BDP -

Phase 1 Remediation Strategy

Fallowfield Campus Redevelopment

9th June 2017



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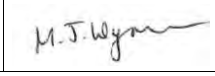
		Signature			
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1 INTRODUCTION

1.1 General

The redevelopment of the Fallowfield Campus of the University of Manchester is proposed. The site is located off Moseley Road in Fallowfield, Manchester. The National Grid Reference of the site is 385790E, 394180N.

The redevelopment will comprise residential flats with associated hardstanding, car parking and landscaped areas (see plan in Appendix A). This report relates to Phase 1 of the redevelopment (formerly named Phase 1A). The footprint of Phase 1 is currently a sports field on the eastern side, a mounded vegetated area on western side ('mound' area) with a works compound area and a car park in the north-west corner (Figure 1). The 'mound' area has been subject to prior remediation works and the Remediation Strategy for the advanced works in this area has been included as an appendix (Appendix B).

1.2 Previous Investigation and Reporting

Various previous investigation and reporting has been undertaken for this site.

- Stage 1 - Desk Study carried out by RSK. The desk study information, Geo-Environmental Desk Study Report (Ref. 1, dated March 2015), was provided by BDP and was taken into account in Stage 2a and 2b investigations.
- Stage 2a – Preliminary Ground Investigation - Limited number of boreholes and windowless sampling with associated in-situ and laboratory testing has been carried out by Geotechnics Ltd (Geotechnics), under the instruction and part-time supervision of Coffey. Details are provided in Coffey's Stage 2a Interpretative Report (Ref. 2, dated August 2015).
- Stage 2b – Principal Ground Investigation – Additional number of boreholes, windowless sampling and trial pits with associated in-situ and laboratory testing has been carried out by Geotechnics, under the instruction and part-time supervision of Coffey. Details are provided in Coffey's Stage 2b Interpretative Report (Ref. 3, dated September 2015).
- Environmental Essentials Ltd undertook trial pitting and testing for asbestos and PAH in the 'mound' area of the site (see Figure 1) as reported in their Compilation Report for Activities at Fallowfield Sports Ground (Ref. 4, dated March 2016).
- Hydrock Consultants Ltd undertook a Remediation Strategy for the 'mound' area of the site as reported in their Fallowfield Residential Campus, Remediation Strategy dated January 2017 (Ref. 5, also enclosed as Appendix B of this report). It is anticipated that the remediation of this area, including removal of the 'mound' material and disposal off site, will be undertaken prior to works commencing in the full Phase 1 area addressed in this (Coffey's) Remediation Strategy.
- A Japanese Knotweed Remediation Methodology was provided by Japanese Knotweed Solutions Ltd, dated November 2016, for Hydrock. This was incorporated in Hydrock's Remediation Strategy for the 'mound area' (Ref. 5 and Appendix B).
- Hydrock Consultants Ltd presented further ground investigation comprising seven window samples in the 'mound' area in a letter dated 2nd February 2017 (Ref. 6).

- Coffey provided a letter report to BDP including an Updated Human Health Risk Assessment on 6th June 2017, incorporating soil screening values from S4ULs, C4SLs and CLEA v1.07 (Ref. 7). This was in response to a request from the Local Authority's Principal Planner, received by BDP in relation to Planning Condition 5 (Robert Griffin email dated 3rd April 2017).

1.3 Appointment

BDP has commissioned Coffey to provide geo-environmental consultancy services in relation to the remediation and validation of the Phase 1 development. These services will comprise:

- Preparation of a Remediation Strategy for the development (this document);
- Site visits during construction to provide independent validation for the remediation ground works; and
- Validation Reporting.

1.4 Objectives

Based on the available information, the geo-environmental remediation requirements for redevelopment of the site are detailed in this document (Remediation Strategy). The objectives of this Strategy are to:

- Present a strategy for the safe, economic and sustainable geo-environmental risk mitigation of the site for the intended end use as a residential flat development with associated public open space (carparks and landscaping); and
- Set out the requirements for validation data needed to demonstrate the requirements of this Strategy are met, for presentation in the post-construction Validation Report.

2 SITE SETTING

2.1 Site Location and Description

The Fallowfield Campus is located in Fallowfield, at the University of Manchester campus which includes student accommodation and sports facilities. The campus is bounded by Moseley Road to the south and Wilmslow Road to the west, fields to the east and a residential area to the north. In terms of topography the site generally falls from 44mAOD on the northern side to 40mAOD on the southern side.

The Phase 1 area ('the site'), approximately 2.8Ha, is generally rectangular and 220m by 110m with additional rectangular extensions in the north-west corner (0.4Ha). The area consists of a sports field on the eastern side, mounded vegetated area on the western side and a works compound area / car park in the north-west corner. It is understood that the sheds in the works/compound area are to be demolished as part of the remediation works but no details are available (Ref. 6).

The sports field comprises a level grassed area surrounded by a boundary fence. On the eastern side, the sports field continues beyond the Phase 1 boundary. It is understood this adjacent sport area is not owned by the university.

Japanese Knotweed is present on site.

The mounded vegetated area on the eastern side is (or was, prior to remediation) about 110m length by 60m wide, and rises up to about 3.5m higher than surrounding ground level in the centre. It is covered with trees, of about 10 to 15 years old, to provide an area of woodland. Anecdotal evidence indicated the mound contains asbestos and asbestos containing material (ACM) and this was confirmed by physical testing (Refs. 2 to 4).

2.2 Proposed Development

Based on the information provided by BDP, the proposed redevelopment of new student accommodation comprises between 1 and 6 storey buildings which may be framed in either steel or reinforced concrete, or load bearing masonry construction. Preliminary loads and design building layout plans for the proposed development have not been provided.

A general layout plan of the proposed development (Phase 1 Landscape Master Plan, Drawing P1A_00_(9-)_Z)_L_200-P04, July '15) is presented in Appendix A. The proposals show the proposed flats, with associated proposed car parking and soft landscaping.

2.3 Planning Application

Coffey has been provided with a copy of the Planning Application for the proposed development (Appendix C). Under Condition 5a of the application, the requirement for submitting "a scheme for the investigation of the site and remediation measures" to the Local Planning Authority is identified. Condition 5a also states that, before the development commences, a report is to be prepared outlining what measures, if any, are required to remediate the land (the Site Investigation Report and/or Remediation Strategy) and be submitted to and approved in writing by the Local Planning Authority. This document is intended to address that requirement. Condition 5b relates to the effective implementation of the Remediation Strategy and the associated documentation to provide validation.

2.4 Findings of Previous Work

Historically, the site was mostly undeveloped until the mid-19th Century. There are two ponds shown on historical maps (Ref. 1) in the north east corner of the Phase 1 area. Buildings and roads were constructed in the area of Phase 1B and Phase 2 by 1892. The 'Manchester athletics ground' stadium was built on the western side of Phase 1 by 1905. The stadium had been demolished between 1986 and 2002.

Ground conditions encountered during the borehole investigation at the site comprised generally Made Ground over natural Glacial Till underlain by sand becoming extremely weak Sandstone. Mudstone was encountered on the eastern side of the Phase 1 area, in place of the sandstone. Groundwater entries were recorded in the exploratory holes (during hole formation and in installations) up to depths of 0.5mbgl. This is considered to be a perched water table in the Made Ground above the Glacial Till.

Chemical testing was undertaken on soil samples and compared to published Generic Assessment Criteria (GAC) for residential and public open space land use scenarios (Refs. 2, 3, 4, 6 and 7). Testing locations are shown in Figure 1 (for the 2016 Coffey investigation). The range of contaminants identified from the test results received included elevated metals (arsenic, lead), TPHs and PAHs in samples of Made Ground. The locations of these exceedences (based on the Residential without home grown produce scenario) are presented on Figure 2. The metals, total petroleum hydrocarbons (TPHs) and polyaromatic hydrocarbons (PAHs) were considered likely to be present due to the ash, clinker, and tarmac / bitumen fragments in the Made Ground (Refs. 3, 7). Hydrock's additional investigation in the 'mound' area also identified PAH and arsenic above GAC levels in soils beneath the proposed formation level (Ref. 6).

The ground gas monitoring results and risk assessment has indicated potential moderate risk to (unprotected) development users from ground gas in the Phase 1 part of the site. The sources of gas are believed to be deeper areas of Made Ground and backfilled former ponds. Protection measures are necessary for the Phase 1 area.

Risk to controlled waters was considered to be insignificant based on the limited amount of perched shallow groundwater above a relatively impermeable clay layer of Glacial Till.

Asbestos and Asbestos Containing Material (ACM) was identified in soils throughout the site, particularly in the 'mound' area.

Japanese Knotweed is present on site.

The UXO risk was concluded to be moderate by 6 Alpha Associates (Ref. 3) and UXO was checked at exploratory hole locations using geophysical methods during Stage 2a and 2b Coffey ground investigations (Refs. 2 and 3). However, Hydrock's Remediation Strategy for the 'mound' area concluded that the remedial works onsite were to be completed at shallow depths and within Made Ground which post-dates 1990, the UXO risk was considered to be low following their discussions with a UXO engineer prior to the commencement of works (Appendix B).

Deeper intrusive works and work in the rest of Phase 1 (such as the sports field) may require further risk assessment or UXO mitigation measures.

2.5 Proposed Remediation of Mound by Hydrock, 2017

It is proposed to undertake remedial earthworks in the 'mound' area of Phase 1 in advance of the main works in the area identified on Figure 2. To this end, the University of Manchester commissioned

Hydrock to undertake a localised Remediation Strategy with associated additional investigation (Ref. 5). Strategies are presented for asbestos removal and disposal, Japanese Knotweed removal and disposal and actions in the event of discovery of areas of unexpected contamination.

The proposals are to level the mound to a formation level of 44.8mAOD (surrounding ground level of 45.3mAOD – 500mm) which requires around 17,800m^3 of cut and 1,200m^3 of fill to provide a level formation. The proposals are also to demolish the existing maintenance compound, and remove and dispose of asbestos and Japanese Knotweed to off-site facilities. Recommendations for further work after earthworks have been completed include additional validation trial pits at formation level on a 25m grid (16 no. trial pits in the 'mound' area) to provide reassurance that asbestos and Japanese Knotweed materials have been fully removed.

This Remediation Strategy for the whole of Phase 1 ('the site') therefore proceeds from the following assumptions:

- The 'mound' area will have been levelled to 44.8mAOD.
- The excavated material will have been exported off site and disposed of in a suitable landfill.
- Japanese Knotweed in the area of the mound will have been removed but may remain in other areas of the site.
- Asbestos may remain in Made Ground in areas of the site outside the 'mound' and area covered by Hydrock's Remediation Strategy (see area on Figure 2).
- Disused buildings will have been demolished and the rubble removed from site.

3 REMEDIATION REQUIREMENTS

3.1 Introduction

The risk assessment process (Refs. 2, 3, 7) has identified potential geo-environmental risks to human health from contamination at shallow depths within the Made Ground. These risks are characterised as:

- HIGH/MODERATE with respect to risk from asbestos.
- MODERATE with respect to ground gas.
- LOW in relation to soil contamination with exceedences of arsenic, lead and polyaromatic hydrocarbons (PAH).

These result in the need for geo-environmental remedial activities and risk mitigation.

The remediation requirements in this section are intended to render the site suitable for the intended end use, thereby addressing Section B of Planning Condition 5 (Appendix C).

Demolition of the maintenance sheds in the works area in the north of the site is not included in this Remediation Strategy.

3.2 Scope

In broad terms, the scope of geo-environmental remedial actions required are summarised as:

- The risk of chronic exposure to asbestos is to be managed by the adoption of good general working practices (during all ground-works) together with guidance and direction from a suitably qualified and experienced asbestos specialist.
- A contingency, during the redevelopment ground works, for encountering ground that is locally impacted with contaminants such as further asbestos-containing matter, hydrocarbons or similar; this will involve communications between the Contractor and Coffey, site visits at appropriate times (e.g. during site clearance, and if/when suspect ground conditions are encountered), and may necessitate further sampling and laboratory testing, with additional assessment and provision of recommendations.
- Investigation and delineation of impacted ground at BH05/1A, BH07/1A and BH15/1A with regard to asbestos, PAH, TPH and metals.
- Sorting, segregation and possibly additional testing of site-won soil materials, particularly if such are to be re-used in the redevelopment (e.g. as uncontaminated capping soils in new/modified landscaped areas).
- Ensuring that the upper 600mm of soils in such landscaped/soft-standing parts of the site are uncontaminated, in particular, are devoid of asbestos and PAH.
- Gas protection measures in accordance with Characteristic Gas Situation (CGS) 2 (Ref. 3).
- Japanese Knotweed removal and treatment.

3.3 Provision of an Asbestos Specialist

As described previously, traces of asbestos have been found in Made Ground at shallow depth outside of the area which will have been remediated by the works proposed by Hydrock (Appendix B) at the locations identified on Figure 2.

Site clearance will include localised de-vegetation, topsoil strip and removal of existing surface hardstandings if present; this will need to be undertaken prior to commencing the main construction works. An asbestos specialist or suitable asbestos trained construction staff should be provided for the project, particularly prior to and during the site clearance. This is required in order to ensure that all risks relating to asbestos at the site are mitigated and that the work is undertaken in accordance with current guidance and legislation. The Principal Contractor is expected to develop a comprehensive risk assessment and method statement (RA/MS) to manage this operation safely.

3.4 Remediation of Asbestos-Impacted Ground at BH05/1A

It has been assumed that the previously remediated zone (see Figure 2) addressed by Hydrock will be free of asbestos (this includes asbestos encountered during the 2016 investigations in BH06/1A and BH02/1A shown on Figure 2). The remaining areas of Phase 1 will need to be remediated in areas of proposed landscaping where asbestos was encountered, and if additional asbestos is encountered during preparation and groundworks. It is likely that additional asbestos may be encountered on site due to past land use.

The asbestos-impacted ground at and around BH05/1A will need to be remediated for the redevelopment. This will involve further sampling and testing of near-surface Made Ground around BH05/1A to delineate the area affected, then placing a marker layer (such as geotextile) over the area delineated as affected by asbestos ('delineated area', for brevity) and covering the marker with new hardstandings or a similar capping layer such as 600mm of uncontaminated fill.

The required delineation work can be undertaken at a very early stage in the redevelopment process, immediately following the site clearance. The Contractor is required to arrange the following near-surface soil sampling and testing to be undertaken at a series of locations by an asbestos specialist or other suitably trained person with appropriate safety PPE, as summarised below:

- Soil sampling is to be undertaken initially at 4 no. sampling locations on a regular grid pattern at a radius of 5.0m from BH05/1A (see Figure 3).
- Each sampling point will be taken to (the shallower of) the base of the Made Ground or a depth of 1.0m bgl; soils shall be described and recorded. Any suspect asbestos containing material should be sampled, otherwise representative soil samples taken from each (Made Ground) horizon, with a minimum 1 sample per sampling point. All sampling point locations will be clearly set-out on site, and surveyed for location using suitable (e.g. GPS) equipment.
- Each sample will be tested for the presence (and if necessary concentration) of asbestos by a suitably accredited laboratory. All sample locations would be subject to asbestos screening and only those that were positive for asbestos fibres would require quantification.
- If asbestos is detected in any of the soil samples from the initial 5m radius sampling locations, further sampling shall be arranged by the Contractor in consultation with a geo-environmental specialist – anticipated to be sampling a second 8 no. sampling locations on a regular grid pattern at a radius of 10m from BH05/1A (see Figure 3), and tested for asbestos. Essentially the process should comprise one 'circle' of four sample locations at about 5m distance from the

central location and a second circle of 8 sample locations at 10m distance from the central location (Figure 3), and more if required. Further consultation may then be appropriate. There would only be nominal logging of these holes, primarily treating them as sample locations, but all would be CAT scanned before digging.

- Following effective delineation of the asbestos-affected ground, the delineated area should be marked by placing a marker layer such as geotextile, underlying a suitable capping layer such as new hardstandings or 600mm of uncontaminated fill, provided that:
    - The extent of the ground affected by asbestos is limited to the areas where new hardstandings / 600mm of uncontaminated fill can be placed. For example, if the ground affected by asbestos is proved to be extended across to areas of soft landscaping, placement of the marker and hardstandings / uncontaminated fill may not be feasible in that specific soft landscaping area. In this case, the asbestos-impacted soils should be excavated out (to a maximum depth of 600mm below finished levels), segregated and removed to landfill. Such works will need to be carried out under the supervision and direction of an Asbestos Specialist or other suitably asbestos trained person with appropriate safety PPE as described in Section 3.3.
    - If the proposed formation levels are below the soil zone where asbestos is encountered (i.e. below the base of the Made Ground) then then the material to be removed (including the asbestos impacted ground) may simply be excavated and disposed of to an appropriate landfill.

If asbestos-impacted soils are found to extend to depths of greater than 600mm, left in situ and capped, future ground intrusive works (if required) should be prohibited within the affected area unless special protective measures are applied.

If additional asbestos is encountered on site, the location should be recorded in discussion with a geo-environmental specialist and the procedures above adopted to delineate the extent of the contamination.

Records including sample as-surveyed locations / depths, description and test results should be maintained by the Contactor for inclusion in the Validation Report, which will be an important reference for stakeholders including those responsible for future site management and for the CDM Principal Designer. It is anticipated that the Validation Report will be referenced in the Health & Safety File for the development.

3.5 Remediation of localised metals and PAH

3.5.1 Northwest of mound (proposed car park area)

The proposed site development plan (Appendix A) shows an area of hardstanding and car park in the northwest corner of Phase 1. Two exceedences of PAH were encountered in this area (BH16/1A and BH17/1A on Figure 2). With regard to remediation in this area, it is considered that capping the area with hardstanding will act as a sufficient barrier to any contaminant pathway for future site users. The risk to construction workers should be managed by adopting appropriate precautions such as provision of appropriate training/guidance, PPE and welfare facilities during the works.

If additional gross contamination is encountered, the proceedures presented in Section 3.6 of this strategy should be adopted.

3.5.2 East of mound (proposed flats and softstanding areas)

The proposed site development plan (Appendix A) shows soft landscaping and residential flats in the eastern of Phase 1. Exceedences for metals, PAH and TPH were encountered at the following locations:

- BH05/1A
- BH07/1A
- BH15/1A

These areas will need to be subject to moderate additional investigation and remediation, in a similar manner to that for asbestos in Section 3.4. This will involve further sampling and testing of near-surface Made Ground around the locations listed above to delineate the area affected, surveying then placing a marker layer (such as geotextile) over the area delineated as affected by exceedences ('delineated area', for brevity) and covering the marker with new hardstandings or a similar capping layer such as 600mm of uncontaminated fill .

The required delineation work can be undertaken at a very early stage in the redevelopment process, immediately following the site clearance. Near-surface soil sampling is to be undertaken at a series of locations, as summarised below:

- Soil sampling is to be undertaken by the Contractor initially at 4 no. sampling locations on a regular grid pattern at a radius of 5.0m from the locations listed above (see Figure 3).
- Each sampling point will be taken to (the shallower of) the base of the Made Ground or a depth of 1.0m bgl; soils shall be described and recorded, and representative soil samples taken from each (Made Ground) horizon, with a minimum 1 sample per sampling point. All sampling point locations will be clearly set-out on site, and surveyed for location using suitable (e.g. GPS) equipment.
- Each sample will be tested by the Contractor for the presence (and if necessary concentration) of PAH, TPH and metals suite by a suitably accredited laboratory. The suite is to include arsenic, cadmium, chromium (all compounds), copper, lead, mercury, nickel, selenium, zinc), pH, SOM, total TPH, total PAH and asbestos.
- If exceedences are detected in any of the soil samples from the initial 5m radius sampling locations further sampling shall be arranged by the Contractor in consultation with a geo-environmental specialist – anticipated to be sampling a second 8 no. sampling locations on a regular grid pattern at a radius of 10m from the starting point (see Figure 3) - and tested for PAH, TPH and metals suite (as listed above) by a suitably accredited laboratory. Essentially the process should comprise one 'circle' of four sample locations at about 5m distance from the central location and a second circle of 8 sample locations at 10m distance from the central location (Figure 3), and more if required. Further consultation may then be appropriate. There would only be nominal logging of these holes, primarily treating them as sample locations, but all would be CAT scanned before digging.
- Following effective delineation of the affected ground, the delineated area should be marked by placing a marker layer such as geotextile, underlying a suitable capping layer such as new hardstandings or 600mm of uncontaminated fill, provided that:

- The extent of the ground affected is limited to the areas where new hardstandings / 600mm of uncontaminated fill can be placed. For example, if the ground affected by exceedences is proved to be extended across to areas of soft landscaping, placement of the marker and hardstandings / uncontaminated fill may not be feasible in that specific soft landscaping area. In this case, the contaminated soils should be excavated out (to a maximum depth of 600mm below finished levels), segregated and removed to landfill.
- If the proposed formation levels are below the soil zone where contamination is encountered (i.e. below the base of the Made Ground) then then the material to be removed (including the contamination impacted ground) may simply be excavated and disposed of to an appropriate landfill.

If additional contamination is encountered on site, the location should be recorded in discussion with a geo-environmental specialist as presented in Section 3.6 below.

Records including sample as-surveyed locations / depths, description, test results should be maintained by the Contactor for inclusion in the Validation Report, which will be an important reference for stakeholders including those responsible for future site management and for the CDM Principal Designer. It is anticipated that the Validation Report will be referenced in the Health & Safety File for the development.

3.6 Other Potential Ground Contamination Sources

As indicated previously, it is possible that localised ground that is impacted with contaminants may exist elsewhere at the site and may be encountered during the site redevelopment. Accordingly, the remediation strategy needs to include contingency measures for dealing with such. The contingency measures are described in the following paragraphs.

On completion of the site clearance, to include breaking out of all residual hardstanding, de-vegetation and removal of topsoil, the exposed formation is to be inspected and recorded by a competent person of the Contractor's site staff.

If during this inspection, or at any other time during the ground works' activities, ground is exposed that is suspected to be impacted with contaminants (such as asbestos, hydrocarbons or similar) the suspect ground is to be sampled and tested by the Contactor, and the test results are to be subjected to further consideration and assessment. A suitably qualified geo-environmental engineer should be contacted with regard to further assessment of the contamination.

In the event that such work confirms the presence of further contaminated ground conditions that could pose a risk to receptors (human health, controlled waters buildings and/or the environment) the impacted area is to be delineated, and appropriate measures agreed and implemented. Such measures could comprise or include: excavation to a suitable depth, segregation and off-site removal to landfill or possibly covering with an uncontaminated cover system (similar to the process described in Section 3.4). If such ground contamination relates to asbestos-impacted soils, the work would need to be undertaken in accordance with the requirements of an asbestos specialist.

3.7 Re-use of Site Won Materials

The proposed development will include areas of soft landscaping. Cover soils (including topsoil) to be used in these areas should be uncontaminated and of sufficient thickness. Topsoil will need to comply with the Specification as set out in the employer's requirements for the development.

Subject to confirmation by validation testing by the Contactor, it is anticipated that site-won soils may be suitably uncontaminated for re-use as soil fill in the redevelopment. All such soils that are to be considered for re-use should be segregated and stockpiled in areas which can be accessed and inspected conveniently. The soil stockpiles should be checked by the Contactor to determine if they are suitable for such re-use and (in the case of cover soils) are free from material such as broken glass, sharps, tree roots, entrained contaminants, etc. Such stockpiled soil materials will also require testing with an appropriate frequency (as defined in Section 4.1 and 4.3 of this Remediation Strategy) by the Contactor; this testing should include geotechnical testing to confirm suitability (particularly if to be reused as structural or engineered fill) and chemical testing to confirm them to be suitably uncontaminated (in accordance with the acceptance criteria presented in Appendix E).

With regard to landscaped areas the following requirements should also be met:

- A minimum thickness of 150mm of uncontaminated topsoil is required to promote and sustain plant growth within any general landscaped (grassed) area.
- A minimum thickness of 450mm topsoil is required to promote plant growth within any proposed planted areas (greater thickness if any deeper rooting species are proposed).
- Validation will need to include sampling, testing and measurement in validation pits to confirm adequate cover thicknesses on a 30m grid. Sampling, testing and measurement to be undertaken by the contractor and photographic records provided to the geo-environmental engineer for validation. The geo-environmental engineer is to be on site during the excavation and photography of pits for validation.

3.8 Imported Soil Materials

For all imported soils, appropriate chain of custody records should be obtained and provided by the Contactor for inclusion in the Validation Report.

3.9 Ground Gas

Coffey's Stage 2b Interpretative Report (Ref. 3) concluded that ground gas protection measures for Characteristic Gas Situation 2 are considered appropriate for proposed new development in Phase 1 of the site. The gas protection measures are for elevated levels of methane and carbon dioxide. BDP has designed the proposed gas protection measures which are presented in Appendix E.

The gas membrane shall be installed by the Contactor in accordance with CIRIA C735 recommendations.

The Contractor shall ensure an appropriately experienced and qualified workforce is employed on site to install ground gas protection systems. The supervisor installing gas protection measures should have Construction Skills level 2 NVQ diploma or equivalent.

The following site inspections should be carried out by the supervisor installing gas protection measures and recorded. For each plot, the gas membrane installation should be subject to visual verification inspections to:

1. establish the adequacy of the ground preparation and subsequently possible damage to the installed gas membrane; and
2. Confirmation the integrity of the gas membrane and that it covers over the whole floor area, paying particular attention to laps, edges and the sealing of service entries and penetrations such as vent pipes and pile caps to ensure continuous barrier is provided.

Any discrepancies with the installation method recommended by the gas membrane supplier / designers should be made good. These may include small or large holes and rips, tears and punctures, absence of tape (double sided or single sided tape) on the lapped areas, loose or unstuck tape, inadequate corner details and unbounded seams such as loose edges and 'fish mouths' in the gas membrane. Tapes used to join gas membranes should be inspected to make sure they are compatible with the gas membrane being joined and are as specified by the gas membrane supplier or designer.

If a gas membrane has a third party accreditation, e.g. BBA certificate, the installation requirements should be checked against it, including the need for protection boards or similar. Where welded joints are used, the verifier should ensure they are correctly tested.

Each inspection by the supervisor shall include photographs as supporting evidence. A pro forma should be completed for each inspection which include as a minimum date of inspection, weather, gas membrane type, gas membrane condition, joining tape product, lapping design, service entry seals and confirmation that the gas membrane has been satisfactory installed in accordance with the design / manufacturer's recommendations.

Coffey is to provide a limited number of independent validation site visits of the installation. The Contractor is to liaise with Coffey to advise when the membrane is complete to co-ordinate these site visits / independent check.

3.10 Japanese Knotweed

A strategy for removal and treatment of Japanese Knotweed in the 'mound' area is presented in Hydrock's Remediation Strategy for this part of the site (Ref. 5) in a report by Japanese Knotweed Solutions Ltd. They, or a similarly qualified contractor, should be consulted to assess and remediate the potential Japanese Knotweed over the full Phase 1 area if such work has not yet been undertaken. The plan provided by Japanese Knotweed Solutions Ltd at ground investigation stage (Ref. 3) is presented in Appendix F. This indicates that the knotweed identified on site is concentrated in the 'mound' area.

4 VALIDATION REQUIREMENTS

4.1 Frequency of Validation Testing of Contaminated Soils

The validation programme has been developed in general accordance with the Environment Agency's guidance on Verification of Remediation of Land Contamination (Ref. 8). The testing frequency proposed here is based on such guidance, together with Coffey's professional judgement and experience. Test requirements are given in Section 4.3 below.

In relation to the validation of site-won or imported soil materials for use in the proposed areas of soft landscaping, the requirements for on-site testing by the Contactor are as follows:

- A testing frequency of 1 no. sample per 100m^3 of material from an approved Greenfield source. The source of the imported soil should be clearly identified and there must be a minimum of 4 no. samples tested from each separate source.
- Ideally, imported soil materials should be sampled and tested either before they are brought to site or when stockpiled on arrival. This will effectively eliminate the need to sample and test soils after placement. Site inspection will subsequently be able to be limited to confirmation of adequate cover thickness via hand-excavated validation pits as described below.

4.2 Independent Validation of the Landscaping Cover System Thickness

Confirmatory inspections are to be undertaken by an independent geo-environmental engineer. Records, including photographic evidence, are to be retained for review, as required.

The number of validation pits required will be based on a grid system. A 30m grid across the areas of new/modified landscaping will be adopted (or 1 no. per 900m^2 or 4 no. tests, whichever is the greater). Sampling, testing and measurement to be undertaken by the contractor and photographic records provided to the geo-environmental engineer for validation. The geo-environmental engineer to be on site during the excavation and photography of pits for validation.

4.3 Validation Laboratory Testing and Assessment

It is proposed that the validation laboratory testing for imported or site-won soil materials to be used in the redevelopment should include for the following standard suite of tests:

- Metal suite (arsenic, cadmium, chromium (all compounds), copper, lead, mercury, nickel, selenium, zinc), pH, SOM, total TPH, total PAH and asbestos.

Appropriate Acceptability Criteria are then to be used for comparison to confirm that the sampled soil materials meet the chemical requirements. Proposed Acceptability Criteria for (imported) capping soils are presented in Appendix C. Given the nature of the redevelopment, the relevant acceptability criteria are those relevant to the "Residential without home grown produce" scenario.

The Contactor to arrange a minimum of 4 No. samples to independent sampled and collected for the landscape areas.

4.4 Validation of Gas Protection Measures

Validation of gas protection measures against proposed design in Appendix E are to include the following for each block of flats:

- Photographic records / completed inspection pro-formas of installed gas protection measures are to be maintained by the Contractor and provided to Coffey.
- Certificates for any geosynthetic materials are to be provided by the Contractor.
- Inspection visits by Coffey may be incorporated into Coffey's confirmatory inspections.

4.5 Validation Reporting

Upon completion of the remediation works described in this document, a Validation Report is to be prepared to include details of the works undertaken, presenting factual data and records.

The required list of records, to be kept by the Contractor and sent to Coffey for validation, include:

- Validation laboratory test results, including the location of where and at what depth samples were taken.
- Validation pit photographs and logs, including the location of each pit.
- Soil import and export records, including location of sources and the volumes imported/exported.
- Certificates and import records of any geosynthetics used in the remedial works.
- Coffey's site visit records, and other photographic evidence including photographs of gas protection measures.

The Validation Report is to assess conformity and demonstrate compliance of the implemented remedial measures with the requirements set out in this strategy. The Validation Report should then be submitted to the Planning Local Authority for their review and approval / comments.

5 CONCLUSIONS

In conclusion:

1. Phase 1 of the Fallowfield Campus site is to be redeveloped as residential flats with associated car parking and landscaping (see Appendix A). This report comprises the Remediation Strategy for Phase 1, to fulfil the requirements of Condition 5 of the Planning Application.
2. The site initially comprised a sports field on the eastern side, a mounded vegetated area on the western side with a works compound area and a car park in the north-west corner. It is understood that the mounded and vegetated area (which included a raised area of Made Ground with asbestos and Japanese Knotweed) is to be levelled and remediated in advance of the main ground works, in accordance with a localised Remediation Strategy for the mound area only, undertaken by Hydrock (Appendix B).
3. This Remediation Strategy proceeds from the following assumptions:
    a. The 'mound' area will have been levelled to 44.8mAOD.
    b. The excavated material will have been exported off site and disposed of in a suitable landfill.
    c. Japanese knotweed in the area of the mound will have been removed but may remain in other areas of the site (Appendix F).
    d. Asbestos may remain in Made Ground below the level of mound excavation and on other areas of the site outside the 'mound'.
    e. Disused buildings will have been demolished and the rubble removed from site.
4. This remediation strategy is to be implemented to mitigate geo-environmental risks for the whole of the Phase 1 area in relation to the intended end use (defined as “Residential without home grown produce”). Geo-environmental risks (see Figure 2) include:
    a. Slightly elevated levels of arsenic and lead in existing Made Ground (LOW risk).
    b. Elevated levels of PAH in existing Made Ground (LOW risk).
    c. Asbestos in Made Ground across Phase 1 (HIGH / MODERATE risk).
    d. Ground gas (MODERATE risk), requiring protection measures in accordance with CGS 2 (details designed by BDP and presented in Appendix E).
5. The scope of the remedial actions required by this strategy is summarised as:
    a. Implement gas protection measures designed by BDP (Appendix E).
    b. Investigate and delineate asbestos impacted ground at BH05/1A
    c. Investigate and delineate ground impacted by PAH, TPH and metals at BH05/1A, BH07/1A and BH15/1A
    d. Ensuring that the upper 600mm of soils in such landscaped/soft-standing parts of the site are uncontaminated, in particular, are devoid of asbestos and PAH.

6. A contingency during the redevelopment ground works for encountering ground that is locally impacted with contaminants such as further asbestos-containing material, hydrocarbons or similar. This will involve communication between the Contractor and Coffey, site visits when required – during site clearance and if/when suspected contaminated material is encountered. This may also require further sampling and testing, with additional assessment and provision of recommendations. The Principal Contractor is expected to develop a comprehensive risk assessment and method statement (RA/MS) to manage this operation safely.
7. The effective implementation of the above remedial actions are to be independently documented (i.e. by Coffey) and presented in a Validation Report for the remediated development. The Validation Report will include details of the works undertaken, factual data and records such as laboratory test results, site visit records and photographic evidence.
8. The list of records Coffey will require from the Contractor include:
    - Validation report relating to the completion of the mound remediation works proposed by Hydrock in their Remediation Strategy (Appendix B).
    - Validation laboratory test results, including the location of where and at what depth samples were taken.
    - Validation pit photographs and logs, including the location of each pit.
    - Soil import and export records.
    - Certificates and import records of any geosynthetics used in the remedial works (e.g. gas protection membrane).
    - Completed inspection pro-formas and photographic evidence including photographs of gas protection measures.

REFERENCES

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2. Coffey Geotechnics Ltd, Geoenvironmental and Geotechnical Interpretative Report, Stage 2a, Project Oak, Fallowfield, Manchester, 10th August 2015, Ref. 02428AA_R_002A_MJW-Stage 2a
3. Coffey Geotechnics Ltd, Geoenvironmental and Geotechnical Interpretative Report, Stage 2b, Project Oak, Fallowfield, Manchester, 4th September 2015, Ref. 02428AA_R_003B_MJW-GIR-Stage 2b
4. Environmental Essentials Ltd, Compilation Report for Activities at Fallowfield Sports Ground, 10th March 2016
5. Hydrock Consultants Ltd, Fallowfield Residential Campus, Remediation Strategy, Ref. UOM-HYD-XX-XX-RP-G-001, Issue 2, 17th January 2017
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7. Coffey Geotechnics Ltd, Letter to BDP incorporating Updated Human Health Risk Assessment, 6th June 2017, Ref. 02428AC_L_001A_AFB_HHRA-Update2
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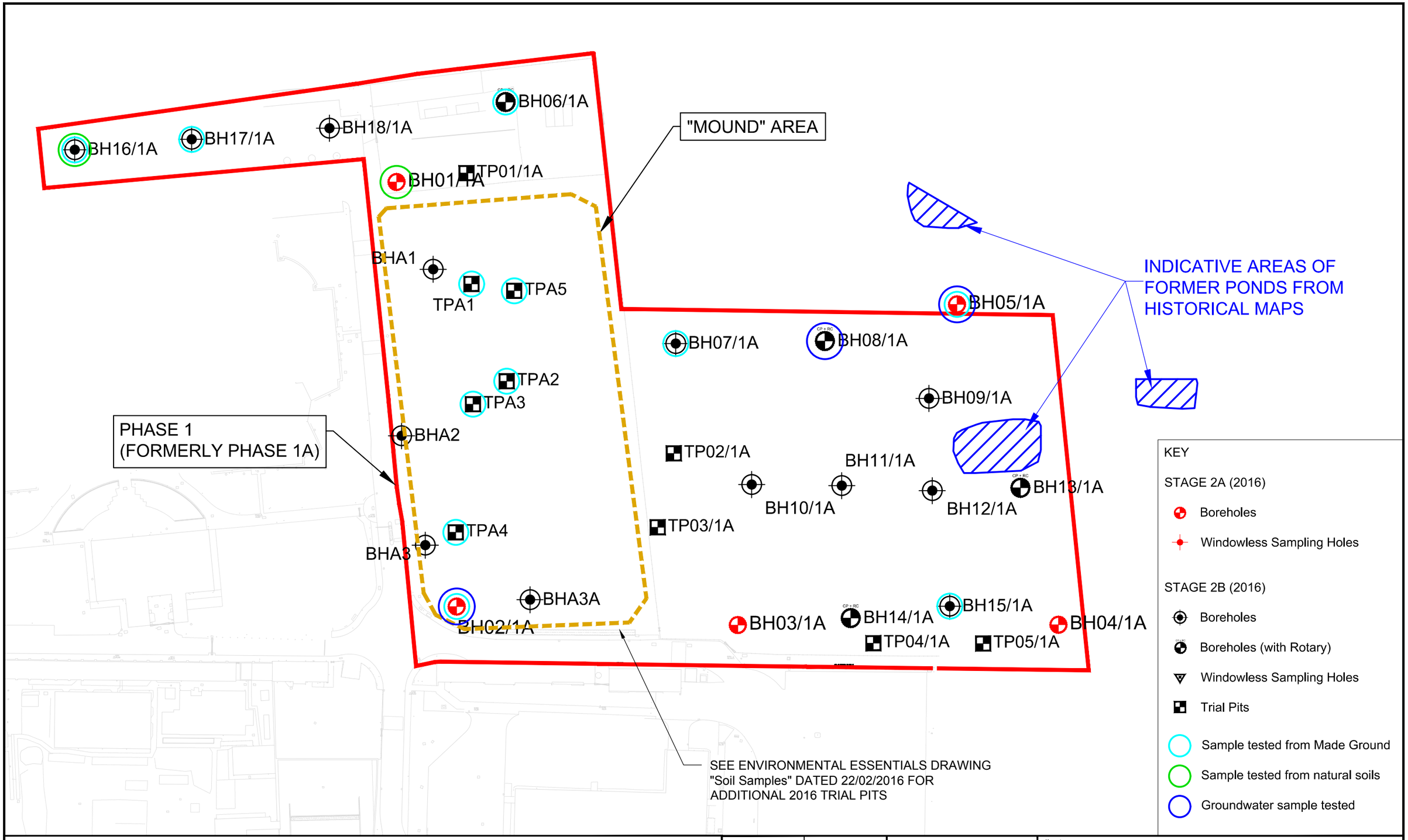
10. The LQM/CIEH S4ULs for Human Health Risk Assessment, Nathanail, C.P.; McCaffrey,C.; Gillett, A.G.; Ogden, R.C. & Nathanail, J.F, Land Quality Press, Nottingham (2015). Suitable For Use Levels (S4ULs) are Copyright Land Quality Management Limited and are reproduced with permission (Publication Number S4UL3338. All rights reserved).
11. CL:AIRE, 2016. Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance. CL:AIRE, London. ISBN 978-1-905046-30-0. Free download at www.claire.co.uk/asbestos

Figures



Notes:

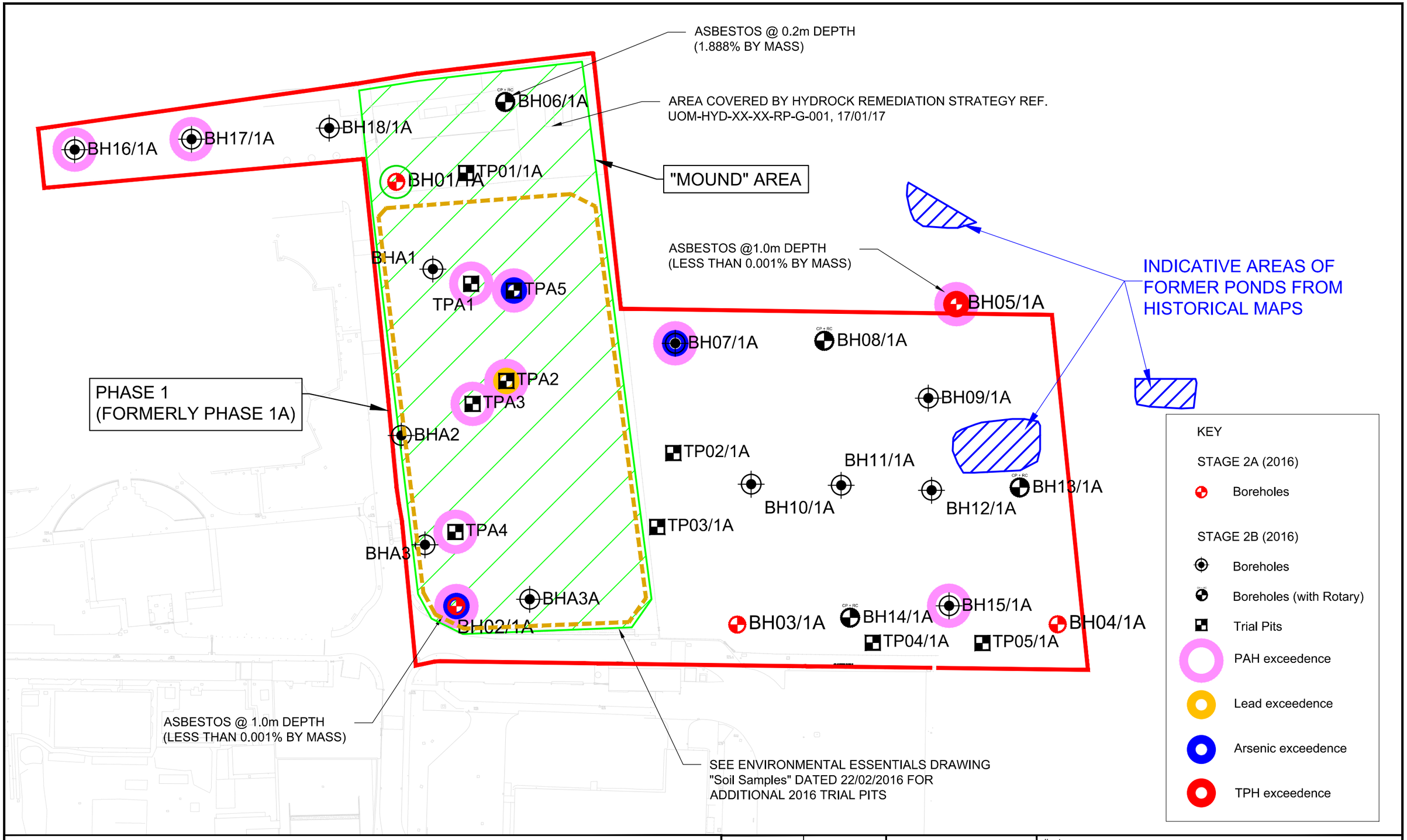
1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Reference drawing: 12650A-MASTER.dwg (Topographical Survey by SURVEY SYSTEMS - February 2014)
4. Exploratory hole locations provided by Geotechnics in AGS format.

drawn	MN
date	06/06/2017
scale	1 : 1,000
original size	A3

coffey

client:	BDP
project:	FALLOWFIELD CAMPUS REMEDIATION
title:	EXPLORATORY HOLE LOCATION PLAN
project no: 02428AC	fig no: FIGURE 1

E-file Ref : \\manchfs02\data$\GEOT\Current Server Data\Server_2400.Done\02428AC Fallowfield Campus - Remediation\Drawings\1 - CWD\02428AC_D10.04_MN_KeyHole_FIG.1-MJW.dwg



Notes:

1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Reference drawing: 12650A-MASTER.dwg (Topographical Survey by SURVEY SYSTEMS - February 2014)
4. Exploratory hole locations provided by Geotechnics in AGS format.
5. Exceedences are for Residential without homegrown procedure from the 2016 procedure.

drawn	MN
date	07/06/2017
scale	1 : 1,000
original size	A3

coffey

client:	BDP
project:	FALLOWFIELD CAMPUS REMEDIATION
title:	SPATIAL DISTRIBUTION OF DETECTED CONTAMINATION IN SOILS
project no: 02428AC	fig no: FIGURE 2

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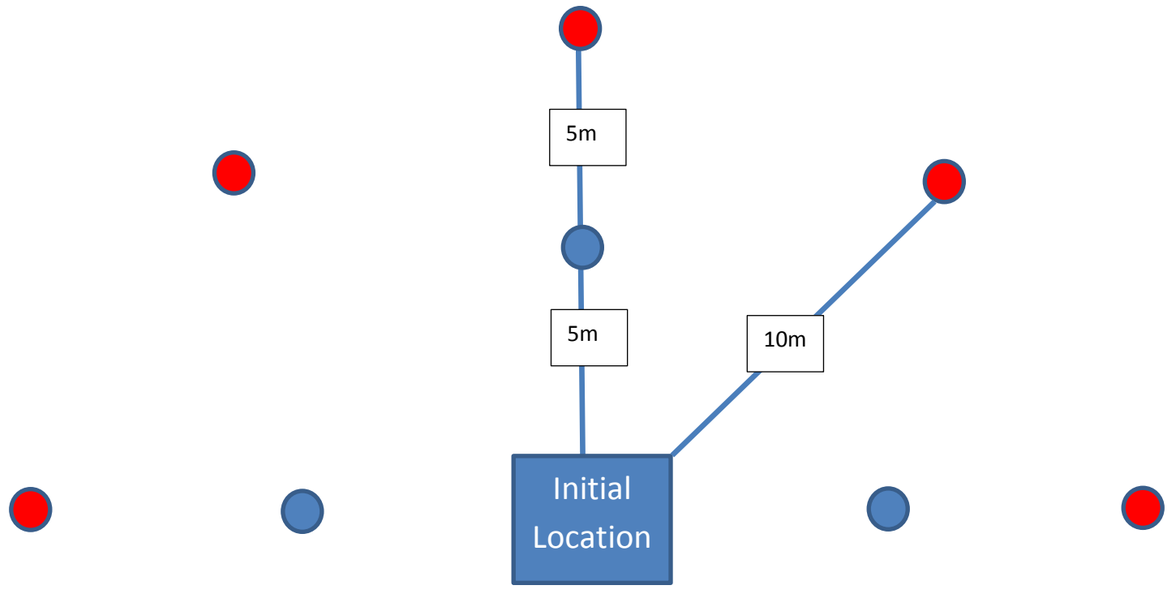


Notes:

See requirements of Section 3.4 and 3.5 of Coffey's Remediation Strategy

drawn	AFB
date	08/06/2017
scale	NTS
original size	A3

coffey

client:	BDP
project:	FALLOWFIELD REMEDIATION
title:	ASBESTOS/CONTAMINATION DELINEATION GRID: PROPOSED ADDITIONAL SAMPLING LOCATIONS
project no: 02428AC	fig no: FIGURE 3

Appendix A

Proposed Site Plan



KEY

- PHASE 1 BOUNDARY
- RESIDENTIAL BUILDINGS
- FEATURE PAVED AREA
- PEDESTRIAN GRADE HARD SURFACING - GENERAL AREAS
- VEHICULAR GRADE HARD SURFACING
- PAVED SEATING AREA WITH BOULDER SEATING
- VEHICULAR GRADE ASPHALT
- EXISTING ASPHALT RETAINED / MADE GOOD
- GRASS AREAS
- MIXED PLANTED BEDS
- SWALE
- NATIVE HEDGEROW
- EXISTING TREE RETAINED
- PROPOSED TREE
- FREE STANDING CYCLE HOOPS
- LOCKABLE CYCLE COMPOUND
- BIN STORE
- CHARITY CLOTHES BIN
- ARTWORK LOCATION- PROVIDED BY UNIVERSITY
- PICNIC TABLE
- DECKED SEATING AREA
- REINFORCED GRASS

LEGEND

1. DISABLED PARKING
2. CONTROLLED ACCESS TO CPU / CHP / MAINTENANCE CAR PARK & DELIVERY AREA
3. CPU / MAINTENANCE BUILDING
4. CPU / CHP / MAINTENANCE CAR PARK & DELIVERY AREA
5. WARDENS ACCOMMODATION
6. STUDENT AMENITY BLOCK AT GROUND LEVEL
7. SUBSTATION
8. WASTE MANAGEMENT
9. ENERGY CENTRE
10. VEHICULAR ACCESS TO ARMITAGE SPORTS CENTRE
11. EXISTING PUBLIC RIGHT OF WAY

BUILDING DESIGN PARTNERSHIP SHALL HAVE NO RESPONSIBILITY FOR ANY USE MADE OF THIS DOCUMENT OTHER THAN FOR THAT WHICH IT WAS PREPARED AND ISSUED.

ALL DIMENSIONS SHOULD BE CHECKED ON SITE.

DO NOT SCALE FROM THIS DRAWING.

ANY DRAWING ERRORS OR DIVERGENCES SHOULD BE BROUGHT TO THE ATTENTION OF BUILDING DESIGN PARTNERSHIP AT THE ADDRESS SHOWN BELOW.

NOTES

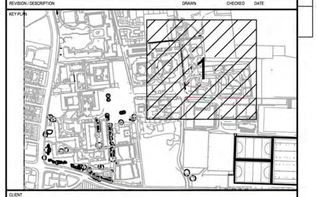
TO BE READ IN CONJUNCTION WITH DRAWINGS:

P1A_00_(9-)_Z0_L_207 - PLANTING STRATEGY PLAN
P1A_00_(9-)_Z0_L_214 - TREE CONSTRAINTS PLAN
P1A_00_(9-)_Z0_L_241 - GENERAL ARRANGEMENT 1 OF 5
P1A_00_(9-)_Z0_L_242 - GENERAL ARRANGEMENT 2 OF 5
P1A_00_(9-)_Z0_L_243 - GENERAL ARRANGEMENT 3 OF 5
P1A_00_(9-)_Z0_L_244 - GENERAL ARRANGEMENT 4 OF 5
P1A_00_(9-)_Z0_L_245 - GENERAL ARRANGEMENT 5 OF 5
P1A_00_(9-)_Z0_L_251 - PLANTING PLAN 1 OF 5
P1A_00_(9-)_Z0_L_252 - PLANTING PLAN 2 OF 5
P1A_00_(9-)_Z0_L_253 - PLANTING PLAN 3 OF 5
P1A_00_(9-)_Z0_L_254 - PLANTING PLAN 4 OF 5
P1A_00_(9-)_Z0_L_255 - PLANTING PLAN 5 OF 5
P1A_00_(9-)_Z0_L_257 - TREE PLANTING PLAN
P1A_00_(9-)_Z0_L_271 - PROPOSED LEVELS PLAN 1 OF 5
P1A_00_(9-)_Z0_L_272 - PROPOSED LEVELS PLAN 2 OF 5
P1A_00_(9-)_Z0_L_273 - PROPOSED LEVELS PLAN 3 OF 5
P1A_00_(9-)_Z0_L_274 - PROPOSED LEVELS PLAN 4 OF 5
P1A_00_(9-)_Z0_L_275 - PROPOSED LEVELS PLAN 5 OF 5
P1A_00_(9-)_Z0_L_301 - LANDSCAPE SECTIONS
P00_00_(9-)_Z0_L_601 - TYPICAL CONSTRUCTION DETAILS
P00_00_(9-)_Z0_L_611 - TYPICAL TREE PIT DETAILS

REFER TO EXTERNAL WORKS SPECIFICATION

REVISION / DESCRIPTION	DRAWN	CHECKED	DATE
P04 BBQ STONES OMITTED. REDUCTION IN 'S1' BENCHES. MINOR AMMENDMENTS TO PATH LAYOUT.	SLB	JF	10.11.16
P03 PROJECT TITLE REVISED	IF	JF	14.09.16
P02 2No. CYCLE ROUNDELS OMITTED, IN LIEU OF ADDITIONAL INTERNAL CYCLE STORE. SEATING AREA OMITTED. SWALES AMENDED IN ACCORDANCE WITH DRAINGAGE STRATEGY. TREE LOCATIONS COORDINATED WITH BELOW GROUND SERVICES. MAINTENANCE PATHS ADDED. REDUCED PATH WIDTHS. RATIONALISED STREET FURNITURE. EXTENT OF PAVING REDUCED. BUILDING TRIM REVISED.	IF	JF	04.09.15
P01 ISSUED FOR UNIVERSITY REQUIREMENTS	IF	JF	17.07.15
FIRST ISSUE			

KEY PLAN



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PROJECT TITLE
OWENS PARK, FALLOWFIELD CAMPUS REDEVELOPMENT

PROJECT NUMBER
P2006665

DRAWING TITLE
PHASE 1
LANDSCAPE MASTERPLAN

SCALE @ A1
1:500

DATE
JULY '15

DRAWING No.
P1A_00_(9-)_Z0_L_200

REVISION
P04

Appendix B

Hydrock 'Mound' Remediation Strategy

Hydrock

Fallowfield Residential Campus, University of Manchester

Remediation Strategy

Final Report for

MANCHESTER 1824

The University of Manchester

January 2017

Hydrock Ref: UOM-HYD-XX-XX-RP-G-001

DOCUMENT CONTROL SHEET

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Project: UNIVERSITY OF MANCHESTER, FALLOWFIELD RESIDENTIAL CAMPUS

Title: REMEDIATION STRATEGY

Status: FINAL

Date: JANUARY 2017

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Issue Number:	**2**	**Name**	**Signature**
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Document Revision Record

Issue Number	**Date**	**Revision Details**
1	28th November 2016	Original issue – Draft for client and stakeholder comments
2	17th January 2017	Revised issue after incorporation of new data and client and stakeholder comments

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

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1.0 INTRODUCTION 2
2.0 CONCEPTUAL MODEL 5
3.0 RISK ASSESSMENT REVIEW 9
4.0 REMEDIATION OPTIONS APPRAISAL 15
5.0 REMEDIAL STRATEGY IMPLEMENTATION 15
6.0 ADDITIONAL WORK 26
7.0 DISCOVERY STRATEGY FOR AREAS OF UNEXPECTED CONTAMINATION 27
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Appendices

Appendix A Drawings

Appendix B Hydrock Site Records, Monitoring and Test Results

Appendix C Hydrock HazWasteOnline and Asbestos Licensing Decision Support Tool Assessments

1.0 INTRODUCTION

1.1 Background

In October 2016, Hydrock Consultants Limited (Hydrock) along with our partners Japanese Knotweed Solutions Ltd (JKSL) was commissioned by the University of Manchester (UoM) (the Client) to produce a Remediation Strategy for a site known as Fallowfield Residential Campus at the University of Manchester.

The site is currently disused, heavily vegetated land and is roughly rectangular in shape, extending to approximately 1ha.

The proposed development will include the erection of a multi-storey residential complex for housing university students.

A Site Location Plan (Drawing UOM-HYD-XX-XX-DR-G-001) and a proposed development layout (Drawing P00_00_(0-)_Z0_A_911) produced by BDP and provided by the Client are presented in Appendix A.

Planning permission for new residential developments at the campus were approved by Manchester City Council in December 2015 (Application No. 110184/FO/2015/S1). Contamination is covered by condition 5, as follows:

5) No development shall commence within each phase of development until:

a) a report (the Preliminary Risk Assessment) to identify and evaluate all potential sources and impacts of any ground contamination, groundwater contamination and/or ground gas relevant to the site shall be submitted to and approved in writing by the City Council as local planning authority. In the event of the Preliminary Risk Assessment identifying risks which in the written opinion of the Local Planning Authority require further investigation, the development shall not commence until a scheme for the investigation of the site and the identification of remediation measures (the Site Investigation Proposal) has been submitted to and approved in writing by the City Council as local planning authority. The measures for investigating the site identified in the Site Investigation Proposal shall be carried out, before the development commences and a report prepared outlining what measures, if any, are required to remediate the land (the Site Investigation Report and/or Remediation Strategy) which shall be submitted to and approved in writing by the City Council as local planning authority.

b) When the development commences, the development shall be carried out in accordance with the previously agreed Remediation Strategy and a Completion/Verification Report shall be submitted to and approved in writing by the City Council as local planning authority. In the event that ground contamination, groundwater contamination and/or ground gas, not previously identified, are found to be present on the site at any time before the development is occupied, then development shall cease and/or the development shall not be occupied until, a report outlining what measures, if any, are required to remediate the land (the Revised Remediation Strategy) is submitted to and approved in writing by the City Council as local planning authority and the development shall be carried out in accordance with the Revised Remediation Strategy, which shall take precedence over any Remediation Strategy or earlier Revised

Remediation Strategy.

In addition, Condition 21 covers invasive species as follows:

21) Prior to the commencement of development (including vegetation clearance and demolition) details of the methodology for the control of invasive species present on site shall be submitted to and approved in writing by the City Council as local planning authority. The development shall be subsequently undertaken in accordance with the agreed details.

1.2 Objectives

This Remediation Strategy is one of a series of reports required to discharge planning conditions relating to contamination and is based on the findings of two historical ground investigation reports (listed below), previous survey works by JKSL and works carried out by Hydrock and JKSL in October 2016.

Based on a summary of the risk assessment findings, remediation objectives are presented followed by an options appraisal to select the most feasible approach to the works required. The preferred option is then described as a series of tasks required to achieve the stated objectives.

1.3 Scope

The scope of work for this commission comprises:

- Review of risk assessment and recognition of unacceptable risks that the remediation is intended to mitigate;
- Remediation options appraisal;
- Remedial strategy implementation details;
- A consideration of materials management plan issues; and
- Validation requirements.

1.4 Provided Information

The following reports and information have formed the basis of this report:

- Greater Manchester Ecology Unit, UoM Fallowfield Campus Biodiversity Assessment, dated October 2013.
- Utility searches, various dated February and March 2014.
- JCA Limited, Tree Constraints Plan (containing topographical information, surveyor unknown) Ref: 11651/LP, undated.
- JCA Ltd, UoM Fallowfield Campus Arboriculture Report, dated August 2014.
- Peter Arrowsmith, UoM Fallowfield Campus Archaeological Desk-based Assessment, dated August 2014.

- RSK (2015), Geoenvironmental Stage 1 Report, Project Oak, Fallowfield, Project No. 321991-R1-01
- Geotechnics, Ground Investigation Factual Report Stage 2A, Ref PN153327, dated June 2015.
- Geotechnics, Ground Investigation Factual Report Stage 2B, Ref PN153349, dated August 2015.
- Coffey, Geoenvironmental and Geotechnical Interpretative Report Stage 2A – Project Oak, Fallowfield, Manchester. Ref 02428AA_R_001F_MJW-GIR, 3rd July 2015.
- Japanese Knotweed Solutions. Drawing: Japanese Knotweed excavation extents. Ref: JK15-0868-003 Rev D. 27th January 2015.
- Environmental Essentials. Compilation Report for Activities at Fallowfield Sports Ground. 10th March 2016.
- Environmental Essentials Report titled, 'Soil Analysis Spreadsheet – Asbestos', dated March 2016.
- Japanese Knotweed Solutions. Drawing: Location of trial pits (undertaken by Bagnalls in February 2016) in relation to proposed excavation areas. Ref: JK15-0868-006 Rev D. 15th March 2016.
- Japanese Knotweed Solutions Limited drawings titled, 'Location of soil samples (undertaken by Coffey in 2015 in relation to proposed excavation areas', dated 15th March 2016.

1.5 Limitations

Hydrock has prepared the report based on available information obtained during the project period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of the University of Manchester and those parties designated by them for the purpose of providing information on the remediation and validation works to be undertaken during the enablement and construction phase of the development. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Hydrock has used reasonable skill, care and diligence in the design of the remediation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred. Information provided by third parties has been used in good faith and is taken at face value. However, Hydrock cannot guarantee its accuracy or completeness.

2.0 CONCEPTUAL MODEL

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	The site is known as Fallowfield Residential Campus At the University of Manchester.
Site location and National Grid Reference	The site is located east of Chancellors Way, Fallowfield, Manchester, M13 9PL. The approximate National Grid Reference of the centre of the wider site is 385790E, 394180N and the centre of the mound site 386063E, 394249N.

A Site Location Plan (Drawing UOM-HYD-XX-XX-DR-G-001) and a proposed development layout (Drawing P00_00_(0-)_Z0_A_911) are provided in Appendix A.

2.2 Site Description and Site History

The site is broadly rectangular in shape and extends to approximately 1.0 ha. It is currently contained by Heras fencing, and is covered by various species of vegetation including Japanese Knotweed.

According to information derived from the Coffey 2015 report, historically the site was part of an athletic ground including part of a stadium and other associated structures.

RSK made the following comments in their desk study report:

“The most significant contamination issue associated with the site is considered to be the potential of asbestos from any made ground associated with the demolition of the former athletic stadium and also from the redevelopment of the student halls during the 1970’s. Made ground potentially used to raise levels across the site may also have come from nearby sources such as the disused railways and comprise ash, ballast and asbestos amongst other contaminants”.

In the University of Manchester Invitation to Bid document, the following comments were made:

“Due to historical knowledge of the area, members of the University team identified that ‘the mound’ may also be contaminated with asbestos due to building material being disposed of in that location as a result of the demolition of the Harris Stadium. The Harris Stadium, formerly known as the Fallowfield Stadium was an athletics stadium and velodrome in Fallowfield, Manchester, England. It opened in May 1892 as the home of Manchester Athletics Club after it was forced to move from its home next to Old Trafford Cricket Ground. Fallowfield was most regularly used for cycling by the Manchester Wheelers' Club, who held their annual competition there until 1976. In the early 1960’s the University of Manchester bought the stadium and it was demolished in 1994”.

Coffey, in their ground investigation report made the following comments:

"The mounded vegetated area on the eastern side is about 110m length by 60m wide, and rises up to about 3.5m higher than surrounding ground level in the centre. It is covered with trees, about 10 to 15 years old, to provide an area of woodland. Anecdotal evidence indicates the mound may include demolition materials from the former athletic and cycling stadium which may contain asbestos. Stuart Mallinson (Outdoor duty manager / groundsperson) has worked at the Armitage for a very considerable period and he described the mounded area as including asbestos containing material (ACM) which originated from a structure associated with the former Reg Harris cycle stadium. Stuart described his recollection of seeing asbestos sheets being buried in this location; apparently the sheets were marked up with 'do not drill' warnings and they had been painted with black bituminous paint, also he described the earthworks operation to infill this mounded area, which apparently contains numerous concrete blocks from the former cycle stadium, being conducted with a series of fire hoses spraying water over the operation – presumably as a means of dust suppression. The compound area in the north west corner contains a workshop, steel lockups, skips and space to park the maintenance vans".

Historical land use in the surrounding areas was predominantly residential and recreational.

It is understood that the proposed HS2 route is to tunnel approximately 30m below the site.

2.3 Unexploded Ordnance

In general accordance with CIRIA Report C681 (Stone et al 2009) a non-specialist unexploded ordnance (UXO) screening exercise was carried out for the site. Screening against the Zetica regional bomb risk map (Manchester) indicated the site to be in an area where the bomb risk is moderate. A copy of the map is presented in Appendix D. As the remedial works onsite are to be completed at shallow depths and within Made Ground which post-dates 1990, the UXO risk is considered to be low following discussions with a UXO engineer prior to the commencement of works.

Deeper intrusive works may require further risk assessment or UXO mitigation measures.

2.4 Geology

Data from the British Geological Survey (BGS) indicates that ground conditions beneath the site comprises of Devensian Till (clays, silts, sands and gravels) over Chester Pebble Beds (sandstone and mudstone).

The site is not within 500m of an area affected by mining according to historic reports.

Mining is not considered to be a risk to this site due to the depth of the worked seams.

The site is in a low probability radon affected area, as less than 1% of homes are above the Action Level. Radon protection measures are not required in the construction of new dwellings or extensions on any part of the site.

2.5 Hydrogeology

The Glacial Till is classified as Unproductive Strata. The underlying Chester Pebble Beds Formation is a Principal Aquifer. The site is located within groundwater source protection zone 3 (SPZ 3) and there are three licensed groundwater abstractions within 2km of the site.

2.6 Hydrology and Flooding

There are no significant surface water features in the vicinity of the site.

The site is in Flood Zone 1 (low risk from flooding).

2.7 Previous Investigations

Geotechnics on behalf of Coffey undertook two phases of ground investigation in of the wider site in June 2015. Ten of the exploratory hole were completed within the site boundary (BH01/1A, BH02/1A, TPA1 to TPA5, TP01/1A, BHA2, BHA3, BHA3A AND BH6/1A). In general, the following ground conditions were encountered:

- Topsoil – to 0.15m (BH02/1A only).
- Made Ground – to 1.1 to 4.4m below ground level (bgl), comprising mainly clayey sand and gravel or gravelly clay, gravel includessandstone, ash, clinker, and brick with some timber and a slight hydrocarbon odour (BHA3A and BH01/1A only).
- Devensian Till – to 3.9 to 4.50m bgl, comprising soft to stiff slightly sandy clay with occasional gravel.
- Chester Pebble Beds (weathered sandstone) – at 4.05 to 6.08m bgl, comprising fine to medium sand and extremely weak sandstone.

Environmental Essentials excavated 25 trial pits in March 2016 to a maximum depth of 3.5m bgl. The pits were not logged.

Hydrock undertook six shallow hand dug pits in October 2016 to 0.5m. These excavations encountered Made Ground comprising clay, sand, gravel, brick and concrete. The borehole logs for the Hydrock investigation are included in Appendix B.

No groundwater was encountered during the Hydrock investigation, however the historic investigation encountered groundwater at 1m bgl in BH02/1A.

2.8 Presence of Invasive Species

Invasive species in the form of Japanese Knotweed have been identified at the site by our partners JKSL. The location of the stands of Japanese Knotweed are shown on Drawing JK15-0868-001 Rev A, included in Appendix A. This drawing represents a re-survey of the site during the recent (October 2016) investigation works by Hydrock. This drawing supersedes the previous version of this JKSL drawing.

2.9 Demolition of Maintenance Sheds

The northern portion of the site on a lower lying piece of ground is a maintenance depot. It is understood that the maintenance depot will be demolished and decommissioned as part of the remediation works. Further details on the maintenance depot to support the demolition works have not yet been supplied by the client.

3.0 RISK ASSESSMENT REVIEW

3.1 Human Health Risk

3.1.1 Context

This section presents a summary of previous investigations regarding the risk to Human Health posed by substances present in the soils at the site. Where data is available, two human health risk scenarios have been calculated, these are: residential without plant uptake (1% SOM has been used as it is the most conservative), and commercial (1%).

The data has been split into two averaging areas comprising:

- Material above the proposed formation level (>44.8m AOD); and
- Material below the proposed formation level (<44.8m AOD)

The data set making up the samples from above the proposed formation level in the mound of material comprises 36 samples collected by Geotechnics/Coffey, Environmental Essentials and Hydrock.

The data set making up the samples from below the proposed formation level comprises 3 samples collected by Geotechnics/Coffey.

Samples tested for asbestos content (5 No.) from Made Ground below the formation level are shown on Drawing UOM-HYD-XX-RMS-DR-G-0006 in Appendix A.

3.1.2 Risk Estimation

The data set for each chemical determinand has been assessed for the presence of potential outliers (based on the conceptual model) and no outliers have been removed.

In line with the guidance provided by the CIEH (May 2008) the 95th upper confidence level on the true mean (US_{95}) has been calculated from the sample data. Data have been assessed using the one-sample t-test or the one-sided Chebychev Theorem, as appropriate to the distribution and number of samples.

Based on a US_{95} exceedance of the GAC, the pervasive chemicals of potential concern which require further assessment are summarised in the following tables.

Table 3.1: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health) in materials above the proposed formation level.

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	US_{95} (mg/kg)	No. Samples Exceeding Generic Criterion
Residential without plant uptake land use scenario							
Benz(a)anthracene	5.5		36	0.62	34.15	11.84	15

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	US_{95} (mg/kg)	No. Samples Exceeding Generic Criterion
Benzo(a)pyrene	1.5	LQM/CIEH + CLEA 1.07	36	0.57	41.21	11.51	34
Benzo(b)fluoranthene	11		36	0.75	43.04	14.38	10
Dibenz(a,h)anthracene	1.3		36	0.08	6.06	1.67	6
Indeno(1,2,3,cd)pyrene	6.3		36	0.12	24.61	6.51	3
Commercial land use scenario							
There are no contaminants of concern there the US95 exceeds the GAC for commercial end use.							

With regards to the samples tested below the proposed formation level due to the small data set, the individual analytical results have been compared with the relevant GACs and are summarised in Table 3.2 below.

Table 3.2: Chemicals where the individual values are above the GAC in soils of Potential Concern for Which Further Assessment is Required (Human Health) in Materials below the proposed formation level.

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion
Residential without plant uptake land use scenario						
Lead	310	C4SL	3	84	1579	1
Benzo(a)pyrene	1.5	LQM/CIEH + CLEA 1.07	3	0.31	3.39	2
Commercial land use scenario						
There are no contaminants of concern there the US95 exceeds the GAC for commercial end use.						

3.1.3 Petroleum Hydrocarbons

Where testing using the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) methodology has been undertaken, the results have been included in the assessment undertaken above and there are no exceedences of the GACs.

Two samples were tested for total petroleum hydrocarbon content (non TPHCWG methodology) in the Geotechnics/Coffey investigation from BH01/1A at 1m depth and BH02/1A at 1m depth. These recorded a total TPH value of 270mg/kg and 3,441mg/kg respectively. There is no GAC for total TPH to be able to make a full assessment, however the values recorded at BH02/1A in conjunction with the observations during drilling (slight hydrocarbon odour) may be suggestive that further assessment is necessary. The levels recorded at BH01/1A and the observations in the borehole log do not suggest a significant issue here.

Environmental Essentials tested 24 soil samples for total TPH content (non TPHCWG methodology), all samples were taken from 0.5m. There is no GAC for total TPH to be able to

make a full assessment. No logs were provided to be able to correlate the results with site observations. The results ranged from 26 to 321mg/kg, which is not considered to suggest a significant petroleum hydrocarbon issue at the locations tested.

3.1.4 Asbestos in Soils

The Geotechnics/Coffey Phase 2A investigation screened two samples for asbestos presence, BH01/1A at 1m depth and BH02/1A at 1m depth. No asbestos was detected in BH01/1A. Asbestos described as chrysotile fibre bundles was detected in BH02/1A. The sample was not quantified.

The Geotechnics/Coffey Phase 2B investigation screened 15 samples for asbestos presence, three samples tested positive and were quantified. TPA3 at 1.5m was recorded at <0.001, TPA3 at 3.9m 0.005% and BH06/1A at 0.2m 1.888%. Chrysotile insulation debris was present in BH06/1A and fibre bundles in TPA3 at 1.5m.

Environmental Essentials screened 74 soil samples for asbestos presence. 16 tested positive for asbestos, 14 for chrysotile and two for amosite. These 16 samples were subsequently quantitatively tested by gravimetric methods. All contained asbestos at a concentration of less than 0.001% with the exception of three samples. These three samples contained chrysotile in the form of cement or loose fibres, and were from trial pits located towards the centre and northeast of the site (see Table 3.1 below).

The Hydrock investigation identified asbestos in four out of six soil samples. These four samples were subsequently quantitatively tested by gravimetric methods. All contained asbestos at a concentration of less than 0.001%. The laboratory test results are included in Appendix B.

The locations of all the samples positively identified for asbestos content are shown on Drawing UOM-HYD-XX-RMS-DR-G-0005 included in Appendix A.

Table 3.3: Samples with asbestos concentrations above the laboratory detection limit <0.001%

Sample location	Sample depth (m bgl)	Concentration (%)	Type of asbestos
TP2	0.50	3.104	Chrysotile cement
TP4	0.50	0.580	Chrysotile cement
TP14	2.50	0.002	Chrysotile loose fibres
TPA3	3.90	0.005	Chrysotile fibre bundles
BH06/1A	0.20	1.888	Chrysotile insulation debris

The potential presence of asbestos in soils at concentrations greater than 0.001% w/w is considered to be a risk that requires mitigation.

Unlike most chemical contaminants there are no GAC values to provide a straightforward assessment of the risk. CIRIA C733 (2014) provides guidance on the management of risk in soil and Made Ground which contains asbestos. The key issue is the propensity for asbestos in the

ground to be released as fibres and (perhaps other than where gross asbestos contamination is found, such as bundles of lagging) properties such as the exposure of such soils to wind and dampness of the soil are the critical issues.

In assessing the risk and determining an appropriate remedial strategy, CIRIA 733 recommends:

- Overall compliance with Control of Asbestos Regulations (CAR) 2012;
- Identification and evaluation of all reasonably likely exposure routes;
- Development of an appropriate remediation strategy.

The laboratory testing certificates indicate that, as well as quantifiable loose fibres, quantifiable levels of chrysotile cement were identified in some samples of Made Ground.

The two main potential exposure routes are:

- Wind-blown dusts during earthworks; and
- Exposure of site end users of the development to soils containing asbestos.

Measures to mitigate the risks associated with asbestos are described in Section 4.0.

3.1.5 Testing of bulk samples for asbestos content

In the Geotechnics/Coffey Phase 2B investigation asbestos cement was proven in TPA1 at 2.5m and TPA5 at 2.2m and TP04/1B.

Environmental Essentials took 15 bulk samples of suspected asbestos containing materials in February 2016. The samples were described as cement debris and were found on the site surface. All the bulk samples were tested and were found to contain no asbestos containing materials.

Environmental Essentials took 11 further bulk samples of suspected asbestos containing materials in February and March 2016 during the trial pitting exercise from soils beneath the site surface. Eight of these were described as cement debris and were determined to be asbestos cement containing chrysotile. Two of these were described as bitumen debris but were found to contain no asbestos containing materials. One of these was described as a floor tile, which was found to contain no asbestos containing materials.

The samples where asbestos containing materials were encountered are shown on Drawing UOM-HYD-XX-RMS-DR-G-0005.

3.1.6 Asbestos in Soils – Licensing Aspects

Hydrock has undertaken an assessment of the likely need to notify the HSE of the works and whether the works need to be undertaken by a licensed contractor. The assessment has been undertaken using the CL:AIRE (2016) endorsed Decision Support Tool (DST) for CAR2012 Work Categories developed by the Joint Industry Working Group for asbestos in soils.

In summary:

- Occasional 'clearly identifiable pieces' of ACM were identified in the form of asbestos cement;
- All visible asbestos recorded in the trial pit logs is asbestos cement;
- Very low levels of loose fibre were detected in a number of samples, however, quantification confirmed concentrations of <0.001% in the majority of samples with the exception of one sample (TP14 at 0.002%); and
- Laboratory analysis of a single sample from BH6/1A identified potentially licensable material in the form of insulation debris, the sample was quantified with a result of 1.888% asbestos. It should be noted that this was not identified during the excavation works.
- Where encountered the asbestos was predominantly Chrysotile (white) fibres.

Based on the above and use of the DST (see Appendix C for full output) it is recommended that a 5m by 5m area around the location of BH6/1A is cordoned off and treated as a 'hotspot' as remediation works in this area may be licensed and required to be completed by a licenced contractor.

The hotspot area should be further investigated by a suitably qualified consultant, the results from this investigation will provide the contractor information to confirm the requirement for notification and licensing.

Based on the works undertaken and the use of the DST, Hydrock considers that works on the remainder of the site would be a non-notifiable non-licensed remediation project with regard to asbestos in soils

However it is the remediation contractors responsibility to determine if the works should be undertaken by a licensed contractor and if the HSE should be notified of any part of the project.

Hydrock advises that it would be prudent for the contractor undertaking the earthworks to have an agreement in place with a licensed asbestos contractor and they have the appropriate permits and approvals in place should they be required if previously unforeseen licensed work is necessary, so as to avoid programme delays later. It should be noted that even so, there would be up to 14 days delay after notification of the HSE via an ASB1 submission.

3.1.7 Airborne Asbestos Monitoring

Environmental Essentials undertook airborne monitoring on ten occasions in February and March 2016 in accordance with the HSE methodology HSG 248. During the monitoring, the maximum number of fibres recorded was two. The result was below the detection limit of the monitoring methodology of less than 0.01f/ml. On six occasions, the results were <0.01f/ml. On four occasions, the level indicated was <0.05 to <0.08f/ml

Lucion Environmental (incorporating Redhills) on behalf of Hydrock undertook airborne monitoring in October 2016. During the monitoring, the maximum number of fibres recorded was 7.5 the monitoring result was 0.01f/ml. On eight occasions, the results were <0.01f/ml. On two occasions, the level indicated was <0.02 to <0.03f/ml. Lucion also undertook two tests using scanning electron microscopy techniques which allow differentiation of different fibre types and also can be quantified to a much lower limit of detection <0.0005%. No asbestos fibres were

recorded and consequently the quantification of both tests is <0.0005%. The Lucion test results are included in Appendix B.

All air monitoring undertaken has proven that the investigation works were below the HSE control limit.

3.1.8 Other Substances

No other substances are present at concentrations in excess of their relevant GAC values for the 'Residential Without Plant Uptake' risk scenario.

3.2 Plant Life

No assessment was carried out regarding risks to plant life during the historic ground investigations.

However, the physical nature of the Made Ground across the majority of the site, which is understood to be demolition rubble, means that it would not provide a suitable growing medium and would need to be replaced by imported, clean topsoil and subsoil where required for any landscaping.

3.3 Controlled Waters

The risk to controlled waters is not considered to be a significant issue as significant levels of mobile contamination have not been identified and the Principal Aquifer (the Chester Pebble Beds) is separated from the Made Ground underlying the site by two metres of likely low permeability Glacial Till, and these strata are unlikely to be in hydraulic continuity. The site is in source protection zone 3 (SPZ 3), and there are no surface water features in the vicinity of the site.

3.4 Summary

A summary of the findings of the generic risk assessment are included in Table 3.4 below.

Table 3.4: Pollution Linkages

Receptor Group	Unacceptable Pollution Linkages	
	Hotspots	**Pervasive**
Human health	Nil	The presence of asbestos and PAHs within the Made Ground.
Plant Life	Nil	An imported growing medium will be required in areas of landscaping as the Made Ground is physically unsuitable as a growing medium.
Groundwater	Nil	
Japanese Knotweed	Presence of Japanese Knotweed needs treatment or removal prior to redevelopment of the site.	

4.0 REMEDIATION OPTIONS APPRAISAL

4.1 Context

This section of the report contains a review of the remedial options to mitigate the risk issues that are the outcome of the assessment of the site as summarised above and presented in more detail in the historic ground investigation reports listed in section 1.0.

The remediation solution needs to take into account the need to mitigate key risks and also needs to be integrated with a cut-and-fill exercise to achieve finished levels agreed with the Client. However, in accordance with CLR11 it is necessary to undertake a review of remedial options in order to derive a strategy that presents the most sustainable solution.

4.2 Key Risk Drivers

The key risk drivers are:

- the risk to human health posed by the elevated concentrations of PAHs in the Made Ground;
- the risk to human health posed by the presence of asbestos fibres in the Made Ground; and
- the presence of invasive weeds in the form of Japanese Knotweed.

4.3 Remediation Options Appraisal

4.3.1 Remediation Objectives

The objectives of the remediation works are as follows:

1. to break the linkage between the soils containing widespread presence of asbestos fibres, and future site users;
2. to break the linkage between soils containing the widespread presence of PAHs; and
3. to remove Japanese Knotweed, both the plants themselves and the impacted soils from beneath and surrounding.

4.3.2 Screening

An initial screening process is required to consider the available remedial techniques based on the following key criteria:

- Effectiveness. The strategy must be effective in the removal of contamination linkages.
- Practicality. The strategy has to have been successfully used in similar situations and be readily available within the UK market. Novel solutions or those still in the research stage are not considered here.
- Durability. The strategy needs to be durable and not reliant on ongoing maintenance to continue being effective.
- Relative Cost. The strategy must not be excessive in terms of cost.

- Relative Operational Time: The strategy should work in a feasible and realistic time scale.
- Sustainability. More sustainable options are preferred.

Table 4.1 summarises the accepted remedial techniques readily available in the UK and assesses each against the six key parameters listed above.

In the first instance, the feasibility of each of the listed remedial options is assessed in terms of effectiveness at treating the contamination, which is broken down into; effective (Y), partially effective (P) or ineffective (N).

The listed techniques are then assessed in terms of relative cost ranging from negligible cost (£) through moderately expensive (££) to prohibitively expensive (£££+).

Timescale over which the remediation technique is operational has been broadly assessed in units of weeks, months, years and decades. If, for example, a given technique is only effective over a period in the order of years to decades, then its overall feasibility is diminished.

Table 4.1: Applicability of Remediation Options and Initial Assessment (screening)

Remedial Activity	Effective for contamination present?	Relative Cost	Relative Operational Time	Comments (Practicality / Sustainability / Durability)	Feasibility (Y- Yes, N – no)
Civil Engineering Methods					
Engineered Cover System	Y	£	Weeks	Will prevent contact between future site users and deeper soils and break the S-P-R linkage for as long as the system is in place.	Y
Excavation and Disposal	Y	£££	Weeks	Will effectively remove the source of the contamination. However, is less sustainable and more expensive compared to other feasible options.	Y
Materials Management – Controlled Excavation and Stockpiling for Re-Use of Suitable Materials	Y	£	Weeks	Some re-use of materials to satisfy the 'fill' requirement is required in accordance with a materials management plan (MMP).	Y
Biological Methods					
Not applicable to soils in this instance					
Chemical Methods					
Not applicable to soils in this instance					
Physical Methods					
Soil Washing	Y	£££	Months	Large scale plant and equipment in a limited space; need to treat process streams (water, sediment) and route to appropriate off-site disposal, as required. Will potentially result in a significant proportion of soils, which are geotechnically unsuitable without extensive treatment.	N - does not create a new material that is suitable for use
Hand Picking	Y	£	Weeks	Hand picking visible ACM fragments using trained operatives during excavation works.	Y – if fragments of bonded asbestos are unexpectedly encountered

Remedial Activity	Effective for contamination present?	Relative Cost	Relative Operational Time	Comments (Practicality / Sustainability / Durability)	Feasibility (Y- Yes, N – no)
Stabilisation and Solidification					
Hydraulic Binders	Y	££	Weeks to Months	Mixing of additives into soils to bind contamination thereby minimising migration from soil to dissolved phases. Also serves as a treatment for geotechnical improvement. Additives may include binding agents for organics and cementitious materials.	N – stabilisation of the upper soils would serve to lock in pervasive contaminants such as PAH. However, widespread disturbance of the soil mass is not recommended where the potential for mobilisation of asbestos fibres is present. Also, there is currently no requirement to stabilise the soils for geotechnical reasons.

4.3.3 Options Appraisal

As described in 4.3.2 certain technologies were rejected on the basis of ineffectiveness, excessive cost, sustainability, or those which are required to operate in timescales of years or greater. In this case the required approach emerges as a straightforward interpretation of the appraisal undertaken, that is:

- off-site disposal of surplus materials

As the exercise is predominantly an earthworks exercise, the timescales are relatively quick allowing for rapid completion of the remediation objectives and this remediation solution could be designed and implemented within a matter of a few months.

The likelihood is that in HSE terms the work would be considered to be Non Notifiable Licensed Work and as no treatment is involved (other than the possibility of minor hand-picking) it is unlikely that an Environmental Permit will be required. Both these issues should be confirmed with the regulatory authorities prior to work commencing.

4.4 Proposed Earthworks

Hydrock has undertaken a basic earthworks assessment based on the topographical information provided by the Client by JCA Limited (referenced below) and a provisional formation level (500mm below surrounding ground levels). The formation level has been selected based on an average surrounding ground level of 45.3mAOD -500mm, which gives a formation level of 44.8mAOD.

- The approximate site area is 9,985m2
- The approximate cut required to remove the mound and reach the formation level of the surrounding ground level -500mm is 17,800m3, with an approximate fill required of 1,200m^3 to provide a level development platform.

4.5 Waste Classification

As detailed in the EA Technical Guidance on Hazardous Waste Classification (WM3), if the waste contains fibres that are free and dispersed then the waste will be hazardous if the waste as a whole contains 0.1% or more asbestos. Also, Where the waste contains identifiable pieces of asbestos containing material (i.e. any particle of a size that can be identified as potentially being asbestos by a competent person if examined by the naked eye), then these pieces must be assessed separately. The waste is hazardous if the concentration of asbestos in the piece of asbestos containing material is 0.1% or more. The waste is regarded as a mixed waste and classified accordingly.

Hydrock inputted all the soil chemical test results from the samples analysed by Geotechnics/Coffey, Environmental Essentials and Hydrock for metals, PAH and TPH into the HazWasteOnline module (compliant with WM3). In total, 41 samples were inputted. Of these, 27 were deemed to be non hazardous, 12 were deemed to be potentially hazardous and two hazardous (TPA4 at 0.25m bgl and BH02/1A at 1m bgl). However, it should be noted that asbestos content has not been taken into account in this assessment and therefore two further

samples that were deemed non hazardous in the assessment would be deemed hazardous due to asbestos content above 0.1% (TP2 at 0.5m bgl and TP4 at 0.5m bgl). Further assessment of those samples deemed to be potentially hazardous would need to be undertaken prior to sentencing for disposal.

The assessment above included only those samples that are above the proposed formation level of 44.8m AOD which are designated for disposal and not those that are below the proposed formation level. The assessment is subject to change if the formation level changes.

Sample BH06/1A at 0.2m bgl would also be deemed to be hazardous waste due to asbestos content above 0.1% and while this will form part of the remedial works the sample lies below the proposed formation level of 44.8m AOD.

5.0 REMEDIAL STRATEGY IMPLEMENTATION

5.1 General Requirements

Remediation will be undertaken such that the site is suitable for its proposed use as a residential campus for housing students.

The required standard of remediation will be achieved through:

- the careful management of the Made Ground, which has been demonstrated to contain asbestos fibres and PAH; and
- removal of Japanese Knotweed, both the plants themselves and the surrounding impacted soils.

5.2 Summary of Remediation Proposals

Based upon the findings of the previous site investigations and risk assessments and the above remediation options appraisal, the following works will be undertaken to create a site which is suitable for its proposed end use.

The following remedial activities will be undertaken to ensure the site is *suitable for use* (SFU) for the defined residential end use. Sequencing has not yet been confirmed by the Contractor.

- Task 1: Appointment of an appropriately experienced and qualified remediation contractor.
- Task 2: Project setup and management including liaison with the local authority, Environment Agency, Health and Safety Executive and interested stakeholders within the University of Manchester estate. Where necessary, appropriate permits / licences / consents and approvals will need to be sought and granted.
- Task 3: Air quality boundary monitoring for dust and asbestos, before earthworks commence and during the earthworks.
- Task 4: Demolition / decommissioning of the maintenance compound at the north of the site.
- Task 5: Disposal of Japanese Knotweed impacted materials.
- Task 6: Disposal of asbestos impacted materials.
- Task 7: Excavations to the required formation level to create the development platform. Disposal of excess soils to appropriate off-site facilities.
- Task 8: Supervision, verification and reporting.

The Principal Contractor will be responsible for ensuring all working areas are cleared of public utilities or infrastructure and for preventing damage to these services and infrastructure.

The works are to be overseen by a suitably qualified consultant who is to complete the necessary verification works.

To enable the discharge of planning conditions, the Earthworks Contractor shall provide all the information detailed in this remediation strategy and any further information for the verification report.

All works need to be undertaken in accordance with the remediation strategy outlined in this document.

All remediation works are to be overseen by suitably experienced site staff and a site watching brief or periodic visits will be made by suitably qualified persons to undertake the necessary verification works described.

5.3 Task 1: Contractor Appointment

The Principal Contractor must manage the risks in accordance with their legal requirements and will need to prepare appropriate health and safety documentation and obtain appropriate approvals, licences, consents and permits prior to commencement.

The Contractor shall have in place at the start of the contract, work procedures designed to ensure the Contractor is working in full compliance of all Health and Safety requirements (including, but not exclusively CAR 2012) and that control measures in place are sufficiently robust to prevent release of airborne asbestos fibres into the surrounding environment.

Whilst appropriate measures are required for all contaminants present, the Contractor should note the additional details provided below with regards to asbestos in the soils:

- Asbestos is a hazard to Human Health when airborne fibres are inhaled. Asbestos containing material (ACM) that is in a bound form (such as asbestos cement tiles) is not hazardous where the asbestos fibres cannot become airborne. However, if lagging is present or the ACM is broken or crumbled in a dry condition the asbestos fibres could become airborne and could then be inhaled. When soil with asbestos is covered by hardstanding, buildings or a cover of clean soil or when the soil is kept damp, the asbestos fibres are less likely to become airborne and the risk is greatly reduced.
- The Health and Safety at Work Act 1974 forms the basis of health and safety legislation in in the UK. In addition, the Control of Asbestos Regulations 2012 (CAR 2012) applies throughout the UK. CAR 2012 applies if land has significant asbestos content and is relevant to any work conducted on asbestos contaminated land.
- CAR 2012 defines a “control limit” of 0.1 fibres per cubic centimetre of air averaged over a continuous period of 4 hours. This limit is not risk based and may be much higher than the levels for control of environmental pollution.
- CAR 2012 applies even where exposure to asbestos of employees is sporadic and of low intensity and where exposure to asbestos of any employee will not exceed the control limit. In addition, the work must be of short non-continuous activities where non-friable materials are handled, or removal without deterioration of non-degraded materials in which asbestos fibres are firmly linked in a matrix.
- Lagging, broken fragments of asbestos and loose fibres have the potential to release airborne fibres in dry conditions. In addition, as the ACM and asbestos fibres have been contained in the soil for many years, the likelihood is that they would be degraded to some

extent. However, the asbestos fibres detected at the site are within a soil matrix and if this is kept damp, this should assist in minimising the risk of the release of airborne fibres.

- Given the above factors, it is possible that the works being undertaken would not be exempt from CAR 2012 licensing requirements. Therefore, until proven otherwise, Hydrock considers that the contractor should treat the work involving handling of the soils as licensed work as defined in CAR 2012.

Hydrock Consultants Ltd will provide a watching brief during the earthworks and compile and issue the verification report.

5.4 Task 2: Project Set Up

Prior to commencement of site activities, detailed planning of the project should be undertaken including liaison with the regulators and interested stakeholders. Detailed risk assessments and method statements (RAMS) will need to be developed for approval by the client and others potentially including the local authority, Environment Agency, HSE and the University of Manchester Asbestos Manager.

The project is notifiable, under Construction, Design and Management (CDM) Regulations (2015).

Hydrock considers that this is a non-notifiable, non-licensed project with regard to asbestos in soils, with the exception of the area around BH06/1A as described in 3.1.6 above.

The Contractor will be required to provide, operate and maintain an appropriate decontamination facility throughout the works.

5.5 Task 3: Air Quality Boundary Monitoring for Asbestos and Dust

Asbestos is known to be present in the Made Ground. consequently, boundary dust monitoring and air monitoring will be undertaken before site works commence to establish baseline conditions, this is to include monitoring for airborne asbestos fibres . This monitoring will continue during earthworks to determine if during the works there is evidence of an increased risk of release of fibres to the air / surface soils.

Boundary air monitoring results during works shall be compared with acceptable maximum standards set by the HSE. For asbestos these air monitoring procedures and limits are given in HSG 248 entitled “Asbestos: The analysts’ guide for sampling, analysis and clearance procedures” and CAR 2012. The limit used is governed by the levels stated in the above guidance documents and the accuracy of the testing used.

However, for asbestos Hydrock recommend using the most stringent limit set by the HSE. Asbestos air monitoring results are acceptable only if they fall below this limit and are as low as reasonably practicable. Exposure from work activities involving asbestos must be reduced to as far below the control limit of 0.1f/ml as possible. If the control limit is exceeded or readings are getting close to 0.1f/ml then further control measures will be required to limit fibre release, this could include additional wetting down or misting.

5.6 Task 4: Demolition / Decommissioning of the Maintenance Compound

The Contractor will assess the existing information for the maintenance compound at the north end of the site including the pre-demolition asbestos survey and undertake the works in accordance with an agreed strategy.

5.7 Task 5: Earthworks Specifically Involving Japanese Knotweed Removal

The Contractor will remediate the areas of Japanese Knotweed located on the mound (within the development boundary) as shown on drawing JK15-0868-001 Rev A.

Initially, a detailed inspection of the ground will be undertaken to determine the location of the Japanese Knotweed. The Contractor will remove above ground stands of Japanese Knotweed and other vegetation and dispose of off-site.

Subsequent to this, there will be a joint approach between the Japanese Knotweed specialist and the asbestos specialist (further details on asbestos specifics in Task 6 below).

After a surface inspection by both experts, areas of obvious suspected asbestos contamination and Japanese Knotweed will be delineated. Handpicking operations for the removal of ACM will commence under controlled working conditions (along with personal and boundary airborne monitoring) prior to removal of Japanese Knotweed rhizomes.

An excavator will take a shallow scrape over the area in order to expose the rhizomes more clearly. Once identified these will be highlighted using spray paint or a similar method if deemed necessary. Alongside this there will also be a watching brief for ACM throughout the exposure of the Japanese Knotweed rhizomes and personal and boundary airborne monitoring.

The Contractor will then carry out removal of all rhizome from the areas highlighted on the associated drawing, within the development boundary, chasing the root structure until fully removed. Stringent methods (includes a clean site policy) will be implemented and adhered to, to avoid any spreading of contaminated material across the site during excavation and removal from site.

Specifically the excavator used to remove the rhizome, will remain in the marked area until completion, upon which the vehicle is fully decontaminated, as is any machinery used to move material or any vehicle that may enter a contaminated zone.

Dust / fibre suppressant procedures will be implemented during the excavation works relating to potential asbestos presence.

Where rhizomes extend beyond the proposed development boundary, a vertical root barrier (an appropriate geo-textile membrane or similar) will be installed along the boundaries within these locations, to prevent rhizomes migrating back into the remediated areas. The vertical root barrier will be installed up to a depth of 2m, extending up to 7m away from the nearest recorded Japanese Knotweed surface growth.

Japanese Knotweed impacted materials will be disposed of to an appropriately licensed waste facility.

5.8 Task 6: Earthworks Specifically Relating to Asbestos

It is Hydrock's opinion that the asbestos contamination identified thus far is sporadic however, could be present at any location within the mound, as shown on Drawing UOM-HYD-XX-RMS-DR-G-0005. The actual products identified in the various reports (predominantly asbestos cement and low levels of loose fibre (All ≤0.02%w/w)) can be successfully and safely excavated, processed and remediated using simple precautionary control measures, site hygiene and appropriately trained site operatives. In accordance with the CAR2012, we would categorise the work to be non-notifiable, non-licensed works as the materials identified are not highly fibrous, and are unlikely (given our experience) to give rise to significant fibre release during the work.

All works shall be done with suitably trained staff working to a site specific method statement written to minimise the potential for fibre release. All working practices should be conducted in accordance with the CAR2012 and current industry guidance.

Specifically, there are 2 locations where the laboratory reports asbestos content to be greater than hazardous waste threshold (TP02 & TP04 both >0.1) for bound asbestos cement. In these areas Category B or C trained asbestos operatives will be used to hand pick visible contamination to allow stockpiling and testing to be undertaken post betterment of the surrounding soils. Experienced operatives will be used with sufficient information, instruction, training and supervision to ensure any work carried out with asbestos products is in accordance with CAR2012 and current industry guidance when working with asbestos in soils.

In addition to this, there is one location where asbestos containing insulation lagging has been encountered at 1.888%. As described in Section 3.1.6. It is recommended that a 5m by 5m area around the location of BH6/1A is cordoned off and treated as a 'hotspot' as remediation works in this area may be licensed and required to be completed by a licenced contractor. The hotspot area should be further investigated by a suitably qualified consultant, the results from this investigation will provide the contractor information to confirm the requirement for notification and licensing.

Appropriate mitigation measures (by suitably trained operatives) will need to be designed and put in place by the Contractors during excavation, processing, screening and placement of Made Ground soils to remove identifiable ACM and mitigate the risks of asbestos fibres becoming airborne.

Task specific risk assessments and method statements shall be in place, and risks and required mitigation measures communicated to all relevant personnel prior to the works commencing. Appropriate PPE and if required RPE shall be provided and utilised.

With regards to the excavation of soils and as far as reasonably practicable, the removal of gross ACM is required. It should be noted that:

- In accordance with CAR 2012 (Regulation 16) there remains a duty of the Contractor to 'prevent or reduce the spread of asbestos anywhere where work is being carried out under their control'. Where complete prevention is not reasonably practicable (this would constitute such a case), the regulation requires the Contractor to reduce to the lowest level reasonably practicable the spread/potential for fibre release of asbestos from any place where work under the Contractor control is carried out.

- CAR 2012 notes that the Contractor should select and use work methods that will reduce the disturbance and release of asbestos fragments and fibres to minimise the risk of spread, e.g. by removing items intact or whole and by using dust suppression techniques. ACMs must never be left loose or in a state where they can be trampled on or spread. All asbestos waste should be bagged or wrapped promptly after removal and the waste should be removed from the work area regularly.
- Additionally, where enclosures are not used (and this is one of those instances, as it is not reasonably practicable to do so), the Contractors risk assessment should establish what will be required to make sure that, as far as is reasonably practicable:
    - the spread of asbestos is prevented (airborne fibres and asbestos in soils);
    - people not involved in the work are excluded from the area;
    - the work area is totally cleaned after work is completed.
- For the proposed activities, there are two activities which could release fibres 1) excavation of soils containing gross ACM and 2) placement of soils containing gross ACM. It reasonably practicable for visible 'gross'/highly fibrous materials to be handpicked and doubled bagged at the point of excavation. As this material has then been removed, and the potential to liberate fibre on the second activity (placement) has thus been alleviated or reduced to as lower level as reasonably practicable.
- As such, in addition to a surface inspection and pick, hand picking of gross ACM is required during excavation and placement activities to ensure that as far as reasonably practicable all visible gross ACM has been removed.

As licensable ACM (asbestos cement and lagging) has been detected during the site investigation, all staff undertaking the hand picking must be suitably qualified to handle licenced ACM. The Contractor is to confirm with Hydrock the qualifications and the suitability of staff prior to commencement. It should be noted that in Hydrock's opinion, Asbestos Awareness is not an appropriate level of competency to pick licenced ACM.

It is likely the hand picking operations will be relatively simple. The asbestos is bound within a cement matrix and our methodologies are written to ensure minimal disturbance occurs while allowing the picking operation to attain soils <0.1%w/w which we hope there is a potential to retain rather than dispose of as hazardous waste. All other samples are <0.001-0.002 but the majority are devoid of asbestos. 61/82 soil samples contained 'no asbestos detected' (NAD) displaying that while there is a potential to encounter asbestos cement fragments, they are sporadic throughout the mound. Our historical knowledge and experience working on a similar site (with similar issues) have allowed us to develop a robust methodology for dealing with soils containing low levels of loose fibre and/or sporadic asbestos fragments in accordance with CAR2012. Air monitoring (Including: personal, reassurance, boundary & scanning electron microscopy) undertaken on these sites has confirmed that our methodologies are an appropriate and reasonably practicable solution to dealing with such contamination safely.

All works undertaken in the soils would need basic asbestos control measures in terms of general nuisance dust suppression, a suitably trained watching brief and good site hygiene (liable to be a primary decontamination bay and boot wash). All plant operatives involved with the disturbance of the soil will be asbestos awareness trained (minimum) conducted through

our UKATA accredited course which is written specifically for operatives involved with asbestos in soils. Ground operatives will be trained to a minimum of Category B 'Working with Non-Licensed Products' enabling them to undertake hand picking operations of non-licensed products as they are encountered. These ground operatives will also act as a watching brief during the excavation works to assess the soils for the potential for licensed asbestos products with the potential for high levels of fibre release. All risk assessment compiled for 'Non-Licensed' work are written with a Health and Safety hold point which stipulates that if highly fibrous material is encountered during works all disturbance is halted to assess the material, reassess control measures and if necessary, seek assistance from a licensed contractor..

The majority of the samples of loose fibre are chrysotile, so it is likely most of the contamination is arising from asbestos cement products. However, there are two detections of amosite and one crocidolite so there may be some licensed asbestos that is as yet unidentified.

As the exact ground conditions can currently only be estimated from the investigation data, initially the works shall commence with full asbestos personal protective equipment in place. This will include for all ground staff at the point of excavation:

- appropriately face fitted P3 filled ori-nasal half mask;
- category 3 Type 5/6 protective coveralls;
- steel toe capped washable footwear (Wellingtons);
- disposable nitrile gloves; and
- eye and ear protection (if required).

As works progress and a full assessment of the level of asbestos contamination can be made, control measures may be reassessed through reviews of the risk assessment and air monitoring data. Ori-nasal half masks can put significant strain on the respiratory system and the assessment will be made in conjunction of factors from CAR2012, HSG53 'Respiratory protective equipment and work' and other site influences such as movement of heavy plant during excavation.

We would advise that a small lockable asbestos waste skip will be required onsite for double bagged asbestos waste from hand-picking operations.

5.9 Task 7: General Earthworks

5.9.1 General

The Principal and Main Contractor will manage works in accordance with relevant legislation.

5.9.2 Control of Risk from Dust Emissions

Dust Suppression

To reduce the potential for the generation of dust, it is recommended that double handling of soils is kept to a minimum and soils are disposed of by direct transfer to wagons and measures to minimise dust (e.g. wind or plant / vehicle movements) should be undertaken.

Appropriate risk assessment and mitigation measures should be in place throughout the development. As a minimum, this should include damping down of the site surface, excavations and stockpiles to prevent the generation of dust, additional measures may include:

- stockpiles (if any are created) should be kept to a minimum to reduce 'wind whip' causing potentially hazardous material to be blown from the pile;
- air quality and dust monitoring stations will be set up and monitored by the contractor to record the dust concentrations during the works;
- stockpiles (if any are created) shall be placed on a suitable and robust polythene membrane or hardstanding to prevent any cross contamination;
- care should be taken not to pierce the sheeting when placing the bulky elements of the material;
- stockpiles (if any are created) should be dampened down or covered to prevent dust - whilst the Contractor, based on site constraints, should make the final choice, the options may include covering with plastic/polythene membrane, or by a layer of clean soil material;
- plant will be appropriately loaded and covered to prevent spillages;
- the drop distance from excavator bucket to stockpile/process plant will be kept as short as reasonably practicable to reduce dust; and
- appropriate signage should be displayed so that site workers/visitors are alerted to the potential hazards associated with the material to be stored on site, and roadways within the site will be kept moist by spraying from a water bowser.

5.9.3 Vehicle Movements

Risks associated with the transport of soils that potentially contain asbestos fibres, such as dust emission, should be appropriately managed.

The works could create mud from vehicle movements and subsequent tracking off site on vehicle tyres. This will be managed during the works to prevent off site mud transfer. Measures to control these issues may include the provision of a wheel wash facility and where necessary a mechanical road sweeper to further ensure that the road is kept clean.

5.9.4 Personal Monitoring

As a matter of good practice, construction workers and services personnel should follow guidance stated in 'HSG 66 Protection of Workers and the General Public during Redevelopment of Contaminated Land' during development works. Adequate standard personal protective equipment and the implementation of basic hygiene measures will be necessary.

Ground workers and sub-surface maintenance workers should be made aware of the possibility of encountering contaminants within soils or groundwater at the site through 'toolbox' talks.

Safe working procedures should be implemented in accordance with CIRIA132, good standards of personal hygiene should be observed, and appropriate levels of PPE provided and utilised.

Eating, drinking and smoking should be strictly prohibited in the development site other than in designated mess areas.

Groundworkers are to have appropriate personal UKAS accredited air monitors to monitor for the presence of airborne asbestos fibres, along with access to a combination of suitable personal protective equipment (PPE) and respiratory protective equipment (RPE) for immediate use if required.

Should elevated levels of airborne asbestos fibre be recorded during personal monitoring, the work item or area shall be suspended and the area affected will be declared a total exclusion zone, the perimeter of which being 3m beyond the limit of the asbestos. A further 3m safety zone shall be established and clearly marked. The Principal Contractors Site Manager shall be immediately informed, who will consider if further mitigation measures are necessary, e.g. whether materials need to be further covered. The Site Manager will inform the client within 24 hours of the encountering suspected asbestos materials / the airborne asbestos fibres recorded and agree appropriate measures necessary to deal with the issues.

5.9.5 Off-site Disposal of Waste Material

Any material excavated on site may be classified as waste and it is the responsibility of the holders of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way it can cease to be classed as waste for a particular purpose. All arisings should be regarded as contaminated unless proven otherwise.

Any Made Ground to be removed from site are to be removed to a licensed waste management facility. The waste is to be taken by a registered waste carrier in accordance with applicable Waste Management Regulations.

Waste consignment / transfer notices will be required and are to be retained by the Contractor. Copies of all waste consignment / transfer notices are to be provided for inclusion in the verification report.

Any soils deemed hazardous waste for whatever reason will require representative samples to be collected for Waste Acceptance Criteria (WAC) testing prior to acceptance of the waste at a licensed hazardous waste landfill.

Waste transfer notes for all material leaving site shall to be provided to Hydrock consultants for inclusion in the final verification report.

5.10 Task 8: Supervision, Verification and Reporting

5.10.1 Site Supervision

The contractor must provide a suitably qualified and experienced geo-environmental / remediation engineer to oversee the works on a full time basis. In addition to this, Hydrock Consultants Ltd will provide a watching brief on behalf of the client on a part-time basis.

To enable the discharge of planning conditions, the Contractor shall provide all the information detailed in this RMS and any further information requested for Hydrock Consultants Ltd to produce the Verification Report.

5.10.2 Collection of Samples

Additional sampling will be required during the works to provide further information for the receiving landfill site. These samples shall taken in accordance with relevant guidance (e.g. BS 10175:2011). Soils for inorganic analysis will be sealed in airtight polythene tubs. Soils for organic analysis will be sealed in amber glass jars with the minimal practicable headspace.

All samples must be scheduled on chain of custody forms prior to being dispatched to a UKAS accredited laboratory for analysis.

Excavated Made Ground will be sampled for asbestos testing at a rate of 1 sample per 500m^3.

The geo-environmental / remediation engineer will need to be suitably trained in taking samples for verification activities specifically relating to asbestos.

5.10.3 Stockpile Verification

Should any stockpiles be formed, the Contractor shall ensure that each stockpile of material is given a clear reference number and a designated sheet recording the following:

- identification reference (e.g. Stockpile A, B, C etc.);
- material type (e.g. Made Ground / natural);
- source area;
- approximate volume; and
- proposed destination of the material.

Each entry shall be signed and dated by the Site Manager or their Assistant. A template form is provided in Appendix B. Other templates or documentation may be used.

A Stockpile / Soil Tracker Sheet shall record where excavated materials originated from and the destination proposed.

These sheets should be available for inspection by the Engineer, local authority officer and others involved with this project, as required. A copy should also be given to the Engineer when verification visits are made.

5.10.4 Verification

Verification shall comprise:

- permitting / consent information; and
- records of waste disposal (consignment notes).

On completion of the verification works the appropriate verification documentation, detailing the works that have been completed in accordance with the agreed implementation plan, will be forwarded to the client and the local authority.

Necessary changes to the agreed implementation plan, arising during the course of the works, are to be agreed in writing with the client, local authority and other interested stakeholders prior to being undertaken on site.

It should be noted that information presented in this document is provided to assist in managing the soil at the site which contains asbestos. Hydrock cannot be held responsible for how the control measures associated with these risks are implemented and recommend that an appropriate asbestos specialist assist with both the preparation of documents and licences and site supervision.

6.0 ADDITIONAL WORK

6.1 Sampling Beneath the Formation Level

Once the formation level is reached, then it is recommended that a series of trial pits are dug on a 25m grid. On a 9,985m^2 site, this equates to 16 trial pits. It is recommended that these are taken to 1m below ground level. This will be 1.5m below finished floor levels and will provide reassurance that asbestos and Japanese Knotweed materials have been fully removed from site and will not present a risk to workers during the project or future users of the site.

To be classed as being free from asbestos containing materials, soils must be characterised by 'below limit of detection' that is, < 0.001% w/w.

7.0 DISCOVERY STRATEGY FOR AREAS OF UNEXPECTED CONTAMINATION

7.1 General Unexpected Contamination

It is possible that contamination above that which has not been recorded by the previous site investigations could be identified during future work. Demolition of existing structures (public house and vehicle repair garage) is required prior to developing out the site. It is recommended that some limited investigation is undertaken post-demolition to confirm that no contamination is present beneath existing structures. This could take the form of visual inspection during the demolition and confirmatory soil testing beneath excavated structures.

If unexpected contamination is found the following procedures should be adhered to:

1. All site works at the position of the suspected contamination should stop.
2. Visual and olfactory observations of the condition of the ground and the extent of contamination should be made and notification shall be given to a suitably qualified person, who will inform the local authority not later than 24 hours after discovery. Should the contamination be likely to affect controlled waters the Environment Agency shall also be informed.
3. In the presence of a suitably qualified geo-environmental engineer, investigation works shall commence to recover samples for testing and, using visual and olfactory observations of the condition of the ground, delineate the area over which contaminated materials are present.
4. The affected material may be excavated and placed in a stockpile on a suitable impermeable surface. This should be suitably quarantined with no addition to, or removal of, the stockpile while chemical analysis is being undertaken. Alternatively, the material should remain in situ until laboratory test results have been obtained.
5. A photographic record should also be made of relevant observations.
6. The testing suite will be determined based on the basis of visual and olfactory observations.
7. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
8. If after testing the ground is found to be contaminated, the Local Authority shall be informed. After consultation with the local authority and if necessary the Environment Agency, materials should either be removed for disposal to a licensed waste management facility or remediated to agreed clean-up criteria.

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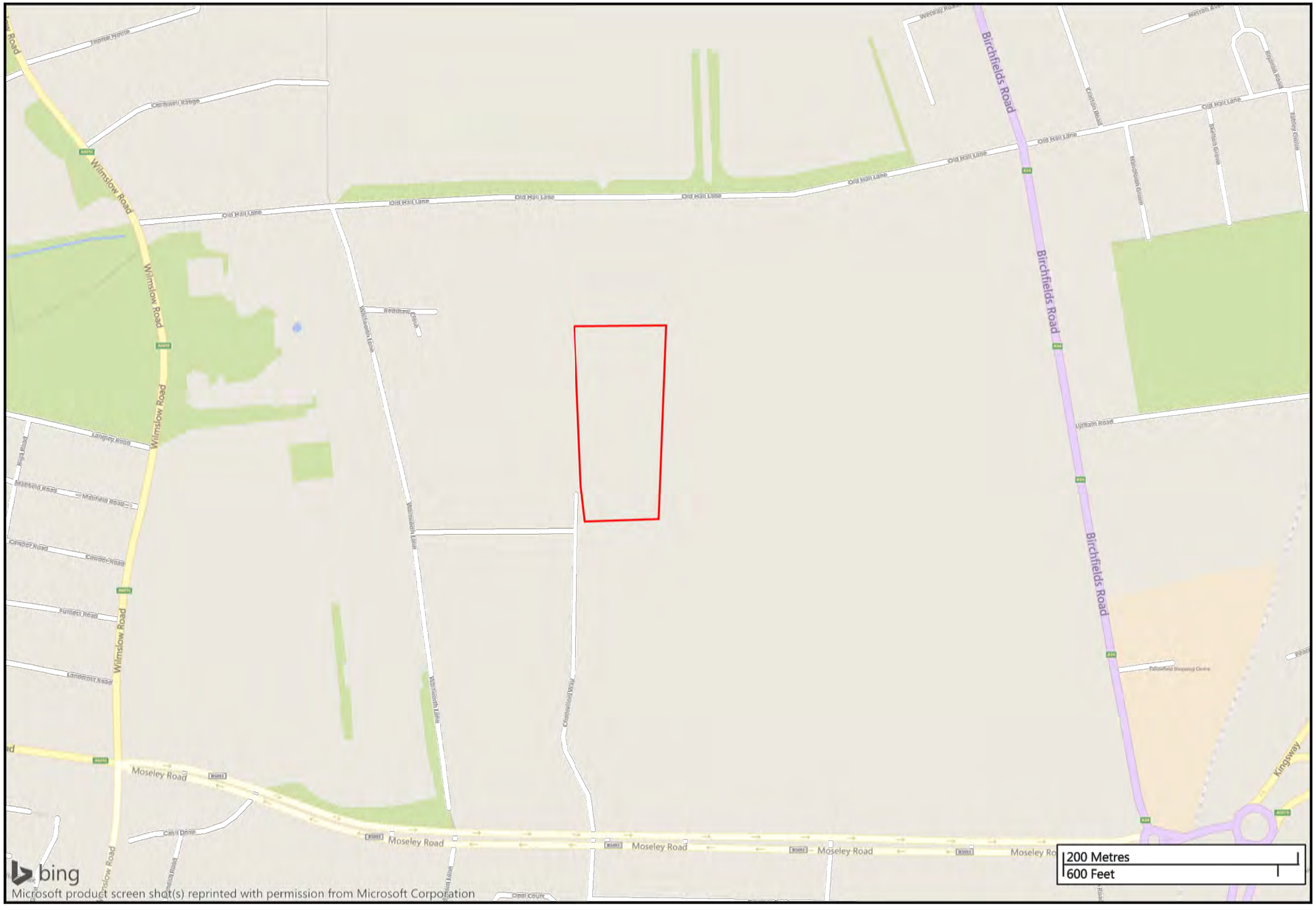
Appendix A

Drawings





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Client :

UNIVERSITY OF MANCHESTER

Project Title:

UNIVERSITY OF MANCHESTER, FALLOWFIELD CAMPUS

Drawing Title:

Site Location Plan

Reference:

UOM-HYD-XX-RMS-DR-G-0001

Hydrock Job No:

C-05139-C

Drawn	Checked	Scale @ A3	Date	Issue Date
AS	DH	As Shown	21/11/16	21/11/16

Revision: P1.1

Status: S0

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NOTES

To be read in conjunction with

- All relevant Surveys, such as Topographical and Tree survey
- All other architectural drawings
- Architectural Specification
- Landscape Architecture Drawings and Specifications
- Civil and Structural Engineering Drawings and Specifications
- MEP Engineering Drawings and Specifications
- Acoustic Report
- Lighting Report
- Fire Strategy Report
- Room Data Sheet

Planning application boundary

REVISION / DESCRIPTION	DRAWN	CHECKED	DATE
P06 - Drawing updated to take into account boundary alterations	JD	MB	08/09/16
P05 - Issued for planning	MS	MB	25/09/15

KEYPLAN



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PROJECT TITLE
Owens Park, Fallowfield
Campus Redevelopment

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DRAWING TITLE
Masterplan Phasing Sequence - Phase 1

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DATE
Mar '15

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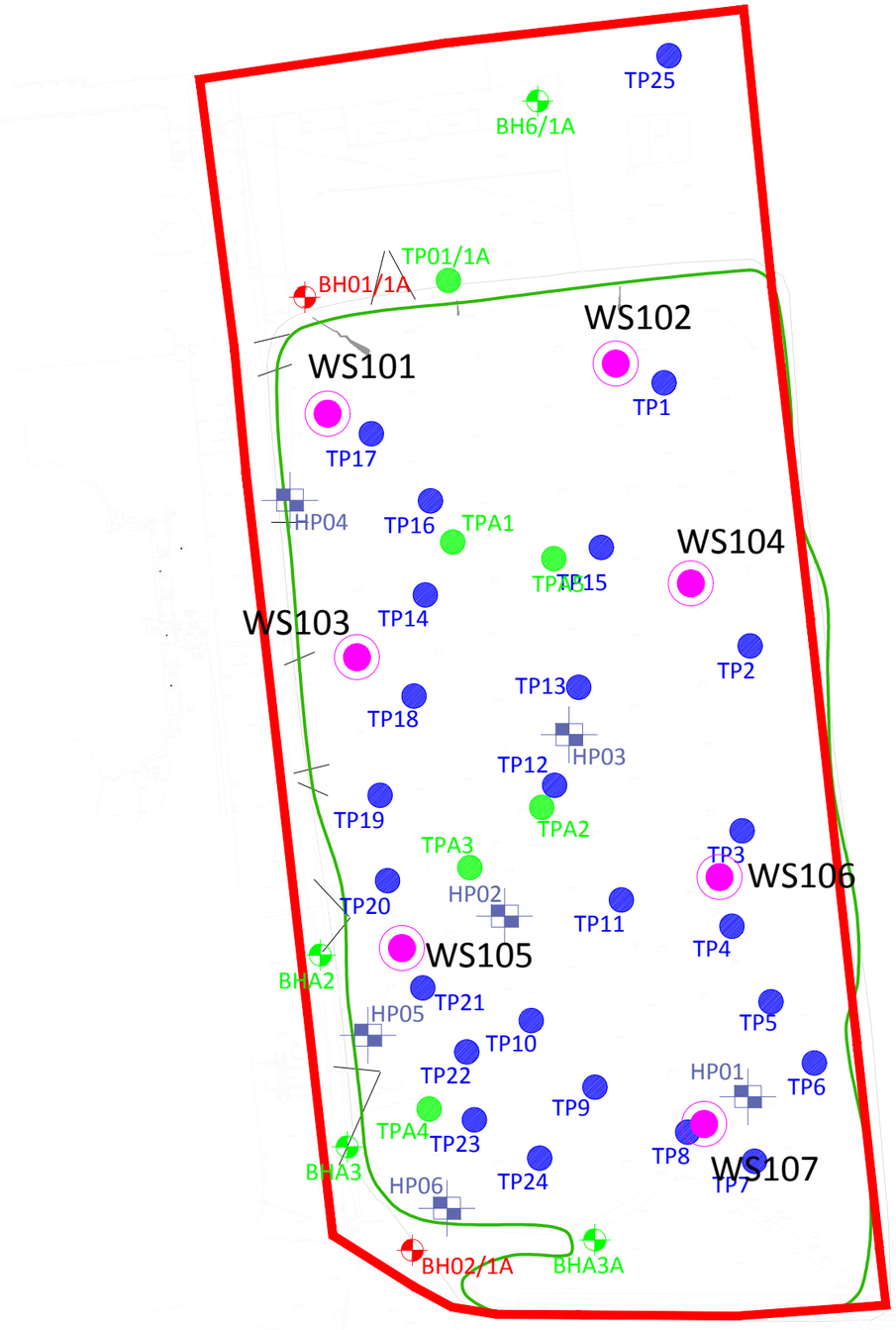
REVISION
P06

Notes:



KEY:

- HYDROCK, 2016 HAND PIT
- ENVIRONMENTAL ESSENTIALS, 2015 TRIAL PIT
- GEOTECHNICS P2A BOREHOLE
- GEOTECHNICS P2B BOREHOLE
- GEOTECHNICS P2B TRIAL PIT
- WS101 PROPOSED ADDITIONAL WINDOW SAMPLE
- SITE BOUNDARY

Rev	Date	Description	By	Ckd
P2	10/01/17	Geotechnics P2B Positions Added	AC	DH

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Project Title:

UNIVERSITY OF MANCHESTER, FALLOWFIELD CAMPUS

Drawing Title:

Exploratory Hole Location Plan

Reference:

UOM-HYD-XX-RMS-DR-G-0002

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