FAIRHURST

UNIVERSITY OF YORK

HESLINGTON EAST

LAKE AND LANDSCAPE CONSTRUCTION

HESLINGTON, YORK

EARTHWORKS METHOD STATEMENT

DOCUMENT REFERENCE: D/I/L/70072/02

JUNE 2008

Client:

University of York

Consultant:

W A Fairhurst & Partners

UNIVERSITY OF YORK

HESLINGTON EAST

LAKE AND LANDSCAPE CONSTRUCTION

HESLINGTON, YORK

EARTHWORKS METHOD STATEMENT

DOCUMENT REFERENCE: D/I/L/70072/02

JUNE 2008

Document Ref: DIL/70072/02			
	Name	Signature	Date
Originator:	J. Hall	JH	03/06/08
Checked by:	A. Anwar	AA	03/06/08
Approved by:	A. Forbes	AF	03/06/08

1.0 INTRODUCTION

The proposed development at Heslington, York is to provide an additional campus for the University of York. The development will comprise landscaped and wetland areas, lake and campus buildings.

Condition 35 of the planning application for the development requires that "Prior to commencement of development, a method of sampling and validation of imported and excavated ground materials shall be submitted to and approved by the Local Planning Authority to ensure that such materials that are used on site are not contaminated. This should include details of the origin of such materials."

This report has been prepared to set out the earthworks strategy for the site in relation planning condition 35. The report details the methodology for the following;

- Earthworks strategy
- Method of validation and audit report
- Method of dealing with unknown contaminants

2.0 Development Layout

The proposed wider development comprises:-

- Lake 1 and 2
- Landscaped bunds 1, 2, 3 and 4
- Development areas
- Access roads

The current Phase A planning application is for the development of the Phase A Lake and landscape. This comprises the following as shown to Drawing No.70072/SK06;

- Lake 1
- Landscape 2
- Borrow pits within Lake Area 2A and 2C

3.0 Development Strategy

The development strategy is to undertake a cut and fill balance within the earthworks operations; materials cut to form the new lake profile will be used to form the new landscape profile. Detailed cut and fill calculations have been completed (Appendix C) and in summary indicate the following;

- Cut and fill operations will involve the movement of 1,089,400m^3 of material

- There is a net excess of final cover materials within the site earthworks. The surplus of existing cover materials will be utilised to form the core of the landscape areas. As such, there is no requirement to import materials to form the final cover to landscape areas
- There is a net shortfall of 94,000m^3 in the volume of materials required to form the core of the landscape areas. This will be generated from on site borrow pits, drainage and excavation arisings from later stages of the development. As such, there will be no requirement for the importation of materials to form the core to the landscape areas.

4.0 EARTHWORKS STRATEGY

4.1 Introduction

The following earthworks operations will be undertaken on site:

- Excavation and stockpiling of cut material from the lake foot print
- Re-engineering of site generated materials to proposed landscape bunds.

4.2 Earthworks Specification

All earthworks required for the site development works are to be undertaken in accordance with the Contract Documentation and Specification as presented in Appendix C, this includes reuse of all site won materials and use of all imported materials.

All suitable excavation arisings generated by excavation of the lake profile shall be re-used as landscape fill on site. These materials shall be assessed and validated for geotechnical works in accordance with the earthworks specification (Appendix B).

It is not anticipated that additional materials will be required to achieve the proposed levels. If imported materials are used these will be assessed and validated at source in accordance with the earthworks specification (Appendix B).

4.3 Site Validation Works

4.3.1 General

Although no contamination has been identified, and in the absence of historical land use none would be expected, the following may be necessary;

- The future requirement to import materials cannot be discounted
- The volume of materials handled within the earthworks strategy is significant and the presence of unknown contaminants cannot be discounted

Therefore, a strategy for the following works is proposed;

- validation of imported materials
- identification and validation of unknown contaminants within site won materials

4.3.2 Site Won Materials

These materials will comprise the following;

- Site stripped topsoil
- Excavation arisings comprising natural sand and clay from the lake excavation

Although contamination is not expected the following works are proposed;

1) Visual assessment of site won materials to assess for evidence of contamination
2) Validate site won materials to confirm absence of contamination
3) It is not anticipated that any materials will require off site disposal. If materials are required to be disposed offsite to landfill this will be done accordance with the requirements of Section 8.

4.3.3 Unknown Contamination Hotspot Delineation and Removal

Soil contamination has not been identified on site. If visual evidence of unknown contamination is identified during the works the following works will be required;

1) In the area of the visual contamination confirm the presence of elevated contaminants via laboratory tests (metals, non metals and hydrocarbons) as presented chemical suit in Appendix A.
2) Delineate extent of contamination by additional site assessment.
3) Validate site won materials as suitable for reuse on site.

4.3.4 Imported Materials

Where imported materials are required in the works the following procedure will be required;

- If bulk fill and clean cover material is imported, it is not acceptable to import materials from sources of known former contaminative use. This shall be confirmed by desk study of the source area prior to importation of materials
- Chemical analysis shall be undertaken to assess the suitability of imported materials prior to acceptance on site

4.3.5 Validation Test Frequency

The following validation test frequency shall be undertaken:

- For the reuse of site won materials validation testing will be undertaken at a minimum rate of 20 (No.) sample per source for bulk fill or cover materials. This validation will be undertaken on materials prior to their inclusion in the earthworks
- For delineation of unknown hot spots of contamination validation testing will be undertaken at a minimum of 6 No. samples for each removed hotspot area
- For imported materials validation testing shall be undertaken at a minimum rate of 1 (No.) sample per 1000m^3 with a minimum of 3 No. tests per source.
- Contaminant concentrations will be reviewed in relation to Assessment Criteria in Tables A1, A2, Appendix A to confirm that contaminants are below assessment level.
- If contaminants are found to still be above assessment level, additional materials will be removed for off-site disposal and the validation process repeated.

5.0 VALIDATION AND AUDIT PROCEDURE

The Contractor shall appoint a Geo Environmental Engineer who will be responsible for auditing site earthworks operations. The responsibilities of the Engineer will be as detailed in the following sections;

The Engineer will be responsible for ensuring that earth works on site are carried out in accordance with the Method Statement.

The Engineer will liaise with the Regulatory and Statutory Authorities on environmental matters, as required, to ensure their satisfaction with the site works, and compliance with all planning consent conditions, licensing etc requirements.

The Engineer will inspect the excavated and stockpiled material, and the cut and prepared ground surfaces, as stated in the Method Statement, to provide a visual assessment of the materials encountered.

The Engineer will carry out or arrange the necessary sampling and laboratory analyses of material handled during the work in order to ensure compliance with the Method Statement.

The Engineer will co-ordinate insitu and laboratory testing, if unknown relic underground structures and tanks are encountered.

The Engineer will review documentary records to be provided by the Contractor of the reclamation procedures carried out. This documentary evidence will include:

- Site diary of the works.
- Plans and records of depths, lateral extent and nature of any contaminated materials encountered.
- Plans and records of insitu and laboratory testing carried out
- Plans and records of the re-use of site excavated fill materials reinstated on site.
- Plans and records of any "imported" fill materials reinstated on site.
- Plans and records of the natural soil arisings reinstated on site.
- Documentation for all wastes disposed of to landfill.
- Plans and records of any "contaminated" fill materials reinstated on site.
- Plans and records of the lateral extent and thicknesses of the cover materials installed in landscaped areas.
- Documentation of all licences, consents, permits etc issued by the Statutory and Regulatory Authorities, and evidence of compliance with any requirements of the above.

All information will be collated and included within a completion report and submitted to the city of York planning authority for assessment and approval.

APPENDIX A

Site Reclamation Acceptability Criteria

SITE RECLAMATION ACCEPTABILITY CRITERIA

Table A1 – Acceptability Criteria for Imported Materials

Contaminant	Proposed Remedial Target Soil mg/kg	Source of Target
Arsenic	511	CLEA 2005
Benzene	1.1	At Risk (Atkins)
Benzo(a)pyrene	29	At Risk (Atkins)
Cadmium	1230	CLEA 2005
Chromium (VI)	3380	CLEA 2005
Ethylbenzene	154000	CLEA 2005
Lead	750	CLEA 2002
Mercury (Inorganic)	NA	CLEA 2005
Nickel	1590	CLEA 2005
Phenol	84400	CLEA 2005
Selenium	7990	CLEA 2005
Toluene	382	CLEA 2005
Xylene	60	CLEA 2005

Table A2 – Validation Criteria for hydrocarbon hotspots (for the Human Health)

Contaminant	Proposed Remedial Target Soil mg/kg	Source of Target
Aliphatic		
TPH >C5-6	220	At Risk (Atkins)
TPH >C6-8	270	At Risk (Atkins)
TPH>C8-10	24	At Risk (Atkins)
TPH >C10-12	86	At Risk (Atkins)
TPH >C12-16	38	At Risk (Atkins)
TPH >C16-35	>1000000	At Risk (Atkins)
Aromatic		
TPH >C5-7	0.3	At Risk (Atkins)
TPH >C7-8	150	At Risk (Atkins)
TPH >C8-10	38	At Risk (Atkins)
TPH >C10-12	210	At Risk (Atkins)
TPH >C12-16	290	At Risk (Atkins)
TPH >C16-21	10600	At Risk (Atkins)
TPH >C21-35	10600	At Risk (Atkins)

APPENDIX B

General Specification for Earthworks during Site Remediation

GENERAL SPECIFICATION FOR EARTHWORKS DURING SITE REMEDIATION

1.0 INTRODUCTION

As part of the site development, earthworks will be carried out. The excavated material from the lake profile will be reused to form the landscaped areas. Some stock piling of materials for reuse as final cover and within the lake construction will be required.

To ensure that an acceptable standard of earthworks operations is achieved it is proposed that the following specification is adopted for the earthworks.

The aim of adopting these earthworks standards is to ensure that the general reinstatement of fill materials is undertaken in a controlled manner to provide a finished surface which will be stable, and will not be subject to excessive settlement or contain near surface obstructions to excavations,

2.0 CLASSIFICATION OF MATERIALS

2.1 Earthworks materials shall be categorised into one of the following classifications.

i. Acceptable material; material which meets with the requirements of Table 1.

ii. Unacceptable material; material which either does not meet the requirements of Table 1 or contains the following materials or constituents:

a. peat, organic soils and organic perishable materials (e.g. wood, straw, sawdust and paper).

b. materials in a frozen condition.

c. clays of liquid limit >90 or plasticity index >65.

d. combustible materials.

e. materials having hazardous chemicals or physical properties requiring special measures for excavation, storage, transportation, deposition and disposal.

3.0 USE OF FILL MATERIALS

3.1 The tests and rate of testing to be carried out by the Contractor in order to assess suitability shall be as detailed in Table 5.

3.2 Maximum particle size of any fill material shall be no more than two thirds of the compacted layer thickness. In addition cobbles, having an equivalent diameter of more than 150mm, shall not be placed within the engineered fill.

3.3 The majority of site won materials will classify as follows;

- Topsoil to be used for landscape final cover and landscape core construction
- Glacial sand to be used for landscape final cover, landscape core construction and cover to lake liner.
- Glacial clays to be reused for landscape final cover, landscape core construction and lake base layer construction.

3.4 The following site won materials are permitted for use within the earthworks;

- Landscape cover; this can comprise site won topsoil (class 5A), site won cohesive (class 2), or site won granular (class 1).

  The cover materials must not be mixed and must be placed in strict accordance with the location of individual material types as identified within the landscape cover plan (Ref 5)
- Landscape core; this can comprise site won topsoil (class 5A), site won cohesive (class 2), site won granular (class 1) or general landscape fill (class 4)
- Lake liner cover; this must comprise site won granular (class 1) ONLY.
- Lake base layer; this must comprise site won cohesive (class 2) ONLY.

4.0 COMPACTION OF FILLS

4.1 Method compaction shall be adopted as required for the Class of fill in Table 1 using the plant and methods appropriate to the Class of fill and the site conditions; as detailed in Table 3.

4.2 Plant and methods not included in Table 3 shall only be used providing the Contractor demonstrates at site trials that the state of compaction is achieved by the alternative method equivalent to that obtained using the specified method.

4.3 The lake base will comprise a minimum 1m thick layer of reengineered site won cohesive material (class 2A, 2B or 2D). This material must be reengineered in such a manner that existing structure within the clay materials and sub formation is broken

down and removed. The method of compaction is subject to the approval of the engineer.

5.0 CHEMICAL PROPERTIES OF SITE WON RECYCLED AND IMPORTED FILL

5.1 All site won recycled and imported fill materials for use as engineering fill in the permanent works shall not contain contaminants in excess of the assessment criteria shown in Table B1, Appendix B.

The Resident Engineer shall determine the chemical testing suite to be used for all site won recycled and imported fill materials used on site.

6.0 Lake Liner Construction

6.1 The construction detail for the lake liner construction is shown on Drawing No. 70072/SK02, Drawing No. 70072/SK08 and Drawing No. 70072/SK09

6.2 The lake liner will be constructed in two parts; on initial engineering lake profile comprising a minimum of 1m of reengineered site won cohesive materials (class 2 only) this will be profiled to form the profile of the lake. An artificial liner will be used to provide hydraulic integrity to the lake.

6.3 The lake profile should be generated to within 50 mm of the design profile.

6.4 The final lake profile should be smooth rolled to remove level variations and ruts.

6.5 The prepared surface should be visually inspected to remove sharp objects and stones to the satisfaction of the engineer.

6.6 Prior to placement of the liner construction each area of prepared surface shall be inspected and approved for liner placement by the engineer.

6.7 The liner shall comprise a CETCO Bentomat CL Geosynthetic clay liner or similar approved (Appendix E).

6.8 The liner shall be installed in accordance with the manufacturer's requirements and specification as included in Appendix E.

Table 1

Acceptable Earthworks Materials : Classification and Compaction Requirements (See Footnotes)

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Section 2)	Material Properties Required for Acceptability (See Note 2)				Compaction Requirements Section 4.0	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 to landscape core and final cover	Any material, or combination of materials.	(i) grading	BS 1377 : Part 2	Table 2	Table 2	Tab 3 Method 2	1	A	-
							(ii) uniformity coefficient	See Note 1	10	-				
							(iii) mc	BS 1377 : Part 2	omc-2	omc+2				
							(iv) omc	BS 1377 : Part 4						
							(v) contamination levels	Table 6	Table 6	Table 6				
	1	B	-	Uniformly graded granular material	General Fill to landscape core and final cover	Any material, or combination of materials	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3 Method 3	1	B	
							(ii) uniformity coefficient	See Note 1	-	10				
							(iii) mc	BS 1377 : Part 2	omc-2	omc+2				
							(iv) omc	BS 1377 : Part 4						
							(v) contamination levels	Table 6	Table 6	Table 6				
	1	C	-	Coarse granular material	General Fill to landscape core and final cover	Any material, or combination of materials	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3 Method 5	1	C	-
							(ii) uniformity coefficient	See Note (1)	5	-				
							(iii) 10% fines value		50kN	-				
							(iv) contamination levels	Table 6	Table 6	Table 6				

Notes:

1. Uniformly coefficient is defined of the ratio of the particle diameters.
   D_{60} to D_{10} on the particle size distribution curve where;
   D_{60} = particle of which 60% of the soil weight is finer
   D_{10} = particle diameter of which 10% of the soil by weight is finer
2. In addition to requirements on use of fill materials detailed in Section 2 and testing for earthworks materials in accordance with BS 1377 : Part 1 to Part 9 inclusive.

Table 1 (Cont/d)

Acceptable Earthworks Materials : Classification and Compaction Requirements (See Footnotes)

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Section 2)	Material Properties Required for Acceptability (See Note 2)				Compaction Requirements Section 4.0	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance With:	Acceptable Limits Within:- Lower	Acceptable Limits Within:- Upper				
GENERAL COHESI	2	A	-	Wet cohesive material	General Fill to landscape core, final cover and lake base layer	Any material, or combination of materials	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3 Method 1 except (I) for materials with liquid limit greater than 50, determined by BS 1377 : Part 2, only deadweight tamping or vibratory tamping rollers or grid rollers shall be used	2	A	-
							(ii) plastic limit (PL)	BS 1377 : Part 2	-	-				
							(iii) mc	BS 1377 : Part 2	PL - 4%					
							(iv) Undrained Shear Strength of Remoulded Material	Clause 633	10kN/m^2					
							(v) contamination levels	Table 6	Table 6	Table 6				
	2	B	-	Dry cohesive	General	Any material, or combination	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3	2	B	-

V E F I L L					Fill to landscape core, final cover and lake base layer	of materials	(ii) plastic limit (PL)	BS 1377 : Part 2	-	-	Method 2			
							(iii) mc	BS 1377 : Part 2						
							(ii) Undrained Shear Strength of Remoulded Material	Clause 633	10kN/m^2					
							(v) contamination levels	Table 6	Table 6	Table 6				

Table 1 (Cont/d)

Acceptable Earthworks Materials : Classification and Compaction Requirements (See Footnotes)

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Section 2)	Material Properties Required for Acceptability (See Note 2)				Compaction Requirements Section 4.0	Class		
							Property (See Exceptions in Previous Column)	Defined and Tested in Accordance With:	Acceptable Limits Within:- Lower	Acceptable Limits Within:- Upper				
	2	C	-	Stoney cohesive	General Fill to landscape core, final cover and lake base layer	Any material, or combination of materials	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3	2	C	-
							(ii) Undrained Shear Strength of Remoulded Material	Clause 633	10kN/m^2					
							(iii) contamination levels	Table 6	Table 6	Table 6				
	2	D	-	Silty cohesive material	General Fill to landscape core, final cover and lake base layer	Any material, or combination of materials	(i) grading (ii) Undrained Shear Strength of Remoulded Material	BS 1377 : Part 2 Clause 633	Tab 2 10kN/m^2	Tab 2	Tab 3 Method 3			
							(v) contamination	Table 6	Table 6	Table 6				
TOPSOIL	5	A		Topsoil	Topsoil cover and landscape core	General purpose grade complying with BS 3882	(i) contamination	Table 6	Table 6	Table 6	-	5	A	-

Class				General Material Description	Typical Use	Permitted Constituents (All Subject to Requirements of Section 2)	Material Properties Required for Acceptability (See Note 2)				Compaction Requirements Section 4.0	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	2	Selected granular material (coarse grading)	Haul Road Construction	Any material, or combination of materials, other than unburnt colliery spoil and argillaceous rock. Recycled aggregate.	(i) grading	BS 1377 : Part 2	Tab 2	Tab 2	Tab 3 Method 6	6	F	2
							(ii) Optimum mc	BS 1377 : Part 4 (vibrating hammer method)	-	10				
							(iii) mc	BS 1377 : Part 2	OMC - 2%	OMC +2%				
							(iv) Los Angeles coefficient	Clause 635	-	50				
							(v) Contamination	Table 6	Table 6	Table 6				

Table 2

Grading Requirements for Acceptable Earthworks Materials

Class	Size (mm)		Size (mm) BS Series													Size (microns) BS Series				Size microns	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																<15		1A
1B		100	95																<15		1B
1C		100	10-95													0-25			<15		1C
2A & 2B		100	95											80-100					15-100		2A & 2B
2C		100	95											15-80					15-80		2C
2D		100	95																80-100	0-20	2D
6F2			100	80-100	65-100	45-100				15-60		10-45				0-25			0-12		6F2

Table 3
Method Compaction for Earthworks Materials : Plant and Methods (Method 1 to Method 6)

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=110mm	N for D=150mm	N for D=250mm
Smooth wheeled roller (or vibratory roller operating without vibration)		Mass per metre width of roll:													
	1	over 2100 kg up to 2700 kg	125	8	125	10	125	10*	175	4	unsuitable		unsuitable	unsuitable	unsuitable
	2	over 2700 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		Mass per metre width of roll:													
	1	over 2700 kg up to 5400 kg	150	10			150	10	250	4	unsuitable		unsuitable	unsuitable	unsuitable
	2	over 5400 up to 8000kg	150	8	125	12	unsuitable		325	4	unsuitable		20	unsuitable	unsuitable
	3	over 8000kg	150	4	150	12	unsuitable		400	4	unsuitable		12	20	unsuitable
Deadweight tamping roller		Mass per metre width of roll:													
	1	over 4000kg up to 6000kg	225	4	150	12	250	4	350	4	unsuitable		12	20	unsuitable
	2	over 6000kg	300	5	200	12	300	3	400	4	unsuitable		8	12	20
Pneumatic-tyred roller		Mass per wheel:													
	1	over 1000kg up to 1500kg	125	6	unsuitable		150	10*	240	4	unsuitable		unsuitable	unsuitable	unsuitable
	2	over 1500kg up to 2000kg	150	5	unsuitable		unsuitable		300	4	unsuitable		unsuitable	unsuitable	unsuitable
	3	over 2000kg up to 2500kg	175	4	125	12	unsuitable		350	4	unsuitable		unsuitable	unsuitable	unsuitable
	4	over 2500kg up to 4000kg	225	4	125	10	unsuitable		400	4	unsuitable		unsuitable	unsuitable	unsuitable
	5	over 4000kg up to 6000kg	300	4	125	10	unsuitable		unsuitable		unsuitable		12	unsuitable	unsuitable
	6	over 6000kg up to 8000kg	350	4	150	8	unsuitable		unsuitable		unsuitable		12	unsuitable	unsuitable
	7	over 8000kg up to 12000kg	400	4	150	8	unsuitable		unsuitable		unsuitable		10	16	unsuitable
	8	over 12000kg	450	4	175	6	unsuitable		unsuitable		unsuitable		8	12	unsuitable
Vibratory tamping roller		Mass per metre width of a vibrating roll:													
	1	over 700kg up to 1300kg	100	12	100	12	150	12	100	10	unsuitable		unsuitable	unsuitable	unsuitable
	2	over 1300kg up to 1800kg	125	12	125	12	175	12*	175	8	unsuitable		12	unsuitable	unsuitable
	3	over 1800kg up to 2300kg	150	12	150	12	200	12*	unsuitable		unsuitable		8	12	unsuitable
	4	over 2300kg up to 2900kg	150	9	150	9	250	12*	unsuitable		400	5	6	10	unsuitable
	5	over 2900kg up to 3600kg	200	9	200	9	275	12*	unsuitable		500	6	6	10	unsuitable
	6	over 3600kg up to 4300kg	25	9	225	9	300	12*	unsuitable		600	6	4	8	unsuitable
	7	over 4300kg up to 5000kg	250	9	250	9	300	9*	unsuitable		700	6	3	7	12
	8	over 5000kg	275	9	275	9	300	7*	unsuitable		800	6	3	6	10

Table 4
Method Compaction for Earthworks Materials : Plant and Methods (Method 1 to Method 6)

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=110mm	N for D=150mm	N for D=250mm
Vibratory roller		Mass per metre width of a vibratory roll:													
	1	over 270kg up to 1500kg	unsuitable		75	16	150	16	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2	over 450kg up to 700kg	unsuitable		75	12	150	12	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	3	over 700kg up to 1300kg	100	12	125	10	150	6	125	10	unsuitable		16	unsuitable	unsuitable
	4	over 1300kg up to 1800kg	125	8	150	8	200	10*	175	4	unsuitable		6	16	unsuitable
	5	over 1800kg up to 2300kg	150	4	150	4	225	12*	unsuitable		unsuitable		4	6	12
	6	over 2300kg up to 2900kg	175	4	175	4	250	10*	unsuitable		100	5	3	5	14
	7	over 2900kg up to 3600kg	200	4	200	4	275	8*	unsuitable		500	5	3	5	10
	8	over 3600kg up to 4300kg	225	4	225	4	300	8*	unsuitable		600	5	2	4	8
	9	over 4300kg up to 5000kg	250	4	250	4	300	6*	unsuitable		700	5	2	4	7
	10	over 5000kg	275	4	275	4	300	4	unsuitable		800	5	2	3	6
Vibrating plate compactor		Mass per m^2 of base plate:													
	1	over 880kg up to 1100kg	unsuitable		unsuitable		75	6	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2	over 1100kg up to 1200kg	unsuitable		75	10	100	6	75	10	unsuitable		unsuitable	unsuitable	unsuitable
	3	over 1200kg up to 1400kg	unsuitable		75	6	150	6	150	8	unsuitable		unsuitable	unsuitable	unsuitable
	4	over 1400kg up to 1800kg	100	6	125	6	150	4	unsuitable		unsuitable		8	unsuitable	unsuitable
	5	over 1800kg up to 2100kg	150	6	150	5	200	4	unsuitable		unsuitable		5	8	unsuitable
	6	over 2100kg	200	6	200	5	250	4	unsuitable		unsuitable		3	6	12
Vibro-tamper		Mass:													
	1	over 50kg up to 65kg	100	3	100	3	150	3	125	3	unsuitable		4	8	unsuitable
	2	over 65kg up to 75kg	125	3	125	3	200	3	150	3	unsuitable		3	6	12
	3	over 75kg up to 100kg	150	3	150	3	225	3	175	3	unsuitable		2	4	10
	4	over 100kg	225	3	200	3	225	3	250	3	unsuitable		2	4	10
Power rammer		Mass:													
	1	100kg up to 500kg	150	4	150	6	unsuitable		200	4	unsuitable		5	8	unsuitable
	2	over 500kg	275	8	275	12	unsuitable		400	4	unsuitable		5	8	14
Dropping-weigth compactor		Mass of rammer over 500kg													
	1	over 1 in up to 2m	600	4	600	8	450	8	unsuitable		unsuitable		unsuitable	unsuitable	unsuitable
	2		600	2	600	8	unsuitable		unsuitable		unsuitable		unsuitable	unsuitable	unsuitable

TABLE 5

Testing to be carried out by the Contractor

The following tests and rate of testing shall be carried out by the Contractor in order to assess material suitability.

Clause	Works, Goods or Material			Test	Frequency of Testing	Test Certificate	Comments
Series 600	Acceptable material						
601	Class	General Description					
631 to	1	General granular fill		Grading / uniformity coefficient	Twice a week		The frequency of testing for earthworks
637				mc (N)	2 per 250m^3 max of 5 per day		
640			1C only	10% fines value (N)	Weekly		classification is a minimum requirement
				contamination testing	20 per source		
	2	General cohesive fill		Grading	Twice a week		
				mc/MCV/PL	1 per 250m^3 max of 5 per day		The actual rate of testing required shall be to ensure that the correct classification of materials taking into account the variation in their properties
				contamination testing	20 per source		
	4	Landscape fill		Grading / mc / MCV (N)	Daily		
				contamination testing	20 per source as per Tables 6.1, 6.2 and 6.3		
	5	Topsoil		Grading	Once a day		
				contamination testing	20 per source		
	6	Selected granular fill		Grading/(N) uniformity coefficient	1 per 200m^3 min 1 per day		Notes: (1) For each source of supply
				PI/LL (N)	Daily (1)		
				10% fines value (N)	Weekly (1)		
				omc / mc (N) or mc/ MCV	1 per 200m^3, max 5 per day		
			6F2, 6F3, 6Z only	Frost susceptibility (N)	2 tests (1)		
			6Z only	Absorption bulk density, stability of slag (N)	2 tests (1)		
				contamination testing	20 per source		
602	Surplus Material			Chemical Properties (N)(q)	As required by tipping licence		See Section 7 of the Method Statement
612	Compaction of fills						Appropriate
		Method compaction		Field dry density (N)	As required		
		End product compaction		Optimum mc (2.5kg rammer/ vibrating hammer method) (N)	20 No.		Applicable to lake base layer
				Field dry density (N)	1 per 25m grid pattern		

APPENDIX C

Indicative Earthworks Volumes for Lake and Landscape

Indicative Earthworks Volumes for Phase 1A Lake and Landscape

Heslington Earthworks- Phase 1 Reserved Matters - Topsoil Stripped

Area	Topsoil Cut (m3)	Earthworks Cut (m3)		Earthworks Fill (m3)			Balance (m3)	
		Topsoil Stripped	No Topsoil Strip	Total Fill	Landscape Core Fill	Landscape Final Cover (m3)		
Landscape Area 2	-69.9	-14.5		+188.3	(+130.3)	(+58.0)	+103.9	
							(+103.9)	
Lake 1	-12.5	-25.4					-37.9	
Lake 2A	-11.4	-59.9					-71.3	
Lake 2C	-9.7	-42.6					-52.3	
Totals	-103.5	-142.4		+188.3	(+130.3)	(+58.0)	-57.6	

Notes

1. -ve Cut
2. +ve Fill
3. +ve Balance indicates material shortfall
4. –ve balance indicates material surplus

Heslington Earthworks
Phase 1 Reserved Matters- Cut and Fill to Topsoil, Sand and Clay Within Lake Profile

Area	Topsoil Cut (m3)	Lake Excavation			Turnover Excavation 1.3m			Turnover Fill 1.0 clay +0.3m liner cover				Totals
		Sand	Glacial Till	Total	Sand	Glacial Till	Total	Sand to Liner Cover	Sand to Fill	Glacial Till to Fill	Total to Fill	
Lake 1	-12.5	(-22.9)	(-2.5)	-25.4	(-24.8)	(-19.2)	-44.0	+9.7	(+15.1)	(+19.2)	+44	(-37.9)
Lake 2A	-11.4	(-34.2)	(-25.7)	-59.9	(-7.4)	(-34.2)	-41.6	+9.3	(-1.9)	(+34.2)	+41.6	(-71.3)
Lake 2C	-9.7	(-32.1)	(-10.5)	-42.6	(-19.7)	(-16.5)	-36.2	+8.1	(+11.6)	(+16.5)	+36.2	(-52.3)
Totals											Total	(-161.5)
Topsoil	-33.6											-33.6
Sand		(-89.2)			(-51.9)			(+27.1)	(+24.8)			-89.2
Clay			(-38.7)			(-69.9)				(+69.9)		-38.7
Totals	-33.6			-127.9			-121.8				+121.8	-161.5

Area	Available Topsoil	Available Sand					Available Clay					Totals (Excludes Topsoil)
	Available Topsoil	Sand Cut from Lake	Sand Cut from Turnover	Total Sand Cut	Sand Fill to Liner Cover	Total Available Sand	Clay Cut from Lake	Clay Cut from Turnover	Total Clay Cut	Clay Fill Required for Turnover	Total Available Clay Balance	
Lake 1	-12.5	(-22.9)	(-24.8)	-47.7	+9.7	(-38.0)	(-2.5)	(-19.2)	-21.7	+34.3	(+12.6)	(-25.4)
Lake 2A	-11.4	(-34.2)	(-7.4)	-41.6	+9.3	(-32.3)	(-25.7)	(-34.2)	-59.9	+32.3	(-27.6)	(-59.9)
Lake 2C	-9.7	(-32.1)	(-19.7)	-51.8	+8.1	(-43.7)	(-10.5)	(-16.5)	-27	+28.1	(+1.1)	(-42.6)
Total											Total	(-175.8)
Topsoil	-33.6											-33.6
Sand Cut		(-89.2)	(-67.8)	-141.1								-141.1
Sand Fill					+27.1							+27.1
Available Sand						(-114.0)					Sand Balance	(-114.0)
Clay Cut							(-38.7)	(-69.9)	-108.6			-108.6
Clay Fill										+94.7		+94.7
Available Clay											(-13.9)	(-13.9)
Totals												-161.5

1. -ve Cut
2. +ve Fill
3. +ve Balance indicates material shortfall
4. –ve balance indicates material available

Heslington Material Usage- Phase 1 Reserved Matters

Item	Description	Landscape ($1000m^3$)	Stockpiles		Lake ($1000m^3$)
			100m from Landscape/1km from Lake ($1000m^3$)	100m from Lake ($1000m^3$)	
1	Topsoil Cut from Landscape	-69.9			-
	Topsoil cut from Lake 1, 2a and 2c				-33.6
2	Topsoil Stockpile from landscape cut for final cover		30 (Topsoil Only)		
3	Topsoil ill to landscape core and landscape cut	+39.9			
4	Topsoil fill to landscape Core from Lake cut	+33.6			
7	Landscape E/W Cut	-14.5			
8	Landscape E/W Fill	+14.5			
11	Lake 1-E/W Cut				-25.4
12	Landscape fill from lake 1Cut- clay materials	+2.5 (Clay Only)			
13	Lake 1 Cut and Stockpile sand for reuse as Landscape final cover -sand		22.9 (Sand Only)		
14	Lake 2a/2c E/W cut				-102.5
15	Lake 2a and 2c cut Stockpile sand and cohesive for reuse			66.3 Sand 36.2 Clay	
16	Lake 1 base turnover cut				-44.0
17	Extract granular from lake 1 base turnover cut-			24.8	
18	Stockpile granular from lake base turnover for reuse as liner cover			9.7 (Sand Only)	
19	Transport and place excess granular from lake turnover cut to landscape core	+15.1			
20	Re-engineer clay from lake turnover cut				+19.2
21	Replace granular extracted from liner base turnover with cohesive				+15.1 (Clay Only)
22	Place Liner				126m2
23	Place liner cover				+9.7 (Sand Only)
24	Obtain shortfall in materials volumes			(-57.6Surplus)	
25	Place final cover to landscape	+30 Topsoil Only +22.9 Sand Only +5.1 Sand Only			
	Fill to Landscape Core	+24.7			

Indicative Earthworks Volumes for wider Development

Heslington Earthworks- Topsoil Stripped

Area	Topsoil Cut (m3)	Earthworks Cut (m3)		Earthworks Fill (m3)			Balance (m3)	
		Topsoil Stripped	No Topsoil Strip	Total Fill	Landscape Core Fill	Landscape Final Cover (m3)		
Landscape Area 1	-95.1	-25		+149	(+71.9)	(+77.1)	+28.9	
Landscape Area 2	-69.9	-14.5		+188.3	(+130.3)	(+58.0)	+103.9	
Landscape Area 3	-12.1	-6.6		+40.1	(+28.8)	(+11.3)	+21.4	
Landscape Area 4	-28.3	-2.4		+180.5	(+156.9)	(+23.6)	+149.8	
Lake Buffer	-19.8	-2.9		+33.8	(+17.2)	(+16.6)	+11.1	
							(+315.1)	
Lake 1	-12.5	-25.4					-37.9	
Lake 2A	-11.4	-59.9					-71.3	
Lake 2B	-11.7	-47.9					-59.6	
Lake 2C	-9.7	-42.6					-52.3	
Totals	-270.5	-227.2		+591.7	(+405.1)	(+186.6)	+94	

Notes

1. -ve Cut
2. +ve Fill
3. +ve Balance indicates material shortfall
4. –ve balance indicates material surplus

Heslington Earthworks
Cut and Fill to Topsoil, Sand and Clay Within Lake Profile

Area	Topsoil Cut (m3)	Lake Excavation			Turnover Excavation 1.3m			Turnover Fill 1.0 clay +0.3m liner cover				Totals
		Sand	Glacial Till	Total	Sand	Glacial Till	Total	Sand to Liner Cover	Sand to Fill	Glacial Till to Fill	Total to Fill	
Lake 1	-12.5	(-22.9)	(-2.5)	-25.4	(-24.8)	(-19.2)	-44.0	+9.7	(+15.1)	(+19.2)	+44	(-37.9)
Lake 2A	-11.4	(-34.2)	(-25.7)	-59.9	(-7.4)	(-34.2)	-41.6	+9.3	(-1.9)	(+34.2)	+41.6	(-71.3)
Lake 2B	-11.7	(-37.9)	(-10)	-47.9	(-15.9)	(-26.3)	-42.2	+9.5	(+6.4)	(+26.3)	+42.2	(-59.6)
Lake 2C	-9.7	(-32.1)	(-10.5)	-42.6	(-19.7)	(-16.5)	-36.2	+8.1	(+11.6)	(+16.5)	+36.2	(-52.3)
Totals											Total	(-221.1)
Topsoil	-45.3											-45.3
Sand		(-127.1)			(-67.8)			(+36.6)	(+31.2)			-127.1
Clay			(-48.7)			(-96.2)				(+96.2)		-48.7
Totals	-45.3			-175.8			-164.0				+164	-221.1

Area	Available Topsoil	Available Sand					Available Clay					Totals (Excludes Topsoil)
	Available Topsoil	Sand Cut from Lake	Sand Cut from Turnover	Total Sand Cut	Sand Fill to Liner Cover	Total Available Sand	Clay Cut from Lake	Clay Cut from Turnover	Total Clay Cut	Clay Fill Required for Turnover	Total Available Clay Balance	
Lake 1	-12.5	(-22.9)	(-24.8)	-47.7	+9.7	(-38.0)	(-2.5)	(-19.2)	-21.7	+34.3	(+12.6)	(-25.4)
Lake 2A	-11.4	(-34.2)	(-7.4)	-41.6	+9.3	(-32.3)	(-25.7)	(-34.2)	-59.9	+32.3	(-27.6)	(-59.9)
Lake 2B	-11.7	(-37.9)	(-15.9)	-53.8	+9.5	(-44.3)	(-10.0)	(-26.3)	-36.3	+32.7	(-3.6)	(-47.9)
Lake 2C	-9.7	(-32.1)	(-19.7)	-51.8	+8.1	(-43.7)	(-10.5)	(-16.5)	-27	+28.1	(+1.1)	(-42.6)
Total											Total	(-175.8)
Topsoil	-45.3											-45.3
Sand Cut		(-127.1)	(-67.8)	-194.9								-194.9
Sand Fill					+36.6							+36.6
Available Sand						(-158.3)					Sand Balance	(-158.3)
Clay Cut							(-48.7)	(-96.2)	-144.9			-144.9
Clay Fill										+127.4		+127.4
Available Clay											(-17.5)	(-17.5)
Totals												-221.1

1. -ve Cut
2. +ve Fill
3. +ve Balance indicates material shortfall
4. –ve balance indicates material available

Heslington Material Usage

Item	Description	Landscape ($1000m^3$)	Stockpiles		Lake ($1000m^3$)
			100m from Landscape/1km from Lake ($1000m^3$)	100m from Lake ($1000m^3$)	
1	Topsoil Cut from Landscape	-205.4			-
	Topsoil cut from Lake				-45.3
2	Topsoil Stockpile from landscape cut for final cover		93 (Topsoil Only)		
3	Topsoil ill to landscape core and landscape cut	+112.4			
4	Topsoil fill to landscape Core from Lake cut	+45.3			
5	Topsoil Cut from Lake Buffer				-19.8
6	Topsoil Fill to Landscape Core from lake Buffer	+19.8			
7	Landscape E/W Cut	-48.5			
8	Landscape E/W Fill	+48.5			
9	Lake Buffer E/W cut				-2.9
10	Lake Buffer E/W Fill				+2.9
11	Lake E/W Cut				-175.8
12	Landscape fill from lake Cut- General materials	+20.1 (Sand Only)			
13	Lake Cut and Stockpile sand for reuse as Landscape final cover -sand		93.6 (Sand Only)		
14	Lake Buffer fill from Lake cut- general materials				+30.9
15	Lake cut Stockpile cohesive for use as lake liner base			31.2 (Clay Only)	
16	Lake base turnover cut				-164
17	Extract granular from lake base turnover cut-			67.8	
18	Stockpile granular from lake base turnover for reuse as liner cover			36.6 (Sand Only)	
19	Transport and place excess granular from lake turnover cut to landscape core	+31.2			
20	Re-engineer clay from lake turnover cut				+96.2
21	Replace granular extracted from liner base turnover with cohesive				+31.2 (Clay Only)
22	Place Liner				$126,000m^2$
23	Place liner cover				+36.6 (Sand Only)
24	Obtain shortfall in materials volumes	+94- bulking, foundation excavations etc			
25	Place final cover to landscape	+93 Topsoil Only +93.6 Sand Only			