

Remediation Strategy and Verification Plan

Millwood SEN School
Development for ISG

August 2010

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Notice

This report was produced by Atkins Limited (Atkins) for ISG for the specific purpose of preparing a remediation strategy and verification plan for the development of Millwood SEN School on the western part of the current Radcliffe Riverside High School site, Radcliffe, nr Bury, Lancashire.

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Drawing 5086974/LA/P/00/4901/4 **External Works General Arrangement**

1. Introduction

1.1 Brief and Scope of Works

Interior Services Group plc (ISG) has instructed Atkins Limited (Atkins) to prepare a remediation strategy and verification plan for the forthcoming development of Millwood Special Educational Needs (SEN) School. The site currently comprises the playing fields and sports hall of Radcliffe Riverside High School, owned by Bury Metropolitan Borough Council (MBC) and located off School Street in Radcliffe, near Bury in Lancashire.

The remediation strategy was requested by Rebecca Jones, Environmental Protection Officer (EPO) of Bury MBC in a letter of 30 June 2010 (Ref: CL294.300610.1) and is a requirement for discharge of Condition 5 of the Planning Decision Notice.

1.2 Development Proposal and Design Layout

The development proposal is for a special needs school with associated car parking, hard landscaped play areas and soft landscaped areas. The current design layout for the school development is presented in Drawing 5086974/LA/P/00/4901/4.

The site occupies an area of approximately 22,500m² (2.25ha). This is subdivided into the following estimated areas:

- school building footprint – approximately 5100m²;
- car parking areas/service yard – approximately 5350m²;
- other hard landscaped areas (including multi use games area (MUGA), area of raised beds, classroom 'gardens' and playgrounds) – approximately 7100m²
- soft landscaped areas – approximately 4900m²

It is intended to raise the entire site by 180mm as agreed with the planning authorities. At the time of writing, the design of the soft landscaping has not been finalised.

It is proposed to include an orchard within the soft landscaped area to the west of the school building. However, no land contamination assessment has been undertaken to assess the risk from consumption of home grown produce. This is outside the scope of this report. If this is to be incorporated into the final design, further assessment will be required.

1.3 Limitations

The remediation strategy and verification plan has been compiled based upon a review of the following reports provided by Bury MBC or prepared by Atkins for Bury MBC as the Design & Build contractor for the project:

- Geoenvironmental Appraisal of Land at Radcliffe Riverside High School (West Campus)' (Report no. 7028/1) dated July 2005, prepared by Encia Consulting Ltd for Bury MBC (Ref 1);
- Ground Investigation at Radcliffe Riverside High School for Bury MBC - Factual and Interpretive Report, (Ref: 5086974.077.32803), dated 11 February 2010, prepared by Atkins Ltd for Bury MBC (Ref 2);
- Millwood Special Educational Needs (SEN) School and Residential Development, School Street, Radcliffe: Planning Application: 52038 – Contaminated Land (Ref: 5086974/32914) dated 6 June 2010, prepared by Atkins Ltd for Bury MBC (Ref 3);
- Geotechnical information provided in an internal memo prepared by Jon Wood (Ref: GTG20092966), dated 7th July 2010 (Ref 4);

- Radcliffe Riverside High School Bury, Factual Report on Ground Investigation (Ref: W10/40691), dated June 2010, prepared by Ian Farmer Associates Ltd for Atkins (Ref 5);
- Various plans prepared by Atkins including current site levels, proposed design layout, cross sections of proposed foundation design.

In carrying out this appraisal, Atkins can accept no liability for the accuracy of information provided by others.

The remediation strategy is based on data relating to ground conditions and contaminants obtained through a series of site investigations. Ground conditions can only be inferred between test locations and as such localised conditions on site could vary significantly. Furthermore, observations made at the time of investigations and during monitoring and associated data visits may be subject to variation due to atmospheric, seasonal or other effects.

This report has been produced in accordance with guidance currently accepted as best practice/industry standard.

This strategy has been based on the findings of the risk assessments provided in the reports referenced above and as previously agreed with the Environment Agency and Environmental Protection Officer (EPO) of Bury MBC.

Atkins accepts no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known other than within the terms of the contract.

2. Site Setting

2.1 Site Location and Description

The site is approximately 2.25ha in area, roughly triangular in shape and located at approximate National Grid Reference of SD 779071 (Figure 1). The boundaries of the site are formed by School Street to the south, the current Radcliffe Riverside High School buildings to the east, vacant land to the north and the disused Manchester, Bury and Bolton Canal to the northwest and west. The River Irwell is located 200m south/south east of the site.

Current vehicular access to the site is gained from School Street to the south or the current school to the east.

The site currently comprises playing fields for Radcliffe Riverside High School. A sports hall is located towards the south eastern corner of the site. No other buildings are present on site. Stands of trees and shrubs are located towards the southern, western and northern boundary.

Topography at the site is generally flat lying, with a gentle fall in slope roughly from west to east. The approximate elevation for the centre of the site is 78.4m AOD. The range of elevation is 78.59m AOD in the south western corner of the site to 77.48m AOD in the south eastern corner of the site. The Manchester, Bury and Bolton Canal to the northwest of the site lies at an elevation approximately 2m lower than the site.

Utility drawings indicate no electricity, gas, public water mains, public sewers, BT or Virgin Media cables present beneath the site.

The current layout of the site is presented in Figures 2 to 4.

2.2 Previous Site Use

The following is a very brief summary of the previous site uses. Reference should be made to the maps in the Encia 2005 report (Ref 1) for more specific details.

A review of historic maps indicates that the site remained undeveloped agricultural land between 1850 and 1893/94 and was developed into a recreation ground with cricket pitch known as Peel Park Ground in the late 1890s. The playing fields at the site and the school to the east were developed by 1937 and are present today.

The area surrounding the site has an historical industrial legacy with some residential property to the east. Off-site historical sources of contamination are reported to include dye works, mills, landfill sites (closest approximately 220m to the south), a foundry, highway depot and an engineering works.

2.3 Geology

The site is surfaced with grass and Topsoil to approximately 0.1m bgl, except within the footprint of the sports hall (approximately 875m²).

Made Ground is present beneath Topsoil to depths of between 0.2m to 2.5m bgl and typically comprises granular material (sandy silt with varying proportions of gravel including brick, coal, pottery, slag, wood, ash, glass, limestone and sandstone). A cream coloured material, interpreted as possible process waste of unidentified origin, was encountered in the Made Ground at three locations (WS209, WS212 and WS213), typically from approximately 0.1m to a maximum of 0.6m depth.

Made Ground is underlain by natural strata, heterogeneous in nature ranging from sand to silty sand, sandy clay and peat. These are interpreted as Alluvial Deposits and extend to depths of between 1.2 and 6.9m bgl. The Alluvial Deposits are underlain by Glacial Till to depths of 10.8 and 26.4mbgl (approximately 16 to 19m in thickness). Coal Measures bedrock was encountered in a recent investigation at depths of between 21.5 and 26.4m bgl.

2.4 Hydrogeology

The Environment Agency website indicates that the site is underlain by a Secondary A aquifer. This relates to the Coal Measures strata beneath the site. The overlying soils are described on the National Rivers Authority (NRA) Groundwater Vulnerability Map (Sheet 10, Central Lancashire) to be of urban classification and thus automatically classified as having a high leaching potential.

The site is not located within a 1km radius of a Source Protection Zone (SPZ). In 2005, Encia reported no licensed groundwater abstractions within 1km of the site.

Several groundwater monitoring rounds have been undertaken at the site. Depth to groundwater is typically greater than 0.8m bgl in the majority of wells. However, in BH6, a depth of 0.47mbgl (77.73m AOD) was recorded in December 2009 and 0.53m bgl (77.67 m AOD) in June 2005 was measured. A depth of 0.47m bgl was also recorded in WS206 in December 2009. During the May 2010 monitoring period, groundwater was recorded at depths of 0.96 to 1.41 mbgl in these two wells suggesting seasonal influence. Perched water is present within Made Ground strata that is considered to be in hydraulic continuity with shallow groundwater within Alluvial Deposits. The Glacial Till strata is interpreted as being of low permeability.

Measurements from wells installed in Made Ground/shallow Alluvial Deposits indicate a flow direction towards the south or south east. Measurements from three deeper wells installed by Encia across Alluvial Deposits and Glacial Till also indicate a flow direction towards the south east. Therefore, shallow groundwater within the Alluvial Deposits appears to flow towards the River Irwell to the south and south east of the site and away from the disused canal on the northwestern boundary.

2.5 Hydrology

The nearest surface water course to the site is the Manchester, Bury and Bolton Canal, reported as disused in 2005 and located along the north west site boundary. The canal level is approximately 1.5 to 2m below the level of the site. As discussed in Section 2.4, shallow groundwater appears to flow away from the Canal and towards the River Irwell located approximately 200m to the south and south east. The river appears to be at a lower elevation than the site.

The stretch of the River Irwell near the site has achieved Grade E (Poor) with regard to chemical quality under the Environment Agency's General Quality Assessment (GQA) scheme. There is no water quality data available for the Canal.

3. Conceptual Site Model Summary

3.1 Hydrogeological Conceptual Site Model

As part of the previous GIs (Refs 2 and 3), a generic quantitative risk assessment (GQRA) was undertaken to assess the potential for contamination within shallow soils, leachate and perched groundwater to impact controlled waters in the vicinity of the site. Based on the geological and hydrogeological understanding of the site, the principal controlled waters receptor was considered to be the River Irwell located approximately 200m south of the site. As such, on-site leachate and perched water/shallow groundwater concentrations were compared to a set of General Assessment Criteria (GAC). Since the principal receptor is surface water, these were Environmental Quality Standards (EQS), or where no EQS are available, Drinking Water Standards (DWS).

The GQRA indicated that PAHs and TPH (C21-C35 fraction) in perched water/shallow groundwater beneath the site are marginally above the GAC. Several PAHs in leachate also exceeded the relevant GAC. The source of contamination is considered likely to be leaching of contaminants from overlying Made Ground.

It is considered unlikely that a significant risk to controlled waters exists from site derived contamination because:

- these compounds have not been detected at significantly high concentrations beneath the site (i.e. near solubility limits or indicative of free phase product);
- they have low mobility in groundwater; and
- attenuation mechanisms within the shallow groundwater pathway (dilution, dispersion, degradation) are likely to decrease concentrations to acceptable levels at the receptor.

In addition a large proportion (nearly 80%) of the surface area of the site will be covered with buildings and hardstanding following development, thus reducing the infiltration capacity of the soils and hence the leachability of soil contaminants.

On the basis of the absence of significant risk to the proposed development and the nature of the development, no remedial works are considered necessary for the protection of controlled waters based on the findings of the investigations to date.

The Environment Agency has agreed in their letter to Bury MBC on 25 June 2010 (Ref: SO/2010/106464/03-L01) that the school “development poses a low risk to inland fresh waters, controlled waters and relevant territorial waters” and they have “no further requirements for additional works at this time”. The EA do however, state that “should unsuspected contamination be identified during development”, appropriate remedial measures will need to be agreed. Atkins has interpreted ‘unsuspected contamination’ to mean the presence of visual or olfactory evidence of contamination.

3.2 Human Health Conceptual Site Model

As discussed, the development proposal is for a special needs school with associated car parking, hard landscaped play areas and soft landscaped areas. A GQRA for human health was carried out as part of the Atkins December 2009 GI (Ref 2). Soil samples have been analysed on an approximate 50m grid pattern.

In the absence of any published guideline values for schools, the soil data from both the Encia 2005 and Atkins December 2009 GIs was screened against Soil Guideline Values (SGVs) and where unavailable, Atkins Soil Screening Values (SSVs), for a residential without plant uptake scenario. These are referred to as General Assessment Criteria (GAC).

The findings of the GQRA indicated elevated concentrations of the arsenic, lead and benzo(a)pyrene in several samples exceeding their relevant GAC). The distribution of these contaminants of concern (CoCs) across the site are shown in Figures 2 to 4 and described as follows:

- Arsenic concentrations in soil exceed the GAC in four out of sixteen samples, three of which are likely to be located within soft landscaped areas. Of these three samples, two were taken at depths greater than 0.4m (WS210 and WS211) and no sample was taken at shallower depth, therefore it is not known whether contamination exists within the top 400mm.
- Lead concentrations in soil exceed the GAC in ten out of sixteen samples, only four of which are likely to be located within soft landscaped areas. Of these four samples, two were taken at depths greater than 0.4m (WS210, WS211 and BH5) and no sample was taken at shallow depth, therefore it is not known whether contamination exists within the top 400mm;
- Benzo(a)pyrene concentrations in soil exceed the GAC in seven of thirteen samples, only one of which is likely to be located within soft landscaped areas. This sample from WS210 was taken at 0.5m depth and sample was taken at shallow depth, therefore it is not known whether contamination exists within the top 400mm; and
- Five other PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(123cd)pyrene and dibenzo(ah)anthracene) were present above their respective GACs in a single soil sample from WS206, (0.4 to 0.6m depth). No shallow sample has been taken at this location, however no exceedences of these compounds were recorded in adjacent location WS7 (0.1 to 0.2m). This area will be covered by hardstanding.

Elevated concentrations are present in both Topsoil and underlying natural strata.

It was accepted by the EPO at Bury MBC that there is not considered to be a potential risk to human health from the inhalation of vapours arising from the presence of elevated concentrations of PAHs in the shallow soils beneath the site.

It was accepted by the EPO at Bury MBC that there is not considered to be a potential risk to human health from perched water/shallow groundwater beneath the site.

The conceptual model for the school development is presented in Table 3.1 below.

Table 3.1 – Conceptual Site Model for the School Development

Potential Sources		Pathways	Receptor
Made Ground – Contaminants within Topsoil and Made Ground	Metals	• Direct soil and dust ingestion (indoors and outdoors) • Inhalation of soil and soil derived dust • Dermal contact with soil and soil derived dust (indoors and outdoors)	0-6 year old female child
	Organics – PAHs	• Direct soil and dust ingestion (indoors and outdoors) • Inhalation of soil and soil derived dust • Dermal contact with soil and soil derived dust (indoors and outdoors)	

3.3 Ground Borne Gas Risk Assessment

A ground gas risk assessment was carried out based on data from four monitoring rounds carried out during the Encia 2005 investigation and two rounds carried out by Atkins as part of the May 2010 works. The assessment indicated the current site is 'very low risk' with respect to ground gas and no mitigation measures are likely to be required to the design of the buildings. This was agreed by Bury MBC's EPO in their letter of 30 June 2010.

3.4 Summary of Potential Pollutant Linkages

The Atkins risk assessments carried out in February and May 2010 consider receptor exposure to the contaminants via the exposure pathways identified. These have been used to develop the remedial approach for the site, enabling the extent of contaminant removal/mitigation to be identified.

Exposure Pathway	Receptor		
	Controlled Waters (groundwater and Canley Brook)	School End-users ^a	Property (e.g. foundation, services)
Ingestion of soil and soil derived dust, indoors and outdoors		√	
Inhalation of soil derived vapours, indoors and outdoors		√	
Inhalation of fugitive, dust indoors and outdoors		√	
Dermal contact with contaminants in soil or soil derived dust, indoors or outdoors		√	
Direct contact with contaminants in soil or groundwater		√	√

^athis includes occupants of the school, visitors and maintenance personnel (including gardeners).

It is understood that the property potential pollutant linkage arising due to direct contact with contaminants in soil and water is dealt with in the concrete design for the foundations and floor.

The following specific contaminants of concern have been identified as requiring remediation due to the risk to human health receptors:

- Arsenic and lead; and
- Polycyclic aromatic hydrocarbons (PAHs).

The CSM has not included future construction workers involved in site development because construction/maintenance activities fall under current Health and Safety legislation. There is a statutory requirement and duty of care for workers to be informed and thus aware of potential contamination at a site. Under current Health and Safety legislation, these workers (employers and employees) are required to carry out their own health and safety assessments and take all reasonable steps to protect themselves from exposure to potential contamination during any intrusive works. Therefore, workers involved with any future construction have been discounted as human receptors on this basis.

4. Remediation Requirements

4.1 Approach to Identifying Remedial Options

Under instruction from Bury MBC, Atkins has reviewed the available reports, has designed supplementary ground investigation and monitoring and has carried out human health and controlled waters risk assessments for the site. Separate investigation in May 2010 also investigated geotechnical constraints to development and proposed foundation design for the building development.

In accordance with the published guidance's (Refs. 6 & 7), Conceptual Site Models (CSM) have been prepared and risk assessments carried out and are presented in the previous Atkins reports (Refs 2 and 3).

As agreed with the EA and the EPO of Bury MBC, no remediation for the protection of controlled waters is required.

Elevated concentrations of arsenic, lead and PAHs have been identified within soil which will present a risk to human health unless mitigated. The human health risk assessment has concluded that there are elevated concentrations (above SSV/SGV) within the upper 0.4m bgl, which would potentially present an unacceptable risk to human health should there be a pathway for exposure. Mitigation measures are proposed to address the human health pollutant linkages. Where exceedences are present at depths below 0.4m and no shallow sample has been taken, further sampling and assessment will be required in these areas.

In developing the remedial options for the site, careful consideration of the most appropriate approach to breaking the Source Pathway Receptor linkages has been made, i.e. whether removal of the source, pathways or receptors will be the most effective method for risk mitigation.

Remedial options selected for the site will address human health linkages.

4.2 Remediation Objectives

The primary objective of the remedial works is to mitigate the exposure of contaminants to site end-users. The objectives of the strategy are to set out measures to address potential risks to human health for the future development from residual contamination at the site. Agreement on the approach and remedial targets will be sought from the appropriate regulatory bodies.

In addition maximising the re-use of materials, where appropriate, will reduce offsite disposal to landfill, reduce import requirements and carbon emissions resulting in a more environmentally sustainable remediation.

4.3 Remediation Criteria

Derivation of the remediation criteria has been carried out using appropriate, recognised methodologies, and regulatory approval has been obtained. The basis of the criteria is that they are appropriate with regard to the remediation objectives outlined above. The remediation criteria for on-site soils which are protective of the human health of the end-users of the site are defined as the GAC (SSVs and SGVs) presented in the GQRA.

5. Potential Remedial Technologies

5.1 Approach to Remediation

The human health contaminants of concern are identified and listed in Section 3. The potential remediation technologies under consideration will selectively address the presence of these contaminants and enable mitigation of identified risks to human health receptors.

There are three broad approaches which can be adopted in order to break the pollutant linkages identified at the site:

- Remove or treat the (source) of pollutants;
- Remove or modify the migration pathway; or
- Remove or modify the behaviour of the receptor.

Given the particular circumstances of the contamination at the site and the proposed redevelopment, the most appropriate approach is considered to be a combination of source treatment and pathway removal.

The chemical analyses data indicates that there are hotspots of metals, and PAH contamination of the soil. Remediation and mitigation of the soil is required to protect human health receptors when these are introduced through redevelopment.

A combination of materials management, removal and on-site treatment of localised PAH, and the removal of the contaminant exposure pathways, e.g. placement of a simple barrier system to prevent the direct contact human health pathway is considered to be a suitable approach for the remediation of the site.

On the basis of the risk assessment it was concluded that the site does not present a significant risk to controlled waters. Whilst, no specific remediation is required to protect controlled waters, procedures are included within the remediation strategy to ensure testing, should visually and olfactory suspect materials be discovered during earthworks. Where contamination is encountered, the remedial targets will be used to protect controlled waters.

5.2 Options Appraisal

The nature of the contaminants and their spatial spread across the site means that a combined remediation approach will be necessary to deal with the source. The PAH are treatable by ex-situ remediation. Other process based solutions such as thermal, chemical and stabilisation techniques have been discounted as they are not the most appropriate techniques for the nature of the contamination present. Given the quantity of material that would be subject to treatment, such techniques are not considered economically viable. In-situ remediation technologies have not been considered as various contaminants identified at this site are recalcitrant in anaerobic conditions.

5.3 Feasible Remediation Options

Feasible remedial techniques include civil engineering based and process based solutions.

Excavate and dispose (Civil Engineering Based Solution)

This technique involves excavating the source of contaminated material. It has the advantage that it is an observational technique and contaminated material identified by visual and olfactory means may be removed with confidence. It is however an expensive and environmentally unsustainable solution requiring disposal of the contaminated material to a suitable disposal

facility, a source of clean inert material to backfill the excavation and, transport of the waste and fill materials.

Ex-situ Bio-remediation (Process Based Solution)

This technique involves excavating the contaminated source material, seeding it with bacteria and allowing biological degradation of the contaminants. It has the advantage that it is an observational technique and visual and olfactory contaminated material may be removed with confidence. Once treated the material can be placed back into the excavation and compacted. However it is a time based solution and requires a drained working area to store material during treatment.

Phytoremediation (In-situ Based Process Solution)

This technique relies upon the use of plants to remediate contaminated soil and groundwater. It has the advantage of avoiding excavation, transportation and disposal of excavated materials, however it is limited to the surface area and depth occupied by roots, growth is slow and the human health receptor is exposed to the source.

Cover Systems/Barriers (Civil Engineering Based Solution)

This technique introduces an appropriate barrier removing the pathway to the receptor. It has the advantage of avoiding excavation, transportation and disposal of excavated materials. Import of clean materials or on-site management of appropriate materials is required for construction of the barrier. Systems range from simple cover systems to provide a reduction of the hazard to human health and to provide a suitable medium for plant growth; through to engineered cover systems designed to provide a complete separation of the receptor from the hazard and to perform a number of functions including limiting upward migration of contaminants due to capillary rise and controlling the downward infiltration of water.

5.4 Remedial Targets

The human health CSM has identified potential pollutant linkages arising due to human health end-users being exposed to ingestion, inhalation of soil and soil derived dust and dermal contact pathways for the determinands presented in the table below.

The proposed development layout is presented in Drg 5086974/LH/P/00/4901/4 Hardstanding and building cover provides mitigation in terms of pathway removal over approximately 70% of the site. The potential pollutant linkages remain for soft landscaped areas.

The GQRA has produced the following remedial targets for the contaminants of concern for areas of soft landscaping.

Determinand	Units	Assessment criteria	Source of assessment criteria
Arsenic	mg/kg	35	SGV
Lead	mg/kg	234	SSV
Benzo(a)pyrene	mg/kg	1.04	SSV

6. Preferred Remediation Strategy

Based upon literature review and advice from specialist contractors, it is considered that an appropriate and cost-effective approach can be adopted using a combination of the technologies above. Atkins has reviewed the available ground investigation data and agreed the remediation targets appropriate to the contamination profile and the development objectives (Section 5.4) with the EPO (Bury MBC).

Based on the available data the preferred solution comprises:

- There is a requirement to raise the existing site levels by 180mm. It is anticipated that this material will be sourced from site won material where suitable for re-use in terms of both contamination regime and engineering performance. Where this is not feasible, materials will be imported to site and unsuitable materials disposed of appropriately;
- Further investigation within the designated soft landscape areas and contamination verification testing;
- Contamination testing and selective recovery of Topsoil materials from the areas of the hardstanding and beneath the building for re-use as cover material;
- Excavation of and delineation of identified areas of contamination and either re-use of material beneath hardstanding and the building (if suitable for re-use as an engineering material) or off-site disposal to a suitably licensed waste facility;
- Reinstatement of excavations and placement of materials suitable for use as a cover and barrier (either imported or generated on site) to achieve formation level;
- Ex-situ bio-remediation of benzo(a)pyrene contaminated soil materials;
- Appropriate recovery of asbestos contaminated material from the sports hall (beyond the scope of this remediation strategy);
- Detailed quantitative risk assessment for human health if considered appropriate;
- Removal and the introduction of 'clean' cover and verification of contaminant regimes within soft landscaping areas will be required to protect end-users and will mitigate against the risks.

Further detail relating to the methodology of the remediation strategy is presented in Section 7.3.

7. Remediation Strategy

7.1 Ground Conditions

With the exception of the existing sports hall building footprint, the site is surfaced with grass and Topsoil to approximately 0.1m bgl. Made Ground is present beneath Topsoil to depths of between 0.2m to 2.5m bgl and typically comprises granular material (sandy silt with varying proportions of gravel including brick, coal, pottery, slag, wood, ash, glass, limestone and sandstone). A cream coloured material, interpreted as possible process waste of unidentified origin, was also encountered in the Made Ground at three locations (WS209, WS212 and WS213), typically from approximately 0.1m to a maximum of 0.6m depth.

Made Ground is underlain by Alluvial Deposits and Glacial Till with Coal Measures at depth.

Marginally elevated contaminants comprising arsenic, lead and benzo(a)pyrene have been identified in a number of samples obtained from the Topsoil, Made Ground and the cream coloured material within existing upper 0.4m of the site as presented on Figures 2 to 4.

Groundwater is typically below 0.8m below ground level however localised shallower perched water (0.5mbgl) has been recorded in two areas of the site (WS206 and BH6).

7.2 Demolition

The sports hall is to be demolished and it is understood that asbestos may be present within the building. Demolition works will be managed and undertaken in a manner to prevent the contamination or cross contamination of asbestos materials with the site materials. Further discussion is beyond the scope of this report.

7.3 Remediation

Remedial works are required to address the localised soil contamination that exists at the site and which poses a risk to human health receptors within soft landscaped areas. The remediation outline strategy is presented in Section 6.

The locations identified for excavation and presented on Figures 2 to 4 are based upon the findings of the human health generic quantitative risk assessment which is based upon all available ground investigation data (Refs 1 to 5). The remediation works will involve excavating elevated arsenic, lead and benzo(a)pyrene within 600mm of finished formation level. Initial excavations will be 5m by 5m in area. The sides of the excavation will be validated to confirm the hotspot has been removed. The cream coloured process waste identified during the investigation shall be removed from site where encountered and disposed off-site to a licensed waste facility.

The designated soft landscaped areas will be subjected to further validation investigation on a 25m grid to a maximum depth of 600mm beneath finished formation level to verify the suitability of the materials to perform as a cover barrier. Soils exceeding the assessment criteria will be excavated and the excavation faces validated.

The material excavated from the hotspots will be stockpiled and where appropriate re-use beneath the hardstanding or building footprint. The hotspot excavations will be extended in the appropriate direction by a further 1m in the event of a failure on an excavation face. Hotspot materials which are unsuitable for re-use within the site will be disposed of off-site to a licensed waste facility.

The Topsoil materials within the areas of the hardstanding and beneath the proposed building footprint will be verified on a 25m grid to confirm its suitability for re-use as cover material within the landscape areas to achieve proposed formation level. Selective recovery of validated Topsoil material will be undertaken where appropriate.

Excavated arisings from foundations and service runs will be validated prior to reuse within the site.

Hotspot excavations will be reinstated and the raised formation level achieved with Topsoil or other site won validated materials proven to conform with the remediation targets.

Benzo(a)pyrene contaminated soil materials will be treated by an appropriately experienced Contractor using ex-situ bio-remediation techniques on site and in accordance with an appropriate mobile treatment licence.

If considered appropriate further detailed quantitative risk assessment for human health will be undertaken.

During excavation potentially visually and olfactory suspect materials will be sampled and tested in accordance with Table 8.2. If necessary the suspect materials will be excavated, tested, treated or disposed of appropriately.

7.4 Waste

The re-use of on-site excavated soils will be undertaken under the CL:AIRE Voluntary Code of Practice (CoP) which was published in September 2008. Under the CoP materials excavated on-site are not deemed contaminated if suitable for re-use at specified locations or generally within the site. A 'Qualified Person' as defined under the CoP will review the development of the Materials Management Plan, Risk Assessments and Remediation Strategy/Design Statement together with documentation relating to Planning and Regulatory issues. If all in order, they will sign a Declaration which is forwarded to the Environment Agency and which confirms compliance with the CoP.

7.5 Asbestos

Asbestos has not been identified during the intrusive works. The presence of asbestos within Made Ground material cannot be discounted however. Should asbestos be encountered during the works, work at the location and in the immediate vicinity will need to cease. Any material suspected to contain asbestos will need to be isolated and the appropriate actions will need to be decided. This may involve removal in accordance with appropriate general health and safety legislation, and specifically the Control of Asbestos at Work Regulations 2002 and the CDM Regulations or, the area affected may be surveyed, covered over, and dealt with at a later stage.

8. Validation and Monitoring

8.1 Sampling and Validation

A programme of monitoring, sampling and analysis will be carried out for the duration of the works. Monitoring to be carried out by the Contractor will specifically include:

- Discharges to ensure consent compliance to sewer;
- Atmospheric monitoring of fugitive dusts and volatile compounds linked to the COSHH assessment and air monitoring strategy;
- Noise, related to equipment operations and working methods;
- Sampling of soils and perched groundwater (where encountered in excavations) for validation of the remediation works.

All samples will be retrieved and tested in a laboratory which is UKAS accredited and MCERTS compliant.

All field and laboratory analytical results will be presented in a Validation Report, which will cover the entire remediation period (pre, during and post-site works).

The progress and validation testing programme will utilise a combination of on-site vapour measurement, together with olfactory and visual observation, combined with off-site laboratory analysis of selected samples.

Verification of suitability for re-use of materials within the soft landscape areas and retention as cover shall be undertaken on a 25m grid prior to excavation. The faces of hotspot excavations will be sampled at a rate of 1 per exposed side face. Foundation and service run excavated arisings shall be tested at a rate of 1/250m³. Imported materials shall be sampled at a rate of 1/500m³. Treated materials shall be tested at a rate of 1/250m³.

Materials identified for off-site disposal shall be tested at the frequency required by the receiving waste disposal facility.

8.2 Validation Monitoring of Remedial Works

Monitoring will involve on-site testing using portable instruments, e.g. photo-ionisation detector (PID), and will be supplemented by more detailed off-site analysis by an approved laboratory on a fortnightly basis.

Appropriately qualified specialist environmental staff will carry out and supervise the investigation, sampling, excavation and monitoring works. Audits will be undertaken.

8.2.1 Soil Monitoring

The soil evaluation and validation exercise has three main objectives:-

- To confirm the removal of contamination where it has been identified currently;
- To ensure that materials re-used in fill operations are suitable for use; and
- To ensure the materials are suitable to remain in-situ as cover.

The evaluation and validation will comprise an initial screening exercise comprising visual and olfactory surveying of any exposed or excavated soils, supplemented by screening with a photo-ionisation detector (PID) and sampling at rates detailed in Section 8.1.

The suite of testing will include as a minimum:

- Arsenic
- Lead
- Benzo(a)pyrene

Where visually or olfactory (either by visual staining, odour or PID readings) suspect materials are identified and material is imported, the testing suite shall be as follows:

- metals suite;
- Speciated TPH (CWG);
- Volatile Organic Compounds (VOCs);
- inorganics (sulphate, cyanide); and
- pH.

8.2.2 Validation Criteria

The validation targets for soils for re-use within the soft landscaped areas are:

Table 8.1 Validation Targets

Substance	Remedial Targets Soil (mg/kg)
Arsenic	35
Lead	234
Benzo(a)pyrene	1.04

No visually or olfactory contaminated material shall be placed within soft landscaped areas.

Suspect visually and olfactory contaminated materials to be re-used in hard landscaped areas shall meet the targets set out in Table 8.2 below.

Table 8.2 Criteria for Material Re-used in Hard Landscaped Areas

Substance	Soil Criteria (human health based) mg/kg	Source of Criteria	Leachate Criteria (controlled waters based) µg/l	Source of Criteria
Nickel	-		150	EQS
Chromium	-		200	EQS
Cadmium	-		5	EQS
Copper	-		10	EQS
Lead	-		125	EQS
Zinc	-		250	EQS
Arsenic	-		50	EQS
Boron	-		2000	EQS
Mercury	-		1	EQS
Selenium	-		10	DWS
Naphthalene	-		10	EQS
Anthracene	-		0.13	Max conc.
Fluoranthene	-		0.70	Max conc.

Substance	Soil Criteria (human health based) mg/kg	Source of Criteria	Leachate Criteria (controlled waters based) µg/l	Source of Criteria
Benzo(b)fluoranthene*	-	SGV/SSV	1.9	Max conc.
Benzo(k)fluoranthene*	-	SGV/SSV	0.73	Max conc.
Benzo(a)pyrene	-	SGV/SSV	1.8	Max conc.
Acenaphthene	-	SGV/SSV	-	
Fluorene	-	SGV/SSV	-	
Pyrene	-	SGV/SSV	-	
Benzo(a)anthracene	-	SGV/SSV	-	
Chrysene	-	SGV/SSV	-	
Indeno(123cd)pyrene*	-	SGV/SSV	-	
Dibenz(ah)anthracene	-	SGV/SSV	-	
Benzo(ghi)perylene*	-	SGV/SSV	-	
Sum of 4 PAHs (sum of *)	-		5.6	Max conc.
Phenol	519	SGV/SSV	30	EQS
Benzene	1.00	SGV/SSV	30	EQS
Toluene	2708	SGV/SSV	50	EQS
Ethylbenzene	843	SGV/SSV	20	EQS
M&P xylenes	590	SGV/SSV	30	EQS
O xylene	321	SGV/SSV	-	
TPH Aliphatic (C5-C6)	26.1	SGV/SSV	-	
TPH Aliphatic (C6-C8)	87.9	SGV/SSV	-	
TPH Aliphatic (C8-C10)	14.5	SGV/SSV	-	
TPH Aliphatic (C10-C12)	87.8	SGV/SSV	-	
TPH Aliphatic (C12-C16)	126	SGV/SSV	-	
TPH Aliphatic (C16-C35)	88883	SGV/SSV	-	
TPH Aromatic (C7-C8)	2708	SGV/SSV	-	
TPH Aromatic (C8-C10)	24.1	SGV/SSV	-	
TPH Aromatic (C10-C12)	147	SGV/SSV	-	
TPH Aromatic (C12-C16)	700	SGV/SSV	-	
TPH Aromatic (C16-C21)	1333	SGV/SSV	-	
TPH Aromatic (C21-C35)	1333	SGV/SSV	-	
Total Petroleum Hydrocarbons (TPH)	-		397	Max conc.
Total cyanide	34	SGV/SSV	50	DWS
Total sulphate	-		400,000	EQS
Vinyl Chloride	0.001	SGV/SSV	0.5	DWS
Carbon Disulphide	0.84	SGV/SSV	-	
1,2-Dichloroethane	0.02	SGV/SSV	10	EQS
1,1,1-Trichloroethane	28.4	SGV/SSV	100	EQS
Carbon Tetrachloride	0.09	SGV/SSV	12	EQS
Trichloroethene	0.51	SGV/SSV	10	EQS
Tetrachloroethene	6.89	SGV/SSV		
Chlorobenzene	45.1	SGV/SSV	-	

It is assumed that imported material will be used in soft landscaped areas only. Imported material shall meet the criteria set out in Table 8.3 below.

Table 8.3 Criteria for Imported Material

Substance	Soil Criteria (human health based) mg/kg	Source of Criteria	Leachate Criteria (controlled waters based) µg/l	Source of Criteria
Nickel	130	SGV/SSV	150	EQS
Chromium	38	SGV/SSV	200	EQS
Cadmium	84	SGV/SSV	5	EQS
Copper	8370	SGV/SSV	10	EQS
Lead	235	SGV/SSV	125	EQS
Zinc	46799	SGV/SSV	250	EQS
Arsenic	35	SGV/SSV	50	EQS
Boron	-		2000	EQS
Mercury	238	SGV/SSV	1	EQS
Selenium	595	SGV/SSV	10	DWS
Naphthalene	9.22	SGV/SSV	10	EQS
Anthracene	24000	SGV/SSV	0.13	Max conc.
Fluoranthene	3210	SGV/SSV	0.70	Max conc.
Benzo(b)fluoranthene*	10.3	SGV/SSV	1.9	Max conc.
Benzo(k)fluoranthene*	4.12	SGV/SSV	0.73	Max conc.
Benzo(a)pyrene	1.04	SGV/SSV	1.8	Max conc.
Acenaphthene	937	SGV/SSV	-	
Fluorene	746	SGV/SSV	-	
Pyrene	2400	SGV/SSV	-	
Benzo(a)anthracene	9.04	SGV/SSV	-	
Chrysene	1010	SGV/SSV	-	
Indeno(123cd)pyrene*	10.3	SGV/SSV	-	
Dibenz(ah)anthracene	1.03	SGV/SSV	-	
Benzo(ghi)perylene*	104	SGV/SSV	-	
Sum of 4 PAHs (sum of *)	-		5.6	Max conc.
Phenol	519	SGV/SSV	30	EQS
Benzene	1.00	SGV/SSV	30	EQS
Toluene	2708	SGV/SSV	50	EQS
Ethylbenzene	843	SGV/SSV	20	EQS
M&P xylenes	590	SGV/SSV	30	EQS
O xylene	321	SGV/SSV	-	
TPH Aliphatic (C5-C6)	26.1	SGV/SSV	-	
TPH Aliphatic (C6-C8)	87.9	SGV/SSV	-	
TPH Aliphatic (C8-C10)	14.5	SGV/SSV	-	
TPH Aliphatic (C10-C12)	87.8	SGV/SSV	-	
TPH Aliphatic (C12-C16)	126	SGV/SSV	-	
TPH Aliphatic (C16-C35)	88883	SGV/SSV	-	
TPH Aromatic (C7-C8)	2708	SGV/SSV	-	
TPH Aromatic (C8-C10)	24.1	SGV/SSV	-	
TPH Aromatic (C10-C12)	147	SGV/SSV	-	
TPH Aromatic (C12-C16)	700	SGV/SSV	-	
TPH Aromatic (C16-C21)	1333	SGV/SSV	-	
TPH Aromatic (C21-C35)	1333	SGV/SSV	-	
Total Petroleum Hydrocarbons (TPH)	-		397	Max conc.
Total cyanide	34	SGV/SSV	50	DWS
Total sulphate	-		400,000	EQS
Vinyl Chloride	0.001	SGV/SSV	0.5	DWS
Carbon Disulphide	0.84	SGV/SSV	-	

Substance	Soil Criteria (human health based) mg/kg	Source of Criteria	Leachate Criteria (controlled waters based) µg/l	Source of Criteria
1,2-Dichloroethane	0.02	SGV/SSV	10	EQS
1,1,1-Trichloroethane	28.4	SGV/SSV	100	EQS
Carbon Tetrachloride	0.09	SGV/SSV	12	EQS
Trichloroethene	0.51	SGV/SSV	10	EQS
Tetrachloroethene	6.89	SGV/SSV		
Chlorobenzene	45.1	SGV/SSV	-	

8.3 Validation Report

The Validation Report for the remediation works will be prepared by the Contractor in accordance with CLR11 to show compliance with remediation objectives and criteria. The Validation Report will provide a complete record of the remediation activities on site and the data collected. It will include detailed descriptions of the Works with associated as-built drawings.

The Validation Report will include:

- Background information – project and site details, remediation objectives;
- Remediation – design, techniques, methodology, programme, verification emissions controls, chemical and physical testing, priority contaminants;
- Monitoring – status, remediation extent, outstanding risks, further works;
- Final site conditions i.e. an account of the state of the site following works;
- Results of perched groundwater monitoring;
- Third party liaison – correspondence and approvals/agreements from regulators, site visits, statutory guidance, third party agreements;
- Supporting information – plans, as-built drawings, progress photographs and reports, analytical results, H&S, QA, environmental monitoring, method statements.

9. Outline Remediation Strategy Design

The outline remediation and reclamation design comprises the following elements:

- Materials exceeding the Remedial Targets will be excavated in identified areas. The areas identified for excavation are based upon contamination test results when compared to human health acceptance criteria. Excavation faces will be validated as meeting the remedial targets for soil. It is anticipated that the majority of the depth of dig will be no greater than 0.4m, although visual and olfactory contamination will be chased out within the excavation.
- Additional validation investigation will be undertaken to confirm materials are suitable for use as cover.
- Arisings excavated with PAH contamination will be bio-remediated to meet the remediated targets for soil.
- Materials with elevated metals will be managed during the works and stockpiled for placement beneath the building and or hardstanding, at depth or beneath a 600mm thick clean cover/ barrier, comprising site won materials or, imported material or, disposed of off-site to an appropriately licensed waste facility.
- Excavated and treated materials will be incorporated into the works where appropriate and, according to their contaminant characteristics and engineering suitability.

9.1 Implementation

Detailed method statements for the works will be prepared and the Contractor shall obtain the necessary permits/licences in order to carry out the works in accordance with the Remediation Strategy.

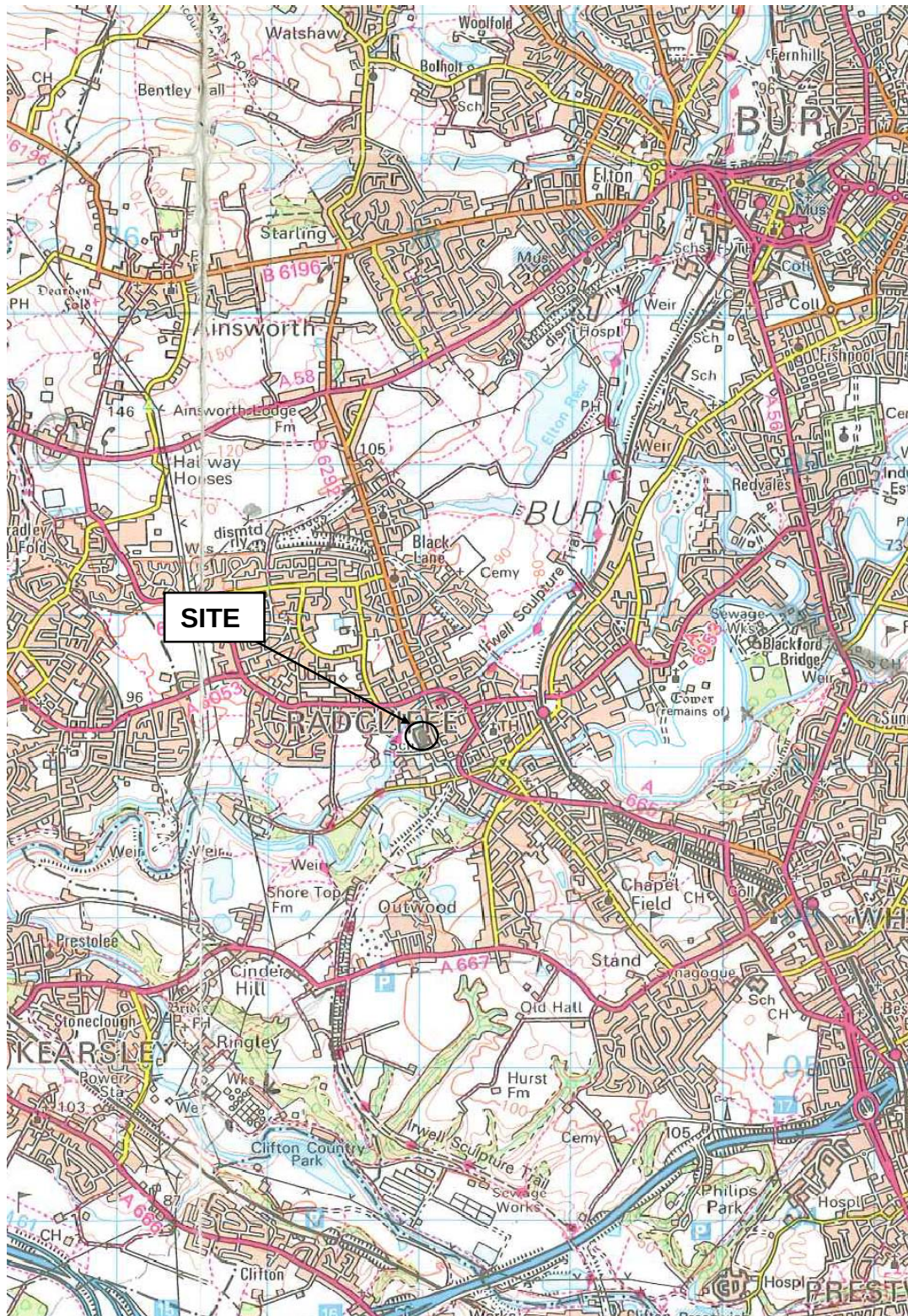
Appropriately qualified environmental personnel will carry out and supervise the investigation, sampling, excavation and monitoring works.

A Validation Report will be prepared.

10. References

- 1) Geoenvironmental Appraisal of Land at Radcliffe Riverside High School (West Campus), (Report no. 7028/1) dated July 2005, prepared by Encia Consulting Ltd for Bury MBC.
- 2) Ground Investigation at Radcliffe Riverside High School for Bury MBC - Factual and Interpretive Report, (Ref: 5086974.077.32803), dated 11 February 2010, prepared by Atkins Ltd for Bury MBC.
- 3) Millwood Special Educational Needs (SEN) School and Residential Development, School Street, Radcliffe: Planning Application: 52038 – Contaminated Land (Ref: 5086974/32914) dated 6 June 2010, prepared by Atkins Ltd for Bury MBC.
- 4) Geotechnical information provided in an internal memo prepared by Jon Wood (Ref: GTG20092966), dated 7th July 2010.
- 5) Radcliffe Riverside High School Bury, Factual Report on Ground Investigation (Ref: W10/40691), dated June 2010, prepared by Ian Farmer Associates Ltd for Atkins Ltd.
- 6) Environment Agency and Department for Environment, Food and Rural Affairs. 2004. Model procedures for the management of contaminated land. Contaminated Land Report 11 (CLR11).
- 7) Department for Environment, Food and Rural Affairs, Environment Agency and Institute for Environment and Health. 2000. Guidelines for environmental risk assessment and management.

Figures & Drawings



Not to scale

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ATKINS

Site Location Plan

Created by:
RJC

Checked by:
LH

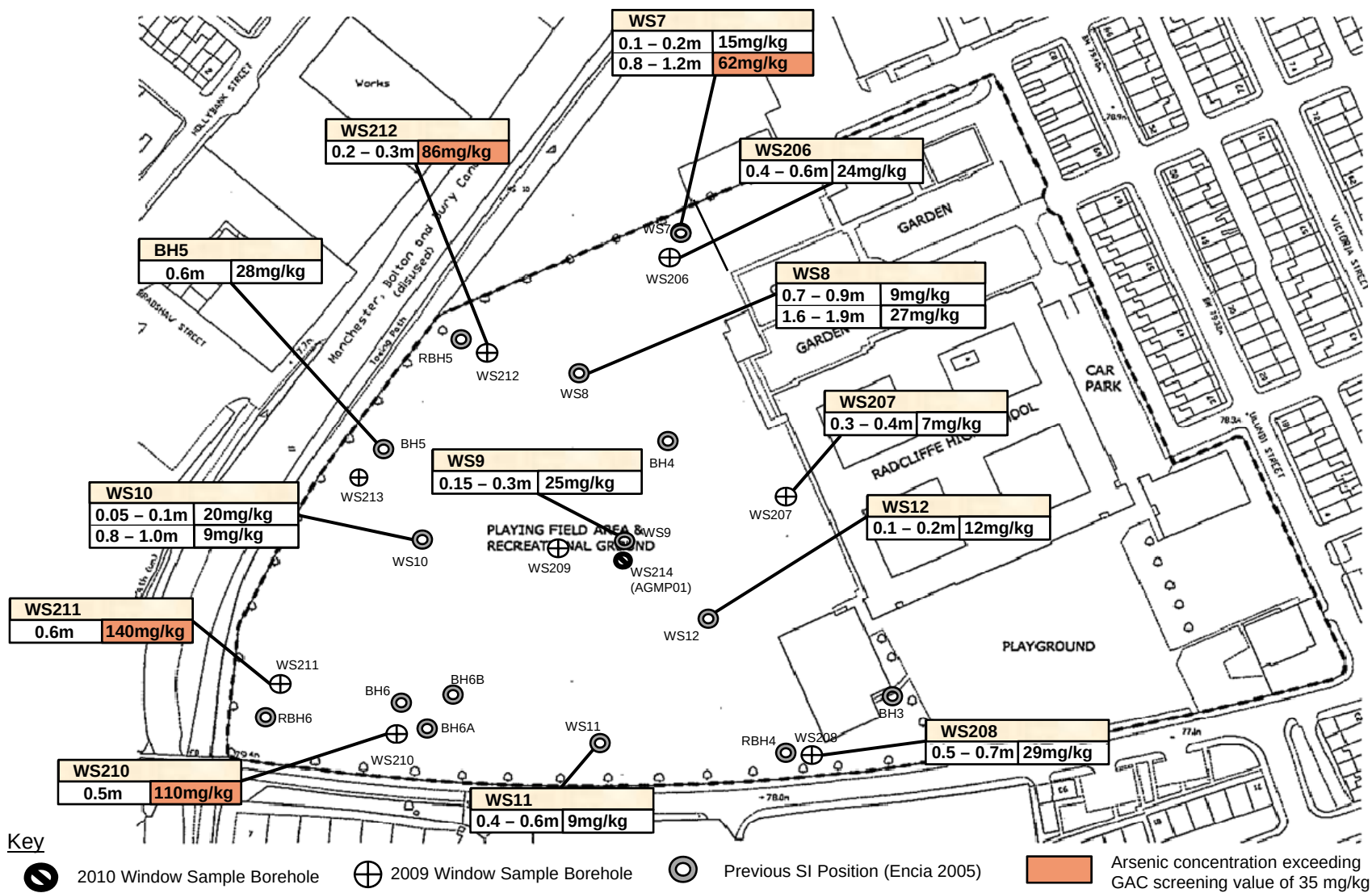
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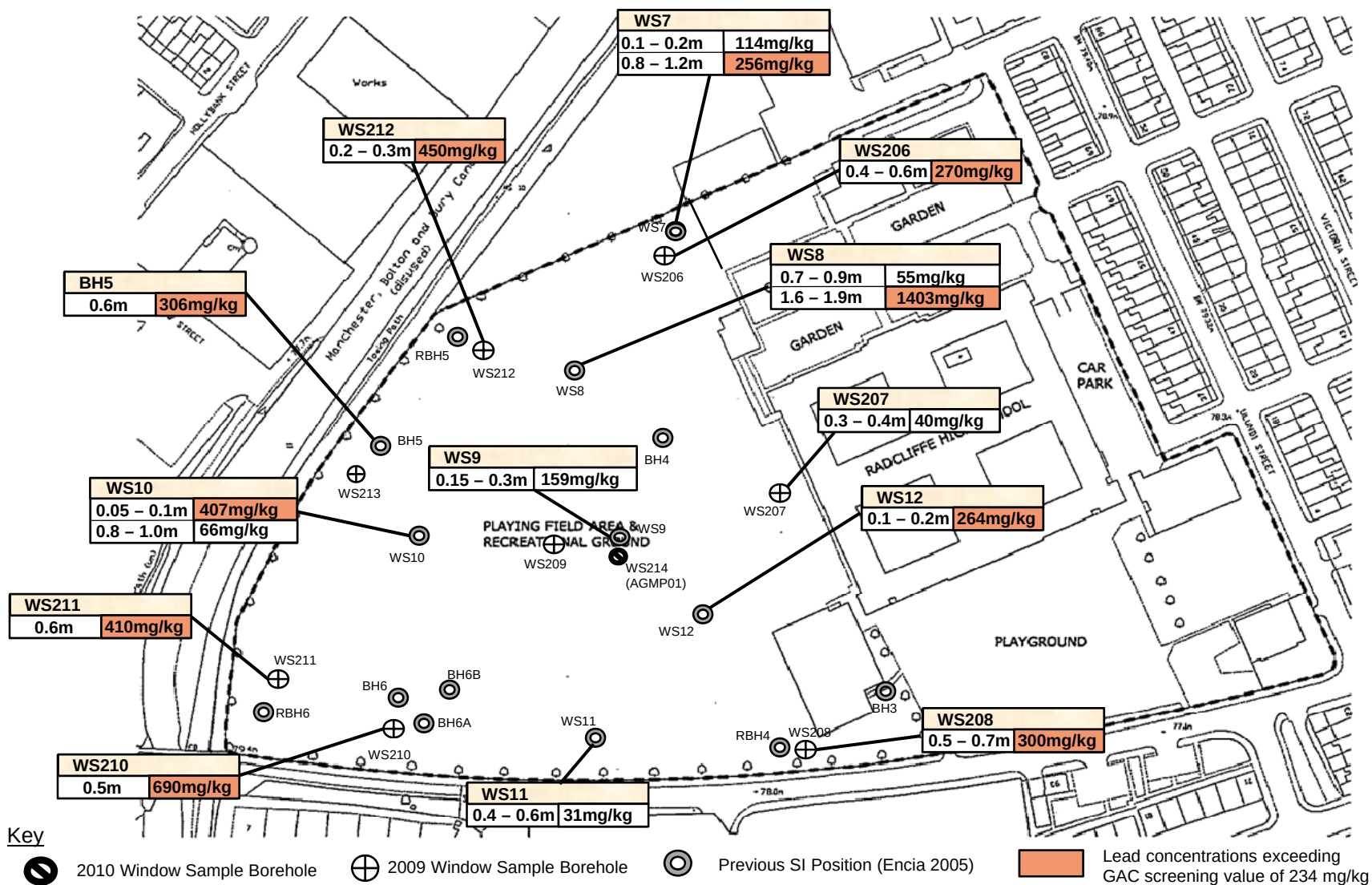
Figure 1

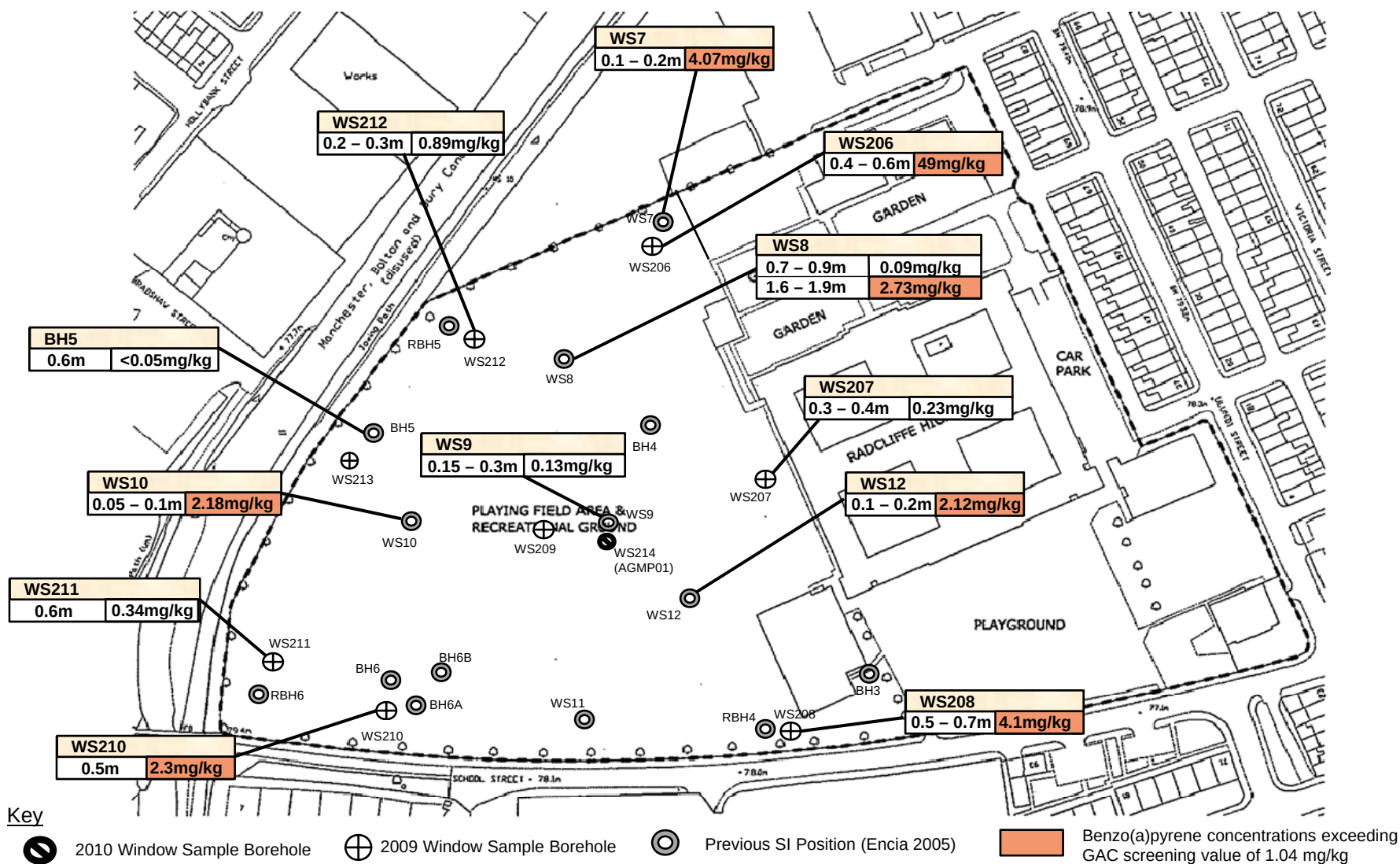
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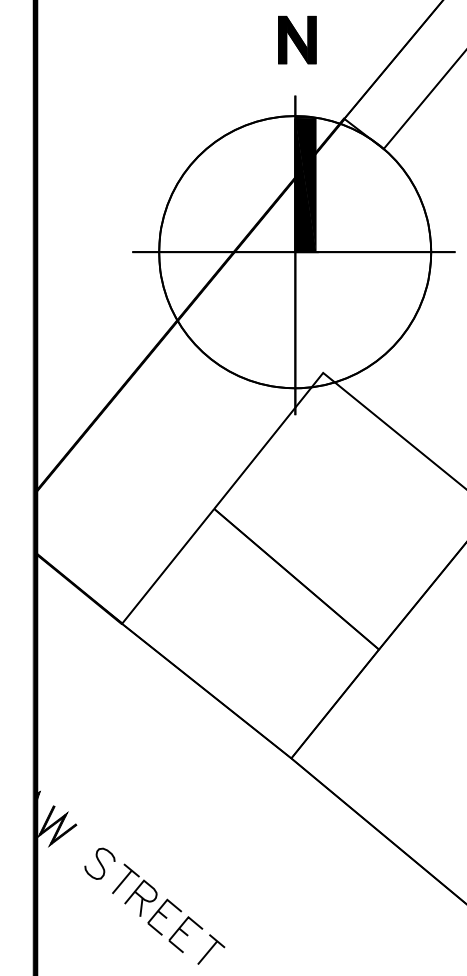
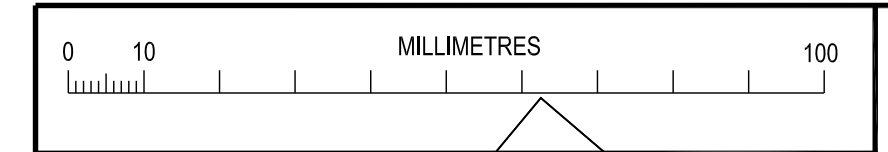
Project: Millwood School

Project No: 5096134









- Key:**
- Car Park Permeable Concrete Block Paving: Formative Aquafloor™, 200x100x50mm deep.
 - Proposed Kerb to Car Park
 - Proposed Macadam Road Surfacing: Vehicular loading
 - Playground Bitmac Surfacing: Pedestrian loading with thermoplastic markings; Bitmac to mini play areas to classrooms to be coloured to match wetpou.
 - Path Demarcation Within Bitmac Surfacing: Thermoplastic play markings define route
 - Concrete Pedestrian Paving: Marshalls Saxon™, 300x300x60mm deep
 - Wetpou to Site Synthetic Surfacing: Colours TBC - beige, grey, black, blue grey
 - Concrete Self Edging: Marshalls Tegula 200x300mm
 - Ashturf Surfacing
 - Proposed Natural Stone Paving: Yorkstone: Natural Greenmore Rustic*, 300x300x65mm deep
 - Timber Children's Bench with Backrest: Woodscape Hardwood Timber Seat type 3", 300x450x180mm
 - Timber Ullerbib: Woodscape Hardwood Timber Litter Bin LBV 115"
 - Boundary Fencing: Oncofil 3 Stereope™, 2400mm high
 - MUGA Sports Fencing: Oncofil 3 Stereope™, 3500mm high
 - Playground Fencing: Oncofil 3 Stereope™, 1200mm high
 - Coloured Timber 'Fencil' Fencing: 900mm high
 - Timber Logroll Fencing: Heights as shown
 - Wet Pour Synthetic Play Spheres: by Playdale™, 350mm, 450mm & 600mm Ø as shown
 - Tensile Canopy: by Tensile Fabric™, Size as shown
 - Raised Logroll Planters
 - Raised Logroll Planters with Climber Frame
 - Poly Tunnel
 - Stepping Stones: 450x450x50mm
 - Timber Forest of poles
 - Natural Stone Boulders
 - Grass Seeded Areas
 - Proposed Trees
 - Existing Trees: to be retained
 - Proposed Shrub Areas
 - Proposed Wildflower Areas
- * or similar approved subject to comment

- Play Area Equipment Schedule:**
- 1 "Tolsa" Multi-Functional Play Frame by Playdale™
 - 2 "Timber Junior Swing" by Playdale™
 - 3 "Basis Integration Carousel" by Elbe™
 - 4 Adventure Trail by Playdale™
 - "Balancing Beam, Balancing Walk, Chain Walk, Balancing Beam"
 - "Clatter Bridge"
 - "Interlurve"
 - "Webnet"
 - 5 "Basis Children's Village" by Elbe™
 - 6 "Move Area" includes:
 - Hardwood Timber decking surfacing
 - Concrete paving surfacing
 - Concrete Setts surfacing
 - Astroturf surfacing
 - Bitmac surfacing
 - Wetpour surfacing
 - Ramped path
 - Mock Pelican crossing
 - Mock Staggered Pedestrian Guardrail
 - Mock street scene
 - Stepped Access Area
 - Seating Area
 - 7 "Biff" Multi-Functional Play Frame by Playdale™
 - 8 "Wavy Mirror Panel" by Playdale™
 - 9 "Musical Panel" by Playdale™
 - 10 "Concave Mirror Panel" by Playdale™
 - 11 Timber Teepees by Playdale™
 - 12 "Basis Hand-controlled Integration Swing" by Elbe™
 - 13 "Nest Swing"
- * or similar approved subject to comment

Notes:

All play equipment to be installed under the requirements of BSEN1176 & 1177 and installed in accordance with manufacturers instructions.

All dimensions to be checked on site.

Discrepancies and/or ambiguities between this drawing and information given elsewhere must be reported immediately to this office for clarification before proceeding.

Potential Suppliers Telephone numbers:
Playdale: 01539 531561
Elbe: 01483 813834
Woodscape: 01254 383322

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS:

ITEM	HAZARD	RISK
4	FOR APPROVAL	JS 08.10 KD AD
3	FOR APPROVAL	JS 08.10 KD AD
2	TENDER	JM 06.03.10 AD AD
1	TENDER	SR 11.01.10 JM AJD
1	FOR PLANNING EXTERNAL LEVELS ADDED	SR 07.12.09 JM AJD
-	FOR PLANNING	OB 23.11.09 MD MD
REV	DESCRIPTION	BY DATE CHKD AUTH

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M1 4EH
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Fax +44(0)161 2453500

CLIENT:

Bury Council

Millwood School

PROJECT:
Millwood SEN

TITLE:
External Works General Arrangement

SCALE:	ORIGINAL AD	DESIGNED OB	DRAWN OB	CHECKED MB	AUTHORISED MB
1:250	DATE: 04.11.09	DATE: 04.11.09	DATE: 17.11.09	DATE: 23.11.09	
OFFICE: Manc					
PROJECT NO:	DISCIPLINE/PE	CODE:	DRG NO	REV:	
5086974	LA	P	00	4901	4

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