey mottled brown CLAY, with occasional peat traces			
1.70	D1									
2.00-2.45	U1	1.20	DRY	13 blows			Mv 25-50 = 0.824 50-100 = 0.562			
2.45-2.60	D2					(2.15)				
2.95-3.40	B3	2.65	DRY							
3.80	D3				5.31	3.70	Soft, brown mottled grey CLAY			
3.95-4.40	CPT N=4	2.55	DRY	1/1,1,1,1						
4.00-4.45	U2	3.70	DRY	43 blows						
4.45-4.60	D4					(2.25)				
5.05-5.50	SPT N=5	4.55	DRY	1,2/1,2,1,1						
5.05-5.50	D5									
5.05-5.60	B4									
6.15	D6				3.06	5.95	Uncompact grey SILT, with occasional peat traces			
6.40-6.85	U3	6.10	DRY	19 blows						
6.85-7.00	D7									
7.55	D8									
8.05-8.50	SPT N=4	7.70	DRY	1,1/1,1,2						
8.05-8.50	D9									
8.05-8.65	B5									
9.10	D10									
9.55-10.00	U4	9.15	DRY	20 blows						

Remarks
Excavating from 0.00m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No.
2624.BH8

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH8

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.50m	9.01	St Modwen Developments Limited	[redacted]
	Location	Dates	Engineer	Sheet
	352202.2 E 179166.3 N	27/01/2004-28/01/2004	Halcrow Group Limited	2/3

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
10.00-10.15	D11					(8.25)				
10.60	D12									
11.00-11.45	SPT N=3	10.75	DRY	1/1,,1,1						
11.00-11.45	D13									
11.00-11.55	B6									
12.05	D14									
12.60-13.05	U5	12.25	DRY	26 blows						
13.05-13.20	D15									
13.60	D16									
13.95-14.40	SPT N=6	13.60	DRY	1,1/1,2,1,2						
13.95-14.40	D17									
13.95-14.50	B7				-5.19	14.20	Uncompact, greyish brown, sandy SILT. Sand is fine to medium			
							Mv 50-100 = 0.571			
15.05	D18					(1.80)				
15.55-16.00	U6	15.10		28 blows						
16.00-16.15	D19				-6.99	16.00	Medium dense, greyish brown, silty, fine to medium SAND			
16.15	W1	15.10	9.30	Water strike(1) at 16.15m, rose to 9.30m in 20 mins.					▽1	
16.15-16.60	D20									
16.15-16.80	B8	15.10	9.30							
16.15-16.60	SPT N=15	15.10	8.60	1,2/3,4,3,5						
17.10	D21					(2.70)				
17.45-17.90	SPT N=11	17.10		1,2/3,2,3,3						
17.45-17.90	D22									
17.45-18.00	B9									
18.50	D23									
18.80	D24				-9.69	18.70	Compact, grey, very sandy SILT, with traces of peat			
18.95-19.40	U6	18.60		63 blows						
19.30-19.45	D25					(0.90)				
19.40-19.55	D26									
					-10.59	19.60	Soft, dark brown, fibrous PEAT			
19.70	D27				-10.74	19.75	Firm, greyish blue, sandy CLAY. Sand is fine to			
19.80	D28									

Remarks

Scale (approx)	Logged By
1:50	AO

Figure No. 2624.BH8

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited, Avonmouth	BH8

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 20.50m	9.01	St Modwen Developments Limited	2624

Location	Dates	Engineer	Sheet
352202.2 E 179166.3 N	27/01/2004-28/01/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
19.85-20.30	U7	19.50		70 blows			medium			
20.05	D29						Very stiff, dark reddish brown CLAY, with lenses of grey, medium to coarse sand			
20.15-20.60	SPT N=49	20.05		4,8/9,11,13,16						
20.15-20.60	D30									
20.15-21.00	B10					(1.00)				
21.00-21.38	SPT 48/225	20.50	13.90	6,9/11,16,21	-11.99	21.00				
21.00-21.38	D31						Complete at 21.00m			

Remarks
Chiselling from 20.40m to 21.00m for 1 hour.

Scale (approx)	Logged By
1:50	AO

Figure No.
2624.BH8

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited, Avonmouth	WS1

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	80mm to 0.50m	7.11	St Modwen Developments Limited	2624
	Location	**Dates**	**Engineer**	**Sheet**
	352043.1 E 179376.1 N	19/01/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: Grey, sandy silt/ clay		
0.10	D1			6.91	0.20	MADE GROUND: Brown, slightly clayey, brick and concrete fill with occasional timber fragments		
0.40	D2		Seepage(1) at 0.40m.		(0.30)			
				6.61	0.50	Complete at 0.50m		

Remarks
Three attempts, window sampler refused at 0.50m.

Scale (approx)	Logged By
1:25	DM

Figure No. 2624.WS1

IAN FARMER ASSOCIATES

Site: Britannia Zinc Limited, Avonmouth			Number: WS2
Excavation Method: Drive-in Window Sampler	Dimensions: 80mm to 2.00m, 70mm to 3.00m, 60mm to 4.00m	Ground Level (mOD): 6.72	Client: St Modwen Developments Limited	Job Number: 2624
	Location: 352123.4 E 179384.5 N	Dates: 19/01/2004	Engineer: Halcrow Group Limited	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.20	D1				(0.40)	MADE GROUND: Grey, sandy, slightly gravelly silt/ clay. Gravel is fine to coarse angular to subangular, of brick and concrete		
				6.32	0.40	MADE GROUND: Brown, gravelly sand. Sand is fine to coarse, gravel is fine to coarse, angular to subangular, of ash and slag		
1.00	D2				(1.80)	Below 1.40m: Clayey		
2.00	D3							
				4.52	2.20	Soft, blue grey SILT/ CLAY (Alluvium)		
3.00	D4				(1.80)			
4.00	D5			2.72	4.00	Complete at 4.00m		

Remarks
No groundwater encountered.

Scale (approx)	Logged By
1:25	NJ

Figure No. 2624.WS2

IAN FARMER ASSOCIATES

Site: Britannia Zinc Limited, Avonmouth			Number: WS3
Excavation Method: Drive-in Window Sampler	Dimensions: 80mm to 2.00m, 70mm to 3.00m, 60mm to 4.00m	Ground Level (mOD): 6.55	Client: St Modwen Developments Limited	Job Number: 2624
	Location: 352314 E 179383.1 N	Dates: 19/01/2004	Engineer: Halcrow Group Limited	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.90)	MADE GROUND: Black, gravelly sand. Sand is fine to coarse, gravel is fine to coarse, angular to subangular, of ash and slag			
0.50	D1		Seepage(1) at 0.70m.					▽1	
				5.65	0.90	Soft to firm, brown SILT/ CLAY			
1.50	D2				(1.80)				
						Below 2.10m: Becoming soft			
2.50	D3			3.85	2.70	Soft, grey SILT/ CLAY			
					(1.30)				
3.50	D4			2.55	4.00	Complete at 4.00m			

Remarks

Scale (approx)	Logged By
1:25	NJ

Figure No. 2624.WS3

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH43

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 18.70m	7.07	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	Sheet
	352104.4 E 179407.8 N	10/12/2004-13/12/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
0.10-0.65	B1					(0.66)	MADE GROUND: Dark grey, cemented, sandy gravel, with inclusions of slag, concrete and metal. Sand is fine to coarse, gravel is fine to coarse, angular			
0.60	A1				6.41	0.66				
0.65-0.95	B2					(0.30)	MADE GROUND: Dark grey/ brown, sandy gravel, with inclusions of concrete, slag, tile, ash and clinker. Sand is fine to coarse, gravel is fine to coarse, angular			
0.95-1.10	B3				6.11	0.96				
1.10	A2				5.97	1.10				
1.15	D1					(0.14)				
1.20-1.65	U1		DRY	27 blows			MADE GROUND: Soft, dark brown/ black, sandy, gravelly clay, with inclusions of brick, concrete, ash and slag. Sand is fine to coarse, gravel is fine to coarse, angular			
1.65-1.70	D2					(1.70)				
2.10-2.55	SPT N=7	1.85	DRY	1/1,2,2,2			Soft, brown, sandy CLAY. Sand is fine			
2.10-2.55	D3									
2.10-2.80	B4									
2.90	D4				4.27	2.80				
3.05-3.50	U2	3.30		10 blows			Very soft, brown mottled grey, sandy CLAY. Sand is fine			
3.50-3.65	D5									
4.15-4.60	SPT N=1	4.35	MOIST	1/,1						
4.15-4.60	D6									
4.15-5.05	B5									
5.05-5.50	U3	5.20		6 blows						
5.50-5.65	D7					(5.30)				
6.10	D8									
6.60-7.05	SPT N=0	6.20	MOIST	/						
6.60-7.05	D9									
7.05-8.00	B6									
8.10-8.55	U4	7.60		10 blows	-1.03	8.10	Very soft, dark grey, slightly sandy, peaty CLAY. Sand is fine		▼1	
8.55-8.70	D10									
9.10	D11									
9.60-10.05	SPT N=2	9.35	MOIST	1/,1,,1						
9.60-10.05	D12									

Remarks
Water added from 8.00m to 17.80m. Excavating from 0.55m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	SS

Figure No. 2780.BH43

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH43

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 18.70m	7.07	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	**Sheet**
	352104.4 E 179407.8 N	10/12/2004-13/12/2004	Halcrow Group Limited	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr.
10.05-11.00	B7					(4.50)	Very soft, dark grey, slightly sandy, peaty CLAY. Sand is fine			
11.00-11.45	U5	10.75		13 blows						
11.45-11.60	D13									
12.15	D14									
12.45-12.90	SPT N=6	12.15	MOIST	1/1,2,1,2						
12.45-12.90	D15				-5.53	12.60	Soft, grey with occasional orange brown mottling, sandy CLAY. Sand is fine			
12.90-13.60	B8					(1.60)				
13.60-14.05	U6	13.30		21 blows						
14.05-14.20	D16									
14.20	W1			Water strike(1) at 14.20m, rose to 8.10m in 20 mins.	-7.13	14.20	Medium dense, grey mottled white and black, clayey, slightly gravelly, fine to coarse SAND, with quartz, mudstone and shell fragments. Gravel is fine to coarse, subrounded		▽1	
14.30	D17									
14.50-14.95	D18									
14.50-14.95	SPT N=16	13.30	MOIST	1/2,3,5,6						
15.55-16.00	SPT N=20	15.30		1,2/3,4,5,8						
15.55-16.00	D19					(3.60)				
16.60-17.10	B9									
17.10-17.55	SPT N=12	16.90		1/2,3,2,5						
17.10-17.55	D20									
17.10-17.80	B10									
17.90	D21				-10.73	17.80	Stiff, grey and brown, sandy, peaty CLAY. Sand is fine to coarse			
18.00-18.45	U7	17.85	7.75	86 blows		(0.80)				
18.45-18.60	D22									
18.80	D23				-11.53	18.60	Very weak, orange red, highly weathered MUDSTONE (Mercia Mudstone)			
19.05-19.50	SPT N=31	18.70	10.30	3,4/5,7,8,11						
19.05-19.50	D24					(1.40)				
19.80-20.00	D25									
20.00-20.45	SPT N=38	18.70	12.70	4,6/8,9,9,12	-12.93	20.00				

Remarks

Scale (approx)	Logged By
1:50	SS

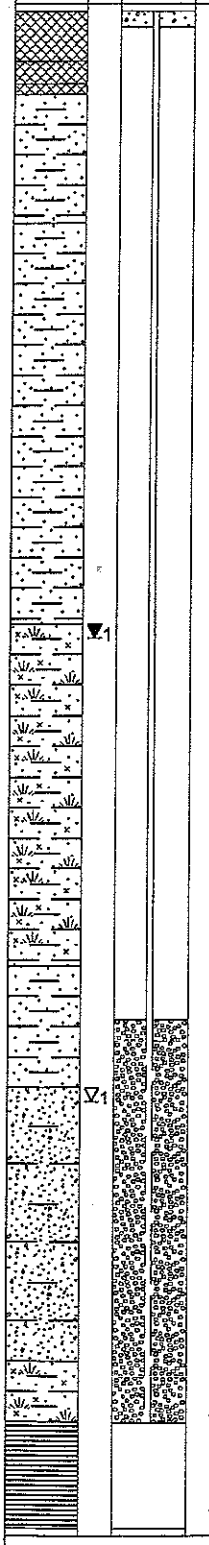
Figure No. 2780.BH43

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH43

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 150 mm	St Modwen Developments Limited	2780

Location	Ground Level (mOD)	Engineer	Sheet
352104.4 E 179407.8 N	7.07	Halcrow Group Limited	1/1



Level (mOD)	Depth (m)	Description
6.87	0.20	Concrete
		Bentonite Seal
-6.23	13.30	Gravel Filter
-6.53	13.60	
		Slotted Standpipe
-11.53	18.60	
		Bentonite Seal
-12.93	20.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings				Depth Sealed (m)
					5 min	10 min	15 min	20 min	
13/12/04		14.20	13.30		9.60	8.60	8.30	8.10	

Groundwater Observations During Drilling

Date	Start of Shift					End of Shift				
	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)	Time	Depth Hole (m)	Casing Depth (m)	Water Depth (m)	Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A]			Remarks
	Time	Depth (m)	Level (mOD)	

Remarks
Gas valve and cover fitted.

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH44

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 18.60m	6.63	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	**Sheet**
	352175 E 179407.4 N	09/12/2004-10/12/2004	Halcrow Group Limited	

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Wat	Instr
					6.47	0.16	MADE GROUND: Red tiles			
0.20-0.45	B1				6.43	0.20	MADE GROUND: Concrete			
0.45-0.90	B2				6.18	(0.04)	MADE GROUND: Black, sandy gravel, with brick, concrete, ash and slag inclusions. Sand is fine to coarse, gravel is fine to coarse, angular			
0.90-1.20	B3					0.45 (0.25) (0.45)				
1.20-1.65	U1			74 blows	5.73	0.90	MADE GROUND: Firm, dark brown mottled black, sandy, gravelly clay, with inclusions of brick, concrete, ash and slag. Sand is fine to coarse, gravel is fine to coarse, angular			
1.65-1.80	D1						Very soft, grey mottled brown, slightly sandy CLAY. Sand is fine			
1.90	D2									
2.05-2.50	SPT N=1	1.80	MOIST	/,1						
2.05-2.50	D3									
2.05-3.00	B4					(3.10)				
3.00-3.45	U2	2.70		7 blows						
3.45-3.60	D4									
4.10-4.55	SPT N=0	3.85	MOIST	/	2.63	4.00	Very soft, grey mottled black, peaty CLAY, with occasional peat bands			
4.10-4.55	D5									
4.10-5.05	B5									
5.05-5.50	U3	4.70		9 blows						
5.50-5.65	D6									
6.00	D7									
6.40-6.85	SPT N=0	5.80	MOIST	/						
6.40-6.85	D8									
6.90-8.10	B6									
8.10-8.55	U4	7.80		8 blows						
8.55-8.70	D9									
9.10	D10									
9.55-10.00	SPT N=3	9.30	MOIST	/1,,1,1						
9.55-10.00	D11									

Remarks
Excavating from 0.20m to 1.20m for 1 hour.

Scale (approx)	Logged By
1:50	SS

Figure No. 2780.BH44

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH44

Boring Method	Diameter	Ground Level (mOD)	Client	Job Number
Cable Percussion	150mm cased to 18.60m	6.63	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	**Sheet**
	352175 E 179407.4 N	09/12/2004-10/12/2004	Halcrow Group Limited	2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water Strikes	Instal
10.00-11.05	B7					(7.30)	Very soft, grey mottled black CLAY, with inclusions of peat and wood fragments			
11.05-11.50	U5	10.70		15 blows						
					-4.67	11.30	Soft, grey, sandy CLAY. Sand is fine to medium, in occasional bands			
11.50-11.65	D12									
12.05	D13					(1.40)				
12.65-13.10	SPT N=7	12.40	MOIST	1/1,2,2,2						
12.65-13.10	D14				-6.07	12.70	Loose, grey speckled brown, clayey, fine to coarse SAND, with quartz, mudstone lithorelicts and shell fragments			
13.10	W1	12.40	7.10	Water strike(1) at 13.10m, rose to 7.10m in 20 mins.			Below 13.10m: Grey speckled black and white, with inclusions of peat and no mudstone lithorelicts		▽1	
13.10-14.00	B8	12.45	7.10							
14.00-14.45	SPT N=14			1,2/3,2,4,5			Below 14.00m: Medium dense			
14.00-14.45	D15									
14.50-15.10	B9	14.25								
						(5.40)				
15.60-16.05	SPT N=15			1/3,3,4,5						
15.60-16.05	D16									
16.05-17.05	B10	15.70								
17.05-17.50	SPT N=25			2,3/3,6,7,9						
17.05-17.50	D17									
17.05-18.10	B11									
					-11.47	18.10 (0.30)	Firm, grey mottled light grey CLAY, with occasional peat			
18.20	D18									
18.30-18.75	SPT N=34	18.15	9.20	3,5/6,9,8,11	-11.77	18.40	Very weak, red brown mottled grey, highly weathered MUDSTONE (Mercia Mudstone)			
18.30-18.75	D19									
19.00	D20					(1.60)				
19.50-19.95	SPT N=43			4,5/7,9,11,16						
19.50-19.95	D21									
20.00	D22	18.60	13.25		-13.37	20.00				

Remarks
Water added from 13.10m to 18.40m.

Scale (approx)	Logged By
1:50	SS

Figure No.
2780.BH44

IAN FARMER ASSOCIATES

Site	Borehole Number
Britannia Zinc Limited Phase 2	BH44

Installation Type	Dimensions	Client	Job Number
Single Installation	Internal Diameter of Tube [A] = 50 mm Diameter of Filter Zone = 150 mm	St Modwen Developments Limited	2780

Location	Ground Level (mOD)	Engineer	Sheet
352175 E 179407.4 N	6.63	Halcrow Group Limited	1

Legend	Water	Instr (A)	Level (mOD)	Depth (m)	Description
			6.43	0.20	Concrete
					Bentonite Seal
	▼1				
			-3.37	10.00	
	▽1				Slotted Standpipe
			-11.37	18.00	
					Bentonite Seal
			-13.37	20.00	

Groundwater Strikes During Drilling

Date	Time	Depth Struck (m)	Casing Depth (m)	Inflow Rate	Readings 5 min	Readings 10 min	Readings 15 min	Readings 20 min	Depth Sealed (m)
09/12/04		13.10	12.40		7.90	7.60	7.25	7.10	

Groundwater Observations During Drilling

Date	Start of Shift Time	Start of Shift Depth Hole (m)	Start of Shift Casing Depth (m)	Start of Shift Water Depth (m)	Start of Shift Water Level (mOD)	End of Shift Time	End of Shift Depth Hole (m)	End of Shift Casing Depth (m)	End of Shift Water Depth (m)	End of Shift Water Level (mOD)

Instrument Groundwater Observations

Inst. [A] Type : Slotted Standpipe

Date	Instrument [A] Time	Instrument [A] Depth (m)	Instrument [A] Level (mOD)	Remarks

Remarks
Gas valve and cover fitted.
Geo-sock fitted.

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited Phase 2	WS44

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	90mm to 2.00m 80mm to 4.00m 70mm to 5.00m	6.48	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	**Sheet**
	352135.1 E 179383.1 N	08/12/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.30)	MADE GROUND: Concrete			
				6.18	0.30	MADE GROUND: Dense, black, sandy, clayey gravel. Sand is fine to coarse, gravel is fine to coarse, angular, of slag, concrete, metal and brick			
0.50	D1				(0.80)				
				5.38	1.10	MADE GROUND: Stiff, brown mottled black, sandy, gravelly clay, with occasional cobbles and inclusions of slag, brick, concrete and chalk. Sand is fine to coarse, gravel is fine to coarse, angular			
					(0.60)				
				4.78	1.70	Stiff to very stiff, brown mottled grey CLAY			
2.50	D2				(1.70)	Below 2.50m: Grey mottled brown			
				3.08	3.40	Soft to firm, grey mottled black, peaty CLAY			
					(1.60)				
				1.48	5.00				

Remarks
No groundwater encountered.

Scale (approx)	Logged By
1:25	SS

Figure No. 2780.WS44

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited Phase 2	WS45

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	90mm to 0.70m	6.68	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	**Sheet**
	352170.7 E 179357.3 N	08/12/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	MADE GROUND: Dense, sand to coarse gravel sized brick rubble, with slag and concrete		
				6.38	0.30	MADE GROUND: Light brown, clayey, sandy gravel, with inclusions of concrete. Sand is fine to coarse, gravel is fine to coarse, angular		
					(0.20)			
				6.18	0.50	Firm to stiff, light brown grey mottled, gravelly clay, with inclusions of brick, concrete and slag. Gravel is fine to coarse, angular		
					(0.20)			
				5.98	0.70	Complete at 0.70m		

Remarks
No groundwater encountered.
Window sampler refused at 0.70m.

Scale (approx)	Logged By
1:25	SS

Figure No. 2780.WS45

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited Phase 2	WS46

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	90mm to 0.70m	6.94	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	Sheet
	352155.4 E 179375 N	08/12/2004	Halcrow Group Limited	

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: Concrete		
				6.74	0.20			
					(0.30)	MADE GROUND: Firm, blue grey mottled black, sandy, gravelly clay, with inclusions of slag and ash. Sand is fine to coarse, gravel is fine to coarse, angular		
0.50	D1			6.44	0.50			
					(0.20)	MADE GROUND: Dense, brown mottled orange, sandy gravel, with inclusions of brick, concrete and slag. Sand is fine to coarse, gravel is fine to coarse, angular		
				6.24	0.70			
						Complete at 0.70m		

Remarks
No groundwater encountered.
Window sampler refused at 0.70m.

Scale (approx)	Logged By
1:25	SS

Figure No.
2780.WS46

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited Phase 2	WS47

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	90mm to 1.00m	6.25	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	Sheet
	352176.3 E 179379.8 N	08/12/2004	Halcrow Group Limited	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50)	MADE GROUND: Dense, black, clayey, sandy gravel, with inclusions of slag, brick and concrete. Sand is fine to coarse, gravel is fine to coarse, angular		
0.50	D1			5.75	0.50	MADE GROUND: Dense, dark brown mottled red and black, sandy gravel, with cobbles and inclusions of brick, concrete and slag. Sand is fine to coarse, gravel is fine to coarse, angular		
					(0.50)			
				5.25	1.00	Complete at 1.00m		

Remarks
No groundwater encountered.
Window sampler refused at 1.00m on brick and reinforced concrete rubble.

Scale (approx)	Logged By
1:25	SS

Figure No. 2780.WS47

IAN FARMER ASSOCIATES

Site	Number
Britannia Zinc Limited Phase 2	WS59

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	90mm to 0.70m	6.31	St Modwen Developments Limited	2780
	Location	**Dates**	**Engineer**	Sh
	352231.8 E 179362.2 N	08/12/2004	Halcrow Group Limited	

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	MADE GROUND: Concrete		
				6.11	0.20			
					(0.30)	MADE GROUND: Firm, blue grey mottled black, sandy, gravelly clay, with inclusions of slag and ash. Sand is fine to coarse, gravel is fine to coarse, angular		
0.50	D1			5.81	0.50			
					(0.20)	MADE GROUND: Dense, brown mottled orange, sandy gravel, with inclusions of brick, concrete and slag. Sand is fine to coarse, gravel is fine to coarse, angular		
				5.61	0.70			
						Complete at 0.70m		

Remarks
No groundwater encountered.
Window sampler refused at 0.70m.

Scale (approx)	Logged By
1:25	SS

Figure No.
2780.WS59

Geotechnical Engineering Limited

BOREHOLE LOG

WS24

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Sheet 1 of 1

Start Date 21st September 2001

Scale 1 : 25

End Date 21st September 2001

Depth 1.20 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
21/09/01	1D	0.20 -					MADE GROUND: Red brown black sand with fine to coarse gravel and fragments of brick, ash and clinker.			
	2D	0.70 -					MADE GROUND: Black sand and gravel with soft gey clay.	0.75		
Dry							Borehole refused at 1.20m	1.20		
								(4.00)		

EQUIPMENT: Competitor 130 rig.

METHOD: Continuous disturbed sampling 0.00-1.20m.

BACKFILL: On completion, hole backfilled with local materials.

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered

CONTRACT 12784

CHECKED NW

Geotechnical Engineering Limited

BOREHOLE LOG

WS27

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Start Date 20th September 2001

End Date 20th September 2001

Sheet 1 of 1

Scale 1 : 25

Depth 2.00 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
20/09/01								MADE GROUND: Red brown black sand with fine to coarse gravel and fragments of brick and ash.			
	1D	0.50	–								
								Soft grey brown SILT:CLAY.	0.70		
	2D	1.00	–								
								Grey SAND	1.10		
								Firm grey brown SILT:CLAY	1.25		
Dry											
								Borehole completed at 2.00m	2.00		
									(4.00)		

EQUIPMENT: Competitor 130 rig.

METHOD: Continuous disturbed sampling 0.00-2.00m.

BACKFILL: On completion, a slotted standpipe was installed to 2.00m, granular response zone 2.00-0.40m, bentonite seal 0.40-0.10m, concrete and raised helmet cover 0.10-0.00m.

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered

CONTRACT 12784

CHECKED NW.

Geotechnical Engineering Limited

BOREHOLE LOG

WS28

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Start Date 20th September 2001

End Date 20th September 2001

Sheet 1 of 1

Scale 1 : 25

Depth 2.00 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
20/09/01								MADE GROUND: Black brown red mottled sand with fine to coarse gravel and fragments of brick, ash and clinker and occasional cobbles of sandstone.			
	1D	0.50	–								
								MADE GROUND: Soft grey brown silt:clay.	0.85		
								MADE GROUND: Black brown clayey sand with medium to coarse angular gravel and ash.	1.00		
								Soft to firm brown SILT:CLAY.	1.20		
	2D	1.30	–								
Dry											
								Borehole completed at 2.00m	2.00		
									[4.00]		

EQUIPMENT: Competitor 130 rig.

METHOD: Continuous disturbed sampling 0.00-2.00m.

BACKFILL: On completion, a slotted standpipe was installed to 2.00m, granular response zone 2.00-0.40m, bentonite seal 0.40-0.10m, concrete and raised helmet cover 0.10-0.00m.

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered

CONTRACT 12784

CHECKED NW.

Geotechnical Engineering Limited

BOREHOLE LOG

GW07

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Start Date 26th September 2001

End Date 26th September 2001

Sheet 1 of 3

Scale 1 : 50

Depth 18.70 m

progress date/time water depth	sample no & type	depth (m) from to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
26/09/01	1D	0.45 - 0.50					MADE GROUND: Brown red coarse sand with some fine angular gravel and some cobbles of crushed brick and concrete.			
	2D	0.95 - 1.00								
	3D	1.45 - 1.50								
	4D	1.95 - 2.00					MADE GROUND: Soft red grey brown silt:clay with some fine to medium subangular to subrounded gravel of sandstone, with some black staining.	1.70		
	5D	2.45 - 2.50								
	6D	2.95 - 3.00					Soft grey brown SILT:CLAY.	2.90		
	7D	3.45 - 3.50								
	8D	3.95 - 4.00								
	9D	4.45 - 4.50								
	10D	4.95 - 5.00								
	11D	5.95 - 6.00								
	12D	6.95 - 7.00								
							Continued Next Page	(8.00)		

EQUIPMENT: Pilcon 150 cable percussion rig.

METHOD: Cable percussion (150mm) 0.00m-18.70m.

BACKFILL: On completion, borehole collapsed 18.70m-16.10m. Standpipe piezometer installed with geotextile filter and response zone 16.10m-9.00m. Bentonite seal placed 9.00m-0.50m. Concrete and raised helmet cover placed 0.50m-0.00m.

REMARKS:

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered.

CONTRACT 12784

CHECKED NW.

Geotechnical Engineering Limited

BOREHOLE LOG

GW07

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Start Date 26th September 2001

End Date 26th September 2001

Sheet 2 of 3

Scale 1 : 50

Depth 18.70 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
	13D	7.95	8.00								
	14D	8.95	9.00					becoming very soft and grey below 9.40m.			
	15D	9.95	10.00								
	16D	10.95	11.00								
	17D	11.95	12.00								
	18D	12.95	13.00								
	19D	13.95	14.00								
	20D	14.95	15.00					Brown medium to coarse SAND	14.80		
	21D	15.95	16.00								
	22D	16.95	17.00								
								Continued Next Page	(18.00)		

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered.

CONTRACT 12784

CHECKED

Geotechnical Engineering Limited

BOREHOLE LOG

GW07

CLIENT HYDER CONSULTING LTD

SITE BRITANNIA ZINC, AVONMOUTH

Start Date 26th September 2001

End Date 26th September 2001

Sheet 3 of 3

Scale 1 : 50

Depth 18.70 m

progress date/time water depth	sample no & type	depth (m) from	depth (m) to	casing depth (m)	SPT type & N value	test /core range	instru -ment	description	depth (m)	reduced level (m)	legend
Dry	23D	18.25	18.30					Brown medium to coarse SAND with some organic material.	18.30		
	24D	18.45	18.50					Firm to stiff red very sandy CLAY	18.40		
								End of borehole at 18.70m.	18.70		
									(28.00)		

water strike (m)	depth of casing (m)	rose to (m)	time to rise (min)	remarks
				Groundwater not encountered.

CONTRACT 12784

CHECKED NV

Hyder Consulting

Project : BRITTANIA ZINC LTD IPPC PHASE 2

Trial Pit : TP1

Depth (m)	Description	Sample Type	Sample No.	Depth (m)
0.25	MADE GROUND: Black sand of ash and clinker with some gravel.			
0.40	MADE GROUND: Coarse angular gravel.			
0.90	MADE GROUND: Black, red and brown sand and gravel of ash, clinker, brick fragments. Some large lumps of black, yellow, white and brown fused clinker and cementatous material.	SOIL	TP1	0.5m
1.20	Firm mottled bluey grey and brown fissured CLAY.	SOIL	TP1	1.15m
	END OF TRIAL PIT AT 1.2M.			

Plant :	Dimensions :	Bearing of Long Axis :	Shored To :	Logged By :	Date :
3CX	–	–	None	DC	11/10/01

Stability :	Groundwater :	Notes :
OK	None Encountered	

R:GEOTECH/DWGS/WX20134/TP1

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES01**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **28.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND:Black brown slightly clayey sandy GRAVEL of fine to coarse subangular to subrounded brick, concrete and ash with rare wood fragments (<10mm) and steel reinforcement bars.		(1.30)	
0.50	1	ES							
1.00-1.45	2	SPT(c)	N=23						
1.00	3	D						1.30	
1.00-1.30	4	B				Soft locally closely fissured light grey mottled light brown CLAY.			
1.30-1.50	5	D							
1.50-2.50	6	P						(1.70)	
2.50	7	B							
								3.00	
3.00-3.50	10	B				Soft light bluish grey silty CLAY.			
3.00	9	D							
4.00	11	D							
4.00-4.50	12	B						(3.00)	
5.00	13	D							
5.00-5.50	14	B							
								6.00	
6.00	15	D				Soft light bluish grey clayey SILT.			
6.00-6.50	16	B							
7.00	18	D							
7.00-7.50	19	B							
8.00	20	D							
8.00-8.50	21	B							

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit hand dug to 1.20m depth.
2. No water added to aid drilling.
3. No groundwater encountered.
4. 50mm diameter monitoring well c/w flush cover installed to 1.0m depth on completion (response zone 0.50-1.00m).

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 150**	**PO**	**MChappell**	

AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES01**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**27.05.09** End: **28.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
9.00-10.00	22	P				Soft light bluish grey clayey SILT. *(stratum text copied from layer at 6.00m depth from previous sheet)*		(8.30)	
11.00	24	D							
11.00-11.50	25	B							
12.00	26	D							
12.00-12.50	27	D							
13.00	28	D							
13.00-13.50	29	B				. . . at 13.50m locally sandy along thin laminations.			
14.30	30	D				Medium dense light grey brown medium to fine SAND.		14.30	
14.30-14.50	31	B							
15.00-15.45	32	SPT	N=17						
15.50	33	D							
15.50-16.00	34	B							
16.00-16.45	35	SPT	N=15					(3.60)	
16.00	36	D							
16.00-16.50	37	B							
17.00	39	D							
17.00-17.50	40	B						17.90	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 150**	**PO**	**MChappell**	

AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES01**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **28.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
17.90	41	D				Firm dark brown fibrous PEAT. *(stratum text copied from layer at 17.90m depth from previous sheet)*		18.10	
18.10-18.50	42	B				Stiff red mottled grey CLAY with rare fine to medium gravel sized pockets of firm fibrous peat.		18.50	
18.50-19.00	43	B				Hard red mottled grey CLAY.			
19.00-19.45	44	SPT(c)	N=34					(1.50)	
20.00	45	D						20.00	
20.00-20.45	46	SPT(c)	N=50						

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 150**	**PO**	**MChappell**	

AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES02**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **28.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.30	1	D				MADE GROUND: Very loose blackish brown slightly clayey sandy GRAVEL of fine to coarse angular to subangular brick and ash with frequent wood fragments (<15mm) and rare polythene sheets.		(1.50)	
0.50	2	ES							
1.20-1.65	3	SPT	N=4					1.50	
2.00-2.50	4	B				Firm locally closely fissured brown mottled grey CLAY.			
2.75	23	W						(3.00)	
3.00	5	D		1					
3.50-4.50	6	P		1					
								4.50	
5.50		V	c_u=90			Soft light bluish grey clayey SILT.			
5.50		V	c_r=60						
6.00-6.50	8	B							
7.50	9	D							
								(8.00)	
8.50	11	D				. . . becoming very soft from 8.50m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit hand dug to 1.2m.
2. Groundwater encountered at 3.50m depth, rising to 3.20m depth after 20 minutes.
3. No water added to aid drilling.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES02**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **28.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
9.00-9.50	12	B				Soft light bluish grey clayey SILT. *(stratum text copied from layer at 4.50m depth from previous sheet)*			
10.50-11.50	13	P							
								12.50	
12.50-12.95	14	$SPT_{(NR)}$	N=5			Medium dense light greyish brown fine to coarse SAND.			
12.50	15	D							
13.00-14.00	17	B							
13.50-13.95	16	SPT	N=11						
14.50-14.95	18	SPT	N=9					(5.00)	
15.50-15.95	19	SPT	N=12						
15.50	20	D							
16.50-16.95	21	SPT	N=18						
16.50-17.50	22	B							
								17.50	
17.50-17.95	24	SPT	N=18			Stiff brownish grey silty CLAY with rare medium gravel size pockets of fibrous peat.		17.80	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES02**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**27.05.09** End: **28.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Description on next sheet			
18.30	25	D				Very stiff red mottled grey CLAY with rare medium gravel size pockets of firm fibrous peat. *(stratum text copied from layer at 17.80m depth from previous sheet)* . . . no peat from 18.30m depth.		(2.20)	
19.00-19.45	26	SPT	N=33						
19.80	27	D						20.00	
20.00-20.44	28	SPT	N=53*			Borehole terminated at 20.00m depth.			

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES03**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **21.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.50-1.00	1	B				MADE GROUND: Dark grey brown and red brown silty very gravelly SAND with a medium cobble content. Gravel and cobbles are angular to subangular concrete and concrete. Gravel is fine to coarse, incldues occasional glass, metal, wood and ash.		(1.20)	
0.50	2	ES						1.20	
1.20-1.65	3	SPT	N=12			MADE GROUND: Firm grey, grey-brown and red-brown slightly gravelly sandy CLAY with a low cobble content. Gravel and cobbles are angular to subangular brick and concrete. Gravel is fine to coarse.		(1.00)	
1.20-2.20	4	B		1				2.20	
2.20-2.65	5	SPT	N=3			Very soft light brown-grey and light grey CLAY.		(1.30)	
2.50	6	D						3.50	
3.50	8	D				Very soft dark blue-grey CLAY.		(2.50)	
3.50-4.00	9	B						6.00	
5.00	10	P							
5.00	11	W							
5.00	12	D		2					
6.00-7.00	13	B				Soft closely fissured blue-grey CLAY. . . . locally slightly gravelly from 7.50m depth, gravel of mudstone lithorelicts, and contains tabular cobbles/boulders/bands of extremely weak to very weak mudstone.		(5.50)	
8.00	14	D							
8.00-9.00	15	B							

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
20/05/09	10:00	1.90	-	150	1.90
20/05/09	10:20	1.90	-	150	1.60
20/05/09	12:00	6.00	5.00	150	6.00
20/05/09	12:20	6.00	5.00	150	5.60
20/05/09	17:00	13.00	13.00	150	-
21/05/09	08:00	13.00	13.00	150	4.20
21/05/09	12:00	20.00	19.50	150	-

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit hand dug to 1.20m depth.
2. No water added to aid drilling.
3. Groundwater struck at 1.90m depth, rising to 1.60m depth after 20 minutes.
4. Groundwater struck at 6.00m depth, rising to 5.60m after 20 minutes.
5. 50mm diameter monitoring well c/w flush cover

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES03**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**20.05.09** End: **21.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
9.50	16	P				Soft closely fissured blue-grey CLAY. *(stratum text copied from layer at 6.00m depth from previous sheet)*			
11.00-12.00	17	B						11.50	
12.00-12.45	18	SPT	N=15			Medium dense brown and grey slightly silty fine to medium SAND.		(1.50)	
12.80	19	D				. . . locally silty from 12.80m depth.		13.00	
13.00-13.45	20	SPT	N=8			Soft blue-grey slightly sandy locally sandy SILT.		(1.00)	
14.00-14.45	21	SPT	N=6			Firm brownish grey slightly sandy locally clayey SILT.		14.00	
14.50	22	D							
15.00-15.45	23	SPT	N=7					(2.00)	
15.00-16.00	24	B							
16.00-16.45	25	SPT	N=6			Firm grey slightly sandy SILT with occasional plant fibres.		16.00	
16.70	26	D						(1.30)	
17.00-17.45	27	SPT	N=10			. . . rare fine gravel size shells from 17.00m depth.		17.30	
						Firm dark brown fibrous PEAT.		17.70	
17.70	28	D				Soft light grey and light brown sandy SILT with occasional plant fibres and fine gravel size shell fragments.		18.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

installed to 1.50m depth on completion (response zone 0.40-1.60m depth).

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES03**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **21.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
18.00-18.45	29	SPT	N=25			Stiff light grey slightly sandy SILT with occasional plant fibres and shell fragments.		18.40	
18.70	30	D				Very stiff red brown CLAY. . . . locally sandy between 18.40 to 19.00m depth with rare plant fibres.		(1.60)	
19.00-19.45	31	SPT	N=40						
19.50	32	D						20.00	
20.00-20.37	33	SPT	N=68*			Borehole terminated at 20.00m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES04**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **27.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND: Dark grey black very silty very gravelly SAND. Gravel is fine to coarse subangular to subrounded brick, concrete and occasional sandstone and ash.			
0.50	1	ES		1					
0.50	2	ES							
0.50-1.00	3	B							
0.80	5	W		1				(2.20)	
1.20-1.65	4	SPT	N=6						
								2.20	
2.20-2.65	6	SPT	N=8			Firm grey and brown locally slightly sandy CLAY.			
3.00	7	D						(2.80)	
4.00	8	B							
								5.00	
5.00-5.50	10	B				Very soft dark grey CLAY.			
5.00		V	c_u=70						
5.00		V	c_r=64						
5.70	11	D							
6.00-7.00	12	P							
8.00	13	B							
8.00		V	c_u=175						
8.00		V	c_r=140					(7.80)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
26/05/09	08:00	1.20	0.00	150	1.20
26/05/09	08:20	1.20	0.00	150	0.80
27/05/09	07:30	19.00	19.00	150	2.20

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit dug to 1.2m
2. No water added during drilling.
3. Groundwater struck at 1.20m depth, rising to 0.80m after 20 minutes.
4. Groundwater standing at 2.20m depth at start of second shift.
5. Water inflow from the sand at 13.00m depth.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES04**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**26.05.09** End: **27.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
9.00-10.00	15	B				Very soft dark grey CLAY. *(stratum text copied from layer at 5.00m depth from previous sheet)*			
11.00	16	D							
11.00		V	c_u=63						
11.00		V	c_r=22					12.80	
12.80	18	D				Loose dark grey slightly silty fine to medium SAND.			
13.00-13.45	19	$SPT_{(NR)}$	N=6			. . . locally silty 12.80 to 14.0m depth.			
14.00	20	B							
14.00-14.45	21	$SPT_{(NR)}$	N=8						
15.00	22	D				. . . becoming medium dense from 15.00m depth.		(4.70)	
15.00-15.45	23	SPT	N=19			. . . becoming lighter in colour from 15.00m depth.			
15.80	24	D							
16.00-16.45	25	SPT	N=12						
16.80	26	D							
17.00-17.45	27	SPT	N=34			. . . locally containing rare fine subrounded quartz gravel and dense from 17.00m depth.		17.50	
17.80	28	D				Dense locally slightly clayey slightly gravelly SAND. Gravel is medium to coarse very weak mudstone and sandstone.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

6. Borehole backfilled with bentonite pellets on completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES04**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**26.05.09** End: **27.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
18.00-18.45	29	SPT	N=42			Dense locally slightly clayey slightly gravelly SAND. Gravel is medium to coarse very weak mudstone and sandstone. *(stratum text copied from layer at 17.50m depth from previous sheet)*		(1.10)	
								18.60	
						Stiff red brown and dark brown CLAY with rare plant fibres/rootlets.			
18.90	30	D							
19.00-19.45	31	SPT	N=27						
								(2.20)	
19.80	32	D							
20.00-20.45	33	SPT	N=36			. . . locally extremely weak mudstone from 20.00m depth.			
								20.80	
						Extremely weak light grey and red brown MUDSTONE.		21.00	
21.00-21.30	34	SPT	N=103*			Borehole terminated at 21.00m depth.			

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES05**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**21.05.09** End: **21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.50 0.50 0.50-1.00	1 2 3	ES J B				MADE GROUND: Firm dark grey and brown slightly sandy slightly gravelly CLAY with low cobble content. Gravel and cobbles are angular to subangular brick and concrete. Gravel is fine to coarse.		(1.50)	
1.20-1.65	4	SPT	N=8						
						Borehole refused at 1.50m depth.		1.50	

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**???**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES05A**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **22.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND: Soft yellow brown gravelly CLAY. Gravel is subangular fine to coarse brick, coal and ash with rare steel reinforcement bars.		(0.50)	
0.50	1	ES						0.50	
0.50-1.00	2	B				MADE GROUND: Black brown slightly clayey sandy GRAVEL of subangular fine to medium ash and brick.		(1.00)	
								1.50	
						Stiff locally closely fissured light grey mottled light brown CLAY.		(1.50)	
2.50	3	D						3.00	
3.00-4.00	5	B				Soft light grey locally mottled brown silty CLAY.			
5.00	6	D							
6.00	9	D							
7.00	10	ES							
8.00	11	P		1				(12.00)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
21/05/09	10:45	15.50	15.00	150	15.50
21/05/09	11:05	15.50	15.00	150	8.10

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit dug to 1.20m.
2. Groundwater struck at 15.50m depth, rising to 8.10m depth after 20 minutes.
3. 3no. buckets of water added from 2.50 to 19.50m to aid drilling.
4. Borehole backfilled with bentonite pellets on completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES05A**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	**21.05.09** End: **22.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
9.00-10.00	12	B				Soft light grey locally mottled brown silty CLAY. *(stratum text copied from layer at 3.00m depth from previous sheet)*			
11.00-11.50	14	B							
13.00	15	P						15.00	
15.00	16	D		1		Soft locally closely fissured grey clayey SILT with fine light grey sand along very closely spaced partings.		(0.50) 15.50	
15.50-15.95	17	SPT	N=15			Medium dense light greyish brown fine to medium SAND.			
16.00	18	D							
16.50-16.95	19	SPT	N=11					(2.30)	
17.50	20	D							
17.50-17.95	21	$SPT_{(NR)}$	N=12					17.80	
						Description on next sheet			

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES05A**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **22.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
18.00	23	D				Firm locally thinly laminated greenish grey sandy SILT with frequent medium gravel sized pockets of black brown firm fibrous peat and fine gravel of shell fragments. Laminations occasionally infilled with fine grey sand. *(stratum text copied from layer at 17.80m depth from previous sheet)*		(1.00)	
18.50-18.95	24	SPT	N=27					18.80	
						Very stiff red mottled grey CLAY.			
19.00	27	W						(0.70)	
19.30	25	D				. . . at 19.30m occasional medium gravel sized pockets of firm fibrous peat.		19.50	
19.50-19.88	26	SPT	N=65*			Borehole terminated at 19.50m.			

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES06**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **27.05.09**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
0.50	1	ES				MADE GROUND: Medium dense dark grey and black very clayey very gravelly SAND. Gravel is fine to coarse angular to subangular concrete, brick, slate and chert includes occasional slag, wood and ash.		(2.00)	
1.00	2	D							
1.00-1.50	3	B							
1.00-1.45	4	SPT(c)	N=27						
								2.00	
2.00	5	D				Firm grey and brown locally slightly sandy CLAY.			
2.00-2.30	6	B						(1.90)	
3.00	8	D							
3.00-3.50	9	D							
								3.90	
4.00	10	D				Very soft dark grey and grey CLAY.			
4.00-4.50	11	B							
5.00	13	D							
5.00-5.50	14	B							
6.00	15	D							
6.00-6.50	16	B							
7.00-8.00	17	P						(7.10)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
26/05/09	17:00	11.00	11.00	150	Dry

Chiselling		
From	To	Duration (hh:mm)
1.30	1.50	00:45

General Remarks

1. Inspection pit dug to 1.20m.
2. No water added to aid drilling,
3. No groundwater encountered.
4. On entering Sand at 12.00m, borehole produced gas. Initial gas monitor reading from the top of the casing showed gas composition of 82% methane.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 150**	**PO**	**TPayne**	AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES06**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **27.05.09**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
9.00	18	D				Very soft dark grey and grey CLAY. *(stratum text copied from layer at 3.90m depth from previous sheet)*			
9.00-9.50	19	B							
10.00	21	D							
10.00-10.50	22	B							
								11.00	
						Grey silty CLAY - (Drillers description).		(1.00)	
								12.00	
						SAND - (Drillers description).		12.10	
						Borehole terminated at 12.10m depth due to high concentrations of methane released on entering the sand at 12.00m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

5. Borehole terminated at 12.0m and a 50mm diameter monitoring well c/w/ flush cover installed to 12.0m depth on instruction of the engineer.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Dando 150**	**PO**	**TPayne**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES07**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **29.05.09**	**---**	**---**	**1** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND:Black brown slightly clayey sandy GRAVEL of fine to coarse subangular to subrounded brick and ash with rare wood fragments (<10mm).		(0.50)	
0.50	1	ES						0.50	
0.50-1.00	2	B				MADE GROUND: Soft brown mottled grey slightly gravelly CLAY. Gravel is fine to medium subangular ash and brick.			
1.20-1.65	3	SPT	N=5						
1.20-2.20	4	B						(2.70)	
2.20-2.65	5	SPT	N=3						
2.20-3.20	6	B						3.20	
3.20-3.65	7	SPT	N=9			Soft locally closely fissured light grey mottled light brown silty CLAY.		(1.30)	
4.00	8	D							
4.00-5.00	9	P						4.50	
						Soft light bluish grey clayey SILT.			
6.00	10	D							
7.00		V	c_u=50						
7.00		V	c_r=32						
8.00	12	D							

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
28/05/09	17:00	16.50	16.50	150	10.50
29/05/09	07:30	16.50	16.50	150	9.40

Chiselling		
From	To	Duration (hh:mm)

General Remarks

1. Inspection pit hand dug to 1.20m.
2. Groundwater standing at 10.50m depth at 17.00 on 28/05/09.
3. Groundwater standing at 9.40m depth at 07.30 on 29/05/09.
4. 50mm diameter monitoring well c/w flush cover installed to 3.00m. (response zone 1.00 to 3.00m)

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	AGS

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES07**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **29.05.09**	**---**	**---**	**2** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
9.00-10.00	13	P				Soft light bluish grey clayey SILT. *(stratum text copied from layer at 4.50m depth from previous sheet)*		(9.50)	
9.40	23	W							
11.00	14	D							
12.00		V	c_u=85						
12.00		V	c_r=65						
13.00	16	D							
13.00		V	c_u=175						
13.00		V	c_r=120						
								14.00	
14.00	18	D				Medium dense light grey brown medium to fine SAND.			
15.00	19	D							
15.50-15.95	20	SPT	N=16						
16.00	21	D						(4.70)	
16.50-16.95	22	SPT	N=35						
17.30	24	D							
17.50-17.95	25	SPT	N=20						
17.50-18.50	26	B							

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

PRELIMINARY BOREHOLE LOG

Contract:	Client:	Borehole:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**BHNES07**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
723110	End: **29.05.09**	**---**	**---**	**3** of **3**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Medium dense light grey brown medium to fine SAND. *(stratum text copied from layer at 14.00m depth from previous sheet)*			
18.50-18.95	27	SPT	N=25					18.70	
						Firm fibrous dark brown PEAT locally thinly interlaminated with stiff light brown gravelly CLAY. Gravel is fine shell fragments.		19.10	
19.00	28	D				Stiff blue greenish grey silty CLAY with frequent medium to coarse gravel sized pockets of firm fibrous peat and shell fragments.		19.30	
19.10	29	D							
19.30	30	D							
19.50-19.95	31	SPT	N=26			Stiff red mottled grey CLAY with occasional fine to medium gravel sized pockets of firm fibrous peat.		(1.70)	
20.30	32	D							
20.50-20.95	33	SPT	N=37					21.00	
						Hard red mottled grey CLAY.		(0.50)	
21.50-	34	SPT	HELP			Borehole terminated at 21.50m depth.		21.50	

Boring Progress and Water Observations						Chiselling			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Pilcon Wayfarer 1500**	**JW**	**MChappell**	

STRUCTURAL SOILS

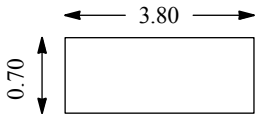
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES01**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.20	1	B				MADE GROUND: Grey and black slightly silty very gravelly SAND with a medium cobble content. Gravel and cobbles are concrete and brick, silt/sand content includes ash.		0.25	
0.50	2	B				MADE GROUND: Brown grey and red brown sandy GRAVEL with a high cobble content and low boulder content.		(1.15)	
1.20	3	B						1.40	
						Trial pit refused at 1.40m depth on concrete.			

Plan (Not to Scale)



General Remarks

1. 1st attempt to excavate trial pit met refusal at 1.10m depth on a concrete slab.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

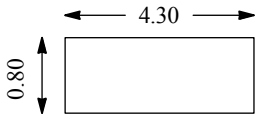
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES01A**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUNDL Light grey slightly sandy slightly gravelly SILT. Gravel is fine to medium angular to subangular brick and concrete.		(0.40)	
0.40	1	B						0.40	
0.50	2	B				MADE GROUND: Dark brown, black and orange brown slightly silty very sandy GRAVEL with a high cobble and a low boulder content. Gravel, cobbles and boulders are angular to subangular brick and concrete.		(0.60)	
0.50	2A	ES						1.00	
1.00	3	B				Light grey and orange brown slightly sandy locally sandy slightly gravelly CLAY with occasional rootlets.		1.20	
						Stiff high strength light grey and brown CLAY.			
1.50	4	D							
1.50		V	c_u=75						
2.00	5	D							
2.00		V	c_u=89					(2.30)	
2.70	6	D				. . . below about 2.7m medium strength.			
2.70		V	c_u=50						
								3.50	
						Soft very low strength dark blue grey and CLAY.			
3.80	7	D							
3.80		V	c_u=20					(1.10)	
4.50	8	D							
4.50		V	c_u=14					4.60	
						Trial pit terminated at 4.60m depth.			

Plan (Not to Scale)



General Remarks

1. Sides stable below 1.20m depth.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

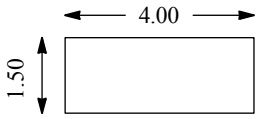
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES02**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.20	1	B				MADE GROUND: Light and dark grey silty very sandy GRAVEL with a medium cobble and a low boulder content.		(0.40) 0.40	
0.50	2	B				MADE GROUND: Dark grey and red brown gravelly SAND.		(0.30) 0.70	
0.50	2A	ES		1		MADE GROUND: Slightly sandy GRAVEL with a high cobble and a high boulder content. Gravel is fine to coarse angular to subangular.		(0.70) 1.40	
1.20	3	B							
1.50	4	D				Firm medium strength dark grey brown slightly sandy CLAY with many rootlets.		(0.30) 1.70	
1.50		V	c_u=46						
2.00	5	D				Stiff high strength light grey and brown slightly sandy CLAY.		(0.80) 2.50	
2.00		V	c_u=130						
2.50	6	D				Trial pit terminated at 2.50m depth due to constant collapse of brick cobble layer and water inflow into pit.			
2.50		V	c_u=90						

Plan (Not to Scale)



General Remarks

1. Water ingress moderate flow at 0.80m depth.
2. Rapid water ingress filling hole water level remained standing at 0.95m depth.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

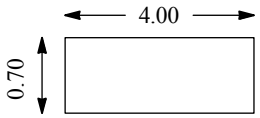
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES03**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND: Dark grey black and brown silty sandy GRAVEL with a medium cobble and a medium boulder content. Gravel, cobbles and boulders are concrete, brick, probable slag and sleepers.		(0.50)	
0.40	1	B						0.50	
0.60	2	ES				MADE GROUND: Dark grey and brown silty very sandy GRAVEL of fine to coarse angular to subangular concrete, brick and slag.		0.75	
0.60	2A	D				Stiff high strength light grey mottled brown slightly sandy CLAY with many rootlets.			
1.00	3	D							
1.00		V	c_u=85/105/120					(1.15)	
1.50	4	B							
1.50		V	c_u=92/110/119					1.90	
2.00	5	D				Very soft low strength light grey and brown slightly sandy CLAY.			
2.00		V	c_u=22					(0.50)	
								2.40	
2.60	6	D				Very soft very low strength blue grey and brown CLAY.			
2.60		V	c_u=14						
3.50	7	D				. . . low strength below about 3.50m depth.		(2.20)	
3.50		V	c_u=34						
4.30	8	D							
4.30		V	c_u=35					4.60	
						Trial pit terminated at 4.60m depth.			

Plan (Not to Scale)



General Remarks

1. First attempt to excavate pit refused on obstruction at 0.30m depth, relocated position 10m west.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

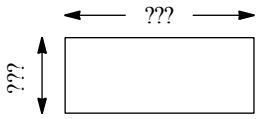
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES04**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
0.10	1	B				MADE GROUND: Light grey slightly gravelly slightly sandy SILT.		(0.35)	
0.10	1A	ES						0.35	
0.40	2	B				MADE GROUND: Black and dark grey slightly gravelly slightly silty fine to coarse SAND. Sand fraction is party crystalline and contains ash. Gravel is fine subangular brick and concrete.		0.60	
0.40	2A	ES							
0.70	3	B		▼1		MADE GROUND: Grey, brown, yellow, and orange-brown slightly silty sandy GRAVEL with a medium cobble content. Gravel and cobbles are brick and concrete with occasional metal and wood.		(0.80)	
								1.40	
1.50	4	B				Stiff dark grey-brown slightly sandy CLAY.		(0.60)	
								2.00	
2.00	5	D				Stiff high strength light and brown slightly sandy CLAY.			
2.00		V	c_u=90					(1.00)	
2.60	6	D				. . . becomes medium strength below about 2.60m depth.			
2.60		V	c_u=52					3.00	
3.10	7	D				Soft low strength blue grey CLAY.			
3.10		V	c_u=22					(1.30)	
4.20	8	D							
4.20		V	c_u=23					4.30	
						Trial pit terminated at 4.30m depth.			

Plan (Not to Scale)



General Remarks

1. Rapid water ingress from 1.00m depth.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

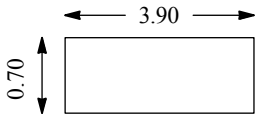
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES05**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUNDL GRAVEL surface of medium to coarse grey limestone.		0.25	
0.40	1	B				MADE GROUND: Dark grey to black slightly silty very sandy GRAVEL of fine to medium angular to subangular brick, limestone, concrete and ash.		(0.70)	
								0.95	
1.00	2	B				Dark grey, brown and black slightly sandy CLAY with a slight organic odour, many rootlets and much organic matter.		(0.45)	
								1.40	
1.40	3	D				Firm medium strength light grey and brown slightly sandy CLAY.			
1.40		V	c_u=62						
2.10	4	D							
2.10		V	c_u=65					(2.40)	
2.70	5	D				. . . locally stiff from 2.70m depth and locally more sandy.			
2.70		V	c_u=82						
3.50	6	D		≈					
								3.80	
3.80		V	c_u=51			Soft medium strength light grey and brown slightly sandy CLAY.		(0.50)	
4.20	7	D				. . . low strength below 4.20m depth.		4.30	
4.20		V	c_u=34			Trial pit terminated at 4.30m depth.			

Plan (Not to Scale)



General Remarks

1. Slight water seepage from 3.80m depth in corner of pit.
2. Sides stable.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

STRUCTURAL SOILS

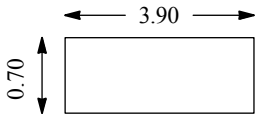
PRELIMINARY TRIAL PIT LOG

Contract:	Client:	Trialpit:
Access 18, Britannia Zinc, Avonmouth	**St. Modwen Developments Limited**	**TPNES06**

Contract Ref:	Date:	Ground Level	Co-ordinates:	Sheet:
723110	**21.05.09**	**---**	**---**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						MADE GROUND: Dark grey and black silty very sandy GRAVEL with a low cobble content. Gravel and cobbles are angular to subangular brick and concrete.		(0.45)	
0.30	1	B							
0.30	1A	ES						0.45	
						MADE GROUND: Orange-brown and brown very sandy GRAVEL with medium cobble content. Gravel and cobbles are angular to subangular brick, concrete, wood and metal.		(0.55)	
0.60	2	B							
								1.00	
						MADE GROUND: Yellow brown gravelly SAND with a low cobble content. Gravel is angular to subangular brick and concrete.		(0.45)	
1.10	3	B							
								1.45	
						Dark grey orange brown slightly silty sandy locally sandy CLAY.		(0.35)	
1.50	4	D							
								1.80	
						Stiff high strength light grey and brown slightly sandy CLAY.			
2.10	5	D							
2.10		V	c_u=115						
						. . . becomes medium strength below 2.60m depth.			
2.60	6	D							
2.60		V	c_u=50					(2.30)	
3.70	7	D							
3.70		V	c_u=48						
								4.10	
4.10	8	D				Soft varying to firm low strength blue, grey, and black CLAY.			
4.10		V	c_u=45					(0.40)	
4.40	9	D							
4.40		V	c_u=39					4.50	
						Trial pit terminated at 4.50m depth.			

Plan (Not to Scale)



General Remarks

1. Sides stable.
2. No groundwater encountered.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Logged By:	Checked By:
Machine dug	**JCB-3CX**	**TPayne**	

									Structual Soils May 2009													Ian Farmers March 2005						
Sample Identity									**TPNES01**	**TPNES02**	**TPNES03**	**TPNES04**	**TPNES04**	**TPNES05**	**TPNES06**	**BHNES03**	**BHNES01**	**BHNES02**	**BHNES04**	**BHNES05A**	**BHNES06**	**BHNES07**	**BH43**	**BH44**	**WS44**	**BH43**	**BH43**	**BH44**	**WS44**
Sampled Strata									MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	MG	TF	TF	TF	MG	MG	MG	MG
Sample Depth									0.5	0.5	0.6	0.1	0.4	1.0	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.1	1.5	2.50	0.6	1.1	0.2	0.5
Determinand	**Units**	**Screening Value SGV**	**Screening Value SSAC**	**Max**	**Mean**	**Count**	**Count >SV**	**%>SV**																					
pH	s.u.			11.4	8.18	15																	8.0	8.7	8.2	7.6	8	11.4	7.4
Cyanide (total)	mg/kg			1.2	0.67	7																							
Cyanide (free)	mg/kg			1	1.00	2																							
Cyanide (complex)	mg/kg			1.2	1.10	16			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1							
Sulphate	mg/kg																												
Asbestos containing material	None					6											No ACM	No ACM	No ACM	No ACM	No ACM	No ACM							
Metals (total)																													
Arsenic	mg/kg	>640		5500	912	34	16	47	2200	1300	62	5500	2100	15	1100	530	300	280	850	320	680	5100	13	7.5	25	650	13	860	1300
Barium	mg/kg			730	234	24	0	0	44	520	390	120	38	120	53	75	520	350	20	380	270	710	70	46	49	37	70	82	29
Cadmium	mg/kg	>1400		18000	1491	34	9	26	2800	1100	120	18000	6100	16	1900	1900	1300	990	4300	350	2200	250	34	7.6	5.1	520	34	3500	990
Chromium	mg/kg	>5000		1400	127	23	0	0	75	27	13	42	120	28	99	180	47	52	1400	66	110	400							
Copper	mg/kg		>45700	25000	2614	34	0	0	5500	1600	260	800	2500	68	3300	2500	660	850	3000	2200	1700	25000	47	29	44	1700	47	1800	6400
Iron	mg/kg			170000	50067	24	0	0	47000	100000	38000	24000	170000	28000	85000	58000	30000	55000	36000	42000	44000	58000	26000	21000	29000	35000	26000	39000	82000
Lead	mg/kg	>750		55000	17447	34	29	85	33000	15000	2200	41000	25000	530	38000	34000	16000	13000	29000	20000	32000	43000	190	840	480	23000	190	41000	55000
Mercury	mg/kg	>3600		220	21	23	0	0	44	3.2	1.0	220	42	0.4	34	11	7.6	7.1	44	5.1	15	2.4							
Nickel	mg/kg	>1800		1400	157	28	0	0	110	73	52	55	39	31	140	100	62	98	1400	71	170	670	41	36		83	41	81	
Selenium	mg/kg	>13000		1600	149	26	0	0	370	45	3	1600	370	3	180	63	78	43	400	31	160	23	1	1		15	1	280	
Zinc	mg/kg		>188000	180000	48626	34	0	0	80000	38000	5700	110000	81000	3300	70000	69000	28000	42000	180000	13000	78000	17000	980	220	390	76000	980	110000	170000
Caesium	mg/kg	>1000		720	282	14	0	0			2.1				2.4	1.8			1				220	350	460	570	220	580	330
BTEX																													
MTBE	mg/kg					2										0.10					0.10								
Benzene	mg/kg	95				2										0.10					0.10								
Toluene	mg/kg	4400				2										0.10					0.10								
Ethyl Benzene	mg/kg	2800				2										0.10					0.10								
m & p Xylene	mg/kg	3500				2										0.10					0.10								
o Xylene	mg/kg	2600				2										0.10					0.10								
BTEX																													
MTBE	mg/kg					2										0.01					0.01								
Aliphatics >C6-C8	mg/kg					2										0.01					0.01								
Aliphatics >C8-C10	mg/kg					2										0.01					0.01								
Aliphatics >C10-C12	mg/kg					2										0.10					0.10								
Aliphatics >C12-C16	mg/kg					2										0.10					0.10								
Aliphatics >C16-C21	mg/kg					2										0.10					0.10								
Aliphatics >C21-C35	mg/kg					2										0.10					0.10								
Total Aliphatics	mg/kg			0.1		2										0.10					0.01								
Aromatics >C5-C7	mg/kg					2										0.01					0.01								
Aromatics >C7-C8	mg/kg					2										0.01					0.01								
Aromatics >C8-C9	mg/kg					2										0.01					0.01								
Aromatics >C9-C10	mg/kg					2										0.01					0.01								
Aromatics >C10-C12	mg/kg					2										0.10					0.10								
Aromatics >C12-C16	mg/kg			8.7		2										8.7					0.10								
Aromatics >C16-C21	mg/kg			62.5		2										62.5					0.10								
Aromatics >C21-C35	mg/kg			65.3		2										65.3					0.4								
Total Aromatics	mg/kg			136.5		2										136.50					0.40								
TPH (Aliphatics & Aromatics)	mg/kg			136.5		2										136.50					0.41								
PAH (Total 16)																													
Naphthalene	mg/kg			0.75		4			0.35		0.75	0.11									0.08								
Acenaphthylene	mg/kg			0.13		4			0.01		0.13	0.01									0.01								
Acenapthene	mg/kg			0.66		4			0.03		0.66	0.01									0.02								
Fluorene	mg/kg			0.28		4			0.01		0.28	0.01									0.01								
Phenanthrene	mg/kg			7.73		4			0.13		7.73	0.32									0.12								
Anthracene	mg/kg			2.15		4			0.05		2.15	0.39									0.06								
Fluoranthene	mg/kg			16.2		4			0.39		16.20	0.37									0.13								
Pyrene	mg/kg			15.7		4			0.32		15.70	0.39									0.15								
Benz [a] anthracene	mg/kg			6.25		4			0.10		6.25	0.01									0.04								
Chrysene	mg/kg			11.2		4			0.35		11.20	0.01									0.13								
Benzo [b] fluoranthene Benzo [k] fluoranthene	mg/kg			9.42		4			0.14		9.42	0.01									0.14								
Benzo [a] pyrene	mg/kg			5.44		4			0.01		5.44	0.01									0.01								
Indeno [123-cd] pyrene	mg/kg			1.5		4			0.01		1.50	0.01									0.01								
Dibenz [ah] anthracene	mg/kg			0.71		4			0.03		0.71	0.01									0.01								
Benzo [ghi] perylene	mg/kg			5.37		4			0.10		5.37	0.01									0.02								
Total 16 PAH Reported	mg/kg			83.49		4			2.00		83.49	1.58									0.92								

TPH = Total Petroleum Hydrocarbons

SGV = Soil Guideline Value

SSAC = Site Specific Assessment Criteria

MG = Made Ground

TF = Tidal Flats

ACM = Asbestos containing material

2200 = Value above adopted screening value

5000 = adopted screening value based on previous CLEA

												Ian Farmers May 2004					Hyder Consulting December 2001				
Sample Identity									**WS45**	**WS46**	**WS47**	**WS3**	***WS3***	***WS3***	**BH1**	**BH2a**	**GW7**	**WSH27**	**WSH24**	**WSH28**	**TPH1**
Sampled Strata									MG	MG	MG	MG	TF	TF	MG	MG	MG	MG	MG	MG	MG
Sample Depth									0.5	0.5	0.5	0.5	1.5	2.5	0.6 - 1.2	0.1 - 1.2	0.5	0.5	0.2	0.5	0.5
Determinand	**Units**	**Screening Value**		**Max**	**Mean**	**Count**	**Count >SV**	**%>SV**													
		SGV	**SSAC**																		
pH	s.u.			11.4	8.18	15			7.6	8.5	8.2	6.7	8.5	8.6	7.7	7.6					
Cyanide (total)	mg/kg			1.2	0.67	7						<1.00			1.2		<0.50	<0.50	<0.50	<0.50	<0.50
Cyanide (free)	mg/kg			1	1.00	2						<1.00			<1.00						
Cyanide (complex)	mg/kg			1.2	1.10	16						<1.00			1.2						
Sulphate	mg/kg																				
Asbestos containing material	None					6															
Metals (total)																					
Arsenic	mg/kg	>640		5500	912	34	16	47	41	960	180	2600	42	83	470	1300	430	680	800	70	150
Barium	mg/kg			730	234	24	0	0	180	720	730										
Cadmium	mg/kg	>1400		18000	1491	34	9	26	20	17	120	1500	55	310	480	330	480	400	380	61	110
Chromium	mg/kg	>5000		1400	127	23	0	0				48	35		37	31	28	18	32	15	11
Copper	mg/kg		>45700	25000	2614	34	0	0	120	1600	600	11000	130	36	2100	5600	1200	1000	2900	680	1900
Iron	mg/kg			170000	50067	24	0	0	8600	81000	39000										
Lead	mg/kg	>750		55000	17447	34	29	85	470	7600	6800	38000	1100	6700	14000	9800	2200	6400	32000	1300	4400
Mercury	mg/kg	>3600		220	21	23	0	0				8.1	1		8.4	1.1	11	0.69	7.2	0.45	0.15
Nickel	mg/kg	>1800		1400	157	28	0	0				280	39		96	130	38	200	91	94	61
Selenium	mg/kg	>13000		1600	149	26	0	0				160			43		2.3	6.1	1.1	0.74	0.1
Zinc	mg/kg		>188000	180000	48626	34	0	0	8100	36000	18000	82000	2600	12000	37000	29000	70000	38000	110000	19000	18000
Caesium	mg/kg	>1000		720	282	14	0	0	48	720	440										
BTEX																					
MTBE	mg/kg					2															
Benzene	mg/kg	95				2															
Toluene	mg/kg	4400				2															
Ethyl Benzene	mg/kg	2800				2															
m & p Xylene	mg/kg	3500				2															
o Xylene	mg/kg	2600				2															
BTEX																					
MTBE	mg/kg					2															
Aliphatics >C6-C8	mg/kg					2															
Aliphatics >C8-C10	mg/kg					2															
Aliphatics >C10-C12	mg/kg					2															
Aliphatics >C12-C16	mg/kg					2															
Aliphatics >C16-C21	mg/kg					2															
Aliphatics >C21-C35	mg/kg					2															
Total Aliphatics	mg/kg			0.1		2															
Aromatics >C5-C7	mg/kg					2															
Aromatics >C7-C8	mg/kg					2															
Aromatics >C8-C9	mg/kg					2															
Aromatics >C9-C10	mg/kg					2															
Aromatics >C10-C12	mg/kg					2															
Aromatics >C12-C16	mg/kg			8.7		2															
Aromatics >C16-C21	mg/kg			62.5		2															
Aromatics >C21-C35	mg/kg			65.3		2															
Total Aromatics	mg/kg			136.5		2															
TPH (Aliphatics & Aromatics)	mg/kg			136.5		2															
PAH (Total 16)																					
Naphthalene	mg/kg			0.75		4															
Acenaphthylene	mg/kg			0.13		4															
Acenapthene	mg/kg			0.66		4															
Fluorene	mg/kg			0.28		4															
Phenanthrene	mg/kg			7.73		4															
Anthracene	mg/kg			2.15		4															
Fluoranthene	mg/kg			16.2		4															
Pyrene	mg/kg			15.7		4															
Benz [a] anthracene	mg/kg			6.25		4															
Chrysene	mg/kg			11.2		4															
Benzo [b] fluoranthene Benzo [k] fluoranthene	mg/kg			9.42		4															
Benzo [a] pyrene	mg/kg			5.44		4															
Indeno [123-cd] pyrene	mg/kg			1.5		4															
Dibenz [ah] anthracene	mg/kg			0.71		4															
Benzo [ghi] perylene	mg/kg			5.37		4															
Total 16 PAH Reported	mg/kg			83.49		4															

TPH = Total Petroleum Hydrocarbons

SGV = Soil Guideline Value

SSAC = Site Specific Assessment Criteria

MG = Made Ground

TF = Tidal Flats

ACM = Asbestos containing material

2200 = Value above adopted screening value

5000 = adopted screening value based on previous CLEA

Sample Identity											BHNES06	BHNES03	BH2	BH2	BH2	BH3	BH43	BH43	BH43	BH44	BH44	BH44	GW7	GW7	GW7	WS44	WS44	WS44
Date Sampled											12-Jun-09	13-Jun-09	1-Feb-05	1-Mar-05	4-Aug-05	13-Jan-06	1-Feb-05	1-Mar-05	4-Aug-05	1-Feb-05	1-Mar-05	4-Aug-05	7-Mar-08	29-May-08	2-Sep-08	1-Feb-05	1-Mar-05	4-Aug-05
Standpipe Response Zone Depth (m)											9.0 - 12.0	0.4 - 1.6	13.8 - 18.75	13.8 - 18.75	13.8 - 18.75	15 - 19	13.3-18	13.3-18	13.3-18	10-18	10-18	10-18	9.0 - 16.1	9.0 - 16.2	9.0 - 16.3	0.5-2	0.5-2	0.5-2
Screened Strata											TF	MG	TF	TF	TF	TF	TF	TF	TF	TF	TF	TF	TF	TF	TF	MG	MG	MG
Ground Elevation											7.43	6.57	6.95	6.95	6.95	8.41	7.07	7.07	7.07	6.63	6.63	6.63				6.48	6.48	6.48
Ground Water Depth (m)											2.18	1.05																
Ground Water Elevation (m AOD)																												
Determinand	**Units**	**Screening Value**		**Screening Value**		**Count**	**Max**	**Mean**	**Count >SV**	**%>SV**																		
		EQS*	**DWS****	**EQS***	**DWS****																							
pH	pH units	6-8.5		6-8.5		12	7.7	7.3					7.3	7.3	7.4	7	7.1	7.1	7.2	7.6	7.7	7.4					7.1	7.1
Free cyanide	mg/l					2	0.05				0.05	0.05																
Electrical Conductivity	µs/cm		>2500		2500	6	7710	3670.7	4	67			3315	5580		790	3275			1354							7710	
Dissolved Oxygen	%					1	9.2	9.2								9.2												
Ammonia	mg/l		>0.5		0.5	4	58	15.5	3	75						2							0.2	58	1.8			
Chloride	mg/l		>250		250	10	3100	861.8	8	80			300	260		28	310	300		1300	240		2400	3100	380			
Alkalinity	mg/l					1	390	390.0		0						390												
Sulphate	mg/l		>250		250	6	850	317.1	2	33			850	1.9			850	0.66		200	0.17							
BOD	mg/l					1	19	19.0		0						19												
COD	mg/l					1	10	10.0		0						10												
Suspended Solids	mg/l					1	2600	2600.0		0						2800												
Total Organic Carbon	mg/l					1	5	5.0		0						5												
Total Organic Nitrogen	mg/l					1	0.7	0.7		0						0.7												
Dissolved solids	mg/l					1	660	660.0		0						660												
Metals (total)																												
Arsenic	µg/l					4	440	207.5		0			<10	110	70											<10	440	210
Barium	µg/l					4	440	260.0		0					110				440			80						410
Cadmium	µg/l					12	11000	1588.3		0			12	1500	3300		11	360	11000	17	150	120				190	1100	1300
Chromium	µg/l					2	19	14.5		0					10				19			<10						
Copper	µg/l					12	1400	292.5		0			8.3	16	88		5	820	200	8.5	230	46				7.6	1400	680
Iron	µg/l					8	86000	25552.5		0			<10	<20	2200		10	29000	86000	<10	3500	2700				10	81000	
Lead	µg/l					12	72000	12529.8		0			13	9700	1800		16	16000	72000	48	4300	2200				280	28000	16000
Mercury	µg/l					2	11	5.8		0					<0.5				11			0.5						
Nickel	µg/l					9	49	24.2		0			20	23	49		20	20	26	20	20	20						
Potassium	mg/l					0	0																					
Selenium	µg/l					9	40	11.9		0			2.8	8.8	40		2.9	5.6	10	22	5.4	10						
Sodium	mg/l					0	0																					
Zinc	µg/l	>40		40		11	98000	32375.5	11	100			2100	15000	31000		930	11000	98000	1000	4100	4000					97000	92000
Caesium	mg/l					12	10	4.2		0	10	10	0.01	6.3	0.28		0.01	7.9	4.0	2.2	2.5	2.7				0.01		4.3
Beryllium	mg/l																											
Metals (dissolved)																												
Arsenic (dissolved)	µg/l	>25		25		8	1200	224.0	6	75	180	32				<10	13	210	1200	24	78	55						
Barium (dissolved)	µg/l					2	140	130.0		0	120	140																
Boron (dissolved)	µg/l	>7000		7000		2	2900	1680.0	0	0	2900	460																
Cadmium (dissolved)	µg/l	>2.5		2.5		8	1800	337.2	7	88	1.1	16			1800	75			94	5.1	26	680						
Chromium (dissolved)	µg/l	>15		15		3	16	9.0	1	33	16	1				10												
Copper (dissolved)	µg/l	>5		5		7	230	47.0	5	71	1.6	7.1			43				31	3	13	230						
Iron (dissolved)	µg/l	>1000		1000		3	510	436.7	0	0	510	320				480												
Lead (dissolved)	µg/l	>25		25		8	9300	1407.9	5	63	3.5	150			1000	50			740	10	10	9300						
Nickel (dissolved)	µg/l	>30		30		3	20	10.5	0	0	5.2	6.3				20												
Potassium (dissolved)	mg/l					4	100	63.0	0	0						11							97	100	44			
Selenium (dissolved)	µg/l		>10		10	8	83	26.5	0	0	48	83			25	2			10	6.3	10	28						
Zinc (dissolved)	µg/l					8	16000	4528.8	0	0	580	180			16000	1900			1500	390	680	15000						
Mercury (dissolved)	µg/l	>0.3		0.3		6	1	0.4	3	50	0.01	0.02			0.22	1			0.5			0.5						
Beryllium (dissolved)	mg/l					0			0																			
Caesium (dissolved)	mg/l					5	15	5.1	0	0					0.24			4	3.8		2.4	2.4					15	
Sodium (dissolved)	mg/l		>200		200	1	29	29.0	0	0						29												
PAH									0																			
Naphthalene	µg/l	>5		5		1	0.01	0.0	0	0		0.01																
Acenaphthylene	µg/l					1	0.01	0.0	0	0		0.01																
Acenapthene	µg/l					1	0.01	0.0	0	0		0.01																
Fluorene	µg/l					1	0.01	0.0	0	0		0.01																
Phenanthrene	µg/l					1	0.03	0.0	0	0		0.03																
Anthracene	µg/l						0.01	0.0	0			0.01																
Fluoranthene	µg/l					1	0.03	0.0	0	0		0.03																
Pyrene	µg/l					1	0.04	0.0	0	0		0.04																
Benz [a] anthracene	µg/l					1	0.02	0.0	0	0		0.02																
Chrysene	µg/l					1	0.02	0.0	0	0		0.02																
Benzo [b] fluoranthene Benzo [k] fluoranthene	µg/l					1	0.02	0.0	0	0		0.02																
Benzo [a] pyrene	µg/l					1	0.01	0.0	0	0		0.01																
Indeno [123-cd] pyrene	µg/l					1	0.01	0.0	0	0		0.01																
Dibenz [ah] anthracene	µg/l								0			0.01																
Benzo [ghi] perylene	µg/l					1	0.02	0.0	0	0		0.02																
Total 16 PAH Reported	µg/l		>0.1		0.1	1	0.22	0.2	0	0		0.22																

Notes:

* = Coastal and Estuarine Environmental Quality Standards (EQS)

** = Water Supply Regs 2000 (where EQS not available) or 1989

DWS - Drinking Water Standards

EQS = Environmental Quality Standard

MG = Made Ground

TF = Tidal Flats

= Value above DWS

= Value above EQS

Ian Farmers Gas Monitoring 2004/2005

Borehole	Strata within Borehole Capture Zone	Monitoring parameters		Date monitored						
				Mar-04	Apr-04	Jun-04	Jul-04	Aug-04	Sep-04	Jan-05
BH1	Base of Tidal Flat deposits including sand horizon 16.2 m - 18.75 m (2.55 m) and top of Mercia Mudstone Group deposits (0.2 m)	Atmospheric pressure (mb)		1028	1008	Unable to locate	Destroyed	Destroyed	Destroyed	Destroyed
		Depth to water (m)		3.65	3.68					
		Flow (l/h)		1	0.2					
		O2%		20.4	20.9					
		CO2	% by volume in air	0	0					
			GSV	0	0					
			Characteristic Situation	1	1					
		CH4	% by volume in air	0	0					
			GSV	0	0					
			Characteristic Situation	1	1					
		H2S (ppm)		0	0					
		CO (ppm)		0	0					
BH2	Base of Tidal Flat deposits including sand horizon 13.8 m - 17.7 m (3.9 m)	Atmospheric pressure (mb)		1028	1012	1014	1018	998	1017	1027
		Depth to water (m)		2.87	3.1	3.83	4.1	4.49	4.56	3.27
		Flow (l/h)		0.2	0.1	0	0	0.1	0.2	-0.9
		O2%		4.7	7.4	6.9	7.7	12.5	20.9	1.9
		CO2	% by volume in air	3.6	4.5	4.5	3.8	3.3	0	4.1
			GSV	0.0072	0.0045	0	0	0.0033	0	-0.0369
			Characteristic Situation	1	1	1	1	1	1	1
		CH4	% by volume in air	56.8	51	53.2	48.5	51.1	0	72
			GSV	0.1136	0.051	0	0	0.0311	0	-0.648
			Characteristic Situation	2	1	1	1	1	1	1
		H2S (ppm)		0	0	0	0	0	0	0
		CO (ppm)		0	0	0	0	0	0	0
BH3	Base of Tidal Flat deposits, sand horizon 14.7 m - 19.2 m (4.5 m)	Atmospheric pressure (mb)		1028	1008	1030	1018	998	1017	Destroyed
		Depth to water (m)		4.45	4.54	1.31	4.24	pipe damaged		
		O2%		19.9	20.8	20.9	20.8	20.3	18.6	
		Flow (l/h)		0.1	0	-0.1	0	0.1	0.9	
		CO2	% by volume in air	0.3	0	0.1	0.3	0.2	1.5	
			GSV	0.0003	0	-0.0001	0	0.0002	0.0135	
			Characteristic Situation	1	1	1	1	1	1	
		CH4	% by volume in air	0.7	0	0	0.1	0.5	0.1	
			GSV	0.0007	0	0	0	0.0005	0.0009	
			Characteristic Situation	1	1	1	1	1	1	
		H2S (ppm)		0	0	0	0	0	0	
		CO (ppm)		0	0	0	0	0	0	
GW7	Tidal Flat deposits (Silt) Sand horizon 14.8 m - 18.4 m (3.6 m)	Atmospheric pressure (mb)		1028	Destroyed	Destroyed	Destroyed	Destroyed	Destroyed	Destroyed
		Depth to water (m)		3.12						
		O2%		20.5						
		Flow (l/h)		0						
		CO2	% by volume in air	0.1						
			GSV	0						
			Characteristic Situation	1						
		CH4	% by volume in air	0.4						
			GSV	0						
			Characteristic Situation	1						
		H2S (ppm)		0						
		CO (ppm)		0						
BH43	Tidal Flat deposit 13.3-18.0 m (4.7m)	Atmospheric pressure (mb)								1035
		Depth to water (m)								3.36
		O2%								5.2
		Flow (l/h)								0
		CO2	% by volume in air							4.1
			GSV							0
			Characteristic Situation							1
		CH4	% by volume in air							59.9
			GSV							0
			Characteristic Situation							1
		H2S (ppm)								0
		CO (ppm)								0
BH44	Tidal Flat deposits 10.0 - 18.0 m (18.0m)	Atmospheric pressure (mb)								1034
		Depth to water (m)								2.94
		O2%								20.6
		Flow (l/h)								-1.6
		CO2	% by volume in air							0.1
			GSV							-0.0016
			Characteristic Situation							1
		CH4	% by volume in air							0
			GSV							0
			Characteristic Situation							1
		H2S (ppm)								0
		CO (ppm)								0
WS44	Made Ground deposit 0.5-2.0m (1.5m)	Atmospheric pressure (mb)								1035
		Depth to water (m)								1.07
		O2%								18.9
		Flow (l/h)								0
		CO2	% by volume in air							0.1
			GSV							0
			Characteristic Situation							1
		CH4	% by volume in air							0
			GSV							0
			Characteristic Situation							1
		H2S (ppm)								0
		CO (ppm)								0

GAS MONITORING RESULTS

Contract No: 723110
Contract Name: ACCESS 18, AVONMOUTH

Contract Engineer: TP
Date: 12/06/09

STRUCTURAL SOILS LTD

Weather Conditions: OVERCAST
Atmospheric Wind Conditions: Light
ALM Pressure: Falling

Equipment used: LMXsi

Data Collected By: BOB DAVIES

Input Checked by (sign):

Ground Conditions (eg dry, flooded, frost, snow etc): DRY

Location	Flow (l/hr) (peak and residual) [ ] = time period	Atmospheric Pressure (mb)	BH Pressure (mb)	Time		Methane			Carbon Dioxide			Oxygen	LEL (%)	(ppm)			Depth range to water (m bgl) (for a period of time (specify) following tap removal)	Well depth (mbgl) Current and [as installed]	Top of Response zone (m bgl)	Notes (eg, samples taken, dual installation, odours, sheens, broken headworks)
				hours mins	secs	% by volume in air	GSV	Characteristic situation	% by volume in air	GSV	Characteristic situation	% by volume in air		H2S	CO	PID				
BHNES01	-0.4 0.0 [2 secs]	1018 1018	1016 1018		**0 (initial)**	0.0			0.0			20.8		0.0	0.0		0.78	0.9 [1.0]		Too shallow to sample.
					15	0.0			1.7			17.0		0.0	0.0					
					30	0.0			1.9			16.7		0.0	0.0					
					60	0.0	0	1	1.9	0	1	16.7		0.0	0.0					
					90	-			-			-		-	-					
					120	-			-			-		-	-					
					180	-			-			-		-	-					
					240	-			-			-		-	-					
BHNES03	-0.4 0.0 [3 secs]	1017 1017	1015 1017		**0 (initial)**	0.0			0.0			20.5		.			1.05	1.4 [1.5]		Tap open Sampled.
					15	0.0			0.0			19.9								
					30	0.0			0.0			19.9								
					60	0.0	0	1	0.0	0	1	19.9								
					90	-			-			-								
					120	-			-			-								
					180	-			-			-								
					240	**-**			**-**			**-**								
BHNES06	21.7 0 [5 secs]	1018 1018	1143 1018		**0 (initial)**	0.0	Peak flow		0.0	Peak flow		20.6		0.0	0.0		2.18	7.87 [12.0]		Sampled.
					15	66.0			2.5			3.1		0.0	0.0					
					30	69.0	14.97	4	3.8	1	3	0.6		0.0	0.0					
					60	66.0			3.6			0.1		0.0	0.0					
					90	59.0			3.2			2.7		0.0	0.0					
					120	56.0	Residual flow		2.9	Residual flow		3.9		0.0	0.0					
					180	51.0			2.5			5.5		0.0	0.0					
					240	48.0			2.2			6.4		0.0	0.0					
					300	43.0	0	1	2.0	0	1	7.9		0.0	0.0					
					360	40.0			1.9			9.1		0.0	0.0					
					420	40.0			1.8			9.1		0.0	0.0					
BHNES07	-0.4 0.0 [2 secs]	1017 1017	1016 1017		**0 (initial)**	0.0			0.0			20.6		0.0	0.0		2.79	2.88 [3.0]		Too shallow to sample.
					15	0.0			0.0			19.8		0.0	0.0					
					30	0.0			0.0			19.6		0.0	0.0					
					60	0.0	0	1	0.0	0	1	19.6		0.0	0.0					
					90	-			-			-		-	-					
					120	-			-			-		-	-					
					180	-			-			-		-	-					
					240	-			-			-		-	-					

GAS MONITORING RESULTS

Contract No: 723110
Contract Name: Access 18, Avonmouth

Contract Engineer:TP
Date:26/06/09

Weather Conditions: Overcast
Atmospheric Wind Conditions: Light
ALM Pressure: Rising

Equipment used: LMXsi

Data Collected By: BD

Input Checked by (sign):

Ground Conditions (eg dry, flooded, frost, snow etc): Dry

Location	Flow (l/hr) (peak and residual) [ ] = time period	Atmospheric Pressure (mb)	BH Pressure (mb)	Time		Methane			Carbon Dioxide			Oxygen	LEL (%)	(ppm)			Depth range to water (m bgl) (for a period of time (specify) following tap removal)	Well depth (mbgl) Current and [as installed]	Top of Response zone (m bgl)	Notes (eg, samples taken, dual installation, odours, sheens, broken headworks).
				hours mins	secs	% by volume in air	GSV	Characteristic situation	% by volume in air	GSV	Characteristic situation	% by volume in air		H2S	CO	PID				
BHNES 01	-0.2	1009	1008		**0 (initial)**	0.0			0.0			20.6		0	0		DRY	0.88 [1.0]		
	0.0	1009	1009		**15**	5.0			3.7			14.1		0	0					
	[2 secs]				**30**	5.1			3.8			13.9		0	0					
					60	5.4	0	1	3.9	0	1	13.7		0	0					
					90	5.6			3.9			13.7		0	0					
					120	6.1			3.9			13.2		0	0					
					180	6.1			3.9			13.2		0	0					
					240															
BHNES 03	0.3	1009	1010		**0 (initial)**	0.0	Peak flow		0.0	Peak flow		20.5		0	0		1.15	1.52 [1.5]		
	0.0	1009	1009		**15**	0.0			0.0			18.6		0	0					
	[2 secs]				**30**	0.0	0	1	0.0	0	1	18.9		0	0					
					60	0.0			0.0			19.1		0	0					
					90	0.0	Residual flow		0.0	Residual flow		19.2		0	0					
					120															
					180		0	1		0	1									
					240															
BHNES 06	0.7	1009	1012		**0 (initial)**	0.0	Peak flow		0.0	Peak flow		20.6		0	0		2.2	7.77 [12.0]		
	0	1009	1009		**15**	56.0			3.0			4.2		0	0					
	[4 secs]				**30**	41.0	0.39	2	2.1	0.02	1	7.7		0	0					
					60	34.5			1.8			9.8		0	0					
					90	29.0	Residual flow		1.9	Residual flow		11.5		0	0					
					120	28.0			1.5			11.9		0	0					
					180	23.0	0	1	1.2	0	1	13.4		0	0					
					240	21.0			0.9			14.0		0	0					
BHNES 07	0.4	1009	1015		**0 (initial)**	0.0	Peak flow		0.0	Peak flow		20.5		0	0		2.79	2.83 [3.0]		
	0.0	1009	1009		**15**	0.0			0.0			20.2		0	0					
	[3 secs]				**30**	0.0	0	1	0.0	0	1	20.2		0	0					
					60	0.0			0.0			20.2		0	0					
					90		Residual flow			Residual flow										
					120															
					180		0	1		0	1									
					240															