BURO HAPPOLD

NOMA 4 Angel Square and NOMA Primary Substation

Remediation Strategy

047214-BHE-XX-XX-RP-GE-0002

047214

27 August 2020

Revision P01

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Revision	Description	Issued by	Date	Checked
P01	Remediation Strategy – DRAFT subject to Local Authority approval	PH	27/08/2020	COH

C:\Users\cohara\Desktop\Plot P\Remediation Strat\047214-BHE-XX-XX-RP-GE-0002.docx

This report has been prepared for the sole benefit, use and information of Bowmer & Kirkland for the purposes set out in the report or instructions commissioning it. The liability of Buro Happold Limited in respect of the information contained in the report will not extend to any third party.

author	**Pip Hunsworth**
date	**27th August 2020**
approved	**Chris O'Hara**
signature	
date	**27th August 2020**

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Contents

1 Introduction 7

1.1 Purpose and scope 7

1.2 Planning 7

1.2.1 Conditions 7

1.3 Report 8

2 Site Context 9

2.1 General 9

2.2 Summary of site setting 9

2.3 Geology, hydrogeology, hydrology 9

2.4 Summary of Socotec Ground Investigation 10

2.5 Profile of residual contamination 11

2.5.1 Soil 11

2.5.2 Groundwater 12

2.5.3 Ground gas and vapour 12

2.6 Summary of potential pollutant linkages 12

2.7 Proposed Development 13

3 Remediation Strategy 15

3.1 Introduction 15

3.2 Relevant Pollutant Linkages 15

3.3 Remedial objectives 15

3.3.1 Contamination Related Objectives 16

3.3.2 Engineering Related Objectives 16

3.3.3 Management and Amenity Related Objectives 16

3.4 Consideration of remediation options 17

3.5 Remedial Design and Mitigation Measures 17

3.5.1 Construction workers 17

3.5.2 Neighbours 18

Copyright © 1976 - 2020 Buro Happold. All rights reserved

3.5.3 Future site users 18

3.5.4 Built Environment 18

3.5.5 Unforeseen Contamination 19

3.6 Earthworks 19

3.6.1 Made Ground 19

3.6.2 Natural Strata 20

4 Landscaping 21

4.1 General 21

4.2 Re-use / imported material 21

4.2.1 Sampling and testing regime 24

5 Below ground infrastructure 25

5.1 Below ground concrete 25

5.2 Below ground water supply pipework 25

6 Verification and Monitoring 27

Appendix A BH Earthworks Specifications

Appendix B Landscape Architect Proposals

Copyright © 1976 - 2020 Buro Happold. All rights reserved

1 Introduction

1.1 Purpose and scope

This report describes the Remediation Strategy for the development of 4 Angel Square (4AS), a new build office development with a basement, and NOMA Primary Substation (PSS) just beyond 4 Angel Square to the north, prepared on behalf of Bowmer & Kirkland Limited. Please note, for the purposes of this report, 4AS and the PSS have been evaluated as one site herein referred to as 'the site'.

At present the site predominantly comprises hard standing which is used for car parking. Oswald Street (orientated northeast-southwest) is located approximately central to the site and the Ducie Bridge Inn (no longer in use) and some derelict industrial buildings are located in the southern portion of the site. This Remediation Strategy has been prepared in general accordance with the Environment Agency CLR11 Model Procedures[1] and has taken into account the Socotec site investigation carried out across the site during September and October 2019 (Socotec Factual Report on Ground Investigation, Project NOMA Plot P – Report No: A9023-19 Issue No:2 dated February 2020). The Strategy also reflects the nature of the development (which includes the removal of Made Ground, the construction of a single storey basement for the new PSS and 4AS and the creation of soft landscaped areas).

This report describes; the planning context to this development (Section 1.2.1), a summary of the site context (Chapter 2), the remediation objectives (Section 3.3), remedial design measures (Section 3.5) and the validation methodology (Chapter 6).

1.2 Planning

1.2.1 Conditions

This report has been prepared to address the requirements of Manchester City Council with respect to land affected by contamination, set out in particular conditions of the planning permission granted 26th July 2019 (4AS) and 31st July 2019 (PSS). The conditions relevant to the land affected by contamination are presented below for ease of reference:

NOMA 4AS - 123437/FO/2019

Condition 9a) *'Notwithstanding the ground conditions report stamped as received by the City Council, as Local Planning Authority, on the 1 May 2019, (a) before the development hereby approved commences (excluding demolition), the following information shall be submitted for approval in writing by the City Council, as Local Planning Authority:*

- Submission of the site investigation and updated final risk assessment;

- Submission of a remediation strategy.

Once approved, the development shall then be carried out in accordance with the approved details.'

Condition 9b) *'When 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 prior to the first occupation of the development'.*

[1] Environment Agency, "Model procedures for the management of land contamination - contaminated land report 11 (CLR11)," 2004

Copyright © 1976 - 2020 Buro Happold. All rights reserved

'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'.

NOMA PSS - 123438/FO/2019

Condition 8a) *'A watching brief shall be maintained for the duration of the construction. In the event that ground contamination, groundwater contamination and/or ground gas are encountered on the site at any time before the development is occupied, then the development shall cease until a report detailing what measures, if any, are required to remediate the land (the remediation strategy) has been submitted for approval in writing by the City Council, as Local Planning Authority. Once approved, the development shall be carried out in accordance with the remediation strategy.'*

Condition 8b) *'Prior to the first occupation of the development, a post completion report shall be submitted to the City Council, as Local Planning Authority, detailing whether any ground conditions were encountered and/or the verification of the previously approved remediation strategy*.'

1.3 Report

This report addresses the pre-commencement elements of Condition 9a (4AS) as well as Condition 8a (PSS), namely the preparation of a detailed remediation strategy for both sites.

Post commencement planning conditions (Condition 9b (4AS) and Condition 8b (PSS)) are the responsibility of the Main Contractor who will be required to produce a verification report suitable for discharging the conditions following completion of groundworks and soft landscaping.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

2 Site Context

2.1 General

This Chapter presents a brief summary of the site context and conditions, consideration of which has enabled the definition of the remediation strategy. This summary has been prepared from source information prepared by BuroHappold Engineering on behalf of NOMA Limited Partnership[2] and Socotec[3].

2.2 Summary of site setting

The site is located approximately 100 m to the northeast of Victoria Station, Manchester (National Grid Reference SJ842990). The site is bounded to the north by Munster Street, the east by Beswick Row, the south by Miller Street and the west by Corporation Street. At present the site predominantly comprises hard standing which is used for car parking. Oswald Street orientated northeast-southwest is located approximately central to the site, Ducie Bridge Inn (no longer in use) and some derelict industrial buildings are located in the southern portion of the site. The immediate surrounding area comprises urban development including residential, warehouses, offices and manufacturing facilities.

A detailed description of the site history is contained within the Phase I Desk Study report[2] and is not reproduced herein. Previous developments on the site included terraced housing, St. Michael's School, various public houses, warehouse and associated smaller units/yards. This has resulted in the presence of a variable thickness (0.50 to 5.80m) of fill (Made Ground) – a mixture of reworked natural soils with many and various man-made inclusions (e.g. clinker, brick, ash etc.). These Made Ground soils have minor contamination which is to be expected for a site such as this. None of the results exceeded the relevant 'commercial threshold' criteria (C4SL/S4UL).

Overall, the site generally slopes in a north-easterly direction towards the north-northeast corner on Rochdale Road. Spot heights from around the site (Miller Street (37.80 m AOD) and Rochdale Road (35.75 m AOD)) identify that there is a ~2.05 m difference in current ground level across the site. A brick retaining wall is present on the NW side of Oswald Street (maximum retaining height ~1.00 m). In addition, there are known existing basements associated with the Ducie Bridge Inn and the Warehouse that survive on-site, and historic backfilled basements and foundations associated with historical buildings have been recorded onsite.

2.3 Geology, hydrogeology, hydrology

A ground investigation has been undertaken at the site which confirmed ground conditions are broadly as expected comprising variable thickness of Made Ground (up to ~6m) which is underlain by superficial deposits (Glacial Till – clay/sand layers) underlain by very weak to weak sandstone bedrock (Chester Formation).

Six post-fieldwork monitoring visits have been undertaken between October 2019 and January 2020 which indicates static water level (SWL) between ~26.40 m AOD and 25.95 m AOD within the Chester Formation. Localised perched groundwater is also recorded within the Made Ground/superficial deposits. It is also important to note that the Chester Formation is classified as a Principal Aquifer by the Environment Agency.

[2] Buro Happold report, "4 Angel Square and NOMA Primary Sub-station – Ground Engineering Desk Study Report, ref: 042512-BHE-XX-XX-RP-GE-0001-FNL)". March 2019.
[3] Socotec report, "NOMA Plot P – Factual Report on Ground Investigation, ref:A9023-19". February 2020.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

The nearest surface water feature to the Site is the River Irk located approximately 150 m northwest of the Site, flowing to the southwest to its confluence with the River Irwell on the south side of Manchester Victoria Railway Station. The River Irk is understood to be culverted beneath the railway station.

2.4 Summary of Socotec Ground Investigation

A ground investigation was designed by BuroHappold Engineering and undertaken by Socotec in September and October 2019. An archaeological investigation was also undertaken during 2019[4], and this document should also be referred to in conjunction with this report. Relevant data from the Socotec 2019 GI has been included into this remediation strategy.

Socotec Limited (2019) GI scope:

- 2 No. combined dynamic sampling with rotary core drilling boreholes and associated in-situ testing to record and allow an assessment of shallow and deep ground conditions for foundation design and to allow groundwater and ground gas monitoring wells to be installed;.
- 2 No. dynamic window sample boreholes to records and allow an assessment of the shallow ground conditions and to allow groundwater and ground gas monitoring wells to be installed;
- 7 No. Machine Dug Trial Pits to allow an assessment of the shallow ground conditions and record any existing sub-surface obstructions (basement walls/floor slabs etc.);
- 3 No. Hand Dug Trial Pits to allow an assessment of the shallow ground conditions, floor slab thickness and foundation construction in the Ducie Bridge Pub basement;
- 2 No. Horizontal Concrete Core in the Ducie Bridge Public House Basement Walls to allow an assessment of the construction and thickness and the ground conditions behind the wall;
- Geoenvironmental laboratory testing to determine the chemical properties of the Made Ground and natural deposits for Human Health Assessment and Waste Acceptance Criteria assessment.
- Geotechnical laboratory testing to determine the physical properties and characteristics of the ground mass for foundation design; and
- Programme of gas and groundwater monitoring to allow ground gas and groundwater regimes beneath the site to be assessed.

The general sequence of strata encountered based on available BGS borehole logs in the surrounding area and that of the ground conditions encountered during the Socotec SSGI is summarised in Table 2-1.

[4] University of Salford Archaeological Desk-based Assessment, NOMA Plots P&Q, Manchester. Report No: 2019/4. January 2019

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Table 2-1 Summary: Conceptual Ground Model based on BGS data and Socotec Site Specific Ground Investigation (SSGI).

Depth to Top of Strata (m BGL)	Typical Thickness (m)	Generalised Description
0.00	>0.50-5.80	Black brown slightly clayey slightly sandy angular to subangular GRAVEL of brick and ash with high cobble and medium boulder content. Gravel comprises various materials including sandstone, mudstone, limestone, glass, tarmac, coal, slag, concrete, slate, clinker, brick (demolition rubble), rare granite and ceramic fragments. [MADE GROUND]
0.50-4.18	>0.30-4.00	Firm to very stiff brown/red brown slightly sandy gravelly CLAY. Gravel is fine to coarse angular to rounded of sandstone & mudstone. AND Orange brown, slightly clayey, slightly gravelly fine to coarse SAND. Gravel is fine to coarse, subangular to rounded of quartzite, limestone, sandstone and ironstone. Occasional layers of brown, sandy, gravel. [GLACIAL TILL]
5.80-7.50	>22.50	Soft becoming medium hard, red/brown, medium to coarse grained sandstone with occasional layers of marl. [CHESTER FORMATION]

Note: During the SSGI groundwater seepages were recorded at 2.55 m bgl in MTP01, 1.85 m bgl in MTP05 and 1.80 m bgl in MTP07.

2.5 Profile of residual contamination

2.5.1 Soil

As part of the Socotec Ground Investigation a total of 9 No. soils chemical tests were undertaken (7 No. in Made Ground and 2 No. in natural ground). Based on the proposed development end use and in respect of contaminated land threshold criteria for the site, 'commercial' threshold criteria are considered to be most relevant. In respect of residential without plant uptake thresholds, a number of slightly elevated levels of lead and PAH's were recorded, however, these are not considered further in this assessment due to the fact that none of the results for all determinands exceeded the relevant 'commercial threshold' criteria (C4SL/S4UL).

Of the 9 No. soil chemical tests, the 7 No. tests on samples within Made Ground deposits were screened for Asbestos Containing Material (ACM). No suspect fragments or gross asbestos contamination was encountered during the intrusive ground investigations. Of these 7 No. Made Ground samples, 3 No. recorded the presence of asbestos fibres, namely, Chrysotile in MTP03 at 0.50 m bgl, Amosite in MTP04 at 0.50 m bgl and Amosite and Chrysotile in MTP05 at 1 m bgl.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Asbestos quantification tests were undertaken on the 3 No. samples that recorded the presence of ACM. The results identify 0.001% in MTP03, 0.012% in MTP04 and <0.001% in MTP05. In accordance with CAR-SOIL Watch Point 12[5] the concentrations of asbestos recorded is 'low'.

Based on the evidence from the intrusive ground investigation, minimal quantities of ACM are likely to be present as free fibres disseminated within the soil. It is most likely that the majority of concentrations will be of trace amounts or as small fragments below the hazardous waste threshold (0.1%).

2.5.2 Groundwater

Due to the low levels of contamination on site, the risk to groundwater was considered to be low. No groundwater testing was completed on site.

2.5.3 Ground gas and vapour

Ground gas monitoring has been undertaken during the Socotec 2019 investigation. The ground gas monitoring data has classified the site to be typically Characteristic Situation 1 (CS1) with a maximum Characteristic Situation 2 (CS2). Although the assessed level of risk related to ground gas is low, this low level of risk associated with the slightly elevated concentrations of CO_2 and CH_4 within the made ground can be further mitigated by the planned construction, namely the removal of the source by basement excavation and by the presence / structure of the basement slab including a waterproof membrane. In accordance with the relevant British Standard[6], the gas protection score required for buildings on a site classified as Characteristic Situation 1 (CS1) is zero, for CS2 it is 3.5 which is representative for 4AS and PSS.

The building substructure will (by default) provide protection against hazardous gas ingress. A reinforced waterproof basement slab with minimal penetrations and cracking control (waterproofing additive / membrane within Grade 2 and Grade 3 areas) along with the presence of basement car parking beneath occupied areas will further contribute to the protection against gas ingress. In addition, the basement will be ventilated to meet Building Regulations requirements for dealing with car exhaust fumes. If the development plan changes and basements are not part of the proposed buildings, the need for and scope of gas protection measures would have to be reconsidered.

2.6 Summary of potential pollutant linkages

In the UK, the assessment of risk from contamination follows the source-pathway-receptor approach. If one of these three elements are absent, it is considered that there is no risk of harm. If, however, there is considered to be a linkage between any given source and any given receptor, then a risk-based approach is used to assess the significance or impact of any such linkage. Risks are defined as the probability of an event occurring combined with the severity of the consequence of that event. To assess the risks to site end users posed by any given source, the sensitivity of each receptor is considered.

Site specific pathway-receptor linkages have been identified with respect to the sources identified in the various reports referenced above and with respect to the future use as a commercial development. The details of the Preliminary Risk Assessment are presented in the BuroHappold Engineering Desk Study report[2]. A summary of the

[5] CAR-SOIL Control of Asbestos Regulations (2012), Interpretation for Managing and working with asbestos in soil and construction demolition materials – Industry Guidance. Published by Contaminated Land: Applications if Real Environments (CL;AIRE).
[6] BSI, "BS8485 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (incorporating corrigendum No. 1)," 2015.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

potential pollutant linkages relevant to the proposed development are included in Table 2-2 below for ease of reference.

Table 2-2 Summary of pollutant linkages

Receptor		Pathway	Source
Human Health	Offsite residents / visitors	Soil and dust inhalation / ingestion during construction/earthworks.	Made Ground with slightly elevated lead, TPH & PAH and trace ACM fibres.
	Current and future site users	Direct contact and dermal uptake, soil and dust ingestion	
	Construction workers	Direct contact and dermal uptake, soil and dust ingestion during construction/earthworks.	
Controlled Waters	Chester Formation [Principal Aquifer]	Migration via permeable strata and surface water drainage	Made Ground with slightly elevated lead, TPH & PAH and trace ACM fibres.
Buildings/ Services	Proposed buildings and structures.	Direct contact / permeation of plastic pipe work by contaminants in soil and leachate. Degradation of below ground concrete.	The Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations (Made Ground) is DS-2 and AC-2.

2.7 Proposed Development

The current development proposals consist of the following main elements:

4 Angel Square

- Demolition of existing industrial buildings and public house,
- Construction of an 11 storey building with external roof terrace to form a mixed use development comprising office use (Use Class B1) and ground floor commercial units (Use Classes A1, A2, A3, A4 and B1). The 4AS building will be founded on piled foundations.
- Creation of a new public square and associated landscaping,
- Basement car and cycle parking,
- Provision of plant and servicing,
- Related access and highways' works.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

NOMA Primary Substation

- Construction of a single storey primary substation on Corporation Street and Munster Street comprising two switch houses and a transformer compound. The NOMA PSS will be founded on piled foundations.
- Related landscaping, access and highways' works, network connections.

Please note, the scheme has been designed as the permanent solution for provision of a primary substation to facilitate the future development of the NOMA Strategic Regeneration Framework area; it is also designed to be capable of being incorporated into the future permanent redevelopment of the wider 5 Angel Square (Plot Q) site, which is identified for hotel and / or multi-storey car park use

Copyright © 1976 - 2020 Buro Happold. All rights reserved

3 Remediation Strategy

3.1 Introduction

There are currently potentially unacceptable risks to people, the natural and built environment associated with the proposed commercial development and the presence of residual contamination summarised above. This chapter lists the Relevant Pollutant Linkages that are then addressed by the series of remedial objectives, necessary to achieve safe development. Consideration is then given to the options available to meet these objectives, taking into account the nature of the development and in particular, the presence of the basement and the limited areas of soft landscaping.

3.2 Relevant Pollutant Linkages

The pollutant linkages (assuming no mitigation measures) listed below are relevant to; the short term (during construction), to the long term (occupation) or to both.

Short term – during construction

1. Construction workers during below ground works potentially exposed to contamination in soils (minimal ACM fibres).

2. Neighbouring people potentially exposed to contaminated dust.

Long term – during occupation

3. Site residents and visitors potentially exposed to contamination in soils in landscaped areas.

4. Built environment (below ground infrastructure including foundations) potentially in direct contact with hazardous/ aggressive ground conditions.

3.3 Remedial objectives

The overall aim of the remediation is to ensure that potential risks from land contamination at the site to construction workers / ground workers, current and future site users, neighbours, controlled waters, property and ecological systems are appropriately mitigated. The strategy also aims to ensure that the development itself can be constructed safely without ground contamination giving rise to unacceptable risks to workers, neighbours and other offsite receptors, in accordance with National Planning Policy[7].

The remedial objectives for the site address all of these significant pollutant linkages. The objectives can be defined in three categories;

i. contamination related,

ii. engineering related, and

iii. management/ amenity related.

These objectives are set out in turn below.

[7] Department for Communities and Local Government, "National Planing Policy Framework," 2012

Copyright © 1976 - 2020 Buro Happold. All rights reserved

3.3.1 Contamination Related Objectives

The contaminated related objectives are:

1. To ensure workers engaged in the redevelopment are not exposed to concentrations of contamination in the solid, liquid or gaseous/vapour phase at concentrations that could give rise to acute risks;
2. To ensure site neighbours are not exposed to concentrations of contamination in dusts at concentration that could give rise to acute risks;
3. To ensure future site occupiers and/or visitors are not exposed to concentrations of contamination in the solid or gaseous/vapour phase that could give rise to acute or chronic risks;
4. To ensure the quality of groundwater resources (Principal Aquifer) are not significantly impacted by any potentially mobile inorganic or organic contaminants in both the short and long terms;
5. To ensure soils in areas of soft landscaping meet appropriate physical and chemical criteria to enable health / growth of on-site plants; and
6. To ensure that the redeveloped site cannot be determined as 'Contaminated Land'.

3.3.2 Engineering Related Objectives

The engineering related objectives are:

1. To ensure integration of the engineering design with the remediation (in particular related to the basement construction);
2. To ensure that building materials are not subject to chemical degradation;
3. To ensure that the foundation design does not give rise to preferential pathways for migration of contamination that could significantly impact upon the quality of the Principal Aquifer.

3.3.3 Management and Amenity Related Objectives

The management and amenity related objectives are:

1. To deliver the redeveloped site to time and budget;
2. To enable discharge of the relevant planning condition(s);
3. To minimise environmental impacts and ensure that 'nuisance' effects to neighbours are mitigated to acceptably low levels; and
4. To ensure the remedial works undertaken are cost effective.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

3.4 Consideration of remediation options

For remediation projects, the Model Procedures[1] advise is that consideration should be given to the full range of remedial design / measures that are potentially capable of meeting the remedial objectives. Appraisal of these options is then carried out to determine which particular remediation options are feasible and likely to be effective for the particular site and circumstances under consideration (i.e. the development proposals and relevant pollutant linkages). A systematic review and evaluation of these options would then be carried out. There are three main types of control for achieving the remedial objectives. These comprise:

1. Source control – the removal or treatment of the source(s) of contamination:

2. Pathway control

a. The construction of a barrier to prevent contact to contaminated materials by sensitive receptors,

b. The construction of a barrier to prevent the migration of contamination to sensitive receptors; and

3. Receptor control – restricting the presence/ access of sensitive receptors to the source(s) of contamination.

The criteria by which remedial actions for each of these control systems are assessed can be summarised under three headings;

- Practicality (e.g. technicality, site, time, regulatory constraints)
- Effectiveness (e.g. in achieving the remedial targets); and
- Durability (e.g. remaining effective over the longer term).

3.5 Remedial Design and Mitigation Measures

The following text provides the written method statement for meeting the remedial objectives set out above, taking into account the proposed development. The receptors are addressed in the order of the pollutant linkages summarised above in Table 2-2.

3.5.1 Construction workers

The potential for direct contact and dust inhalation (including asbestos fibres) by the construction workforce during the enabling works, earthworks and any subsequent below ground works and landscaping will be mitigated by a combination of the measures set out below. The measures comprise:

i. Avoiding below ground excavations / earthworks not required for development purposes;

ii. Ensuring awareness of the potential for contamination in the construction workforce engaged in any below ground works by the provision of briefing and site induction including description of the potential for and the nature of potential contaminants and setting out the provisions being implemented on site;

iii. Providing an appropriate level of Personal Protective Equipment (PPE) and ensuring this is worn at all times;

Copyright © 1976 - 2020 Buro Happold. All rights reserved

iv. Ensuring that supplementary PPE that may be necessary (e.g. masks) are immediately available to be used if required;

v. Ensuring a good standard of hygiene with the consumption of food and drink permitted only in designated areas. Smoking will not be permitted on site; and

vi. Ensuring good construction practice (including appropriate mitigation) is followed during excavation and any below ground works to prevent the generation and migration of dusts created by below ground works and other construction activities. These measures shall be set out in a Construction Environmental Management Plan (CEMP) and Foundation Works Risk Assessment (FWRA) which will be submitted with the planning application and include use of dust suppression measures (e.g. damping down dust, avoiding the dropping of spoil from height, sheeting all lorries, sheeting any areas of soil stockpile etc.).

vii. Air monitoring shall be carried out to detect presence of any airborne asbestos fibres in the event that significant amounts of suspected asbestos containing material are identified, in accordance with HSE guidance[8]. The specific processes shall be defined in the Contractors Method Statement.

viii. Making plans and provisions for unforeseen contamination (see Section 3.5.5)

3.5.2 Neighbours

The potential for dust inhalation (including asbestos fibres) by neighbours during earthworks will be mitigated by ensuring good construction practice to prevent the generation and the migration of dusts created by below ground works and other construction activities. These measures shall be set out in a CEMP and include use of dust suppression measures (e.g. damping down dust, avoiding the dropping of spoil from height, sheeting all lorries, sheeting any areas of soil stockpile etc.).

3.5.3 Future site users

The proposed reduced level below the site and the basement will remove a large volume of the Made Ground and effectively isolate residents from the underlying geology (including residual contamination in the Made Ground) mitigating the potential for direct contact and dust generation.

However, soft landscaped areas are proposed as part of the development, which have the potential to be constructed on existing site soils. Where such areas of landscaping are present an appropriate thickness of subsoil/topsoil will be provided primarily for horticultural/landscaping reasons, but also acting as a cap on any underlying Made Ground. Clean suitable soils will be imported and placed to a minimum thickness of 500-600mm (see Chapter 4). This soil cover will also provide a suitable barrier between people on site and the underlying ground and mitigate the generation of contaminated dust during the operational phase.

3.5.4 Built Environment

The potential for aggressive attack on below ground concrete will be mitigated by designing the below ground concrete in accordance with the BRE guidance[9]. The design will therefore take into account the ground conditions in classification of the Design Sulphate Class and Aggressive Chemical Environment for Concrete (ACEC) as recommended within the Preliminary Site Assessment[2] and included within Table 2-2.

[8] Health and Safety Executive, "Managing and working with asbestos L143," 2013.
[9] Building Research Establishment (BRE), "BRE Special Digest 1: Concrete in aggresive ground," 2005.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

The potential for contaminant permeation of water supply pipework in the ground will be mitigated by designing the below ground water supply pipework in the ground to take account of the Water UK guidance[10] and to meet the requirements of the water utility provider (United Utilities[11]).

3.5.5 Unforeseen Contamination

The site investigations indicate variably impacted materials with a potential to encounter relatively localised more grossly contaminated materials. The potential risks related to any such localised/ gross or otherwise unforeseen contamination will be mitigated by the following management regime:

i. A 'watching brief' will be held by the Contractors Site Engineer/Manager to involve periodic inspection, appropriately recorded in a site diary. This will supplement daily records maintained by the Contractor;

ii. The Contractor's tool box talk will alert the construction workforce to the potential for such unforeseen contamination. Encountering any such unforeseen contamination will require immediate cessation of excavation and notification of the Contractor's Site Manager and the Engineer;

iii. In the event of any such unforeseen contamination being encountered an appropriately qualified environmental specialist will be contacted and will visit the site as soon as practicable (but within a maximum of 24 hours) to determine the need for and scope of any remedial action. Proposals for any such action (investigation, analysis, modelling, monitoring and remedial action if appropriate) will be discussed and agreed with the Local Authority (and Environment Agency if appropriate) prior to implementation.

Any such action will be appropriately recorded and included in the Verification Report (see Chapter 6).

3.6 Earthworks

3.6.1 Made Ground

Substantial volumes of Made Ground arisings will be derived from the basement excavation. As discussed above, there is very limited opportunity for the re-use of such materials on site. These arisings will therefore be subject to off-site treatment / disposal at an appropriately licensed facility.

The majority of Made Ground from the site is likely to be classified as Non-Hazardous Waste. Any unforeseen more impacted material and/or material containing visible ACM, is likely to be classified as Hazardous Waste and will require segregation for separate disposal accordingly. In line with current good practice, where appropriate and in agreement with the receiving facility, these waste streams will be separated on excavation while confirmatory testing is carried out. This will ensure correct classification and disposal of any hazardous materials (if encountered). It is the earthworks contractor's responsibility, in association with the operator and / or owner of the landfill to classify and record any such materials for disposal in line with current regulation and guidance. Waste classification and landfill Waste Acceptance Criteria (WAC) leachate testing should be undertaken prior to disposal to landfill to meet the requirements of the disposal facilities licence. Any Made Ground (fill) material considered for reuse on site (e.g. as sub soil or fill) will meet the criteria set out in Chapter 4.

[10] Water UK, "Contaminated Land Assessment Guidance (Protocols published by arrangement between Water UK and the Home Builders Federation)," January, 2014.
[11] https://www.unitedutilities.com/builders-developers/larger-developments/water/

Copyright © 1976 - 2020 Buro Happold. All rights reserved

During the works, the risks of potential ACM will be mitigated by on-site controls such as dust suppression, dust monitoring and PPE/RPE. If 'pickable' asbestos fragments are identified, they will be picked by competent and trained personnel, removed, double bagged and placed into a clearly labelled covered skip, prior to off-site disposal to an appropriately licensed facility by a competent and licenced contractor. This will be defined in the Contractors Method Statement.

3.6.2 Natural Strata

The basement (and other deep) excavations (e.g. piling) will result in spoil arisings of natural material (clay and sand from the Glacial Till and sand/sandstone from the Chester Formation) will be classified as Inert and chemically suitable for reuse either on or off site. There is also a potential for these arisings (either in whole or in part) to be impacted by mobile contamination. The properties of any such potentially contaminated material would be proven chemically and physically to ensure appropriate re-use or disposal. Testing would be carried out on representative samples at an approximate frequency of one sample per 250m^3 or a minimum of three samples per source area.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

4 Landscaping

4.1 General

The proposed landscaping across the site has not been finalised, however based on the current design, it is anticipated there will be localised soft landscaped areas around the periphery of the site (Appendix B refers).

All topsoil to be used as part of the landscaped areas of the development must comply with the physical, biological and chemical parameters set out in this specification. Made Ground unsuitable as a subsoil (i.e. not complying with the physical and chemical parameters set out in this specification) will not be re-used on site in landscaped areas. For imported soils within the planters, the horticultural specification will define the thickness requirement, for areas where landscaping is underlain by natural soils a minimum thickness of 600mm of clean materials suitable for the protection of human health will be required. This is in addition to any suitability requirements set out by the landscape architect.

4.2 Re-use / imported material

All topsoil must comply with British Standard 3882:2015[12] as a multipurpose soil (as set out in Table 1 of the standard). The soil should be a clay loam as defined in Figure 1 of the standard. The soil is to have a defined granular or blocky structure and be free from non-soil material i.e. brick, other building materials, wastes, hydrocarbons, plant matter, roots and rhizomes of perennial weeds and any other foreign matter or material of substance that would render the topsoil unsuitable for use.

For the protection of human health imported topsoil and sub soil (including any fill materials suitable for re-use as a sub soil) will comply with the parameters set out below and in the Buro Happold Earthworks Specifications – PSS and 4AS (Appendix A). In addition to the requirements from the British Standard the horticultural specialist will set out a specification for any additional parameters relating to soil quality and suitability for use from a landscaping perspective. The maximum permissible "average" concentrations (mean or US_{95} value as appropriate) for imported soil materials batch are set out in Table 4-1 and Table 4-2.

In the first instance the values have been derived from the Category 4 Screening Values[13], however, if the LQM Suitable for Use Levels[14] or the phytotoxic values are lower than the C4SL then these have been adopted.

[12] British Standards Institute, "BS3882:2015 Specification for topsoil," 2015.
[13] Contaminated Land: Applications in Real Environments (CL:AIRE), "SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contmaination," CL:AIRE, 2014.
[14] LQM/CIEH, "The LQM/CEIH S4ULs for Human Health Risk Assessment, Land Quality Press," 2015.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Table 4-1 Chemical thresholds

Determinand	Site Won and Imported material	Topsoil
	Maximum Soil Concentration	Maximum Soil Concentration
Arsenic	40 mg/kg	37 mg/kg
Cadmium	149 mg/kg	26 mg/kg
Chromium (total)	910 mg/kg	910 mg/kg
Chromium (VI)	21 mg/kg	21 mg/kg
Lead	310 mg/kg	200 mg/kg
Mercury	56 mg/kg	1.2 mg/kg
Selenium	430 mg/kg	250 mg/kg
Copper	7,100 mg/kg	2,400 mg/kg
Nickel	180 mg/kg	130 mg/kg
Zinc	40,000 mg/kg	3,700 mg/kg
TPH	**See Table 4-2**	490 mg/kg Note 1
PAH (USEPA 16)	**See Table 4-3**	**See Table 4-3**
Phenol Index	1,200 mg/kg	380 mg/kg
Free Cyanide	760 mg/kg	4.6 mg/kg
pH	5<pH<9	5<pH<9
Asbestos	See Note 2	None detectable Note 3

Note: 1. Materials exceeding these thresholds shall be subject to speciated analysis and comparison with Table 4-12**.**
2. Free fibres <0.1%. Cement-bound asbestos <0.1% of total material volume.
3. No free fibres and no cement bound asbestos.

Elevated concentrations of hydrocarbons are not anticipated in imported subsoil and topsoil materials. However, in the event that elevated concentrations of Total Petroleum Hydrocarbons are recorded (i.e above the 490mg/kg set out in Table 4-1 then speciated (TPH CWG) testing will be undertaken to determine if the materials are suitable. The thresholds for this additional testing are detailed in Table 4-2 below.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Table 4-2 Threshold concentrations for risk banded hydrocarbons and BTEX.

Determinand		Maximum Concentration for Site Won and Imported material	Maximum Concentration for Topsoil
Aliphatic	EC>5 - EC6	42 mg/kg	42 mg/kg
	EC>6 – EC8	100 mg/kg	100 mg/kg
	EC8 – EC10	27 mg/kg	27 mg/kg
	EC10 – EC12	130 mg/kg	130 mg/kg
	EC12 – EC16	1,100 mg/kg	1,100 mg/kg
	EC16 – EC21	65,000 mg/kg	65,000 mg/kg
	EC21 – EC35	65,000 mg/kg	65,000 mg/kg
Aromatic	EC5 – EC7	370 mg/kg	70 mg/kg
	EC7 – EC8	860 mg/kg	130 mg/kg
	EC8 – EC10	47 mg/kg	34 mg/kg
	EC10 – EC12	250 mg/kg	74 mg/kg
	EC12 – EC16	1800 mg/kg	140 mg/kg
	EC16 – EC21	1900 mg/kg	260 mg/kg
	EC21 – EC35	1900 mg/kg	1,100 mg/kg
Benzene		0.38 mg/kg	0.087 mg/kg
Ethylbenzene		83 mg/kg	47 mg/kg
Toluene		869 mg/kg	130 mg/kg
Xylene		79 mg/kg	56 mg/kg

Table 4-3. Threshold concentrations for Poly Aromatic Hydrocarbons (USEPA 16).

Determinand	Maximum Concentration for Site Won and imported material	Maximum Concentration for Topsoil
Naphthalene	2.3 mg/kg	2.3 mg/kg
Acenaphthylene	2,900 mg/kg	170 mg/kg
Acenaphthene	3,000 mg/kg	210 mg/kg
Flourene	2,800 mg/kg	170 mg/kg
Phenanthrene	1,300 mg/kg	95 mg/kg
Anthracene	31,000 mg/kg	2,400 mg/kg
Fluoranthene	1,500 mg/kg	280 mg/kg
Pyrene	3,700 mg/kg	620 mg/kg
Benzo(a)anthracene	11 mg/kg	7.2 mg/kg
Chrysene	30 mg/kg	15 mg/kg
Benzo(b)fluoranthene	3.9 mg/kg	2.6 mg/kg
Benzo(k)fluoranthene	110 mg/kg	77 mg/kg
Benzo(a)pyrene	3.2 mg/kg	2.2 mg/kg
Indendo(123-cd)pyrene	45 mg/kg	27 mg/kg
Dibenzo(ah)anthracene	0.31 mg/kg	0.24 mg/kg
Benzo(ghi)perylene	360 mg/kg	320 mg/kg

Note: All laboratory contamination testing shall be carried out in a UKAS and MCerts accredited laboratory, in accordance with the standards and procedures defined by MCerts.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

4.2.1 Sampling and testing regime

Topsoil material imported from offsite sources can be tested at source and prior to import to ensure conformity prior to transport to site and placement. Topsoil will also be tested in-situ for verification purposes. In-situ testing will be at a frequency of one sample per 250m^3 or a minimum of three samples per source (whichever is greater). This data will supplement any data provided by the topsoil supplier. The depth of the samples will be dependent upon the thickness of the sub soil / topsoils at that location but typically for a 600mm thick topsoil samples would be taken at 0-150mm; 200-350mm; and 400-550mm – commensurate with the nature of the material, its homogeneity and the overall frequency of 1 sample per 250m^3.

If in-situ testing shows that some areas of topsoil fail the criteria (i.e. average concentrations exceed thresholds) the contractor will be required to either carry out further testing to demonstrate compliance or to excavate and remove the non-compliant soils and replace them with fresh imported topsoil with further sampling of the fresh imported material to confirm suitability. Non-compliant material will be determined on the basis of the average values (mean or US^{95} as appropriate) for each batch/source of topsoil. Exceedance of this average would either result in rejection of that material and its removal and replacement by compliant material or in further testing to confirm non-compliance and/or delineate any particular contaminant 'hotspot'. The further testing would be at a frequency, spacing and depth specific to reflect the location specific circumstances. The potential for non-compliance will be reduced by the contractor obtaining data from the supplier prior to importation.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

5 Below ground infrastructure

5.1 Below ground concrete

Below ground concrete will be designed in accordance with the relevant BRE Special Digest[9] to take account of the recorded ground conditions as set out by the Preliminary Risk Assessment[2]. For ease of reference, the below ground aggressive chemical environment for concrete has been tabulated below.

Table 5-1 Assessing the aggressive chemical environment

Strata	Sulphate Design Class	*Aggressive Chemical Environment for Concrete (ACEC) classification*
Made Ground/Natural Ground	DS-2	AC-2

5.2 Below ground water supply pipework

The analytical data have been assessed against UKWIR Guidance[15] and Water UK[10]. This assessment indicates that polyethylene (PE), poly-vinyl chloride (PVC) and copper pipes may not be appropriate for potable water supply in the redevelopment of the site within the Made Ground due to the slightly elevated concentrations of heavy end TPHs. If Made Ground remains in-situ and the pipes are laid within the Made Ground, barrier pipe materials are likely to be required unless otherwise agreed with the utility company.

Table 5-2 Water supply pipework selection chemical criteria

Determinands		Determinand used [based on]	No. of samples	Mean [mg/kg]	Max. [mg/kg]	PE threshold [mg/kg]	Barrier Pipework
Banded hydrocarbons EC5-EC10, EC10-EC16, EC16-EC40 *[Total aliphatic and aromatic hydrocarbons for each banding may be summed]*	EC5-EC10	Aliphatic and Aromatic C5-C10	9	7.61 *(aromatic C8-C10 only mean. All other samples below detection limits)*	9.04 *(MTP05 at 1.00 m bgl. Note: max values in aromatic C8-C10 only. All others below detection limits)*	2	Pass
	EC-10-EC16	Aliphatic and Aromatic C10-C16	9	7.45	12.20 *(MTP07 at 0.50 m bgl)*	10	Pass
	EC16-EC40	Aliphatic and Aromatic C16-C35	9	67.70	373	500	Pass
Total Volatile Organic Compounds (VOCs) *[Summation of VOCs above limit of detection]*		Naphthalene	9	0.25	0.52	0.5	Pass
Total Benzene, Toluene, Ethyl Benzene, Xylenes (BTEX) plus MTBE		Benzene, Toluene, Ethyl Benzene, Xylenes	9	<LoD *(ranges between <0.001 to <0.003)*	<LoD *(ranges between <0.001 to <0.003)*	0.1	Pass

[15] UKWIR, "Guidance for the selection of water supply pipes to be used on brownfield sites," 2010.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Determinands	**Determinand used [based on]**	**No. of samples**	**Mean [mg/kg]**	**Max. [mg/kg]**	**PE threshold [mg/kg]**	**Barrier Pipework**
Total Semi-Volatile Organic Compounds (SVOCs) *[Summation of SVOCs above limit of detection]*	-	-	No data available	No data available	0.5	Pass
Phenols	Total Phenols (monohydric)	9	<LoD *(ranges between <0.5-<0.6)*	<LoD *(ranges between <0.5-<0.6)*	2	Pass
Cresols and chlorinated phenols (from SVOC analysis)	-	-	No data available	No data available	2	Pass
Corrosive (conductivity, REDOX and pH)	pH (min. 8.1, max. 9.8)	9	N/A	N/A	Pass	*See **Note 1***

Note 1 *– Threshold: For wrapped steel, corrosive if pH <7 and conductivity >400uS/cm. For wrapped ductile iron corrosive if pH <5, Eh not neutral and conductivity >400uS/cm. For copper, corrosive if pH <5 or >8 and Eh positive.*

Note 2 *– Where concentrations of specific determinands exceed the relevant thresholds for PE pipework, these have been highlighted orange. Where concentrations are below the relevant threshold, these are highlighted green.*

Copyright © 1976 - 2020 Buro Happold. All rights reserved

6 Verification and Monitoring

A Verification Plan will be prepared by the Main Contractor for the site in accordance with the Environment Agency CLR11 Model Procedures[1]. The Plan will describe the activities necessary to demonstrate achievement of the remedial objectives and will be suitable for submission to the Local Authority. Appendix A of the BH Earthworks Specification should also be referred to (Appendix A).

The proposed scope of works for the verification programme will comprise;

- Collation of all relevant information available from contractors reports, drawings and records,
- Monitoring of works undertaken at site,
- Review all of this data and assessment of compliance with the agreed remediation strategy,
- Liaison with the local authority, and
- Preparation of the Verification Report at the conclusion of below ground and landscaping works detailing how the work has been carried out in accordance with the approved remediation scheme.

Monitoring of the works as they proceed will be required in order to;

- Record the works as they are undertaken,
- Record any unexpected contamination that was encountered during the development, together with any remedial action undertaken in agreement with the local authority,
- Provide confirmation of successful implementation, and
- Enable completion of a verification report.

The record of works will comprise;

- collation of all relevant information available from data and reports collected by the Contractor(s),
- records of the Building Inspector approval(s),
- review of the contractor's site records relating to: source removal / waste management of spoil (contaminated and uncontaminated natural soils), management of groundwater, air monitoring data,
- periodic site inspections, and
- review of all of this data and assessment in relation to the completed construction; detailing remedial works undertaken and liaison with local authority as appropriate.

Chemical analysis of soils (and groundwater if encountered) will be carried out by an appropriate specialist laboratory (with MCERTS/UKAS accreditation for relevant determinands). The chemical analytical suite will be designed to reflect the contaminants of concern on the site and will also be subject to agreement with the local authority and the Environment Agency. The chemical analytical suite for topsoil and subsoil is set out in Chapter 4.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

The overall objective of verification activity is to demonstrate that the remedial works have been carried out in accordance with the agreed plan and that the works have not given rise to any unacceptable impacts upon people or the environment. The verification activities will also provide evidence that:

- Planning/permit/licence conditions have been met; and
- Environmental management goals have been met.

The verification report will be prepared on completion of the works and will comply with relevant Environment Agency guidance[1]. The object of the report is to provide authoritative documentary evidence of the remedial works. The report will describe the site, the remediation objectives, the techniques or processes employed and the verification/monitoring data in succinct text supported by as built drawings, figures, photographs etc. The source data will accompany this text as appendices to the main report. A satisfactory Verification Report will allow the local authority to discharge Conditions 9b (4AS) and 8b (PSS).

Copyright © 1976 - 2020 Buro Happold. All rights reserved

Appendix A BH Earthworks Specifications

A.1 BH Earthworks Specification – PSS.

A.2 BH Earthworks Specification – 4AS.

Copyright © 1976 - 2020 Buro Happold. All rights reserved

BUROHAPPOLD ENGINEERING

NOMA Primary Substation

Specification for Earthworks

046912

20 July 2020

Revision 00

042512-BHE-XX-XX-SP-GE-0003

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Revision	Description	Issued by	Date	Checked
00	For Stage 4 Foundations Issue	L.R	20/07/2020	COH/PH

This report has been prepared for the sole benefit, use and information of Bowmer & Kirkland for the purposes set out in the report or instructions commissioning it. The liability of Buro Happold Limited in respect of the information contained in the report will not extend to any third party.

author	**Louise Richards**
date	**20th July 2020**
approved	**Chris O'Hara/Pip Hunsworth**
signature	
date	**20th July 2020**

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Table of Contents

1 Introduction **6**

1.1 Earthworks Scope 6

1.2 Site Investigation 6

2 Particular Specification **7**

2.1 General 7

2.2 Submission of Information 7

2.3 Contractor Obligations 8

2.4 List of Amendments, Additions and Substitute Clauses to Series 600 Specification 9

2.5 Fill Acceptance Criteria 11

3 Series 600 Specification Appendices **26**

3.1 Appendix 6/1: Requirements for Acceptability and Testing of Earthworks Materials 26

3.2 Appendix 6/2: Requirements for Dealing with Class U2 Unacceptable Material. 27

3.3 Appendix 6/3: Requirements for Excavation, Deposition and Compaction 28

3.4 Appendix 6/6: Fill to Structures and Fill Above Structural Foundations 34

3.5 Appendix 6/8: Topsoiling, Grass Seeding and Turfing 35

3.6 Appendix 6/15: Limiting Values for Harm to Human Health and the Environment 37

Appendix A Contamination Procedures & Documentation **39**

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

1 Introduction

1.1 Earthworks Scope

Further details of the scope of works and roles and responsibilities are as defined by the Supervisor and Project Manager and in the Contract Documents.

The works covered by this specification include, but are not limited to the following items:

- Forming bulk, pit, trench and surface area excavations (excluding those for services);
- Filling holes and excavations (excluding those for services); and
- Making up levels by filling in bulk or in layers.

1.2 Site Investigation

Information regarding the site investigation can be found by referring to the site investigation reports:

- BuroHappold Ground Engineering Desk Study Report entitled ' 4 Angel Square and NOMA Primary Sub-station, Manchester' (ref: 4AS-BHE-XX-XX-RP-GE-0001), on behalf of NOMA Limited Partnership, dated 15th March 2019;
- EOD Contracts Limited Explosive Ordnance Desk Top Study entitled 'Miller Street, Manchester' on behalf of the Co-operative Group, dated 16th March 2009;
- University of Salford Archaeological Desk Based Assessment entitled 'NOMA Plots P & Q, Manchester (ref: 20192019/4), on behalf of Hermes Investment Management and MEPC Limited, dated January 2019;
- William Downie Associates Report entitled 'NOMA, Manchester Plot P Design Study – Miller Street New Building Line Impact Study on Existing Utilities Infrastructure' (ref: WDA 67_UIS_v01_3rd October), on behalf of MEPC, dated 3rd October 2018; and
- SOCOTEC Factual Report on Ground Investigation entitled 'Project NOMA PLOT P - FINAL' (ref A9023-19) on behalf of BuroHappold, dated February 2020.

Attention is drawn to the ground conditions of the Site. The envisaged ground conditions likely to be encountered include Made Ground, superficial deposits (Glaciofluvial) and the Chester Formation bedrocke (part of the Sherwood Sandstone Group).

It is worthy of note that asbestos fibres were recorded locally during the ground investigation. The locations and results from the asbestos quantification analysis are summarised below:

- MTP03 at 0.50 m bgl (Made Ground) – Chrysotile – 0.001%;
- MTP04 at 0.50 m bgl (Made Ground) – Amosite – 0.0012%; and
- MTP05 1.00 m bgl (Made Ground) – Amosite and Chrysoltile - <0.001%.

The strategy for dealing with unexpected contamination 'hot spots' is outlined in Appendix A.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

2 Particular Specification

2.1 General

The earthworks shall be undertaken in accordance with:

- MCHW - Series 600 of the Specification for Highway Works (Vol 1), 2009; and
- BS6031 Code of Practice for Earthworks, 2009;

Where a conflict exists this specification shall take precedence.

2.2 Submission of Information

Submittals at 15 days prior to commencement of the works:

- Detailed method statements
- Any temporary works design.
- Instrumentation and monitoring proposals

Submittals during the works:

- Weekly progress reports.
- Excavation/construction records as per specification requirements.
- Records of recorded features (known and unknown).
- Records of monitoring
- Geotechnical laboratory test results
- Contamination test results

Submittals following completion of the works:

- Survey of *as-built* levels, detailing areas and depths of cut and fill including drawings and supporting records including material volumes and types re-used on site, details and volumes of materials imported and any materials sent off site to landfill
- Clear hand-over plan and documentation
- Certification for all imported/exported materials (as a result of excavation and filling operations).
- Works completion *close-out* report (including design, construction and health, safety & welfare summary).

All submittals are subject to review (or approval as necessary) by the Supervisor and Project Manager.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

2.3 Contractor Obligations

a) The Contractor is responsible for any material disposal, undertaken in accordance with any local regulations/guidelines/legislation.

b) Inspection and acceptance of materials, Contract Drawings, and workmanship by the Supervisor, does not in any way relieve the Contractor of their responsibilities under the Contract. The works are to be executed as specified and in accordance with good practice. No changes are permitted without written approval.

c) The following materials are specifically precluded from all specifications pertaining to works carried out under this contract:

i. High alumina cement or concrete;

ii. Woodwool slabs as permanent shuttering;

iii. Calcium chloride in admixtures for use in reinforced concrete;

iv. Asbestos in any form;

v. Sea dredged aggregates for use in reinforced concrete unless otherwise instructed by the Project Manager;

vi. Calcium silicate bricks;

vii. Urea formaldehyde;

viii. Hazardous, aggressive or unstable materials:

Do not import or use fill materials which would, either in themselves or in combination with other materials, liquids, vapours and/or gases, give rise to a health hazard, damage to building structures or instability in the filling.

d) If/where unrecorded features are encountered, the Contractor shall inform the Supervisor immediately. The Contractor shall survey and document any unrecorded features prior to agreeing clearance action with the Supervisor.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

2.4 List of Amendments, Additions and Substitute Clauses to Series 600 Specification

601 Definitions (addition):

The following definitions of earthworks materials shall apply to all clauses of the Specification in which reference is made to the defined classes of materials:

i. Unless and until defined by the Landscape Architect, "Topsoil" shall mean the top layer of soil that can support vegetation;

ii. "Soil" shall mean natural or artificial material without inherent cementing with Uniaxial Compressive Strength less than 0.5MPa;

iii. "Rock" shall mean natural or artificial material with inherent cementing or structure and with a Uniaxial Compressive Strength greater than 0.5MPa;

The following definition shall apply to all clauses of the Specification where reference is made to "Supervisor".

iv. "Supervisor (or Overseeing Organisation)" shall be as defined in the Contract Documents.

602 General Requirements (addition):

1. Existing Services

The existing services must be maintained at all times unless the service is identified to be abandoned on the associated utility drawings. The Contractor shall be responsible for verifying the position of any buried services on the site.

The Contractor's attention is drawn to the presence of known services throughout and immediately adjacent to the development site, in particular:

- North West Limited Electricity;
- Cadnet Gas Low Pressure (LP) Gas Mains;
- Openreach telecommunications;
- Sky Telecommunications;
- Vodafone Telecommunications;
- Zayo Telecommunications; and
- United Utilities potable water and foul sewer;
- The Contractor should familiarize their self with all available historical reports and any associated services information detailed therein.

2. UXO

The Contractor's attention is drawn to the site risk associated with UXO as highlighted in the EOD Contracts Limited Explosive Ordnance report for the site (Section 1 refers). The Contractor should familiarize themselves with the available UXO reports and associated information detailed therein.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3. Site Features to be Retained

Refer to the Architect's drawings.

4. Site Features to be Removed

Before starting work the Contractor shall verify which existing fences, gates, walls, roads, paved areas and other site features are to be removed. Materials arising are to be removed from site.

5. Site Features of Archaeological Interest

Before starting work the Contractor shall verify which areas of the site, if any, are subject to specific archaeological requirements, e.g. archaeological watching brief prior excavation etc. The Contractor's attention is drawn to the University of Salford Archaeology Desk Study (Section 1 refers). The contractor should familiarise themselves with the available report and associated information detailed therein.

6. Trees

Before starting work the Contractor shall verify which trees, shrubs and hedges are to be removed. Cut down, grub up main roots and fill voids with approved material. Dispose of all wood.

7. Undergrowth

Clear site of bushes, scrub and undergrowth. Grub up and dispose of large roots.

8. Japanese Knotweed

None envisaged to be on site.

Japanese Knotweed is an invasive, non-native plant species. The Wildlife and Countryside Act (1981) made it illegal to spread Japanese Knotweed and guidance on the management of Japanese Knotweed on development sites is given in the Environment Agency's (EA) code of practice, 2001.

The Contractor is responsible for ensuring that Japanese Knotweed is not spread across the site. There are a variety of methods available for treating infested areas including spraying with herbicides or digging, spraying and removal to landfill. The Client is responsible for selecting a method of treatment and obtaining approval for the selected method from the Local Authority.

9. Site Clearance

Clear site of all rubbish, debris and vegetation before stripping topsoil. The compaction of topsoil should be avoided.

10. Cultivated Turf

Before starting work the Contractor shall verify any areas of turf to be retained. At the Contractor's discretion, cost and/or profit, other turf may be either:

- lifted and sold, or
- left to be incorporated with the existing topsoil.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

11. Site Access and Working Area

Access to the site and the Contractor's working area will be shown on the drawings. The Contractor shall provide:

- All necessary signs, safety measures and watchmen to ensure security and safe operation of their traffic.
- All necessary servicing for his own offices, stores, workshops, etc.
- Access routes for the Employer and other contractors as shown on the drawings.

2.5 Fill Acceptance Criteria

The fill acceptance criteria are as detailed below:

Engineering Application	Material Classification	Acceptance Criteria	Method of Compaction
General Fill	Classes 1A, 1B, 2A, 2B, 2C, 2D	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4
Fill to Structures	Class 6P or 6N	As per attached Table 6/1	Contractor to propose, subject to achieving 95% of maximum dry density
General Landscape Filling	Class 4	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4
Pavement Capping	Class 6F1 or 6F2	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
GENERAL GRANULAR FILL	1	A	–	Well graded granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) and (iv) in next column, shall not apply to chalk). Recycled aggregate. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries); B1 (municipal incinerator bottom ash (MIBA)); D2 (air cooled blast furnace slag) D3 (basic oxygen furnace slag) D4 (electric arc furnace slag (EAF C)) E (non ferrous steel industry – except E2 molybdenum slag) G (mining and quarry industry)	(i) grading	BS 1377: Part 2 or BS EN 13242	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	1	A	–
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
GENERAL GRANULAR FILL	1	B	–	Uniformly graded granular material	General Fill	Any material, or combination of materials, other than chalk. Recycled aggregate Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates – except chalk); A (construction and demolition recycling industries); B1 (municipal incinerator bottom ash (MIBA)); C1 (coal fly ash) C4 (coal bottom ash) D2 (air cooled blast furnace slag) D3 (basic oxygen furnace slag) D4 (electric arc furnace slag (EAF C)) E (non ferrous steel industry – except E2 molybdenum slag) F (foundry industry) G (mining and quarry industry) H1 (dredge spoil sand)	(i) grading	BS 1377: Part 2 or BS EN 13242	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	1	B	–
							(ii) uniformity Coefficient	See Note 5	–	10				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
GENERAL COHESIVE FILL	2	A	–	Wet cohesive material	General Fill	Any material, or combination of materials, other than chalk.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4	2	A	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	B	–	Dry cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2	B	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	C	–	Stony cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2	C	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	D	–	Silty cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	2	D	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
LANDSCAPE FILL	4	-	-	Various	Fill to landscape areas	Materials arising from the excavations or imported, but excluding unsuitable materials as defined in Appendix 6/15.	(i) grading	BS 1377: Part 2 (On site materials only)	Maximum particle size of 150mm.		Lay in layers not more than 200mm thick and consolidate each layer with the earthmoving plant.	4	-	-

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
SELECTED GRANULAR FILL	6	F	1	Selected granular material (fine grading)	Capping	Any material, or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials contaminated with tar and tar-bitumen binders, unburnt colliery spoil, argillaceous rock and chalk. Property (iv) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less. Where material in this Class is imported onto site it shall be classified as Class 6F4 and comply with the requirements for that material.	(i) grading	BS 1377: Part 2 (On site materials only)	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	1
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
							(iii) Class Ra (asphalt) content	Clause 710	–	50%				
							(iv) bitumen content	BS EN 12697-1 or BS EN 12697-39	–	2.0%				
	6	F	2	Selected granular material (coarse grading)	Capping	Any material, or combination of materials - including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials contaminated with tar and tar-bitumen binders, unburnt colliery spoil and argillaceous rock. Property (i) in the next column shall not apply to chalk. Property (iv) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less. Where material in this Class is imported onto site it shall be classified as Class 6F5 and comply with the requirements for that material.	(i) grading	BS 1377: Part 2 (On site materials only)	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	2
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
							(iii) Class Ra (asphalt) content	Clause 710	–	50%				
							(iv) bitumen content	BS EN 12697-1 or BS EN 12697-39	–	2.0%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
SELECTED GRANULAR FILL	6	N	–	Selected well graded granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates – except shale, siltstone or slate, see Note 7); A2 (crushed concrete) A3 (crushed bricks, masonry) D2 (air cooled blast furnace slag) G1 (red coal shale).	(i) grading	BS 1377: Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377: Part 4 (vibrating hammer method)	6	N	–
								BS EN 933-2 (Imported onto site)	Tab 6/5	Tab 6/5				
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
SELECTED GRANULAR FILL	6	P	–	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, chalk, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. (Properties (i), (ii) and (ix) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates – except shale, siltstone or slate, see Note 7); A2 (crushed concrete) A3 (crushed bricks, masonry) D2 (air cooled blast furnace slag) G1 (red coal shale).	(i) grading	BS 1377: Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377: Part 4 (vibrating hammer method)	6	P	–
								BS EN 933-2 (Imported onto site)	Tab 6/5	Tab 6/5				
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Footnotes to Table 6/1

1	(02/16) App = contract specific Appendix
2	(02/16) Tab = Table
3	(02/16) Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in contract specific Appendix 6/1 shall apply. Where contract specific Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.
4	(02/16) Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 where the material is a soil or BS EN 1097-5 where the material is required to conform to a harmonised European Standard.
5	(02/16) Uniformity coefficient is defined as the ratio of the particle diameters D_{60} to D_{10} on the particle-size distribution curve, where: D_{60} = particle diameter at which 60% of the soil by weight is finer D_{10} = particle diameter at which 10% of the soil by weight is finer
6.	(02/16) The limiting values for Class U1B material are given in contract specific Appendix 6/14 and contract specific Appendix 6/15.
7	(02/16) For works in Wales see sub-Clause 601.21W.
8	(02/16) Where material source codes are referenced these are as listed in Table 6/7.
9	(02/16) Where materials are required to be aggregates conforming to BS EN 13242 materials certificated as being compliant with BS EN 13285 are acceptable for use provided that they meet all the specification requirements and the Declaration of Performance for constituent parts to BS EN 13242 are provided to the Overseeing Organisation.
10	(02/16) Materials shall comply with the current Environmental Regulations at the time of use. Reference shall be made to Annex ZA (informative) of BS EN 13242.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/2: (02/17) Grading Requirements for Acceptable Earthworks Materials Other Than Classes 6F4, 6F5 and 6S

Percentage by Mass Passing the Size Shown																					
Class	**Size (mm)**		**Size (mm) BS Series**													**Size (microns) BS Series**				**Size (micr-ons)**	**Class**
	500	**300**	**125**	**90**	**75**	**37.5**	**28**	**20**	**14**	**10**	**6.3**	**5**	**3.35**	**2**	**1.18**	**600**	**300**	**150**	**63**	**2**	
1A		100	95-100																<15		1A
1B			100																<15		1B
2A & 2B			100											80-100					15-100		2A & 2B
2C			100											15-80					15-80		2C
2D			100																80-100	0-20	2D
6F1					100	75-100				40-95		30-85				10-50			<15		6F1
6F2			100	80-100	65-100	45-100				15-60		10-45				0-25			0-12		6F2
6N & 6P					100														<15		6N & 6P

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/4: (02/16) Method Compaction for Earthworks Materials: Plant and Methods (Method 1 to Method 6) (This Table is to be read in conjunction with sub-Clause 612.10)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~	~~Method 5~~	Method 6		
			D	N#	D	N#	D	N#	~~D N~~	~~D N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Smoothed wheeled roller (or vibratory roller operating without vibration)	1	Mass per metre width of roll: over 2100 kg up to 2700 kg	125	8	125	10	125	10*	~~175 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	2	over 2700 kg up to 5400 kg	125	6	125	8	125	8*	~~200 4~~	~~unsuitable~~	16	unsuitable	unsuitable
	3	over 5400 kg	150	4	150	8	unsuitable		~~300 4~~	~~unsuitable~~	8	16	unsuitable
Grid roller	1	Mass per metre width of roll: over 2700 kg up to 5400 kg	150	10	unsuitable		150	10	~~250 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	2	over 5400 kg up to 8000 kg	150	8	125	12	unsuitable		~~325 4~~	~~unsuitable~~	20	unsuitable	unsuitable
	3	over 8000 kg	150	4	150	12	unsuitable		~~400 4~~	~~unsuitable~~	12	20	unsuitable
Deadweight tamping roller	1	Mass per metre width of roll: over 4000 kg up to 6000 kg	225	4	150	12	250	4	~~350 4~~	~~unsuitable~~	12	20	unsuitable
	2	over 6000 kg	300	5	200	12	300	3	~~400 4~~	~~unsuitable~~	8	12	20
Pneumatic-tyred roller	1	Mass per wheel: over 1000 kg up to 1500 kg	125	6	unsuitable		150	10*	~~240 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	2	over 1500 kg up to 2000 kg	150	5	unsuitable		unsuitable		~~300 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	3	over 2000 kg up to 2500 kg	175	4	125	12	unsuitable		~~350 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	4	over 2500 kg up to 4000 kg	225	4	125	10	unsuitable		~~400 4~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	5	over 4000 kg up to 6000 kg	300	4	125	10	unsuitable		~~unsuitable~~	~~unsuitable~~	12	unsuitable	unsuitable
	6	over 6000 kg up to 8000 kg	350	4	150	8	unsuitable		~~unsuitable~~	~~unsuitable~~	12	unsuitable	unsuitable
	7	over 8000 kg up to 12000 kg	400	4	150	8	unsuitable		~~unsuitable~~	~~unsuitable~~	10	16	unsuitable
	8	over 12000 kg	450	4	175	6	unsuitable		~~unsuitable~~	~~unsuitable~~	8	12	unsuitable

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~	~~Method 5~~	Method 6		
			D	N#	D	N#	D	N#	~~D N~~	~~D N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Vibratory tamping roller		Mass per metre width of a vibrating roll:											
	1	over 700 kg up to 1300 kg	100	12	100	12	150	12	~~100 10~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	2	over 1300 kg up to 1800 kg	125	12	125	12	175	12*	~~175 8~~	~~unsuitable~~	12	unsuitable	unsuitable
	3	over 1800 kg up to 2300 kg	150	12	150	12	200	12*	~~unsuitable~~	~~unsuitable~~	8	12	unsuitable
	4	over 2300 kg up to 2900 kg	150	9	150	9	250	12*	~~unsuitable~~	~~400 5~~	6	10	unsuitable
	5	over 2900 kg up to 3600 kg	200	9	200	9	275	12*	~~unsuitable~~	~~500 6~~	6	10	unsuitable
	6	over 3600 kg up to 4300 kg	225	9	225	9	300	12*	~~unsuitable~~	~~600 6~~	4	8	unsuitable
	7	over 4300 kg up to 5000 kg	250	9	250	9	300	9*	~~unsuitable~~	~~700 6~~	3	7	12
	8	over 5000 kg	275	9	275	9	300	7*	~~unsuitable~~	~~800 6~~	3	6	10

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

TABLE 6/4: (02/16) Method Compaction for Earthworks Materials: Plant and Methods (Method 1 to Method 6) (This Table is to be read in conjunction with sub-Clause 612.10) (continued)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~		~~Method 5~~		Method 6		
			D	N#	D	N#	D	N#	~~D~~	~~N~~	~~D~~	~~N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Vibratory roller		Mass per metre width of vibratory roll:													
	1	over 270 kg up to 450 kg	unsuitable		75	16	150	16	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 450 kg up to 700 kg	unsuitable		75	12	150	12	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	3	over 700 kg up to 1300 kg	100	12	125	10	150	6	~~125~~	~~10~~	~~unsuitable~~		16	unsuitable	unsuitable
	4	over 1300 kg up to 1800 kg	125	8	150	8	200	10*	~~175~~	~~4~~	~~unsuitable~~		6	16	unsuitable
	5	over 1800 kg up to 2300 kg	150	4	150	4	225	12*	~~unsuitable~~		~~unsuitable~~		4	6	12
	6	over 2300 kg up to 2900 kg	175	4	175	4	250	10*	~~unsuitable~~		~~400~~	~~5~~	3	5	11
	7	over 2900 kg up to 3600 kg	200	4	200	4	275	8*	~~unsuitable~~		~~500~~	~~5~~	3	5	10
	8	over 3600 kg up to 4300 kg	225	4	225	4	300	8*	~~unsuitable~~		~~600~~	~~5~~	2	4	8
	9	over 4300 kg up to 5000 kg	250	4	250	4	300	6*	~~unsuitable~~		~~700~~	~~5~~	2	4	7
	10	over 5000 kg	275	4	275	4	300	4*	~~unsuitable~~		~~800~~	~~5~~	2	3	6
Vibrating plate compactor		Mass per m^2 of base plate:													
	1	over 880 kg up to 1100 kg	unsuitable		unsuitable		75	6	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 1100 kg up to 1200 kg	unsuitable		75	10	100	6	~~75~~	~~10~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	3	over 1200 kg up to 1400 kg	unsuitable		75	6	150	6	~~150~~	~~8~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	4	over 1400 kg up to 1800 kg	100	6	125	6	150	4	~~unsuitable~~		~~unsuitable~~		8	unsuitable	unsuitable
	5	over 1800 kg up to 2100 kg	150	6	150	5	200	4	~~unsuitable~~		~~unsuitable~~		5	8	unsuitable
	6	over 2100 kg	200	6	200	5	250	4	~~unsuitable~~		~~unsuitable~~		3	6	12
Vibro-tamper		Mass:													
	1	over 50 kg up to 65 kg	100	3	100	3	150	3	~~125~~	~~3~~	~~unsuitable~~		4	8	unsuitable
	2	over 65 kg up to 75 kg	125	3	125	3	200	3	~~150~~	~~3~~	~~unsuitable~~		3	6	12
	3	over 75 kg up to 100 kg	150	3	150	3	225	3	~~175~~	~~3~~	~~unsuitable~~		2	4	10
	4	over 100 kg	225	3	200	3	225	3	~~250~~	~~3~~	~~unsuitable~~		2	4	10
Power rammer		Mass:													
	1	100 kg up to 500 kg	150	4	150	6	unsuitable		~~200~~	4	~~unsuitable~~		5	8	unsuitable
	2	over 500 kg	275	8	275	12	unsuitable		~~400~~	4	~~unsuitable~~		5	8	14

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~		~~Method 5~~		Method 6		
			D	N#	D	N#	D	N#	~~D~~	~~N~~	~~D~~	~~N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Dropping-weight compactor		Mass of rammer over 500 kg weight drop:													
	1	over 1 m up to 2 m	600	4	600	8	450	8	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 2 m	600	2	600	8	unsuitable		~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3 Series 600 Specification Appendices

The applicable appendices are presented in this section. Appendices 6/4 (Requirements for Class 3 Material), 6/12 (Instrumentation and Monitoring). and 6/14 (Limiting Values for Pollution of Controlled Waters) are not used.

3.1 Appendix 6/1: Requirements for Acceptability and Testing of Earthworks Materials

Acceptable limits for fills are defined in Table 6/1 of this specification. Fill used for forming any construction platform required shall comply with Class 1A, 1B or other such materials proposed by the Contractor which when placed and compacted shall perform as a stable platform for trafficking by piling plant and ready mix concrete trucks without damaging the underlying formation.

The Contractor shall be responsible for determining the Class and acceptability of the material to be used for filling. The contractor shall be responsible for Class/acceptability testing which shall be undertaken by an approved independent testing organisation at frequencies given in the table below. All testing shall be undertaken by accredited NAMAS or equivalent approved geotechnical and chemical analysis laboratories to be paid for by the Contractor. The Contractor shall allow sufficient time in their programme for the required testing. The Contractor is required to provide **daily** records of testing of the material placed to show compliance with the Specification. The minimum requirements are:

Class / Use	Test	Frequency
General Granular Fill (Class 1A and 1B)	Grading	At least 1 test/day or 1 test/500m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
General Cohesive Fill (Class 2A, 2B, 2C and 2D)	Grading	At least 1 test/day or 1 test/500m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
	Plasticity Tests	1 test/day per material type of every 500m^3 placed
Structural Granular Fill (Class 6N and 6P)	Grading	At least 1 test/day or 1 test/50m^3
	mc	3 tests/day per material type placed or every 20m^3 placed
	Maximum dry density	1 test/ 50m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
	In-situ dry density (by sand replacement or nuclear test method) for end product requirement	1 test for each 10m × 10m square grid of placed fill (all layers to be tested) with at least 4 tests per compacted layer
Capping (Class 6F1 and 6F2)	Grading	At least 1 test/day or 1 test/50m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 50m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
Landscape Fill (Class 4)	Grading	At least 1 test/day or 1 test/500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Note: 1. For each element cited above the option giving the greatest number of tests shall apply.
2. In areas of general filling, the density of the placed fill shall be checked **twice daily** by means of sand replacement density tests to ensure suitable compaction is achieved and to avoid excessive settlement in areas of substantial fill.

3.2 Appendix 6/2: Requirements for Dealing with Class U2 Unacceptable Material.

1. The Contractor is responsible for disposal.

2. A 'watching-brief' should be maintained during all stages of the work (included trial pitting) to remain vigilant to possibility of hitherto undetected areas of contamination.

Where materials that appear to be contaminated (either visually or on the basis of odour) are encountered during the excavation works, the Contractor shall inform the Supervisor immediately to obtain further instruction. The Contractor shall be responsible for carrying out laboratory testing to enable the materials to be classified for hazard assessment and waste disposal purposes, and for disposal to suitably licensed tip if unsuitable to remain on site. Such work is to be carried out by a suitably qualified professional. Test methods and appropriate assessment criteria for chemical analysis shall be as required by the relevant authority or otherwise agreed with the Supervisor.

The Contractor shall maintain records and copies of assignment notes and duty of care documentation for all materials disposed of off-site and shall submit copies on completion of the work.

Where surplus soils for disposal are chemically contaminated, the Contractor shall be responsible for disposal of these materials. The Contractor shall be deemed the producer and holder of the waste and shall be responsible for classifying the materials for disposal to landfill. The Contractor shall be responsible for carrying out any further soil contaminant testing and Waste Acceptance Criteria testing to enable classification of the waste in accordance with current regulatory guidance and the requirements of the receiving landfill.

The Contractor shall prepare an earthworks spoil management strategy which shall take account of the range of waste types expected to be encountered and set out any proposed sampling and testing regime for waste classification. The strategy shall include consideration of stockpile management, measures and working methods to protect site worker health and safety and the environment, and working methods to minimize the degree of intermixing of wastes of different classes and to minimize disposal costs.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3.3 Appendix 6/3: Requirements for Excavation, Deposition and Compaction

Earthworks requirements are defined in the relevant contract drawings. For general working conditions and contract specific requirements refer to the Contract Documents.

1. Basic Workmanship for Excavating

Comply with BS 8000: Part 1, Sections 3.1, 3.2 and 3.3.

2. Temporary Works

The Contractor is responsible for the design of such works, details of these to be submitted for review at least 14 days before commencing work on site.

3. Excavation of Chemically Contaminated Materials

Where contaminated materials are to be excavated the Contractor shall be responsible for all Health and Safety precautions required to protect the site personnel and the local environment and shall provide method statements covering these issues. It should be noted that during previous Ground Investigations asbestos fibres have been recorded locally.

It is essential that where feasible, all materials should be stockpiled separately to allow their material/chemical properties to be assessed and their re-use potential appraised against the re-use criteria outlined in Appendix 6/15.

4. Materials Arising

Materials arising from the excavations and surplus to requirements for filling are to remain the property of the Contractor. Remove from site surplus excavated material (subsoil) not specified to be spread and levelled or stockpiled.

5. Benching

Surfaces of excavations with a gradient greater than 1 in 5 which are to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.

6. Adjacent Excavations

Where an excavation encroaches below a line drawn at an angle of 45º from the horizontal from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto must be completed before the higher excavation is made.

7. Proposed Levels of Formation

Refer to Contract Drawings. Permissible deviations from formation levels:

- Embankments and cuttings: ±50mm;

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

8. Accuracy

Permissible deviations from formation levels:

- Beneath mass concrete foundations: ±25 mm.
- Beneath ground bearing slabs and r.c. foundations: -15 mm, +0 mm.
- Embankments and cuttings: ±50 mm.
- Ground abutting external walls: ±50 mm, but such as to ensure that finished level is not less than 150 mm below dpc.

9. Formations Generally

The Contractor shall undertake inspection of formations for the following:

a) Mass Concrete Pad and Strip Foundations.

b) Reinforced Concrete Pad and Strip Foundations.

c) Basement and Ground Floor Slabs.

d) Basement slabs/lift pits

e) Roads, Footpaths or other Pavements.

f) Retaining Walls.

Remove the last 50 mm of excavations just before inspection. Trim excavations to required profiles and levels and remove all loose material.

Visual inspection at the base of each foundation is required by a suitably qualified ground engineer to ensure that the required founding strata is consistent with the strength assumed in the foundation design. Arisings from the base of the foundation excavations can also be tested with a penetrometer to verify suitable material strength has been achieved. When preparing formations, all soft spots shall be removed and replaced with suitable fill materials. Any obstructions encountered shall also be removed. The final surface of all formations shall be well rolled, smooth, and free from movement under compaction plant and from ridges, cracks, loose material, ruts or other defects. Due to the susceptibility of any cohesive deposits from moisture and water ingress into excavations, unless otherwise instructed, formations must be sealed immediately after excavation/inspection with concrete.

10. Foundations Generally

Obtain instructions if:

- A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
- The formation contains soft or hard spots or highly variable material.

11. Trench Fill Foundations

Excavate the whole depth of the trench down to formation by machine in one operation. The Contractor shall undertake inspection of the formation as soon as it is exposed. Unless otherwise instructed place concrete immediately after inspection.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

12. Foundations in Made Up Ground

Excavate down to a natural formation of undisturbed subsoil. Obtain instructions if this is at a lesser depth than that shown on the drawings.

13. Unstable Ground

The Contractor shall satisfy themselves that any newly excavated face will remain unsupported sufficiently long to allow the necessary earthwork support to be inserted. If unexpected unstable conditions are encountered which are likely to affect adjacent structures or roadways, appropriate emergency action should be undertaken until the instability can be rectified.

14. Recorded Features

Break out old foundations, beds, drains, etc. where and to the extent stated on the drawings. Seal off drain ends, remove contaminated earth and disinfect as required by local authority. Backfill as specified on the drawings.

Due to the rich site history, a number of obstructions have been recorded locally within the ground. Consideration will need to be given to foundation penetration/installation, plant and equipment required to enable excavation in areas of obstructions and any stability issues associated with removal of obstructions etc. . Before starting work the Contractor shall verify which areas of the site, if any, are subject to specific archaeological requirements, e.g. archaeological watching brief prior excavation etc. It should also be noted that the proposed development is in a constrained urban environment. It is the responsibility of the Contractor to enter dialogue with the relevant service providers and Local Authority (Manchester City Council) and their representatives to agree an acceptable methodology of working when in close proximity to the associated infrastructure.

15. Unrecorded Features

Where old foundations, beds, basements, filling, tanks, service pipes, drains, hotspots of soil contamination etc. not shown on the drawings are encountered, obtain instructions before proceeding. See also Appendix 6/15.

Where old foundations, beds, basements etc. are encountered, these are to be grubbed out, processed and reused as part of the works subject to suitability testing (both geotechnical (Section 2.5 and Appendix 6/1 refer) and chemical (Appendix 6/15 refer). Note any Archaeological restrictions/requirements are also to be adhered to.

16. Excess Excavation

Backfill any excavations taken:

- Wider than required with the material specified for backfilling.
- Deeper than required with well graded granular material or lean mix concrete.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

17. Hauling

Hauling of material from excavation and spoil heaps to fill areas to proceed only where sufficient spreading and compacting plant are operated at the place of deposition.

18. Cut Slopes

The Contractor is to ensure that the slopes of all cuttings are such that stability and safety are maintained at all times. Any temporary cuttings should be identified in the Contractor's method statements, and slope angles agreed in advance with the Contract Supervisor.

19. Use of Plant

Do not use plant at the surface of the bottom of the excavation unless:

- The excavation is in rock and contains no soft material, or
- The level of the bottom surface is maintained at least 300 mm above formation level.

Any damage to the subgrade to be made good at the Contractor's expense and using material having the same characteristics as that which has been damaged.

20. Temporary Stockpiles

Allowance shall be made for the possible deterioration of the stockpiled material due to weathering. Precautions shall be taken to ensure stability, taking into account the strength of the underlying ground and the effect on drainage. It may be necessary to carry out partial compaction of stockpiles and/or to provide additional protection to maintain the quality of the stockpiled material. Where temporary stockpiles of contaminated soils are required i.e. either arisings of made ground or any unexpected contamination hot spots, then protective measures will be required to minimize run-off/leachates and washing of fines.

21. Constraints on Excavation Phasing

At tender stage the Contractor shall produce an Enabling Works Plan which clearly shows the phasing of the bulk excavation with respect to the other specific Enabling Works.

22. Groundwater Level

Details of the groundwater levels are included in the site investigation reports. Localized post fieldwork monitoring data from previous phases of GI suggests the groundwater regime is located between ~26.00 m AOD and ~27.00 m AOD. Perched groundwater (seepages) were also recorded locally between ~30.94 m AOD and 33.64 m AOD. The Contractor should expect that seasonal effects may lead to groundwater being encountered at a different level to those stated above. During the works groundwater must be controlled to ensure no flooding of the site or degradation of excavated materials or exposed slopes.

23. Water Courses

Any watercourses that have been diverted and are to be filled must be cleared of all vegetable growth and soft deposits before filling.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

24. Water

Keep all excavations free from water until the construction of basements and retaining walls is able to resist leakage, water pressure and flotation. The Contractor shall be responsible for obtaining all discharge licenses for disposal of water via sewer or to surface water.

25. Running Water

The Contractor shall inform the Supervisor immediately if any springs or running water are encountered during the Works.

26. Pumping

Any pumping undertaken shall comply with the following requirements:

- Excavated faces or stability of adjacent ground or structures shall not be disturbed.
- Pumped water shall be discharged without flooding the site or adjoining property.
- Any sumps shall be constructed clear of excavations and filled on completion.

27. Suitable and Unsuitable Fill Materials

'Suitable material' comprises all that which is acceptable to the Contractor in accordance with this specification. No excavated suitable material is to be removed from the site unless this suits the Contractor's operational procedure and then the Contractor is to make good any subsequent deficit at their own expense. Where the excavation reveals a combination of suitable and unsuitable materials (as described below) the Contractor is to propose the methods by which suitable material may be excavated without contamination by unsuitable materials.

Do not import or use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling. Limiting values for contaminant concentrations in fill materials are given in Appendix 6/15.

Any materials arising or imported that appear suspect in terms of contamination based on either appearance or smell shall be stockpiled separately and tested for the contaminant suite listed in Appendix 6/15 in addition to any other appropriate contaminant as indicated by appearance or by smell and accepted into the Works or disposed of off site as appropriate.

Soluble sulphate content (SO4) of imported materials for filling under concrete slabs or within 1 m of substructures must not exceed 0.5 g/litre when tested BS 1377:Part 3, Clause 5 using a 2:1 water-soil extract.

Other unsuitable materials include: material from marshes or bogs, peat, logs, stumps, slurry, mud and perishable material, material susceptible to spontaneous combustion, material in a frozen condition, clays of liquid limit exceeding 80% and/or plasticity index exceeding 55, material with excessive moisture content. See also Section 2.3 of this Specification.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

28. Frost Susceptibility

Except as allowed below, fill must be non frost-susceptible as defined in Highways Agency 'Specification for Highway Works', Clause 602. If the following fill materials are proposed, a laboratory report shall be obtained confirming they are non-frost-susceptible:

- Fine grained soil with a plasticity index less than 20%.
- Coarse grained soil or crushed granite with more than 10% retained on a 0.063 mm sieve.
- Crushed chalk.
- Crushed limestone fill with average saturation moisture content in excess of 3%.
- Burnt colliery shale.

Frost-susceptible fill may only be used if:

- It is to be placed within the external walls of buildings below spaces that will be heated.
- It is placed in excess of 500 mm beneath the proposed final ground level.
- Any frost-susceptible fill shall be protected from frost at all times during construction.

29. Placing Fill Generally

- Ensure that excavations and areas to be filled are free from loose soil, rubbish and standing water.
- Do not use frozen materials or materials containing ice. Do not place fill on frozen surfaces.
- Take all necessary precautions to ensure stability of adjacent structures. Place and compact fill against structures, membranes or buried services in a sequence and manner which will ensure stability and avoid damage.
- Plant employed for transporting, laying and compacting must be suited to the type of material.
- Lay differing materials separately so that only one type of material occurs in each layer.

30. Benching in Fill

Where, during the progress of the work, the difference in level between adjacent areas of filling exceeds 600 mm, cut into edge of higher filling to form benches having a minimum width of 600 mm and a height equivalent to the depth of a layer of compacted filling. Spread and compact new filling to ensure maximum continuity with the previous filling.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3.4 Appendix 6/6: Fill to Structures and Fill Above Structural Foundations

This specification is in respect of the permanent works only.

1. First Layer of Compacted Filling

To be of suitable hard granular material thoroughly compacted to 150 mm thickness.

2. Protection of Compacted Filling

Do not allow construction traffic on compacted cohesive soil filling until the level has been raised not less than 150 mm above formation level by properly compacted temporary protective filling.

Remove temporary protective filling from site before beginning permanent construction.

The Contractor shall be responsible for making good any damage to the compacted fill.

3. Deterioration of Fill Materials

If the material to be deposited as fill subsequently reaches a condition where it cannot be compacted to the requirements of this specification the Contractor shall:

- make good by removing the material from site until it is in a suitable condition for reuse and/or replace with suitable material; or
- make good the material by mechanical or chemical means; or
- cease work until the physical condition of the material is such that it can be compacted as described in this specification.

4. Blinding

Surfaces to receive sheet overlays or concrete to have sufficient sand, fine gravel, PFA or other approved fine material applied to fill interstices and provide a close smooth surface.

- Permissible deviations on surface level: +0/-25 mm.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3.5 Appendix 6/8: Topsoiling, Grass Seeding and Turfing

1. General

Refer to Landscape Architect's drawings and specifications for details of subsoil preparation and topsoiling operations but the following requirements in respect of chemical suitability should also be complied with.

2. Grade Subsoil

Grade topsoil to smooth flowing contours and to achieve the specified finished levels of the topsoil. Excavate locally as necessary for areas of thicker topsoil. Small planting beds located in general landscape areas may be excavated separately at a later date.

3. Loosen Subsoil (Non-Cohesive)

Loosen subsoil consisting of light, non-cohesive material with a 3 tine ripper, drawn 300 mm deep at 600 mm centres.

4. Loosen Subsoil (Cohesive)

Loosen subsoil consisting of stiff clays or other cohesive material with a single tine ripper driven 450 mm deep at 1 m centres and drawn by a crawler tractor.

5. Stripping Topsoil

Before beginning general excavation or filling excavate topsoil from required areas to an average depth of 200 mm and keep separate from excavated subsoil. At the time of excavation the topsoil must be reasonably dry.

6. Treating Topsoil

Not less than two weeks before excavating topsoil treat with a suitable herbicide.

7. Handling Topsoil

The following requirements shall be complied with:

- Where aggressive weeds as included in the Weeds Act – Section 2 or the Wildlife and Countryside Act – Schedule 9 – Part 2 are encountered, instructions should be obtained prior to moving topsoil.
- Earthmoving equipment shall be selected and used to minimize disturbance, trafficking and compaction of topsoil.
- On no account should topsoil be mixed with:
    a) Subsoil, stone, hardcore, rubbish or material from demolition work.
    b) Oil, fuel, cement or other substances harmful to plant growth.
    c) Other grades of topsoil.
- Multiple handling should be kept to a minimum. Where practicable topsoil should be used immediately after stripping.
- Topsoil handling should be undertaken in the driest condition possible. It should not be handled during or after heavy rainfall or when it is wetter than the plastic limit defined by BS 3882 Annex N2.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

8. Undisturbed Topsoil which is to be Landscaped

Prepare as necessary to ensure that the topsoil is in a suitable state for the cultivation operations specified in sections Q30 and/or Q31. In particular:

- Where the ground is hard, break up with ripper operated in transverse directions, removing any roots and boulders.
- Where the ground is covered with turf or a thick sward plough or dig over to the full depth of the topsoil.
- After any such cultivation leave fallow for not less than 1 month. During this period treat with a suitable herbicide at appropriate times to prevent seeding of weeds.

9. Imported Topsoil

Provide as necessary to make up any deficiency of topsoil existing on site and to complete the work.

10. Topsoil Spoil Heaps

To be not more than 2m high. Treat with a suitable herbicide at appropriate times to prevent seeding of weeds. Prevent compaction and contamination.

11. Surplus Excavated Topsoil

Remove from site.

12. Contamination

Do not use topsoil contaminated with subsoil, rubbish, oil-based products or other materials toxic to plant life. Dispose of contaminated topsoil as instructed.

Both **imported topsoil** and **site won topsoil** for use as fill to the top metre (if required) on the site will be tested for the contaminant suite listed in Appendix 6/15 to ensure that contaminant threshold levels are not exceeded.

13. Spread Topsoil

Spread topsoil over prepared subsoil layers not exceeding 150 mm and firm each layer before spreading the next. At the time of laying, both the material and the weather must be reasonably dry. Overall minimum depths after firming and settlement to be 150 mm but locally increased with tree pits as necessary in accordance with the Architects requirements.

14. Finished Levels of Topsoil

After settlement, unless otherwise stated, to be:

- 30 mm above adjoining paving or kerbs
- Not less than 150 mm below dpc of adjoining buildings
- 30 mm higher for shrub areas than for adjoining grass areas.
- Married in with adjoining soil areas.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

3.6 Appendix 6/15: Limiting Values for Harm to Human Health and the Environment

Fill materials and imported / site won topsoil must not contain any contaminant in the suite listed below that is in excess of the given maximum permissible contaminant concentrations. Soil concentrations only will be determined.

For all site won and imported recycled fill, stone or brick, this testing shall be carried out at a rate of 1 test per 250 m^3 of placed fill material. In addition, any materials arising or imported that appear suspect in terms of contamination based on either appearance or smell shall be stockpiled separately and tested for the contaminant suite listed below in addition to any other appropriate contaminant as indicated by appearance or by smell and either accepted into the Works or disposed of off-site as appropriate. Thresholds are C4SLs and S4ULs (except SGV for Free Cyanide).

The rate of validation testing on imported topsoil will be 1 sample per 250 m^3 of backfill or a minimum of 3 (whichever is greater). The rate of validation testing on site won topsoil will be 10 no. representative samples from stockpile.

Determinand	Site Won and Imported material		Topsoil	
	Maximum Soil Concentration	Maximum Soil Leachate Concentration	Maximum Soil Concentration	Maximum Soil Leachate Concentration
Arsenic	40 mg/kg	-	37 mg/kg	-
Cadmium	149 mg/kg	-	26 mg/kg	-
Chromium (total)	910 mg/kg	-	910 mg/kg	-
Chromium (VI)	21 mg/kg	-	21 mg/kg	-
Lead	310 mg/kg	-	200 mg/kg	-
Mercury	56 mg/kg	-	1.2 mg/kg	-
Selenium	430 mg/kg	-	250 mg/kg	-
Copper	7,100 mg/kg	-	2,400 mg/kg	-
Nickel	180 mg/kg	-	130 mg/kg	-
Zinc	40,000 mg/kg	-	3,700 mg/kg	-
TPH	**See Table A1**	-	490 mg/kg Note 1	-
PAH (USEPA 16)	**See Table A2**	-	**See Table A2**	-
Phenol Index	1,200 mg/kg	-	380 mg/kg	-
Free Cyanide	760 mg/kg	-	4.6 mg/kg	-
pH	5<pH<9	-	5<pH<9	-
Asbestos	See Note 2	-	None detectable Note 3	-

Note: 1. Materials exceeding these thresholds shall be subject to speciated analysis and comparison with **Table A1.**
2. Free fibres <0.1%. Cement-bound asbestos <0.1% of total material volume.
3. No free fibres and no cement bound asbestos.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Table A1. Threshold concentrations for risk banded hydrocarbons and BTEX.

Determinand		Maximum Concentration for Site Won and Imported material	Maximum Concentration for Topsoil
Aliphatic	EC>5 - EC6	42 mg/kg	42 mg/kg
	EC>6 – EC8	100 mg/kg	100 mg/kg
	EC8 – EC10	27 mg/kg	27 mg/kg
	EC10 – EC12	130 mg/kg	130 mg/kg
	EC12 – EC16	1,100 mg/kg	1,100 mg/kg
	EC16 – EC21	65,000 mg/kg	65,000 mg/kg
	EC21 – EC35	65,000 mg/kg	65,000 mg/kg
Aromatic	EC5 – EC7	370 mg/kg	70 mg/kg
	EC7 – EC8	860 mg/kg	130 mg/kg
	EC8 – EC10	47 mg/kg	34 mg/kg
	EC10 – EC12	250 mg/kg	74 mg/kg
	EC12 – EC16	1800 mg/kg	140 mg/kg
	EC16 – EC21	1900 mg/kg	260 mg/kg
	EC21 – EC35	1900 mg/kg	1,100 mg/kg
Benzene		0.38 mg/kg	0.087 mg/kg
Ethylbenzene		83 mg/kg	47 mg/kg
Toluene		869 mg/kg	130 mg/kg
Xylene		79 mg/kg	56 mg/kg

Table A2. Threshold concentrations for Poly Aromatic Hydrocarbons (USEPA 16).

Determinand	Maximum Concentration for Site Won and Imported material	Maximum Concentration for Topsoil
Naphthalene	2.3 mg/kg	2.3 mg/kg
Acenaphthylene	2,900 mg/kg	170 mg/kg
Acenaphthene	3,000 mg/kg	210 mg/kg
Flourene	2,800 mg/kg	170 mg/kg
Phenanthrene	1,300 mg/kg	95 mg/kg
Anthracene	31,000 mg/kg	2,400 mg/kg
Fluoranthene	1,500 mg/kg	280 mg/kg
Pyrene	3,700 mg/kg	620 mg/kg
Benzo(a)anthracene	11 mg/kg	7.2 mg/kg
Chrysene	30 mg/kg	15 mg/kg
Benzo(b)fluoranthene	3.9 mg/kg	2.6 mg/kg
Benzo(k)fluoranthene	110 mg/kg	77 mg/kg
Benzo(a)pyrene	3.2 mg/kg	2.2 mg/kg
Indendo(123-cd)pyrene	45 mg/kg	27 mg/kg
Dibenzo(ah)anthracene	0.31 mg/kg	0.24 mg/kg
Benzo(ghi)perylene	360 mg/kg	320 mg/kg

Note: All laboratory contamination testing shall be carried out in a UKAS and MCerts accredited laboratory, in accordance with the standards and procedures defined by MCerts.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Appendix A Contamination Procedures & Documentation

A1 Validation Strategy

As soon as practicable after the completion of the groundworks and removal of any anticipated or unexpected 'hot spots' a **Validation Report** shall be prepared and submitted by the Contractor and agreed with the relevant Local Authority Planning Development Department

The validation strategy shall be as follows:

- All materials should be stockpiled separately to allow their material/chemical properties to be assessed and their re-use potential appraised against the reuse criteria outlined in Appendix 6/15.
- All placed fill material, both site won and imported, is to be validated for the suite of chemicals detailed in Appendix 6/15 at the frequency required in Appendix 6/1.
- Anticipated areas of elevated concentrations or 'hot spots' shall be excavated and removed to at least 1.00 m beyond any visual or olfactory (odorous) indication of contamination. As a minimum, 5 No. samples will be required (four sides and base) but for larger 'hot spots' sample spacing should not exceed 10 m with the requisite increase in number of samples.
- Samples of the surrounding soil will be taken from the excavation formed and tested for the suite of determinands listed in Appendix 6/15 in addition to any other appropriate contaminant as indicated by appearance or by smell.
- If the chemical concentrations of the soil samples are less than the concentrations recorded in Appendix 6/15 or other appropriate guidance in respect of other appropriate contaminant, the elevated concentrations or 'hot spot' can be considered to have been removed and no further remedial action is required.
- If the chemical concentrations of the soil samples are greater than the concentrations recorded in Appendix 6/15, further excavation is required and the sequence of sampling and testing should be repeated. Incremental excavation and testing should continue until the chemical concentrations encountered are less than the concentrations recorded in Appendix 6/15 or other appropriate guidance in respect of other appropriate contaminant.
- During this procedure, the following information should be collected and recorded:
  - The exact extent of each phase of excavation should be recorded using 3D topographical surveying techniques.
  - The exact position and depth of each sample taken should be recorded using 3D topographical surveying techniques.
  - The samples should be given a unique reference number.
  - The laboratory testing results for each unique sample shall be recorded.
  - A photographic record of each phase of excavation and sampling will be collected and recorded.
- A general photographic record of the works should also be collected and recorded to provide a general record of the nature and characteristics of the materials encountered and/or laid to form formations etc. Where practicable, the photographic record should be cross referenced with any chemical testing available for the material type.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

A validation report should be prepared, comprising substantiating completion documentation to include type of documentation listed above and photographic records in addition to Environmental Protection Act 1990 Section 34 Duty of Care documentation relating to waste disposal of the material removed from site.

A2 Validation Documentation Requirements

The following documentation shall be prepared by the Contractor and submitted to the relevant Local Authority Planning Development Department.

- Plan or plans showing earthworks movement of materials on site (cut and fill) and imported if appropriate. This is to include confirmation of the volumes of each material placed (i.e. volume of site won and volume of imported).
- Plan or plans showing the location of any 'hot spots' located, if any, or confirmation that none were encountered.
- Plan or plans showing location of chemical testing undertaken as appropriate plus supporting information.
- Plan or plans showing surface finishes and thickness of build-ups, topsoil or clean cover as appropriate.
- Plan or plans showing the location of any hotspots encountered during service trench excavation, if any, and plan sections of remedial measures undertaken for water pipe provision.
- Appropriate records of material removed from site including testing records.
- Appropriate records of material imported to site including testing records.
- Appropriate records of topsoil imported to site including testing records.
- Appropriate photographic records of the earthworks plus any specific areas of interest ('hotspots', tanks etc).
- Appropriate photographic records demonstrating the required thickness of material has been placed in soft landscaped areas.
- Records of any water control of groundwater that may have been contaminated, if any, or confirmation that none were encountered.
- Other records, if appropriate, not included in above summary.
- A statement confirming the earthworks was undertaken in accordance with this specification.

Copyright © 1976 - 2020 BuroHappold Engineering. All Rights Reserved.

Louise Richards
Buro Happold Limited
3 Wellington Place
Brewery Wharf
Leeds
LS10 1NE
UK

T: +44 (0)113 204 2200
F: +44 (0)870 787 4144
Email: louise.richards@burohappold.com

BUROHAPPOLD ENGINEERING

NOMA 4 Angel Square

Specification for Earthworks

042512

12 December 2019

Revision P01 **DRAFT – Subject to Local Authority Approval**

042512-BHE-XX-XX-SP-GE-0003-P01

Copyright © 1976 - 2019 BuroHappold Engineering. All Rights Reserved.

Revision	Description	Issued by	Date	Checked
P00	For Stage 3 Tender	LR	02/12/19	COH
P01	For Stage 3 Tender DRAFT (subject to Local Authority Approval)	LR	12/12/19	COH

\\Srv-manc02\project filing\0042512 NOMA Plot P\F9 Ground Eng- Site Inv\05 Specifications\Earthworks\Rev01\4AS-BHE-XX-XX-SP-GE-0003_P01.docx

This report has been prepared for the sole benefit, use and information of MEPC for the purposes set out in the report or instructions commissioning it. The liability of Buro Happold Limited in respect of the information contained in the report will not extend to any third party.

It should be noted that at the tie of issue this document is DRAFT and those clauses related to contaminated land detailed in this specification are subject to Local Authority Approval.

author	**Louise Richards**
date	**12th December 2019**
approved	**Chris O'Hara**
signature	
date	**12th December 2019**

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Table of Contents

1 Introduction **6**

1.1 Earthworks Scope 6

1.2 Site Investigation 6

2 Particular Specification **7**

2.1 General 7

2.2 Submission of Information 7

2.3 Contractor Obligations 8

2.4 List of Amendments, Additions and Substitute Clauses to Series 600 Specification 9

2.5 Fill Acceptance Criteria 11

3 Series 600 Specification Appendices **26**

3.1 Appendix 6/1: Requirements for Acceptability and Testing of Earthworks Materials 26

3.2 Appendix 6/2: Requirements for Dealing with Class U2 Unacceptable Material. 27

3.3 Appendix 6/3: Requirements for Excavation, Deposition and Compaction 28

3.4 Appendix 6/6: Fill to Structures and Fill Above Structural Foundations 35

3.5 Appendix 6/8: Topsoiling, Grass Seeding and Turfing 36

3.6 Appendix 6/15: Limiting Values for Harm to Human Health and the Environment 38

Appendix A Contamination Procedures & Documentation

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

1 Introduction

1.1 Earthworks Scope

Further details of the scope of works and roles and responsibilities are as defined by the Supervisor and Project Manager and in the Contract Documents.

The works covered by this specification include, but are not limited to the following items:

- Forming bulk, pit, trench and surface area excavations (excluding those for services);
- Filling holes and excavations (excluding those for services); and
- Making up levels by filling in bulk or in layers.

1.2 Site Investigation

Information regarding the site investigation can be found by referring to the site investigation reports:

- BuroHappold Ground Engineering Desk Study Report entitled ' 4 Angel Square and NOMA Primary Sub-station, Manchester' (ref: 4AS-BHE-XX-XX-RP-GE-0001), on behalf of NOMA Limited Partnership, dated 15th March 2019;
- EOD Contracts Limited Explosive Ordnance Desk Top Study entitled 'Miller Street, Manchester' on behalf of the Co-operative Group, dated 16th March 2009;
- University of Salford Archaeological Desk Based Assessment entitled 'NOMA Plots P & Q, Manchester (ref: 20192019/4), on behalf of Hermes Investment Management and MEPC Limited, dated January 2019;
- William Downie Associates Report entitled 'NOMA, Manchester Plot P Design Study – Miller Street New Building Line Impact Study on Existing Utilities Infrastructure' (ref: WDA 67_UIS_v01_3rd October), on behalf of MEPC, dated 3rd October 2018; and
- SOCOTEC Factual Report on Ground Investigation entitled 'Project NOMA PLOT P - DRAFT' (ref A9023-19) on behalf of BuroHappold, dated November 2019.

Attention is drawn to the ground conditions of the Site. The envisaged ground conditions likely to be encountered include Made Ground, superficial deposits (Glaciofluvial) and the Chester Formation Sandstone (part of the Sherwood Sandstone Group).

The Contractors attention is drawn to the identification of asbestos fibres on-site during the ground investigation. The locations and results from the asbestos quantification analysis are as summarised below;

- MTP03 at 0.50 m bgl (Made Ground) – Chrysotile – 0.001%;
- MTP04 at 0.50 m bgl (Made Ground) – Amosite – 0.0012%; and
- MTP05 at 1.00 m bgl (Made Ground) – Amosite and Chrysoltile - <0.001%.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

2 Particular Specification

2.1 General

The earthworks shall be undertaken in accordance with:

- MCHW - Series 600 of the Specification for Highway Works (Vol 1), 2009; and
- BS6031 Code of Practice for Earthworks, 2009;

Where a conflict exists this specification shall take precedence.

2.2 Submission of Information

Submittals at 15 days prior to commencement of the works:

- Detailed method statements
- Any temporary works design.
- Instrumentation and monitoring proposals

Submittals during the works:

- Weekly progress reports.
- Excavation/construction records as per specification requirements.
- Records of recorded features (known and unknown).
- Records of monitoring
- Geotechnical laboratory test results
- Contamination test results

Submittals following completion of the works:

- Survey of *as-built* levels, detailing areas and depths of cut and fill including drawings and supporting records including material volumes and types re-used on site, details and volumes of materials imported and any materials sent off site to landfill
- Clear hand-over plan and documentation
- Certification for all imported/exported materials (as a result of excavation and filling operations).
- Works completion *close-out* report (including design, construction and health, safety & welfare summary).

All submittals are subject to review (or approval as necessary) by the Supervisor and Project Manager.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

2.3 Contractor Obligations

a) The Contractor is responsible for any material disposal, undertaken in accordance with any local regulations/guidelines/legislation.

b) Inspection and acceptance of materials, Contract Drawings, and workmanship by the Supervisor, does not in any way relieve the Contractor of their responsibilities under the Contract. The works are to be executed as specified and in accordance with good practice. No changes are permitted without written approval.

c) The following materials are specifically precluded from all specifications pertaining to works carried out under this contract:

i. High alumina cement or concrete;

ii. Woodwool slabs as permanent shuttering;

iii. Calcium chloride in admixtures for use in reinforced concrete;

iv. Asbestos in any form;

v. Sea dredged aggregates for use in reinforced concrete unless otherwise instructed by the Project Manager;

vi. Calcium silicate bricks;

vii. Urea formaldehyde;

viii. Hazardous, aggressive or unstable materials:

Do not import or use fill materials which would, either in themselves or in combination with other materials, liquids, vapours and/or gases, give rise to a health hazard, damage to building structures or instability in the filling.

d) If/where unrecorded features are encountered, the Contractor shall inform the Supervisor immediately. The Contractor shall survey and document any unrecorded features prior to agreeing clearance action with the Supervisor.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

2.4 List of Amendments, Additions and Substitute Clauses to Series 600 Specification

601 Definitions (addition):

The following definitions of earthworks materials shall apply to all clauses of the Specification in which reference is made to the defined classes of materials:

i. Unless and until defined by the Landscape Architect, "Topsoil" shall mean the top layer of soil that can support vegetation;

ii. "Soil" shall mean natural or artificial material without inherent cementing with Uniaxial Compressive Strength less than 0.5MPa;

iii. "Rock" shall mean natural or artificial material with inherent cementing or structure and with a Uniaxial Compressive Strength greater than 0.5MPa;

The following definition shall apply to all clauses of the Specification where reference is made to "Supervisor".

iv. "Supervisor (or Overseeing Organisation)" shall be as defined in the Contract Documents.

602 General Requirements (addition):

1. Existing Services

The existing services must be maintained at all times unless the service is identified to be abandoned on the associated utility drawings. The Contractor shall be responsible for verifying the position of any buried services on the site.

The Contractor's attention is drawn to the presence of known services throughout and immediately adjacent to the development site, in particular:

- North West Limited Electricity;
- Cadnet Gas Low Pressure (LP) Gas Mains;
- Openreach telecommunications;
- Sky Telecommunications;
- Vodafone Telecommunications;
- Zayo Telecommunications; and
- United Utilities potable water and foul sewer;
- The Contractor should familiarize their self with all available historical reports and any associated services information detailed therein.

2. UXO

The Contractor's attention is drawn to the site risk associated with UXO as highlighted in the EOD Contracts Limited Explosive Ordnance report for the site (Section 1 refers). The Contractor should familiarize themselves with the available UXO reports and associated information detailed therein.

3. Site Features to be Retained

Refer to the Architect's drawings.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

4. Site Features to be Removed

Before starting work the Contractor shall verify which existing fences, gates, walls, roads, paved areas and other site features are to be removed. Materials arising are to be removed from site.

5. Site Features of Archaeological Interest

Before starting work the Contractor shall verify which areas of the site, if any, are subject to specific archaeological requirements, e.g. archaeological watching brief prior excavation etc. The Contractor's attention is drawn to the University of Salford Archaeology Desk Study (Section 1 refers). The contractor should familiarise themselves with the available report and associated information detailed therein.

6. Trees

Before starting work the Contractor shall verify which trees, shrubs and hedges are to be removed. Cut down, grub up main roots and fill voids with approved material. Dispose of all wood.

7. Undergrowth

Clear site of bushes, scrub and undergrowth. Grub up and dispose of large roots.

8. Japanese Knotweed

None envisaged to be on site.

Japanese Knotweed is an invasive, non-native plant species. The Wildlife and Countryside Act (1981) made it illegal to spread Japanese Knotweed and guidance on the management of Japanese Knotweed on development sites is given in the Environment Agency's (EA) code of practice, 2001.

The Contractor is responsible for ensuring that Japanese Knotweed is not spread across the site. There are a variety of methods available for treating infested areas including spraying with herbicides or digging, spraying and removal to landfill. The Client is responsible for selecting a method of treatment and obtaining approval for the selected method from the Local Authority.

9. Site Clearance

Clear site of all rubbish, debris and vegetation before stripping topsoil. The compaction of topsoil should be avoided.

10. Cultivated Turf

Before starting work the Contractor shall verify any areas of turf to be retained. At the Contractor's discretion, cost and/or profit, other turf may be either:

- lifted and sold, or
- left to be incorporated with the existing topsoil.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

11. Site Access and Working Area

Access to the site and the Contractor's working area will be shown on the drawings. The Contractor shall provide:

- All necessary signs, safety measures and watchmen to ensure security and safe operation of their traffic.
- All necessary servicing for his own offices, stores, workshops, etc.
- Access routes for the Employer and other contractors as shown on the drawings.

2.5 Fill Acceptance Criteria

The fill acceptance criteria are as detailed below:

Engineering Application	Material Classification	Acceptance Criteria	Method of Compaction
General Fill	Classes 1A, 1B, 2A, 2B, 2C, 2D	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4
Fill to Structures	Class 6P or 6N	As per attached Table 6/1	Contractor to propose, subject to achieving 95% of maximum dry density
General Landscape Filling	Class 4	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4
Pavement Capping	Class 6F1 or 6F2	As per attached Table 6/1	As per attached Table 6/1 and Table 6/4

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
GENERAL GRANULAR FILL	1	A	–	Well graded granular material	General Fill	Any material, or combination of materials, other than material designated as Class 3 in the Contract. (Properties (i), (ii) and (iv) in next column, shall not apply to chalk). Recycled aggregate. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates); A (construction and demolition recycling industries); B1 (municipal incinerator bottom ash (MIBA)); D2 (air cooled blast furnace slag) D3 (basic oxygen furnace slag) D4 (electric arc furnace slag (EAF C)) E (non ferrous steel industry – except E2 molybdenum slag) G (mining and quarry industry)	(i) grading	BS 1377: Part 2 or BS EN 13242	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	1	A	–
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
GENERAL GRANULAR FILL	1	B	–	Uniformly graded granular material	General Fill	Any material, or combination of materials, other than chalk. Recycled aggregate Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9, and 10: P (natural aggregates – except chalk); A (construction and demolition recycling industries); B1 (municipal incinerator bottom ash (MIBA)); C1 (coal fly ash) C4 (coal bottom ash) D2 (air cooled blast furnace slag) D3 (basic oxygen furnace slag) D4 (electric arc furnace slag (EAF C)) E (non ferrous steel industry – except E2 molybdenum slag) F (foundry industry) G (mining and quarry industry) H1 (dredge spoil sand)	(i) grading	BS 1377: Part 2 or BS EN 13242	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	1	B	–
							(ii) uniformity Coefficient	See Note 5	–	10				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Table 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
GENERAL COHESIVE FILL	2	A	–	Wet cohesive material	General Fill	Any material, or combination of materials, other than chalk.	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4	2	A	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	B	–	Dry cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2	B	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	C	–	Stony cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 2	2	C	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
	2	D	–	Silty cohesive material	General Fill	Any material, or combination of materials, other than chalk	(i) grading	BS 1377: Part 2	Tab 6/2	Tab 6/2	Tab 6/4 Method 3	2	D	–
							(ii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within:					
									Lower	Upper				
LANDSCAPE FILL	4	-	-	Various	Fill to landscape areas	Materials arising from the excavations or imported, but excluding unsuitable materials as defined in Appendix 6/15.	(i) grading	BS 1377: Part 2 (On site materials only)	Maximum particle size of 150mm.		Lay in layers not more than 200mm thick and consolidate each layer with the earthmoving plant.	4	-	-

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
SELECTED GRANULAR FILL	6	F	1	Selected granular material (fine grading)	Capping	Any material, or combination of materials – including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials contaminated with tar and tar-bitumen binders, unburnt colliery spoil, argillaceous rock and chalk. Property (iv) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less. Where material in this Class is imported onto site it shall be classified as Class 6F4 and comply with the requirements for that material.	(i) grading	BS 1377: Part 2 (On site materials only)	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	1
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
							(iii) Class Ra (asphalt) content	Clause 710	–	50%				
							(iv) bitumen content	BS EN 12697-1 or BS EN 12697-39	–	2.0%				
	6	F	2	Selected granular material (coarse grading)	Capping	Any material, or combination of materials - including recycled aggregates with not more than 50% by mass of recycled bituminous planings and granulated asphalt, but excluding materials contaminated with tar and tar-bitumen binders, unburnt colliery spoil and argillaceous rock. Property (i) in the next column shall not apply to chalk. Property (iv) in the next column shall not apply if the Class Ra (asphalt) content of any recycled aggregate is 20% or less. Where material in this Class is imported onto site it shall be classified as Class 6F5 and comply with the requirements for that material.	(i) grading	BS 1377: Part 2 (On site materials only)	Tab 6/2	Tab 6/2	Tab 6/4 Method 6	6	F	2
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				
							(iii) Class Ra (asphalt) content	Clause 710	–	50%				
							(iv) bitumen content	BS EN 12697-1 or BS EN 12697-39	–	2.0%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
SELECTED GRANULAR FILL	6	N	–	Selected well graded granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates – except shale, siltstone or slate, see Note 7); A2 (crushed concrete) A3 (crushed bricks, masonry) D2 (air cooled blast furnace slag) G1 (red coal shale).	(i) grading	BS 1377: Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377: Part 4 (vibrating hammer method)	6	N	–
								BS EN 933-2 (Imported onto site)	Tab 6/5	Tab 6/5				
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/1: (02/16) Acceptable Earthworks Materials: Classification and Compaction Requirements (See footnotes) (continued).

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Clause 601 and contract specific Appendix 6/1)	Material Properties Required for Acceptability (In Addition to Requirements on Use of Fill Materials in Clause 601 and Testing in Clause 631)				Compaction Requirements in Clause 612	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance with:	Acceptable Limits Within: Lower	Acceptable Limits Within: Upper				
SELECTED GRANULAR FILL	6	P	–	Selected granular material	Fill to structures	Natural gravel, natural sand, crushed gravel, crushed rock, crushed concrete, slag, chalk, well burnt colliery spoil or any combination thereof. None of these constituents shall include any argillaceous rock. (Properties (i), (ii) and (ix) in next column shall not apply to chalk.) Recycled aggregate except recycled asphalt. Where material is imported onto site which is not 'as dug' it shall be aggregate conforming to BS EN 13242 from one or more of the following source codes, see Notes 8, 9 and 10: P (natural aggregates – except shale, siltstone or slate, see Note 7); A2 (crushed concrete) A3 (crushed bricks, masonry) D2 (air cooled blast furnace slag) G1 (red coal shale).	(i) grading	BS 1377: Part 2 (On-site)	Tab 6/2	Tab 6/2	End product 95% of maximum dry density of BS 1377: Part 4 (vibrating hammer method)	6	P	–
								BS EN 933-2 (Imported onto site)	Tab 6/5	Tab 6/5				
							(ii) uniformity coefficient	See Note 5	10	–				
							(iii) mc	BS 1377: Part 2 See Note 4	Optimum mc -2%	Optimum mc +2%				

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Footnotes to Table 6/1

1	(02/16) App = contract specific Appendix
2	(02/16) Tab = Table
3	(02/16) Where in the Acceptable Limits column reference is made to App 6/1, only those properties having limits ascribed to them in contract specific Appendix 6/1 shall apply. Where contract specific Appendix 6/1 gives limits for other properties not listed in this Table such limits shall also apply.
4	(02/16) Where BS 1377: Part 2 is specified for mc, this shall mean BS 1377: Part 2 where the material is a soil or BS EN 1097-5 where the material is required to conform to a harmonised European Standard.
5	(02/16) Uniformity coefficient is defined as the ratio of the particle diameters D_{60} to D_{10} on the particle-size distribution curve, where: D_{60} = particle diameter at which 60% of the soil by weight is finer D_{10} = particle diameter at which 10% of the soil by weight is finer
6.	(02/16) The limiting values for Class U1B material are given in contract specific Appendix 6/14 and contract specific Appendix 6/15.
7	(02/16) For works in Wales see sub-Clause 601.21W.
8	(02/16) Where material source codes are referenced these are as listed in Table 6/7.
9	(02/16) Where materials are required to be aggregates conforming to BS EN 13242 materials certificated as being compliant with BS EN 13285 are acceptable for use provided that they meet all the specification requirements and the Declaration of Performance for constituent parts to BS EN 13242 are provided to the Overseeing Organisation.
10	(02/16) Materials shall comply with the current Environmental Regulations at the time of use. Reference shall be made to Annex ZA (informative) of BS EN 13242.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/2: (02/17) Grading Requirements for Acceptable Earthworks Materials Other Than Classes 6F4, 6F5 and 6S

Percentage by Mass Passing the Size Shown																					
Class	**Size (mm)**		**Size (mm) BS Series**													**Size (microns) BS Series**				**Size (micr-ons)**	**Class**
	500	**300**	**125**	**90**	**75**	**37.5**	**28**	**20**	**14**	**10**	**6.3**	**5**	**3.35**	**2**	**1.18**	**600**	**300**	**150**	**63**	**2**	
1A		100	95-100																<15		1A
1B			100																<15		1B
2A & 2B			100											80-100					15-100		2A & 2B
2C			100											15-80					15-80		2C
2D			100																80-100	0-20	2D
6F1					100	75-100				40-95		30-85				10-50			<15		6F1
6F2			100	80-100	65-100	45-100				15-60		10-45				0-25			0-12		6F2
6N & 6P					100														<15		6N & 6P

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/4: (02/16) Method Compaction for Earthworks Materials: Plant and Methods (Method 1 to Method 6) (This Table is to be read in conjunction with sub-Clause 612.10)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~		~~Method 5~~		Method 6		
			D	N#	D	N#	D	N#	~~D~~	~~N~~	~~D~~	~~N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Smoothed wheeled roller (or vibratory roller operating without vibration)	1	Mass per metre width of roll: over 2100 kg up to 2700 kg	125	8	125	10	125	10*	~~175~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 2700 kg up to 5400 kg	125	6	125	8	125	8*	~~200~~	~~4~~	~~unsuitable~~		16	unsuitable	unsuitable
	3	over 5400 kg	150	4	150	8	unsuitable		~~300~~	~~4~~	~~unsuitable~~		8	16	unsuitable
Grid roller	1	Mass per metre width of roll: over 2700 kg up to 5400 kg	150	10	unsuitable		150	10	~~250~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 5400 kg up to 8000 kg	150	8	125	12	unsuitable		~~325~~	~~4~~	~~unsuitable~~		20	unsuitable	unsuitable
	3	over 8000 kg	150	4	150	12	unsuitable		~~400~~	~~4~~	~~unsuitable~~		12	20	unsuitable
Deadweight tamping roller	1	Mass per metre width of roll: over 4000 kg up to 6000 kg	225	4	150	12	250	4	~~350~~	~~4~~	~~unsuitable~~		12	20	unsuitable
	2	over 6000 kg	300	5	200	12	300	3	~~400~~	~~4~~	~~unsuitable~~		8	12	20
Pneumatic-tyred roller	1	Mass per wheel: over 1000 kg up to 1500 kg	125	6	unsuitable		150	10*	~~240~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 1500 kg up to 2000 kg	150	5	unsuitable		unsuitable		~~300~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	3	over 2000 kg up to 2500 kg	175	4	125	12	unsuitable		~~350~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	4	over 2500 kg up to 4000 kg	225	4	125	10	unsuitable		~~400~~	~~4~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	5	over 4000 kg up to 6000 kg	300	4	125	10	unsuitable		~~unsuitable~~		~~unsuitable~~		12	unsuitable	unsuitable
	6	over 6000 kg up to 8000 kg	350	4	150	8	unsuitable		~~unsuitable~~		~~unsuitable~~		12	unsuitable	unsuitable
	7	over 8000 kg up to 12000 kg	400	4	150	8	unsuitable		~~unsuitable~~		~~unsuitable~~		10	16	unsuitable
	8	over 12000 kg	450	4	175	6	unsuitable		~~unsuitable~~		~~unsuitable~~		8	12	unsuitable

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~	~~Method 5~~	Method 6		
			D	N#	D	N#	D	N#	~~D N~~	~~D N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Vibratory tamping roller		Mass per metre width of a vibrating roll:											
	1	over 700 kg up to 1300 kg	100	12	100	12	150	12	~~100 10~~	~~unsuitable~~	unsuitable	unsuitable	unsuitable
	2	over 1300 kg up to 1800 kg	125	12	125	12	175	12*	~~175 8~~	~~unsuitable~~	12	unsuitable	unsuitable
	3	over 1800 kg up to 2300 kg	150	12	150	12	200	12*	~~unsuitable~~	~~unsuitable~~	8	12	unsuitable
	4	over 2300 kg up to 2900 kg	150	9	150	9	250	12*	~~unsuitable~~	~~400 5~~	6	10	unsuitable
	5	over 2900 kg up to 3600 kg	200	9	200	9	275	12*	~~unsuitable~~	~~500 6~~	6	10	unsuitable
	6	over 3600 kg up to 4300 kg	225	9	225	9	300	12*	~~unsuitable~~	~~600 6~~	4	8	unsuitable
	7	over 4300 kg up to 5000 kg	250	9	250	9	300	9*	~~unsuitable~~	~~700 6~~	3	7	12
	8	over 5000 kg	275	9	275	9	300	7*	~~unsuitable~~	~~800 6~~	3	6	10

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

TABLE 6/4: (02/16) Method Compaction for Earthworks Materials: Plant and Methods (Method 1 to Method 6) (This Table is to be read in conjunction with sub-Clause 612.10) (continued)

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~		~~Method 5~~		Method 6		
			D	N#	D	N#	D	N#	~~D~~	~~N~~	~~D~~	~~N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Vibratory roller		Mass per metre width of vibratory roll:													
	1	over 270 kg up to 450 kg	unsuitable		75	16	150	16	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 450 kg up to 700 kg	unsuitable		75	12	150	12	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	3	over 700 kg up to 1300 kg	100	12	125	10	150	6	~~125~~	~~10~~	~~unsuitable~~		16	unsuitable	unsuitable
	4	over 1300 kg up to 1800 kg	125	8	150	8	200	10*	~~175~~	~~4~~	~~unsuitable~~		6	16	unsuitable
	5	over 1800 kg up to 2300 kg	150	4	150	4	225	12*	~~unsuitable~~		~~unsuitable~~		4	6	12
	6	over 2300 kg up to 2900 kg	175	4	175	4	250	10*	~~unsuitable~~		~~400~~	~~5~~	3	5	11
	7	over 2900 kg up to 3600 kg	200	4	200	4	275	8*	~~unsuitable~~		~~500~~	~~5~~	3	5	10
	8	over 3600 kg up to 4300 kg	225	4	225	4	300	8*	~~unsuitable~~		~~600~~	~~5~~	2	4	8
	9	over 4300 kg up to 5000 kg	250	4	250	4	300	6*	~~unsuitable~~		~~700~~	~~5~~	2	4	7
	10	over 5000 kg	275	4	275	4	300	4*	~~unsuitable~~		~~800~~	~~5~~	2	3	6
Vibrating plate compactor		Mass per m^2 of base plate:													
	1	over 880 kg up to 1100 kg	unsuitable		unsuitable		75	6	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 1100 kg up to 1200 kg	unsuitable		75	10	100	6	~~75~~	~~10~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	3	over 1200 kg up to 1400 kg	unsuitable		75	6	150	6	~~150~~	~~8~~	~~unsuitable~~		unsuitable	unsuitable	unsuitable
	4	over 1400 kg up to 1800 kg	100	6	125	6	150	4	~~unsuitable~~		~~unsuitable~~		8	unsuitable	unsuitable
	5	over 1800 kg up to 2100 kg	150	6	150	5	200	4	~~unsuitable~~		~~unsuitable~~		5	8	unsuitable
	6	over 2100 kg	200	6	200	5	250	4	~~unsuitable~~		~~unsuitable~~		3	6	12
Vibro-tamper		Mass:													
	1	over 50 kg up to 65 kg	100	3	100	3	150	3	~~125~~	~~3~~	~~unsuitable~~		4	8	unsuitable
	2	over 65 kg up to 75 kg	125	3	125	3	200	3	~~150~~	~~3~~	~~unsuitable~~		3	6	12
	3	over 75 kg up to 100 kg	150	3	150	3	225	3	~~175~~	~~3~~	~~unsuitable~~		2	4	10
	4	over 100 kg	225	3	200	3	225	3	~~250~~	~~3~~	~~unsuitable~~		2	4	10
Power rammer		Mass:													
	1	100 kg up to 500 kg	150	4	150	6	unsuitable		~~200~~	4	~~unsuitable~~		5	8	unsuitable
	2	over 500 kg	275	8	275	12	unsuitable		~~400~~	4	~~unsuitable~~		5	8	14

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Type of Compaction Plant	Ref No.	Category	Method 1		Method 2		Method 3		~~Method 4~~		~~Method 5~~		Method 6		
			D	N#	D	N#	D	N#	~~D~~	~~N~~	~~D~~	~~N~~	N for D = 110 mm	N for D = 150 mm	N for D = 250 mm
Dropping-weight compactor		Mass of rammer over 500 kg weight drop:													
	1	over 1 m up to 2 m	600	4	600	8	450	8	~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable
	2	over 2 m	600	2	600	8	unsuitable		~~unsuitable~~		~~unsuitable~~		unsuitable	unsuitable	unsuitable

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

3 Series 600 Specification Appendices

The applicable appendices are presented in this section. Appendices 6/4 (Requirements for Class 3 Material), 6/12 (Instrumentation and Monitoring). and 6/14 (Limiting Values for Pollution of Controlled Waters) are not used.

3.1 Appendix 6/1: Requirements for Acceptability and Testing of Earthworks Materials

Acceptable limits for fills are defined in Table 6/1 of this specification. Fill used for forming any construction platform required shall comply with Class 1A, 1B or other such materials proposed by the Contractor which when placed and compacted shall perform as a stable platform for trafficking by piling plant and ready mix concrete trucks without damaging the underlying formation.

The Contractor shall be responsible for determining the Class and acceptability of the material to be used for filling. The contractor shall be responsible for Class/acceptability testing which shall be undertaken by an approved independent testing organisation at frequencies given in the table below. All testing shall be undertaken by accredited NAMAS or equivalent approved geotechnical and chemical analysis laboratories to be paid for by the Contractor. The Contractor shall allow sufficient time in their programme for the required testing. The Contractor is required to provide **daily** records of testing of the material placed to show compliance with the Specification. The minimum requirements are:

Class / Use	Test	Frequency
General Granular Fill (Class 1A and 1B)	Grading	At least 1 test/day or 1 test/500m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
General Cohesive Fill (Class 2A, 2B, 2C and 2D)	Grading	At least 1 test/day or 1 test/500m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
	Plasticity Tests	1 test/day per material type of every 500m^3 placed
Structural Granular Fill (Class 6N and 6P)	Grading	At least 1 test/day or 1 test/50m^3
	mc	3 tests/day per material type placed or every 20m^3 placed
	Maximum dry density	1 test/ 50m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
	In-situ dry density (by sand replacement or nuclear test method) for end product requirement	1 test for each 10m × 10m square grid of placed fill (all layers to be tested) with at least 4 tests per compacted layer
Capping (Class 6F1 and 6F2)	Grading	At least 1 test/day or 1 test/50m^3
	mc	1 test/day per material type placed
	Maximum dry density	1 test/ 50m^3
	Chemical (see Appendix 6/15)	1 test/250m^3
Landscape Fill (Class 4)	Grading	At least 1 test/day or 1 test/500m^3
	Chemical (see Appendix 6/15)	1 test/250m^3

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Note: 1. For each element cited above the option giving the greatest number of tests shall apply.
2. In areas of general filling, the density of the placed fill shall be checked **twice daily** by means of sand replacement density tests to ensure suitable compaction is achieved and to avoid excessive settlement in areas of substantial fill.

3.2 Appendix 6/2: Requirements for Dealing with Class U2 Unacceptable Material.

1. The Contractor is responsible for disposal.

2. A 'watching-brief' should be maintained during all stages of the work (included trial pitting) to remain vigilant to possibility of hitherto undetected areas of contamination.

Where materials that appear to be contaminated (either visually or on the basis of odour) are encountered during the excavation works, the Contractor shall inform the Supervisor immediately to obtain further instruction. The Contractor shall be responsible for carrying out laboratory testing to enable the materials to be classified for hazard assessment and waste disposal purposes, and for disposal to suitably licensed tip if unsuitable to remain on site. Such work is to be carried out by a suitably qualified professional. Test methods and appropriate assessment criteria for chemical analysis shall be as required by the relevant authority or otherwise agreed with the Supervisor.

The Contractor shall maintain records and copies of assignment notes and duty of care documentation for all materials disposed of off-site and shall submit copies on completion of the work.

Where surplus soils for disposal are chemically contaminated, the Contractor shall be responsible for disposal of these materials. The Contractor shall be deemed the producer and holder of the waste and shall be responsible for classifying the materials for disposal to landfill. The Contractor shall be responsible for carrying out any further soil contaminant testing and Waste Acceptance Criteria testing to enable classification of the waste in accordance with current regulatory guidance and the requirements of the receiving landfill.

The Contractor shall prepare an earthworks spoil management strategy which shall take account of the range of waste types expected to be encountered and set out any proposed sampling and testing regime for waste classification. The strategy shall include consideration of stockpile management, measures and working methods to protect site worker health and safety and the environment, and working methods to minimize the degree of intermixing of wastes of different classes and to minimize disposal costs.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

3.3 Appendix 6/3: Requirements for Excavation, Deposition and Compaction

Earthworks requirements are defined in the relevant contract drawings. For general working conditions and contract specific requirements refer to the Contract Documents.

1. Basic Workmanship for Excavating

Comply with BS 8000: Part 1, Sections 3.1, 3.2 and 3.3.

2. Temporary Works

The Contractor is responsible for the design of such works, details of these to be submitted for review at least 14 days before commencing work on site.

3. Excavation of Chemically Contaminated Materials

Where contaminated materials are to be excavated the Contractor shall be responsible for all Health and Safety precautions required to protect the site personnel and the local environment and shall provide method statements covering these issues. It should be noted that during previous Ground Investigations asbestos fibres have been recorded locally.

The Contractors attention is drawn to the identification of asbestos fibres on-site during the ground investigation. The locations and results from the asbestos quantification analysis are as summarised below;

- MTP03 at 0.50 m bgl (Made Ground) – Chrysotile – 0.001%;
- MTP04 at 0.50 m bgl (Made Ground) – Amosite – 0.0012%; and
- MTP05 at 1.00 m bgl (Made Ground) – Amosite and Chrysoltile - <0.001%.

It is essential that where feasible, all materials should be stockpiled separately to allow their material/chemical properties to be assessed and their re-use potential appraised against the re-use criteria outlined in Appendix 6/15.

4. Materials Arising

Materials arising from the excavations and surplus to requirements for filling are to remain the property of the Contractor. Remove from site surplus excavated material (subsoil) not specified to be spread and levelled or stockpiled.

5. Benching

Surfaces of excavations with a gradient greater than 1 in 5 which are to receive filling must have horizontal benches cut to match the depths of compacted layers of filling.

6. Adjacent Excavations

Where an excavation encroaches below a line drawn at an angle of 45° from the horizontal from the nearest formation level of another higher excavation, the lower excavation, all work within it and backfilling thereto must be completed before the higher excavation is made.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

7. Proposed Levels of Formation

Refer to Contract Drawings. Permissible deviations from formation levels:

- Embankments and cuttings: ±50mm;

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

8. Accuracy

Permissible deviations from formation levels:

- Beneath mass concrete foundations: ±25 mm.
- Beneath ground bearing slabs and r.c. foundations: -15 mm, +0 mm.
- Embankments and cuttings: ±50 mm.
- Ground abutting external walls: ±50 mm, but such as to ensure that finished level is not less than 150 mm below dpc.

9. Formations Generally

The Contractor shall undertake inspection of formations for the following:

a) Mass Concrete Pad and Strip Foundations.

b) Reinforced Concrete Pad and Strip Foundations.

c) Basement and Ground Floor Slabs.

d) Basement slabs/lift pits

e) Roads, Footpaths or other Pavements.

f) Retaining Walls.

Remove the last 50 mm of excavations just before inspection. Trim excavations to required profiles and levels and remove all loose material.

Visual inspection at the base of each foundation is required by a suitably qualified ground engineer to ensure that the required founding strata is consistent with the strength assumed in the foundation design. Arisings from the base of the foundation excavations can also be tested with a penetrometer to verify suitable material strength has been achieved. When preparing formations, all soft spots shall be removed and replaced with suitable fill materials. Any obstructions encountered shall also be removed. The final surface of all formations shall be well rolled, smooth, and free from movement under compaction plant and from ridges, cracks, loose material, ruts or other defects. Due to the susceptibility of any cohesive deposit from moisture and water ingress into excavations, unless otherwise instructed, formations must be sealed immediately after excavation/inspection with concrete.

10. Foundations Generally

Obtain instructions if:

- A natural bearing formation of undisturbed subsoil is not obtained at the depth shown on the drawings.
- The formation contains soft or hard spots or highly variable material.

11. Trench Fill Foundations

Excavate the whole depth of the trench down to formation by machine in one operation. The Contractor shall undertake inspection of the formation as soon as it is exposed. Unless otherwise instructed place concrete immediately after inspection.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

12. Foundations in Made Up Ground

Excavate down to a natural formation of undisturbed subsoil. Obtain instructions if this is at a lesser depth than that shown on the drawings.

13. Unstable Ground

The Contractor shall satisfy themselves that any newly excavated face will remain unsupported sufficiently long to allow the necessary earthwork support to be inserted. If unexpected unstable conditions are encountered which are likely to affect adjacent structures or roadways, appropriate emergency action should be undertaken until the instability can be rectified.

14. Recorded Features

Break out old foundations, beds, drains, etc. where and to the extent stated on the drawings. Seal off drain ends, remove contaminated earth and disinfect as required by local authority. Backfill as specified on the drawings.

Due to the rich site history, a number of obstructions have been recorded locally within the ground. Consideration will need to be given to foundation penetration/installation, plant and equipment required to enable excavation in areas of obstructions and any stability issues associated with removal of obstructions etc. Before starting work the Contractor shall verify which areas of the site, if any, are subject to specific archaeological requirements, e.g. archaeological watching brief prior excavation etc. It should also be noted that the proposed development is in a constrained urban environment. It is the responsibility of the Contractor to enter dialogue with the relevant service providers and Local Authority (Manchester City Council) and their representatives to agree an acceptable methodology of working when in close proximity to the associated infrastructure.

15. Unrecorded Features

Where old foundations, beds, basements, filling, tanks, service pipes, drains, hotspots of soil contamination etc. not shown on the drawings are encountered, obtain instructions before proceeding. See also Appendix 6/15.

Where old foundations, beds, basements etc. are encountered, these are to be grubbed out, processed and reused as part of the works subject to suitability testing (both geotechnical (Section 2.5 and Appendix 6/1 refer) and chemical (Appendix 6/15 refer). Note any Archaeological restrictions/requirements are also to be adhered to.

16. Excess Excavation

Backfill any excavations taken:

- Wider than required with the material specified for backfilling.
- Deeper than required with well graded granular material or lean mix concrete.

17. Hauling

Hauling of material from excavation and spoil heaps to fill areas to proceed only where sufficient spreading and

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

compacting plant are operated at the place of deposition.

18. Cut Slopes

The Contractor is to ensure that the slopes of all cuttings are such that stability and safety are maintained at all times. Any temporary cuttings should be identified in the Contractor's method statements, and slope angles agreed in advance with the Contract Supervisor.

19. Use of Plant

Do not use plant at the surface of the bottom of the excavation unless:

- The excavation is in rock and contains no soft material, or
- The level of the bottom surface is maintained at least 300 mm above formation level.

Any damage to the subgrade to be made good at the Contractor's expense and using material having the same characteristics as that which has been damaged.

20. Temporary Stockpiles

Allowance shall be made for the possible deterioration of the stockpiled material due to weathering. Precautions shall be taken to ensure stability, taking into account the strength of the underlying ground and the effect on drainage. It may be necessary to carry out partial compaction of stockpiles and/or to provide additional protection to maintain the quality of the stockpiled material. Where temporary stockpiles of contaminated soils are required i.e. either arisings of made ground or any unexpected contamination hot spots, then protective measures will be required to minimize run-off/leachates and washing of fines.

21. Constraints on Excavation Phasing

At tender stage the Contractor shall produce an Enabling Works Plan which clearly shows the phasing of the bulk excavation with respect to the other specific Enabling Works.

22. Groundwater Level

Details of the groundwater levels are included in the site investigation reports. Localized post fieldwork monitoring data from the ongoing SOCOTEC investigation along with previous investigations undertaken in the immediate surrounding area suggests the groundwater regime is located between ~26.00 m AOD and ~27.00 m AOD. Perched groundwater (seepages) were also recorded locally between ~30.94 m AOD and 33.64 m AOD. The Contractor should expect that seasonal effects may lead to groundwater being encountered at a different level to those stated above. During the works groundwater must be controlled to ensure no flooding of the site or degradation of excavated materials or exposed slopes.

23. Water Courses

Any watercourses that have been diverted and are to be filled must be cleared of all vegetable growth and soft deposits before filling.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

24. Water

Keep all excavations free from water until the construction of basements and retaining walls is able to resist leakage, water pressure and flotation. The Contractor shall be responsible for obtaining all discharge licenses for disposal of water via sewer or to surface water.

25. Running Water

The Contractor shall inform the Supervisor immediately if any springs or running water are encountered during the Works.

26. Pumping

Any pumping undertaken shall comply with the following requirements:

- Excavated faces or stability of adjacent ground or structures shall not be disturbed.
- Pumped water shall be discharged without flooding the site or adjoining property.
- Any sumps shall be constructed clear of excavations and filled on completion.

27. Suitable and Unsuitable Fill Materials

'Suitable material' comprises all that which is acceptable to the Contractor in accordance with this specification. No excavated suitable material is to be removed from the site unless this suits the Contractor's operational procedure and then the Contractor is to make good any subsequent deficit at their own expense. Where the excavation reveals a combination of suitable and unsuitable materials (as described below) the Contractor is to propose the methods by which suitable material may be excavated without contamination by unsuitable materials.

Do not import or use fill materials which would, either in themselves or in combination with other materials or ground water, give rise to a health hazard, damage to building structures or instability in the filling. Limiting values for contaminant concentrations in fill materials are given in Appendix 6/15.

Any materials arising or imported that appear suspect in terms of contamination based on either appearance or smell shall be stockpiled separately and tested for the contaminant suite listed in Appendix 6/15 in addition to any other appropriate contaminant as indicated by appearance or by smell and accepted into the Works or disposed of off site as appropriate.

Soluble sulphate content (SO4) of imported materials for filling under concrete slabs or within 1 m of substructures must not exceed 0.5 g/litre when tested BS 1377:Part 3, Clause 5 using a 2:1 water-soil extract.

Other unsuitable materials include: material from marshes or bogs, peat, logs, stumps, slurry, mud and perishable material, material susceptible to spontaneous combustion, material in a frozen condition, clays of liquid limit exceeding 80% and/or plasticity index exceeding 55, material with excessive moisture content. See also Section 2.3 of this Specification.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

28. Frost Susceptibility

Except as allowed below, fill must be non frost-susceptible as defined in Highways Agency 'Specification for Highway Works', Clause 602. If the following fill materials are proposed, a laboratory report shall be obtained confirming they are non-frost-susceptible:

- Fine grained soil with a plasticity index less than 20%.
- Coarse grained soil or crushed granite with more than 10% retained on a 0.063 mm sieve.
- Crushed chalk.
- Crushed limestone fill with average saturation moisture content in excess of 3%.
- Burnt colliery shale.

Frost-susceptible fill may only be used if:

- It is to be placed within the external walls of buildings below spaces that will be heated.
- It is placed in excess of 500 mm beneath the proposed final ground level.
- Any frost-susceptible fill shall be protected from frost at all times during construction.

29. Placing Fill Generally

- Ensure that excavations and areas to be filled are free from loose soil, rubbish and standing water.
- Do not use frozen materials or materials containing ice. Do not place fill on frozen surfaces.
- Take all necessary precautions to ensure stability of adjacent structures. Place and compact fill against structures, membranes or buried services in a sequence and manner which will ensure stability and avoid damage.
- Plant employed for transporting, laying and compacting must be suited to the type of material.
- Lay differing materials separately so that only one type of material occurs in each layer.

30. Benching in Fill

Where, during the progress of the work, the difference in level between adjacent areas of filling exceeds 600 mm, cut into edge of higher filling to form benches having a minimum width of 600 mm and a height equivalent to the depth of a layer of compacted filling. Spread and compact new filling to ensure maximum continuity with the previous filling.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

3.4 Appendix 6/6: Fill to Structures and Fill Above Structural Foundations

This specification is in respect of the permanent works only.

1. First Layer of Compacted Filling

To be of suitable hard granular material thoroughly compacted to 150 mm thickness.

2. Protection of Compacted Filling

Do not allow construction traffic on compacted cohesive soil filling until the level has been raised not less than 150 mm above formation level by properly compacted temporary protective filling.

Remove temporary protective filling from site before beginning permanent construction.

The Contractor shall be responsible for making good any damage to the compacted fill.

3. Deterioration of Fill Materials

If the material to be deposited as fill subsequently reaches a condition where it cannot be compacted to the requirements of this specification the Contractor shall:

- make good by removing the material from site until it is in a suitable condition for reuse and/or replace with suitable material; or
- make good the material by mechanical or chemical means; or
- cease work until the physical condition of the material is such that it can be compacted as described in this specification.

4. Blinding

Surfaces to receive sheet overlays or concrete to have sufficient sand, fine gravel, PFA or other approved fine material applied to fill interstices and provide a close smooth surface.

- Permissible deviations on surface level: +0/-25 mm.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

3.5 Appendix 6/8: Topsoiling, Grass Seeding and Turfing

1. General

Refer to Landscape Architect's drawings and specifications for details of subsoil preparation and topsoiling operations but the following requirements in respect of chemical suitability should also be complied with.

2. Grade Subsoil

Grade topsoil to smooth flowing contours and to achieve the specified finished levels of the topsoil. Excavate locally as necessary for areas of thicker topsoil. Small planting beds located in general landscape areas may be excavated separately at a later date.

3. Loosen Subsoil (Non-Cohesive)

Loosen subsoil consisting of light, non-cohesive material with a 3 tine ripper, drawn 300 mm deep at 600 mm centres.

4. Loosen Subsoil (Cohesive)

Loosen subsoil consisting of stiff clays or other cohesive material with a single tine ripper driven 450 mm deep at 1 m centres and drawn by a crawler tractor.

5. Stripping Topsoil

Before beginning general excavation or filling excavate topsoil from required areas to an average depth of 200 mm and keep separate from excavated subsoil. At the time of excavation the topsoil must be reasonably dry.

6. Treating Topsoil

Not less than two weeks before excavating topsoil treat with a suitable herbicide.

7. Handling Topsoil

The following requirements shall be complied with:

- Where aggressive weeds as included in the Weeds Act – Section 2 or the Wildlife and Countryside Act – Schedule 9 – Part 2 are encountered, instructions should be obtained prior to moving topsoil.
- Earthmoving equipment shall be selected and used to minimize disturbance, trafficking and compaction of topsoil.
- On no account should topsoil be mixed with:
    a) Subsoil, stone, hardcore, rubbish or material from demolition work.
    b) Oil, fuel, cement or other substances harmful to plant growth.
    c) Other grades of topsoil.
- Multiple handling should be kept to a minimum. Where practicable topsoil should be used immediately after stripping.
- Topsoil handling should be undertaken in the driest condition possible. It should not be handled during or after heavy rainfall or when it is wetter than the plastic limit defined by BS 3882 Annex N2.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

8. Undisturbed Topsoil which is to be Landscaped

Prepare as necessary to ensure that the topsoil is in a suitable state for the cultivation operations specified in sections Q30 and/or Q31. In particular:

- Where the ground is hard, break up with ripper operated in transverse directions, removing any roots and boulders.
- Where the ground is covered with turf or a thick sward plough or dig over to the full depth of the topsoil.
- After any such cultivation leave fallow for not less than 1 month. During this period treat with a suitable herbicide at appropriate times to prevent seeding of weeds.

9. Imported Topsoil

Provide as necessary to make up any deficiency of topsoil existing on site and to complete the work.

10. Topsoil Spoil Heaps

To be not more than 2m high. Treat with a suitable herbicide at appropriate times to prevent seeding of weeds. Prevent compaction and contamination.

11. Surplus Excavated Topsoil

Remove from site.

12. Contamination

Do not use topsoil contaminated with subsoil, rubbish, oil-based products or other materials toxic to plant life. Dispose of contaminated topsoil as instructed.

Both **imported topsoil** and **site won topsoil** for use as fill to the top metre (if required) on the site will be tested for the contaminant suite listed in Appendix 6/15 to ensure that contaminant threshold levels are not exceeded.

13. Spread Topsoil

Spread topsoil over prepared subsoil layers not exceeding 150 mm and firm each layer before spreading the next. At the time of laying, both the material and the weather must be reasonably dry. Overall minimum depths after firming and settlement to be 150 mm but locally increased with tree pits as necessary in accordance with the Architects requirements.

14. Finished Levels of Topsoil

After settlement, unless otherwise stated, to be:

- 30 mm above adjoining paving or kerbs
- Not less than 150 mm below dpc of adjoining buildings
- 30 mm higher for shrub areas than for adjoining grass areas.
- Married in with adjoining soil areas.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

3.6 Appendix 6/15: Limiting Values for Harm to Human Health and the Environment

Fill materials and imported / site won topsoil must not contain any contaminant in the suite listed below that is in excess of the given maximum permissible contaminant concentrations. Soil concentrations only will be determined.

For all site won and imported recycled fill, stone or brick, this testing shall be carried out at a rate of 1 test per 250 m^3 of placed fill material. In addition, any materials arising or imported that appear suspect in terms of contamination based on either appearance or smell shall be stockpiled separately and tested for the contaminant suite listed below in addition to any other appropriate contaminant as indicated by appearance or by smell and either accepted into the Works or disposed of off-site as appropriate.

The rate of validation testing on imported topsoil will be 1 sample per 250 m^3 of backfill or a minimum of 3 (whichever is greater). The rate of validation testing on site won topsoil will be 10 no. representative samples from stockpile.

Determinand	**Site Won and Imported material**	**Topsoil**
	Maximum Soil Concentration	**Maximum Soil Concentration**
Arsenic	40 mg/kg	37 mg/kg
Cadmium	149 mg/kg	26 mg/kg
Chromium (total)	910 mg/kg	910 mg/kg
Chromium (VI)	21 mg/kg	21 mg/kg
Lead	310 mg/kg	200 mg/kg
Mercury	56 mg/kg	1.2 mg/kg
Selenium	430 mg/kg	250 mg/kg
Copper	7,100 mg/kg	2,400 mg/kg
Nickel	180 mg/kg	130 mg/kg
Zinc	40,000 mg/kg	3,700 mg/kg
TPH	**See Table A1**	490 mg/kg **Note 1**
PAH (USEPA 16)	**See Table A2**	**See Table A2**
Phenol Index	1,200 mg/kg	380 mg/kg
Free Cyanide	760 mg/kg	4.6 mg/kg
pH	5<pH<9	5<pH<9
Asbestos	See Note 2	None detectable **Note 3**

Note: 1. Materials exceeding these thresholds shall be subject to speciated analysis and comparison with **Table A1.**
2. Free fibres <0.1%. Cement-bound asbestos <0.1% of total material volume.
3. No free fibres and no cement bound asbestos.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Table A1. Threshold concentrations for risk banded hydrocarbons and BTEX.

Determinand		Maximum Concentration for Site Won and Imported material	Maximum Concentration for Topsoil
Aliphatic	EC>5 - EC6	42 mg/kg	42 mg/kg
	EC>6 – EC8	100 mg/kg	100 mg/kg
	EC8 – EC10	27 mg/kg	27 mg/kg
	EC10 – EC12	130 mg/kg	130 mg/kg
	EC12 – EC16	1,100 mg/kg	1,100 mg/kg
	EC16 – EC21	65,000 mg/kg	65,000 mg/kg
	EC21 – EC35	65,000 mg/kg	65,000 mg/kg
Aromatic	EC5 – EC7	370 mg/kg	70 mg/kg
	EC7 – EC8	860 mg/kg	130 mg/kg
	EC8 – EC10	47 mg/kg	34 mg/kg
	EC10 – EC12	250 mg/kg	74 mg/kg
	EC12 – EC16	1800 mg/kg	140 mg/kg
	EC16 – EC21	1900 mg/kg	260 mg/kg
	EC21 – EC35	1900 mg/kg	1,100 mg/kg
Benzene		0.38 mg/kg	0.087 mg/kg
Ethylbenzene		83 mg/kg	47 mg/kg
Toluene		869 mg/kg	130 mg/kg
Xylene		79 mg/kg	56 mg/kg

Table A2. Threshold concentrations for Poly Aromatic Hydrocarbons (USEPA 16).

Determinand	Maximum Concentration for Site Won and imported material	Maximum Concentration for Topsoil
Naphthalene	2.3 mg/kg	2.3 mg/kg
Acenaphthylene	2,900 mg/kg	170 mg/kg
Acenaphthene	3,000 mg/kg	210 mg/kg
Flourene	2,800 mg/kg	170 mg/kg
Phenanthrene	1,300 mg/kg	95 mg/kg
Anthracene	31,000 mg/kg	2,400 mg/kg
Fluoranthene	1,500 mg/kg	280 mg/kg
Pyrene	3,700 mg/kg	620 mg/kg
Benzo(a)anthracene	11 mg/kg	7.2 mg/kg
Chrysene	30 mg/kg	15 mg/kg
Benzo(b)fluoranthene	3.9 mg/kg	2.6 mg/kg
Benzo(k)fluoranthene	110 mg/kg	77 mg/kg
Benzo(a)pyrene	3.2 mg/kg	2.2 mg/kg
Indendo(123-cd)pyrene	45 mg/kg	27 mg/kg
Dibenzo(ah)anthracene	0.31 mg/kg	0.24 mg/kg
Benzo(ghi)perylene	360 mg/kg	320 mg/kg

Note: All laboratory contamination testing shall be carried out in a UKAS and MCerts accredited laboratory, in accordance with the standards and procedures defined by MCerts.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Appendix A Contamination Procedures & Documentation

A1 Validation Strategy

As soon as practicable after the completion of the groundworks and removal of any anticipated or unexpected 'hot spots' a **Validation Report** shall be prepared and submitted by the Contractor and agreed with the relevant Local Authority Planning Development Department

The validation strategy shall be as follows:

- All materials should be stockpiled separately to allow their material/chemical properties to be assessed and their re-use potential appraised against the reuse criteria outlined in Appendix 6/15.
- All placed fill material, both site won and imported, is to be validated for the suite of chemicals detailed in Appendix 6/15 at the frequency required in Appendix 6/1.
- Anticipated areas of elevated concentrations or 'hot spots' shall be excavated and removed to at least 1.00 m beyond any visual or olfactory (odorous) indication of contamination. As a minimum, 5 No. samples will be required (four sides and base) but for larger 'hot spots' sample spacing should not exceed 10 m with the requisite increase in number of samples.
- Samples of the surrounding soil will be taken from the excavation formed and tested for the suite of determinands listed in Appendix 6/15 in addition to any other appropriate contaminant as indicated by appearance or by smell.
- If the chemical concentrations of the soil samples are less than the concentrations recorded in Appendix 6/15 or other appropriate guidance in respect of other appropriate contaminant, the elevated concentrations or 'hot spot' can be considered to have been removed and no further remedial action is required.
- If the chemical concentrations of the soil samples are greater than the concentrations recorded in Appendix 6/15, further excavation is required and the sequence of sampling and testing should be repeated. Incremental excavation and testing should continue until the chemical concentrations encountered are less than the concentrations recorded in Appendix 6/15 or other appropriate guidance in respect of other appropriate contaminant.
- During this procedure, the following information should be collected and recorded:
  - The exact extent of each phase of excavation should be recorded using 3D topographical surveying techniques.
  - The exact position and depth of each sample taken should be recorded using 3D topographical surveying techniques.
  - The samples should be given a unique reference number.
  - The laboratory testing results for each unique sample shall be recorded.
  - A photographic record of each phase of excavation and sampling will be collected and recorded.
- A general photographic record of the works should also be collected and recorded to provide a general record of the nature and characteristics of the materials encountered and/or laid to form formations etc. Where practicable, the photographic record should be cross referenced with any chemical testing available for the material type.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

A validation report should be prepared, comprising substantiating completion documentation to include type of documentation listed above and photographic records in addition to Environmental Protection Act 1990 Section 34 Duty of Care documentation relating to waste disposal of the material removed from site.

A2 Validation Documentation Requirements

The following documentation shall be prepared by the Contractor and submitted to the relevant Local Authority Planning Development Department.

- Plan or plans showing earthworks movement of materials on site (cut and fill) and imported if appropriate. This is to include confirmation of the volumes of each material placed (i.e. volume of site won and volume of imported).
- Plan or plans showing the location of any 'hot spots' located, if any, or confirmation that none were encountered.
- Plan or plans showing location of chemical testing undertaken as appropriate plus supporting information.
- Plan or plans showing surface finishes and thickness of build-ups, topsoil or clean cover as appropriate.
- Plan or plans showing the location of any hotspots encountered during service trench excavation, if any, and plan sections of remedial measures undertaken for water pipe provision.
- Appropriate records of material removed from site including testing records.
- Appropriate records of material imported to site including testing records.
- Appropriate records of topsoil imported to site including testing records.
- Appropriate photographic records of the earthworks plus any specific areas of interest ('hotspots', tanks etc).
- Appropriate photographic records demonstrating the required thickness of material has been placed in soft landscaped areas.
- Records of any water control of groundwater that may have been contaminated, if any, or confirmation that none were encountered.
- Other records, if appropriate, not included in above summary.
- A statement confirming the earthworks was undertaken in accordance with this specification.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Louise Richards
Buro Happold Limited
3 Wellington Place
Brewery Wharf
Leeds
LS10 1NE
UK

T: +44 (0)113 204 2200
F: +44 (0)870 787 4144
Email: louise.richards@burohappold.com

Copyright © 1976 - 20199 BuroHappold Engineering. All Rights Reserved.

Appendix B Landscape Architect Proposals

Copyright © 1976 - 2020 Buro Happold. All rights reserved



Revision	Date	Description	Drawn	Apprvd.
S4-P22	21-04-20	Planters removed along building	AT	AT
S4-P21	14-04-20	Update following Curtin's comments	AT	AT
S4-P20	27-02-20	Update to entrance planters	TF	KR
S4-P19	27-02-20	Update to entrance planters	TF	KR
S4-P18	19-12-19	Tender addendum - amendments to substation	AT	AT
S4-P17	06-12-19	Update to substation steps	AT	AT
S4-P16	28-11-19	Coordination with SH	AT	AT
S4-P15	18-11-19	Red line amended	AT	AT
S4-P14	11-11-19	Tender - Green wall added	AT	AT
S4-P13	11-11-19	Service yard steps coordination with SH	AT	AT
S4-P12	18-10-19	Issued for Tender	AT	AT
S4-P11	20-09-19	Issued for Stage 3	AT	AT
S1-P10	22-08-19	Draft Stage 3	AT	AT
S1-P09	26-07-19	Draft Stage 3	AT	AT
S1-P08	02-07-19	Update to service yard	AT	AT
S1-P07	02-07-19	Update to service yard	AT	AT
S1-P06	24-04-19	Planning	AT	KR
S1-P05	24-04-19	Planning	AT	KR
S1-P04	10-04-19	Draft planning	AT	KR
S1-P03	29-03-19	Draft planning	AT	KR
S1-P02	15-03-19	For information	AT	AT
S1-P01	07-03-19	For information	AT	KR

Client MEPC

Project NOMA, Plot P, Manchester

Drg Title Landscape General Arrangement
A1 Portrait

Created on	Created by	Approved by
05.04.19	AT	KR

Scale	Size	Workstage
1:250	A1	Tender addendum

Drg No. 4AS-PLA-XX-XX-DR-L-0002

Suitability S4

Revision P22

Planit I.E. Limited

E: info@planit-ie.com **W:** planit-ie.com

MANCHESTER
2 Back Grafton St , Altrincham, WA14 1DY
T: 0161 928 9281

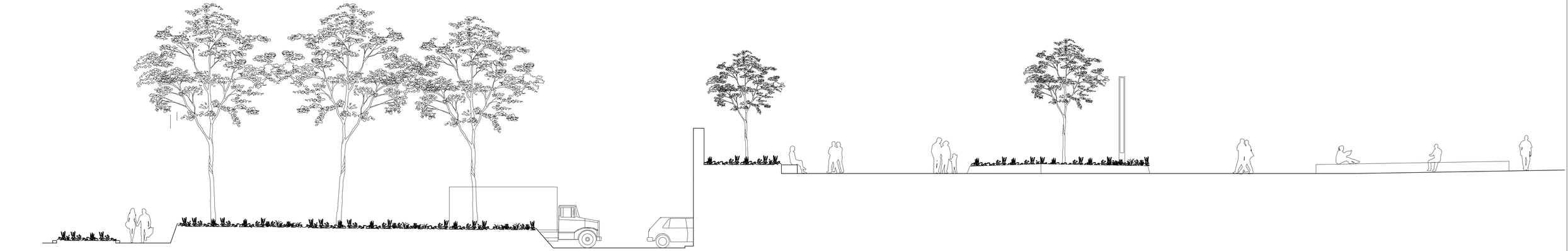
LONDON
Unit 6 Waterside, 44-48 Wharf Road, London, N1 7UX
T: 0207 253 5678

LIVERPOOL
No. 8 Princes Parade, Princes Dock, Liverpool, L3 1DL
T: 0151 705 6746

© THIS DRAWING IS COPYRIGHT PROTECTED AND MAY NOT BE REPRODUCED IN WHOLE OR PART WITHOUT WRITTEN AUTHORITY FROM THE OWNER.

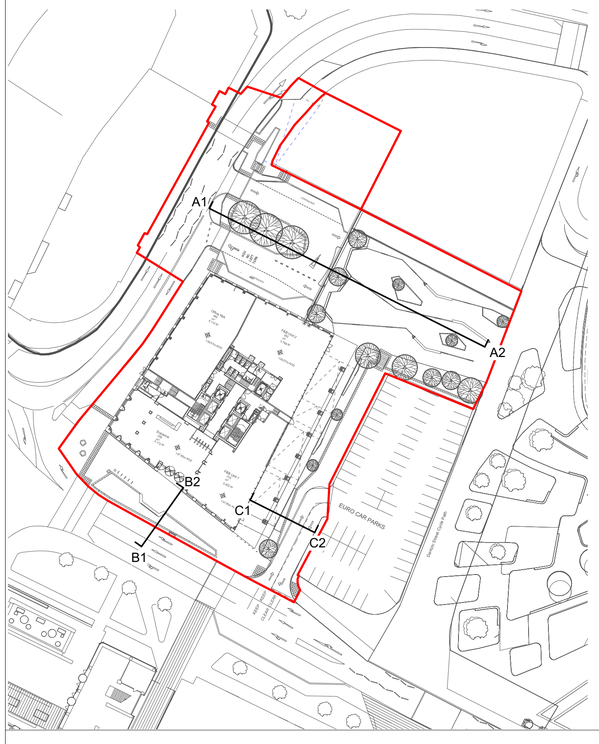
NOTES:
1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

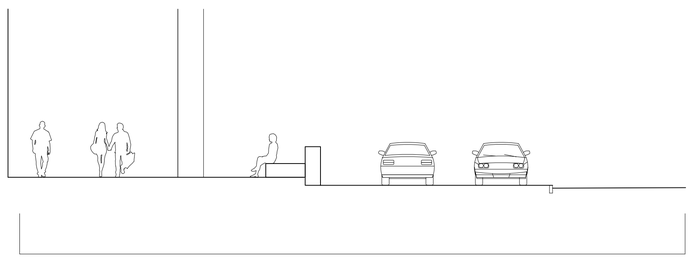
© Planit I.E. Limited



Section A1
Scale 1:100 @ A1

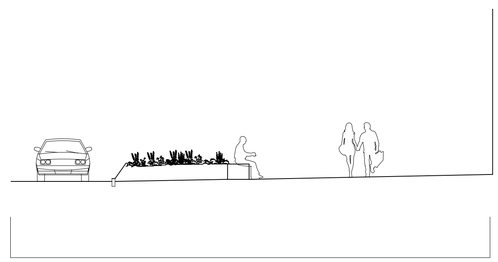
A2





Section C1
Scale 1:100 @ A1

C2



Section B1
Scale 1:100 @ A1

B2

Revision	Date	Description	Drawn	Apprvd.
S4-P04	18-10-19	Issued for Tender	AT	AT
S4-P03	20-09-19	Issued for Stage 3	AT	KR
S1-P02	24-04-19	Planning	AT	KR
S1-P01	24-04-19	Planning	AT	KR

Client MEPC

Project NOMA, Plot P, Manchester

Drg Title Site Wide Sections

Created on	Created by	Approved by
05.04.19	AT	KR

Scale	Size	Workstage
1:100	A1	Tender

Drg No.	Suitability	Revision
4AS-PLA-XX-XX-DR-L-0003	S4	P04

Planit I.E. Limited
E: info@planit-ie.com **W:** planit-ie.com
MANCHESTER
2 Back Grafton St , Altrincham, WA14 1DY
T: 0161 928 9281
LONDON
Unit 6 Waterside, 44-48 Wharf Road, London, N1 7UX
T: 0207 253 5678
LIVERPOOL
No. 8 Princes Parade, Princes Dock, Liverpool, L3 1DL
T: 0151 705 6746

© THIS DRAWING IS COPYRIGHT PROTECTED AND MAY NOT BE REPRODUCED IN WHOLE OR PART WITHOUT WRITTEN AUTHORITY FROM THE OWNER.

NOTES:
1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

© Planit I.E. Limited



SOFTWORKS

- Proposed trees.
- Ornamental planting/shrubs
- Green wall

For green wall detailed information please refer to Simpson Haugh drawings.

Revision	Date	Description	Drawn	Apprvd.
S4-P16	21-04-20	Planters removed along building	AT	AT
S4-P15	14-04-20	Update following Curtin's comments	AT	AT
S4-P14	19-12-19	Tender addendum - amendments to substation	AT	AT
S4-P13	18-11-19	Red line amended	AT	AT
S4-P12	11-11-19	Tender - green wall added	AT	AT
S4-P11	04-11-19	GPR survey overlaid onto plan	AT	AT
S4-P10	11-01-19	GPR survey overlaid onto plan	AT	AT
S4-P09	18-10-19	Issued for Tender	AT	KR
S4-P08	20-09-19	Issued for Stage 3	AT	AT
S1-P07	22-08-19	Draft Stage 3	AT	KR
S1-P06	24-04-19	Planning	AT	KR
S1-P05	24-04-19	Planning	AT	KR
S1-P04	18-04-19	Removal of trees to north	AT	KR
S1-P03	10-04-19	Draft planning	AT	KR
S1-P02	04-03-19	Amendment to tree species	AT	AT
S1-P01	29-03-19	Draft planning	AT	KR

Client MEPC

Project NOMA, Plot P, Manchester

Drg Title Softworks General Arrangement

Created on	Created by	Approved by
05.04.19	AT	KR

Scale	Size	Workstage
1:250	A1	Tender addendum

Drg No. 4AS-PLA-XX-XX-DR-L-2000 **Suitability** S4 **Revision** P16

Planit I.E. Limited

E: info@planit-ie.com **W:** planit-ie.com

MANCHESTER
2 Back Grafton St , Altrincham, WA14 1DY
T: 0161 928 9281

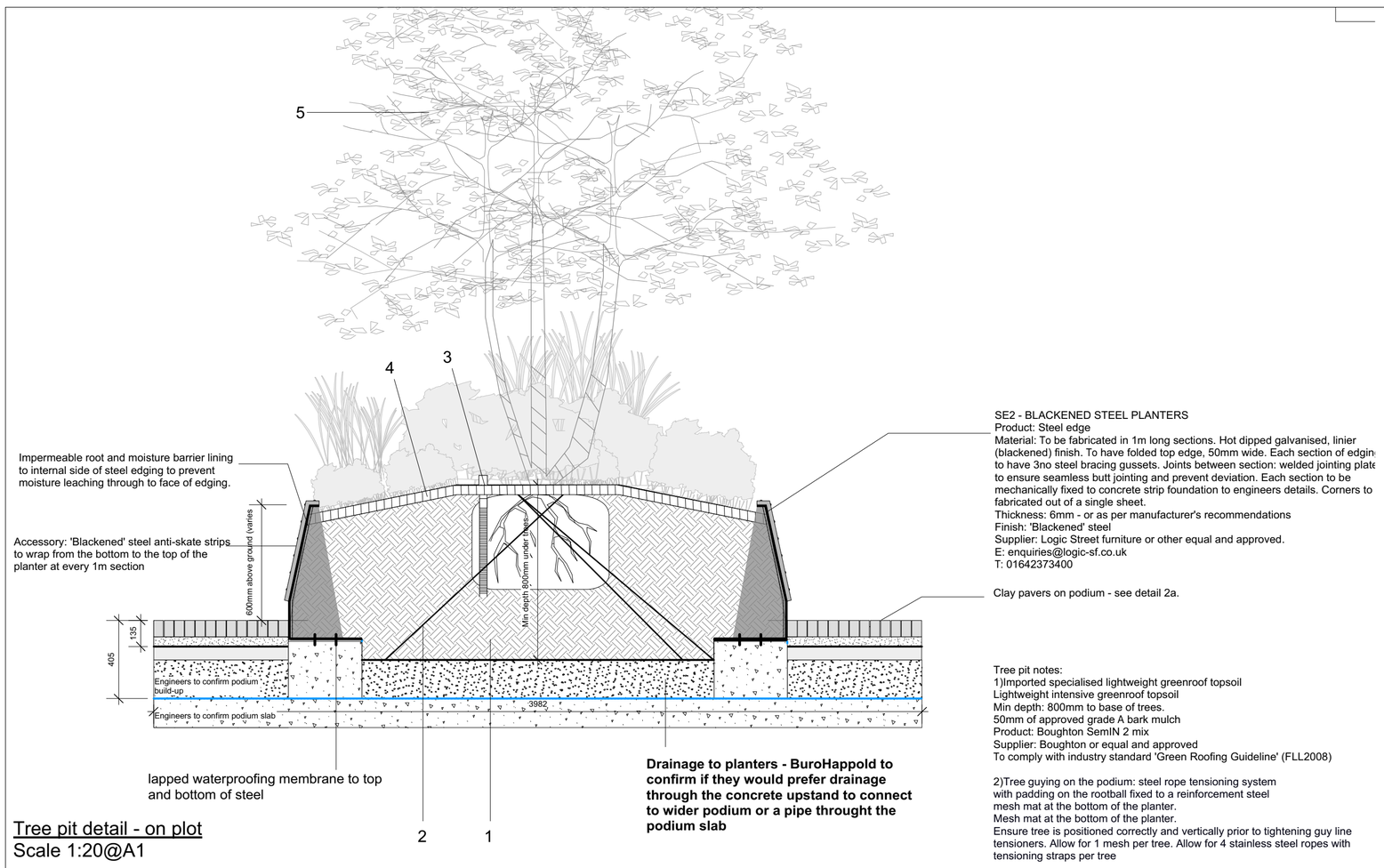
LONDON
Unit 6 Waterside, 44-48 Wharf Road, London, N1 7UX
T: 0207 253 5678

LIVERPOOL
No. 8 Princes Parade, Princes Dock, Liverpool, L3 1DL
T: 0151 705 6746

© THIS DRAWING IS COPYRIGHT PROTECTED AND MAY NOT BE REPRODUCED IN WHOLE OR PART WITHOUT WRITTEN AUTHORITY FROM THE OWNER.

NOTES:
1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

© Planit I.E. Limited



Tree pit detail - on plot
Scale 1:20@A1

SE2 - BLACKENED STEEL PLANTERS
Product: Steel edge
Material: To be fabricated in 1m long sections. Hot dipped galvanised, linier (blackened) finish. To have folded top edge, 50mm wide. Each section of edgin to have 3no steel bracing gussets. Joints between section: welded jointing plate to ensure seamless butt jointing and prevent deviation. Each section to be mechanically fixed to concrete strip foundation to engineers details. Corners to fabricated out of a single sheet.
Thickness: 6mm - or as per manufacturer's recommendations
Finish: 'Blackened' steel
Supplier: Logic Street furniture or other equal and approved.
E: enquiries@logic-sf.co.uk
T: 01642373400

Clay pavers on podium - see detail 2a.

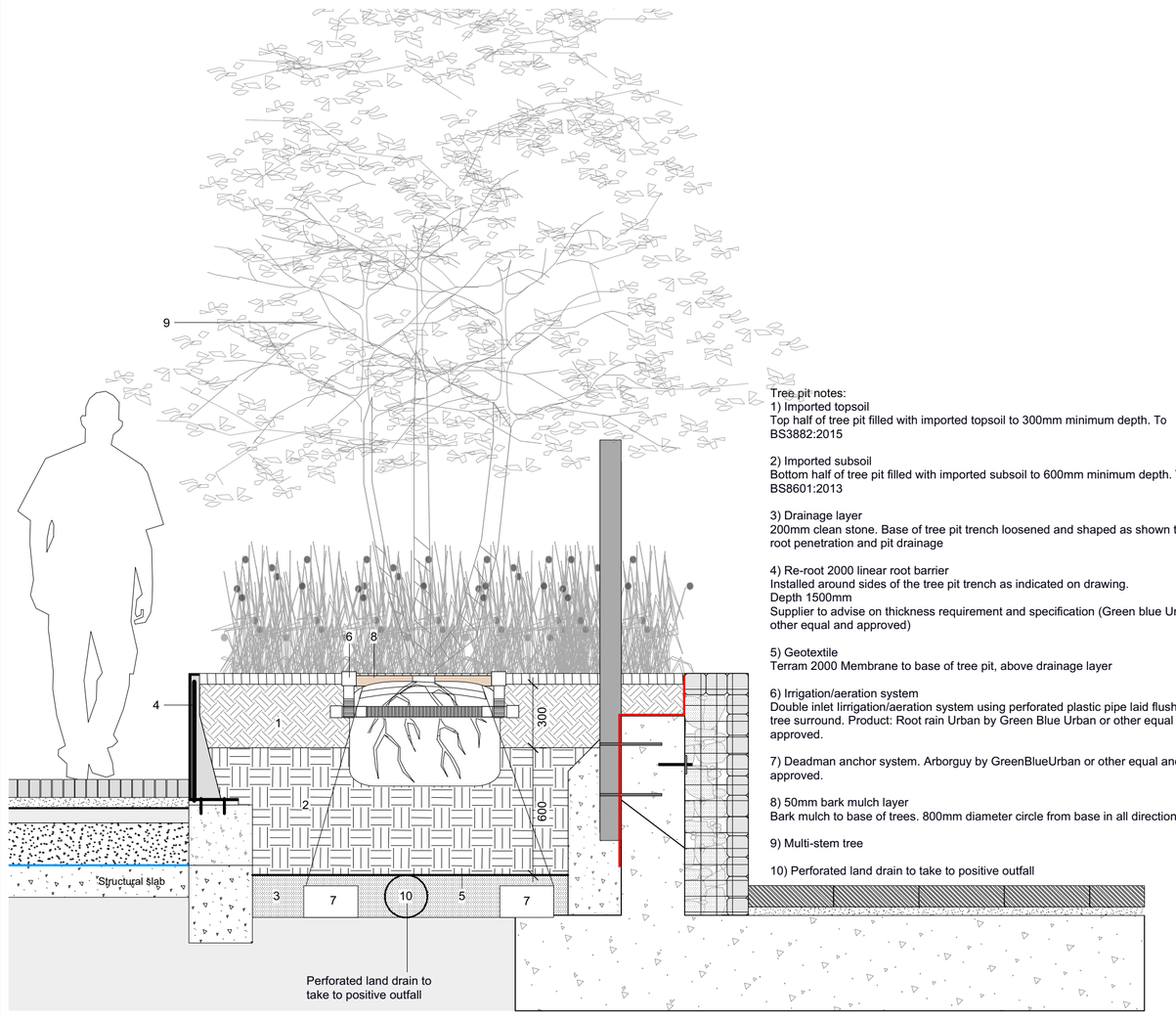
Tree pit notes:
1)Imported specialised lightweight greenroof topsoil
Lightweight intensive greenroof topsoil
Min depth: 800mm to base of trees.
50mm of approved grade A bark mulch
Product: Boughton SemIN 2 mix
Supplier: Boughton or equal and approved
To comply with industry standard 'Green Roofing Guideline' (FLL2008)

2)Tree guying on the podium: steel rope tensioning system with padding on the rootball fixed to a reinforcement steel mesh mat at the bottom of the planter.
Mesh mat at the bottom of the planter.
Ensure tree is positioned correctly and vertically prior to tightening guy line tensioners. Allow for 1 mesh per tree. Allow for 4 stainless steel ropes with tensioning straps per tree

3) Manual irrigation system to all trees.
Supplier: Green Blue Urban, or equal and approved.
Installed to manufacturer's instructions

4) 50mm amenity grade bark mulch

5) Multi-stem tree



Tree pit notes:
1) Imported topsoil
Top half of tree pit filled with imported topsoil to 300mm minimum depth. To BS3882:2015

2) Imported subsoil
Bottom half of tree pit filled with imported subsoil to 600mm minimum depth. To BS8601:2013

3) Drainage layer
200mm clean stone. Base of tree pit trench loosened and shaped as shown to aid root penetration and pit drainage

4) Re-root 2000 linear root barrier
Installed around sides of the tree pit trench as indicated on drawing.
Depth 1500mm
Supplier to advise on thickness requirement and specification (Green blue Urban or other equal and approved)

5) Geotextile
Terram 2000 Membrane to base of tree pit, above drainage layer

6) Irrigation/aeration system
Double inlet lirrigation/aeration system using perforated plastic pipe laid flush with tree surround. Product: Root rain Urban by Green Blue Urban or other equal and approved.

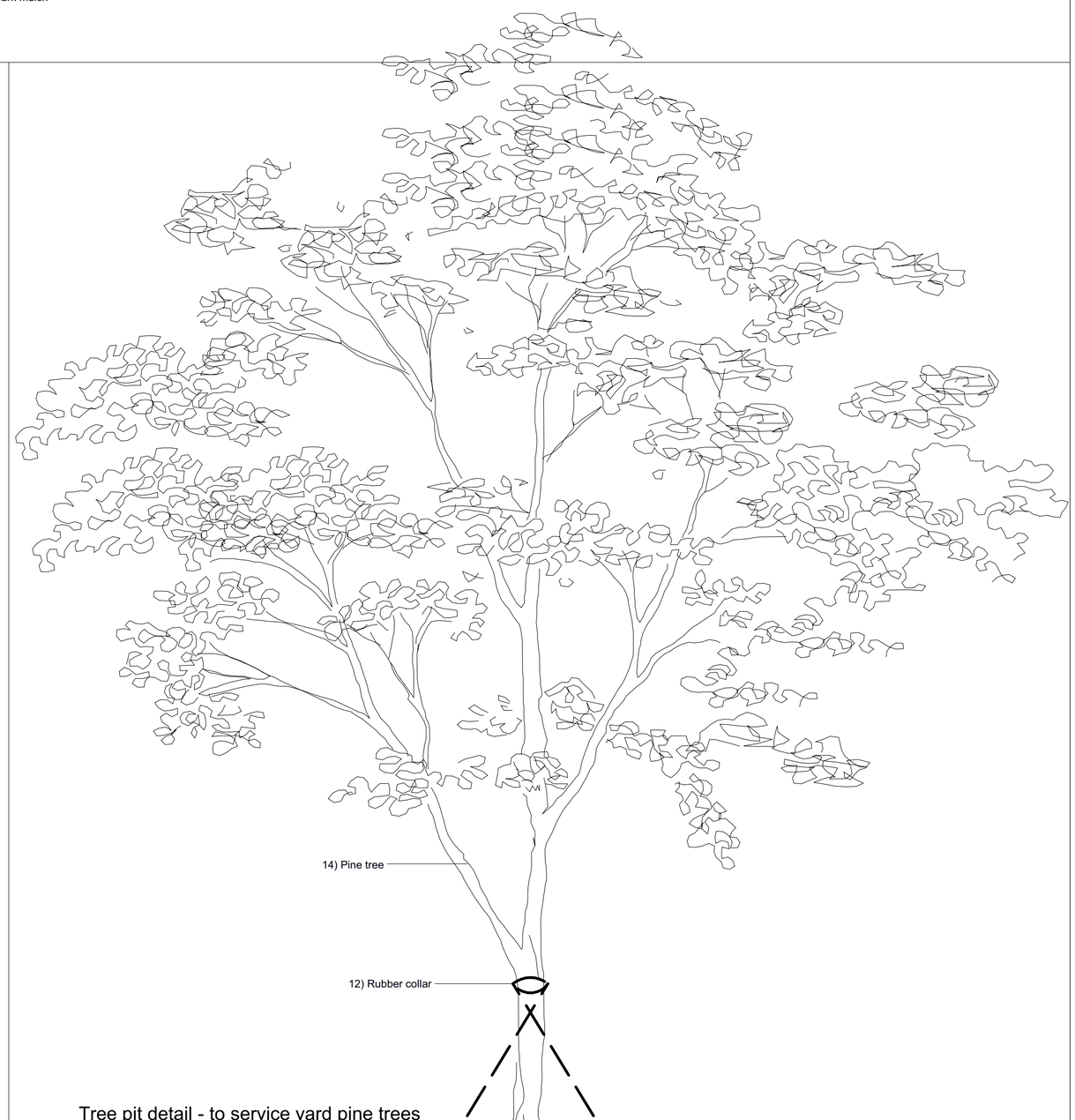
7) Deadman anchor system. Arborguy by GreenBlueUrban or other equal and approved.

8) 50mm bark mulch layer
Bark mulch to base of trees. 800mm diameter circle from base in all directions

9) Multi-stem tree

10) Perforated land drain to take to positive outfall

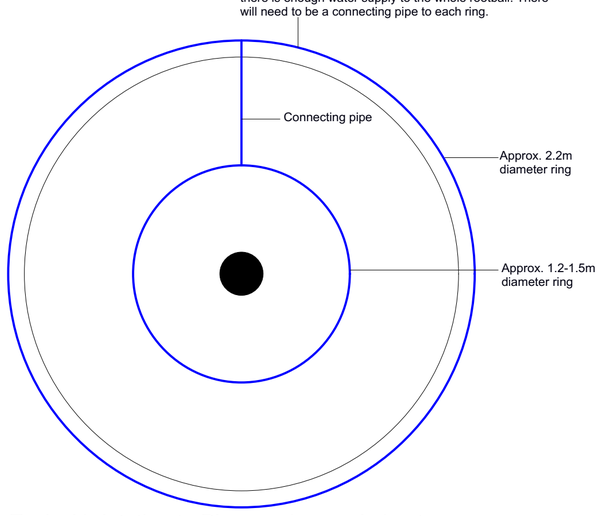
Tree pit detail - off-plot
Scale 1:20@A1



Tree pit detail - to service yard pine trees
Scale 1:20@A1

The Pinus sylvestris trees to the service yard will need an automatic drip irrigation system to each tree.
Supplier: Netafim or other equal and approved

Note: The drip system needs to run around the outside of the rootball and also in the middle of the rootball to ensure there is enough water supply to the whole rootball. There will need to be a connecting pipe to each ring.



Typical irrigtation to Pine service yard pine trees
Scale 1:20@A1

Revision	Date	Description	Drawn	Apprvd.
S4-P05	18-10-19	Issued for Tender	AT	AT
S4-P04	16-10-19	Coordination with BH	AT	AT
S4-P03	20-09-19	Issued for Stage 3	AT	AT
S1-P02	05-08-19	Draft Stage 3	TF	AT
S1-P01	22-08-19	Draft Stage 3	TF	AT

Client MEPC

Project NOMA, Plot P, Manchester

Drg Title Tree Pit Details

Created on	Created by	Approved by
05.04.19	AT	KR

Scale	Size	Workstage
1:250	A1	Tender

Drg No. 4AS-PLA-XX-XX-DR-L-6000
Suitability S4
Revision P05

Planit I.E. Limited
E: info@planit-ie.com **W:** planit-ie.com
MANCHESTER
2 Back Grafton St , Altrincham, WA14 1DY
T: 0161 928 9281
LONDON
Unit 6 Waterside, 44-48 Wharf Road, London, N1 7UX
T: 0207 253 5678
LIVERPOOL
No. 8 Princes Parade, Princes Dock, Liverpool, L3 1DL
T: 0151 705 6746

© THIS DRAWING IS COPYRIGHT PROTECTED AND MAY NOT BE REPRODUCED IN WHOLE OR PART WITHOUT WRITTEN AUTHORITY FROM THE OWNER.

NOTES:
1. Do not scale from this drawing.
2. Always work to noted dimensions.
3. All dimensions are in millimetres unless otherwise stated.
4. All setting out, levels and dimensions to be agreed on site.
5. The dimensions of all materials must be checked on site before being laid out.
6. This drawing must be read with the relevant specification clauses and detail drawings.
7. Order of construction and setting out to be agreed on site.

© Planit I.E. Limited

Pip Hunsworth
Buro Happold Limited
3 Wellington Place
Leeds
LS1 4AP
UK

T: +44 (0)113 204 2200
F: +44 (0)870 787 4144
Email: pip.hunsworth@burohappold.com