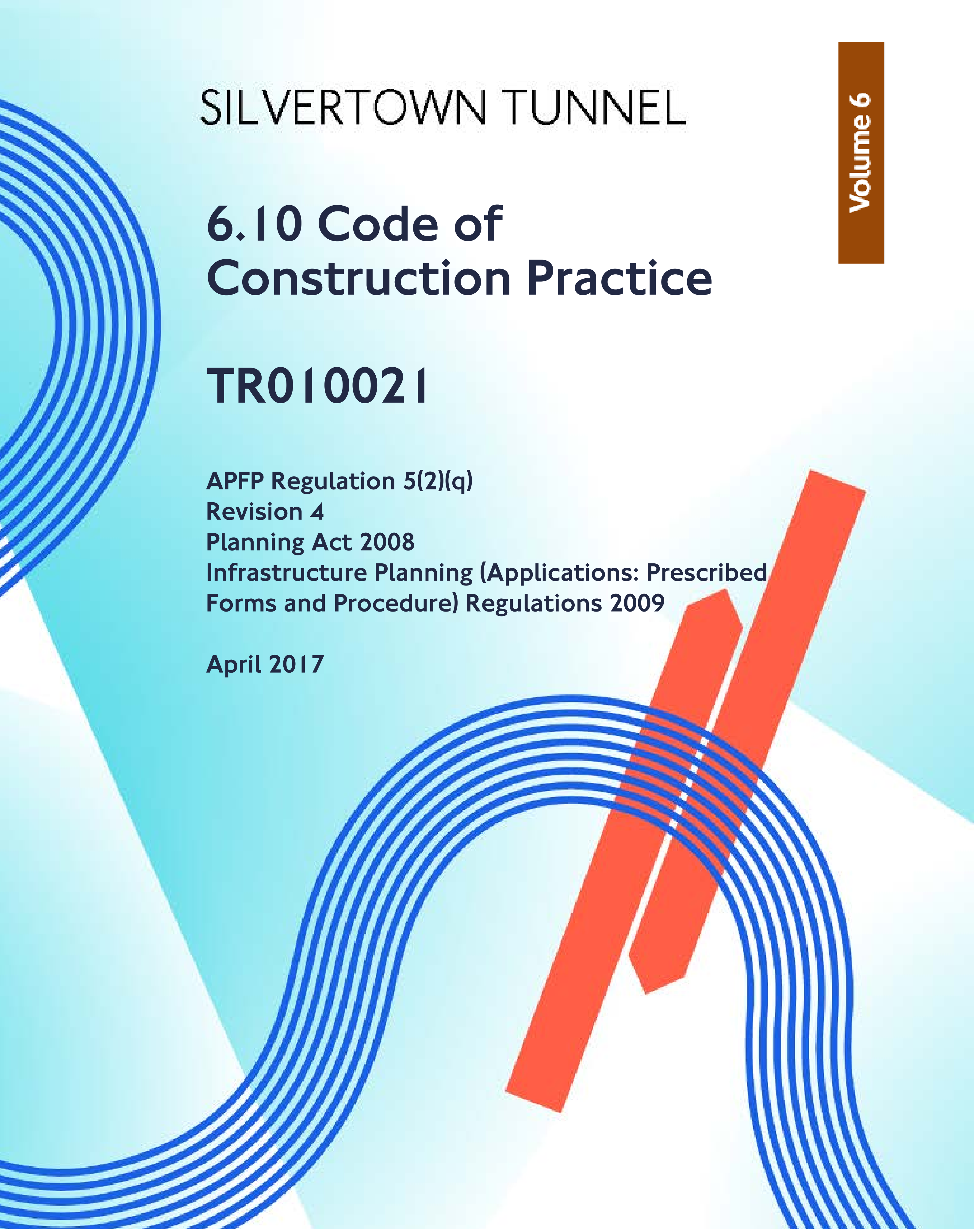

SILVERTOWN TUNNEL

Volume 6

6.10 Code of Construction Practice

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APFP Regulation 5(2)(q)
Revision 4
Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

April 2017

MAYOR OF LONDON

TRANSPORT FOR LONDON
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Silvertown Tunnel

Code of Construction Practice
6.10

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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4	03/04/2017	David Rowe (TfL Lead Sponsor)	[redacted]	For DCO Deadline 6

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List of Abbreviations

AQMP	Air Quality Management Plan
BPM	Best Practicable Means
CEMP	Construction Environmental Management Plan
CEP	Community Engagement Plan
CMMP	Construction Materials Management Plan
CoCP	Code of Construction Practice
CTMP	Construction Traffic Management Plan
DCO	Development Consent Order
DLR	Docklands Light Railway
EAL	Emirates Air Line
EHO	Environmental Health Officer
EMP	Environmental Management Plan
EOD	Explosive Ordnance Disposal
EP	Emergency Plan
ES	Environmental Statement
FORS	Fleet Operator Recognition Scheme
HGV	Heavy Goods Vehicle

HMP	Heritage Management Plan
LFEPA	London Fire and Emergency Planning Authority
NVMP	Noise and Vibration Management Plan
PP	Passage Plan
RPA	Root Protection Area
RSA	Receptor Site Assessment
SRN	Strategic Road Network
SWMP	Site Waste Management Plan
TBM	Tunnel Boring Machine
TfL	Transport for London
WSI	Written Scheme of Investigation
UXO	Unexploded Ordnance

Glossary of Terms

Asset Control Limits	The predefined values, based on assessment, relating to safety and serviceability considerations that instigate a review of risk to third party assets.
Asset protection	Asset protection is a process by which the impacts to all structures (that is buildings, utilities and highways or other structures) potentially at risk of damage from ground movements, or other effects arising from construction of the Scheme, are kept to acceptable levels.
Beneficial use	• Ecological benefit or land reinstatement / landscaping: The activity will assist in ecological benefit and/or help to facilitate an approved change/alteration in land use or form. • Works (linked to a consented planning activity or permit) that aims to restore, enhance or be part of a land management scheme i.e. landfill or quarry. • Reduce the requirement for alternative material (waste or not) to be used for the purposes of any such Scheme.
Black redstart	The black redstart is a small robin-sized bird that has adapted to live at the heart of industrial and urban centres. Its name comes from the plumage of the male, which is grey-black in colour with a red tail. With fewer than 100 breeding pairs in the UK, the black redstart is on the amber list of Birds of Conservation Concern.
Blackwall Tunnel	An existing road tunnel underneath the River Thames in east London, linking the London Borough of Tower Hamlets with the Royal Borough of Greenwich, comprising two bores each with two lanes of traffic.
Considerate Constructors Scheme (CCS)	Construction sites, companies and suppliers can voluntarily register with the CCS and agree to abide by the Code of Considerate Practice, designed to encourage best practice beyond statutory requirements. The Code of Considerate

	Practice commits those sites and companies registered with the CCS to respect the community, protect the environment, secure everyone's safety and value their workforce.
Contractor	The Contractor will be the construction entity through which the Project Company would deliver the design and construction of the Scheme and includes anyone who directly employs or engages construction workers or manages construction work, including sub-contractors, or any individual self-employed worker or business that carries out, manages or controls construction work.
Detailed Design	A finalised design, complete in all aspects and suitable for construction of the Scheme.
Development Consent Order (DCO)	This is a statutory order which provides consent for the project and means that a range of other consents, such as planning permission and listed building consent, will not be required. A DCO can also include provisions authorising the compulsory acquisition of land or of interests in or rights over land which is the subject of an application. http://infrastructure.planninginspectorate.gov.uk/help/glossary-of-terms/
Dewatering	The process of removing groundwater from an aquifer.
Emergency Preparedness Plan	The plan which defines specific actions to be taken in response to observed asset/ground movements in accordance with the Asset Control Limits.
Excavated Material	Ground or other material removed during a construction process, usually by mechanical means.
Heavy Good Vehicle (HGV)	European Union term for any vehicle with a gross combination mass of over 3500kg.
Heritage Asset	A building, monument, site, place, area of landscape identified as having a degree of significance meriting consideration in planning decisions, because of heritage interest. Heritage

	asset includes designated heritage assets and assets identified by the local planning authority (including local listing).
Illustrative Design	An example of how the proposals could be developed at the next stage of design as a result of engagement with the Project Company contractor, planning authority and other relevant stakeholders. This is an example of how the Scheme may look, but it is not the final design.
Instrumentation and Monitoring Plan	The plan which defines the type and location of instrumentation used to monitor an asset, as well as the frequency of recording and reporting.
Jetty	A structure that projects from land out into water for the purposes of marine logistics.
Order Limits	The extent of land and rights over land that will be needed temporarily to construct the Scheme, and permanently to operate, maintain and safeguard the Scheme (often referred to as ‘the red line boundary’).
Pollution Prevention Guidelines	Best practice guidelines set out by the Environment Agency to advise industry and public on legal responsibilities and good environmental practice.
Project Company	A Project Company is typically a consortium of private sector companies, formed for the specific purpose of providing the services under a private finance contract. This is also technically known as a Special Purpose Vehicle (SPV). The Project Company will obtain funding to design and build the new facilities and then undertake routine maintenance and capital replacement during the remainder of the contract period. The total contract period is typically 30 years. The Project Company will repay funders from payments received from TfL during the post construction period of the contract. Receipt of payments from TfL will depend on the ability of the Project Company to deliver the services in accordance with the output specified in the contract.

Public health	All organised efforts to improve population health through prevention and promotion activities. The focus of public health is the population and not the individual.
Reference Design	The design proposals for the Scheme that the DCO application refers to, as modified and developed in response to the Statutory Consultation process. The Reference Design has been developed to a concept stage appropriate to prove engineering and construction feasibility and to inform the construction and operational land requirements, environmental impact assessments and Scheme cost estimate.
Settlement	Settlement is the technical term given to the way the ground moves around a hole after it has been dug out.
Site Waste Management Plan	A document that outlines how the Scheme will reduce, manage, and dispose of its solid waste.
Silt	The generic term for particles with a grain size of 4-63μm, i.e. between clay and sand.
Suitable Excavated Material	"Suitable Excavated Material" means all bored or excavated material from the tunnel works for which treatment is not technically feasible or which would not require treatment were it to be disposed of to a permitted facility.
Surface Water	Water that appears on the land surface that has not seeped into the ground, i.e. lakes, rivers, streams, standing water, ponds, precipitation.
The Scheme	The construction of a new bored tunnel with cut and cover sections at either end under the River Thames (the Silvertown Tunnel) between the Greenwich peninsula and Silvertown, as well as necessary alterations to the connecting road network and the introduction of user charging at both Silvertown and Blackwall tunnels.
Transportable	Transportable Moisture Limits are defined in The Merchant Shipping (Carriage of Cargoes) Regulations 1999 as the

Moisture Limits	9/10ths (or 90%) of the flow moisture point. This limit sets the standard for accepting cargoes which may liquefy for marine transport. Cargoes with a moisture content above the TML should not be transported by ship unless *“appropriate safety arrangements are made to the satisfaction of the Certifying Authority to ensure adequate stability in the case of cargo shifting, and the ship has adequate structural integrity.”*
Transport for London (TfL)	A local government body responsible for most aspects of the transport system in Greater London. Its role is to implement transport strategy and to manage transport services across London. These services include: buses, the Underground network, Docklands Light Railway, Overground and Trams. TfL also runs Santander Cycles, London River Services, Victoria Coach Station and the Emirates Air Line. As well as controlling a 580km network of main roads and the city's 6,000 traffic lights, TfL regulates London's private hire vehicles and the Congestion Charge scheme
The Tunnel, Silvertown Tunnel	Proposed new twin-bore road tunnels under the River Thames from the A1020 in Silvertown to the A102 on Greenwich Peninsula, East London.
Tunnel Boring Machine (TBM)	A machine used to excavate tunnels with a circular cross section. There are two main types of closed face TBMs: Earth Pressure Balance (EPB) and Slurry Shield (SS). Please see those terms for further explanation.
Unexploded Ordnance	Unexploded ordnance are explosive weapons (bombs, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded.
Waste	Waste is defined in Article 1(a) of the European Waste Framework Directive 2008/98/EC as ‘any substance or object in the categories set out in Annex I which the holder discards or intends to discard or is required to discard’. The term ‘holder’ is defined as the producer of the waste or the person

	who is in possession of it and ‘producer’ is defined as anyone whose activities produce waste. Waste can be further classified as hazardous, non-hazardous or inert.
Watching Brief	The watching of a situation by a suitably qualified person to ensure that works (e.g. an excavation) are being done correctly, and in accordance with relevant environmental standards.
Worksite	An area of land within the Scheme Order Limits which is temporarily occupied and used to undertake construction works.

SUMMARY

S.1.1 The purpose of this Code of Construction Practice (CoCP) is to set a framework to control possible impacts arising from the construction of the Silvertown Tunnel, hereafter referred to as the Scheme. The CoCP covers environmental, public health and safety aspects of the Scheme that may affect the interests of local residents, businesses, the general public and the surroundings in the vicinity of the Scheme.

S.1.2 Transport for London (TfL) proposes to deliver the Silvertown Tunnel through a private finance contract, as this would best meet the project objectives and constraints, and achieve an appropriate risk balance between the public and private sector. The Contractor would be responsible for the design, construction, financing and maintenance of the tunnel and supporting infrastructure for a period of 25 years.

S.1.3 The Contractor would be responsible for undertaking the Detailed Design in accordance with the constraints and parameters of the DCO; TfL's specifications; and the requirements, and any other commitments given by TfL.

S.1.4 The Contractor will also be responsible for compliance with this CoCP, including production of an overarching Construction Environmental Management Plan and any other detailed plans required to be produced. A summary of these subsidiary plans is included in chapter 1 of the CoCP.

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1. INTRODUCTION

1.1 Purpose of the Code of Construction Practice

1.1.1 This document is the Code of Construction Practice (CoCP), for the Silvertown Tunnel (hereafter referred to as the Scheme), which has been prepared to accompany the Development Consent Order (DCO) Application.

1.1.2 The purpose of the CoCP is to set a framework to control possible impacts arising from the construction of the Scheme including removal/de-commissioning of temporary works. The CoCP covers environmental, public health and safety aspects of the Scheme that may affect the interests of local residents, businesses, the general public and the surroundings in the vicinity of the Scheme.

1.1.3 The control measures set out in this CoCP are based on the findings and mitigation measures set out in the Environmental Statement (Document Reference: 6.1) prepared following consultation with stakeholders.

1.1.4 The CoCP will apply to all works authorised by the DCO and all works undertaken by the Contractor. The Contractor will also comply with all legislation relating to the construction activities.

1.1.5 Compliance with this CoCP is a requirement of the DCO. Non-compliance with the CoCP would therefore be a breach of the terms of the DCO. In the event of a breach, both TfL and the Contractor would be open to enforcement action under Section 161 of the Planning Act 2008.

1.1.6 TfL will direct and manage the Contractor’s compliance with these controls and will specify that all construction activities shall be carried out in accordance with the terms of the DCO, including the CoCP. Further details are included in the relevant sections of the CoCP.

1.2 Description of the Scheme

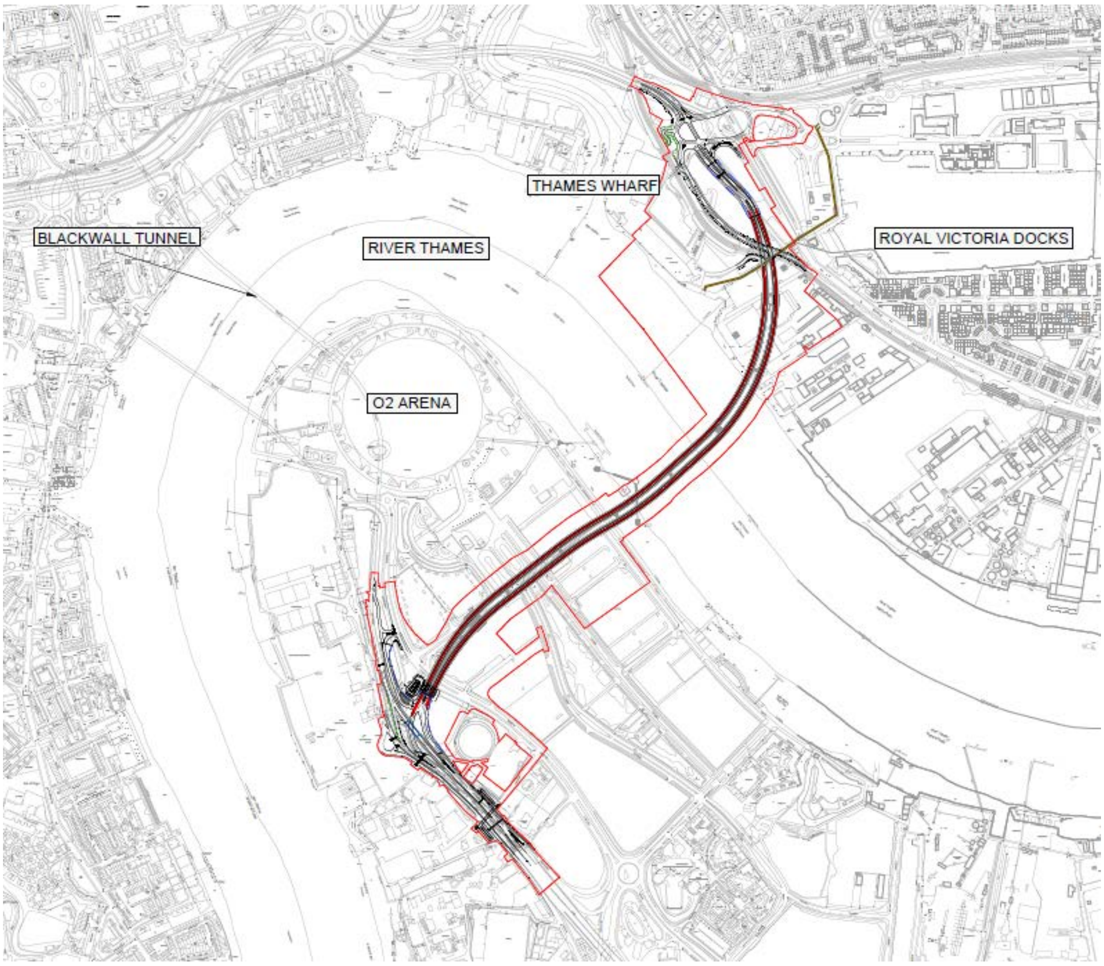
1.2.1 The Silvertown Tunnel scheme (the Scheme) involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. It would include a dedicated bus, coach and goods vehicle lane, which would enable TfL to provide additional cross-river bus routes.

1.2.2 The Scheme also includes the introduction of free-flow user charging on both the Blackwall Tunnel (northern portal located in London Borough of Tower Hamlets) and at the new Silvertown Tunnel. This measure is intended to play a fundamental role in managing traffic demand and supporting the financing of the construction, maintenance and operation of the Silvertown Tunnel.

1.2.3 Main construction works could commence in late 2018 and would last approximately four years with the new tunnel opening in 2022/23. The main construction Worksite would be located at Silvertown, enabling the utilisation of the existing barge facilities at Thames Wharf along with a new temporary jetty, if necessary, for the removal of spoil and delivery of materials by river. A secondary Worksite would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich Peninsula.

1.2.4 Figure 1-1 Order Limits, represents the 'envelope' within which the Scheme would be constructed.

Figure 1-1 Order Limits



1.3 Approach to Scheme delivery

1.3.1 TfL proposes to deliver the Silvertown Tunnel through a private finance contract, as this would best meet the project objectives and constraints. The contract would be competitively tendered in accordance with EU procurement procedures.

1.3.2 The successful tenderer, to be called the Project Company, would be responsible for the detailed design, construction, financing and maintenance of the tunnel and supporting infrastructure for a period. TfL would retain control of traffic management for Silvertown Tunnel and Blackwall Tunnel as part of the strategic road network in London, and would continue to maintain and operate Blackwall Tunnel and approach roads under existing arrangements.

1.3.3 The Project Company would be responsible for undertaking the Detailed Design and constructing the works, in accordance with the constraints and parameters of the DCO; TfL's specifications; and any other commitments given to stakeholders by TfL.

1.3.4 TfL through the Contractor will ensure that the tunnel is built in accordance with all relevant and current environmental legislation and, where reasonably practicable, with good practice for minimising the environmental effects of construction.

1.4 Construction environmental management approach

1.4.1 Contractual arrangements will require the Contractor to provide suitably qualified environmental staff to monitor, manage and execute works for which they are responsible. TfL will require that the Contractor demonstrates an appropriate awareness of local sensitivities, expected codes of conduct, working knowledge of relevant legislation, codes of practice, and guidance relevant to the various construction activities in which they are engaged. TfL would require the Contractor to have an Environmental Management System in accordance with BS EN ISO14001[1] requirements.

1.4.2 Following the appointment of the Contractor for the works, it will be the Contractor's responsibility to produce and maintain an overarching Construction Environmental Management Plan (CEMP) for the construction

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[1] BSI (2015). BS EN ISO14001 Environmental Management Systems.

works. The CEMP will be developed in consultation with the local authorities and the relevant statutory stakeholders for each topic area, and will be submitted for approval to TfL. The CEMP will set out the Contractor’s roles and responsibilities, together with appropriate control measures, training and briefing procedures, risk assessments, stakeholder engagement responsibilities, monitoring systems, and operations to be employed during planning and constructing the works for all relevant environmental topics to demonstrate compliance with the measures and controls set out in the CoCP and the DCO (including its requirements and the Protective Provisions).

1.4.3 In addition to the measures specifically mentioned in the CoCP, the Contractor is required to produce and implement a number of subsidiary plans which are specific to particular environmental topics. As set out in the CoCP, these plans have to be produced in consultation with, or approved by, the relevant planning authorities or other stakeholders, and include the measures required for inclusion within these plans by the CoCP.

1.4.4 These subsidiary plans will set out the specific protection, mitigation and compensation measures to be taken by the Contractor to control the environmental effects for the individual topic during the construction of the Scheme including removal/de-commissioning of temporary works. A summary of the subsidiary plans that are required to be produced under the CoCP is set out in Table 1-1.

1.4.5 Nothing in this CoCP precludes any of the subsidiary plans set out below being amended by the Contractor following their approval or consultation with the relevant bodies set out below. Any amendment to these plans will be required to go through the same consultation and approval mechanisms set out in the table.

1.4.6 No approval of any individual plan listed in Table 1-1 will fetter the discretion of any relevant stakeholder in relation to the content of any other plan in which they have a consultative or approval role.

1.4.7 An environmental impact assessment was carried out for the Scheme and an Environmental Statement (ES) prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009, as amended. Through the assessment process, mitigation identified with respect to construction effects is embedded within the CoCP.

1.4.8 The Contractor must ensure that the construction of the Scheme does not give rise to materially new or materially different environmental effects to those reported in the ES. This will be achieved through the process described in paragraph 1.4.9.

1.4.9 The Contractor must identify, before the commencement of the relevant phase of construction, whether its detailed design, construction methodology, programme, site-specific mitigation or other assumptions are different from those assumed during the preparation of the ES. If they are different, the Contractor must assess the likely significant effects of the proposals and identify any design changes or mitigation measures that are necessary to ensure that the construction does not give rise to materially new or materially different environmental effects to those reported in the ES.

1.4.10 The results of this assessment must be included in the subsidiary plans set out in Table 1-1 below when these are submitted to the relevant local planning authority and other stakeholders for approval or consultation. Each submission must include evidence, including details of further mitigation where necessary, to demonstrate that the construction method will not give rise to materially new or materially different environmental effects to those reported in the ES.

1.4.11 For the purposes of this assessment, the Scheme shall be deemed not to give rise to materially new or materially different environmental effects if the significance of the effect reported for each topic, taking account of any necessary mitigation, is the same as or better than the level of significance reported against that topic in the ES. In this context, 'the ES' means the documents of that description set out in Schedule 14 to the DCO.

Table 1-1 Summary of subsidiary environmental management plans

	Document	**Role**	**Role of Local Authorities and/or Stakeholders**
1	Construction Environmental Management Plan (CEMP)	The CEMP will set out the Contractor's roles and responsibilities to demonstrate compliance with the measures and controls of the CoCP and the DCO (including its Requirements and the Protective Provisions).	The CEMP will be produced by the Contractor for approval by TfL in consultation with the relevant planning authorities and other relevant stakeholders including the PLA.
Emergency Planning			
2	Emergency Plan (including	The Emergency Plan will relate to the Order land that is not within the River Thames and	The Emergency Plan will be produced by the Contractor in

	Document	**Role**	**Role of Local Authorities and/or Stakeholders**
	Emergency Spill Response Plan)	will include: • notification procedures for Emergency Services in the event of an incident; • coordination procedures for TfL Customer Services and the Traffic Control Centre; • flood risk emergency procedures; • emergency spill response procedures; • emergency phone numbers; and • a Flood Warning and Evacuation Plan	consultation with the local Emergency Services, and the relevant local authority emergency planning officer. It will include a Flood Warning and Evacuation Plan to be approved by the relevant local authority emergency planning officer in consultation with the Environment Agency.
3	Fire Plan	The Fire Plan will include procedures for evacuation in the event of fire during construction including details of escape routes, emergency doors, meeting points, and fire training.	The Fire Plan will be produced by the Contractor in consultation with the London Fire and Emergency Planning Authority.
Construction Transportation			
4	Construction Traffic Management Plan (CTMP)	The CTMP will include: • details of how logistics will be managed, e.g. lorry routes, diversions, main access/egress points; • traffic incidents plan dealing with incidents or severe congestion on agreed construction routes; and • construction workers travel plan, developed to encourage the use of sustainable modes of transport (including river transport) to and from the	A CTMP will be produced by the Contractor for each worksite and approved by the relevant planning authority in consultation with the relevant highway authority.

	Document	Role	Role of Local Authorities and/or Stakeholders
		worksite by those working on the project.	
5	Passage Plan (PP)	To establish cycle times for loading, unloading and both journeys for vessels in relation to tides and will permit an informed decision regarding the number of vessels required to meet the production rates achieved for the TBM and civil works, and will include an updated navigational risk assessment which will reflect the findings and recommendations of the Navigational Issues and Preliminary Risk Assessment submitted with the application. To make provision in respect of the River Thames that is equivalent to the provision for dry land in the Emergency Plan.	The Passage Plan will be produced by the Contractor for approval by the PLA.
6	Construction Site River Strategy (CSRS)	The CSRS will include details of the approach adopted by the Contractor to maximise river transport for construction and excavated materials and to meet the commitments in respect of the use of river transport set out in this CoCP.	The CSRS prepared by the Contractor will be submitted to TfL for approval in consultation with the relevant planning authority and the PLA.
Communication and Community Liaison			
7	Community Engagement Plan (CEP)	The CEP will identify how communication with stakeholders will be managed and programmed throughout the construction period. It will include steps that will be taken to liaise with specific stakeholders, where they are potentially affected by the works.	The Community Engagement Plan (CEP) will be prepared by the Contractor and submitted to the relevant planning authorities for approval.

	Document	Role	Role of Local Authorities and/or Stakeholders
Environmental Controls			
8	Air Quality Management Plan (AQMP)	The AQMP will contain details of the measures to limit vehicle, plant and dust emissions during construction.	An AQMP will be prepared for each worksite by the Contractor and submitted for approval to the relevant planning authority.
9	Archaeological Written Scheme of Investigation (AWSI)	An AWSI will outline the mitigation measures and recording proposals for dealing with the currently unknown sub-surface archaeological remains that could potentially be affected by the Scheme on both the north and south side of the Scheme.	The AWSI will be prepared by the Contractor in consultation with Historic England and submitted for approval to the relevant planning authority. Where mitigations measures within the river Thames are identified in the AWSI, the Contractor shall consult the MMO and PLA.
10	Ecology Management Plan (EMP)	The Ecology Management Plan will set out measures to manage the risk of adversely affecting flora and fauna on and within the vicinity of the worksites, including method statements in the event invasive species are encountered and details how additional survey requirements would be accommodated in the programme for both the north and south side of the Scheme. A Site Clearance Plan will form part of each Ecology Management Plan.	The Ecology Management Plan will be prepared by the Contractor substantially in accordance with the Draft Ecology Management Plan (Appendix G) and in consultation with Natural England and then submitted for approval to the relevant planning authority.
11	Construction Materials	The CMMP will set out measures to ensure materials	The CMMP will be prepared by the

	Document	Role	Role of Local Authorities and/or Stakeholders
	Management Plan (CMMP)	are handled and used in a way that prevents harm to human health and pollution of the environment.	Contractor and will be subject to approval by the relevant planning authorities.
12	Groundwater Monitoring and Verification Plan (GMVP)	The Groundwater Monitoring and Verification Plan will set out monitoring and reporting criteria during pre-construction, construction and post construction.	The GMVP will be prepared by the Contractor and will be subject to approval by the Environment Agency.
13	Noise and Vibration Management Plan (NVMP)	The NVMP will set out measures to control and limit noise and vibration levels in the vicinity of the construction works.	An NVMP will be prepared by the Contractor for each Worksite and will be subject to approval by the relevant planning authority.
14	Lighting Management Plan (LMP)	The Lighting Management Plan will include appropriate industry standard procedures which will be implemented at both worksites.	The Lighting Management Plan for each worksite will be prepared by the Contractor in consultation with the relevant planning authority, the Environment Agency, and the PLA .
15	Site Waste Management Plan (SWMP)	The SWMP submitted with the DCO application will be updated by the Contractor. The updated SWMP will consider how the waste hierarchy will be applied and details of how all wastes will be managed. The SWMP will also provide a framework for checking compliance with waste legislation and the Duty of Care.	No consultation/approval needed.

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2. GENERAL SITE OPERATIONS

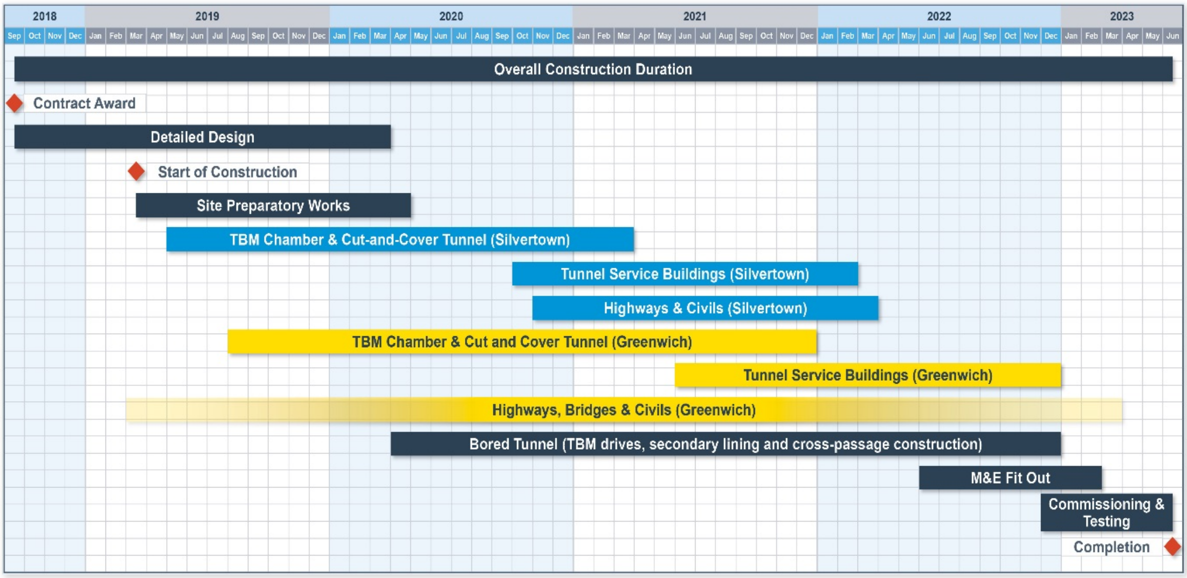
2.1 Construction process

2.1.1 The Scheme is a major construction project and will involve many different types of construction activities. These activities are likely to include but will not be limited to: demolition; site clearance; site investigation; treatment of excavated materials (as necessary); tunnelling; piling; excavation; services diversion and new installations; jetty works; new bridge works, highway works; and below ground and surface building works.

2.2 Construction programme

2.2.1 Main construction activities could commence at both Silvertown and Greenwich in late 2018 and will continue for approximately four years, as shown in Figure 2-1.

Figure 2-1 Envisaged construction programme



2.3 Construction hours of work

2.3.1 Hours of work would be in line with standard good practice for major construction works. Normal working hours for non-tunnel construction works will be from 08:00 to 18:00 Monday - Friday and 08:00 to 13:00 on Saturday with no work taking place on Sundays or bank/public holidays. To maximise productivity within the core hours, the Contractor will require a period of up to one hour before and up to one hour after normal working hours for start-up and close down of activities. Start-up and close down activities can include, but are not limited to, preparation, maintenance, site briefings, meetings and training. Plant or machinery likely to cause a disturbance to local residents or businesses must not be operated during these start-up and close-down periods. These periods will not be considered an extension of core working hours.

2.3.2 Where feasible, operations likely to cause disturbance and/or disruption would be limited to within the core working hours. However, some activities may be required outside these hours, e.g. delivery of abnormal loads. Except where activities are safety critical or in an emergency, any works outside these hours must be subject to agreement with the relevant local Environmental Health Officers (EHO).

2.3.3 Some minor activities, such as changes in traffic management operations, may be required out of core working hours on a more frequent basis, but this would not be expected to have a significant impact in the context of the existing movements of traffic. A Construction Traffic Management Plan (CTMP) will be put in place and will include mechanisms to review the changes in traffic management operations and measures to minimise any impacts on the local residents of each borough.

2.3.4 Tunnel boring works and associated supporting activities will be undertaken on a 24 hour, seven days per week basis. Associated supporting activities will include any below ground works as well as above ground works which may include, but are not limited to; lifting operations into and out of the TBM launch/reception chambers, movement and manufacture/fabrication of materials required for tunnelling (including segments) on site, movement of tunnel spoil using conveyors, HGVs (in accordance with the CTMP) and barges, production/treatment and transportation of concrete and slurry for use in the tunnels, dewatering activities, and any other works required to ensure the continued safe operation of the tunnelling works (including lighting in accordance with the LMP).

2.4 Worksites

2.4.1 There will be two main worksites: the Silvertown worksite to the north of the River Thames and the Greenwich worksite to the south of the River Thames.

2.4.2 It is envisaged that the worksite located at Silvertown would likely contain offices, stores, plant maintenance facilities, materials testing laboratory, recycling facilities and potential concrete batching plants, materials stockpiles and a wheel wash. This worksite has been selected as the best location for utilising Thames Wharf for marine logistics.

2.4.3 A further worksite would be located adjacent to the alignment of the proposed tunnel on the Greenwich Peninsula. It is envisaged that this would likely comprise site offices, spoil and material storage areas and plant storage areas. The Greenwich site does not have any direct wharf access.

2.4.4 The worksites would be established at the commencement of the works and will be removed and the worksites will be reinstated at the end of the construction phase.

2.4.5 The Contractor will be registered with, and comply with the principles of the Considerate Constructors Scheme or similar.

2.4.6 The layout and appearance of the worksites will be designed using the following principles:

- the size of worksite to be occupied at each of the locations would provide sufficient space to undertake the works in a safe manner without taking space that is non-essential to the construction;
- worksites will be secure and screened where necessary;
- storage sites, fixed plant, machinery, equipment and temporary offices will be located to limit environmental effects, as far as reasonably practicable, and have due regard to adjacent buildings, as far as allowed by the constraints of the worksite(s);
- site lighting will be located and directed so as not to intrude into occupied residential properties or disturb wildlife on sensitive areas or constitute a road hazard or affect navigation; and
- fixed site plant and facilities will be powered from mains electrical sources.

2.4.7 A helpline service will be set up and the helpline number, and a contact name and address will be displayed at appropriate locations on the boundaries of the worksites. Further details of the communication and community liaison are provided in Chapter 4 of this CoCP.

2.4.8 Access to the worksites would be limited to specified entry points only and all personnel entries/exits would be recorded and monitored for both security and health and safety purposes. The worksites boundaries will be secured and constructed such that they minimise opportunities for unauthorised entry.

2.5 Advance works

2.5.1 Advance works could be undertaken prior to the main works at both Silvertown and Greenwich worksites. These works may include but are not limited to:

- utility connections;
- utilities diversions:
- geotechnical, obstructions and UXO investigations;
- ecological surveys;
- archaeological surveys;
- site clearance;
- asset protection – condition surveys and establishment of monitoring baselines as necessary;
- design works for early TBM and segment procurement advance (pre-construction) surveys; and
- fencing and footway diversions; All advance works will be subject to the controls set out in the CoCP.

2.6 Access Arrangements

2.6.1 The Contractor will take measures to maintain reasonable access to premises during the construction works. These will include:

- Measures to ensure the continuation of access for premises including requirements for complementary measures to ensure that delivery and servicing access can take place.
- Localised temporary diversions will be sought during the cut and cover tunnel works.

2.7 Emergency planning

2.7.1 The Contractor will ensure that emergency procedures for each worksite are developed. The procedures will be standardised as far as possible across both worksites and will be appropriate to the anticipated hazards and the specific layout. The Contractor will set these procedures out in an Emergency Plan (EP) which must be produced in consultation with the

Emergency Services, the PLA the relevant local authority emergency planning officer and the Environment Agency where appropriate. The EP will include:

- notification procedures for Emergency Services , e.g. Police, in the event of an incident;
- coordination procedures for TfL operational services;
- flood risk emergency procedures, as set out in paragraph 2.7.4 and 2.7.5;
- an emergency spill response procedures that will take into account Environment Agency guidelines[2]; and
- emergency phone numbers and the method of notifying local authorities and statutory bodies. Contact numbers for the key TfL and the Contractor’s staff will also be included.

Emergency access

2.7.2 The Contractor will ensure that the requirements of the London Fire and Emergency Planning Authority (LFEPA) will be followed for the provision of site access points.

Fire prevention and control

2.7.3 A Fire Plan will be prepared, in consultation with LFEPA, and will be updated as necessary, having due regard to relevant current guidance.

Flood risk

2.7.4 A Draft Flood Warning and Evacuation Plan (FWEP) (Document Reference: 6.3.16.3) has been prepared and contains information on flood emergency response actions for both construction and operational phases of the Scheme. A number of actions have been outlined within the plan, including registering both the northern and southern portals of the Scheme with the Environment Agency Floodline Warning Direct service, identifying appropriate access and egress routes and designating evacuation points.

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[2] Environment Agency (2014). Incident Response Planning PPG21.

2.7.5 The Contractor will be required to further develop and refine the procedures in the Draft FWEP specifically for the construction phase, to be approved by the relevant local authority emergency planning officer in consultation with the Environment Agency. These flood risk emergency response procedures will be included in the Emergency Plan, as set out in paragraph 2.7.1.

2.7.6 The Contractor will ensure that all site operatives are familiar with the emergency arrangements.

3. CONSTRUCTION TRANSPORTATION

3.1 Construction Traffic Management Plan

3.1.1 Construction worksites and proposed lorry routes have been developed in consultation with local authorities to minimise the impacts of construction traffic on the road network and local communities. The main access routes at both worksites will be further detailed by the Contractor as the Scheme construction solutions are finalised.

3.1.2 The management of construction logistics will be established in a Construction Traffic Management Plan (CTMP) to be prepared by the Contractor before construction commences. The plan will embed contractual requirements, the outcome of consultation with the relevant local authorities, and comprehensive logistics planning.

3.1.3 A CTMP will be produced by the Contractor for each worksite for approval by the relevant planning authority in consultation with the relevant highway authority, prior to commencing the relevant part of the authorised development The Contractor may bring forward changes to an approved CTMP during the construction of the Scheme, but changes must be approved by the relevant planning authority in consultation with the relevant highways authority.

3.1.4 The CTMP for each worksite will be developed in accordance with relevant best practice including for example TfL’s guidance on Construction Logistics Plans (or equivalent). The CTMPs will include information on the following aspects:

- **Site information**

  This section will include details of the construction site locations and main access/egress points for vehicles and pedestrians.

- **Construction details**

  This section will set out the works programme, with indicative dates for stages of construction, and information on the level of deliveries required. Detailed construction and delivery traffic routes will be specified and agreed by the relevant planning authority in consultation with the relevant highway authority, with local roads only to be used for immediate access to the worksites or local businesses (including wharves).

Constraints and restrictions on road vehicle movements to be included in the CTMP are likely to include:

  - days of the week and times of the day when road vehicle movements are not permitted;
  - maximum number of vehicle movements permitted at defined periods of the day, e.g. between 08:00 and 09:00, or restrictions on the use of the Blackwall Tunnel by construction lorries at peak times; and
  - procedures for abnormal loads.

- **Traffic management**

  This section of the CTMP will detail how non-construction traffic will be managed at each stage of construction, including temporary and permanent road closures and diversions and pedestrian and cycle facilities (pursuant to Article 10 of the DCO). Details of any changes that are required to signage and parking arrangements in the vicinity of the worksites will be set out in this section. Information on the process that will be followed by the Contractor in dealing with traffic incidents or severe congestion on agreed construction and delivery routes will also be set out.

- **Policies and procedures**

  The CTMP will incorporate the outcome of communications undertaken in accordance with the CEP.

  The CTMP must include a construction workers travel plan (CWTP) developed to encourage the use of sustainable modes of transport (including river transport) to and from the worksite by those working on the project.

- **Monitoring, compliance and reporting**

  The CTMP will also detail how, when and by whom it will be monitored, including, but not limited to, the ongoing review of the following:

  - Freight Operator Recognition Scheme (membership);
  - collision reporting;
  - driver licence checks;

- vehicle safety equipment audits;
- number of vehicle movements to site;
- vehicle mileage;
- level of vehicle fill;
- CO2 emissions;
- delivery accuracy;
- breaches and complaints; and
- construction workers’ travel behaviour to inform the ongoing monitoring of the CWTP.

3.1.5 The CTMP will ensure that safety measures are implemented to minimise road-related risks. The Contractor will specify the highest current standards in construction vehicle safety, including visibility. This includes but is not limited to FORS Gold (Fleet Operator Recognition Scheme), CLOCS (Construction Logistics and Cycle Safety), SLS (Safety Lorry Scheme) and WRRR (Work Related Road Risk) scheme. Signs identifying the Silvertown Tunnel project and Contractor contact numbers will be displayed in a prominent position on all construction vehicles. All vehicles working in the construction of the Silvertown Tunnel will be compliant with the Mayor’s Direct Vision Standard.

3.1.6 The CTMP must provide contact details of key personnel, including key stakeholders and highway / planning authorities. These details must be reviewed and updated as necessary as part of the ongoing CTMP monitoring programme.

3.1.7 The CTMP will specify the routes to be used by construction heavy goods vehicles (HGVs) to and from the worksites. Construction HGVs would be routed on the TLRN and principal roads as far as possible, with local roads only used to directly access the worksites, local businesses, and wharves used for the import and/or export of material by river. The principal routes to and from the worksites will be the A12, the A13, the A2 and the A102 with access between these routes and the worksite via Lower Lea Crossing, , Blackwall Lane and Millennium Way. Any deviations from this approach would need to be agreed in advance in the CTMP with the local planning authorities.

3.2 River transport

3.2.1 The Scheme will seek to maximise river transport for construction materials and excavated material.

3.2.2 The river transport objectives are to:

- minimise the effects of construction of the Scheme associated with the transport of construction materials and excavated materials;
- minimise the number and length of construction-related transport movements; and
- minimise the potential social and environmental impacts arising from construction-related transport associated with the Scheme.

3.2.3 Subject to paragraphs 3.2.12 – 3.2.14 the Contractor shall transport:

- at least 55% by weight of all materials associated with the Scheme by River; and
- 100% of suitable excavated material out by River.

3.2.4 For the purposes of the commitments given in paragraph 3.2.3, the following materials associated with the Scheme shall be deemed to have been transported by river:

- Materials which are transported to or from the worksite directly by river;
- Materials which are re-used on site;
- Materials which are transported by river to a wharf local to the Scheme, transferred to road vehicles and subsequently delivered to the worksite by road, provided that:
    - the worksite lies within a 4km radius of the wharf; and
    - the distance over which the materials are carried by road from the wharf to the worksite does not exceed the distance that the materials are transported by river from the point of loading up to the local wharf.
- Concrete for use in the Scheme which is produced at a batching plant sited at a wharf local to the Scheme and using aggregates delivered to the wharf by river and which is delivered to a worksite by road, provided that:

    - the worksite lies within 4km of the batching plant; and
    - the distance over which the concrete is carried by road from the batching plant to the worksite does not exceed the distance that the aggregates are transported by river to the local wharf.

- Suitable excavated material which is transported by road from the worksite to a wharf local to the Scheme and subsequently transferred to a receptor site using the river, provided that:
    - The worksite lies within 4km of the wharf; and
    - the distance over which the suitable excavated material is carried by road from the worksite to the wharf does not exceed the distance over which the material is transported by river.

3.2.5 "Suitable Excavated Material" means all bored or excavated material from the tunnel works which would not require treatment were it to be disposed of to a permitted facility.

3.2.6 For the purposes of paragraph 3.2.5, the definition of treatment shall be in accordance with the Landfill Directive (1999/31/EC) and the Environmental Permitting Guidance: The Landfill Directive (Defra, 2008).

3.2.7 Before commencing construction of the Scheme, the Contractor must prepare a Construction Site River Strategy (CSRS), which must:

- explain how the Contractor will maximise river transport for construction and excavated materials;
- explain how the Contractor meet the commitments set out in paragraph 3.2.3;
- provide a breakdown of the quantities of materials that will be transported by river;
- provide a baseline programme for when materials proposed to be transported by river will be transported to/from site.

3.2.8 Construction of the Scheme must not commence until the CSRS has been submitted to and approved by TfL in consultation with the relevant planning authority(s) and the PLA.

Monitoring

3.2.9 The Contractor shall submit monthly monitoring reports to TfL, the relevant planning authority(s) and the PLA on the performance of the Scheme in meeting the commitments in paragraph 3.2.3.

3.2.10 The monthly monitoring reports shall show the measured quantities of materials in and out of site by river. These measured quantities shall be compared against the baseline programme contained in the CSRS and the total materials in and out of site.

3.2.11 In the event that monitoring demonstrates that the quantities of materials being transported by river are not consistent with the baseline programme in the CSRS, the report must contain an explanation of the reasons for this and detail the measures which the Contractor will take to ensure that the commitments in 3.2.3 are met. Anyuch measures must be undertaken in accordance with the CoCP and other relevant subsidiary plans.

Derogations

3.2.12 Where circumstances outside the Contractor's control arise which mean that the commitments in paragraph 3.2.3 cannot be met, the Contractor shall submit an application for a Derogation for approval to TfL and the relevant planning authority(s), who shall consult with the PLA prior to approval. Examples of such circumstances include where the river use is unavailable due to poor weather or damage to the river transport system (conveyors/barges).

3.2.13 The Contractor may agree with the relevant planning authority(s), who must consult the PLA, additional circumstances in which the Contractor may apply for a Derogation from the commitments in paragraph 3.2.3. Any such agreement must be given in writing by the relevant planning authority(s) and may only be given if the Contractor has demonstrated to the satisfaction of the relevant planning authority(s) that the Derogation will not give rise to any materially new or materially different environmental effects to those assessed in the ES.

3.2.14 An application for a Derogation must:

- Be submitted at the same time as the monthly monitoring report for the month following the month in which the circumstances which require the derogation occur;

- Demonstrate that the Contractor has undertaken such measures as are reasonably practicable to attempt to meet the commitments in 3.2.3 despite the circumstances outside of the Contractor's control;
- Identify measures to mitigate the effects of the derogation which could include additional traffic management and/or mitigation, or limiting permitted hours for HGV movements;
- Provide a revised breakdown of the quantities of materials that will be transported by river;
- Provide a revised programme for when materials proposed to be transport by river will be transported to/from site.

Navigational risk management

3.2.15 The Contractor will be responsible for producing a full Passage Plan (PP). The PP will establish cycle times for loading, unloading and journeys for vessels in relation to tides and will permit an informed decision regarding the number of vessels required to meet the production rates achieved for the TBM and civil works. The PP will be prepared for approval by the PLA.

3.2.16 The PP will include an updated navigational risk assessment which will reflect the findings and recommendations of the Navigational Issues and Preliminary Risk Assessment (Document Reference: 6.3.7.1) prepared for the Scheme. Risk control measures will include, but will not be limited to:

- appointing a berthing co-ordinator for the duration of the Scheme's riverine activities to assist with planning, managing and ensuring that safe berthing, approach and manoeuvring practices are adopted and maintained during the construction period;
- establishing a permanent construction River Response Team to manage the construction and river user vessel interface; in particular with any recreational users. The River Response Team would consult with the PLA and ensure that any exclusion zones are enforced and that safe distances are maintained between construction plant and construction related vessel movements in particular when and if river conditions change;
- engagement with the PLA; and
- employment of suitably qualified staff, Masters of Commercial Vessels and marine operators.

4. COMMUNICATIONS AND COMMUNITY LIAISON

4.1.1 Communication with local authorities and all key stakeholders will be undertaken throughout the construction period. Key stakeholders will include, but are not limited to; local residents, local businesses, community resources (such as schools and community centres) and vulnerable groups, where they are potentially affected by the works.

4.1.2 The Contractor will appoint a Community Construction Liaison Manager (CCLM) for the duration of the works. This manager will prepare and implement a Community Engagement Plan (CEP) which must be submitted to the relevant planning authority for approval. The CCLM will be the main point of contact for stakeholders on site, providing information and resolving issues of concern.

4.1.3 The CEP will identify how communication with stakeholders will be managed and programmed throughout the construction period. It will include steps that will be taken to liaise with specific stakeholders, such as schools, where they are potentially affected by the works. This may cover, but is not limited to, community meetings at key stages of work, one-on-one meetings with key resources, newsletters and letter drops (explaining forthcoming works).

4.1.4 The CEP will include the following measures:

- The Contractor will set up and maintain a 24 hour telephone helpline service. This will act as a first point of contact for information or queries raised by stakeholders. All calls and emails will be actioned within a specified time (set out in the CEP) and will be logged, including action taken. There will also be an agreed complaints procedure which shall include a central complaints log.
- The Contractor will be required to set up and maintain a website which will include the construction programme, main construction activities, and updates. There will also be a project email address, which will enable stakeholders to contact the construction team direct with any queries or concerns.
- The Contractor will establish and maintain a Community Liaison Group. This group will meet regularly before and during the construction period. It will comprise representatives from key local groups, user representatives, and the local authorities. Invitations to join the group

will also be sent to all affected landowners for the Scheme. The regular meetings will provide an opportunity for the Community Construction Liaison Manager to brief people about up and coming construction activity and answer questions. This will include, but not be limited to, informing the Group of upcoming construction traffic management measures and noisy works. The terms of reference (which will include provision for communications to the Group from the Community Construction Liaison Manager in between meeting dates), chair, and frequency of this group will be finalised at the first meeting.

- The CEP will explain how the needs of vulnerable groups will be met in terms of use of accessible media, English as a second language and appropriate formats for the visually impaired.
- The Contractor will develop a programme of community involvement through volunteering and educational activity.
- The Contractor shall establish co-ordination and communication meetings with key stakeholders. Such meetings will include regular road traffic meetings with TfL, the relevant highway authority, the relevant planning authority as well as affected businesses & developments, which shall include, but not be limited to, Ansco, Knight Dragon, Quintain, Brenntag, Kloeckner Metals UK, Royal Mail, London City Airport and ExCel London Ltd. Where such meetings already exist the Contractor shall be obliged to attend and contribute.

5. AIR QUALITY

5.1 General

5.1.1 The Contractor will, as far as reasonably practicable, seek to control and limit emissions to the atmosphere in terms of gaseous and particulate pollutants from vehicles and plant used on the worksites, and dust from construction, demolition, vehicles and plant activities.

5.1.2 For each worksite, the Contractor will develop and implement an Air Quality Management Plan (AQMP) to be approved by the relevant planning authority. The AQMP will contain details of the measures to limit vehicle, plant and dust emissions during construction, including those set out in this chapter.

5.2 Vehicle and plant emissions

5.2.1 Vehicle and plant emissions will be controlled by implementing the following measures within the AQMP:

- all Non-road Mobile Machinery (NRMM) will comply with the standards set within the Greater London Authority's Control of Dust and Emissions During Construction and Demolition Supplementary Planning Guidance3. This outlines that, from 1st September 2015, all NRMM of net power 37 kW to 560 kW used on the site of a major development in Greater London must meet Stage IIIA of EU Directive 97/68/EC (Directive 97/68/EC of the European Parliament and of the Council, 1997) and its subsequent amendments as a minimum. From 1st September 2020 NRMM used on any site within Greater London will be required to meet Stage IIIB of the Directive as a minimum;
- engines of all vehicles, mobile and fixed plant on site will not be left running/idling unnecessarily;
- using low emission vehicles and plant fitted with catalysts, diesel particulate filters or similar devices;

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[3] Greater London Authority (2014). The Control of Dust and Emissions during Construction and Demolition.

- using ultra low sulphur fuels in plant and vehicles;
- plant will be well maintained, with routine servicing of plant and vehicles to be completed in accordance with the manufacturer's recommendations and records maintained for the work undertaken;
- minimising the use of diesel or petrol powered generators and using mains electricity or battery powered equipment where practicable;
- maximising energy efficiency (this may include using alternative modes of transport, maximising vehicle utilisation by ensuring full loading and efficient routing);
- the Contractor's delivery vehicles will be required to comply with any low emission zone applicable to the worksite and delivery routes at the time;
- all members of the Contractor's staff who drive vehicles under the contract will undertake a fuel efficient driver training course; and
- all vehicles working on the construction of the Silvertown Tunnel will be Euro 6 unless otherwise agreed with the GLA and relevant local planning authorities.

5.3 Dust management

5.3.1 The Institute of Air Quality Management (IAQM) guidance[4] and Mayor's Dust and Emissions Supplementary Planning Guidance[5] provide a number of potential mitigation measures to reduce dust impacts during the construction phase. The measures to be included in the AQMP are set out, but are not limited to those, in Table 5-1.

Table 5-1 Mitigation measures to reduce dust impacts

Issue	Control measure
Communications	• Develop and implement the CEP to include community engagement before work commences on site; • Display the name and contact details of person(s)

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[4] Institute of Air Quality Management (2015). Land-Use Planning & Development Control: Planning For Air Quality

[5] GLA (2014). The Control of Dust and Emissions Supplementary Planning Guidance.

Issue	Control measure
	accountable for air quality and dust issues on the site boundary of both construction worksites; • Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and particulate matter emissions are minimised.
Site Management	• Record all dust and air quality complaints in a complaints log which may be made available to the Local Authority upon request; and • Record any exceptional incidents that cause dust/or air emissions, and the action taken to resolve the situation.
Monitoring	• Undertake on-site and off-site inspections to monitor dust; • Carry out regular site inspections to monitor compliance with the AQMP; • Increase frequency of site inspections when activities with a high potential to produce dust are being carried out; • Record inspection results in an inspection log; and • Make an inspection log available to the Local Authority upon request.
Preparing and maintaining the worksites	• Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible; • Erect suitable solid screens or barriers around dusty activities or the site boundary; • Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period; • Install green walls, screens or other green infrastructure where appropriate to minimise the impact of dust and pollution; • Avoid site runoff of water or mud; • keep site fencing, barriers and scaffolding clean using wet methods; • Use water as dust suppressant where applicable; • Remove waste materials that have a potential to produce dust from site as soon as practicable; • Cover, seed or fence stockpiles to prevent wind whipping; • carry out regular dust soiling checks of buildings within 100 m of site boundary and cleaning to be provided if necessary; and

Issue	Control measure
	• provide showers and ensure a change of shoes and clothes are required before going off-site to reduce transport of dust.
Operating Vehicle/ Machinery and Sustainable Travel	• Well maintained/low emission vehicles and equipment fitted with catalysts, diesel particulate filters or similar devices; • All vehicles to switch off engines - no idling vehicles; • Avoid the use of diesel or petrol powered generators where practicable; and • Impose a maximum-speed-limit of 25kph on surfaced and 15kph on un-surfaced haul roads and work areas.
Operations	• Cutting equipment to use water as dust suppressant or suitable local extract ventilation; • Ensure an adequate water supply on the site for effective dust/particulate matter suppression, using recycled water where possible and appropriate; • Use enclosed chutes and covered skips; • Minimise drop heights; and • Ensure equipment is readily available on site to clean any spillages.
Waste Management	• Reuse and recycle waste to reduce dust from waste materials; and • No bonfires and burning of waste materials.
Demolition	• Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust); • Ensure water suppression is used during demolition operations; • Avoid explosive blasting, using appropriate manual or mechanical alternatives; and • Bag and remove any biological debris or damp down such material before demolition.
Earthworks and Construction	• Re-vegetate earthworks and exposed areas; • Use hessian, mulches or trackifiers where it is not possible to re-vegetate; • Only remove the cover in small areas during work and not all at once; • Avoid removing a thin layer of concrete from structures by compressed air powered machines;

Issue	Control measure
	• Ensure sand and other aggregates are stored and not able to dry out; and • Ensure bulk cement and other fine power materials are delivered and stored to prevent escape.
Trackout	• Use water-assisted dust sweepers on the access and local roads; • Avoid dry sweeping of large areas; • Ensure vehicles entering and leaving worksites are covered to prevent escape of materials; • Inspect on-site routes for integrity, instigate necessary repairs and record in site log book; • install hard surfaced haul routes on site, which are regularly damped down with fixed or mobile sprinkler systems or mobile water bowsers, and regularly cleaned; • Implement a wheel washing system at a suitable location near site exit; • ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; • Access gates at least 10m from receptors where possible; • Apply dust suppressants to locations where a large volume of vehicles enter and exit the construction site.

5.4 Monitoring

5.4.1 Automatic continuous PM_{10} monitoring will be required as part of the AQMP. It may be appropriate to determine the existing (baseline) pollution levels before work begins. Baseline monitoring will commence three months before main construction works begin. The AQMP will set out appropriate PM_{10} monitoring procedures and timescales.

5.4.2 Automatic continuous dust monitors will be installed across the site and checked regularly. The locations of the dust monitors will be included in the AQMP and agreed with the Local Authority. Baseline monitoring will commence three months before the construction phase begins. The AQMP will set out appropriate dust monitoring procedures and timescales.

5.5 Odour

5.5.1 As contaminated materials may be excavated at Greenwich and Silvertown, the excavated materials could contain volatiles that may have a bad smell. The following mitigation measures will be included in the AQMP and implemented by the Contractorto ensure that there is no significant effect to local residents:

- Contaminated and non-contaminated materials will be stockpiled separately following excavation;
- Early identification of contaminated material which could generate an odour issue;
- Covering up of any odorous materials;
- Locating contaminated materials as far away from residential receptors as possible; and
- Ensuring odorous material is prioritised for removal from the worksites.

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6. CULTURAL HERITAGE

6.1.1 The following measures in relation to Cultural Heritage will form part of Archaeological Written Scheme of Investigations (AWSI) to be prepared by the Contractor in consultation with Historic England ..

6.1.2 The AWSIs will provide the framework through which archaeological mitigation will be managed and monitored. The AWSI will be prepared for each work site to be approved by the relevant planning authority (in consultation with Historic England and GLASS) prior to commencing construction. Where mitigations measures within the river Thames are identified in the AWSI, the Contractor shall consult the MMO and PLA before submitting to the relevant planning authority for approval.

6.1.3 The Archaeological AWSIs will detail a programme of archaeological evaluation as part of the advance works. The programme of archaeological works will include adequate archaeological evaluation in order to properly characterise and quantify further archaeological mitigation works. The Contractor will consult with Historic England / GLAAS on the scope and methodologies for the programme of archaeological mitigation works prior to construction works commencing and ongoing consultations will be held during the archaeological works.

6.1.4 Detailed measures to protect any known or unknown archaeological assets and an outline method of approach during the construction of the Scheme will be incorporated into the AWSI and will include but not be limited to:

- updated baseline to ensure the most up-to-date Archaeological Priority Areas information is taken into account;
- rationale of locations of various interventions based on the known assets that may be affected;
- requirement to consider the significance of unknown and known heritage assets,
- monitoring measures of any in-river works;
- contingency measures, including measures in the event that unexpected, highly significant remains are encountered; and

- method for preservation and the approach to post-construction phase assessment, analysis, local knowledge sharing and public dissemination of the results of the programme of archaeological work.

6.1.5 If any heritage assets are found, the Contractor must liaise with Historic England and GLASS to determine the need for any consents, or licences and whether a Heritage Management Plan (HMP) is required.

6.1.6 The HMP, if required, will set out how the Contractor will protect the heritage assets that have been identified in a consistent and integrated manner during the works. It will include general standards of good practice across the project and specific measures, in relation to individual worksites.

6.1.7 Impacts of dredging within the area of the proposed jetty on currently unknown archaeological remains will be mitigated through the monitoring of dredged material in order to identify and record any archaeological materials that are recovered. If any remains are recorded, the Contractor will liaise with Historic England/ GLASS as to any scour protection measures required.

6.1.8 Prior to construction, an assessment of the likely effects of settlement on the Grade II listed Blackwall Tunnel building will be undertaken in accordance with Chapter 10: (Settlement) of this Code of Construction Practice.

7. TERRESTRIAL ECOLOGY

7.1 General

7.1.1 An Outline Ecology Management Plan (OEMP) has been prepared and can be found at Appendix G to this Code of Construction Practice.

7.1.2 Detailed Ecology Management Plans will be developed by the Contractor to be in substantial accordance with this OEMP, but taking into account the detailed design and local issues at each worksite and consultation with Natural England. These detailed Ecology Management Plans will be submitted for approval to the relevant planning authority for both the north and south sides of the Scheme. As can be seen in the OEMP, the detailed Ecology Management Plans will specify measures to manage the risk of adversely affecting flora and fauna on and within the vicinity of the worksites.

7.1.3 This CoCP includes dust attenuation measures to prevent pollution, as described in detail in Chapter 5 (Air Quality), and pollution prevention measures following Environment Agency Guidelines, as described in detail in Chapter 9 (Geology, Soils and Hydrogeology).

7.2 Monitoring

7.2.1 The detailed EMPs will state the programme for ecological monitoring during the construction of the Scheme. The monitoring programme should be in substantial accordance with the OEMP.

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8. MARINE ECOLOGY

8.1.1 The Contractor will employ the following measures to minimise any adverse effects from the construction and demolition of a temporary jetty and any in-river construction activities:

- the application of EA pollution prevention guidance throughout the construction phase;
- the development of a non-native species risk assessment and management plan (in liaison with the MMO, PLA and EA as necessary);
- the use of soft start procedures during piling for a minimum of 20 minutes. Should piling cease for a period greater than 10 minutes the soft start procedure must be repeated;
- percussive piling will be limited to November-March inclusive (unless otherwise agreed with the MMO, PLA and EA);
- the lighting on the jetty will be designed to minimise light levels in the marine environment. The lighting on the jetty head would have the lamps facing out to the watercourse, to facilitate unimpeded loading and unloading operations. Reflectors, that avoid excessive light pollution to surrounding areas, will be used.

8.1.2 The decommissioning programme of the jetty will adhere to the same seasonal restrictions for piling if hydraulic vibratory methods are used.

8.1.3 Any planned (i.e. non-emergency) dredging work must avoid the period of June-August inclusive. Any dredging within the months of June-August inclusive shall only be undertaken with the approval of the Environment Agency in consultation with the PLA.

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9. GEOLOGY, SOILS AND HYDROGEOLOGY

9.1 General

9.1.1 The Contractor will prepare a Construction Materials Management Plan CMMP) before construction commences which must be approved by the relevant planning authority. The CMMP will set out measures to ensure materials are handled and used in a way that prevents harm to human health and pollution of the environment.

9.1.2 Furthermore, the Contractor will prepare a Groundwater Monitoring and Verification Plan (GMVP) which must be approved by the Environment Agency. The GMVP will set out monitoring and reporting criteria during pre-construction, construction and post-construction.

9.2 Intrusive Groundworks

Contamination Protocol

9.2.1 For works on the Greenwich peninsula, the Contractor will follow measures outlined within the “The Greenwich Peninsula Environmental Method Statement (EMS)”, which details area specific development / construction measures to manage mobilisation potential of existing contamination.

9.2.2 Specific pollution prevention measures will be identified and adopted for the removal of historical (gasworks) sub-structures (where they exist) and any retained contaminated soils and liquids that have the potential to become mobilised as a result of construction.

9.2.3 With the possibility that unknown hydrocarbon contamination within soils and groundwater may yet still be encountered beneath the Greenwich site during excavation works, the Contractor will employ a watching brief to be maintained to cover the eventuality of unknown contamination. If visually contaminated or odorous material is encountered during those works, the assistance of a suitably qualified and experienced person (a geo-environmental engineer) would be sought.

9.3 Geology and soils

Construction Materials Management Plan (CMMP)

9.3.1 To limit any potential adverse impacts upon geology, soils, and hydrogeology, the Contractor will prepare a CMMP setting out measures to ensure excavated materials are handled and used in a way that prevents harm to human health and pollution of the environment. The CMMP must be approved by the relevant planning authority prior to commencing the relevant part of the authorised development.

9.3.2 The CMMPmust comply with the Good Practice Guide for Handling Soils. Any contaminated soils encountered during excavation works will be screened, treated if necessary and either re-used on site or removed from site.

9.3.3 In the event that on-site treatment of excavated material is required, the regulator would be consulted and any requisite licences (e.g. Mobile Treatment Permit) sought.

9.4 Groundwater

Detailed Measures

9.4.1 When developing the final construction methodology, the Contractor will consider suitable control methods to manage groundwater ingress and dewatering. The Contractor will liaise with the Environment Agency to determine the need for detailed assessment of dewatering impacts.

9.4.2 The Contractor will ensure that good practice is employed to establish ground and groundwater conditions, including verifying the presence of geotechnical hazards such as scour features in the vicinity of the Scheme alignment, and that the most appropriate groundwater exclusion or management method is adopted to minimise risks.

9.4.3 In particular, the removal of historical piled foundations can be disruptive to ground in immediate contact with the pile shafts. The Contractor will develop a method for pile removal which will prevent potential groundwater flow between aquifers.

9.4.4 Some activities with the potential to affect watercourses or groundwater may require either consent or authorisation under the Environmental Permitting (England and Wales) Regulations 2010, and the Contractor will obtain these consents prior to commencing these activities.

9.4.5 The Contractor will control the abstraction of potentially contaminated water from excavations through the adoption of mitigation measures as outlined in the Environment Agency's PPG5[6].

9.4.6 To prevent additional land and groundwater contamination the Contractor will adhere to the EA Pollution Prevention Guidelines, including (but not be limited to) the following pollution prevention measures:

- Silt pollution potentially produced when working in surface water will be minimised by keeping water out of work areas, using appropriate isolation techniques or through operation of special excavation plant. Any water generated from such activities will be disposed of by following guidance set out in the Environment Agency's document PPG 5 – Works and maintenance in or near water;
- Surplus waste slurry / water produced during tunnel construction will likely require filtration prior to its disposal, because of the anticipated quality. Where necessary, a permit and licence will be obtained;
- Polymers used for the TBM operation will be bio-degradable and non-hazardous to the water environment. Agreement with the Environment Agency will be sought prior to their use and any licences obtained (where necessary). Discharges which contain polymers will be tested to show that they are bio-degradable and low risk to the water environment;
- Provision of wheel washing facilities and defined clean down areas for vehicles and equipment;
- Regular cleaning of site access points;
- Defined areas for loading / unloading of plant and materials;
- Defined areas for the storage of plant and materials used during construction;
- Production of and adherence to an emergency spill response plan (as part of the Emergency Plan developed in consultation with the

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[6] Pollution Prevention Guidance Notes, Works and maintenance in or near water, EA, 2014.

Environment Agency), and ready availability of associated equipment and materials;

- Groundwater and dewatering control measures (e.g. during concrete pouring, where necessary);
- Sediment control measures (compliant with the Site Waste Management Plan); and
- Methods for the removal and reinstatement of obstructions (e.g. piles).

9.4.7 The Contractor will apply for any permits and licences that may be needed for excavation and dewatering purposes. These are outlined below:

- Environmental Permit - a Discharge Licence (e.g. for discharge of excavation water into a watercourse, should waste water meet the Environmental Quality Standards (EQS) for discharge);
- Environmental Permit - a Mobile Treatment Plant Licence (e.g. for treatment of contaminated soils prior to their re-use on site)

9.4.8 The DCO will dis-apply the need for an abstraction (dewatering) licence. Abstraction will be controlled through the measures set out in a Groundwater Monitoring and Verification Plan to be prepared by the Contractor and approved by the Environment Agency.

Groundwater Monitoring and Verification Plan (GMVP)

9.4.9 The GMVP will contain the following measures for the monitoring of baseline, construction and post construction effects:

- Pre-construction baseline monitoring will commence as soon as practicable and continue until the commencement of construction or the implementation of the construction phase of the GMVP. The pre-construction monitoring will be used to establish a baseline which will inform the setting of alert and trigger levels, for both water quality and groundwater elevations, against which the construction phase monitoring will be compared.
- Monitoring will be undertaken throughout the construction and post construction of the relevant part of the Scheme, and reported to the Environment Agency. These reporting requirements will be outlined in the Groundwater Monitoring and Verification Plan.

9.4.10 Any changes to the GMVP proposed by the appointed Contractor must be approved by the Environment Agency before being adopted.

9.4.11 The GMVP will be developed with regard to the Groundwater Monitoring Strategy (Appendix F).

9.5 Human Health

9.5.1 Health and safety risks to construction workers from contamination will initially be controlled by the Contractor’s responsibility to design out risk, as per the requirements of the Construction Design and Management (CDM) Regulations[7].

9.5.2 The Contractor will be required to produce health and safety risk assessments that specify appropriate precautionary measures during works. These shall be completed by a suitably qualified person appointed by the Contractor.

9.5.3 The Contractor will employ appropriate health and safety measures which will be incorporated within the general construction site safety standards at a level sufficient to protect both members of the public and site workers.

9.5.4 The Contractor will also employ specific measures to manage the risks of asphyxiation caused by the potential release of deoxygenated air where excavation is required within the Thanet Sand Formation.

9.6 Unexploded Ordnance

9.6.1 Linear UXO surveys of the Scheme have previously been undertaken to identify the risk within the Order Limits. The Contractor will carry out further assessment prior to undertaking any intrusive investigation works on the Scheme within areas identified as medium and high risk.

9.6.2 Once the assessment is complete, the Contactor will develop a detailed UXO mitigation strategy for the project prior to construction commencing.

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[7] Construction, Design and Management Regulation, 2015, HSE

10. GROUND SETTLEMENT

10.1 General

10.1.1 The construction of the Silvertown Tunnel, comprising bored tunnels, cut-and-cover sections and retained cuttings, will lead to settlement at the ground surface. The amount of settlement will depend on a number of factors including the depth and volume of the works below ground, soil conditions and the presence and nature of building foundations. The amount of settlement will vary across the area affected and for some buildings the magnitude of settlement may vary across the building; this is known as differential settlement.

10.1.2 The Contractor will design and undertake construction of the Scheme in a manner that will avoid or minimise the damage to land and property as a result of settlement. TfL has carried out an initial assessment of potential settlement attributable to the Scheme that assessed the risk of damage to all buildings and structures potentially affected by settlement.

10.1.3 The Contractor shall investigate the potential for ground movement (including settlement) associated with the construction methods. This investigation will be carried out in accordance with the Settlement Assessment and Mitigation Process appended to the CoCP (Appendix A).

10.1.4 Depending on the level of damage risk identified by the investigation, either no action will be required, or buildings and structures will be monitored during construction, or measures will be implemented to protect the buildings and structures.

10.2 Surveys

10.2.1 Defect surveys will be undertaken on all assets (including buildings, structures, bridges, tunnels and service media) assessed to experience 1mm or more settlement in the assessment carried out in accordance with Appendix A. These will capture the condition of those assets immediately prior to tunnel construction commencing in an area. A defects survey will comprise a written and photographic record of existing cracking and the state of the finishes and structures. They will be carried out by a reputable firm of chartered building surveyors or chartered engineers commissioned by the Contractor on behalf of TfL but in joint names with the asset owner and any other persons as TfL may determine. Asset owners are free to commission their own survey but this will be at their own cost since the survey undertaken by the Contractor is an objective survey/record of pre-existing defects and is not intended to draw any conclusions as to the cause.

10.2.2 An electronic copy of the report will be available to asset owners on request.

10.2.3 Following the construction of the Scheme in the vicinity of the asset, a second survey will then be undertaken by the appointed professional to record changes from the first survey. The owner may request his own surveyor to attend when the second survey is undertaken and to comment on the draft survey report produced.

10.3 Repairs

10.3.1 The Contractor will reimburse asset owners for the reasonable costs they incur in remedying material physical damage arising from ground movement (including settlement) caused by the Scheme, provided:

- the damage is caused by the Scheme;
- the owner gives not less than 28 days' notice in writing to the Contractor of the proposal to carry out the repair work;
- the owner takes reasonable steps to obtain 3 competitive quotes for the repairs beforehand where required by the Contractor; and
- any claim is made within two years of the opening of the Silvertown Tunnel.

10.3.2 The Contractor may, on receiving the advanced notice of the proposal to carry out the repair work, elect to undertake the repair work itself.

10.3.3 If there are any pre-existing defects which have worsened as a result of the Scheme then the recoverable loss will be limited to the additional cost of repair over and above that which would have been required to deal with existing defects.

10.3.4 If it can be demonstrated that the undertaking to assess the compensation claim based on the reasonable cost of repairs does not compensate the claimant fully for the reduction in value of his interest in the property the reimbursement of repair costs will not prejudice a further claim for compensation in accordance with the national compensation code within the normal limitation period applying to such claims.

10.4 Settlement Deed

10.4.1 A Settlement Deed will be offered to asset owners in a standard form, setting out the procedures to determine the need for the monitoring of buildings and other structures and, if necessary, the carrying out of protective and/or remedial works. This is a formal legal undertaking concerning ground movement (including settlement), giving effect to the matters set out in this CoCP.

10.4.2 The Deed, the terms of which are subject to change during the DCO examination, is attached as Appendix B. Subject to paragraphs 10.4.3 and 10.4.4 below, the Contractor will enter into a deed in substantially the form of the final version of those terms.

10.4.3 To enter into a Settlement Deed the Owner must meet the legal definition of 'owner' in the Acquisition of Land Act 1981 which is as follows:

> *"a person, other than a mortgagee not in possession, who is for the time being entitled to dispose of the fee simple of the land, whether in possession or reversion, and includes also a person holding or entitled to the rents and profits of the land under a lease or agreement, the unexpired term of which exceeds three years [and a person who would have power to sell and convey or release the land to the acquiring authority if a compulsory purchase order were operative]."*

10.4.4 The requirement for the Contractor to enter into the Deed does not apply to new buildings that receive planning permission after the date on which the Silvertown Tunnel Order comes into force.

10.4.5 It is not necessary to enter into the deed in order to benefit from the process set out in this Chapter.

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11. NOISE AND VIBRATION

11.1 General

11.1.1 The Contractor will control and limit noise and vibration levels to minimise any disturbance to the environment and communities in the vicinity of the construction works.

11.2 Detailed measures

11.2.1 Pre-construction noise monitoring surveys will be undertaken and agreed with the relevant planning authority to establish a pre-construction baseline for monitoring compliance with construction noise limits. Baseline monitoring will commence three months beforeconstruction works begin.

11.2.2 The Contractor will then carry out an updated construction noise assessment aganst this baseline based on the detailed design and construction methodology. This will be carried out in accordance with BS 5228 using specific manufacturer's data and position of equipment. This assessment will inform a Noise and Vibration Management Plan (NVMP), which will be prepared by the Contractor for each work site, setting out the proposed specific mitigation measures to be approved by the relevant planning authority prior to commencing construction. This assessment will also inform the eligibility of any persons eligible for the Construction Noise and Vibration Mitigation Scheme which the Contractor will deliver, set out at Appendix H of this Code of Construction Practice.

11.2.3

11.2.4 Where appropriate the Contractor will obtain consents from the relevant local authority under Section 61 of the Control of Pollution Act 1974 (which will include noise and vibration limits where relevant) for the proposed construction works. Any Section 61 consent that is obtained may contain site specific management and mitigation requirements for noise and vibration. The details of this consent will be included in the NVMP. The Section 61 process may not be appropriate in the case of some types of tunnelling operations.

11.2.5 Best Practicable Means[8] (BPM) as defined under Section 72 of the Control of Pollution Act 1974 will be employed during the construction phase and included in the NVMP. These will include, but not be limited to:

- installing appropriate fencing around the construction areas likely to generate noise;
- providing contact details for a site representative in the event that disturbance due to noise or vibration from the construction works occurs; ensuring that any complaints are dealt with pro-actively and that subsequent resolutions are communicated to the complainant;
- keeping site access routes in good condition and well maintained with no potholes or other significant surface irregularities;
- turning off plant machinery when not in use;
- maintaining all vehicles and mobile plant such that loose body fittings or exhausts do not rattle or vibrate;
- using silenced equipment where possible, in particular silenced power generators and pumps;
- using the most modern equipment available where possible and maintaining and operating equipment properly by trained staff;
- locating static noisy plant, including generators, as far away from noise sensitive receptors as is feasible for the particular activity;
- speed limits of to reduce the effect of construction traffic noise;
- monthly condition assessments on site to inspect for defects such as pot holes which could cause an increase in noise levels. Indentations of greater than 20mm to be repaired when identified. Existing potholes would need to be considered by a condition assessments prior to the commencement of works;
- ensuring that the quietest plant and equipment, techniques and working practices available are selected and used; and

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[8] Control of Pollution Act1974.

- no music or radios would be played on site.

11.2.6 The NVMP will require that noise and vibration from conveyor systems will be minimised through the implementation of a maintenance programme which includes regular inspection of the conveyor equipment.

11.2.7 The Contractor will be responsible for notifying the local residents of particularly noisy work prior to commencement. The mechanisms for notification will be detailed in the Community Engagement Plan. Effective communication should be established, keeping local residents informed of the type and timing of works involved, paying particular attention to potential evening and night time works and activities which may occur in close proximity to receptors.

11.2.8 During the construction phase, day time and night time noise and vibration monitoring will be undertaken at key sensitive receptors to ensure that the mitigation measures suggested are working effectively. The location and duration of the monitoring will be set out in the NVMP.

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12. TOWNSCAPE AND VISUAL AMENITY

12.1 Visual disruption

12.1.1 The Contractor will employ construction good practices to minimise townscape and visual disruption, for example protection of existing vegetation and targeted use of hoarding to screen construction worksites.

12.1.2 The visual intrusion of construction worksites on nearby residents and users of local facilities will be contained and limited. Signage, decoration or enhancement, for information or aesthetic purposes, on the hoarding will be in accordance with TfL’s corporate requirements.

12.2 Lighting

12.2.1 For each worksite a Lighting Management Plan (LMP) will be prepared by the Contractor in consultation with the relevant planning authority, the Environment Agency and the PLA. The Contractor will implement the measures set out in the LMP.

12.2.2 The LMP will reflect appropriate industry standard procedures which will be implemented at both worksites. Lighting will be designed, positioned and directed so as not to unnecessarily intrude on adjacent buildings and so as to prevent unnecessary interference with local residents, the DLR, passing motorists, the navigation lights for air or water traffic, wildlife breeding seasons and adjacent habitats that may be used by foraging and commuting bats.

12.2.3 Site specific lighting measures to minimise the adverse impacts on adjacent buildings, wildlife sites and land uses will be taken from and applied in accordance with the ‘Guidance Notes for the Reduction of Obtrusive Light GN01:2011’ (published by the Institution of Lighting Professionals).

12.2.4 The Contractor will use cowling, reflectors and other measures on the temporary jetty to avoid excessive light pollution to surrounding areas. These measures will be detailed within the LMP.

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13. MATERIAL RESOURCES AND WASTE

13.1 General

13.1.1 The Contractor will manage Construction Demolition and Excavation (CD&E) materials generated at worksites in accordance with the waste hierarchy to prevent, reduce, re-use, recycle, recover, and dispose of materials and within the relevant regulatory controls[9]. Measures would be implemented to reduce the impacts of material resources use and waste arisings from the Scheme.

13.1.2 A Construction Materials Management Plan (CMMP) will be prepared by the Contractor and approved by the local authorities. The CMMP will include appropriate mitigation measures to ensure that materials are handled and used in a way that prevents harm to human health and pollution of the environment.

13.2 Materials management

13.2.1 Measures to manage materials as part of the CMMP will include but are not limited to:

- Materials delivered to the project will be received and controlled by the Contractor’s Logistics Team or appointed person.
- Materials will be stored to minimise the potential of damage or wastage. Measures will include off-ground storage e.g. on pallets, remaining in original packaging, protection from rain or collision by plant or vehicles.
- The materials storage area will be secured during out of hours to prevent unauthorised access.
- The Contractor will be encouraged to apply good practice to source construction materials from suppliers with responsible sourcing certification (as far as practicable).
- Local sources for aggregate supplies will be considered whenever possible.

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[9] Mayor of London (2015). London Plan.

- Materials will be ordered, where possible, in sizes to prevent wastage e.g. in the form of off cuts and waste to be able to be returned to the original supplier e.g. plastic pipe.
- The procurement process shall ensure that materials are ordered so that the timing of the delivery (e.g. 'just in time' deliveries), the quantity delivered and the storage are optimised to reduce opportunity for oversupply and damage on site.
- Wherever possible, standardisation of materials and building elements will be incorporated into the Scheme design in order to minimise required material resources and the production of waste, e.g. the use of prefabricated components.
- Where possible, consideration will be given to the reuse of material (e.g. uncontaminated soils) back into the project.

13.2.2 The Contractor must deal with CD&E Materials in accordance with the CD&E Materials Commitments that have been agreed by TfL and are set out at Appendix C.

13.2.3 The Contractor will also, as part of measures to be included in the CMMP:

- where specification allows, utilise at least a 10% portion of construction materials to include reused and recycled content;
- minimise the use of primary aggregated by the selection of secondary materials, where possible;
- obtain all timber products from sustainable sources. All timber procured will be obtained from recycled, reclaimed sources or be accredited to meet sustainable forestry standard such as the Forestry Stewardship Council (FSC). Any remaining timber not sourced through the above will target a known temperate source using the Department for Environmental, Food and Rural Affairs (Defra) central point of expertise in timber (CPET);
- use low embodied carbon materials; and
- achieve a score of Very Good and ideally Excellent using CEEQUAL, adherence to materials and waste elements.

13.3 Waste

13.3.1 A Site Waste Management Plan (Appendix D) has been developed for the Scheme and will be refined and updated by the Contractor as the design and the Scheme progresses. The Contractor will manage waste in accordance with the SWMP. This includes the management of material dredged from the River Thames to facilitate the construction and operation of the temporary jetty and NAABSA at the Silvertown site (if required). All transport of waste will be in accordance with relevant waste legislation.

13.3.2 The SWMP will also provide a framework for checking compliance with waste legislation and the Duty of Care[10].

13.3.3 Waste on site will be managed through the implementation of the CMMP and SWMP. Waste management measures include but are not limited to:

- The Contractor will have a Waste Manager or Champion who will oversee the implementation of the waste control strategy and the handling of any waste material, as set out in the SWMP.
- The Contractor will consider setting off-cut/surplus targets for sub-contractors with a positive incentive scheme for on-site waste champions.
- A waste management compound will be established within the Silvertown site to handle incoming waste from construction activities. This will be designed to facilitate the segregation of key waste streams to maximise the opportunity to re-use, recycle and return wastes generated on site.
- Excavated materials, such as soils, will be carefully stored in segregated piles for subsequent reuse on the site, where possible. If the material is contaminated then it will be kept separate from clean material and sent for either treatment, recycling or recovery, where appropriate, or disposal at appropriately permitted facilities.

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[10] Waste Framework Directive, Directive 2008/98/EC European Waste Framework Directive [2008] OJ L 312/3. Environmental Permitting (England and Wales) Regulations 2010. SI 675. EU Landfill Directive, Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste [1999] OJ L 182/1. The Waste (England and Wales) Regulations 2011.

- The Contractor will be required to divert all vegetation waste from landfill, unless identified as an invasive species and no other options are available. The greatest opportunity for the sustainable management of vegetation waste is through recycling into compost.
- A specific area will be laid out and labelled within the waste management compound to facilitate the separation of materials, where possible, for potential recycling, salvage, reuse and return. Recycling and waste bins/skips are to be kept clean and will be clearly marked/colour coded in order to avoid contamination of materials.
- Shelter will be provided to prevent materials such as cardboard and paper from deteriorating while being sorted or awaiting collection. Space will be provided to accommodate skips and the storage of reusable materials.
- For all waste management options on the site compound, consideration will need to be given for identifying whether waste exemptions or permits are required to enable for the storage and treatment of waste materials.
- Waste management options will be supported by the identification of appropriately permitted waste management and recycling facilities in close proximity to the site compound as set out within the SWMP.

13.3.4 A Receptor Site Assessment (RSA) (Appendix E) has been developed to provide a transparent process and methodology for the evaluation of worksites that may receive excavated material, including material dredged from the River Thames to facilitate the construction and operation of the temporary jetty and NAABSA at the Silvertown site (if required). The final output from the RSA will be a preferred list of receptor sites as well as a reserve list and their scores against each of the assessment criteria. The assessment criteria consider environmental impacts, the operation of the facilities, the proximity principle, and the impact on the local area.

13.3.5 The Contractor will be required to select receptor sites from the preferred list or reserve list of sites or to follow the RSA methodology to identify alternative sites.

13.4 Asbestos and health risks

13.4.1 Some of the materials generated by excavation activities will be contaminated or hazardous.

13.4.2 The Contractor will comply with all relevant legislation relating to protection of employees and others who may be affected from health risks within working environments, including COSHH regulations.

13.4.3 The risk from release of asbestos during alteration, demolition and excavation works will be managed in accordance with The Control of Asbestos Regulations 2012 and associated codes of practice and guidance. Measures for managing asbestos in excavation works will include but are not limited to:

- employing competent contractors to carry out the works;
- contractors implementing a procedure for dealing with potentially suspect materials exposed requiring sampling and analysis by an independent specialist consultant;
- formal exchange of information before start of work, including relevant information from the Asbestos Register to clearly identify location of asbestos-containing materials; and
- method statements for any works in the vicinity of asbestos-containing materials to avoid any disturbance to such materials.

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14. EFFECTS ON ALL TRAVELLERS

14.1 Pedestrians and cyclists

14.1.1 To minimise any adverse effects on pedestrian and/or cyclists during construction the following mitigation measures will be implemented as part of the Construction Traffic Management Plan for each worksite to be prepared by the Contractor, and agreed with the relevant planning authority, in consultation with the local highways authority, in accordance with Chapter 3:

- All existing public rights of way and provision for cyclists and pedestrians that are affected by the construction works will be clearly signed, fenced and diversion routes provided from the outset to ensure that their usage would not be unduly impaired by construction activities. Envisaged diversion routes are provided in the Transport Assessment (Document Reference: 6.5). The Scheme phasing would accommodate all revisions to the alignment of these public rights of way and any changes would occur progressively during the construction period.
- The alternative routes for pedestrian and cyclists will be kept to a minimum feasible length. Alternative safe routes will be provided for people with reduced mobility to ensure that they can access facilities in a safe manner. On completion of the works the pedestrian and cycle routes will be reinstated to their original or revised alignments.
- The existing footbridge over the A102 Blackwall Tunnel Approach at Boord Street will be demolished and replaced with a new foot and cycle bridge. Ramped access to the current footbridge or to the replacement foot and cycle bridge will be maintained during all stages of construction.

14.2 Active traffic demand management

14.2.1 Active traffic demand management during the works will be coordinated and controlled by TfL to ensure consistent and accurate information for the network users.

14.3 Additional mitigation

14.3.1 Table 14-1 summarises the additional mitigation measures which are envisaged to be likely to be required to be implemented at specific roads/junctions. The necessity of these measures will be determined by the Contractor following consultation with the relevant highway authorities as part of the development of the Construction Traffic Management Plan. Where these measures have been determined to be necessary, the Contractor will implement them, subject to the approval of the relevant highway authority where they are outside of the Order Limits.

Table 14-1 Mitigation measures at roads/junctions

Road/Junction	**Mitigation measures**
Lower Lea Crossing between Leamouth Road and Tidal Basin Road	Improve lighting and increase effective width of footways by cutting back overgrown vegetation. Provide dropped kerbs at all crossing locations.
Temporary realignment of Millennium Way	Provide temporary pedestrian and cycle crossing facilities. Provide a shared use path or segregated cycle track.
Temporary link road through the worksite connecting Millennium Way to West Parkside to the south of the current alignment of Edmund Halley Way.	Provide temporary pedestrian and cycle crossing facilities.
Blackwall Lane/A102 junction	At pedestrian/cycle crossings, provide wider waiting areas and remove pinch points where feasible. Repaint road markings, repair tactile paving and remove rutting in the carriageway. Remove clutter in footways where feasible. Cut back overgrown vegetation. Improve footway drainage and improve lighting.
Millennium Way/John Harrison Way/Bugsby's Way/Blackwall Lane Junction	Repaint road markings and improve footway drainage. Review signal timings for pedestrians and cyclists.
Tidal Basin Roundabout	Improve lighting. Repair tactile paving. Provide safer pedestrian and cycle routes.

14.3.2 The Contractor will determine whether it is necessary to review signal timings for pedestrians and cyclists at the Blackwall Lane/A102 junction following consultation with the relevant highway authorities as part of the development of the Construction Traffic Management Plan. If this measure has been determined to be necessary, the Contractor must procure that TfL implements such a change to the signal timings.

15. WATER ENVIRONMENT AND FLOOD RISK

15.1 General

15.1.1 The Contractor shall implement measures to protect surface water from pollution as well as measures to conserve water and manage flood risk during the construction of the Scheme.

15.1.2 The Contractor will employ the appropriate water conservation and pollution prevention measures and site drainage and in river works controls set out below.

15.1.3 The Contractor will employ measures to minimise spillage of materials associated with the Scheme being loaded onto, or unloaded from, barges or other vessels;

15.2 Site drainage

15.2.1 The Contractor will ensure that the site drainage meets the effluent standards required by the sewerage undertaker, or Environment Agency, as appropriate, and will provide holding or settling tanks, separators, and other measures as may be required. It will be the Contractor’s responsibility to ensure that access is provided to the sewerage undertaker so that samples of discharge can be obtained and analysed and the flows verified as required. The relevant sections of BS 6031:2009 Code of Practice for Earthworks[11] for the general control of site drainage will be followed.

15.2.2 Drainage systems will be inspected regularly and maintained as necessary to ensure they operate to the appropriate standard. Inspection and maintenance will be required more often in areas with a high level of construction activity.

15.2.3 Where required, new drainage outfalls, storage and pollution control systems will be built as early in the construction sequence as is practicable.

15.2.4 Consideration will be given to protecting any existing drainage when storing fill materials, aggregates and plant to prevent potential drainage and pollution issues.

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[11] BSI (2009). BS 6031:2009 Code of Practice for Earthworks

15.2.5 Temporary site drainage systems will be put in place to retain surface water runoff within the Order Limits, where practicable.

15.2.6 Any ingress of water into excavations will be pumped to a suitable settlement lagoon or tank and the clear water discharged into the drainage system in a condition suitable to meet the requirements of the Environment Agency/ Thames Water as applicable. As outlined in paragraph 9.3.6, a Mobile Treatment Plant Licence (e.g. for treatment of dewatering water) will be obtained, if required.

15.3 Control of pollution

15.3.1 The Contractor will undertake the works and implement working methods which will be developed to protect surface water from pollution and other adverse impacts including change to flow volume, water levels and quality. This will be completed in accordance with relevant legislative requirements and appropriate industry guidance and in liaison with the Environment Agency.

15.3.2 The Contractor will utilise good practice pollution prevention methods for activities such as excavation and dewatering, storage of fuels, chemicals and oils, vehicle washing.

15.3.3 All refuelling, oiling and greasing by the Contractor will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling.

15.3.4 Access to pollution control equipment and spillage clean up facilities will be provided at all worksites and the Contractor must take measures to prevent pollution caused by severe weather.

15.3.5 Measures to deal with major pollution incidents at the worksites will be included within the Emergency Plan to be produced in accordance with Chapter 2. The measures will reflect the Environment Agency guidance on pollution incident response planning.

15.3.6 The Contactor will carry out an assessment of the mobilisation of off-site contamination, and if necessary, mitigation measures will be implemented to deliver protection of controlled waters.

15.4 In-river works

15.4.1 If necessary, a temporary jetty may be constructed to permit the operation of the proposed marine transportation system.

15.4.2 In order to mitigate against the potential for increases in turbidity and scour during construction of the jetty, works will be undertaken in accordance with good practice methods for pollution control. Other mitigation measures may include the use of drill water recycling and capture during piling and the deployment of silt curtains, if these are considered necessary at the detailed design stage.

15.4.3 Measures to minimise effects on water quality from dredging associated with the temporary jetty will include but are not limited to:

- the management of spill water decanting from the excavated material transport barge to minimise locally high concentrations of suspended sediment and changes in water quality;
- the minimisation of the loss of material from the back-hoe by optimising angle of dredge to the prevailing tidal current flow;
- avoiding summer/low river flow periods if possible; and
- limiting the areas of dredging to a minimal footprint to allow safe access to the jetty.

15.5 Water conservation

15.5.1 The Contractor will implement working methods that control water consumption and ensure water is used efficiently on the construction worksites to support water conservation wherever possible. The measures will include but will not be limited to:

- water audits that identify all water-using processes, activities and equipment on site (aligned with significant changes in site(s) activities throughout the construction phases);
- staff engagement and training, to reduce water consumption by all water-using processes, activities and equipment on site;
- a monitoring regime that assesses the effectiveness of water conservation measures;

- stored water collected by the drainage systems would be used for dust suppression and for other construction phase tasks, such as operation of the TBM; and
- if required, pumps will be provided at each storage lagoon for use in filling water bowsers.

15.5.2 Measures to encourage water use efficiency in the worksite offices and canteens will be adopted.

15.6 Flood risk

15.6.1 The existing flood defences provide a high standard of flood protection from the River Thames. The construction of the Scheme is not anticipated to affect the integrity of existing river walls.

15.6.2 The draft DCO (Document Reference: 3.1) requires that any works carried out under the DCO within 16m of the banks of the River Thames or River Lea, or which might affect flood defences require the prior approval of the Environment Agency, which may be given subject to requirements for the protection of water resources and the prevention of flooding.

15.6.3 During the construction phase flood warning and emergency procedures will be in place, as part of the Emergency Plan. Construction site operatives would use the plan to assess the need to put evacuation and Scheme shutdown procedures into action, thereby mitigating the residual risk of flooding in the very unlikely scenario of a breach on the River Thames defences during the construction period.

16. CARBON EMISSIONS

16.1.1 The Contactor will take measures to reduce energy consumption and improve energy efficiency onsite during construction, which may include but are not limited to the following:

- minimising the use of diesel or petrol powered generators and instead using mains electricity or battery powered equipment;
- powering down of equipment/plant during periods of non-utilisation;
- ensuring all vehicles and machinery is serviced at recommended intervals to guarantee optimum engine efficiencies and reduce waste energy;
- using fuel-efficient plant, machinery and vehicles wherever possible;
- implementing SMART targets for consumption during construction;
- deploying correctly sized generators for electrical provision onsite, where applicable; and
- providing appropriate levels of thermal insulation to the relevant areas of site accommodation to reduce energy demand for heating.

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Appendix A Settlement Assessment and Mitigation Process

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A.1 Settlement Assessment and Mitigation Process

A.1.1 The Contractor shall investigate the potential for ground movement associated with the design and possible construction methods using the process defined in paragraph 1.2 for the following purposes:

- to assess risk of building damage by identifying those zones where the implementation of the design is likely to cause ground movements which may result in Risk Category 2 ‘Slight’ being exceeded (see Table 1);
- to assess the degree of such damage risk occurring and consider alternative designs as necessary;
- to undertake an assessment of the potential consequences where there is a significant likelihood that Risk Category 2 ‘Slight’ will be exceeded and identify specifically what the risks are;
- to design protective measures where necessary to mitigate against the risk of damage exceeding Risk Category 2;
- to demonstrate that the environmental effects of excavation induced ground movements have been considered and taken account of in the design;
- to assess the risk of damage to utilities and to design mitigation measures in agreement with the utility owner;
- to assess the effects of excavation to existing above-ground and underground infrastructure and to design suitable mitigation measures;
- to indicate where property may require demolition or structural modification; and
- to enable the preparation of contingency plans to deal with residual risks.

A.1.2 A phased assessment process shall be followed to identify the risk and impact of construction activities on third parties. Five phases have been identified to assess the impact and risk from pre-construction to completion. The initial phases are aimed at assessing risk, whilst the latter are about limiting, managing and recording the impact of construction. The 5 phases are:

Phase 1 – Scoping

A.1.3 Schedules and plans shall be prepared to identify all third party assets assessed to experience ground movement exceeding 1mm using conservative parameters.

Phase 2 – Initial Assessment

A.1.4 The Contractor shall carry out initial assessment calculations using simple, empirically calibrated methods and moderately conservative parameters to classify the risk of damage to assets. For building structures the risk should be classified in accordance with Table A-1. For non-building infrastructure the level of risk will be determined by ensuring that deformations do not exceed tolerable values determined in consultation with the asset owner. These calculations shall be based on record drawings, where available and an inspection for assessment. Assets estimated to be at risk of damage greater than Risk Category 2 (Slight) or where damage exceeds the agreed tolerable limits will require further detailed assessment at Phase 3. A schedule and plans of predicted damage shall be prepared for that phase.

Table A-1 Building Damage Classification

Building damage classification				
Risk Category	DDescription of degree of damage+	Description of typical and likely forms of repair for typical masonry buildings	Approx. crack width* (mm)	Max. tensile strain %
0	NNegligible	Hairline cracks		< 0.05
• 11	VVery slight	Fine cracks easily treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in exterior visible upon close inspection	00.1 to 1.0	00.05 to 0.075
• 22	SSlight	Cracks easily filled. Redecoration probably required. Several slight fractures inside building. Exterior cracks visible; some repainting may be required for weathertightness. Doors and windows may stick slightly	• 11 to 5	00.075 to 0.15
• 33	MModerate	Cracks may require cutting out and patching. Recurrent cracks can be masked by suitable linings. Tuck pointing and possible replacement of a small amount of exterior brickwork may be required. Doors	5 5 to 15 or a number of cracks greater than 3	00.15 to 0.3

		and windows sticking. Utility services may be interrupted. Weather tightness often impaired		
• 44	SSevere	Extensive repair involving removal and replacement of walls especially over door and windows required. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some loss of bearing in beams. Utility services disrupted.	15 to 25 but also depends on number of cracks	> > 0.3
• 55	VVery Severe	Major repair required involving partial or complete reconstruction. Beams lose bearing, walls lean badly and required shoring. Windows broken by distortion. Danger of instability	UUsually > 25 but depends on number of cracks	

+ In assessing the degree of damage, account must be taken of its location in the building or structure.

* Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Burland, J.P. and Wroth, C.P., Settlement of Buildings and Associated Damage, Proceedings of a Conference on the Settlement of Structures, Cambridge, 1974, pp 611 – 54 and 764 – 810;

A.1.5 The heritage value of a Listed Building should be considered during the initial assessment by reviewing the sensitivity of the building structure and of any particular features together with the initial assessment calculations. The heritage assessment examines the following:

- the sensitivity of the building / structure to ground movements and its ability to tolerate movement without significant distress. The potential for interaction with adjacent buildings / structures is also considered. A score within the range of 0- 2 should be allocated to the building/structure in accordance with the criteria set out in Table A-2; and
- the sensitivity to movement of particular features within the building / structure and how they might respond to ground movements. A score within the range of 0-2 should be allocated to the building in accordance with the criteria set out in Table A-2.

A.1.6 The scores for each of the two categories (a) and (b) should be added to the category determined in paragraph 3.1 to inform the decision making process. In general, Listed Buildings which score a total of 3 or higher should be subject to further assessment as part of the Phase 3 – Detailed Assessment. Buildings that score a total of 2 or less are predicted to suffer a degree of damage which may be easily repairable using standard conservation based techniques and hence no protective measures for the building's particular features should be required. However, ultimately the professional judgement of engineering and historic building specialists should be used to determine whether additional analysis is required.

Table A-2 Scoring for Sensitivity Assessment of Listed Buildings

Score	Criteria	
	Sensitivity of the structure to ground movements and interaction with adjacent buildings	Sensitivity to movement of particular features within the building
0	Masonry building with lime mortar not surrounded by other buildings. Uniform facades with no particular large openings.	No particular sensitive features
• 11	Buildings of delicate structural form or buildings sandwiched between modern framed buildings which are much stiffer, perhaps with one or more significant openings.	Brittle finishes, e.g. tight-jointed masonry, which are susceptible to small movements and difficult to repair.
• 22	Buildings which, by their structural form, will tend to concentrate all their movements in one location.	Finishes which if damaged will have a significant effect on the heritage of the building, e.g. cracks through frescos.

Phase 3 - Detailed Assessment and Mitigation Design

A.1.7 The Contractor shall carry out detailed assessments of structures assessed at being at Risk Category 3 or above so that any monitoring works and mitigation works can be designed and implemented.

A.1.8 The detailed assessment should determine:

- the influence of the structure and its foundations on the predicted ground movements;

- the volume loss at which the risk of damage to the structure (or any sensitive finishes/features) is ‘slight’ or better;
- whether this volume loss may be achieved by the proposed excavation design/control measures;
- any special control measures required to reduce the predicted damage to acceptable levels (i.e. Risk Category 2 or below) such as significantly higher face pressures with EPBM tunnelling and the practicality of these;
- the amount of ground movement that the structure (and or any sensitive finishes/features) can accommodate without exceeding Risk Category 2 or any other agreed damage level; and
- the level of residual risk if intrusive mitigation measures are not implemented.

A.1.9 The detailed assessments should include a number of iterations to determine how the risk of damage to a building may be reduced. Asset-specific empirical models shall be prepared successively using moderately conservative and best estimate parameters. If after these iterations the use of empirical methods do not reduce the risk of building damage to acceptable levels (i.e. Risk Category 2 (slight) and below), the damage assessment shall be refined by increasing the sophistication of the analysis with the aim of reducing the risk of asset damage to acceptable levels and to eliminate the asset from further assessment.

A.1.10 If the risk of damage cannot be shown to be reduced by detailed assessment to acceptable levels, then mitigation measures shall be designed.

A.1.11 The primary means of settlement mitigation shall be practical measures to control ground movement by good design and construction practice. This could include staged excavation sequences within sprayed concrete lining (SCL) works, ground treatment, face stabilisation, spiling / face dowels, increasing face pressure when using an tunnel boring machine (TBM), adopting stiffer walls/propping for rectangular shafts etc.

A.1.12 In the event that physical mitigation measures are still required (i.e. to control building damage to Risk Category 2 or lower or to meet the third party asset owner’s requirements), the Contractor shall seek to obtain the owner’s approval or may use the powers under the DCO to undertake protective works.

A.1.13 The Contractor shall also undertake a comparative risk assessment to demonstrate that the risks associated with installation/implementation of any intrusive mitigation measures (such as compensation grouting) are no worse than the risks associated with the base case.

A.1.14 The relevant Local Authority and Historic England shall be consulted on the results of the Listed Building assessment reports and the proposals for protective measures, if any are required. Historic England shall also be consulted in relation to Listed Buildings where they would normally be notified or consulted on planning applications or listed building consent applications.

A.1.15 When considering the need and type of protective measures for Listed Buildings, due regard should be given to the sensitivity of the particular features of the building which are of architectural or historic interest and the sensitivity of the structure of the building to ground movement. Where the assessment highlights potential damage to the features of the building which it will be difficult or impossible to repair and/or if that damage will have a significant effect on its heritage value, the assessment may recommend appropriate measures to safeguard those features either in-situ or by temporary removal and storage off-site if those with relevant interest(s) in the building consent.

A.1.16 The form of monitoring of Listed Buildings should be determined based on the results of the assessment process.

A.1.17 Where repair works are necessary they will require the consent of those with relevant interest(s) in the building.

A.1.18 For Docklands Light Railway (DLR) track and track support structures the Contractor shall:

- review the track surveys (including specifying additional surveys if required) and establish that ground movement can be accommodated without exceeding track standard operational tolerance in conjunction with the DLR Infrastructure Manager;
- identify locations where fettling of the track is required pre construction and /or during construction to ensure the track geometry and clearances are acceptable.

A.1.19 The Contractor shall prepare plans and sections showing the zone of influence of the works that is defined by ground movements exceeding 1mm.

A.1.20 The Contractor shall develop an instrumentation and monitoring plan to validate that ground movements within the zone of influence are in accordance with design assumptions and that the infrastructure remains within acceptable limits. The Contractor shall ensure that there is a clear distinction between parameters measured to confirm the change in any parameter is in accordance with the design and parameters measured to limit damage to the assets. This plan shall identify the minimum period of time required to obtain base line data for each monitoring point. Instrumentation adjacent to the railway, which will remain in place during traffic hours, shall conform to the standards of the asset owner.

A.1.21 Note: A competent engineer responsible for the works shall consider those factors which may influence the monitoring data and shall determine an appropriate period and frequency for baseline monitoring. This decision making process will include an element of engineering judgement to account for the possible effects of any underlying environmental trends in the assets under consideration.

A.1.22 The Contractor shall demonstrate that the monitoring system complies with the British Tunnelling Society Monitoring Underground Construction best practice guide.

A.1.23 Note: A review of the monitoring system against the checklists provided in Appendix B of the BTS Monitoring Underground Construction best practice guide may be used as a tool to demonstrate compliance.

A.1.24 The detailed assessments shall define the control limits that need to be imposed on the tunnel construction methods in the zone of influence. The Contractor shall state these control measures on drawings and specifications.

A.1.25 The Contractor shall identify the critical parameters to be monitored and define the Asset Control Limits based on:

- the ability of the asset or structure to withstand ground movement investigated during the assessments carried out in Phases 2 and 3.
- the risk to third party operations.

A.1.26 The Contractor shall link the Asset Control Limits to actions within the Emergency Preparedness Plan.

A.1.27 The Instrumentation and Monitoring Plan and Emergency preparedness Plan shall be agreed with the relevant third party asset Owner.

Phase 4 – Construction

A.1.28 Contingency plans shall be developed and agreed with third party asset Owners to cover the risks posed to third parties before commencement of the construction of the Scheme.

A.1.29 Contingency plans shall be implemented where the results of monitoring or inspection so indicate.

A.1.30 Ground movement and construction progress records shall be maintained and reported in regular reviews when construction processes are taking place within the zone of influence.

A.1.31 Predictions and assumptions made during design in respect of both ground movement and the effects which such ground movement will have on adjacent assets shall be verified by measurement during construction.

Phase 5 – Completion and Close-out

A.1.32 After ground movement has stopped as confirmed by instrumentation the Contractor shall prepare a “Completion Report”. This shall include the following:

- details of any modifications/mitigation measures to the existing structure;
- graphs that show the ground movement and construction progress over time with at least 3 months duration of readings which show no change;
- a schedule showing actual movement compared to predicted movement;
- a schedule of defects recording only the exceptions (changes) identified during the post construction defects survey;
- details of any remedial works undertaken; and
- as-built records (including any temporary works remaining in situ).

Appendix B. Settlement Deed

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DATED **201[X]**

(1) ***[PROJECT CO]***

and

(2) **[*PARTY NAME*]**

DEED

Concerning the mitigation of the effects of settlement arising from the construction works undertaken at [*Location*]

THIS DEED is made on the day of two thousand and [***YEAR***]

BETWEEN

(1) ***[PROJECT CO]*** (Company Registration No. [xxx] whose registered office is at [*ADDRESS*] (***"PARTY NAME"***); and

(2) **[*PARTY NAME*][*REP [X]*]**(Company Registration No. [xxx]) whose registered office is at [*ADDRESS*] (***"PARTY NAME"***).

RECITALS

WHEREAS:

(A) TfL applied on 3 May 2016 for an Order under section 37 of the Planning Act 2008 entitled "Silvertown Tunnel Order" ("**the Order**") to authorise TfL to construct and operate a twin bored road tunnel under the River Thames linking the Greenwich Peninsula and Silvertown together with necessary alterations to the connecting road network ("**the Authorised Works**").

(B) The Order was made on [*date*] and came into force on [*date*].

(C) TfL has appointed Project Co to construct the Authorised Works.

(D) Under article 58 of the Order TfL has transferred its obligation to carry out the Authorised Works in accordance with the code of construction practice to Project Co.

(E) The Order requires that the Authorised Works are carried out in accordance with a code of construction practice which includes an obligation to enter into this Deed with property owners who satisfy certain qualifying conditions.

(F) The Owner satisfies those qualifying conditions and has required that this Deed be entered into.

OPERATIVE PROVISIONS

1. INTERPRETATION

1.1 In this Deed:-

"**the Assessment**"	means the Assessment described in clause 3.1;
"the Authorised Works"	mans the works authorised by the Order;
"Box"	means an excavated structural box of a depth of 3 metres or more;
"**the Building"**	means the building [*insert address and description of the building concerned*] together with any bridge, tunnel or water, sewerage, gas, electricity or other major service media connected thereto in which the Owner has a legal estate or legal interest;
"Conditions Precedent"	means the conditions set out in clause 2;
"Ground Movement"	means movement of the ground in response to the Relevant Construction;
"Listed building"	means a listed building within the meaning of the Planning (Listed Buildings and Conservation Areas) Act 1990;
"the Notice"	means the Notice described in clause 3.6.2;
"the 1 mm settlement contour"	means a prescribed predicted settlement contour undertaken as part of an initial "green field" stage 1 settlement analysis within the Order limits and identified for assessment as set out in the Appendix to this deed;
"**the Opening Date"**	means the date of opening to the public of such of the Authorised Works that are intended for public use in the vicinity of the Building;
"**the Order"**	means the Silvertown Tunnel Order 201[ ];
"the Owner"	includes the Owner's successors in title to and assigns of the Protected Property;
"the Owner's Engineer"	means the Engineer appointed in accordance with

	clause 3.6.1;
"Project Co"	means *[name of company entering into deed with owner]*
“the Protected Property”	means any part of the Building in which the Owner has a legal estate or in respect of which the Owner has repairing obligations;
“Protective Works”	means works for the supporting or strengthening of the Building or its foundations undertaken to minimise damage to the Building arising as a result of the Relevant Construction;
“the Relevant Construction”	in relation to the Building, means any part of:- (a) bored tunnels, comprised in the Authorised Works and which is within the 1 mm settlement contour; or (b) excavations comprising a Shaft or Box, comprised in the Authorised Works and which is within the 1 mm settlement contour;
“Relevant Protective Works”	means the Protective Works described in the Report as necessary (whether as consulted on under clause 3.5 or as agreed or deemed to have been agreed or as determined as mentioned in clause 3.6 as the case may be);
“the Report”	means the Report for the Building described in clause 3.2;
“Sent”	means (in relation to the sending to the Owner of the Report under clause 3 and of the Notice transmitted by facsimile (and confirmed by transmission confirmation slip), delivered by hand or posted by ordinary first-class post or recorded delivery post addressed to the address referred to

	in clause 10.1) and "send" shall be construed accordingly;
"Shaft"	means an excavated shaft of a depth of 3 metres or more; and
"the Surveyor"	means the surveyor or engineer appointed by the Owner for the purposes of this Deed;
"TfL"	means Transport for London; and
"Working Day"	means a day other than a Saturday or Sunday or public Holiday in England.

1.2 Where in this Deed reference is made to any clause, paragraph or appendix or recital such reference (unless the context otherwise requires) is a reference to a clause, paragraph or appendix or recital in this Deed.

1.3 Words importing the singular meaning where the context so admits include the plural meaning and vice versa.

1.4 Words of the masculine gender include the feminine and neuter genders and words denoting actual persons include companies, corporations and firms and all such words shall be construed interchangeably in that manner.

1.5 TfL may appoint any of its contractors or sub-contractors for any of the Authorised Works as agent in relation to the exercise of any of its functions under this Deed (but without prejudice to any liability of TfL in the event of a failure to comply with the terms of this Deed).

2. CONDITIONALITY

2.1 The obligation on Project Co to carry out the Assessment, the Relevant Protective Works and/or monitoring of the Building under this Deed is subject to:-

2.1.1 the obtaining of any necessary consents, agreements or other approvals (which Project Co shall use reasonable endeavours to obtain) required for the purpose, whether required under any provision having effect under statute, or under any undertaking or agreement given or entered into by the Secretary of State, TfL or Project Co which governs the exercise of the powers given by the Order, or otherwise and the obligation to use reasonable endeavours to obtain such consents, agreements or other approvals includes (where applicable) the obligations at clause 3.8; and

2.1.2 the Owner permitting Project Co to enter the Protected Property at reasonable times and on the giving of reasonable notice to perform its obligations under this Deed.

3. GROUND MOVEMENT AND PROTECTIVE WORKS

Preparation of Assessment and Report

3.1 Before it commences the Relevant Construction Project Co shall carry out an assessment (to be undertaken by a competent qualified person with appropriate experience) to predict any Ground Movement to the Building that may result from the Relevant Construction and any damage to the Building which may be caused by such movement.

3.2 The Assessment shall be carried out in accordance with the procedures set out in the Appendix to this Deed and following the Assessment Project Co shall prepare the Report in respect of the Building which shall contain such of the following as may be applicable:-

3.2.1 an assessment of predicted Ground Movement to the Building caused by the Relevant Construction (Stage 1) and if Ground Movement is assessed at Stage 1 to be more than 1 mm, a Stage 2 assessment will be carried out;

3.2.2 if the Building has been subject to a Stage 2 or Stage 3 assessment as described in the Appendix to this Deed:

3.2.2.1 the assessed maximum tensile strain and an assessment of the predicted damage to the Building;

3.2.2.2 the results of any structural inspection of the Building;

3.2.2.3 any proposed monitoring specific to the Building;

3.2.2.4 an assessment of whether Protective Works are required; and

3.2.2.5 details of any such Protective Works, including designs, method of working and programme of such Protective Works;

3.2.3 if the Building is a listed building, particulars of any such additional safeguarding measures as are referred to in paragraph 4.9 of the Appendix to this Deed.

3.3 The Report shall be sent to the Owner before commencement of the Relevant Construction, following which Project Co will (subject always to clauses 3.5 and 3.6 in a case where those clauses apply) be entitled to proceed with that construction without prejudice to any claim for compensation which the Owner may have (whether against TfL or Project Co).

3.4 Without prejudice to article 15 (Protective works to buildings) of the Order Project Co may, as often as it may reasonably require and upon giving not less than 14 days' notice in writing to the Owner, enter the Protected Property at any reasonable time for the purposes of carrying out the Assessment.

Cases in Risk Category 2 or below

3.5 Subject to clause 3.6 below, if the assessment of the predicted damage to the Building concerned contained in the Report is that the Building falls into Risk Category 2 (as set out in the Appendix to this Deed) or below, Project Co, if so requested by the Owner by notice given in writing to Project Co not later than 20 working days after the day on which the Report is Sent to the Owner, shall seek to consult with the Owner regarding the Report following which consultation (or if no request for consultation is made by the Owner within the time limit referred to above) Project Co shall be entitled to proceed with the Relevant Construction without prejudice to any claim for compensation which the Owner may have.

Cases in Risk Category 3 or above

3.6 If following the carrying out of the Assessment the assessment of the predicted damage to the Building concerned contained in the Report assesses that the Building falls into Risk Category 3 (as set out in the Appendix to this Deed) or above or if the Report recommends that Protective Works should be carried out wholly or partly from within the Building:-

3.6.1 the Owner shall be entitled to appoint an Engineer (at Project Co's cost in accordance with clause 3.6.9) save that:-

3.6.1.1 in the event of Project Co entering into a Deed with any other person or persons (whether on, before or after the date of this Deed) in relation to the whole or part of the Building containing provisions similar to this clause 3:-

(a) the Owner's Engineer shall be appointed jointly by the Owner and the other person or persons with a legal interest in the Building (or, failing agreement between them, by the President of the Institution of Civil Engineers on the written application of either or, as the case may be, any of them), and

(b) as regards any disputes concerning the Report and the appropriate protective works for the Building (if any), for the purpose of obtaining a consistent outcome with respect to the Building capable of implementation by Project Co clause 9.12 has effect;

3.6.1.2 where Project Co enters (or is to enter) into such a Deed as is mentioned in clause 3.6.1.1 above with any other person or persons, to enable the joint appointment to be made Project Co shall either send a notice in writing to the Owner specifying the other person or persons before the beginning of the period of 15 working days ending with the day on which the Report is Sent to the Owner under clause 3.3, or shall send that notice at some later time before the Report is Sent (in which case the Report shall be deemed to have been sent for the purposes of paragraphs 3.6.3 on the day 15 working days after the day on which that notice is Sent);

3.6.2 where the Owner decides not to appoint an engineer in accordance with clause 3.6.1 Project Co, if so requested by the Owner by Notice given in writing to Project Co not later than 20 working days after the day on which the Report is Sent to the Owner, shall seek to consult with the Owner regarding the Report following which Project Co shall be entitled to proceed with the Relevant Construction without prejudice to any claim for compensation which the Owner may have;

3.6.3 where an engineer is appointed in accordance with clause 3.6.1 the Owner's Engineer may, not later than 20 working days after the day on which the Report was sent to the Owner, give written Notice to Project Co stating whether or not the Report is agreed;

3.6.4 if the Owner's Engineer does not agree the Report the Notice shall contain detailed reasons for the objections to it;

3.6.5 if in Project Co's opinion (Project Co acting reasonably) the Notice contains reasonable objections:-

3.6.5.1 Project Co and the Owner's Engineer shall seek to agree such amendments to the Report as are reasonably necessary to address those objections; and

3.6.5.2 in the event that Project Co and the Owner's Engineer fail to agree the Report within 20 working days of the giving of the Notice the dispute shall be referred to dispute resolution in accordance with the provisions in clause 9.

3.6.6 if in Project Co's opinion (Project Co acting reasonably) the Notice contains unreasonable objections Project Co shall consult with the Owner's Engineer regarding the Report following which Project Co shall be entitled to proceed with the Relevant Construction without prejudice to any claim for compensation which the Owner may have and the right of the Owner to refer the dispute as to the reasonableness of the objections to dispute resolution in accordance with clause 9;

3.6.7 in the event that no Notice is served within the period specified in clause 3.6.3 the Report shall be deemed to have been agreed;

3.6.8 upon the Report being agreed or deemed to be agreed or upon determination of the dispute (as the case may be) Project Co shall be entitled to proceed with the Relevant Construction and the Relevant Protective Works in accordance with the Report as so agreed or determined; but if the Notice contains objections to the Report and the Report has not been agreed or finally determined within the period of 75 working days after the day on which the Report was Sent to the Owner then provided that Project Co has used its reasonable endeavours to agree the Report and facilitate the determination of the adjudicator Project Co shall be entitled to proceed with the Relevant Construction and the Relevant Protective Works specified in the Report in accordance with its terms without prejudice to any claim for compensation which the Owner may have;

3.6.9 Project Co shall, within 20 working days of being called on to do so and of being provided with the appropriate documentation, repay to the Owner all reasonable costs, charges and expenses properly incurred by the Owner, including VAT thereon insofar as the same is not recoverable by the Owner (whether as a deduction against output tax or as a VAT credit or otherwise), in connection with:-

3.6.9.1 the services of the Owner's Engineer under clauses 3.6.2 to 3.6.4; and

3.6.9.2 the services of architects, surveyors, engineers and other technical advisers to whom the Owner's Engineer finds it reasonably necessary to refer in connection with clause 3.6.5(a).

3.7 Subject to the Conditions Precedent and clause 3.8 if Project Co carries out the Relevant Construction it shall also carry out the Relevant Protective Works (including the method of working and programme therefore).

3.8 The duty to carry out Protective Works under clause 3.7 has effect subject to the obtaining of any necessary consents, agreements or other approvals (which Project Co shall use reasonable endeavours to obtain) required for the purpose, whether required under any provision having effect under statute, or under any undertaking or agreement given or entered into by Project Co which governs the exercise of the powers conferred by the Order, or otherwise and the obligation to use reasonable endeavours to obtain such consents, agreements or other approvals includes an obligation:-

3.8.1 where the Report in the form sent to the Owner identifies Protective Works as necessary, Project Co shall also serve notice under paragraph 5 of article 15 of the Order not later than 10 working days after the day on which the Report is so sent to the Owner on all persons who have not entered into a Deed in relation to the whole or part of the Building containing provisions similar to clause 3 and 4 of this Deed and who after reasonable inquiry by Project Co are (as at that time) found eligible to receive such notice in relation to the Building and the Protective Works so identified; and

3.8.2 after the sending of the Report to the Owner, to do what else is reasonable under article 18 of the Order to enable the Relevant Protective Works to be carried out at a time consistent with Project Co's construction timetable including, if a person gives notice of dispute under paragraph 6 of article 15 in relation to the Building (whether in consequence of a notice by Project Co given pursuant to paragraph 5 of article 18 of the Order or subsequently)-

3.8.2.1 to pursue the arbitration with all due despatch; and

3.8.2.2 to do all that is reasonable to argue the case in the arbitration in favour of the Relevant Protective Works in consultation with the Owner.

3.9 For the avoidance of doubt:

3.9.1 for the purposes of clause 3.8 the circumstances in which Project Co shall be treated as not being able to carry out any protective works under article 18 to the Order includes a case where the decision of an arbitrator under paragraph 6 of article 15 of the Order precludes those works being carried out, or makes the carrying out of those works impractical; and

3.9.2 if Project Co has done the things required by clause 3.8.2(a) and (b) but, on an arbitration under paragraphs of article 15 of the Order relating to the Building, a decision of the arbitrator has not been obtained by the time that would be required in order to maintain Project Co's construction timetable for the Relevant Construction (or for the Relevant Protective Works), Project Co may carry out the Relevant Construction in accordance with its construction timetable without carrying out such of the Relevant Protective Works as it could not or cannot lawfully or practicably carry out in accordance with that timetable because the decision has not been obtained.

3.10 Protective Works carried out in accordance with this Deed shall be treated as carried out under the powers conferred by article 15 of the Order, save that the Owner agrees that paragraph 6 of article 15 shall not apply to the Owner.

4. MONITORING OF PROTECTED PROPERTY

4.1 If the Report prepared under clause 3.2 above recommends that monitoring specific to the Building should be carried out, subject to clause 4.6 Project Co shall, if it proceeds with the construction of the Authorised Works, undertake monitoring of the Building.

4.2 Except in so far as further or different types or methods of monitoring are recommended in that Report, monitoring shall consist of precise surveying of studs and targets on the outside of the Building, and shall begin prior to the commencement of the carrying out of the Relevant Construction and continue during the period of the Relevant Construction and shall end at the later of (a) six months from the Opening Date and (b) (if prior to the end date the monitoring has established any movement of the Building arising in consequence of the Relevant Construction) the date on which the monitoring indicates that such movement has reduced to a rate of 2mm per annum or less.

4.3 As soon as practicable after monitoring results have been obtained, whether interim or final, Project Co shall:-

4.3.1 in the case of final results, make them available for inspection by the Owner for a period of three months commencing on the date on which Project Co notifies the Owner that the monitoring has ceased; and

4.3.2 in the case of both interim and final results, inform the Owner that Project Co will send to the Owner a copy of such of those results as the Owner may request.

4.4 Such monitoring will be recommenced at the written request of the Owner if:-

4.4.1 the Owner can show reasonable grounds for concluding that building movement arising in consequence of the Relevant Construction of a rate greater than 2mm per annum has started again after the monitoring period specified in clause 4.2 or a monitoring period under this clause 4.4 has elapsed;

4.4.2 that request is made within two years from the Opening Date; and

4.4.3 any such recommenced monitoring shall continue until the monitoring indicates that building movement arising in consequence of the Relevant Construction has reduced to a rate of 2mm per annum or less.

4.5 The Owner hereby agrees that prior to and during the construction of the Authorised Works Project Co may as often as it may reasonably require, upon giving not less than 7 days' notice in writing to the Owner, enter the Protected Property to monitor the effect of the Authorised Works (including entering to place and maintain studs and targets for the purposes of monitoring referred to above) Provided always that such inspection, entering, placing and maintaining shall be conducted with a duly authorised representative of the Owner and at reasonable hours and that before placing such studs and targets on any of the Protected Property Project Co shall consult with the Owner on their positioning.

4.6 The obligations of Project Co to carry out monitoring under this clause 4 are subject to the obtaining of any necessary consents, which Project Co shall use its reasonable endeavours to obtain.

5. SCHEDULE OF DEFECTS

5.1 Before it commences construction of so much of the Authorised Works as will or may affect the Building, Project Co shall at its own expense appoint in the joint names of Project Co and the Owner (and such other persons as Project Co may determine so that Project Co shall not be obliged to prepare more than one such schedule for the Protected Property) a reputable firm of chartered building surveyors or chartered engineers to prepare a schedule of defects existing in the Protected Property (including, so far as relevant and can be established from the visual inspection normally conducted in relation to the preparation of such schedules, a description of the apparent magnitude of any defect) and that firm shall submit a copy of the schedule of defects (“the original schedule”) to Project Co and the Owner.

5.2 In a case where clause 5.1 applies, after Project Co has constructed the Authorised Works in the vicinity of the Building and either at the written request of the Owner or on the initiative of Project Co, a schedule shall be prepared at the expense of Project Co by the firm appointed under clause 5.1 (or a similar firm if the original firm is unable to act for whatever reason) similar to (and with similar inspection techniques as) the original schedule setting out what changes appear to have occurred in respect of the defects identified in the original schedule prepared pursuant to clause 5.1 (as amended pursuant to any procedure under clause 9), provided such request is made before the end of the period of 2 years from the Opening Date or if later (and building-specific monitoring of the Building is carried out under clause 4) the end of the period of three months from the day on which Project Co notifies the Owner that monitoring has ceased, and provided further that Project Co will not be obliged to commission more than one such schedule for the Protected Property.

6. COMPENSATION FOR DAMAGE

6.1 In addition to any claim which the Owner may make under the provisions of any enactments incorporated with or applied by the Order with respect to compensation for lands taken or injuriously affected, the Owner may (subject to clause 6.2, 6.3 and 6.5) make a separate claim (a “clause 6.1 claim”) upon Project Co for compensation for the reasonable and proper costs properly incurred by the Owner in remedying any material physical damage caused to the Protected Property by Ground Movement arising from the construction of the Authorised Works, provided that the claim is made before the end of the period of two years from the Opening Date, or if later (and where building-specific monitoring of the Building is carried out under clause 4) the end of the period of six months from the day on which Project Co notifies the Owner that monitoring has ceased.

6.2 For the avoidance of doubt, if the Building or the Protected Property suffers from a pre-existing defect or defects which are worsened by the construction of the Authorised Works, the compensation payable under clause 6.1 is limited to the additional costs of repair of the Protected Property which go beyond those that would be incurred upon remedying the pre-existing defect or defects (assuming the Authorised Works had not been constructed), provided always that Project Co may not assert any pre-existing defect that is not recorded in a schedule of defects prepared in accordance with clause 5 or otherwise specifically agreed in writing by Project Co and the Owner, in each case subject always to the outcome of any dispute determined in accordance with the procedure set out in clause 9.

6.3 Before carrying out any work in respect of which a clause 6.1 claim may be made, the Owner shall give not less than 28 days' notice in writing to Project Co, specifying the material physical damage concerned and the proposed remedial work; and if within the period of 28 days after the giving of such notice:-

6.3.1 Project Co elects by notice in writing to the Owner to remedy all or part of that damage, then no claim may be made under that paragraph in respect of the damage or part, but Project Co shall be under a duty to remedy the damage or part to the reasonable satisfaction of the Owner as soon as reasonably practicable thereafter in accordance with a specification agreed with the Owner or in default of such agreement, determined under clause 9 below; and/or

6.3.2 Project Co by notice in writing to the Owner requires the Owner to obtain competitive quotes for all or any of the remedial work, then before entering into a contract for or arranging for the carrying out of the work concerned the Owner shall (i) take reasonable steps to obtain not less than 3 competitive prices for the work and (ii) obtain the consent of Project Co to the quote to be accepted, such consent not to be unreasonably withheld.

6.4 If it appears to the Owner or Project Co that any damage in respect of which notice is given by the Owner under clause 6.3 is likely to be of a recurring nature by reason of the programme for or the nature of the Authorised Works, either of them may, in the relevant notice, require a timetable for the carrying out of the remedial work relating to the damage (including a timetable and specification of any interim repairs reasonably necessary in consequence of the damage) to be agreed or, in default of agreement, determined under clause 9; and for this purpose "the relevant notice" means:-

6.4.1 where the requirement is made by the Owner, the notice given by him under clause 6.3;

6.4.2 where the requirement is made by Project Co, and Project Co gives a notice of election under clause 6.3(a), the notice of election;

6.4.3 where the requirement is made by Project Co, and Project Co gives notice requiring competitive quotes under clause 6.3(b), the notice requiring competitive quotes;

6.4.4 where the requirement is made by Project Co and Project Co gives no such notice of election or notice requiring competitive quotes, a separate notice in writing stating the requirement, which is given within the period of 28 days after the giving of the notice by the Owner under clause 6.3; and

6.4.5 The Owner hereby agrees that Project Co may as often as it may reasonably require and upon giving not less than 14 days' notice in writing to the Owner, enter the Protected Property at any reasonable time to carry out works in compliance with any duty under clause 6.3

or 6.4 but in doing so Project Co agrees that it will have due regard to any activities carried out by those with an interest in the Building.

6.5 For the avoidance of doubt, the Owner shall not be entitled to (and hereby accepts the fulfilment of the obligations of Project Co under this clause in satisfaction of any right to) compensation under any enactment as regards any damage or claim in respect of which the Owner is entitled to payment under clause 6.1 or which Project Co is under a duty to remedy under clause 6.3 or 6.4.

6.6 In clause 6.5 reference to "any enactment" includes reference to the Order.

7. COSTS

7.1 Project Co shall repay to the Owner all reasonable costs charges and expenses properly incurred by the Owner, including VAT thereon insofar as the same is not recoverable by the Owner (whether as a deduction against output tax or as a VAT credit or otherwise), in connection with:-

7.1.1 the services of the Surveyor under clause 5.2 of this Deed;

7.1.2 the services of the Surveyor in connection with the successful proving of a claim under clause 6.1 of this Deed; and

7.1.3 the services of architects, surveyors, engineers and other technical advisers to whom the Surveyor finds it reasonably necessary to refer in connection with the successful proving of a claim under clause 7.1(b).

7.2 Before any services in respect of which repayment may be claimed under clause 7.1.2 and 7.1.3 above are undertaken, the Owner or the Surveyor shall give Project Co not less than 28 days' notice in writing of the services proposed to be undertaken, the basis on which any costs charges or expenses are to be calculated, and an estimate of the total amount of those costs charges and expenses.

7.3 Any amount payable under clause 7.1 shall be paid by Project Co within 20 working days of that amount being agreed between Project Co and the Owner or being determined in accordance with clause 9.

8. AS TO PROJECT CO'S LIABILITY IN CERTAIN CASES

8.1 The fact that any work or thing has been executed or done in accordance with a Report prepared or agreed under clause 3 above or in accordance with any decision of an adjudicator shall not relieve Project Co from any liability for damage caused to the Protected Property or affect any claim by the Owner in respect of such damage.

9. DISPUTES

9.1 Any dispute or difference arising between the parties hereto as to their respective rights duties and obligations under this Deed or as to any matters arising out of or in connection with the subject matter of this Deed shall be determined by adjudication in accordance with the provisions of this clause.

9.2 Either party may give notice in writing to the other referring the dispute to adjudication under this clause, and that notice shall briefly state the matter which is in dispute between them.

9.3 Unless the dispute in question is one that falls to be consolidated under clause 9.12 below with other disputes relating to the Building and an adjudicator has already been appointed for any of the disputes (under a provision in another Deed similar to this clause 9) which fall to be so consolidated (in which case that adjudicator shall act on the consolidated proceedings), the party giving notice under clause 9.2 shall upon giving that notice forthwith request the appointing body to nominate an independent person to act as adjudicator, who shall be a person professionally qualified for not less than 10 years and who is also a specialist in relation to the subject matter of the dispute, and the request shall ask the appointing body to nominate the adjudicator within 7 days of the notice being given with a view to the matter being referred to the adjudicator within that period.

9.4 The appointing body for the purposes of clause 9.3 shall be the President, Vice-President or other duly authorised officer of the Institution of Civil Engineers, except in the case of a dispute or difference with regard to the meaning or construction of this Deed, when the appointing body shall be the President, Vice-President or other duly authorised officer of the Law Society.

9.5 The terms of reference of the adjudicator shall be as follows:-

9.5.1 the adjudicator is to reach a decision within 28 days of the dispute being referred to him or within such longer period (if any) as may be agreed by the parties after the dispute has been referred to him;

9.5.2 the adjudicator may extend that period of 28 days by up to 14 days without the agreement of the parties to the dispute if the party referring the dispute consents;

9.5.3 the adjudicator must act impartially; and

9.5.4 the adjudicator may take the initiative in ascertaining the facts and the law.

9.6 In reaching his decision, the adjudicator shall act as an expert and not an arbitrator and he shall accordingly take into account his expert knowledge and judgement.

9.7 The parties hereto agree that the decision of the adjudicator shall be final and binding except in a case of manifest error.

9.8 In a case of manifest error the decision shall (so far as consistent with the terms of this deed) be binding until the matter is finally determined by legal proceedings or by agreement between the parties.

9.9 The adjudicator shall not be liable for anything done or omitted in the discharge or purported discharge of his functions as adjudicator unless the act or omission is in bad faith, and any employee or agent of the adjudicator shall be similarly protected from liability.

9.10 The incidence of the adjudicator's reasonable costs and fees in the adjudication shall lie (as between the parties to the dispute) at the award of the adjudicator.

9.11 This clause 9 shall apply to disputes falling both within and outside section 108 of the Housing Grants, Construction and Regeneration Act 1996, and (in the case of a dispute falling within that section) if there is any inconsistency between the provisions of this Deed and the requirements of subsections (1) to (4) of that section the inconsistency shall be resolved in favour of those subsections and those subsections shall to the extent of such inconsistency be deemed to be incorporated in this Deed and have effect accordingly (so that amongst other matters the Scheme for Construction Contracts is not intended to apply).

9.12 In the event of Project Co entering into a Deed with any person or persons other than the Owner (whether on, before or after the date of this Deed) in relation to the whole or part of the Building containing provisions similar to clause 3 above, then:-

9.12.1 all disputes of the land mentioned in clause 3.6.6 relating to the Building shall be consolidated into a single proceeding with a single adjudicator for all of them and this clause 9 shall have effect accordingly; and

9.12.2 the finding of the adjudicator shall have effect with respect to the Building for the purposes of clause 3 with respect to the Owner even if the Owner did not become or did not remain a party to the adjudication.

10. SERVICE OF NOTICES

10.1 Any notice in writing that is to be given by Project Co to the Owner shall be deemed effectively given if left at, or despatched by a postal service in which receipt is recorded addressed to, [specify address within United Kingdom] or such other address within the United Kingdom as the Owner notifies to Project Co in writing, and in the case of the documents referred to in the definition of "sent" in clause 2(1) above, the documents shall be deemed effectively given if posted by ordinary first class post to that address (whether or not received).

10.2 Any notice in writing that is to be given by the Owner to Project Co shall be deemed effectively given if left at, or sent by a postal service in which receipt is recorded addressed to, the address as set out in this Deed or at such other address within the United Kingdom as is notified in writing by Project Co to the Owner.

11. RIGHTS OF THIRD PARTIES

11.1 This Deed may be varied determined or supplemented without the consent of any third party.

11.2 This Deed does not and is not intended (save where this clause is in any other clause expressly (or by express reference) excluded) intended to confer any rights whatsoever on any person who is not a party to this Agreement pursuant to the Contracts (Rights of Third Parties) Act 1999.

IN WITNESS of which the parties have executed this document as a Deed on the day and year first before written

EXECUTED AS A DEED by the Parties on the day and year first before written

EXECUTED as a Deed by)
[*PROJECT CO*])
acting by two Directors or a)
Director and Secretary)

____
Director

____
Director / Secretary

EXECUTED as a Deed by)
[*PARTY NAME*])
acting by two Directors or a)
Director and Secretary)

____
Director

____
Director / Secretary

APPENDIX
Ground Movement Assessment

1.0 Assessment and Mitigation Process

1.1 Project Co shall investigate the potential for ground movement associated with the design and possible construction methods using the process defined in paragraph 1.2 for the following purposes:

a) to assess risk of building damage by identifying those zones where the implementation of the design is likely to cause ground movements which will result in Risk Category 2 'Slight' being exceeded (see Table 1);

(b) to assess the risks of such degrees of damage occurring and consider alternative designs as necessary;

c) to undertake an assessment of the potential consequences where there is a significant likelihood that Risk Category 2 'Slight' will be exceeded and identify specifically what the risks are;

d) to design protective measures where necessary to mitigate against the risk of damage exceeding Risk Category 2;

e) to demonstrate that the environmental effects of excavation induced ground movements have been considered and taken account of in the design;

f) to assess the risk of damage to utilities and to design mitigation measures in agreement with the utility owner;

g) to assess the effects of excavation to existing above-ground and underground infrastructure and to design suitable mitigation measures;

h) to indicate where property may require demolition or structural modification; and

i) to enable the preparation of contingency plans to deal with residual risks.

1.2 A staged assessment process shall be followed to identify the risk and impact of construction activities on third parties. Five stages have been identified to assess the impact and risk from project inception to completion. The initial stages are aimed at maximising the benefit from assessments, whilst the latter are about managing and recording the impact of construction. The five stages are:

2.0 Stage 1 – Scoping

2.1 Schedules and plans shall be prepared to identify all third party assets assessed to experience ground movement exceeding 1mm using conservative parameters.

3.0 Stage 2 – Initial Assessment

3.1 Project Co shall carry out initial assessment calculations using simple empirically calibrated, methods and moderately conservative parameters to classify the risk of damage to assets. For building structures the risk should be classified in accordance with Table 1. For non-building infrastructure the level of risk should be determined by ensuring that deformations do not exceed tolerable values determined in consultation with the asset owner. These calculations shall be based on record drawings, where available and an inspection for assessment. Assets estimated to be a risk of damage greater than Risk Category 2 –Slight or where damage exceeds the agreed tolerable limits require further detailed assessment at Stage 3. A schedule and plans of predicted damage shall be prepared.

Building damage classification				
Risk Category	**Description of degree of damage +**	**Description of typical and likely forms of repair for typical masonry buildings**	**Approx. crack width* (mm)**	**Max. tensile strain %**
0	Negligible	Hairline cracks		< 0.05
1	Very slight	Fine cracks easily treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in exterior visible upon close inspection	0.1 to 1.0	0.05 to 0.075
2	Slight	Cracks easily filled. Redecoration probably required. Several slight fractures inside building. Exterior cracks visible; some repainting may be required for weathertightness. Doors and windows may stick slightly	1 to 5	0.075 to 0.15
3	Moderate	Cracks may require cutting out and patching. Recurrent cracks can be masked by suitable linings. Tuck pointing and possible replacement of a small amount of exterior brickwork may be required. Doors and windows sticking. Utility services may be interrupted. Weather tightness often impaired	5 to 15 or a number of cracks greater than 3	0.15 to 0.3
4	Severe	Extensive repair involving removal and replacement of walls especially over door and windows required. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some	15 to 25 but also depends on number of cracks	> 0.3

		loss of bearing in beams. Utility services disrupted.		
5	Very Severe	Major repair required involving partial or complete reconstruction. Beams lose bearing, walls lean badly and required shoring. Windows broken by distortion. Danger of instability	Usually > 25 but depends on number of cracks	

+ In assessing the degree of damage, account must be taken of its location in the building or structure.
* Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Burland, J.P. and Wroth, C.P., Settlement of Buildings and Associated Damage, Proceedings of a Conference on the Settlement of Structures, Cambridge, 1974, pp 611 – 54 and 764 – 810;

Table 1: Building Damage Classification

3.2 The heritage value of a Listed Building should be considered during the initial assessment by reviewing the sensitivity of the building structure and of any particular features together with the initial assessment calculations. The heritage assessment examines the following:

a) the sensitivity of the building / structure to ground movements and its ability to tolerate movement without significant distress. The potential for interaction with adjacent buildings / structures is also considered. A score within the range of 0- 2 should be allocated to the building/structure in accordance with the criteria set out in Table 2;

b) the sensitivity to movement of particular features within the building / structure and how they might respond to ground movements. A score within the range of 0-2 should be allocated to the building in accordance with the criteria set out in Table 2.

The scores for each of the two categories (a) and (b) should be added to the category determined in paragraph 3.1 to inform the decision making process. In general, Listed Buildings which score a total of 3 or higher should be subject to further assessment as part of the Stage 3 – Detailed Assessment. Buildings that score a total of 2 or less are predicted to suffer a degree of damage which may be easily repairable using standard conservation based techniques and hence no protective measures for the building’s particular features should be required. However, ultimately the professional judgement of engineering and historic building specialists should be used to determine whether additional analysis is required.

Score	**Criteria**	
	Sensitivity of the structure to ground movements and interaction with adjacent buildings	**Sensitivity to movement of particular features within the building**
0	Masonry building with lime mortar not surrounded by other buildings. Uniform facades with no particular large openings.	No particular sensitive features
1	Buildings of delicate structural form or buildings sandwiched between modern framed buildings which are much stiffer, perhaps with one or more significant openings.	Brittle finishes, e.g. tight-jointed masonry, which are susceptible to small movements and difficult to repair.
2	Buildings which, by their structural form, will tend to concentrate all their movements in one location.	Finishes which if damaged will have a significant effect on the heritage of the building, e.g. cracks through frescos.

Table 2: Scoring for Sensitivity Assessment of Listed Buildings

4.0 Stage 3 - Detailed Assessment and Mitigation Design

4.1 Project Co shall carry out detailed assessments of structures that will be affected by the works so that any monitoring works and mitigation works can be designed and implemented.

4.2 For structures at risk of exceeding Risk Category 2 (Slight) Project Co's designer shall undertake a detailed assessment (more rigorous) to determine:

a) the influence of the structure and its foundations on the predicted ground movements;

b) the volume loss at which the risk of damage to the structure (or any sensitive finishes/features) is 'slight' or better;

c) whether this volume loss may be achieved by the proposed excavation design/control measures;

d) any special control measures required to reduce the predicted damage to acceptable levels (i.e. Risk Category 2 'slight' damage category or below) such as significantly higher face pressures with EPBM tunnelling and the practicality of these;

e) the amount of ground movement that the structure (and or any sensitive finishes/features) can accommodate without exceeding Risk Category 2 or any other agreed damage level;

f) the level of residual risk if intrusive mitigation measures are not implemented.

4.3 The detailed assessments should include a number of iterations to determine how the risk of damage to a building may be reduced. Asset-specific empirical models shall be prepared successively using moderately conservative and best estimate parameters. If after these iterations the use of empirical methods do not reduce the risk of building damage to acceptable levels (i.e. Damage Category 2 ‘slight’ damage category and below), the damage assessment shall be refined by increasing the sophistication of the analysis with the aim of reducing the risk of asset damage to acceptable levels and to eliminate the asset from further assessment.

4.4 If the risk of damage cannot be shown to be reduced by detailed assessment to acceptable levels, then mitigation measures shall be designed.

4.5 The primary means of settlement mitigation shall be practical measures to control ground movement by good design and construction practice. This could include staged excavation sequences within sprayed concrete lining (SCL) works, ground treatment, face stabilisation, spiling / face dowels, increasing face pressure when using an tunnel boring machine (TBM), adopting stiffer walls/propping for rectangular shafts etc.

4.6 In the event that physical mitigation measures are still required (i.e. to control building damage to Damage Category 2 or less or to meet the third party asset Owner’s requirements), Project Co shall seek to obtain the third party asset Owner’s approval or may use TfL's powers under the Order as transferred to Project Co or as remain vested in TfL to undertake protective works.

4.7 Project Co shall also undertake a comparative risk assessment to demonstrate that the risks associated with installation/implementation of any intrusive mitigation measures (such as compensation grouting) are no worse than the risks associated with the base case.

4.8 The relevant Local Authority and English Heritage shall be consulted on the results of the Listed Building assessment reports and the proposals for protective measures, if any are required. English Heritage shall also be consulted in relation to Listed Buildings where they would normally be notified or consulted on planning applications or listed building consent applications.

4.9 When considering the need and type of protective measures for Listed Buildings, due regard should be given to the sensitivity of the particular features of the building which are of architectural or historic interest and the sensitivity of the structure of the building to ground movement. Where the assessment highlights potential damage to the features of the building which it will be difficult or impossible to repair and/or if that damage will have a significant effect on its heritage value, the assessment may recommend appropriate measures to safeguard those features either in-situ or by temporary removal and storage off-site if those with relevant interest(s) in the building consent.

4.10 The form of monitoring of Listed Buildings should be determined based on the results of the assessment process.

4.11 Where repair works are necessary they will require the consent of those with relevant interest(s) in the building.

4.12 For railway track and track support structures Project Co shall:

a) review the track surveys (including specifying additional surveys if required) and establish that ground movement can be accommodated without exceeding track standard operational tolerance in conjunction with the relevant Infrastructure Manager;

b) identify locations where fettling of the track is required pre construction and /or during construction to ensure the track geometry and clearances are acceptable.

4.13 Project Co shall prepare plans and sections showing the zone of influence of the works that is defined by ground movements exceeding 1mm.

4.14 Project Co shall develop an instrumentation and monitoring plan to validate that ground movements within the zone of influence are in accordance with design assumptions and that the infrastructure remains within acceptable limits. Project Co shall ensure that there is a clear distinction between parameters measured to confirm the change in any parameter is in accordance with the design and parameters measured to limit damage to the assets. This plan shall identify the minimum period of time required to obtain base line data for each monitoring point. Instrumentation adjacent to the railway, which will remain in place during traffic hours, shall conform to the Standards of the asset Owner.

Note: A competent engineer responsible for the works shall consider those factors which may influence the monitoring data and shall determine an appropriate period and frequency for baseline monitoring. This decision making process will include an element of engineering judgement to account for the possible effects of any underlying environmental trends in the assets under consideration.

4.15 Project Co shall demonstrate that the monitoring system complies with the British Tunnelling Society Monitoring Underground Construction best practice guide.

Note: A review of the monitoring system against the checklists provided in Appendix B of the BTS Monitoring Underground Construction best practice guide may be used as a tool to demonstrate compliance.

4.16 The detailed assessments shall define the control limits that need to be imposed on the TBM/SCL excavation in the zone of influence. Project Co shall state these control measures on drawings and specifications.

4.17 Project Co shall identify the critical parameters to be monitored and define the Asset Control Limits based on:

a) the ability of the asset or structure to withstand ground movement investigated during the assessments carried out in Stage 2 and 3.

b) the risk to third party operations

4.18 Project Co's designer shall link the Asset Control Limits to actions within the Emergency Preparedness Plan.

4.19 The Instrumentation and Monitoring Plan and Emergency preparedness Plan shall be agreed with the relevant third party asset Owner.

5.0 Stage 4 – Construction

5.1 Contingency plans shall be developed and agreed with third party asset Owners to cover the risks posed to the third parties before commencement of the Authorised Works.

5.2 Contingency plans shall be implemented where the results of monitoring or inspection so indicate.

5.3 Ground movement and construction progress records shall be maintained and reported in regular reviews when construction processes are taking place within the zone of influence.

5.4 Predictions and assumptions made during design in respect of both ground movement and the effects which such ground movement will have on adjacent assets shall be verified by measurement during construction.

6.0 Stage 5 – Completion and Close-out

6.1 After ground movement has stopped as confirmed by instrumentation Project Co shall prepare a "Completion Report". This shall include the following:

a) details of any modifications/mitigation measures to the existing structure;

b) graphs that show the ground movement and construction progress over time with at least 3 months duration of readings which show no change;

c) a schedule showing actual movement compared to predicted movement;

d) a schedule of defects recording only the exceptions (changes) identified during the post construction defects survey;

e) details of any remedial works undertaken; and

f) as-built records (including any temporary works remaining in situ).

Appendix C. CD&E Materials Commitments

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SILVERTOWN TUNNEL

Construction, Demolition and Excavated Materials Commitments

April 2016

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

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ABBREVIATIONS

The abbreviations, descriptions and project terminology used within this document can be found in the table below.

BMW	Biodegradable Municipal Waste
CL:AIRE	Contaminated Land: Applications In Real Environments
CD&E	Construction, Demolition and Excavation
CLP	The Classification, Labelling and Packaging
CoCP	Code of Construction Practice
DCO	Development Consent Order
DoW CoP	Definition of Waste Development Industry Code of Practice
EC	European Commission
End-use	Final use of materials after being re-used, recycled or recovered (e.g. energy, aggregates, compost)
EU	European Union
EWC	European Waste Catalogue
MMP	Materials Management Plan
PPE	Personal Protective Equipment
RSA	Receptor Site Assessment (for Excavated Materials only)
SWMP	Site Waste Management Plan
TfL	Transport for London
TML	Transport Moisture Limit
WEEE	Waste Electronic and Electrical Equipment

WRAP	Waste And Resources Action Programme

GLOSSARY

A description of key terms and project terminology used within this document can be found in the table below.

Circular economy	A circular economy is based upon extracting the maximum value from a resource whilst in use. Followed by recovering and regenerating the product or material at each subsequent phase of its life
Proximity Principle	Requirement to manage, treat and/or dispose of waste close to the source in order to reduce environmental and costs impacts

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SUMMARY

S.1.1 The Silvertown Tunnel scheme (herein after referred to as ‘the Scheme’) is a new road tunnel under the River Thames connecting the Greenwich Peninsula and Silvertown. The Scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

S.1.2 The Construction, Demolition and Excavation (CD&E) Materials Commitments document defines TfL’s overall vision, aims and commitments for the management of CD&E materials on the Scheme and the proposed measures which will be taken to record and track progress towards achieving these commitments. The commitments included within this document have been prepared for a Development Consent Order (DCO) application.

S.1.3 The aim of this document is to provide TfL’s commitments with regard to the management of CD&E materials, and are the benchmarks by which the performance of the Scheme will be assessed. The commitments presented in this document are set to be challenging but achievable and in line with applicable regulations, similar infrastructure schemes and industry benchmarks.

S.1.4 TfL is committed to achieve the following for the Scheme:

- 80% (by weight) of CD&E materials to be re-used on site or removed from site for beneficial use with an aspiration to reach 95% (by weight).
- Safely manage CD&E materials in order to minimise their impact on the environment and communities.
- Follow the self-sufficiency and the proximity principles through the local management and end-use of CD&E materials.

S.1.5 The commitments provide a clear message to stakeholders of what the Scheme sets out to achieve with regards to the management and end-use of CD&E materials.

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1 INTRODUCTION

1.1 Scheme Description

1.1.1 The Silvertown Tunnel scheme (herein after referred to as 'the Scheme') is a new road tunnel under the River Thames connecting the Greenwich Peninsula and Silvertown. The Scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

1.1.2 New portal buildings would be located close to each tunnel portal to house the plant and equipment necessary to operate the tunnel.

1.1.3 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and would help to support the funding of the construction and operation of the Silvertown Tunnel.

1.1.4 The design of the Silvertown Tunnel would include a dedicated bus/coach and HGV lane, which would provide opportunities for TfL to provide additional cross-river bus routes.

1.1.5 Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. The main construction compound would be located at Silvertown, utilising the existing barge facilities at Thames Wharf along with a new temporary jetty for the removal of spoil and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich Peninsula.

1.1.6 The Construction, Demolition and Excavation (CD&E) Materials Commitments defines the Scheme's overall objectives and commitments for the management of CD&E materials and the proposed measures which will be taken to record and track progress towards achieving these commitments. The commitments included within this document have been prepared for a Development Consent Order (DCO) application.

1.1.7 Throughout the Scheme's lifetime, CD&E materials will be generated and transported to material/waste receptor sites for their management, treatment and end-use.

1.1.8 CD&E materials (wastes) are defined under Article 3 (1) of the revised EU Waste Framework Directive[2] as 'any substance or object which the holder discards or intends or is required to discard'. It should be noted that a material being classed as a waste does not preclude it from becoming a 'non-waste', providing that it demonstrated that it has reached its 'end of waste' status (see Article 6 of the revised EU Waste Framework Directive). Within the United Kingdom, the process of demonstrating a waste has reached its end of waste status is typically demonstrated through the CL:AIRE Development of Waste Code of Practice.

1.1.9 The commitments set out within this document relate to the management and handling of waste and materials are based upon legislation and regulator guidance set out at the time of writing. Changes in regulation or its interpretation by regulating bodies may require an amendment to the commitments and aspirations. Should this be the case, then the impacts of the change shall be reviewed and the appropriate changes made.

1.2 **Vision**

1.2.1 The vision of The CD&E Materials Commitments is set out in TfL's Corporate Environmental Framework, which states:

> *"We aim to ensure that we use resources responsibly, by minimising our consumption of natural resources and encouraging the re-use and recycling of materials. The amount of waste produced increases or decreases in direct relation to the volume of maintenance or construction activities carried out as we expand our transport services. We intend to minimise waste as much as possible and reach a position where 'unwanted' materials are no longer referred to as 'waste', but are considered a potential resource."* [1]

1.3 **Objectives**

1.3.1 The objectives of The CD&E Materials Commitments document are the following:

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[1] Mayor of London (2014) 'TfL Corporate Environment Framework.'

- To provide a clear statement of TfL's commitments in relation to maximising beneficial use and conforming to the principles set forth in the waste hierarchy[2].
- To provide an outline of the waste regulatory regime of how CD&E materials will be legally managed;

1.4 Structure

1.4.1 The CD&E Materials Commitment document is structured as follows:

- *Section 2: CD&E Materials Arisings.* This section outlines the current quantities of CD&E materials in the Greater London area as well as the projected quantities for the Scheme.
- *Section 3: Waste Hierarchy.* This section outlines the principles and definitions of the waste hierarchy which directly impact the CD&E materials commitments.
- *Section 4: CD&E Materials Commitments.* This section outlines the commitments proposed for CD&E materials from the Scheme.

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[2] The EU Waste Framework Directive 2008/98/EC

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2 CONSTRUCTION, DEMOLITION AND EXCAVATED WASTE ARISINGS

2.1 Overview

2.1.1 The following section provides an overview on the quantity of materials generated from CD&E activities in the Greater London area and those projected for the Scheme.

2.1.2 These quantities are for information purposes and help provide perspective as to the contribution of materials from the Scheme compared to those projected for all schemes in the Greater London area.

Greater London Material Arisings

2.1.3 In 2012, the CD&E sector in the UK generated 100.23 million tonnes of material of which 85.24 million tonnes were generated in England[3]. In the Greater London area, the 2010 reported quantities generated by the CD&E sector were 20.5 million tonnes[4].

2.1.4 The Scheme is expected to begin construction in 2018 with an expected opening date for the tunnel of 2022/ 2023. For illustrative purposes only during this time period, it is expected that the CD&E sector in the Greater London area will be generating between 10 and 11 million tonnes of material[4] (per annum).

2.1.5 Regional estimated future CD&E waste arisings for Greater London are shown in the table below.

Table 2-1 Projected CD&E Material Quantities for Greater London area

Projected Material Quantities from CD&E Sector (tonnes per annum) [4]				
2010	2015	2020	2025	2030
9,753,000	10,203,000	10,512,000	10,736,000	11,029,000

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[3] Defra (2015), 'UK Statistics on Waste – 2010 to 2012'

[4] Greater London Authority (2011) 'Future Waste Arisings in London 2010-2031: Summary Note.'

Silvertown Tunnel Scheme Projected Material Arisings

2.1.6 The Scheme is expected to generate approximately 1,194,000 tonnes of CD&E materials throughout the construction phase, more specifically 108,000 tonnes of non-excavated materials (arisings from construction and demolition activities) and 1,086,000 tonnes of excavated material, including material dredged from the River Thames to facilitate the construction and operation of the temporary jetty and NAABSA at the Silvertown site (if required). These material quantities have been extracted from the Scheme’s up to date Cost Estimates and Site Waste Management Plan (SWMP), which has been based on the Scheme’s reference design for DCO submission.

2.1.7 The SWMP is a live (working) document which requires the relevant sections to be completed at different stages throughout the lifespan of the Scheme. The plan is used to record the management of excavated materials and waste generated. Final completion of the SWMP should occur when the construction phase is complete. Therefore, at any point during Scheme construction, sections of the SWMP will be incomplete and material types and quantities will be updated.

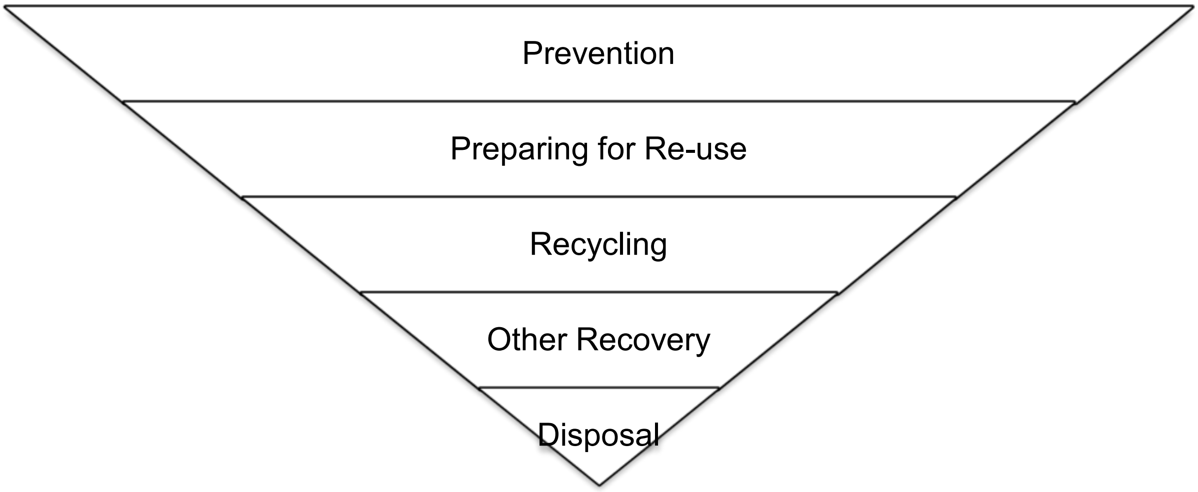
3 WASTE HIERARCHY

3.1 Waste Hierarchy Overview

3.1.1 The internationally recognised waste hierarchy, shown in the figure below is set within the revised EU Waste Framework Directive 2008/98/EC. The waste hierarchy is a widely adopted benchmark for assessing a project or an activity's environmental performance, where different waste management options and processes are prioritised into the most and least environmentally favourable alternatives. The CD&E Materials Commitments for the Scheme are based around the principles of the waste hierarchy, which prioritises waste prevention, preparing for re-use, recycling and recovery over disposal to landfill.

3.1.2 Effective management of material usage and waste, actioned through following these principles, is crucial to improving resource management and minimising environmental impact.

Figure 3-1 Waste Hierarchy



3.2 Definitions

3.2.1 Each waste management option illustrated in the waste hierarchy is described below in the order of most to least preferred with regards to its environmental impact. The revised EU Waste Framework Directive defines the waste management options from the waste hierarchy as:

- Prevention: *"Measures taken before a substance, material or product has become waste that reduce: (a) the quantity of waste, including through the* *re-use of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of harmful substances in materials and products."*

- Preparing for Re-use: *"Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing."*
- Recycling: *"Any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations."*
- Other Recovery: *"Any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II sets out a non-exhaustive list of recovery operations."*
- Disposal: *"Any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy."*

3.2.2 The waste hierarchy promotes the efficient use of material resources, reducing the amount of waste produced and reducing as far as reasonably practicable the amount of waste that falls under disposal.

3.2.3 In line with the waste hierarchy, disposal to landfill should only be a last resort, due to the range of potential adverse environmental effects and in order to conserve existing landfill capacity.

4 CONSTRUCTION, DEMOLITION AND EXCAVATED MATERIALS COMMITMENTS

4.1 Overview

4.1.1 Integral to this document are TfL's commitments, which demonstrate how waste materials are to be managed. These commitments will form part of the contract specification. The commitments also provide a means by which the performance of the contract will be assessed. The commitments presented in this document are set to be challenging, but achievable, and in line with similar infrastructure schemes and industry benchmarks. They aim to provide a clear message to stakeholders of what the Scheme sets out to achieve with regards to the management and end-use of CD&E materials.

4.1.2 The CD&E material commitments are based on a review of applicable regulations, policies, sustainability strategies and other similar sized infrastructure Schemes in London.

4.1.3 TfL is committed to achieve the following for the Scheme:

- 80% (by weight) of CD&E materials to be re-used on site or removed from site for beneficial use with an aspiration to reach 95% (by weight).
- Safely manage CD&E materials in order to minimise their impact on the environment and communities.
- Follow the self-sufficiency and the proximity principles through the local management and end-use of CD&E materials.

4.1.4 Achievement of the objectives would be assessed, by TfL using specific reporting targets.

4.1.5 The commitments for CD&E materials are discussed in further detail below. Followed by further background and details of how the commitments can be achieved.

4.2 CD&E Materials Commitment

80% (by weight) of CD&E materials to be re-used on site or removed from site for beneficial use with an aspiration to reach 95% (by weight).

4.2.1 The commitment follows the principles set forth within the waste hierarchy. For the Scheme, beneficial use is an activity that meets one of the following criteria:

- Ecological benefit or land reinstatement/landscaping: The activity will assist in ecological benefit and/or help to facilitate an approved change/alteration in land use or form.
- Works (linked to a consented planning activity or permit) that aims to restore, enhance or be part of a land management scheme i.e. landfill or quarry.
- Reduce the requirement for alternative material (waste or not) to be used for the purposes of any such Scheme.

4.2.2 In addition to the above, the beneficial use of material will pose no harm to the environment or human health.

4.2.3 In support of this commitment a Receptor Site Assessment (RSA) is currently underway and will be completed prior to the commencement of construction. The purpose of the RSA is to demonstrate that the commitment is feasible and achievable, and a transparent process and methodology in the evaluation of potential sites that may receive material / waste has been followed. The methodology allows both TfL and any third parties appointed by TfL to use this RSA process to determine whether a facility is suitable to receive materials / wastes generated by the Scheme in order that this commitment can be met. The methodology used in the Receptor Site Assessment has been included within the Environmental Statement (Document Reference 6.1).

4.2.4 The commitment is based on the anticipated quantities and composition of material. For materials that cannot be re-used, recycled or recovered by the Scheme, these would need to be transported to an externally managed and appropriate facility.

4.2.5 TfL's Corporate Environmental Framework states that "We will continue to minimise generation of waste as far as possible." [5] As per TfL's commitment, the prevention of waste generation from the Scheme will be prioritised through the development of an efficient design, sustainable procurement of materials and seeking opportunities through the waste hierarchy.

4.2.6 The waste hierarchy prioritises prevention as the preferred waste management option (see Section 3). Even though prevention of material generation will be prioritised, there will be unavoidable generation of CD&E material during the construction phase of the Scheme.

4.2.7 At a minimum, 80% (by weight) of the Scheme's CD&E materials equates to approximately 940,000 tonnes (as per Section 2).

4.2.8 In addition, there is a Scheme aspiration for 95% (by weight) of CD&E materials to be made available to other schemes where the material can be used for beneficial use (where possible and/ or technically feasible). This aspiration is in line with The London Plan[6] which states that "95% recycling/ re-use of construction, demolition and excavation waste by 2020."

4.2.9 As the design of the Scheme progresses, materials will be identified for which a higher recycling and re-use rate may be achieved, if technically and economically feasible.

4.2.10 In line with TfL's Corporate Environmental Framework[5] adherence to this commitment, and the aspiration of 95% may help to create innovative solutions for reducing wastes or its beneficial use.

4.2.11 As per the Duty of Care obligations (the (Environmental Protection (Duty of Care) Regulations 1991), all CD&E materials will be tracked from their origin to their final destination, including information on the quantities, classification and end destination.

4.2.12 Diversion from the disposal of waste will be achieved using one or more of the following industry best practices, as appropriate for the type of waste material produced:

- *Site Waste Management Plans (SWMPs):* Adopting this best practice allows for the efficient management of materials and waste generated and transported. The SWMP helps to highlight materials and waste streams that could be more efficiently managed, for example redirecting recyclable/

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[5] Mayor of London (2014) 'TfL Corporate Environment Framework.'

recovered resources back to the manufacturing process, redirect usable materials to appropriate sites, and identifying materials and their adequate treatment to minimise impacts to the environment. The SWMPs is a live document which is regularly updated by the contractors of the Scheme. It helps to plan for the management of materials generated by CD&E activities as well as for recycling, re-use and recovery. Further details about the Scheme's SWMP can be found in the Site Waste Management (Appendix to Document Reference 6.10).

4.2.13 The SWMP will be the principal method of monitoring progress against the commitment. The details of which should be reported in line with the Code of Construction Practice (CoCP) (Document Reference 6.10).

- *Receptor Site Assessment (for Excavated Materials) (included within the Chapter 13 of the Environmental Statement (Document Reference 6.1):* used to identify and assess the receptor sites which will be suitable for receiving and managing the excavated materials generated from the Scheme. The criteria used in the assessment have been developed to ensure that the sites conform to the vision and commitments detailed in this document. The RSA takes a range of sites (facilities) and provides a clear scoring system to the capabilities and functions of each site. Sites that are considered to recycle, re-use etc. score higher than those who dispose (landfill) material.

Monitoring

4.2.14 Progress in achieving the commitment will be monitored through population of the SWMP with the 'actuals' in terms of volume of waste produced and its end destination regularly recorded within the SWMP.

4.2.15 At defined periods the SWMP can be presented to TfL to evidence the Contractors progress. The issue of the SWMP will help to track progress in achieving (or exceeding) the commitment.

4.2.16 Should the information contained within the SWMP (and any other information the Contractor may present) indicate that the commitment would not be met then a 'Remedial Action Plan' may need to be prepared. This plan would be prepared by the Contractor following liaison with TfL.

4.3 CD&E Environment and Communities Commitment

Safely manage CD&E materials in order to minimise their impact on the environment and communities.

4.3.1 The safe management of CD&E materials from the Scheme will be implemented through a range of industry best practices in order to minimise the materials' impact on the environment and communities.

Measuring Safe Management of Materials

4.3.2 The safe management of CD&E materials will be achieved by using one or more of the following best industry practices along with liaison with stakeholders.

- *Code of Construction Practice (CoCP*): The purpose of the CoCP is to set a framework to control possible impacts arising from the construction of a Scheme. The CoCP covers environmental, public health and safety aspects that may affect the interests of local residents, businesses, the general public and the surroundings in the vicinity of the Scheme. The control measures set out in the CoCP are based on the findings set out in the Environmental Statement.
- *The CL:AIRE Definition of Waste Development Industry Code of Practice (DoW CoP):* demonstrating 'safe' in terms of limiting risks the environment and human health, the DoW CoP is used (where applicable) in order to maximise the re-use of excavated materials in a safe and efficient manner. The objective of the DoW CoP is to implement good industry practice (on a case by case basis) for classifying excavated materials which reached 'end of waste' status, as per the revised EU Waste Framework Directive 2008/98/EC. DoW CoP also provides a detailed step by step process to demonstrate that the requirements set within the DoW CoP has been followed and encourages the use of industry best practices, such as using a Materials Management Plan (MMP) for the materials generated on site, basing the MMP on a risk assessment, and demonstrating the use of the MMP in a Verification Report. Should the DoW CoP be used, the CoCP imposes a requirement upon the contractor to produce an MMP in liaison with relevant stakeholders.

- *Transportable Moisture Limit (TML):* defined in The Merchant Shipping (Carriage of Cargoes) Regulations 1999 as the 9/10ths (or 90%) of the flow moisture point. This limit sets the standard for accepting cargoes which may liquefy for marine transport. Cargoes with a moisture content above the TML will not be transported by barge unless *"appropriate safety arrangements are made to the satisfaction of the Certifying Authority to ensure adequate stability in the case of cargo shifting, and the ship has adequate structural integrity."* Details of the commitments relating to the river transport of CD&E materials are set out within the CoCP.

4.4 Self Sufficiency Commitment

Follow the self-sufficiency and the proximity principles through the local management and end-use of CD&E materials.

4.4.1 The self-sufficiency and proximity principles are established in the revised EU Waste Framework Directive 2008/98/EC, which states that waste should be *"recovered in one of the nearest appropriate installations, by means of the most appropriate methods and technologies, in order to ensure a high level of protection of the environment and public health."*

4.4.2 These principles are also shared in the Mayor of London's 2015 London Plan which state that "London should manage as much of the capital's waste within its boundaries as practicable, enabling London and Londoners to receive environmental and economic benefits from its management."[6]

Measuring Self-Sufficiency and Proximity

4.4.3 Transport of CD&E materials to the nearest receptor sites will be a key aspect of meeting this commitment and forms part of the RSA methodology which the Contractor will be required to comply with as part of the CoCP (Document Reference 6.10). The nearest receptor sites which are the most suitable for the management and end-use of the excavated materials will be identified through the RSA. Based on the RSA methodology, receptor sites that are closer to the scheme would be attributed a higher score and would therefore rank more favourably than others at a greater distance.

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[6] Mayor of London (2015) 'The London Plan'

4.4.4 The RSA will be used to identify and assess the receptor sites which will be suitable for receiving and managing the excavated materials generated from the Scheme. The criteria used in the assessment have been developed to ensure that the sites conform to the vision and commitments detailed in this document

4.4.5 This criteria helps ensure the commitment to self-sufficiency and proximity for the management and end-use of CD&E materials is being met for the Scheme.

4.4.6 Permit or exemption details of all sites that have the potential to receive the excavated materials generated during the Scheme will be checked as part of the RSA methodology document to ensure all sites are legally complaint. It is recommended that such compliance is verified prior to any materials being sent to the receptor sites.

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5 CONCLUSION

5.1.1 The CD&E Materials Commitments document identifies the commitments for the Scheme in order to minimise impact on the environment and communities.

5.1.2 Through a review of applicable regulations, policies, sustainability strategies and other similar sized infrastructure projects in London, a list of commitments have been developed commensurate with TfL and the Mayor of London's sustainability visions.

5.1.3 Commitments for the Scheme are:

- 80% (by weight) of CD&E materials to be re-used on site or removed from site for beneficial use with an aspiration to reach 95% (by weight).
- Safely manage CD&E materials in order to minimise their impact on the environment and communities.
- Follow the self-sufficiency and the proximity principles through the local management and end-use of CD&E materials.

5.1.4 The performance of the Scheme in line with the commitments will be measured as outlined in the CoCP. They will also prioritise maximising re-use, recycling and recovery in order to help drive innovative solutions to finding beneficial uses for the materials and reduce their impact on the environment and communities.

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Appendix D. Receptor Site Assessment

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SILVERTOWN TUNNEL

Methodology

Receptor Site Assessment (for Excavated Materials)

TR010021

October 2016

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

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Silvertown Tunnel

TR010021
Methodology
Receptor Site Assessment (for Excavated Materials)

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Document Reference: 6.10
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Regulation Number: 5(2)(Q)
Author: Transport for London

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0	29/04/16	David Rowe (TfL Lead Sponsor)	[redacted]	
1	01/11/2016	David Rowe (TfL Lead Sponsor)	[redacted]	

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List of Abbreviations

AQMA	Air Quality Management Areas
CCS	Compliance classification scheme
CD&E	Construction, Demolition and Excavation
CL:AIRE	Contaminated Land: Applications in Real Environments
DCO	Development Consent Order
Defra	Department of Environment, Food and Rural Affairs
EMOA	Excavated Materials Options Assessment
FOI	Freedom of Information
GHG	Greenhouse gases
HMRC	HM Revenue and Customs
HSE	Health, safety and environmental
km	Kilometres
m	Metres
N / A	Not applicable
Opra	Operational Risk Appraisal
PM	Particulate matter
RSA	Receptor Site Assessment (for Excavated Materials)

Glossary of Terms

Contractor	Anyone who directly employs or engages construction workers or manages construction work. Contractors include sub-contractors, any individual self-employed worker or a business that carries out, manages or controls construction work.
Detailed Options Assessment	A phase of the Receptor Site Assessment which assesses the receptor sites on the short list in more detail. The output is a preferred list of suitable receptor sites that meet the principles as outlined in the methodology. Each receptor site is scored against the criteria in each principle, with successful sites being included on the preferred list and remaining sites in the reserve list.
Excavated Material	Ground or other material removed during a construction process, usually by mechanical means.
Proximity Principle	Managing, treating and / or disposing of materials close to the material source in order to reduce environmental and costs impacts.
Receptor Site Assessment	A phased methodology and evaluation criteria to assess suitable sites to receive, treat and/or dispose of the excavated materials from the Scheme. The methodology provides a transparent process to stakeholders to ensure that the excavated material will be managed and treated with the least impact to the environment and communities.
Development Consent Order	The means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects. This includes energy, transport, water and waste projects.
List of Waste	A series of waste classification codes for all hazardous and non-hazardous wastes. List of Waste codes are often referred to as European Waste Catalogue codes.
Preliminary Viability Assessment	A phase of the Receptor Site Assessment which assesses the long list against high level criteria in order to identify a short list of potentially suitable receptor sites

	for the excavated materials from the Scheme
Reserve List	Receptor sites that fail to successfully pass the Detailed Options Assessment but may become viable/ suitable prior to construction starting.
The Scheme	The construction of a new bored tunnel under the River Thames between the Greenwich Peninsula and Silvertown, as well as necessary alterations to the connecting road network and the introduction of user charging at both Silvertown and Blackwall tunnels.
Transport for London (TfL)	A London government body responsible for most aspects of the transport system in Greater London. Its role is to implement transport strategy and to manage transport services across London. These services include: buses, the Underground network, Docklands Light Railway, Overground and Trams. TfL also runs Santander Cycles, London River Services, Victoria Coach Station and the Emirates Air Line. As well as controlling a 580km network of main roads and the city's 6,000 traffic lights, TfL regulates London's private hire vehicles and the Congestion Charge scheme.

SUMMARY

S.1.1 The Silvertown Tunnel scheme (herein after referred to as 'the Scheme') is a new road tunnel under the River Thames connecting the Greenwich Peninsula and Silvertown. The Scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

S.1.2 The Scheme aims to minimise disposal to landfill and promote safe management of materials at local facilities. In order to achieve this, a Receptor Site Assessment (for Excavated Materials) will be undertaken in order to identify the most suitable sites to receive, treat and/or dispose of the excavated material.

S.1.3 The Receptor Site Assessment (for Excavated Materials) follows a standardised methodology and evaluation criteria which meets the vision and commitments set forth within the Scheme's Construction, Demolition and Excavated Materials Commitments document (Appendix to Document Reference 6.10). It also provides a transparent process to stakeholders in order to ensure that the excavated material will be managed and treated with the least impact to the environment and communities.

S.1.4 A step by step process will be used in order to develop a preferred list of receptor sites which are the most suitable for receiving, treating and/or disposing of the incoming material from the Scheme.

S.1.5 The Receptor Site Assessment consists of four key steps:

1. The development of a long list of receptor sites which encompasses all possible receptor sites for the excavated materials from the Scheme;
2. A Preliminary Viability Assessment to assess the long list against high level criteria in order to identify a short list of potentially suitable receptor sites for the excavated materials from the Scheme;
3. A Detailed Options Assessment to assess the short list against a more detailed set of criteria in order to identify a preferred list of

suitable receptor sites for the Scheme’s excavated material. A reserve list is generated from sites that fail to successfully pass through the Detailed Options Assessment but may become viable/ suitable prior to construction; and

4. The preferred list is used by contractors tendering for the Scheme.

S.1.6 Transport for London (TfL) aims to minimise disposal by only using receptor sites which meet or exceed the criteria presented in The Receptor Site Assessment (for Excavated Materials) for the Scheme.

S.1.7 This document is intended to support the application for Development Consent Order for the Scheme. The Receptor Site Assessment (for Excavated Materials) methodology will be completed prior to the commencement of construction.

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1. INTRODUCTION

1.1 Overview

1.1.1 The Silvertown Tunnel scheme (herein after referred to as ‘the Scheme’) is a new road tunnel under the River Thames connecting the Greenwich Peninsula and Silvertown. The Scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

1.1.2 New portal buildings would be located close to each tunnel portal to house the plant and equipment necessary to operate the tunnel.

1.1.3 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and would help to support the funding of the construction and operation of the Silvertown Tunnel.

1.1.4 The design of the Silvertown Tunnel would include a dedicated bus/coach and HGV lane, which would provide opportunities for TfL to provide additional cross-river bus routes.

1.1.5 Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. The main construction compound would be located at Silvertown, utilising the existing barge facilities at Thames Wharf along with a new temporary jetty for the removal of spoil and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich Peninsula.

1.1.6 A large portion of the material that will be generated during the construction phase of the Scheme will be excavated material. The Scheme aims to minimise disposal to landfill and promote the safe management of materials at local facilities. As such a Receptor Site Assessment (for Excavated Materials) (herein after referred to as ‘RSA’) has been developed in order to identify the most suitable sites to receive, treat and/or dispose of the excavated material.

1.2 Aim

1.2.1 The aim of the RSA is to produce a list of preferred receptor sites for the excavated material produced by the Scheme.

1.2.2 The RSA provides a standard methodology and evaluation criteria which should be used in conjunction with the requirements and commitments set forth within the CD&E Materials Commitments document (Appendix to Document Reference 6.10). The RSA also provides a transparent process to stakeholders to ensure that the excavated material will be managed and treated commensurate with the least impact to the environment and communities.

1.2.3 The RSA uses a phased approach to develop a list of receptor sites which may be suitable to receive, treat and/or dispose of the CD&E materials from the Scheme. The approach is as follows:

1. The development of a long list of sites which encompasses all possible receptor sites for the excavated materials from the Scheme;
2. A Preliminary Viability Assessment to assess the long list against high level criteria in order to identify a short list of potentially suitable receptor sites for excavated materials;
3. A Detailed Options Assessment to assess the short list against a more detailed set of criteria in order to identify a preferred list of suitable receptor sites for the Scheme’s excavated material. A reserve list is generated from sites that fail to successfully pass through the Detailed Options Assessment but may become viable / suitable prior to construction starting; and

1.2.4 The preferred list is taken forward and used by contractors tendering for the Scheme. Further to the Code of Construction

Practice, TfL will require the use of receptor sites which meet or exceed the criteria presented in this document.

1.2.5 In the instance that suitable sites on the preferred and reserve list are not available, or materials cannot be placed at a suitable facility either on site (subject to necessary consents and licences) or on these lists, or they do not allow for the Contractor to meet other commitments outlined by TfL, Contractors should assess receptor sites beyond the 100km radius criteria (including transfrontier sites) using the RSA methodology. For transfrontier sites, the effect of local legislation should be taken into account when applying the RSA methodology and evaluation criteria.

1.2.6 It is important to note that although this RSA relates to excavated material from the Scheme only, this methodology can also be applied (if necessary) to identify receptor sites for other materials, such as construction and demolition materials.

1.2.7 The RSA methodology identifies available receptor sites of potential suitability at the time of assessment and it is likely that other sites may become available before construction commences. Sites that fail to successfully pass through the Detailed Options Assessment but could potentially pass in the future (e.g. due to pending permit applications or land acquisition) will be placed onto the reserve list.

1.2.8 This document is intended to support the application for Development Consent Order (DCO) for the Scheme.

1.3 Principles

1.3.1 The seventeen principles presented below (see Table 1-1) provide the overarching criteria used to evaluate the receptor sites. They have been divided into four categories which address impacts to the environment and the public, promote sustainable transport options and evaluate the capability and operations of the receptor sites.

1.3.2 The methodology used to address these principles is described in more detail in Section 2.

Table 1-1 The Principles used in the Receptor Site Assessment

Category	Principle
Environment	1. To follow the waste hierarchy.
	2. To address and reduce contribution to climate change.
	3. To reduce impact on air quality and noise.
	4. To protect the quality of water.
	5. To protect and enhance biodiversity.
	6. To ensure efficient use of land and resources.
	7. To protect cultural heritage.
Public	8. To protect local public amenities.
	9. To reduce visual impact on surrounding areas.
	10. To provide opportunities for a diverse workforce.
Transport	11. To promote sustainable transportation.
	12. To manage materials locally, as per the proximity principle.
Operations	13. To identify receptor sites with suitable capacity and operational capability.
	14. To use receptor sites with appropriate permits or exemptions.
	15. To ensure health and safety guidelines are followed.
	16. To ensure legal compliance.
	17. To develop solutions which minimise costs.

1.3.3 The principles are discussed in more detail below.

Environment

1.3.4 The principles included within the environment category address the impacts that the receipt (and treatment if required) of the incoming material to a waste facility may have on the environment and communities.

To follow the waste hierarchy

1.3.5 Receptor sites are assessed based on the waste hierarchy which prioritises prevention of waste followed by re-use, recycle, recover and disposal. In this case, waste prevention does not apply since the waste is already generated by the time it reaches the receptor site. Preference is given to sites which re-use, recycle and recover materials rather than those which dispose of the materials.

To address and reduce contribution to climate change

1.3.6 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on greenhouse gas emissions and climate change. This criteria includes the greenhouse gas emissions from the site operations as well as the transport of the material from the Scheme to the receptor site.

To reduce impact on air quality and noise

1.3.7 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on air emissions (e.g. dust, pollutants), noise and vibration levels which may cause harm and/ or nuisance to the surrounding areas. This includes a review of the site's air quality management plan.

To protect the quality of water

1.3.8 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on water quality. This includes an evaluation on the site's proximity to surface water bodies and groundwater, contamination pathways and risks to the receptors in the surrounding areas.

To protect and enhance biodiversity

1.3.9 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on local habitats in the short and long term. This includes an evaluation on the site's proximity and impact on international, national and local nature conservation sites.

To ensure efficient use of land and resources

1.3.10 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on the land uptake or footprint of the receptor site and surrounding areas.

To protect cultural heritage

1.3.11 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on designated cultural heritage sites. This includes an evaluation on the site's proximity and impact on international, national and local cultural heritage sites.

Public

1.3.12 The principles included within the public category address the impacts that the receipt/treatment/disposal of the incoming material may have on public amenities, heritage, land and employment.

To protect local public amenities

1.3.13 Receptor sites are assessed based on the impact the receiving material and the site's operations will have on public amenities. Public amenities are defined as complimentary, benefits, resources and facilities provided to the general public (e.g. public toilets, recreational areas, parks, open spaces.)

To reduce visual impact of surrounding areas

1.3.14 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on changes in the fabric, character and quality of the landscapes, as well the availability of views.

To provide opportunities for a diverse workforce

1.3.15 Receptor sites are assessed based on the impact the receipt/treatment/disposal of the incoming material has on the number of jobs at the receptor site. This includes an evaluation on the site’s commitment to employing a diverse workforce.

Transport

1.3.16 The principles included within the transport category address the extent to which the transportation of the receipt/treatment/disposal of the incoming material promotes sustainability.

To promote sustainable transportation

1.3.17 Receptor sites are assessed based on their ability to receive material from various modes of transportation, including rail, river and road. Preference is given to receptor sites which have marine and rail access compared to road access only.

To manage materials locally, as per the proximity principle

1.3.18 Receptor sites are assessed based on their distance to the Scheme site. The proximity principle is the concept of treating and/ or disposing of materials at the closest point to the point of generation in order to minimise cost, carbon and impact on the environmental and communities.

Operations

1.3.19 The principles included within the operations category address the operational capability of the receptor sites to receive, treat and/or dispose of the incoming material.

To identify receptor sites with suitable capacity and operational capability

1.3.20 Receptor sites are assessed on the available capacity to receive, treat and/or dispose of the incoming material in the short and long term. This includes available storage space and equipment capability to handle the required volumes of incoming material.

To use receptor sites with appropriate permits or exemptions

1.3.21 Sites are assessed on having the necessary documentation to receive, treat and/or dispose of the incoming material. This includes (but is not limited to) having adequate permits or exemptions.

To ensure health and safety guidelines are followed

1.3.22 Receptor sites are assessed on meeting health and safety good practices when receiving/treating/disposing of the incoming material.

To ensure legal compliance

1.3.23 Receptor sites are assessed on their compliance with applicable regulations and an evaluation of their history of enforcement notices/cautions issued by the Environment Agency and/or decisions made by the Magistrates or Crown Court.

To develop solutions which minimise costs

1.3.24 Receptor sites are assessed on their consideration of cost minimisation during the receipt/treatment/disposal of incoming material at the receptor site.

2. METHODOLOGY

2.1 Overview

2.1.1 The Receptor Site Assessment (for Excavated Materials) uses a standardised methodology and evaluation criteria which meets the vision and commitments set forth within the Scheme's Construction, Demolition and Excavated Materials Commitments document (Appendix to Document Reference 6.10). It also provides a transparent process to stakeholders in order to ensure that the excavated material will be received, treated and/or disposed of with the least impact to the environment and communities.

2.2 Assumptions

2.2.1 The following assumptions are made throughout the Preliminary Viability Assessment:

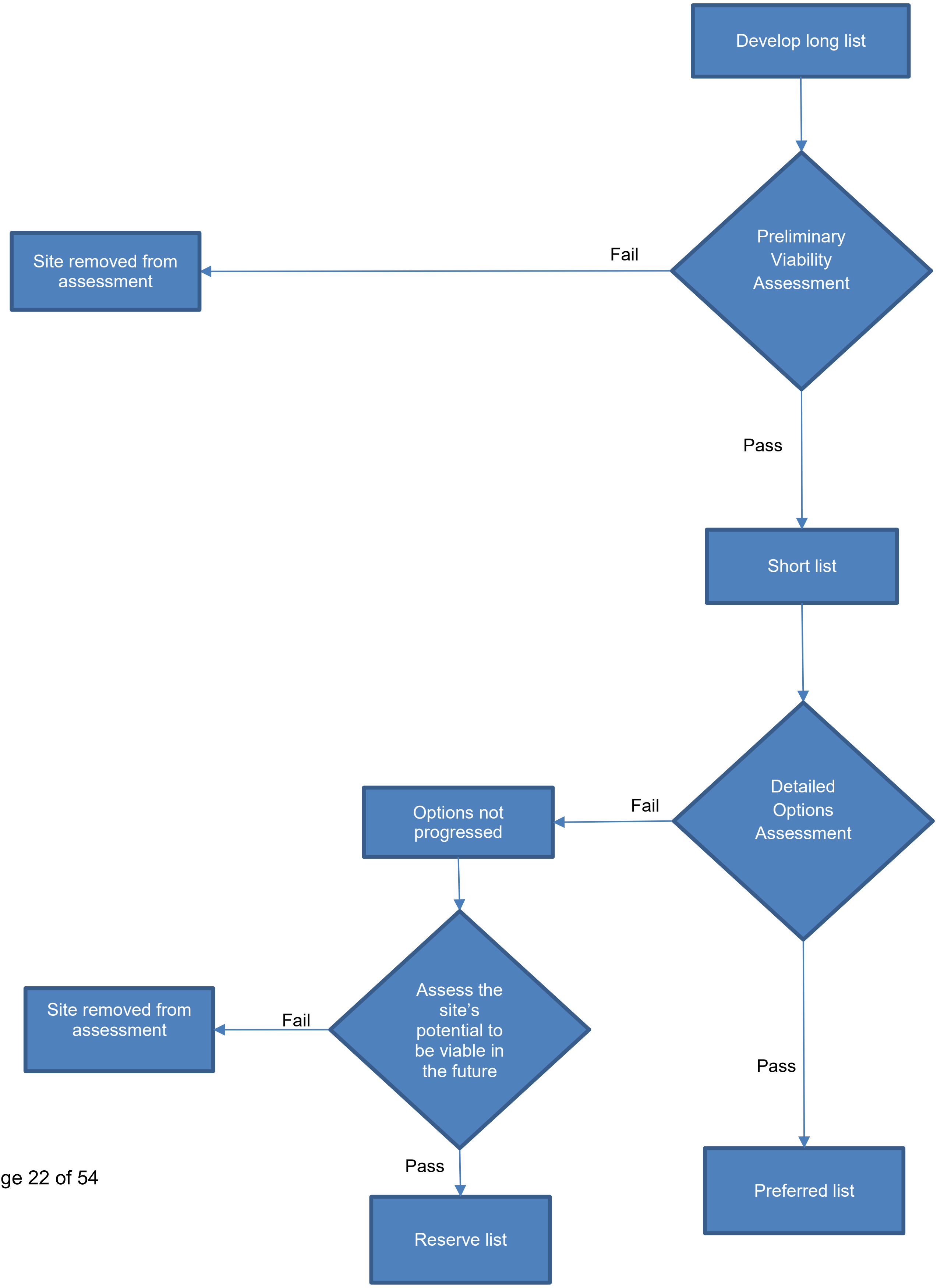
- Materials arising from the Scheme will be separated at source;
- As per the proximity principle, only receptor sites which are within 100 km radius of the Scheme will be evaluated, unless such sites are unavailable and a receptor site is available at a greater distance beyond 100 km;
- New receptor sites, which may be available after the assessment is complete, are not included;
- Material quantities and composition may change following the development of the Scheme's detailed design completion and contract appointment; and
- Scheme timescales may change following the development of the Scheme's detailed design, completion and contract appointment.

2.3 Methodology Overview

2.3.1 Figure 2-1 provides an overview of the steps which will be followed in the RSA's methodology. The key steps which will be undertaken include:

- **Develop long list:** Develop a long list of sites which will encompass all possible receptor sites for the excavated materials from the Scheme;
- **Preliminary Viability Assessment:** This stage assesses the long list against high level criteria in order to identify a short list of potentially suitable receptor sites. The assessment consists of a series of basic requirements which may determine the operational suitability of the receptor site. Sites that pass through this assessment are included on the short list;
- **Detailed Options Assessment:** Receptor sites on the short list are taken through a more detailed assessment in order to identify a preferred list of suitable receptor sites. The assessment will use the principles as outlined in Section 1.3 as criteria to determine the receptor site's suitability to receive, treat and/or dispose of material and any impacts to the facilities environment and communities. Each receptor site will be scored against the criteria, with successful sites being included on the preferred list; and
- **Preferred list and reserve list:** The preferred list of receptor sites is used by contractors tendering for the Scheme. A reserve list of receptor sites will be generated from sites that fail to successfully pass the Detailed Options Assessment but may become viable/ suitable prior to construction starting.

Figure 2-1: Overview of Methodology



2.4 Step 1: Develop Long List

2.4.1 The first step of the assessment aimed to develop a long list of sites which will encompass all possible receptor sites that may receive, treat and/or dispose of the excavated materials from the Scheme (i.e. sites that either hold an environmental permit or registered with an exemption).

2.4.2 In order to conform to the proximity principle, a criteria of 100 km radius from the Scheme was used to identify a list of potential receptor sites. This ensured that the search was focused on receptor sites within London, the east and the south east of England. No other pre-considerations relating to the suitability of the sites (cost, capacity, etc.) or environmental impacts were applied. For organisations which operate more than one potential receptor site, each site was recorded separately on the list.

2.4.3 The Environment Agency's list of permitted and exempt facilities[1] was used as the main source for the creation of the long list.

2.4.4 Sites which receive, treat and/or dispose of materials which were not relevant to the Scheme were also removed from the long list. Examples of receptor sites which were excluded from the long list include sites which process single waste streams not associated with 'soil and stones', such as electrical and electronic appliances, clinical wastes, and metals.

2.4.5

2.5 Step 2: Preliminary Viability Assessment

2.5.1 The second stage of the assessment aims to evaluate the operational capacity and high level viability of the receptor sites identified in the long list. This stage of the assessment aims to remove all sites that fail to comply with basic requirements of viable receptor sites.

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[1] Environment Agency 'Waste Data Interrogatory'.

2.5.2 The criteria which will be used in the Preliminary Viability Assessment include:

- **Criteria 1: Receptor Site Capacity.** The capacity of the receptor site to receive, treat and/or dispose of volumes of excavated material in excess of 200,000 tonnes). Capacity refers to the total (originally permitted) capacity of the sites, without considering the available capacity (or void space) remaining at the sites. For permitted sites, capacity information is found in the environmental permit issued by the Environment Agency. For exempt sites, capacity information is dependent upon the exemption type.
- **Criteria 2: Validity of Permit/ Exemption**. The operator holds a valid permit or exemption, which allows them to receive, treat and/or dispose of the principal excavated material type(s), i.e. soil and stones. The sub-criteria below is used to assess a valid permit or exemption;

Table 2-1 Permit/ Exemption Validity Sub-Criteria

Permit/ Exemption	Sub-Criteria
Permitted sites	An assessment of either the environmental permit or any recent variation will be undertaken to establish if the receptor site is licenced to receive, treat and/or dispose of the following: • Inert and Non-hazardous (non-inert) soils and stones (List of Waste (LoW) Code: 17 05 04); • Hazardous soils and stones (LoW Code: 17 05 03*). These excavated materials streams are the two LoW codes identified in the Site Waste Management Plan (SWMP) (Appendix to Document Reference 6.10). Receptor sites which are permitted to receive, treat and/or dispose of either 17 05 04 only or 17 05 04 and 17 05 03* will be taken through to next stage of the assessment.
Exempt sites	A list of sites with exemptions can be obtained from the Environment Agency and filtered by the

Permit/ Exemption	Sub-Criteria
	paragraph number, as outlined in Schedule 3 of The Environmental Permitting (England and Wales) Regulations 2010. Only sites with the following paragraph numbers are taken forward as they demonstrate receptor sites which could receive, treat and/or dispose of the materials likely to be produced from excavation (LoW codes 17 05 04 and 17 05 03*). • Disposal of Waste - D5 - Depositing waste samples for testing or analysis; • Treating Waste - T5 - Screening and blending waste; • Use of Waste - U1 - Use of waste in construction; • Use of Waste - U8 - Using waste for a specified purpose; • Use of Waste - U10 - Spreading waste to benefit agricultural land; and • Use of Waste - U11 - Spreading waste to benefit non-agricultural land. Storage of Waste exemptions were not considered as they apply to the temporary storage of waste only, and not at the point of production.

Note that any waste marked with an asterisk (*) is considered as a hazardous waste pursuant to Article 1(4), first indent, of Directive 91/689/EEC on hazardous waste, and subject to the provisions of that Directive unless Article 1(5) of that Directive applies.

- **Criteria 3: Receptor Site Availability:** The anticipated availability of the receptor site to receive, treat and/or dispose of the excavated material during the Scheme's construction (from year 2019 specifically).

If receptor sites state they plan to create additional space to remain operational in / beyond 2019, they remain on the short list.

- **Criteria 4: Enforcement Notices, Court Cases and Cautions.** Any enforcement notices, court cases (assumed to mean guilty by the Crown Prosecution Service in either a Magistrates Court or the Crown Court) and cautions will be gathered from the Environment Agency public register database[2]. The following information will be gathered for each site: appropriate reference numbers, applicable date(s), a summary description and the act/action issued. This criteria would not preclude sites from being taken to the short list and the outcomes will be subject to further assessment during the Detailed Options Assessment.
- **Criteria 5: Receptor Site Accessibility.** The receptor site is accessible via road (i.e. lorry), water (i.e. barge) and / or rail (defined by distances to the nearest rail head/jetty defined by road travel). This criteria would not preclude a receptor site from being taken to the short list and the outcomes will be subject to further assessment during the Detailed Options Assessment.

Table 2-2 Accessibility Evaluation Sub-Criteria

Transportation	Criteria
Road	• Accessible via road.
River	• Accessible if there is a jetty or the site has access to a jetty located within 3.2 km (2 miles) of the receptor site; • Exclude brooks, culverts and streams that are less than 2 m wide or go underground to reach a river.
Rail	• Accessible if there is a rail head or the site has access to a rail head located within 3.2 km (2 miles) of the receptor site.

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[2] Environment Agency Public Register Database,

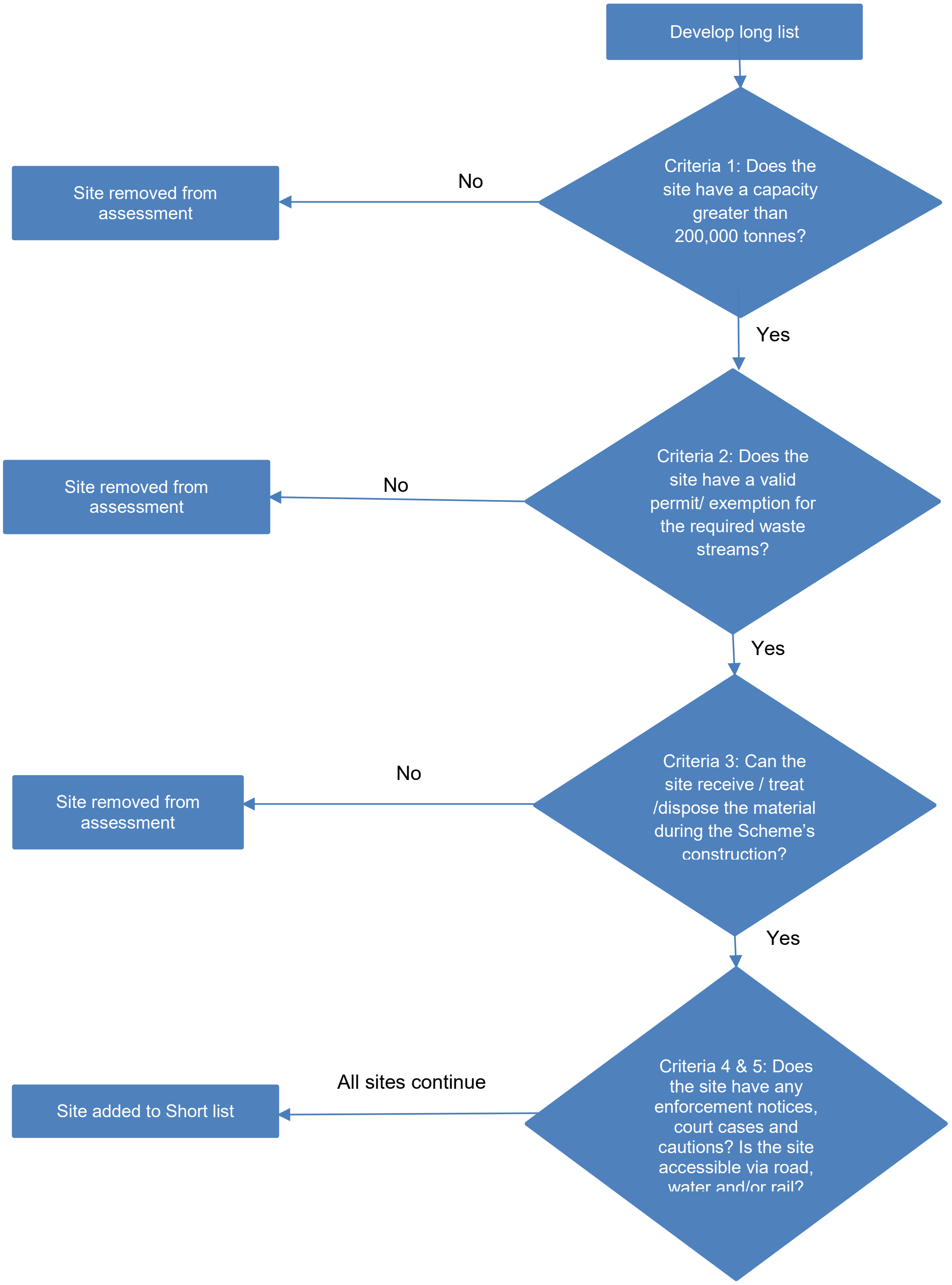
2.5.3 Information relating to each evaluation indicator will be obtained using one or more of the following:

- Web based sources and online literature;
- Direct contact (via telephone and email); and
- Information received directly from the Environment Agency (e.g. permit and licencing information).

2.5.4 Following completion of this stage all sites that pass the viability criteria listed above will be progressed onto the short list. Any sites that fail to comply with one or more of the criteria will not be progressed further unless they have the potential to become viable in the future. Future viability is measured by identifying sites which sites can meet the criteria in the future. Examples include sites which are expanding to increase capacity or sites which are in the process of applying for permits.

2.5.5 In addition, receptor sites for which evaluation information is unavailable will be progressed onto the short list, should the evaluation criteria not be available at the next stage the receptor sites will be removed. However, sites which refuse to provide information will not proceed to the next stage.

Figure 2-2: Overview of Preliminary Viability Assessment



2.6 Step 3: Detailed Options Assessment

2.6.1 All sites on the short list are taken through the Detailed Options Assessment. This is a more detailed assessment of the receptor site's suitability in relation to the seventeen principles discussed previously.

2.6.2 At this stage, the principles are expanded further to include specific criteria used to score the receptor sites. The receptor sites on the short list are given a red, amber or green colour ('traffic light' grading system), along with an additional scoring grade for each evaluation criteria (see Table 2-1 for full list of criteria and scores). Those sites that perform best progress to the preferred list based on:

- The overall score awarded to the site;
- Number of red, amber and greens awarded to each site; and
- Professional judgement as to whether any individual red grade (or combination of grades) made a particular site unsuitable.

2.6.3 All of the receptor sites on the short list will be contacted again to obtain further details to inform the Detailed Options Assessment. More in depth telephone discussions and / or face to face interviews are held with the site operators using a standard questionnaire sheet as a guide (see Appendix A). The prompt sheet is used to ensure that all relevant topics are covered and that the sites can be effectively scored against each criteria with a detailed suite of supporting information.

2.6.4 To supplement and corroborate information received from the operators, a review of the site's planning consents and environmental permits/ exemptions is undertaken. Additionally, secondary sources are used to determine the environmental baseline of the site and obtain more detailed data on site operations. Secondary sources include (but are not limited to):

- Magic website[3] (includes environmental and cultural designations, potential receptors, etc.);
- HM Revenue and Customs (HMRC) list of operators[4];
- CL:AIRE Register of Materials list of donor and receiver sites[5];
- Air Quality Management Areas (AQMA)[6];
- 'What's in my Backyard' Environment Agency tool[7] (includes flood zone areas, aquifers, permitted activities);
- Defra 'Greenhouse Gas Conversion Factor Repository[8]; and
- Other relevant documents, consents and plans.

2.6.5 Receptor sites that successfully pass through the Detailed Options Assessment by achieving the required score threshold will be placed on the preferred list. This list will contain sites that meet the Scheme's requirements with respect to the assessment principles and high level objectives detailed in the CD&E Materials Commitments document (Appendix to Document Reference 6.10). Sites that fail to meet the required score will not be included on the preferred list.

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[3] Magic, 'Map Application', http://www.magic.gov.uk/.
[4] HM Revenue & Customs, 'Landfill Site Operators'.
[5] CL:AIRE, 'Register of Materials'.
[6] Defra, 'Air Quality Management Areas'.
[7] Environment Agency, 'What's in my Backyard?'.
[8] Defra, 'Greenhouse Gas Conversion Factor Repository'.

Table 2-3 Scoring Indicators and Evaluation Criteria for the Detailed Options Assessment

Category	Principles	Indicators	Evaluation Criteria				
			- 2	**- 1**	**0**	**+ 1**	**+ 2**
Environment	1. To follow the waste hierarchy	Extent to which end-use of the material follows the principles of the waste hierarchy.	More than 50% of the incoming material will be disposed in landfill.	The incoming material will be partly recovered and partly disposed in landfill.	The incoming material will be partly recovered and partly recycled at the receptor site.	The incoming material will be partly recycled and partly reused at the receptor site.	More than 50% of the incoming material will be beneficially reused at the receptor site, with no or minimal treatment.
	2. To address and reduce contribution to climate change	Greenhouse gases (GHG) emitted through on site operations (including receipt, treatment and transportation of the incoming material).	The incoming material requires active treatment and onsite transportation and GHG emissions produced are expected to be high.	N / A	The incoming material requires minimal treatment or onsite transportation and GHG emissions produced are expected to be low.	N / A	N / A
		Extent of additional vehicle movements required once incoming material has entered the receptor site.	A significant number of vehicle movements are required once the incoming material has entered the receptor site.	A low number of vehicle movements are required once the incoming material has entered the receptor site.	Minimal vehicle movements are required once the incoming material has entered the receptor site.	N / A	N / A
		Greenhouse gases (GHG) emitted during transportation of material to receptor site. This is calculated using standard carbon factors (see Section 2.6.11)	The carbon footprint of the material transport to the receptor site is in the highest 20% compared to other receptor sites.	N / A	The carbon footprint of the material transport to the receptor site is in the 20%-80% range compared to other receptor sites.	N / A	The carbon footprint of the material transport to the receptor site is in the lowest 20% compared to other receptor sites.

Category	Principles	Indicators	Evaluation Criteria				
		Extent to which flood risk is altered by the receipt/treatment/disposal of incoming material at the receptor site, or in the local catchment.	The receipt/treatment/disposal of incoming material will significantly increase flood risk at the receptor site.	The receipt/treatment/disposal of incoming material will slightly increase flood risk at the receptor site.	The receipt/treatment/disposal of incoming material will have minimal impact on the risk from flooding at the receptor site.	N / A	N / A
	3. To reduce impact on air quality and noise	Extent to which the receipt/treatment/disposal of the incoming material generates pollutants (within the permitted limits). This excludes transport to the site.	The receipt/treatment/disposal of the incoming material are expected to significantly increase pollutants within the permitted limits.	The receipt/treatment/disposal of the incoming material are expected to slightly increase pollutants within the permitted limits.	The receipt/treatment/disposal of the incoming material are expected to have minimal impact on the generation of pollutants.	N / A	N / A
		Extent to which air quality is impacted by the receipt/treatment/disposal of incoming material at the receptor site (excluding transport) in the short and long term.	The receipt/treatment/disposal of incoming material is expected to increase pollutants in the long term.	The receipt/treatment/disposal of incoming material is expected to increase pollutants in the short term.	The receipt/treatment/disposal of the incoming material are expected to have minimal impact on the generation of pollutants.	N / A	N / A
		Extent to which the receipt/treatment/disposal of the incoming material generates noise (within the permitted limits). This excludes transport to the site.	The receipt/treatment/disposal of incoming material is expected to significantly increase noise levels at the receptor site (within permitted limits).	The receipt/treatment/disposal of incoming material is expected to slightly increase noise levels at the receptor site (within permitted limits).	The receipt/treatment/disposal of the incoming material is expected to have minimal impact on noise levels at the receptor site.	N / A	N / A

Category	Principles	Indicators	Evaluation Criteria				
		Extent to which the receipt/treatment/disposal of the incoming material generates noise in the short and long term.	The receipt/treatment/disposal of incoming material is expected to increase noise levels in the long term.	The receipt/treatment/disposal of the incoming material is expected to increase noise levels in the short term.	The receipt/treatment/disposal of the incoming material is expected to have minimal impacts on noise levels.	N / A	N / A
	4. To protect the quality of water	Extent to which surface water quality is impacted by the material receipt/treatment/disposal at the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will have adverse impacts on the local watercourses (within allowable limits).	The receipt/treatment/disposal of the incoming material at the receptor site will have slight adverse impacts on the local watercourses.	The receipt/treatment/disposal of the incoming material at the receptor site will have minimal impact on the water quality of local watercourses.	N / A	N / A
		Extent to which ground water quality is impacted by the material receipt/treatment/disposal at the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will have adverse impacts on the underlying groundwater.	The receipt/treatment/disposal of the incoming material at the receptor site will have slight adverse impacts on the underlying groundwater.	The receipt/treatment/disposal of the incoming material at the receptor site will have minimal impact on the water quality of the underlying groundwater.	N / A	N / A
	5. To protect and enhance biodiversity	Extent to which designated sites are impacted in the short and long term by the material receipt/treatment/disposal the receptor site.	The receipt/treatment/disposal of the incoming material is likely to have an adverse impact on biodiversity at the designated sites in the long term.	The receipt/treatment/disposal of the incoming material is likely to have an adverse impact on biodiversity at the designated sites in the short term.	The receipt/treatment/disposal of the incoming material will have minimal impact on biodiversity at the designated sites.	The receipt/treatment/disposal of the incoming material is likely to have a positive impact on biodiversity at the designated sites in the short term.	The receipt/treatment/disposal of the incoming material is likely to have a positive impact on biodiversity at the designated sites in the long term.
	6. To ensure efficient use of	Extent to which incoming material replaces the need for virgin material use at	N / A	N / A	The incoming material will have minimal impact on the need for virgin material use at the	The incoming material will partly replace virgin material used at the receptor site.	The incoming material will directly replace virgin material used at the receptor site.

Category	Principles	Indicators	Evaluation Criteria				
	land and resources	the receptor site.			receptor site.		
		Extent to which the efficiency of the receptor site's operations are impacted by the receipt/treatment/disposal of incoming material.	The receipt/treatment/disposal of the incoming material at the receptor site will significantly increase the use of water, electricity and/ or fuel.	The receipt/treatment/disposal of the incoming material at the receptor site will slightly increase the use of water, electricity and/ or fuel.	The receipt/treatment/disposal of the incoming material at the receptor site will have a minimal impact on additional use of water, electricity and/ or fuel.	The receipt/treatment/disposal of the incoming material at the receptor site will slightly reduce the use of water, electricity and/ or fuel.	The receipt/treatment/disposal of the incoming material at the receptor site will significantly reduce the use of water, electricity and/ or fuel.
		Extent to which incoming material will affect land take (footprint) of the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will significantly increase the overall footprint of the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will slightly increase the overall footprint of the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will have minimal impact on the overall footprint of the receptor site	The receipt/treatment/disposal of the incoming material at the receptor site will slightly decrease the overall footprint of the receptor site	The receipt/treatment/disposal of the incoming material at the receptor site will significantly decrease the overall footprint of the receptor site
	7. To protect cultural heritage	Extent to which designated sites are impacted in the short and long term by the material receipt/treatment/disposal the receptor site.	The receipt/treatment/disposal of the incoming material is likely to have an adverse impact on designated sites in the long term.	The receipt/treatment/disposal of the incoming material is likely to have an adverse impact on designated sites in the short term.	The receipt/treatment/disposal of the incoming material is unlikely to have an impact on designated sites.	The receipt/treatment/disposal of the incoming material is likely to have a positive impact on designated sites in the short term.	The receipt/treatment/disposal of the incoming material is likely to have a positive impact on designated sites in the long term.
Public	8. To protect local public amenities	Extent to which local public access are impacted by the material receipt/treatment/disposal at the receptor site.	The receipt/treatment/disposal of the incoming material at the receptor site will restrict public access in the long term.	The receipt/treatment/disposal of the incoming material at the receptor site will restrict public access in the short term.	The receipt/treatment/disposal of the incoming material at the receptor site will not restrict local public access.	The receipt/treatment/disposal of the incoming material at the receptor site will improve local public access in the short term.	The receipt/treatment/disposal of the incoming material at the receptor site will improve local public access in the long term.

Category	Principles	Indicators	Evaluation Criteria				
	9. To reduce visual impact of surrounding areas	Extent to which the surrounding areas are visually impacted in the short and long term by the receipt/treatment/disposal of incoming material.	The receipt/treatment/disposal of incoming material at the receptor site will have adverse visual impacts on the surrounding area in the long term.	The receipt/treatment/disposal of incoming material at the receptor site will have adverse visual impacts on the surrounding area in the short term.	The receipt/treatment/disposal of incoming material at the receptor site will have minimal visual impact on the surrounding area.	The receipt/treatment/disposal of incoming material at the receptor site will have positive visual impacts on the surrounding area in the short term.	The receipt/treatment/disposal of incoming material at the receptor site will have positive visual impacts on the surrounding area in the long term.
	10. To provide opportunities for a diverse workforce	Extent to which receipt/treatment/disposal of incoming material at the receptor site creates new job opportunities.	The receipt/treatment/disposal of incoming material contributes to a significant loss of jobs at the receptor site or local area.	The receipt/treatment/disposal of incoming material contributes to a slight loss of jobs at the receptor site or local area.	Receipt/treatment/disposal of incoming material will have a minimal impact on number of jobs at the receptor site or local area.	Receipt/treatment/disposal of incoming material will create a slight quantity of new job opportunities at the receptor site or local area.	Receipt/treatment/disposal of incoming material will create a significant quantity of new job opportunities at the receptor site or local area.
		Extent to which receipt/treatment/disposal of incoming material at the receptor site considers diversity of workforce.	N / A	N / A	N / A	N / A	A workforce diversity strategy is in place for the employment of a diverse work force at the receptor site.
Transport	11. To promote sustainable transportation	Extent to which sustainable forms of transport are available and considered for the receipt of incoming material at the receptor site.	The receptor site can only be accessed by road only.	N / A	The receptor site can be directly accessed by rail or marine transport but requires additional transport by road.	N / A	The receptor site can be directly accessed by rail or marine transport without the need for additional transport by road.
	12. To manage material locally,	Average distance from the excavation site to the receptor site.	N / A	The receptor site is 75 km to 100 km from the excavation site.	The receptor site is 50 km to 75 km from excavation site.	The receptor site is 25 km to 50 km from the excavation site.	The receptor site is less than 25 km from the excavation site

Category	Principles	Indicators	Evaluation Criteria				
	as per the proximity principle						
Operations	13. To identify receptor sites with suitable capacity and operational capability	Likelihood of the receptor site to conform to the project's timescales.	The receptor site will be available to receive/treat/dispose of material during less than 25% of the timescale proposed.	The receptor site will be available to receive/treat/dispose of material during 25% to 50% of the timescale proposed.	The receptor site will be available to receive/treat/dispose of material during 50% to 75% of the timescales proposed.	The receptor site will be available to receive/treat/dispose of material during 75% to 100% of the timescale proposed.	The receptor site will be available to receive/treat/dispose of material during 100% of the timescale proposed.
		The receptor site's ability to receive/treat/dispose of various types of incoming material.	N / A	N / A	The receptor site is only able to receive/treat/dispose of one type of incoming material (based on geotechnical and chemical characteristics).	The receptor site is able to receive/treat/dispose of two to four types of incoming material (based on geotechnical and chemical characteristics).	The receptor site is able to receive/treat/dispose of five or more types of incoming material (based on geotechnical and chemical characteristics).
		The receptor site's capacity to receive/treat/dispose of the volume of incoming material.	The receptor site has the capacity to receive/treat/dispose of less than 25% of the incoming material.	The receptor site has the capacity to receive/treat/dispose of 25% to 50% of the incoming material.	The receptor site has the capacity to receive/treat/dispose of 50% to 75% of the incoming material.	The receptor site has the capacity to receive/treat/dispose of 75% to 100% of the incoming material.	The receptor site has the capacity to receive/treat/dispose of 100% of the incoming material.
	14. To use receptor sites with appropriate permits /	The receptor site has the appropriate permits/ exemptions to receive/treat/dispose of and treat the incoming materials.	The receptor site does not have the appropriate permits/ exemptions to receive/treat/dispose of and treat the incoming materials. There are no plans to	The receptor site does not have the appropriate permits/ exemptions to receive/treat/dispose of and treat the incoming materials. The permit/ exemption	The receptor site has the appropriate permits/ exemptions to receive/treat/dispose of and treat the incoming materials.	N / A	N / A

Category	Principles	Indicators	Evaluation Criteria				
	exemptions		apply for the appropriate permits/ exemptions.	application is currently being processed.			
	15. To ensure health and safety guidelines are followed	Extent to which health, safety and environmental (HSE) best practices are followed.	The receptor site has had at least one recorded HSE accident resulting in injury or fatality in the last year.	The receptor site has had at least one recorded HSE accident resulting in injury or fatality in the last two to five years.	The receptor site has not had any recorded accidents in more than five years.	N / A	N / A
	16. To ensure legal compliance	Extent to which the site operator has been issued with a ruling by UK court of law.	The site operator has been formally charged guilty by a UK court of law.	N / A	The site operator has never been found guilty by a UK court of law.	N / A	N / A.
		Extent to which the operator is in risk of breaching environmental regulations.	The site operator has been issued with enforcement notice/caution from the Environment Agency.	N / A	The site operator or receptor site has not been issued with enforcement notices from the Environment Agency.	N / A.	N / A.
	17. To develop solutions which minimise costs	Extent to which cost minimisation is considered for the receipt/treatment/disposal of incoming material at the receptor site.	Cost minimisation options appraisal for the receipt/treatment/disposal of incoming material are not typically undertaken at the receptor site.	Cost minimisation options appraisal for the receipt/treatment/disposal of incoming material are sometimes undertaken at the receptor site.	Cost minimisation options appraisal for the receipt/treatment/disposal of incoming material are always undertaken at the receptor site and can be supported by appropriate reporting.	N / A	N / A

Category	Principles	Indicators	Evaluation Criteria				
		Extent to which the receipt/treatment/disposal of the incoming material at the receptor site will increase operational costs.	The receptor site's gate fee is in the highest 20% compared to other receptor sites.	N / A	The receptor site's gate fee is in the 20%-80% range compared to other receptor sites.	N / A	The receptor site's gate fee is in the lowest 20% compared to other receptor sites.

2.6.6 Details of the scoring procedure are provided below.

2.6.7 Each receptor site is scored against the seventeen principles and their criteria. Scores range from -2 to +2 with negative impacts assigned negative scores (red colour), neutral impacts assigned a 0 score (amber colour) and positive impacts assigned positive scores (green colour).

2.6.8 The majority of the criteria requires a qualitative assessment, while only a select few require a quantitative assessment. Qualitative criteria provide flexibility during the evaluation in order to allow for professional judgment to be made on the receptor site's information. Quantitative criteria is not always readily available and, thus, it can add complexity in the evaluation process of a receptor site.

2.6.9 Table 2-4 below provides guidance on how the scores should be interpreted when assessing the receptor sites.

Table 2-4 Scoring Guidance

	Scores				
	-2	**-1**	**0**	**+1**	**+2**
Level of Impact	Major Adverse	Minor Adverse	Neutral	Minor Benefit	Major Benefit
	Significant Increase/ Decrease	Slight Increase/ Decrease	Neutral	Slight Increase/ Decrease	Significant Increase/ Decrease
	Long term Effect	Short term Effect	Neutral	Short term Effect	Long term Effect

2.6.10 During the assessment of each principle, human health and ecological receptors will be considered to determine the level of impact the receptor site's activities will have on the environment and communities. The sites are then scored depending on their level of impact against the receptors. As an example, close proximity to more sensitive human health and ecological receptors (e.g. internationally or nationally designated locations, high exposure areas) pose a higher risk and thus are scored more negatively.

Carbon Calculations

2.6.11 In order to assess the principle ‘to address and reduce contribution to climate change’ under the Environment category, a carbon footprint of transport modes to receptor sites will be calculated as follows:

- The carbon footprint is first calculated using the formula below.

Sum of: Total tonnes by mode × distance travelled by mode × CO2 eq conversion factor = Total kg CO2 eq

- Where more than one transport mode is used, the kg CO2 eq per tonne for each mode is calculated and then these are added together. The value is then converted to a kg CO2 eq per tonne accepted by the receptor site.
- The carbon values used to calculate the carbon footprint are based on publicly available datasets, see table below. The Defra 2015 conversion factors for transport are used and are as follows:

Table 2-5 Carbon Values used to Calculate Carbon Footprint[9]

kg CO_2 eq per tonne per km	**HGV (all diesel) all articulates (50% laden)**	**Cargo ship, general cargo, average**	**Rail, freight train**
Scope 3	0.93742	0.013155	0.02601

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[9] Defra, ‘Greenhouse Gas Conversion Factor Repository’, http://www.ukconversionfactorscarbonsmart.co.uk/

- The Heavy Goods Vehicle (HGV) carbon value has been assumed to be 50% laden and the Rail and Cargo ship options have been assumed to be 100% laden as specified in the Defra conversion factors.
- Scope 3 emissions have been used as these are used for downstream transportation of material/goods.

2.6.12 After calculating the carbon footprint of the transport mode to each site, the values are compared against each other in order to identify site's which rank highest, middle and lowest carbon footprint. High carbon footprint values are scored lower than lower carbon footprint values.

Scoring

2.6.13 After assessing and scoring each site, the scores for the individual principles are added to obtain a total score. Each site is ranked from highest to lowest score in order to determine whether it is included in the preferred list, the reserve list, or discounted entirely.

2.6.14 Below is a guide to the scoring thresholds for progression:

- *Progress to preferred list:* Score of 0 to +34; and
- *Option not progressed (but with potential to be included on the reserve list):* Score of -62 to -1.

2.7 Preferred List

2.7.1 The preferred list includes receptor sites which scored 0 to +34 and therefore will have a neutral or positive impact on the environment and the communities. The receptor sites which do not progress are those sites which scored -62 to -1 and, therefore, will have a negative impact on the environment and local communities.

2.7.2 The receptor sites should be ranked, focussing on sites with the most positive impact. Both lists are taken forward and receptor sites from the reserve list can be used in case any problems exist with using a site in the preferred list.

2.7.3 Special attention should be given to the negative scores for each site. It may be that a receptor site scores positive overall, but negatively in one or two areas that may be of specific concern.

2.7.4 Professional judgment will be used in order to determine whether those negative scores should be prioritised over the positive scores in other criteria. For example, a receptor site might score positive in all criteria except having the right permit/ exemption to receive, treat and/or dispose of the incoming material. In this case, professional judgment should be made to determine whether this site can be included in the preferred list given that it cannot receive/treat/dispose of the material.

2.7.5 During this further assessment of the preferred list, it may be concluded that some receptor sites may no longer be viable.

2.8 Reserve List

2.8.1 It must be noted that the RSA represents available receptor sites at the time of assessment and it is likely that other sites may become available and suitable before construction commences. Sites that fail to successfully pass through the Detailed Options Assessment but could potentially pass in the future (due to pending permit applications or land acquisition) will be placed onto the reserve list.

2.8.2 Receptor sites may move on or off the preferred list if their performance alters, for example:

- If a receptor site obtains planning consent, it may move on to the preferred list from the reserve list
- If a receptor site finds alternative materials and no longer requires the Scheme’s excavated material, it may move off the preferred list.

2.9 Use of the Lists

2.9.1 The full RSA will be completed prior to the commencement of construction.

2.9.2 The preferred list and reserve list are used by contractors tendering for the Scheme. The inclusion of a receptor site on the preferred list or reserve list does not ensure that the site would be ultimately utilised as a receptor site for the excavated material arising from the Scheme. Should additional receptor sites be identified in the future, they would go through the same assessment process, as detailed in this document.

2.9.3 In the instance that suitable sites on the preferred and reserve list are not available, or materials cannot be placed at a suitable facility either on site (subject to necessary consents and licences) or on these lists, or they do not allow for the Contractor to meet other commitments outlined by TfL, Contractors should assess receptor sites beyond the 100km radius criteria (including transfrontier sites) using the RSA methodology. For transfrontier sites, the effect of local legislation should be taken into account when applying the RSA methodology and evaluation criteria.

2.9.4 TfL aims to minimise disposal by only using receptor sites which meet or exceed the criteria presented in this RSA methodology document.

3. CONCLUSION

3.1.1 The methodology used throughout the RSA provides a standard approach to assess the suitability of receptor sites to receive, treat and/or dispose of the incoming material from the Scheme.

3.1.2 The criteria used throughout the RSA are aligned with the commitments within the scheme's CD&E Materials Commitments document (Appendix to Document Reference 6.10).

3.1.3 The RSA provides a transparent process to stakeholders in order to ensure that the excavated material will be managed and treated with the least impact to the environment and communities.

3.1.4 The RSA will be completed prior to the commencement of construction. This will ensure that suitable sites will be in place to receive, treat and/or dispose of the excavated material from the Scheme.

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Appendix A. Questionnaires

Preliminary Viability Assessment

A.1.1 The following list of questions can be used as guidance for research or communications with the receptor sites in the long list. These questions may not necessary if the information is available through other sources.

A.1.2 In addition to these questions, general information about the receptor site (e.g. contact name, address, date contacted, etc.) should also be recorded.

A.1.3 Guidance questions for the Preliminary Viability Assessment include (but are not limited to) the following:

Preliminary Viability Assessment Criteria	**Guidance Questions**
The capacity of the receptor site to receive/treat/dispose of volumes of excavated material in excess of 200,000 tonnes)	• What is the total volume of material that the site can receive/treat/dispose of (tonnes per annum or total tonnes)? • What is the end-use of the materials? • Are there any potential future barriers / improvements to capacity (e.g. future contracts or expansions)?
The operator holds a valid permit or exemption, which allows them to receive/treat/dispose of the principal excavated material type(s), i.e. soil and stones	• Does the site have the appropriate permits / exemptions to receive/treat/dispose of the material?
The anticipated availability of the receptor site to receive, treat and/or dispose of the excavated material during the Scheme's construction (from the year 2019)	• What is the period of time which the site can receive/treat/dispose of the required capacity? • Are there any future timescale constraints? • Does the site have a future strategy or plan (e.g. expansion)?
Any enforcement notices, court cases and cautions from the	• Has the operator or receptor site been issued with any enforcement notices, court

Preliminary Viability Assessment Criteria	Guidance Questions
Environment Agency issued to the operator and / or receptor site	cases or cautions in the past? - If so, what was the type of offense, what date did the offense occur and what was the action taken?
The receptor site is accessible via road (i.e. lorry), water (i.e. barge) and / or rail	- Is the site accessible via road, water or rail? - For water and rail access does the site have access to existing infrastructure for receiving material, e.g. jetty / rail head?

Detailed Options Assessment

A.1.4 The following list of questions can be used as guidance for interviews (via telephone, email, face to face interviews) with the receptor sites in the short list. These questions may not necessary if the information is available through other sources.

A.1.5 These questions may be used to prompt the sites to provide more details which may be helpful in the detailed assessment.

A.1.6 In addition to these questions, general information about the receptor site (e.g. contact name, address, date contacted, etc.) should also be recorded. Guidance questions for the Detailed Options Assessment include (but are not limited to) the following:

Detailed Options Assessment Criteria			Guidance Questions
Category	Principles	Indicators	
Environment	1. To follow the waste hierarchy	Extent to which end-use of the material follows the principles of the waste hierarchy.	- What type of treatment is used? - What is the end-use of the incoming material? - What portion of the incoming material is disposed, recovered, recycled or re-used?
	2. To address and reduce contribution to climate change	Greenhouse gases (GHG) emitted through on site operations (including receipt, treatment and	- Is a carbon management in place at the site? - Will the incoming material have to be transported once on site

Detailed Options Assessment Criteria			**Guidance Questions**
Category	**Principles**	**Indicators**	
		transportation of the incoming material).	– If so, how will it be transported? • Will the incoming material have to be treated once on site – If so, how will it be treated?
		Extent of additional vehicle movements required once incoming material has entered the receptor site.	• Will the incoming material require movement via a vehicle once on site? • What is the total distance material will travel on site, before it is placed?
		Greenhouse gases (GHG) emitted during transportation of material to receptor site. This is calculated using standard carbon factors (see Section 2.6.11)	• What is the transport mode used to transport material to the site? (rail/river/road)
		Extent to which flood risk is altered by the receipt/treatment/disposal of incoming material at the receptor site, or in the local catchment.	• Is the site in a flood risk area? • Are there any water abstraction points on or near to the site? • Has an assessment been made on the impact on local flood risk due to receipt/ treatment of the incoming materials? • Is there any information in your permit that covers flood risk?
	3. To reduce impact on air quality and noise	Extent to which the receipt/treatment/disposal of the incoming material generates pollutants (within the permitted limits). This	• Please provide details of any air quality abatement measures in place. • Do you believe the receipt/ treatment of incoming material will

Detailed Options Assessment Criteria			**Guidance Questions**
Category	**Principles**	**Indicators**	
		excludes transport to the site.	have an impact on local air quality?
		Extent to which air quality is impacted by the receipt/ treatment/ disposal of incoming material at the receptor site (excluding transport) in the short and long term.	• Will local air quality be affected in the short term due to the receipt/ treatment of incoming material? • Will local air quality be affected in the long term due to receipt/ treatment of incoming material?
		Extent to which the receipt/treatment/ disposal of the incoming material generates noise (within the permitted limits). This excludes transport to the site.	• Please provide any details about any local noise complaints. • Are there any noise abatement measures in place?
		Extent to which the receipt/treatment/disposal of the incoming material generates noise in the short and long term.	• Will local noise levels be affected in the short term due to receipt/ treatment of incoming material? • Will local noise levels be affected in the long term due to receipt/ treatment of incoming material?
	4. To protect the quality of water	Extent to which surface water quality is impacted by the material receipt/ treatment/ disposal at the receptor site.	• Are there any surface water bodies within the site boundary or close to the site? • What measures are in place to prevent contamination to the water bodies from the receipt/ treatment of the incoming material?
		Extent to which ground water quality is impacted by the material receipt/ treatment/disposal at	• Are there any aquifers within the site boundary or close to the site? • What measures are in place to prevent

Detailed Options Assessment Criteria			**Guidance Questions**
Category	**Principles**	**Indicators**	
		the receptor site.	contamination entering the groundwater on site? - Have there been any historical issues with groundwater contamination?
	5. To protect and enhance biodiversity	Extent to which designated sites are impacted in the short and long term by the material receipt/ treatment/ disposal the receptor site.	- Are there any designated areas on site or in close proximity? - What measures are in place to prevent designated areas being detrimentally affected? - Would local biodiversity be impacted in the short term by the receipt/ treatment of the incoming material at the receptor site? - Would local biodiversity be impacted in the long term by the receipt/ treatment of the incoming material at the receptor site?
	6. To ensure efficient use of land and resources	Extent to which incoming material replaces the need for virgin material use at the receptor site.	- What percentage of the virgin material used on site will be replaced by the incoming material? - Where is the virgin material sourced from?
		Extent to which the efficiency of the receptor site's operations are impacted by the receipt/treatment/disposal of incoming material.	- Will the efficiency of the receipt/ treatment of incoming material increase/ decrease?

Detailed Options Assessment Criteria			Guidance Questions
Category	Principles	Indicators	
		Extent to which incoming material will affect land take (footprint) of the receptor site.	• Will the site footprint be affected by the receipt/ treatment of the incoming material?
	7. To protect cultural heritage	Extent to which designated sites are impacted in the short and long term by the material receipt/ treatment/disposal the receptor site.	• Are there any scheduled ancient monuments or archaeological features on or in close proximity to the site which were assessed/ mitigated prior to the site becoming operational? • Would the receipt/ treatment of the incoming material have any effects on local scheduled ancient monuments or archaeological sites in the short term? • Would the receipt/ treatment of the incoming material have any effects on local scheduled ancient monuments or archaeological sites in the long term?
Public	8. To protect local public amenities	Extent to which local public access are impacted by the material receipt/ treatment/disposal at the receptor site.	• Is there odour abatement measures in place at the site? • Are there currently any public rights of way (PRoW) on the site? • Will the receipt of material have an impact on PRoWs?
	9. To reduce visual impact of surrounding areas	Extent to which the surrounding areas are visually impacted in the short and long term by the receipt/ treatment/disposal of	• What screening is there currently in place at the site to reduce visual impact? • Is the proposed restoration for the site

Detailed Options Assessment Criteria			Guidance Questions
Category	Principles	Indicators	
		incoming material.	different to surrounding landscape? • How will the receipt/ treatment of incoming material affect the local landscape in the short term? • How will the receipt/ treatment of incoming material affect the local landscape in the long term?
	10. To provide opportunities for a diverse workforce	Extent to which receipt/treatment/disposal of incoming material at the receptor site creates new job opportunities.	• Would the receipt/ treatment of incoming material have any impact on employment at the site or local area?
		Extent to which receipt/treatment/disposal of incoming material at the receptor site considers diversity of workforce.	• Does the site have a workforce diversity strategy? • Does the site currently employ a diverse workforce?
Transport	11. To promote sustainable transportation	Extent to which sustainable forms of transport are available and considered for the receipt of incoming material at the receptor site.	• How can the site be accessed (road/rail/barge)? • Will any major upgrades need to be completed in order to receive material by rail/barge?
	12. To manage material locally, as per the proximity principle	Average distance from the excavation site to the receptor site.	• What is the distance (miles/ kilometres) from the source site to the receptor site, by rail/ road/ barge?
Operations	13. To identify receptor sites with suitable	Likelihood of the receptor site to conform to the project's timescales.	• Over what timeframe could you receive/treat/dispose of the incoming material?

Detailed Options Assessment Criteria			Guidance Questions
Category	Principles	Indicators	
	capacity and operational capability	The receptor site's ability to receive/ treat/dispose of various types of incoming material.	• What material types are listed in your permit/ exemption? • Are there any limitations to the materials you can receive/treat/dispose of?
		The receptor site's capacity to receive/treat/dispose of the volume of incoming material.	• How much material are you permitted to receive/ treat/dispose of? • How much material could you receive/treat/dispose of on a daily/ monthly/ yearly basis based on your expected capacity?
	14. To use receptor sites with appropriate permits/ exemptions	The receptor site has the appropriate permits/ exemptions to receive/treat/dispose of and treat the incoming materials.	• Please can you provide a copy of permit or exemption issued by the Environment Agency • Information relating to any permit constraints • If permits/exemptions have not been granted yet, when do you anticipate they will be in place? • Can you receive/treat/dispose of material prior to the pending permits being issued?
	15. To ensure health and safety guidelines are followed	Extent to which health, safety and environmental (HSE) best practices are followed.	• How many health and safety incidents have you had in the past year? • Does the site have a HSE advisor? • Does the site have a HSE plan in place? • Does the site have ISO 18001 certification?

Detailed Options Assessment Criteria			**Guidance Questions**
Category	**Principles**	**Indicators**	
	16. To ensure legal compliance	Extent to which the site operator has been issued with a ruling by UK court of law.	• Has the site operator been formally charged guilty by a UK court of law?
		Extent to which the operator is in risk of breaching environmental regulations.	• Has the site operator has been issued with enforcement notice/ caution from the Environment Agency?
	17. To develop solutions which minimise costs	Extent to which cost minimisation is considered for the receipt/treatment/disposal of incoming material at the receptor site.	• Has the site undertaken a cost minimisation options appraisal for the receipt/ treatment of incoming material?
		Extent to which the receipt/treatment/disposal of the incoming material at the receptor site will increase operational costs.	• Will operational costs at the site be effected by the receipt/ treatment of the incoming material? • What are the site's gate fees for the incoming material?

Appendix E. Site Waste Management Plan

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SILVERTOWN TUNNEL

Site Waste Management Plan

April 2016

MAYOR OF LONDON

TRANSPORT
FOR LONDON
EVERY JOURNEY MATTERS

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List of Abbreviations

CD&E	Construction, Demolition and Excavation
CD&EMC	Construction, Demolition and Excavation Materials Commitments
CL:AIRE DoW CoP	Contaminated Land: Applications in Real Environments Definition of Waste: Code of Practice
CoCP	Code of Construction Practice
DCO	Development Consent Order
DEFRA	Department for Environment Food & Rural Affairs
DLR	Docklands Light Railway
DoC	Duty of Care
Edoc	Electronic Duty of Care
EA	Environment Agency
EAL	Emirates Air Line
EMS	Environmental Management System (for the Scheme)
ELoW	European List of Waste
ES	Environmental Statement
LOW	List of Waste
NSIP	Nationally Significant Infrastructure Project
PEMP	Project Environmental Management Plan

RSA	Receptor Site Assessment (for Excavated Materials)
SWMP	Site Waste Management Plan
SPV	Special Purpose Vehicle
TBM	Tunnel Boring Machine
TfL	Transport for London
WAC	Waste Acceptance Criteria
WEEE	Waste Electrical and Electronic Equipment
WRAP	Waste and Resources Action Programme

Glossary of Terms

Contractor	Anyone who directly employs or engages construction workers or manages construction work. Contractors include sub-contractors, any individual self-employed worker or business that carries out, manages or controls construction work.
Development Consent Order (DCO)	This is a statutory order which provides consent for the project and means that a range of other consents, such as planning permission and listed building consent, will not be required. A DCO can also include provisions authorising the compulsory acquisition of land or of interests in or rights over land which is the subject of an application. http://infrastructure.planninginspectorate.gov.uk/help/glossary-of-terms/
ELoW	The European List of Waste provide definition and code assignment for hazardous and non-hazardous wastes.
Contractor	A term defined under the Construction Design and Management Regulations (2015). Contractors are appointed by the client to coordinate the construction phase of a project where it involves more than one contractor.
Envisaged Design	Design proposals that the consultation and DCO application will refer to.
The Scheme	The construction of a new bored tunnel with cut and cover sections at either end under the River Thames (the Silvertown Tunnel) between the Greenwich peninsula and Silvertown, as well as necessary alterations to the connecting road network and the introduction of user charging at both Silvertown and Blackwall tunnels.
Transport for London (TfL)	A London government body responsible for most aspects of the transport system in Greater London. Its role is to implement transport strategy and to manage transport services across London. These services include: buses, the Underground network, Docklands Light Railway, Overground and Trams. TfL also runs Santander Cycles, London River Services, Victoria Coach Station and the Emirates Air Line.

	As well as controlling a 580km network of main roads and the city's 6,000 traffic lights, TfL regulates London's private hire vehicles and the Congestion Charge scheme.
Waste and Resources Action Programme (WRAP)	WRAP is a registered charity that works with businesses, individuals and communities to achieve a circular economy by helping them reduce waste, develop sustainable products and use resources in an efficient way.

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SUMMARY

S.1.1 This Site Waste Management Plan (SWMP) details the anticipated waste streams to be generated during the construction phase of the Silvertown Tunnel project and the means that could be implemented to minimise and manage the waste. This document should be read in conjunction with the associated Waste and Resources Action Programme (WRAP) excel template which provides estimates for the type and volume of anticipated waste arising from the construction phase of the Scheme.

S.1.2 This SWMP has been developed to provide a consistent framework for managing and documenting waste generated during the construction phase. The plan will be updated throughout the construction phase of the Scheme. This SWMP submitted with the DCO application presents the framework in which the SWMP will subsequently be developed by the contractor.

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1. INTRODUCTION

1.1 Purpose

1.1.1 This Site Waste Management Plan (SWMP) has been developed to reflect the Silvertown Tunnel envisaged design and the associated quantities of waste that are anticipated to be generated during the construction phase of the Silvertown Tunnel project (herein referred to as the 'Scheme').

1.1.2 SWMPs are developed and maintained to facilitate good practice on construction sites, recording duty of care information and by that preventing waste crime. They are also an important tool for improving environmental performance and reducing waste disposal costs for schemes.

1.1.3 This document summarises estimates of how much waste is anticipated to be generated during the construction phase of works (covering construction, demolition and excavation (CD&E) waste) and to provide an initial indication as to whether materials and waste streams have the potential to be reused, recycled, recovered or disposed of based on information available at this stage.

1.1.4 The main phases for a SWMP include:

- The preparation stage – which is the responsibility of TfL prior to construction; and
- The construction stage – which is the responsibility of the Contractor from when construction begins.

1.1.5 The SWMP is a live document that will be updated throughout the construction phase by the Contractor.

1.1.6 The Waste and Resource Action Programme (WRAP) SWMP template has been / will be (as the Scheme progresses) utilised to record the following details:

- Record the Contractor's responsible personnel, where known, who will be involved in the project;
- Forecast waste that is anticipated to be produced during the project, recorded using the appropriate European List of Waste (ELoW) code and waste description;

- Supply details on waste minimisation actions, by both TfL and the Contractor; and
- Contain a register of waste carriers and their waste carrier registration number and details of the site the waste and/or material will be taken to.

1.1.7 For information on TfL's overall vision, objectives and commitments for the management of CD&E materials the Construction, Demolition and Excavated Materials Commitments (CD&EMC) report (Appendix to Document Reference 6.10) should be consulted.

1.1.8 The SWMP will be used to review the progress of the Scheme towards the targets contained within the CD&EMC, which are also detailed within this document.

1.1.9 SWMPs set a framework to facilitate good practice on site and are an important tool for improving environmental performance, meeting regulatory control and reducing waste disposal costs.

1.2 Responsibilities

1.2.1 TfL and the appointed contractor shall take all reasonable steps to ensure that:

- All waste from the site will be dealt with in accordance with the waste Duty of Care as set out in Section 34 of the Environmental Protection Act 1990[1] (as amended) and the Waste (England and Wales) Regulations 2011[2]
- Emphasis is put on the waste hierarchy to ensure that waste is dealt with in the priority order of: prevention; preparing for re-use; recycling; other recovery (for example, energy recovery); disposal as per the Waste Regulations 2011[2]; and
- Materials will be handled efficiently and waste managed appropriately.

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[1] Environmental Protection Act 1990 (c. 43) Part II, section 34 (as amended in 1996 and 1999).

[2] The Waste (England & Wales) Regulations 2011 (SI 2011/988) (as amended 2012 (SI 2012/1889) and 2014 (SI 2014/656)).

1.2.2 TfL are responsible for preparing the SWMP prior to construction.

1.2.3 This plan has been developed at this early stage to ensure a guidance document is in place. On award of Scheme's contract, the appointed Contractor will be responsible for developing this plan and ensuring it relates specifically to the works associated with the solution adopted for the completion of the works.

1.2.4 The Contractor and appointed site manager are responsible for instructing workers, overseeing and documenting results in the SWMP. Copies of this plan shall be distributed to the design team, TfL project manager, project director and each subcontractor involved in the Scheme. This will be undertaken every time the plan is updated.

1.3 Purpose of the SWMP

1.3.1 This SWMP has been developed to provide a consistent framework for managing and documenting waste generated during the construction phase and to highlight areas in which waste could be reduced, reused, recycled and those that require disposal. This SWMP also records design decisions that demonstrate good and best practice in waste minimisation and management. By recording these project details contractors are able to:

- Estimate waste and identify actions to reduce waste and cost;
- Record actual waste movements; and
- Review the Scheme's performance.

1.3.2 At detailed design stage, actions will be taken to design out waste and specify that materials and components with a recycled content are used in the construction of the Scheme where practicable. These considerations are in line with the designing out waste principles and adopting best practice approaches advocated by WRAP.

1.3.3 The SWMP is designed to follow the key stage process of:

- Plan;
- Implementation;
- Measure; and
- Review.

1.3.4 The creation of a SWMP allows the Contractor to demonstrate how their approach to excavated materials and waste has taken into account; the waste hierarchy, Contaminated Land: Applications in Real Environments

Definition of Waste: Code of Practice (CL:AIRE DoW CoP) code of practice and Duty of Care (DoC).

1.3.5 Best practice suggests that the SWMP process is to be implemented at the earliest opportunity within the Scheme to encourage the process of developing design and construction solutions that contribute towards the minimisation of waste.

1.3.6 The SWMP will outline the methods required to minimise waste, manage waste produced responsibly, measure the quantities and costs of waste produced effectively and on review, provide lessons learned to enhance future schemes.

1.3.7 The SWMP WRAP Excel template is a live working document that requires the relevant sections to be completed at different stages throughout the development of the Scheme. Final completion of the spreadsheet will not happen until the construction phase of the Scheme has finished. Therefore, at any point during the construction phase, sections of the spreadsheet will be incomplete, pending completion.

1.3.8 The Contractor is expected to take ownership of, and update the SWMP document, completing the various sections until it has reached the point of being finalised and signed off at the point of the overall Scheme completion. The SWMP will identify the types and quantities of waste that are produced throughout the construction phase of the Scheme and will identify management options for each type of waste, paying attention to the waste hierarchy (see Section 4).

1.3.9 It shall also state stringent requirements for the control and disposal of hazardous wastes (see Section 7.6).

1.3.10 The adoption of the SWMP will help to ensure the Scheme fulfils its legal obligations towards waste management and Duty of Care. The SWMP shall be communicated to selected employees and sub-contractors on the Scheme.

1.3.11 Adopting an extended Duty of Care i.e. ensuring that sub-contractors and facility operators with a good and proven record of environmental performance and compliance are appointed to treat and/or receive materials from the site, is also recommended.

1.3.12 The measurement and control of fly-tipping will not be included in the SWMP as this will be controlled by on-site measures.

1.4 Site Description

1.4.1 The Silvertown Tunnel scheme (herein after referred to as ‘the Scheme’) is a new road tunnel under the River Thames connecting the Greenwich Peninsula and Silvertown. The Scheme involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham). The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

1.4.2 New portal buildings would be located close to each tunnel portal to house the plant and equipment necessary to operate the tunnel.

1.4.3 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and would help to support the funding of the construction and operation of the Silvertown Tunnel.

1.4.4 The design of the Silvertown Tunnel would include a dedicated bus/coach and HGV lane, which would provide opportunities for TfL to provide additional cross-river bus routes.

1.4.5 Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. The main construction compound would be located at Silvertown, utilising the existing barge facilities at Thames Wharf along with a new temporary jetty for the removal of spoil and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich Peninsula.

1.4.6 Figure 1-1 below, shows the sites location and surrounding features.

Figure 1-1 Location of Scheme

2. TYPES OF WASTE

2.1 Overview

2.1.1 Waste streams categorised as either excavation (E) or demolition (D) are those which exist within the Scheme footprint already, such as topsoil, sub-soil, vegetation and demolition materials etc.

2.1.2 Imported materials are those which are imported to site for inclusion into the temporary and permanent construction works (such as concrete, construction aggregates, asphalt and cabling etc.) which also produce a waste stream. Included within this waste stream is an estimated quantity of product packaging. This waste stream is produced from a range of potentially avoidable activities such as damaged materials and the over ordering of materials. This waste stream is described as construction (C) waste within the SWMP.

2.1.3 In order to assist the management and segregation of waste, estimations have been made of the types and quantities that will be generated during the construction phase of the Scheme. For this the WRAP SWMP Excel template has been utilised (Appendix A).

2.1.4 For all CD&E waste there are a number of considerations to be implemented in terms of management; such as waste reduction, segregation of waste, disposal of waste, financial impacts of waste disposal and recording, monitoring, education and reviewing data (see Section 7).

2.1.5 The following sections discuss the main waste streams anticipated as a result of the Scheme construction phase (covering CD&E). This list is not exhaustive, however it forms a basis for the SWMP based on the current envisaged design. Any additional streams will be included in the plan as part of the updates.

2.2 Construction and Demolition wastes (C&D)

2.2.1 Construction and demolition wastes will largely consist of inert material; concrete (structural and pavement), bricks and glass.

2.2.2 Construction waste figures are included in the SWMP (Appendix A). These approximate figures have been generated by calculating the percentage of imported material that will become a waste. These are calculated by using the WRAP industry standard wastage rates for imported material.

2.2.3 Currently the SWMP does not account for workforce waste streams, for example Waste Electrical and Electronic Equipment (WEEE) and organic waste or any operational waste. Once details of workforce are known such waste streams are to be incorporated into the SWMP.

2.2.4 Any waste produced through the importation of materials needs to be monitored and included in the SWMP as the Scheme progresses. Where possible, consideration will be given to the use of recycled imported material such as concrete or those with a higher recycled content. However, due to the high level of specification expected of the material required for the tunnel structure, this may not be considered a viable option.

2.2.5 Demolition waste figures are also included within the SWMP (Appendix A). Demolition figures are calculated based on the assumption that all materials generated as a result of the demolition works will be waste.

2.2.6 Demolition works are anticipated to consist of the removal of above ground buildings and structures.

2.3 Excavated Materials (E)

2.3.1 Excavated materials will be generated through tunnel excavation, the construction of portal launch chamber and surrounding highways.

2.3.2 In relation to materials removed from site it is anticipated the majority of the material would be excavated material, for which beneficial uses would be sought. Beneficial use, in terms of this Scheme is defined within the CD&EMC report (Appendix to Document Reference 6.10).

2.3.3 Appropriately experienced staff, familiar with working on brownfield sites and with the contaminant groups anticipated will supervise the excavation works to manage the segregation of spoil materials. Site-derived materials of a similar nature will be stockpiled together and any changes in the physical and/or chemical properties will prompt further segregation.

2.3.4 As part of the construction phase works, excess material from tunnelling and other excavation activities will be removed from the construction sites at Greenwich Peninsula and Silvertown by road or river transport.

2.3.5 Where possible alternatives have been exhausted there will be a requirement to dispose of excavated material, by licensed waste carriers to licensed landfill sites. The material will be handled in accordance with the Waste (England and Wales) Regulations 2011[2].

2.4 Tunnel Materials

2.4.1 The bored tunnel section is likely to be constructed using a segmental concrete lining, excavated through the use of a TBM, which will form the structural (or primary) lining. The type of TBM is envisaged to be a closed face earth pressure balance configuration. This machine works to balance the pressure of the excavation by controlling the rate of material excavation as opposed to the use of pressurised slurry. The condition of the excavated material will vary however it is anticipated that this method will not result in the production of slurry.

2.4.2 Final TBM selection will be determined by the contractor based on the assessment of the construction risk with consideration for tunnel alignment depth, associated ground pressure, ground cover, anticipated geology and depth of the water table. The envisaged design has therefore ensured that sufficient temporary land is available for a slurry separation plant if this option is chosen.

2.4.3 Due to the size of the tunnel bores the anticipated excavated spoil at any one time is likely to consist of more than one type of material (i.e. different strata).

2.4.4 If the water content of the excavated material is considered too high for transport by barge it may be necessary to dry it out prior to transportation.

2.4.5 The TBM will be maintained underground and by-products of this process will typically be oils and greases, and will therefore require subsequent classification for inclusion within the SWMP.

2.5 Contaminated Waste

2.5.1 Given the nature of the works and site history there is the potential for excavation works to give rise to potentially contaminated material that will require remediation and/or appropriate disposal.

2.5.2 Site wide remediation was undertaken at Greenwich during the late 1990s. It is understood that notable sources of contamination, such as tar tanks and known contamination hot spots were removed, groundwater remediation was undertaken and near surface soils were removed or cleaned prior to landscaping. However, it is understood that contaminated materials remain at depth beneath much of the site. Allowance will need to be made in the forecasted waste for the removal of impacted material that may be encountered.

2.6 Hazardous Waste (including asbestos containing waste)

2.6.1 It is anticipated that a small amount of hazardous material will be produced from CD&E activities.

2.6.2 Hazardous waste including any contaminated excavated spoil will be kept separate and secure in receptacles in line with the Waste (England) Regulations 2011[2]. Doing so will also act to reduce cross contamination.

2.6.3 The waste will then be removed from site and treated in accordance with all applicable legislation.

2.6.4 Asbestos based materials may arise during the excavation of the ground for tunnels and portals especially in areas of previously high industrial use and the historic gas works. Asbestos fragments in soil and low levels of loose fibres in soils have been identified within some of the samples taken during the ground investigations. Therefore, waste streams containing asbestos have been estimated within the SWMP.

2.6.5 The edge of one of the historic gas work buildings on Greenwich Peninsula is located above the proposed alignment. Therefore, there is the possibility that the foundations or items of infrastructure (including asbestos sheeting) remain underground. No records have been found detailing the demolition works associated with these features.

2.6.6 Currently, the full extent of below ground structures (i.e. piles) and their interaction with the proposed tunnel alignment is not fully known.

2.6.7 During demolition and construction activities additional streams of hazardous waste are anticipated, including: oils and grease from equipment maintenance, batteries, waste paint and solvents and fluorescent tubes. Quantities of this waste stream have not been estimated at this stage, once plant set up is established this waste stream should be accounted for.

2.7 Vegetation

2.7.1 In order for construction to take place, areas of vegetation, comprising mainly of grass and shrubs will require clearance in advance of general excavation works. If Japanese Knotweed, or any other invasive species, is located then special measures will be required to deal with this vegetation (such as classification and disposal of the waste as a ‘controlled waste’ under the Environmental Protection Act 1990 (c. 43) (as amended in 1996 and 1999).

2.7.2 As a minimum all vegetation waste should be diverted from landfill, unless it has been identified as an invasive species and no other options are available. The greatest opportunity for the sustainable management of vegetation waste is through recycling into compost.

2.8 Fit Out Material

2.8.1 Imported materials for the final fit out of the tunnels and associated infrastructure will meet a pre-designed specification, which will have taken into consideration when designing out waste measures.

2.8.2 Any WEEE waste generated should be reused or recycled. Where practicable this should be managed through a take-back or other local recycling schemes. A full audit trail should be kept for such WEEE compliant schemes (in accordance with regulations).

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3. WASTE FORECAST

3.1 Overview

3.1.1 One of the initial stages of completing the SWMP is to forecast anticipated waste arisings. This allows for early stages of designing out waste to be incorporated into the Scheme.

3.1.2 The waste estimates produced are formulated from available data for the Scheme including current envisaged design and cost estimates. Details used are consistent with other application documents.

3.1.3 Appendix A contains the forecast waste tables from the WRAP spreadsheet produced for the construction phase and covers CD&E waste from both the temporary and permanent works for the Scheme. The waste forecast tables set out the current estimates of waste types and quantities that are anticipated. This list is not exhaustive and additional waste streams shall be added when they occur.

3.1.4 The forecast waste table provides important information such as identifying the waste activity (either C,D or E), the waste stream, the material classification, the ELoW code, quantity and the management methods.

3.1.5 This information is duplicated in subsequent tabs within the spreadsheet. Actual waste movements are completed by the Contactor during construction, which feed into the key performance indicators (KPIs) tab.

3.1.6 Demolition waste and excavation materials quantities are calculated as a whole for an activity, i.e. assuming all of the material is classified as a waste and generally based on estimated volumes.

3.1.7 Construction waste quantities are calculated using WRAP and industry standard wastage rates. The rates assume a certain percentage of the imported material will become a waste.

3.1.8 As well as determining where waste has been generated there are other considerations to waste management such as waste reduction, segregation of waste, disposal of waste and the financial impacts of waste disposal which are completed further into the Scheme and discussed in subsequent sections of the SWMP.

Table 3-1 Overall Material / Waste Arisings

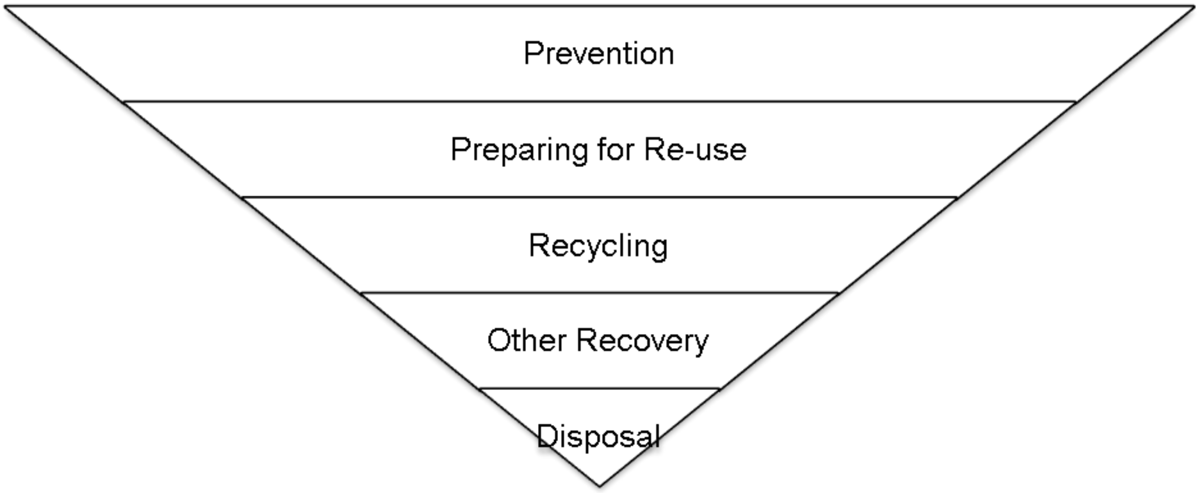
Activity	**Total Material / Waste (tonnes)**
Construction Phase: Excavation	
Excavated material	1,086,000
Construction Phase: Non-excavation	
Demolition waste	66,000
Construction waste	23,000
Total	**1,175,000**

4. WASTE MANAGEMENT STRATEGY

4.1 Overview

4.1.1 The waste management strategy for the Scheme will follow the accepted waste hierarchy (Figure 4-1) which is taken from the Waste Framework Directive (2008/98/EC). This shows the priority that must be applied when making decisions on reuse, recycling, recovery or disposal of each type of waste generated during the construction phase.

Figure 4-1: Waste Hierarchy



4.1.2 Contractors, design teams and suppliers are encouraged to minimise the amount of waste produced at the work sites. Waste arisings have been considered in terms of their suitability for:

- Reuse on site: as part of the development or future maintenance works;
- Reuse off site: materials of reusable value but for which a need cannot be demonstrated on site; and
- Recycling off site: where materials are suitable for recycling/treatment at an appropriately permitted facility.

4.1.3 The SWMP helps to ensure best practice and sustainable waste management is considered throughout. The SWMP will be updated with every design feature that will potentially have an impact on waste prevention, reduction or re-use.

4.1.4 The prevention of waste is the preferential option of waste management in terms of the hierarchy. Contractors are therefore required, through the SWMP to identify actions relating to waste prevention/minimisation.

4.1.5 In line with the Schemes commitment of the diversion of 80% (by weight) of CD&E materials to be re-used on site or removed from site for beneficial use with an aspiration to reach 95% (by weight), the following sections aim to highlight potential areas of waste minimisation and management that will be considered as part of the Scheme’s waste management strategy.

4.2 Reduction and Reuse

4.2.1 By implementing a SWMP from design stage it is possible to reduce the amount of waste produced as part of the Scheme.

4.2.2 The contractor will maximise opportunities for the potential for reuse and recycling of all waste streams on site.

4.2.3 Construction waste, or waste arising from imported material may be minimised through careful product specification and use.

4.2.4 Over-purchasing can lead to significant wastage and will be avoided in the first place. Ensuring materials are ordered for delivery shortly before they are used on the Scheme will also avoid possible damage and therefore wastage.

4.2.5 A continual review of the type of surplus materials being generated on site will aid in identifying approaches to reduce the amount produced.

4.2.6 Site set-up should maximise reuse or recycling and minimise disposal to landfill.

4.2.7 Materials delivered to the Scheme will be received and controlled by the Contractor. Materials will be stored to minimise the potential of damage or wastage. Measures will include off-ground storage e.g. on pallets, remaining in original packaging, protection from rain damage or collision by plant or vehicles.

4.2.8 The materials storage area will be secured during out of hours to prevent unauthorised access.

4.2.9 The use of precast concrete segments for the tunnel and other components of the Scheme will act to reduce the amount of concrete waste on site.

4.2.10 For any surplus material that may arise on site other options will be explored. These may include reuse on another site or take back options with the manufacturer.

4.2.11 If applicable, surplus inert excavated materials with some engineering strength (e.g. stone, bricks, clay, rubble, rock) may be suitable for reuse in land reclamation schemes. The material could be reused in other schemes in the surrounding area, if such a scheme was proceeding at the same time, to avoid disposal at landfill and the associated impacts and costs. Such a reuse scheme will need to be in accordance with all applicable legislation. This will require compliance with the criteria and thresholds for an Environment Agency issued exemption (U1 or U11 may be applicable) or it may require a permit under the Environmental Permitting Regulations 2010[3] as amended or compliance with CL:AIRE DoW CoP by production a materials management plan.

4.2.12 Although onsite soil reuse options will be used where applicable, it is still likely that there will be a requirement for importation of additional fill materials with specific properties such as structural backfill and topsoil.

4.2.13 If any materials, which are deemed acceptable, are produced from the enabling works (e.g. good quality topsoil), this will be stored and re-laid, within the Scheme or if this is not possible it will be sent to a topsoil recycling facility.

4.3 Segregation of Non-excavation Waste

4.3.1 Successful recycling relies upon early planning, clear responsibility and space within a compound for segregation and storage. Shelter may be needed to prevent some materials such as cardboard and paper from deteriorating while being sorted or awaiting collection.

4.3.2 A specific area shall be laid out and labelled to facilitate the segregation of materials, where possible, for potential recycling, reuse and return.

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[3] The Environmental Permitting Regulations, as amended in 2011 (SI 2011/2043), 2012 (SI 2012/630) and 2014 (2014/255)

4.3.3 Enclosed and lockable skips prevent deterioration of waste and also stops unauthorised access to the skips. Recycling and waste receptacles (e.g. skips) are to be kept clean and clearly marked in order to avoid contamination of materials. The following waste streams are currently identified for segregation:

- Plastics;
- Mixed inert (e.g. concrete and rubble);
- Hazardous (e.g. asbestos, polychlorinated biphenyls);
- Mixed non-hazardous (welfare waste and general waste);
- Metal (e.g. copper and iron);
- Wood (e.g. fencing/hoarding);
- Food (canteen waste);
- Paper and cardboard (office waste);
- WEEE (e.g. cables, disused electrical appliances and equipment); and
- Oils and oily rags.

4.3.4 Space requirements within the compound will need to be identified to accommodate skips and storage of reusable materials. Individual waste streams will be kept separate including the use of an excavated material only area.

4.3.5 For all waste management options within the red line boundary of the Scheme, consideration will need to be given to identifying whether waste exemptions or permits are required to enable the storage and treatment of waste materials.

4.3.6 Waste management options will be supported by the identification of appropriately permitted waste management and recycling facilities within an acceptable proximity to the Scheme. Further details are contained within the Receptor Site Assessment (RSA) document (Appendix to Document Reference 6.10) within the Environment Statement (Document Reference 6.1)

4.4 Colour-coded Skips

4.4.1 Different coloured skips (or sufficiently clear labelling) will be used to ensure that construction workers are clear about where to put each type of waste. This will reduce the levels of contamination in the skips and increases the likelihood that a load will not subsequently be rejected once the waste stream has been sent off-site for reprocessing. In cases where the load is rejected, the likely destination will be landfill (which will increase the costs of the Scheme).

4.4.2 Typical segregated skip categories and management methods include:

4.4.3 WRAP recommends the following materials and associated colour-code to aid material segregation on site:

- Wood (red/yellow);
- Plastic (orange);
- Plasterboard (blue);
- Bricks and rubble (green);
- Cardboard/paper (no colour coding specified); and
- General waste (no colour coding specified) .

4.4.4 The colour schemes adopted on site must be made clean to operative and simple labelling illustrating suitable material types for collection may be used in addition to colour coding.

4.4.5 Skips will be monitored by the Contractor to ensure that contamination of segregated skips does not occur.

4.5 Contaminated Land and Hazardous Waste

4.5.1 Samples should be taken at predetermined time frames appropriate to the type and quantity of soil.

4.5.2 Soils will be placed in clearly identified stockpiles and chemical testing undertaken to confirm the potential for reuse on site, or, if considered inappropriate for reuse (due to geotechnical or chemical properties or being surplus), to inform off site treatment and/or disposal routes. Where soil materials meet the geotechnical and chemical criteria for reuse given the proposed end use scenario, such materials may be reused on site, if required. Any surplus materials will be removed from site for either direct beneficial use elsewhere (such as land remediation schemes) or for recycling or recovery at an appropriately permitted off-site facility. Where excavated materials are affected by contamination, such materials will be separated and sent for either treatment, where appropriate, or disposal at appropriately permitted facilities.

4.5.3 The cost of hazardous waste treatment and disposal is significantly higher than treatment or disposal of non-hazardous or inert waste. Through identifying areas of contamination early on, the scheme layout and construction methods to be adopted could be amended to minimise the handling of such materials, potentially reducing the scheme costs. Any soils removed from site during construction will be subject to appropriate chemical characterisation and Waste Acceptance Criteria (WAC) testing to determine their destination facility i.e. type of landfill etc[4].

4.5.4 Hazardous waste cannot be re-used on site nor can it be mixed with non-hazardous or inert waste. There is a statutory requirement under the Landfill Directive[4] to pre-treat any waste (including hazardous waste) at the point of origin or at an alternative suitable site prior to disposal. Pre-treatment may reduce the cost of disposal by rendering the waste non-hazardous.

4.5.5 Where potentially hazardous materials are encountered, appropriate mitigation measures will be employed on site. The following list details best practice approaches:

- Prepare a 'quarantine' receiver location with a bunded perimeter to a suitable size compared to the assumed quantity of materials (a maximum height to be agreed);
- The storage area will have an impermeable base to prevent leachate escape to groundwater and will be protected against flood damage or inundation with any accumulated rainwater regularly emptied and managed appropriately. The area will be regularly checked and kept in a good condition, as well as being protected from vandalism; and
- Appropriate spill kits will be available, located near to the hazardous waste storage area and checks carried out regularly to ensure they are adequately stocked.

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[4] Landfill Directive 99/31/EC and Council Decision 2003/33/EC.

4.5.6 Once appropriate analysis has been completed, treatment and/or disposal of materials/waste can be carried out. Where this waste needs to be removed from site, a suitable disposal facility will be sourced.

4.5.7 Suitable facilities will be assessed as part of the RSA process.

4.5.8 The suitable facility must have the relevant licenses and permissions to receive the waste. Completed waste transfer notes (or consignment notes for hazardous waste) detailing the relevant waste codes must be raised and the waste moved from site with a licensed waste carrier. Wastes shall be moved under the requirements of the Duty of Care**.** Responsibility for the basic characterisation of waste rests with the producer.

4.5.9 All site staff will be made aware of their responsibilities and liabilities in terms of hazardous waste handling and management at site inductions and repeated during toolbox talks.

4.5.10 When hazardous waste is generated all efforts will be made to ensure it is not stored on site for any longer than is necessary.

4.6 Disposal and Treatment Options

4.6.1 It is anticipated that the majority of excavated material from the Scheme will be taken as “natural” material, the volume of which exceeds that for reuse on site. This material will therefore be transported to a suitable location such as a remediation scheme or another scheme. This approach works towards the commitments detailed within CoCP (Document Reference 6.10)

4.6.2 For excavated materials, suitable treatment, recycling and disposal facilities within a reasonable proximity of the Silvertown Tunnel site will be identified by the Contractor using the RSA. The RSA uses pre-determined criteria to assess the suitability of receptor sites to receive and treat the excavated materials. Sites which are closer to the Scheme will score higher than those which are further away.

4.6.3 For construction and demolition waste, suitable treatment, recycling and disposal facilities within a reasonable proximity of the Silvertown Tunnel site will be identified by the Contractor.

4.6.4 The Landfill Directive[4] requires that disposal sites are classified into one of three categories dependent on the chemical composition of the material; these are hazardous, non-hazardous or inert.

4.6.5 The ability for waste to be deposited at these sites will be dependent on the available space and the conditions imposed on the sites through the relevant licence/permit. Such facility details have been assessed as part of the RSA process.

4.6.6 For excavated materials that are confirmed to be non-hazardous or inert, by chemical screening and are below hazardous waste thresholds, there are a number of reuse and recycling options that could be explored, both on and off site.

4.6.7 The excavated materials (excluding hazardous materials) could potentially be used as infill, bunding and/or landscaping for the Scheme. Further uses could include the construction or maintenance of pavements, footings for fencing etc. Materials produced could also be used in the laying of roads around the site or stored for later use, providing there are adequate storage areas and the materials are adequately managed to minimise dust and runoff. The use of these materials would need to be undertaken under the relevant regulatory controls and appropriate guidance.

4.6.8 For any vegetation removed consideration will be given to mulching and/or composting. Reuse of such materials will be considered where possible i.e. mulch or compost to be reused back in the Scheme for landscaping purposes.

4.6.9 Table 4-1 details waste minimisation measure that may be implemented during the construction phase.

Table 4-1 Waste Minimisation Measures

Waste Minimisation Measures	
Excavation	• Excavation will be for highways, tunnels and portals and foundations. It is anticipated that any waste produced through the construction of the tunnels will be cut and fill, it is anticipated that a small amount maybe reused elsewhere on site. • Surplus excavated materials including soils, gravels and man-made fill can potentially generate the largest quantities of all the waste streams that will be removed off site. Preference for disposal should be given to off-site reuse following the waste hierarchy. • Excavated material suitable for reuse, where appropriate, will be stored for reuse as landscaping material or infilling.
Minimisation of vegetation clearance at the design phase	• The small amount of vegetation on site is predominantly grass with some shrubs; clearance of vegetation has the potential to be insignificant due to the nature of the area as former commercial and industrial/gasworks. • Identify, during the design phase, ways to minimise the loss of vegetation on site. Where minimisation is not possible, composting or mulching the vegetation will be considered for reuse in landscaping within the Scheme.
Minimisation of impacted materials arisings	• Where possible impacted material arisings will be treated and reused on site. This can act to minimise potential transport and disposal costs. This approach will be standard practice among designers and contractors.
Contractor targets	• The Contractor will consider setting off-cut/surplus targets for sub-contractors with a positive incentive scheme for on-site waste champions. • On site good practice construction wastage rates for the total amount of construction material handled on site should be achieved.
Imported material	• Enabling the purchase of materials in shape/dimension and form that minimises the creation of off-cuts waste. Avoiding over-purchasing as this can lead to significant wastage and will be avoided in the first place. Ensuring materials are ordered for delivery shortly before they are used on the Scheme will also avoid possible damage and therefore wastage. • Secure storage to prevent damaged materials/theft. Keeping deliveries packaged until they are ready to be used and the inspection of deliveries on arrival helps to reduce damage and wastage.

Waste Minimisation Measures	
Use of take back schemes	- Some suppliers offer a take back scheme, which will be utilised where practicable, particularly for packaging and pallets.
Monitoring and review	- Data from waste removal and the periodic review process (required as part of the SWMP) used to assess whether the waste objectives are being met, and if not to review procedures to steer the Scheme towards achieving them. This will require clear responsibilities to be identified, supported with authority and incentives to act on any deviations from the SWMP.
Education and awareness	- Site inductions are to include waste minimisation education and will be mandatory. Regular toolbox talks which all contractors and site workers will be expected to attend will also cover waste management education.
Consideration of end of life materials	- Consideration will be given to what will happen to the materials specified when they reach the end of their useful life. Where possible, elements will be designed for repair, modular repair, recycling at the end of life or safe disposal. The use of hazardous materials, in particular, will be minimised.

5. TRAINING

5.1 Overview

5.1.1 The Contractor will provide training to employees on the Scheme on the SWMP, roles and responsibilities and DoC.

5.1.2 On-site instruction and training covering appropriate waste separation, handling, storage, recycling, and reuse and return methods to be used by all parties (e.g. sub-contractors), at all appropriate stages of the Scheme.

5.1.3 Training will consist of an initial toolbox talk that will form part of the site induction process that introduces and explains the requirements of the SWMP and the concept of the waste hierarchy, as well as regular toolbox talks that provide updates on wider environmental issues. Workshops and other forms of training may be utilised where appropriate. Appropriate staff will be identified to attend these.

5.1.4 Where possible the Scheme will appoint a waste champion to act as a point of contact to deal with any waste queries from staff and promoting best waste management practice and be responsible for the upkeep of the SWMP.

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6. MONITORING

6.1 Overview

6.1.1 Under the Waste (England and Wales) Regulations 2011[2] and in line with Duty of Care, the Contractor has a number of responsibilities which it will execute as follows:

- To ensure that suitable storage is made available, including correct signage;
- To check the waste carrier has the appropriate waste carrier licenses; and
- To retain Waste Transfer Notes / Consignment Notes for 2/3 years as appropriate.

6.1.2 Responsibility for waste management lies with the Contractor unless a contractual agreement with sub-contractors to manage their own waste arisings exists – the contractor would still ensure that the Duty of Care process is in place when this situation occurs.

6.1.3 Duty of Care details are to be logged within the WRAP SWMP template under the appropriate tabs. Details are to include the waste management licenses, waste carrier licenses and exempt site licenses for waste management contractors employed on the Scheme. All waste management contractors licences must be checked and verified before any waste movement occurs.

6.1.4 Appendix B contains an extract from the WRAP SWMP template which will be populated with such detail, including waste management facility information once the Scheme commences.

6.1.5 All Waste Transfer Notes will be safely stored for two years. Consignment notes for the transport of hazardous waste will be held for three years. The Scheme could also consider using electronic transfer notes rather than paper based. An example of such a system is Department for Environment Food & Rural Affair's Electronic Duty of Care (Defra Edoc).

6.1.6 In addition to monitoring and recording the performance of contractors, waste management facilities could be monitored periodically through the lifespan of the contract. This will ensure that high standards of compliance and environmental performance are maintained throughout the supply chain, including accurate recording of waste types and the origin/destinations of wastes.

6.1.7 Waste monitoring will be included as an agenda item at construction progress meetings. In addition, this SWMP will be communicated to the whole project team (including TfL) at regular management meetings.

6.1.8 Throughout the project the Contractor will be responsible for reviewing the performance of all parties which are involved in the management of waste at the sites.

6.1.9 Progress towards the commitments contained in the CD&EMC (Appendix to Document Reference 6.10) will be reported regularly and performance will be reviewed and monitored in line with the CoCP (Document Reference 6.10)

6.1.10 A comparison of forecast and actual waste streams with key associated notes should be documented. This information could consist of explanation for diversion, lessons learnt and revision of plans.

7. ACTUAL QUANTITIES

7.1 Overview

7.1.1 Within the SWMP a record of the type and quantities of waste actually being produced and what has happened to this waste will be kept.

7.1.2 Appendix C contains an extract from the ‘Actual Waste Movements’ tab of the WRAP SWMP spreadsheet, to be completed. The table provides an example of how the waste movements will be logged, which ultimately feeds into actual waste figures for each waste activity (on subsequent WRAP template tabs).

7.1.3 Under this section the Contractor would be responsible for recording the: waste activity, ELoW code, method of management and where required the off-site carrier and destination and waste totals (amongst others).

7.1.4 Maintaining these records will also help to identify which waste streams are not achieving anticipated recycling potentials so that alternative methods to handle that waste stream can be explored for the remainder of the Scheme.

7.1.5 The actual quantities table within the WRAP SWMP template will be completed during construction phase and data taken from the amounts recorded on waste transfer notes and hazardous waste consignment notes.

7.1.6 This information then feeds into the summary of KPIs tab, which details key commitment information such as the amount of recycled, reused/beneficially reused and diverted from landfill quantities.

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8. REVIEW

8.1 Overview

8.1.1 The SWMP shall be reviewed on a regular basis, with waste data being entered frequently i.e. fortnightly or monthly. Further reviews shall take place where any significant changes occur. A log will be kept of when the plan has been reviewed and the outcomes.

8.1.2 An appropriate monitoring regime of the waste objective and targets shall be put in place.

8.1.3 Table 8-1 provides an example of a SWMP review checklist. This checklist should be completed at the start of the project, where possible and reviewed throughout the duration of project.

Table 8-1 Review Checklist

CHECKS – ENTER YES OR NO	YES	NO
Has a Waste management (WM) Contractor(s) been appointed with terms and conditions agreed?		
Have all WM Contractor(s) Carriers & Disposal Licences been checked & verified?		
Has a data reporting procedure been agreed with the WM Contractor(s)?		
Has a waste compound and segregation area been adequately set up & resourced?		
Has a SWMP implementation planning meeting been set up?		
Has the waste management document control process been set up?		
Have all necessary staff read & signed the SWMP?		
Have all site and sub-contractor staff been trained / briefed on SWMP requirements?		
Have waste management objective and targets been set?		
Has the SWMP received approval from the Project Lead?		
List comments and further actions if necessary.		

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9. POST SCHEME COMPLETION

9.1.1 At the end of the Scheme, both TfL and the Contractor are responsible for reviewing, revising and refining the SWMP as necessary, to ensure best practice and to identify if lessons could be learned for the next time a similar scheme is undertaken. This review will aim to identify and conclude the following:

- Confirmation that the SWMP has been monitored and updated within the defined timescales;
- An explanation of any deviation from the original plan;
- A comparison of the estimated quantities of each waste type against the actual quantities generated; and
- An action plan to address the lessons that have been learnt from the Scheme that could be implemented for the next scheme.

9.1.2 An estimation of the cost savings (if any) that have been achieved through the measures undertaken to minimise, reuse, recycle or recover waste arisings rather than disposal to landfill will be recorded.

9.1.3 The “reporting” tab of the SWMP summarises key performance indicators such as: diversion from landfill, cost of waste disposal and recovery of materials.

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Appendix A. Waste Forecast Tables (WRAP SWMP Extract)

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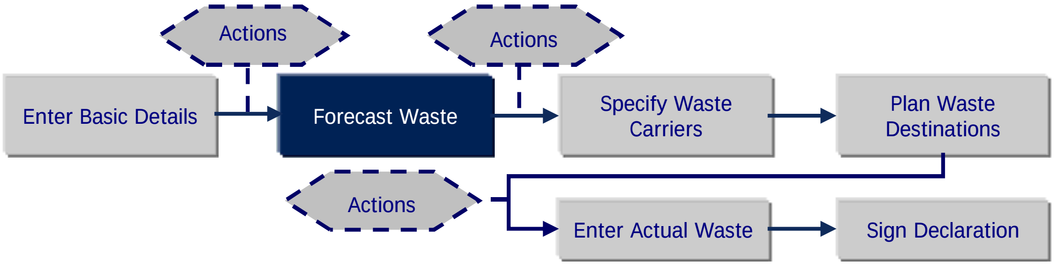

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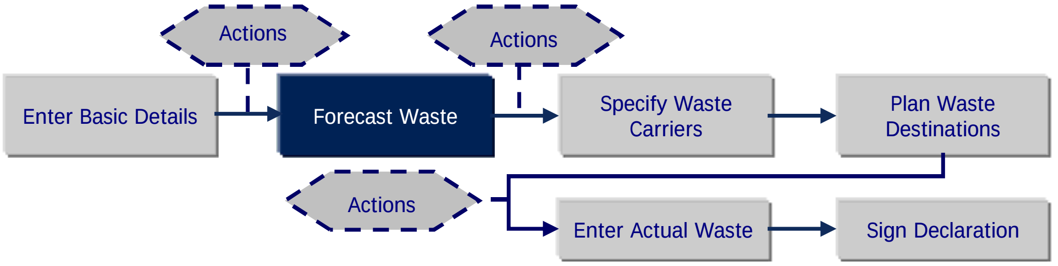
Forecast Waste

						Forecast Quantities		Calculated Quantities (Converting between m^3 and t)		
C, D or E Activity	**Waste Stream**	**Material Type**	**Further description of waste - optional**	**Suggested LOW Code**	**Waste or Re-Use**	**(m^3)**	**(tonnes)**	**(m^3)**	**(tonnes)**	**Forecast provided by**
Excavation	*Packaging*	*plastic packaging*	*plastic packaging*	*15 02 02*	*Off-site destination*	*###*	*###*	*###*	*###*	*A.N Other*
Excavation	Inert - Soil & stones	soil and stones (inert) other than those mentioned in 17 05 03	material from surface works.	17 05 04	Off-site segregated		56,319	45055.20	56319.00	S. Panesar
Excavation	Non Haz (Non Inert) - Soil & stones	Topsoil (non inert)	material from surface works and tunnel boring.	17 05 04	Off-site segregated		740,005	592004.00	740005.00	S. Panesar
Excavation	Segregated Haz - Soil & stones	soil and stones containing dangerous substances	material from surface works and tunnel boring.	17 05 03*	Off-site segregated		194,965	155972.00	194965.00	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	grout (tunnel) - miss pours and surplus - industry waste rate 7.5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated	1,003		1003.00	1273.81	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	STL (secondary tunnel lining) in situ concrete - miss pours and surplus concrete, industry waste rate 2.5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated	375		375.00	476.25	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	PTL (primary tunnel lining) - segmental concrete - damage to components - based on industry average waste rate of 5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated		1,662	1308.66	1662.00	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	structural concrete - miss pours and surplus - based on industry average waste rate of 2.5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated	3,074		3074.00	3903.98	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	mass concrete - miss pours and surplus - based on industry average waste rate of 2.5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated	374		374.00	474.98	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	concrete	structural concrete - utility building - miss pours and surplus - based on industry average waste rate of 2.5%. Values from Cost Estimate (Feb 2016).	17 01 01	Off-site segregated		78	61.42	78.00	S. Panesar



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Forecast Waste

						Forecast Quantities		Calculated Quantities (Converting between m^3 and t)		
C, D or E Activity	**Waste Stream**	**Material Type**	**Further description of waste - optional**	**Suggested LOW Code**	**Waste or Re-Use**	**(m^3)**	**(tonnes)**	**(m^3)**	**(tonnes)**	**Forecast provided by**
Construction	Inert - mixture of concrete, bricks, tiles etc.	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	Ruble and hardcore-utility building - damage to components, miss pours and surplus concrete / screed / blinding - based on industry average waste rate of 2.5%. Values from Cost Estimate (Feb 2016).	17 01 07	Off-site mixed		18	14.52	18.00	S. Panesar
Construction	Metals	iron and steel	structural steel - off cuts based on industry average waste rate of 7.55%. Values from Cost Estimate (Feb 2016).	17 04 05	Off-site segregated		110	268.29	110.00	S. Panesar
Construction	Metals	iron and steel	structural steel (reinforcing bar) - off cuts - based on industry average waste rate of 7.55%. Values from Cost Estimate (Feb 2016).	17 04 05	Off-site segregated	1,438		1438.00	589.58	S. Panesar
Construction	Inert - Glass	glass	Structural glass- based on industry average waste rate of 5%. Values from Cost Estimate (Feb 2016).	17 02 02	Off-site segregated		1	1.64	1.00	S. Panesar
Construction	Metals	mixed metals	VRS offcuts or surplus material. Based on 29kg per m. Value taken from Cost Estimate (Feb 2016)	17 04 07	Off-site segregated		1	2.38	1.00	S. Panesar
Construction	Metals	mixed metals	non ferrous - offcuts - calculated on 1% of total length of service buildings in metres. Values from tunnel service building quantities (Feb 2016)	17 04 07	Off-site segregated		4	9.52	4.00	S. Panesar
Construction	Metals	iron and steel	structural steel / reinforcements (utilities buildings) - offcuts - based on industry average waste rate of 7.55%. Values from tunnel service building qauntities (Feb 2016)	17 04 05	Off-site segregated		136	331.71	136.00	S. Panesar
Construction	Inert - mixture of concrete, bricks, tiles etc.	bricks	bricks -off cuts, damaged and surplus material - based on industry average waste rate of 5%. Values from tunnel service building quantities (Feb 2016)	17 01 02	Off-site segregated		218	181.67	218.00	S. Panesar

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Forecast Waste

C, D or E Activity	Waste Stream	Material Type	Further description of waste - optional	Suggested LOW Code	Waste or Re-Use	Forecast Quantities		Calculated Quantities (Converting between m^3 and t)		Forecast provided by
						(m^3)	(tonnes)	(m^3)	(tonnes)	
Construction	Inert - mixture of concrete, bricks, tiles etc.	tiles and ceramics	tiles - offcuts, damaged and surplus material - based on industry average waste rate of 5%. Values from tunnel service building quantities (Feb 2016)	17 01 03	Off-site segregated		2	3.39	2.00	S. Panesar
Construction	Gypsum (17 08 02)	gypsum-based construction materials other than those mentioned in 17 08 01	Gypsum from utilities buildings. 5% wasteage rate. Values from Cost estimate (Feb 2016).	17 08 02	Off-site segregated		12	36.36	12.00	S. Panesar
Construction	Packaging	mixed packaging	packaging from all components delivered to the site for works. No data available so assumed 1% of total waste as a result of imported material from the service buildings	15 01 06	Off-site mixed		126	600.00	126.00	S. Panesar
Construction	Other C&D segregated waste	track ballast other than those mentioned in 17 05 07	type 1 sub base - surplus. based on industry average waste rate of 13%. Values from Cost Estimate (Feb 2016)	17 05 08	Off-site segregated	3,405		3405.00	3701.92	S. Panesar
Excavation	Inert - Soil & stones	soil and stones (inert) other than those mentioned in 17 05 03	from cosntruction work- imported fill (soil); surplus material. based on industry average waste rate of 13%. Values from Cost Estimate (Feb 2016).	17 05 04	Off-site segregated	7,906		7906.00	9882.50	S. Panesar
Construction	Mixed C&D waste (17 09 04)	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	lighting - offcuts, damaged and surplus material. Based on 1% of total length of tunnels in metres. Values taken from Cost Estimate (July 2015) and (Feb 2016).	17 09 04	Off-site mixed	28		28.00	24.36	S. Panesar
Construction	Other C&D segregated waste	bituminous mixtures other than those mentioned in 17 03 01	bitumen surfacing - including roads and tunnels - miss pours and surplus material. Assumed to include kerbs, pathways, cycleways). Waste rate of 4.9%. Values taken from Cost Estimate (Feb 2016)	17 03 02	Off-site segregated	619		619.00	507.58	S. Panesar
Construction	Wood	wood	Timber from utilities buildings. based on industry average waste rate of 3.8%. Values from Cost Estimate (Feb 2016) .	17 02 01	Off-site segregated		17	50.00	17.00	S. Panesar

Material change for
a better environment

Actions
Actions
Enter Basic Details
Forecast Waste
Specify Waste Carriers
Plan Waste Destinations
Actions
Enter Actual Waste
Sign Declaration

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Forecast Waste

C, D or E Activity	Waste Stream	Material Type	Further description of waste - optional	Suggested LOW Code	Waste or Re-Use	Forecast Quantities (m^3)	Forecast Quantities (tonnes)	Calculated Quantities (Converting between m^3 and t) (m^3)	Calculated Quantities (Converting between m^3 and t) (tonnes)	Forecast provided by
Construction	Other C&D segregated waste	household plastics	drainage pipes, cables and ducts: offcuts - damaged and surplus material. Based on 1% of total length in metres. Value taken from Cost Estimate (Feb 2016)	20 01 39	Off-site segregated	368		368.00	51.52	S. Panesar
Demolition	Wood	wood	timber from building demolition	17 02 01	Off-site segregated	566		566.00	192.44	S. Panesar
Demolition	Gypsum (17 08 02)	gypsum-based construction materials other than those mentioned in 17 08 01	gypsum from building demolition	17 08 02	Off-site segregated	963		963.00	317.79	S. Panesar
Demolition	Metals	mixed metals	nonferrous metal from building demolition	17 04 07	Off-site segregated	482		482.00	202.44	S. Panesar
Demolition	Metals	iron and steel	ferrous metal from building demolition.	17 04 05	Off-site segregated	28,825		28825.00	11818.25	S. Panesar
Demolition	Inert - Glass	glass	glass from building demolition.	17 02 02	Off-site segregated	48		48.00	29.28	S. Panesar
Demolition	Inert - mixture of concrete, bricks, tiles etc.	tiles and ceramics	tiles form building demoliton.	17 01 03	Off-site segregated	157		157.00	92.63	S. Panesar

Appendix B. Waste Carriers (WRAP SWMP Extract)

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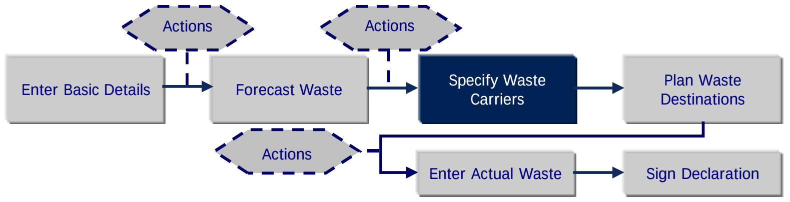

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Specify Waste Carriers

Name	Contact Details	Date checked with Environment Agency (dd/mm/yyyy)	Registration Number	Expiry Date (dd/mm/yyyy)

Specify Waste Management Facilities

Name	Type of facility	% reused if known	% recycled if known	% energy recovery if known	% total all forms of recovery	Overall diverted from landfill / recovery
						0%
						0%
						0%
						0%
						0%
						0%
						0%
						0%
						0%
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Appendix C. Actual Waste Movements

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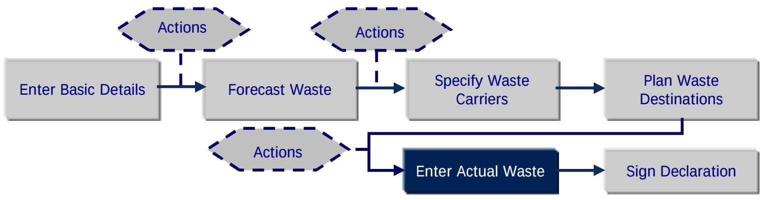

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Waste Totals

Display summary as:
Tonnes

Waste Stream	Total waste arising (Tonnes)	Total material retained on site (Tonnes)	Total waste sent offsite (Tonnes)	Total waste to landfill (Tonnes)	Total waste recovered offsite (Tonnes)	Cost of waste disposal
Inert - Soil & stones						£0.00
Hazardous - Soil & stones						£0.00
Non Haz (Non Inert) - Dredgings						£0.00
Segregated Haz - Soil & stones						£0.00
Gypsum						£0.00
Metals						£0.00
Wood						£0.00
Packaging						£0.00
Inert - Building rubble						£0.00
Inert - Glass						£0.00
Mixed Hazardous - C&D waste						£0.00
Mixed C&D waste						£0.00
Segregated Haz Waste						£0.00
Other C&D segregated waste						£0.00
Total						**£0.00**

Actual Waste Movements

												Waste Totals				
Movement Number	C, D or E Activity	Waste Stream	Material Type	Further description of waste - optional	LOW Code used	On or off-site destination	Off-site carrier	Off- site destination	Overide facility recovery rate for individual skip	Overall diversion from landfill / recovery (further detail on Sheet 4)	Date of Movement(s) (dd/mm/yyyy)	(m^3)	(tonnes)	Actual Cost	£ / m^3	£ / t
1										100%						
2										100%						
3										100%						
4										100%						
5										100%						
6										100%						
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Appendix F. Groundwater Monitoring Strategy

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Silvertown Tunnel

Groundwater Monitoring Strategy

Transport for London

September 2016

Notice

This document and its contents have been prepared and are intended solely for Transport for London's information and use in relation to the baseline groundwater monitoring for Silvertown Tunnel.

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Document history

<table>
<tr><th colspan="3">Job number: 5123288</th><th colspan="4">Document ref: STWTM-ATK-EWE-XXXX-RP-EN-0002</th></tr>
<tr><td>Revision</td><td>Purpose description</td><td>Originated</td><td>Checked</td><td>Reviewed</td><td>Authorised</td><td>Date</td></tr>
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Client signoff

Client	Transport for London
Project	Silvertown Tunnel
Document title	Silvertown Tunnel Groundwater Monitoring Strategy
Job no.	5123288
Copy no.	Rev P05
Document reference	STWTM-ATK-EWE-XXXX-RP-EN-0002

Table of contents

Tables

List of Abbreviations

AGS	The Association of Geotechnical and Geoenvironmental Specialists
AOD	Above Ordinance Datum
BGS	British Geological Society
BTEX & MTBE	Benzene Toluene Ethylbenzene Xylene and Methyl tert-butyl ether
CEMP	Construction Environmental Management Plan
CLEA	Contaminated Land Exposure Assessment
CQA	Construction Quality Assurance
COC	Contaminants of Concern
COCP	Code of Construction Practice
DCO	Development Consent Order
DNAPL	dense non aqueous phase liquid
DQRA	Detailed Quantitative Risk Assessment
ECC	Buro Happold Engineering
EH	Oxidation/Reduction Potential
EOH	end of hole
EPA	Environmental Protection Agency.
EPR	Environmental Permitting Regulations
GAC	granular activated carbon
GLA	Greater London Authority
GP-LTGWM	Greenwich Peninsula Long Term Groundwater Monitoring
m	metre
MCERTS	Environment Agency Monitoring Certification Scheme
MS	Microsoft
NAPL	non aqueous phase liquid
QA/QC	Quality Assurance / Quality Control
P	Proven
PAH	polycyclic aromatic hydrocarbons
PINS	Planning Inspectorate
RTD	River Terrace Deposits
STWTN-GI	Atkins Silvertown Tunnel Ground Investigation Project
SVOC	Semi-Volatile Organic Compounds
TBM	Tunnel Boring Machine
TfL	Transport for London
TOC	Total Organic Carbon
TPH CWG	Total Petroleum Hydrocarbons Criteria Working Group
UKAS	United Kingdom Accreditation Service
VOC	Volatile Organic Compounds

1. Introduction

The Silvertown Tunnel, a Transport for London (TfL) managed project, will provide an additional highway transport link between the Greenwich Peninsula and the Royal Docks at Silvertown. The Silvertown Tunnel project is currently in the process of obtaining a Development Consent Order (DCO), with the DCO application accepted for examination on 31 May 2016 by the Planning Inspectorate (PINS). Detailed design of the scheme is to be completed following engagement with a Contractor with procurement to be undertaken concurrently with the DCO process. At detailed design stage, further details regarding the exact tunnel alignment and dewatering requirements will be established.

This document outlines the Groundwater Monitoring Strategy which has been developed to inform the Environmental Statement and Code of Construction Practice, part of the DCO application. It is intended to provide the necessary overarching framework to allow for production of a detailed Groundwater Monitoring and Verification Plan, as part of detailed design and as required by the Code of Construction Practice, and to assess the potential impact to groundwater resources as a result of tunnel construction.

1.1. Objectives

This Groundwater Monitoring Strategy is intended to outline the requirements for the monitoring of groundwater during the baseline, construction and post construction phases of the Silvertown Tunnel project.

The overall aim of this document is to set out a strategy to monitor and manage the effects of the Silvertown Tunnel development, during and post construction, on groundwater quality and quantity within both the Upper and Lower Aquifers across Greenwich and Silvertown as a result of construction (including dewatering if required). This includes measures to monitor the following:

- baseline groundwater quality and quantity conditions prior to construction works being undertaken;
- changes in groundwater quality and levels as a result of dewatering and the effectiveness of mitigation measures to counter these effects;
- changes to the local hydrogeological regime as a result of construction and the effects on neighbouring structures and associated potential contaminant transport;
- the effects of long-term changes in groundwater pressures and the design of the tunnels and structures to accommodate these changes;
- potential for mobilisation of contaminants already present in groundwater by the creation of alternative pathways, or significantly altering existing pathways using sentinel monitoring boreholes to assess the impacts;
- early identification of trends towards derogation of pumping rights. Such monitoring would also inform mitigation actions that would need to be taken in the event of (or trends towards) derogation; and
- potential increased turbidity in groundwater due to the physical action of tunnelling construction within the Lower Aquifer and subsequent migration with the prevailing groundwater flow.

This document sets out a strategy to monitor groundwater during the life cycle of the Silvertown Tunnel project. The strategy is set out as follows:

- the development and implementation of baseline groundwater monitoring, where the data will be used to inform the following:
    - detailed tunnel design and subsequent dewatering requirements (if required);
    - site specific preliminary groundwater risk assessments and detailed groundwater risk assessments if required;
    - development of alert and trigger levels for construction;
    - a Groundwater Monitoring and Verification Plan; and

- a Dewatering Strategy (if required).

The content of the various report sections is as follows:

- Sections 3 provide site specific information with regards to the Silvertown Tunnel alignment including geology and hydrogeology, details of known sources of groundwater contamination and an outline of potential source-pathway-receptor linkages present along the alignment;
- Section 4 provides details and objectives of the Groundwater Monitoring Strategy;
- Section 5 outlines the requirements to be included within the Groundwater Monitoring and Verification Plan, including the overarching management protocols for the construction phase (and post construction phase) and an outline content for a monitoring plan to be produced by the appointed Contractor or their nominated representatives; and
- Section **Error! Reference source not found.** outlines the requirements to be included in the dewatering strategy and dewatering plan and summarises the project's approach to dewatering.

1.2. Project Context

1.2.1. Site Details

The proposed Silvertown Tunnel will link the Greenwich Peninsula at the A102 Blackwall Tunnel approach to the Royal Docks at Silvertown Way. The proposed tunnel alignment is shown on the General Arrangement Drawings (document reference 2.2). The tunnel will pass under the River Thames and will follow the general alignment of the London (Emirates) Cable Car.

For the purposes of groundwater monitoring the site is divided into two separate areas:

- **Silvertown** – located north of the River Thames within the London Borough of Newham. This area includes the Thames and Clyde Wharves with the Canning Town London Underground and Docklands Light Rail (DLR) station located to the north. The Royal Victoria Docks are located to the east approximately 100 m away from the proposed northern tunnel portal entrance; and

- **Greenwich Peninsula –** located to the south of the River Thames within the Royal Borough of Greenwich. This development area includes land around Edmund Halley/Millennium Way and Cutter Lane, with the O2 arena located on the northern edge. The area extends south within the confines of the Blackwall Tunnel approach and West Parkside.

Numerous assessments have been completed for the Silvertown Tunnel project which include in depth descriptions of the site. A concise background description is included within this strategy document (Section 3.4). For further information regarding the site and hydrogeological setting reference should be made to the Silvertown Tunnel 6.10 Environmental Statement, referenced below.

- Transport for London, 2016. Silvertown Tunnel 6.1 Environmental Statement TR010021 (ST150030-PLN-ZZZ-DSD-ZZ-0066), April 2016.

2. Scope of Groundwater Monitoring

The groundwater monitoring programme will be initiated ahead of construction to enable collection of baseline data. The data obtained would then be used to quantify any potential impacts produced by the Scheme. The groundwater monitoring programme would be designed to allow for ongoing construction monitoring. This would then be used to compare against pre-construction predictions and to initiate trigger and control measures, in the event of an identified risk starting to materialise. The Groundwater Monitoring and Verification Plan will contain measures for the monitoring of baseline, construction and post construction effects.

The monitoring regimes will be described in a Groundwater Monitoring and Verification Plan to be implemented for the life of the project. This is to ensure that TfL and the Contractor can identify and respond to changes in groundwater levels or groundwater quality as a result of any changes in the project design and/or the site conceptual model.

2.1.1. Baseline Groundwater Monitoring

Pre-construction baseline monitoring should commence as soon as practicable and continue until the commencement of construction or the implementation of the construction phase of the Groundwater Monitoring and Verification Plan.

The pre-construction monitoring will be used to establish a baseline which will inform the setting of alert and trigger levels, for both water quality and groundwater elevations, against which the construction and post construction phases can be compared. These alert and trigger levels will be proposed by TfL or their nominated representatives for discussion and agreement with the Environment Agency, as the principal controlled waters regulator. Any changes in the alert and trigger levels proposed by the appointed Contractor must be approved by TfL and agreed with the Environment Agency before being adopted.

2.1.2. Construction Monitoring

Construction groundwater monitoring will be undertaken throughout the project construction programme. The results shall be reported to TfL and the Environment Agency.

The monitoring requirements during construction will be outlined in the Groundwater Monitoring and Verification Plan (Section 5) to be completed following detailed design by the Contractor.

2.1.3. Post Construction Monitoring

Post construction monitoring will be required as part of the Groundwater Monitoring and Verification Plan. The extent of this monitoring will depend on the extent of impact the development has on the groundwater environment which will be identified through assessment of the baseline and construction monitoring data and the associated detailed design. TfL or its nominated representative will be responsible for ensuring that post construction monitoring is undertaken and satisfactorily reported.

Post construction monitoring will be undertaken until groundwater elevations and groundwater quality stabilise (details of what constitutes ‘stabilised’ conditions are to be confirmed). It is envisioned that a minimum duration of six months of monitoring will be required following the completion of construction, however the length of post construction monitoring will need to be assessed and agreed with the Environment Agency following detailed design stage.

3. Site Setting

3.1. Geology

The regional geology of the project area includes extensive made ground located to the northeast and southeast of the proposed routes of the Silvertown Tunnel. Table 3-1 below presents the regional geological sequence and typical strata boundaries and associated thicknesses are presented in Table 3-2 below.

Table 3-1 Regional Geological Sequence

System	Series	Formation
Quaternary	Holocene	Alluvium
	Pleistocene	River Terrace Deposits (RTD)
Palaeogene	Eocene	Bagshot Formation
		Thames Group (London Clay)
	Palaeocene	Lambeth Group • Woolwich Formation: Shelley clay, laminated beds with sand channels, 2 to 4 m thick in central London • Reading Formation: Highly variable; mottled clay and silt. Fine to medium grained sand in layers and channels may constitute up to 60% • Upnor Formation: Glauconitic sand with thin clay seams
		Thanet Sands
Cretaceous	Upper	Chalk Group

Table 3-2 Typical Strata depth and thicknesses for Silvertown and Greenwich

Formation	Greenwich			Silvertown		
	Top (m AOD) (Min – Max)	Bottom (m AOD) (Min – Max)	Thickness (m) (Min – Max)	Top (m AOD) (Min – Max)	Bottom (m AOD) (Min – Max)	Thickness (m) (Min – Max)
Made Ground	2.13 – 5.72	-0.91 – 2.57	0.91 – 6.2	1.35 – 5.28	-9.22 – 1.76	1.0 – 14.50
Alluvium	-0.91 – 2.57	-3.95 – -0.48	1.22 – 4.5	-3.23 – 1.76	-5.95 (EOH) - -1.1	1.45 – 7.7 (EOH)
River Terrace Deposits	-3.95 – -0.48	-10.96 – -6.88	5.95 – 8.38	-5.84 – -1.1	-8.74 – 4.43	1.6 – 4.4
London Clay Formation	-10.96 – -6.88	-16.93 – -11.86	0.9 – 6.8	-9.22 – -4.43	-22.3 – 16.54	9 – 17.9 (P)
Harwich Formation	-16.93 – -14.48	-22.76 – -15.39	1.02 – 5.83	-20.76 – -19.48	-25.48 – -20.54	0.52 – 5.17
Lambeth Group	-22.76 – -6.88	-35.26 – -18.8	8.9 – 14.8	-25.48 – -20.15	-40.08 (EOH) - -27.83	5.0 – 15.83
Upnor Formation	-35.26	-37.41	2.15	-38.97 – -36.37	-40.47 – -39.33	1.5 – 2.96
Thanet Formation	-37.41 – -18.8	-45.9 – 29.5	10.7 – 12.5 (P)	-40.47 – -39.33	-52.52 – 50.44	10.02 – 13.19
Chalk	-45.9	N/A	N/A	-52.52 - -50.44	N/A	N/A

P – Proven
EOH – End of Hole

Scour features have been identified during multiple investigations (BGS boreholes, Blackwall Tunnel assessments, Greenwich Peninsula gasworks assessments and Crossrail assessments) within the vicinity of the proposed Silvertown tunnel alignment. Three known scour features located within the vicinity of the assessment area are the Blackwall scour feature, Lea scour feature and the Greenwich Peninsula scour feature, the presence of further scour features in the vicinity of the site cannot be ruled out.

At the current design stage (reference design), geological cross sections produced during the Silvertown Tunnel Ground Investigation, indicate the Tunnel will be constructed through the Made Ground, Alluvium River Terrace Deposits, London Clay, Harwich and Lambeth Group.

3.2. Hydrogeology

There are two distinct aquifers identified in the area; an Upper Aquifer present within the RTD which is located above the low permeability London Clay Formation; and a Lower Aquifer within the Lambeth Group, Thanet Sand and Chalk. The Chalk is generally considered to be in hydraulic continuity with the overlying Thanet Sand and Lambeth Group though this is constrained to some degree by the elevated fines and subsequent relatively low vertical permeability continuity of the lower part of the Lambeth Group and the Thanet Sand. Also localised perched aquifers have been identified within the Alluvium and Made Ground.

The Environment Agency has classified the different geological units based on the water-bearing permeability of the deposit from which groundwater can be extracted. The Environment Agency has classified the Chalk as a Principal Aquifer based on its high fracture permeability meaning it has the ability to provide a high level of water storage and may support water supply and/or river base flow on a strategic scale. The Lambeth Group and Thanet Sands are classified as bedrock Secondary A Aquifers by the Environment Agency meaning they are capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The RTD is also classified as a Secondary A Aquifer by the Environment Agency while the Alluvium is classified as the Secondary Undifferentiated Aquifer meaning the deposit could not be classified as either a Secondary A or a Secondary B (predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering).

The London Clay is considered relatively impermeable and where present effectively hydraulically separates the Upper and Lower Aquifers. The London Clay is thickest on the northern side of the River Thames (Silvertown assessment area) and is thin (and maybe locally absent) on the southern side of the River Thames (Greenwich assessment area). Scour features also have the potential to increase the hydraulic connectivity between the Upper and Lower Aquifers. The Lambeth Group has been described as being predominantly granular in east London, and as such there may be some connectivity between the Upper and Lower Aquifers in the area where the London Clay is locally thin or absent. Where present, the laminated beds at the base of the Lambeth Group decreases this connectivity. The Upper Aquifer is likely to be subject to tidal influence due to its proximity to the River Thames. Perched water may be present within the Made Ground.

According to the Envirocheck report (2013) the proposed tunnel crossing is over 3 km away from the closest (to the north and southwest) groundwater source protection zones.

Long term groundwater monitoring has been completed in the vicinity of the Site for previous projects. These include the Greenwich Peninsula Long-Term Groundwater Monitoring programme and groundwater monitoring associated with the Crossrail project.

3.3. Licensed Abstractions

At the time of DCO submission there are 30 Environment Agency licensed abstractions within 5 km of the Silvertown Tunnel from both the Upper and Lower Aquifers as well as surface water. Of the 30, four licensed abstractions are within close proximity to the Silvertown Tunnel alignment on the Greenwich Peninsula and two are in close proximity to the tunnel alignment on the Silvertown side. Full details of these abstractions are presented in the Environmental Statement, Chapter 12 Geology and Soils. Further assessment into active licensed abstractions and the potential risk to this receptor will be assessed within the Assessment of

Risk described in Section 4.6 to be completed following both detailed design and baseline groundwater monitoring.

3.4. Historical Site Uses

Both Silvertown and the Greenwich Peninsula have historically been used for heavy industrial activity.

3.4.1. Silvertown

The principal contamination sources in the Silvertown assessment area are related to the former land uses including railway land (including coal and goods depots), manure works, chemical works, oil storage facilities, dockland warehouses, garages, and engineering works, as well as those associated with continued light industrial use. Present day activities include an aggregate manufacturing facility, waste recycling facilities and a scrap metal yard.

In addition to the potential on-site sources above, a number of potential off-site sources have been identified including the paint works to the south of Clyde Wharf and surrounding warehouses. Historical off-site land uses such as a former manure works, iron works and soap works are also considered potential contamination sources.

A landfill is situated at the location of the proposed northern tunnel portal and is associated with the infilling of the former Western Entrance lock to the Royal Victoria Dock.

3.4.1.1. Potential Groundwater Sources

An extensive investigation into identifying potential sources of groundwater contamination within the Silvertown site has not been completed to date. The main potential source of groundwater contamination is the former western entrance to Victoria Dock which has been backfilled and is designated as a landfill, the Silvertown Tunnel alignment crosses this dock at an angle. The various other land uses listed above, either along the alignment or in the vicinity, also have the potential to be sources of groundwater contamination.

3.4.2. Greenwich Peninsula

Historically the Greenwich Peninsula was dominated by the South Metropolitan Gas Works; considered to be a major source of ground and groundwater contamination. A single remaining gas holder and ancillary equipment currently operated by SGN Ltd. are the sole above ground remnants of the facility. The key sources of contamination identified during phases of ground investigation and remediation works in the 1990s on the Greenwich Peninsula, such as tar tanks and contamination hotspots, were removed; however residual soil and groundwater contamination is known to remain beneath much of the assessment area. This is particularly the case within the RTD, where residual dense non aqueous phase liquids (DNAPLs) have pooled in depressions in the London Clay surface.

To the southwest of the remaining gasholder, neighbouring the Blackwall Tunnel Approach, is a registered waste treatment / recovery site. It is understood that the site has since surrendered its licence and been issued with a completion certificate by the Environment Agency.

3.4.2.1. Potential Contaminant Groundwater Sources

Groundwater monitoring at Greenwich Peninsula has shown that the Upper Aquifer is predominantly contaminated, and is therefore considered a source of contamination. The north of the Greenwich Peninsula has specifically been identified as a zone of increased contamination within the Upper Aquifer as well as localised points within the Lower Aquifer. This area is understood to have held the main tar works including underground tar storage tanks, the London Clay is also locally thin or absent in this area and the Blackwall scour feature is located to the north northwest. In addition, inorganic contamination (specifically ammoniacal nitrogen) has been identified within the Lower Aquifer in other parts of the peninsula.

3.5. Silvertown Tunnel Construction Methodology

It is envisioned that two main proposed construction methods of cut-and-cover and bored tunnel will be used, Appendix B of the Construction Method Statement (ES Appendix 4A) (document reference 6.3) indicates the respective sections. It should be noted that the stated envisioned construction could be adopted for the scheme though the precise methods adopted by the contractor may vary.

The approaches to the tunnel at Silvertown and Greenwich are envisioned to be formed via cut-and-cover techniques as these sections are considered to be too shallow to be completed as bored tunnels. The walls of the cut-and-cover section are intended to be constructed using a combination of secant or diaphragm piling techniques. Once piled walls have been constructed it is probable that one of two methods of cut-and-cover construction will be implemented either top-down construction or bottom-up construction.

3.6. Potential Pollutant Linkages

A brief discussion of the potential pollutant linkages, as discussed within Transport for London Silvertown Tunnel Environmental Statement Chapter 12 (document reference 6.2) is presented below. Further assessment into the pollutant linkages present at the site and the risk to receptors will be assessed within the Assessment of Risk described in Section 4.6 to be completed following both detailed design and baseline groundwater monitoring.

3.6.1. Sources

- **Silvertown** - ground investigations and monitoring have identified contamination both within soil and groundwater at Silvertown. A number of potential sources of contamination within the assessment area and surrounding area which may be mobilised by dewatering activities have also been identified. The primary potential source of contamination is considered to be within the RTD groundwater itself.

- **Greenwich Peninsula** - sources of contamination within the assessment area and surrounding area, predominantly associated with the historical gasworks site use, have the potential to be mobilised by dewatering activities. Contamination has previously been identified within the Upper Aquifer and in localised areas of the Lower Aquifer.

A comprehensive groundwater contamination assessment has not been completed within close proximity of the Silvertown Tunnel alignment.

3.6.2. Pathways

The potential pathways considered relevant are discussed below:

- dewatering from the shallow aquifer (RTD) and or Lower Aquifer (Thanet Sand / Chalk);
- creation of preferential pathways: The introduction of the proposed tunnel between the Silvertown and Greenwich sites or the removal of underground structures prior to using the tunnel boring machine (TBM) may create preferential pathways for contamination within the shallow aquifer;
- direct discharge of abstracted groundwater to the surrounding environment – a quantitative risk assessment should be undertaken at detailed design stage to provide assessment criteria against which the discharged water can be monitored.
- migration of contaminants from off-site (e.g. wider Greenwich Peninsula etc.) towards the area of dewatering;
- migration of contaminants towards cleaner areas of the Greenwich Peninsula;
- vertical migration of contaminants from RTD following increased hydraulic gradient between the two aquifers, this may be of particular relevance where London Clay is thin or absent;
- lowering of piezometric heads and interference with other nearby abstractions – a quantitative assessment may be required to assess the potential impact of local abstractions; and
- hydraulic connectivity between the upper and Lower Aquifers: local thinning of the London Clay has been documented on the Greenwich Peninsula, there is also the possibility for scour features to be present which have the potential to increase the hydraulic connectivity. Piezometric pressures also suggest that in areas of the peninsula there may be a hydraulic connection between the Upper and Lower Aquifers.

3.6.3. Receptors

The following receptors have been identified with the potential to be impacted by changes in quality, quantity or both:

- potential discharge points. Previous dewatering in the area, undertaken by Crossrail, was discharged into the River Thames, nearby docks, or reinjected into the aquifer. Discharge options will be assessed following detailed design but it is likely that similar options for discharge as employed by Crossrail will be considered;
- third party groundwater users. Multiple third party users have been identified in the vicinity of the sites;
- groundwater within the Upper Aquifer; and
- groundwater within the Lower Aquifer.

3.6.4. Monitoring of linkages

The identified potential linkages discussed above are based on current information. The potential linkages will be further assessed through investigation and monitoring as the design develops to help inform the Groundwater Monitoring and Verification Plan.

4. Groundwater Monitoring Strategy

4.1. Groundwater Monitoring Strategy

4.1.1. Objectives and Rationale

Based on the source-pathway-receptor linkage model, monitoring of groundwater is proposed to enable the following:

Baseline:

- collection of a groundwater level dataset to be used as a baseline such that an assessment can be completed as to whether or not the tunnel has significantly impacted groundwater flow during construction and operation;
- collection of a groundwater quality dataset to establish baseline groundwater quality, identify trends and determine trigger levels, where possible;
- assessment of risk of mobilisation and migration of pre-existing contaminants affecting the groundwater (i.e. if source-pathway-receptor linkages exist);
- direct the placement of sentinel monitoring boreholes to be utilised during construction to ensure that mobilisation of contaminants is not adversely affecting identified receptors; and
- enable the development of site specific alert and trigger levels and the development of a contingency plan.

Construction and Post Construction Phases:

- Collection of groundwater quality samples during both phases, to establish whether:
  - mobilisation and migration of contaminants has taken place; and
  - significant changes in water quality as a result of dewatering and tunnel seepages have occurred.
- To ensure alert and trigger levels are not exceeded and if they are that the contingency plan is activated.

4.2. Baseline Assessment and Compliance Criteria for Groundwater

The Code of Construction Practice (document reference 6.10) sets out that the Contractor will be required to undertake pre-construction baseline monitoring to help inform the Groundwater Monitoring and Verification Plan. To facilitate this, a proposed baseline groundwater level and quality monitoring plan has been included in Appendix A. A proposed list of monitoring wells is included within the proposed baseline monitoring plan. Following an assessment into the viability of these wells the Baseline Monitoring Plan will be submitted to the Environmental Agency for information. Baseline monitoring should be implemented as soon as practicable and continue until the commencement of construction or the implementation of the monitoring plan outlined in Section 4.8. It is suggested that at least 12 months of monitoring is completed prior to the commencement of construction of the Silvertown Tunnel, but this shall be agreed with the regulators in advance of monitoring.

A Baseline Monitoring Report will be produced incorporating the collected baseline groundwater level and water quality data and will outline a typical range for both groundwater levels and selected contaminants of concern (COC) for the site. The report will also include initial assessment and compliance criteria (developed in conjunction with the Groundwater Risk Assessment detailed in Section 4.5) against which project impacts can be assessed as part of the Groundwater Monitoring and Verification Plan. Baseline data, in conjunction with the detailed design, will also be used to select sentinel monitoring boreholes which will be used to monitor the potential movement of contamination throughout the construction phase of the project. The initial criteria will be derived in consultation with the Environment Agency.

A two-tier system of screening criteria shall be adopted:

- assessment criteria (alert levels) will be used to provide an early warning of potential issues; and
- compliance criteria (trigger levels) will be used to identify potentially significant risks to receptors.

4.3. Alert and Trigger Levels

Alert levels will be used on a day-to-day basis by the Contractor. Alert levels aim to draw the attention of the Contractor's site management team to the development of adverse trends in groundwater conditions. The alert levels should be treated primarily as an early warning system to enable appropriate investigative or corrective measures to be implemented so that the risk of breaching a compliance limit can be reduced and before impacts can cause harm to the environment or human health.

Comparison of measured water quality with trigger levels will be used to demonstrate compliance with agreed water quality standards to stakeholders. Trigger levels are standards to be agreed with the Environment Agency through the approval of the Groundwater Monitoring and Verification Plan. Breaches of the trigger levels should be prevented. Should a breach of a trigger level occur a Contingency Action plan will be implemented, this is outlined in Section 4.7.

Alert and trigger levels will not be derived for every water quality monitoring determinand. Instead, key indicator parameters will be identified using a risk-based approach that reflects the baseline water quality dataset, extent of dewatering required, discharge points and identified receptors. The indicator parameters will be agreed with the Environment Agency through the approval of the Groundwater Monitoring and Verification Plan. The choice of indicator parameters will be reviewed by the Contractor at least annually for adequacy; any proposed changes must be approved by TfL and the Environment Agency prior to implementation.

Alert and trigger levels may be derived on a borehole-specific basis. The levels will be based on the baseline dataset and will take into account existing variability and trends. Statistical methods will be used, where possible, to derive appropriate alert and trigger levels. The alert and trigger levels will be reviewed at least annually by the Contractor for adequacy; any proposed changes must be approved by TfL and the Environment Agency prior to implementation.

The alert and trigger levels, and associated procedures, will determine whether contingency plans need to be activated. The assessment process will involve evaluation of the significance of a departure from baseline conditions.

4.4. Sentinel Monitoring Boreholes

Sentinel monitoring boreholes, which will provide an early warning to the mobilisation of contamination, will be selected following analysis of the baseline dataset and completion of the detailed design and subsequent scope of dewatering required. These monitoring boreholes could be a combination of already established monitoring locations and newly installed boreholes, depending on the specific scope of dewatering and availability of existing monitoring locations. The selected sentinel monitoring borehole details, justifications and associated alert and trigger levels will be submitted to the Environment Agency by the contractor for review and approval in the Groundwater Monitoring and Verification Plan.

In the event that new monitoring boreholes / sentinel monitoring boreholes are required, a dataset will need to be established prior to the commencement of construction. A dataset of 12 months of monitoring for each sentinel monitoring boreholes is desirable. However in the event that new sentinel monitoring boreholes are required a minimum four rounds (over a minimum of four months) of monitoring data should be collected (groundwater level and quality) to provide a reasonable baseline, however, this will depend on the scope of dewatering and will be subject to Environment Agency agreement.

4.5. Deliverables

A one-off pre-construction groundwater Baseline Monitoring Report will be provided to the Environment Agency. The Baseline Monitoring Report which will be completed prior to the start of construction, will contain the following:

- relevant historical and current groundwater level and quality data;
- interpretation of data;
- trends in key water quality parameters;
- appropriate alert and trigger levels defined at this stage; and
- an outline of sentinel boreholes selected for the project to monitor the movement / migration of contamination.

4.6. Assessment of Risk

If during detailed design it is identified there is a potential risk to receptors then a Groundwater Risk Assessment will be required to assess all source-pathway-receptors linkages, as explained in the Code of Construction Practice.. If dewatering is required as part of the construction process a detailed qualitative risk assessment (DQRA) maybe required to assess the risks to controlled waters from dewatering. This/these document(s) will be submitted to the Environment Agency for information. The Groundwater Risk Assessment / DQRA will inform the following:

- the requirement for further assessment of identified potential impacts to receptors through detailed risk assessments;
- further development / verification of appropriateness of alert and trigger levels;
- the development of the Groundwater Monitoring and Verification Plan including the requirement for additional and/or more frequent monitoring relative to the baseline programme (including long term monitoring) based on the risk identified;
- inform additional groundwater monitoring requirement to be implemented during periods of dewatering; and
- remedial groundwater treatment as mitigation shall be proposed where a detailed quantitative risk assessment identifies an unacceptable risk to receptors. The proposal shall include an options appraisal and full details of the remedial works required and how they are to be undertaken.

4.6.1. Deliverables

The Groundwater Risk Assessment and the DQRA if required will be completed and submitted to the Environment Agency, for information, following the completion of detailed design, the establishment of dewatering requirements and baseline monitoring.

4.7. Contingency Action Plan

A Contingency Action Plan will be developed following baseline monitoring in conjunction with the Baseline Monitoring Report, Groundwater Risk Assessment and Groundwater Monitoring and Verification Plan. If during construction or operation, trigger levels are exceeded, the Contingency Action Plan will be implemented. The Contingency Action Plan will include the following:

- notification of the exceedances to the Environment Agency, as soon as possible;
- determining the cause of any exceedances;
- evaluation of location, likely scale, duration and effect; and
- identification of appropriate mitigation or remediation measures.

In all cases, the need for remediation should be balanced against the risk posed to groundwater receptors and the benefits gained by remediation. Remedial actions and their objectives will be agreed in advance with the Environment Agency.

Any exceedances of alert levels will be reported to the Environment Agency using the agreed reporting process outlined in Section 5. Only in cases where trigger levels are subsequently exceeded will the Environment Agency be contacted specifically.

4.8. Groundwater Monitoring and Verification Plan

A Groundwater Monitoring and Verification Plan is to be developed to implement the Groundwater Monitoring Strategy (Section 4.1) during construction and post-construction and will be developed by the Contractor following detailed design. The Groundwater Monitoring and Verification Plan will include the following aspects as well as include measures identified within the following assessments:

- provide a methodology and schedule for groundwater level and quality monitoring;
- baseline monitoring data including updated alert and trigger levels;
- detailed design – dewatering requirements; and
- measures identified through any risk assessment / detailed risk assessment completed for the project.
- provide methodology and schedule for additional groundwater and quality monitoring to be carried out during dewatering activities (if required)
- outline post-construction monitoring requirements both in frequency and duration. The post construction monitoring requirements will depend on the extent of dewatering required for construction.

The objectives of the Groundwater Monitoring and Verification Plan are to:

- enable routine monitoring of groundwater levels and quality during construction and post-construction to discern breaches of alert and trigger levels;
- review combined monitoring results across the project area as a whole, during construction, to assess impacts; and
- carry out routine monitoring of groundwater levels and quality during construction and post-construction to discern breaches of alert and trigger levels.

5. Requirements for Groundwater Monitoring and Verification Plan

The Groundwater Monitoring and Verification Plan document aims to aid the implementation of the Groundwater Monitoring Strategy outlined in Section 4.1.

The objectives of the Groundwater Monitoring and Verification Plan are:

- to ensure groundwater level and quality monitoring is appropriate with respect to detailed design using a risk-based groundwater monitoring network;
- enable routine monitoring of groundwater levels and quality during construction is undertaken by Contractors to discern breaches of alert and trigger levels;
- to outline post-construction monitoring requirements and provide a mechanism for cessation of monitoring. The duration of post-construction monitoring will depend on the effects construction activities have on the groundwater environment;
- provide a methodology to ensure consistency of monitoring techniques and outline quality assurance and quality control requirements; and
- the Contractor shall be responsible for preparing the Groundwater Monitoring and Verification Plan. The Groundwater Monitoring and Verification Plan must be approved by TfL and the Environment Agency prior to construction works which may affect groundwater on site.

5.1. Proposed Scope of Groundwater Monitoring and Verification Plan

The Groundwater Monitoring and Verification Plan will include the following elements:

- management structure, including roles and responsibilities within Contractor team;
- monitoring network already in existence;
- monitoring measurements and laboratory analysis to be obtained and the methodology;
- monitoring and analysis schedules;
- data management procedures, data review procedures, including comparison with assessment and compliance criteria;
- contingency actions;
- reporting procedures; and
- details of the quality assurance / quality control (QA/QC) protocols that will be implemented to provide confidence in the groundwater monitoring results.

The Groundwater Monitoring and Verification Plan shall be a live document and subject to regular review by TfL for adequacy (at least annually). The Contractor will not deviate from the approved Groundwater Monitoring and Verification Plan without written permission from TfL and the Environment Agency.

5.2. Monitoring

The Groundwater Monitoring and Verification Plan will present details regarding the groundwater monitoring network that will be monitored during the construction and post-construction phases.

As a minimum, groundwater monitoring will be undertaken in the monitoring boreholes summarised in Appendix A. Additional monitoring locations may be required following the completion of detailed design and subsequent risk assessments (if required).

The Contractor will be responsible for maintaining the groundwater monitoring network during the construction phase and ensuring critical monitoring wells are retained throughout works and post-construction.

The Groundwater Monitoring and Verification Plan will include a protocol and schedule for regular monitoring location inspection and maintenance. This will include procedures for the repair and replacement of monitoring locations as required.

Each new or repaired monitoring point will be designed, constructed, supervised and certified in accordance with normal engineering construction quality assurance (CQA) procedures. Detailed borehole logs for each monitoring point will be provided.

An up-to-date register of all monitoring points will be incorporated within the Groundwater Monitoring and Verification Plan and Annual Interpretative Report.

5.2.1. Monitoring Methodology

The Contractor will be responsible for undertaking groundwater monitoring, a proposed methodology is included in Appendix B.

The Groundwater Monitoring and Verification Plan will present details regarding the groundwater monitoring methodology that will be implemented during the construction and post-construction phases for approval by the Environment Agency.

The Groundwater Monitoring and Verification Plan will specify a process for managing any required changes in monitoring methods, procedures or protocols over the life of the project taking into account the need for reliable comparison of future monitoring results against the baseline dataset.

The Groundwater Monitoring and Verification Plan will specify the following for each methodology used:

- the measurement method;
- detailed protocols for sampling and/or measurement and record keeping; and
- QA/QC protocols.

5.2.2. Sampling and field analysis

The Groundwater Monitoring and Verification Plan will specify field protocols with respect to:

- monitoring network condition inspections;
- in situ groundwater measurement protocols:
  - manual measurements; and
  - data loggers.
- water sampling method(s) and protocols, including purging (where appropriate);
- field analysis protocols;
- sample handling protocols;
- sample containers and preservation;
  - sample labelling;
  - sample storage and transportation; and
- QA/QC protocols.

The samples collected and measurements made should not be affected by contamination associated with surface run-off, contact with the sampling equipment or extraneous matter that may have entered the monitoring structure. Nor should they be affected by the products of reaction with materials used in the construction of the monitoring point, sampling equipment or containers.

The Groundwater Monitoring and Verification Plan shall reference appropriate protocols for managing any waste waters generated during sampling procedures (e.g. purging).

The Groundwater Monitoring and Verification Plan shall reference appropriate protocols for managing HSE hazards and risks during field activities.

5.2.3. Laboratory analysis

The Groundwater Monitoring and Verification Plan shall specify laboratory analysis protocols with respect to:

- laboratory selection, including accreditation requirements (UKAS and MCERTS accredited);
- analytical suite (as per the project list at the time);
- analytical methods;
- detection limits; and
- QA/QC protocols.

The analytical methods adopted should not be affected by cross contamination, poor recovery and interference or instrument errors.

5.3. Monitoring Schedule

The Groundwater Monitoring and Verification Plan shall present a detailed schedule for groundwater monitoring during construction, dewatering and post-construction phases of work. The monitoring schedule will ensure that identified risks to groundwater from construction activities are monitored such that potential moderate and large adverse effects are identified such that actions can be implemented to ensure the security of receptors.

5.3.1. Data Management and Review

The Contractor shall be responsible for managing the groundwater monitoring data collected.

The Groundwater Monitoring and Verification Plan will specify protocols for data management, including:

- data collection;
- data collation;
- data verification; and
- data storage.

As a minimum, monitoring data will be checked for laboratory and scheduling inconsistencies within five working days of receipt.

The Contractor will be responsible for keeping original monitoring records and submitting these to TfL on completion of construction.

Water level and quality data will be stored in Excel-compatible formats.

Initial alert and trigger levels will be provided to the Contractor by TfL at the start of the construction period.

The Contractor or nominated representative will be responsible for reviewing the groundwater monitoring data collected and for interpreting the results.

The data review process will be undertaken in a timely manner. The Groundwater Monitoring and Verification Plan will specify the required timescales for data reviews and turnaround times at analytical laboratories.

The Contractor's review of the verified data will include:

- comparison of actual against specified monitoring;
- evaluation of significance of QA/QC data;
- application of assessment and compliance tests;
- a review of the conceptual site model (i.e. current understanding of the hydrology and hydrogeology of the site); and
- a review of the significance of risks and impacts including comparison of data collected against alert and trigger levels.

The Contractor will be responsible for ongoing review of the alert and trigger levels for adequacy during the construction period.

When risks are re-evaluated or monitoring data reveal unexpected variations or trends, it may be necessary to review and occasionally change assessment or compliance criteria. However, any proposed changes to the alert and trigger levels used in the Groundwater Monitoring and Verification Plan need to be justified technically and may be implemented only after consultation and agreement between the Contractor, TfL and the Environment Agency.

5.4. Dewatering

Dewatering may be required to complete the construction of the Silvertown Tunnel, if dewatering is required the following approach will be taken and appropriate measures will be included within the Groundwater Monitoring and Verification Plan.

5.4.1. Approach to Dewatering

When developing the final construction methodology, the Contractor will consider suitable control methods to manage groundwater ingress and dewatering. The Contractor will liaise with the Environment Agency to determine the need for detailed assessment of dewatering impacts.

The project will implement measures to ensure that the following objectives are met:

- the project is compliant with Environmental Permitting Regulations (EPR) – Schedule 22 (England and Wales) 2010 with respect to dewatering;
- adequate protection of surface water and groundwater resources, in line with principles as set out under the Water Resources Act 2003 (required for abstraction licence applications);
- construction effects arising directly or indirectly from dewatering systems and from discharges to the water environment are mitigated; and
- movements of poor quality groundwater as a result of dewatering activities will be minimised.

The Environment Agency propose to implement changes to the licensing policy which will mean that licences with damaging effects on the environment will not be issued by the Environment Agency. A number of previously exempt activities, including dewatering, are likely to require authorisation from the Environment Agency (licences or permits) from 2016 onwards. As set out in the COCP the Contractor will be responsible for obtaining all necessary licences and permits from the Environment Agency prior to dewatering commencing (TfL has applied through the DCO to disapply the need for abstraction licences and/or permits in which case the Contractor will need to meet the requirements stipulated within the DCO). The Contractor will be responsible for ensuring compliance with the conditions of all licences and permits granted by the Environment Agency.

On the Greenwich Peninsula and, potentially at Silvertown, it is likely that water pumped from the ground via dewatering systems will require some form of treatment prior to discharge. An appropriate discharge point/s will be assessed prior to the commencement of dewatering and approval from appropriate statutory authorities will be obtained (i.e. the Environment Agency and/or Thames Water).

5.4.2. Dewatering Plan

A Dewatering Plan will be developed the objectives of which are to ensure that any negative environmental impacts arising directly or indirectly from dewatering systems and discharges to the water environment are mitigated.

The plan will be developed by the Contractor and submitted to the Environment Agency for approval as a requirement of the Groundwater Monitoring and Verification Plan. The structure and content of the plan will include the following:

- an overview of expected dewatering;
- preliminary and detailed (if required) dewatering risk assessment;
- summarise all the licences and permits to abstract and discharge from dewatering systems issued by the Environment Agency; and
- A Method Statement.

Prior authorisation will be obtained from Thames Water for groundwater discharge to sewer and an outline of pre-treatment measures will be provided to the Environment Agency and/or Thames Water for approval.

5.4.3. Dewatering Method Statement

Method statements shall include the following:

- main discharge points;
- details of bore installation;
- details of monitoring network (surface and groundwater);
- details of equipment used;
- proposed construction sequence;
- licences and permits from the Environment Agency;
- prior authorisation from local sewerage provider; and
- outline of any pre-treatment required prior to discharge, approved by the Environment Agency/Thames Water.

5.4.4. Dewatering Overarching Management Protocols

TfL or their nominated representative will review and approve the site-specific dewatering plans prior to submission to the Environment Agency for approval.

TfL will review the monitoring reports, as required under the various permits and provide comments to Contractor within four weeks of receipt of all the reports.

6. Contingency Planning

The Groundwater Monitoring and Verification Plan will make reference to the Contingency Action Plan with any necessary updates required. The Contingency Action Plan will describe a phased contingency response process that will be implemented so that risks to the project and nearby receptors can be assessed and managed in the event of any breach of approved alert or trigger levels.

Where risks are unacceptable, corrective or remediation measures will be initiated and a strategy to monitor their effectiveness will be determined within one week of the trigger level exceedance being confirmed by the laboratory and in consultation with the Environment Agency.

In all cases, the need for remediation should be balanced against the risk posed to groundwater receptors and the benefits gained by remediation. In complex cases, specialist advice should be taken and remedial actions and their objectives agreed in consultation between the Contractor and the Environment Agency.

Recommended contingency strategies are outlined below; the Groundwater Monitoring and Verification Plan may include alternative or additional contingency plans as appropriate. The Contingency Action Plan shall specify the required timescales and parties responsible for implementing each action.

6.1. Assessment Criteria (Alert Levels)

Assessment criteria are intended to draw the attention of site management to the development of adverse trends in monitoring data or the breach of a specified alert level. The assessment process will involve the evaluation of the significance of a departure from baseline conditions. The assessment criteria should be treated primarily as an early warning system to enable appropriate investigative or corrective measures to be implemented, particularly where there is the potential for a compliance limit to be breached.

The Groundwater Monitoring and Verification Plan shall specify the assessment criteria being applied, including the alert levels and the protocols for identifying adverse trends.

If an alert level is breached on a single occasion the following actions will be taken by the Contractor:

- notify Site Management Team;
- repeat sampling round if no routine sampling is planned within seven days; and
- report in next quarterly factual monitoring report.

If an alert level is breached on three consecutive monitoring rounds or if the annual review process identifies significant adverse trends in four monitoring rounds, further assessment will be required as follows:

- characterise observed issues (desk-based data review), including:
    - parameter(s) involved;
    - magnitude of exceedance(s);
    - frequency of exceedance(s);
    - spatial pattern; and
    - temporal trends.
- review relevant site activities;
- review potential cause(s) for observed results;
- review monitoring plan for adequacy;
- undertake additional investigation or monitoring (if required) to better characterise issue; and
- identify likely cause(s) for observed results.

If the observed issue is considered to relate to the project the following actions will be taken by the Contractor:

- consult with regulator(s)/stakeholders (as appropriate);
- review significance of potential risks to receptors;
- implement mitigation measures (as appropriate) to try and halt or reverse adverse trends and/or manage risks for receptors; and
- carry out ongoing monitoring at an increased frequency and review to confirm effectiveness of measures implemented.

The assessment findings and actions will be reported in the next monitoring report.

6.2. Compliance Criteria (Trigger Levels)

If a trigger level is breached on a single occasion:

- notify Site Management Team in writing;
- undertake Assessment of Significance (desk-based data review):
    - parameter(s) involved;
    - magnitude of exceedance(s);
    - frequency of exceedance(s);
    - spatial pattern;
    - temporal trends; and
    - risks to nearby receptors.
- repeat sampling round if no routine sampling is planned within seven days; and
- prepare notification report and inform key stakeholders.

If a trigger level breach:

- occurs on two consecutive monitoring rounds;
- is part of a significant adverse trend;
- is considered to indicate an immediate and significant risk to nearby receptors.

The Contractor will undertake the following additional actions:

- prepare a notification report and inform key stakeholders (e.g., Environment Agency, TfL), as soon as possible;
- notify other relevant stakeholders within one week as appropriate, e.g., other abstractors;
- review relevant activities occurring on site;
- review potential cause(s) for observed results;
- review existing monitoring plan for adequacy;
- undertake additional targeted monitoring or investigation (if required) to characterise the issue better; and
- identify likely cause(s) for observed results.

If the observed issue is considered to relate to the project:

- review significance of risks to nearby receptors;

- develop strategy within one week of the Trigger Level exceedance being confirmed by the laboratory, to mitigate and/or remediate issue(s) in consultation with key stakeholders;
- implement mitigation and/or remedial measures (as appropriate) to reduce risk of future breaches affecting project or nearby receptors; and
- ongoing monitoring and review to confirm effectiveness of measures implemented.

The assessment findings and actions will be reported in Notification Report to be submitted to TfL and the Environment Agency within a time frame approved by TfL and the Environment Agency.

6.3. Emergency Measures

Additional groundwater monitoring may be required in the event of a pollution incident accidentally occurring at or near the site. The scope of any such additional monitoring will be proposed by the Contractor for the approval of TfL and the Environment Agency. The scope should be targeted to reflect the nature of the pollution incident and potential risks. This cannot be readily defined in advance of any incident occurring. Instead, the Contingency Action Plan will include a phased process by which the necessary scope of additional monitoring is proposed by the Contractor in consultation with TfL and the Environment Agency following a pollution incident.

In the event of a pollution incident, the Contractor shall inform the Environment Agency as soon as practicably possible and the Contractor will comply in full with all of their requirements as well as requirements outlined within the Silvertown Construction Environmental Management Plan (CEMP).

In addition the Contractor will complete the following actions:

- review significance of risks to nearby groundwater receptors;
- notify other relevant stakeholders within one week as appropriate, e.g., other nearby abstractors;
- review the existing Groundwater Monitoring and Verification Plan for adequacy;
- design additional targeted monitoring or investigation (if required) to better characterise issue; consult with the Environment Agency and other stakeholders as appropriate;
- undertake additional targeted monitoring or investigation (if required) and review results;
- develop strategy to mitigate and/or remediate issue(s) in consultation with key stakeholders;
- implement mitigation and/or remedial measures (as appropriate) to reduce risk of future breaches affecting project or nearby receptors; and
- ongoing monitoring and review to confirm effectiveness of measures implemented.

The assessment findings and actions will be reported within the notification report to be produced and submitted to TfL and the Environment Agency within a time frame approved by TfL and the Environment Agency as part of the Contingency Action Plan.

7. Reporting

The Contractor will be responsible for reporting the groundwater monitoring results during construction as part of the Groundwater Monitoring and Verification Plan. The Groundwater Monitoring and Verification Plan will set out that monitoring reporting will include the following types of reports, which will be presented in the formats set out in the rest of this chapter:

- notification reports (if required);
- factual reports for each monitoring round; and
- interpretative reports (frequency to be agreed with the Environment Agency via the Groundwater Monitoring and Verification Plan).

The monitoring reports shall be:

- submitted on time;
- quality assured; and
- collated and presented in a consistent format.

The templates for the monitoring reports will be approved in advance by TfL in consultation with the Environment Agency. The reporting templates will not be altered without approval from TfL.

The reports will be submitted electronically in PDF format. The factual data will be submitted in an Excel-compatible format.

7.1. Notification report

Notification reports will be used to disseminate information regarding breaches of Trigger Levels or pollution incidents. These reports should provide clear, concise information and carry a recommendation for action (or describe action taken). Notification reports should be issued within a time frame approved by TfL and the Environment Agency.

Notification reports will include:

- date and time of issue of report;
- name, position and contact information for person issuing report;
- date and time of monitoring surveys or observations that confirm the breach of a compliance limit, or an actual pollution incident;
- pollution incident recorded or compliance limit breached;
- details of any emergency contingency actions implemented; and
- an indication of the urgency of response needed by TfL and/or the Environment Agency.

In instances where assessment criteria or compliance limits are breached regularly and action is being implemented by the site operator (e.g., where remedial measures are underway or where the source of contamination to groundwater is being investigated), alternative ongoing reporting procedures may be agreed between the Contractor, TfL and the Environment Agency to avoid unnecessary duplication of notification reports.

7.2. Factual Report

Factual monitoring reports shall be prepared by the Contractor quarterly. Minimum factual monitoring report requirements are as follows:

- self-audit of compliance with monitoring plan requirements;
- groundwater level data in graphical form;
- key groundwater quality data to be displayed in graphical form;
- breaches of alert levels in tabular form;
- breaches of trigger levels in tabular forms;
- urgent actions;
- mitigation and/or remedial measures (if required) to manage groundwater-related risk to project or nearby receptors; and
- factual datasets (electronic).

The quarterly factual reports will be submitted to TfL within four weeks of the end of each quarter. The quarterly reports will be made available to the Environment Agency.

7.3. Interpretative Report

Interpretative monitoring reports shall be prepared by the Contractor annually. Minimum Annual Interpretative report requirements are as follows:

- self-audit of compliance with monitoring plan requirements;
- updated register of monitoring network;
- groundwater level data in graphical form;
- spatial contour plots of groundwater levels in Upper and Lower Aquifers;
- spatial plots of key COC in upper and Lower Aquifer to an appropriate scale;
- groundwater quality data in graphical form for agreed indicator species (outlined in the Groundwater Monitoring and Verification Plan);
- breaches of Alert Levels in tabular form;
- breaches of Tigger Levels in tabular form;
- summary of QA/QC checks e.g. ionic balance calculations;
- review of Key groundwater issues and patterns (in context of existing conceptual model and baseline dataset);
- update or refinement of conceptual model (if appropriate);
- likely causes of significant groundwater issues;
- influence of site activities on groundwater;
- influence of off-site/third party activities on local and regional groundwater;
- assessment of risk to nearby receptors;
- identification of any data gap at the site;
- proposed modification to monitoring plan (if required);
- changes to monitoring network;
- changes to monitoring frequency;
- changes to sampling methodology;
- changes to analytical suite;
- proposed revision to alert and trigger levels (if appropriate);

- mitigation and/or remedial measures (if required) to manage groundwater-related risk to project or nearby receptors; and
- other proposed modifications to site activities to better manage risk to/from groundwater (if appropriate).

The annual reports will be submitted by the Contractor in draft to TfL within four weeks of monitoring year end. The approved draft final annual report shall be submitted to the Environment Agency within two months of monitoring year end. Following receipt of corrections and comments from the Environment Agency, the final report will be produced within one month of receipt of these comments.

Appendices

Appendix A. Proposed Baseline Monitoring Programme

A.1. Proposed Baseline Monitoring Programme

The objectives of this Baseline Monitoring Programme are as follows:

- to establish a data set such to direct monitoring requirements for construction and post construction phases of works;
- to allow the development of Alert and Trigger levels;
- to allow for the verification of predictions, and to confirm that actual performance is as expected; and
- to assess what further monitoring bores (new installations) are required to implement the Groundwater Monitoring Strategy during the construction of the Silvertown Tunnel.

Baseline monitoring comprises the following tasks:

- continuous groundwater elevation monitoring using groundwater elevation data loggers;
- manual groundwater level dip measurement to validate and convert data into levels and provide information on levels in monitoring bores not installed with data loggers; and
- collection of groundwater chemistry samples and subsequent chemical analysis for an appropriate suite of determinants.

As the detailed design and construction programme is developed this monitoring strategy will be periodically reviewed and amended, where necessary.

A.2. Access Arrangements and Health and Safety

Many of the proposed monitoring locations belong to a third party, permission to use these boreholes will need to be obtained prior to monitoring being undertaken. Additionally the proposed monitoring scope requires accessing areas of the Greenwich Peninsula and Silvertown Site which are managed by a variety of different parties. To facilitate access permission from these parties must be obtained and they should be informed of the works and provided the relevant works and health and safety information in advance of each proposed monitoring visit and/or be compliant with specific requirements of the affected parties. For certain areas within the sites a permit to dig / work system will need to be completed prior to entry to undertake the monitoring.

In addition to access arrangements, a Health and Safety risk assessment, method statement and appropriate contaminated land exposure risk assessment (CLERA) will need to be completed in advance of the works to outline the methodology for the monitoring and sampling and to assess any relevant hazards and proposed appropriate mitigation / control measures.

A.3. Baseline Monitoring Network

An initial groundwater level monitoring network, utilising existing boreholes, is proposed and the boreholes are presented below in Table A-1 and Table A-2. The monitoring network has been selected based on the following:

- to ensure that baseline water level data from both the Upper (RTD) and Lower Aquifers (Thanet Sand and Chalk);
- assess the connectivity of the Lambeth Group with the underlying Lower Aquifer at both Silvertown and Greenwich Peninsula via groundwater level monitoring;
- to obtain baseline groundwater quality data from both the Upper (RTD) and Lower Aquifers (Thanet Sand and Chalk); and
- to facility the assessment of contamination source zones and the selection and or installation of sentinel monitoring boreholes.

The monitoring network includes monitoring boreholes from several projects completed in the vicinity of the Silvertown Tunnel Scheme, the projects include the following:

- Greenwich Peninsula long term groundwater monitoring (GP-LTGWM) locations which form part of the Housing and Land Directorate of Greater London Authority's (GLA) monitoring network.
- London Cable Car Project (Emirates Cable Car) completed by Buro Happold (ECC).
- Crossrail Limmo Peninsula Project (Crossrail).
- Atkins Silvertown Tunnel Ground Investigation Project (STWTN-GI).
- A borehole condition survey of all selected monitoring locations should be completed as soon as possible to establish the current status of the proposed monitoring boreholes / piezometers. Pending the results of the condition survey, installation of further monitoring boreholes maybe required. Assuming all monitoring locations selected and defined in Table A-1 and Table A-2 are useable / suitable to be sampled, it is considered that the following monitoring boreholes will be required:

Greenwich Peninsula

- Chalk monitoring borehole installed adjacent to BHN1(A) and BHN1(B);
- Chalk monitoring borehole adjacent to BHN2(A);
- Lambeth Group monitoring borehole adjacent to BHN5(A);
- Chalk monitoring borehole adjacent to BHN5(A) – see comments under Table A-1 below.

Silvertown

- Chalk monitoring borehole installed adjacent to NT BH02;

Borehole construction will be in accordance with BS ISO 5667-22: 2009, Water Quality – Sampling – Part 22: Guidance on the design and installation of groundwater monitoring points.

Monitoring boreholes have been separated into three groups; primary, secondary and auxiliary monitoring boreholes, the groups represent levels of decreasing monitoring requirements. Primary monitoring boreholes (and piezometers) represent monitoring positions located in strategic locations to obtain critical data for future assessments. Secondary monitoring boreholes (and piezometers) and auxiliary monitoring boreholes are aimed at obtaining water levels and chemistry from the greater assessment areas.

Table A-1 Groundwater Monitoring Location Specifications - Greenwich Peninsula

Location	Project	Easting	Northing	Ground Level (mAOD)	Depth to Base (m bgl)	Indicative Depth to Groundwater (m bgl)	Installation
Primary Monitoring Boreholes							
River Terrace Deposit Monitoring Boreholes							
BHN1(A)	GP-LTGWM	539164	179925	5.67	12.3	6.7	Monitoring Bore
BHN5(A)*	GP-LTGWM	539488	179955	5.68	15.0	6.6	Monitoring Bore
BHN6(A)	GP-LTGWM	539331	179808	4.92	15.0	5.8	Monitoring Bore
BHN7(A)	GP-LTGWM	539179	179560	2.43	13.0	3.1	Monitoring Bore
BHN9(A)	GP-LTGWM	539727	179631	7.27	15.0	7.1	Monitoring Bore
Lambeth Group Monitoring Boreholes							
BHN1(B)	GP-LTGWM	539167	179927	5.62	50.0	12.5	Monitoring Bore
BHN5(B)	To be installed						Monitoring Bore
Thanet Sand Formation and Chalk Monitoring Boreholes							
BHN1(C)	To be installed - Chalk						Monitoring Bore
BHN2(B)	To be installed - Chalk						Monitoring Bore
BHN5(C)	To be installed -Chalk						Monitoring Bore
Secondary Monitoring Boreholes							
River Terrace Deposit Monitoring Boreholes							
BHN2(A)	GP-LTGWM	539332	180158	5.80	14.0	6.3	Monitoring Bore
BHN8(A)	GP-LTGWM	539570	179480	4.56	14.0	5.4	Monitoring Bore
BNH12(A)	GP-LTGWM	539414	179299	2.77	15.0	3.5	Monitoring Bore
EB3A	STWTN-GI	539241	179657	2.92	15.0	4.3	Monitoring Bore
Thanet Sand Formation and Chalk Monitoring Boreholes							
BHN7(B)	GP-LTGWM	539178	179557	2.51	45.0	3.8	Monitoring Bore
BHN9(B)	GP-LTGWM	539722	179637	7.27	45.0	8.1	Monitoring Bore
BH(AB)	GP-LTGWM	539405	179301	-	97	1.3	Monitoring Bore
Auxiliary Monitoring Boreholes							
River Terrace Deposit Monitoring Boreholes							
BHN3(A)	GP-LTGWM	539047	1803023	6.06	14.0	6.7	Monitoring Bore
BHN4(A)	GP-LTGWM	538828	180155	6.23	14.5	7.0	Monitoring Bore
BHN10(A)	GP-LTGWM	539917	179424	6.05	15.0	6.8	Monitoring Bore
BNH11(A)	GP-LTGWM	539783	179279	5.32	14.5	6.1	Monitoring Bore
BHN13(A)	GP-LTGWM	539540	179000	1.21	9.0	2.3	Monitoring Bore
Thanet Sand Formation and Chalk Monitoring Boreholes							
BHN4(B)	GP-LTGWM	538829	180157	6.22	60.0	11.9	Monitoring Bore
BH106	GP-LTGWM	538849	180119	5.56	60.0	12.2	Monitoring Bore

*** the Environment Agency has indicated that there is an application to decommission BHN5(A), if this application is approved an assessment should be undertaken to assess options to obtain/install a like for like, replacement monitoring borehole as this monitoring well is deemed necessary.**

Table A-2 Groundwater Monitoring Location Specification – Silvertown

Location	Project	Easting	Northing	Ground Level (mAOD)	Depth to Base (m bgl)	Indicative Depth to Groundwater (m bgl)	Installation
Primary Monitoring Boreholes and Piezometers							
River Terrace Deposit Monitoring Bores/Piezometers							
G16A	STWTN-GI	540009	180357	2.29	10.5	3.0	Monitoring Bore
G15A	STWTN-GI	539891	180266	2.68	10.3	2.7	Piezometer
G22B	STWTN-GI	539814	180622	3.54	8.5	4.0	Piezometer
Lambeth Group Monitoring Boreholes/Piezometers							
G15B	STWTN-GI	539891	180266	2.68	26.9	6.9	Piezometer
G16B	STWTN-GI	540009	180359	2.29	26.0	3.0	Piezometer
Thanet Sand Formation and Chalk Monitoring Boreholes							
NIT BH02	ECC	539973	180437	5.28	60.0	6.2	Monitoring Bore
NT BH02	ECC	539850	180286	5.16	40	7.2	Piezometer
NT BH02 (B)	To be installed -Chalk						Monitoring Bore
Auxiliary Monitoring Boreholes							
River Terrace Deposit Monitoring Boreholes/Piezometers							
NS BH01A	ECC	540153	180702	4.87	11.4	6.67	Monitoring Bore
CH81(RTD)	Crossrail	539617	180734	5.40	30.0	6.3	Monitoring Bore
CH82(RTD)	Crossrail	539580	180624	5.22	13.0	5.9	Monitoring Bore
CH82(RTD)	Crossrail	539580	180624	5.22	30.0	5.4	Monitoring Bore
CH97(RTD)	Crossrail	540077	180851	1.39	6.65	4.6	Monitoring Bore
CH96(RTD)	Crossrail	539938	180808	2.61	7.7	3.0	Monitoring Bore
CH30(RTD)	Crossrail	541030	180978	1.44	10.20	1.91	Monitoring Bore
Harwich Formation and Lambeth Group Monitoring Boreholes							
CH96(SND)	Crossrail	539938	180808	2.61	28.7	6.20	Monitoring Bore
NT BH01	ECC	539869	180301	2.76	50.0	3.96	Monitoring Bore
CH3R(LMB)	Crossrail	538305	180534	3.40	25.60	8.26	Monitoring Bore
CH4R(HF)	Crossrail	538396	180586	2.44	15.60	7.46	Monitoring Bore
CH27(HF)	Crossrail	540706	180869	3.10	23.50	4.07	Monitoring Bore
CH30(UF)	Crossrail	541030	180978	1.44	33.20	8.61	Monitoring Bore
Thanet Sand Formation and Chalk Monitoring Boreholes							
SN6RA(CK)	Crossrail	539274	180803	2.7	78.22	15.4	Monitoring Bore
CH91R(CK)	Crossrail	539425	181013	10.94	114.0	18.1	Monitoring Bore
CH3R(CK)	Crossrail			3.40	49.60	15.95	Monitoring Bore
CH7R(TS)	Crossrail	538723	180810	5.92	45.00	18.33	Monitoring Bore
CH4R(TS)	Crossrail	538396	180586	2.44	42.41	21.22	Monitoring Bore
CH27(TS)	Crossrail	540706	180869	3.10	44.70	8.61	Monitoring Bore

A.4. Baseline Monitoring Programme

The groundwater monitoring strategy / programme comprises of the elements presented below, a proposed methodology is presented in Appendix B:

1. Collection of continuous groundwater elevation data from primary monitoring bores (and primary piezometers, Silvertown assessment area) using divers, corrected for atmospheric pressure using baraloggers, over as long as possible a period prior to commencement of construction works.

2. Manual groundwater elevation monitoring (dip readings) and groundwater samples for chemical analysis should be collected as per the schedules outlined in Table A-3 for Greenwich Peninsula Table A-4 for Silvertown. It is suggested that these schedules be completed for the first year of monitoring at which time an assessment should be undertaken to reassess further data requirements.

3. For the first month, weekly groundwater monitoring should be completed on monitoring boreholes/piezometers containing continuous loggers to provide re-assurance that the data recorded by the loggers are not drifting.

Groundwater samples should be scheduled for analysis of the analytical suites presented in Appendix C, refer to Groundwater monitoring suites have been developed based on historical site uses identified during the Mott Macdonald (2013) Phase 1 Contamination Assessment and the Atkins (2016) Ground Investigation.

4. Table C-1 for Suite A, Table C-2 for Suite B and Table C-3 for Suite C.

Table A-3 and Table A-4 below present the initial and pre-construction monitoring schedules for Greenwich Peninsula and Silvertown respectively.

Table A-3 Greenwich Peninsula Monitoring Requirements

Location	Monitoring				
	Manual Dip	Chemistry Suite A	Additional Chemistry Suite C	Continuous Elevation (divers)	Barometric Pressure
Primary Monitoring Boreholes	Monthly*	Monthly*	Quarterly	Hourly	BHN1(A)
Secondary Monitoring Boreholes	Monthly*	Quarterly		-	-
Auxiliary Monitoring Boreholes	Quarterly	Quarterly		-	-

* following 6 months of monitoring reduce frequency to every two months.

Table A-4 Silvertown Monitoring Requirements

Location	Monitoring				
	Manual Dip	Chemistry Suite A and B**	Additional Chemistry Suite C **	Continuous Elevation (divers)	Barometric Pressure
Primary Monitoring Boreholes and Piezometers	Monthly*	Monthly*	Quarterly	Hourly-	NT BH02
Auxiliary Monitoring Boreholes and Piezometers	Quarterly	Quarterly		-	-

* following 6 months of monitoring reduce frequency to every two months.
** groundwater chemistry sampling from accessible monitoring locations.

Appendix B. Proposed Sample Collection Methodology

B.1. Groundwater Elevation Loggers (Divers) and Barologgers

B.1.1. Equipment Specification

The rental/procurement cost is to be covered by the Contractor. The divers must have:

- a minimum tolerance of a 20 m water column;
- adequate storage capacity;
- sufficient battery to monitor throughout the entire period;
- be compatible with the barologgers;
- resistant to the potential presence of non aqueous phase product (NAPL); and
- for piezometer sites the data logger needs to fit a 19 mm piezometer.

The barologgers must have:

- adequate storage capacity;
- a sufficient battery to monitor throughout the entire period; and
- be compatible with the divers.

The level divers and barologgers will need to be suspended within the borehole. The material used to suspend the divers must be:

- resistant to corrosion and chemical attack; and
- non-stretch (maximum of 0.01% of length).

B.1.2. Methodology

The groundwater diver installation methodology is summarised below:

1. The Contractor shall undertake an equipment test prior to commencing placing the logging equipment in the specified boreholes, this shall include ensuring that the equipment is functioning correctly;
2. The divers and barologgers shall be programmed to monitor groundwater elevation data at 30 minute intervals. The divers and barologgers shall be programmed to monitor at the same time;
3. Measure the depth to groundwater using a dipmeter (as discussed in Section B.2);
4. The divers will be placed such that they are within the water table at all times;
5. The divers shall be securely attached;
6. The barologgers shall be installed at a depth immediately below ground level, to ensure that they are at no point submersed below groundwater;
7. The groundwater level shall be manually dipped (as discussed in Section B.2) at a time corresponding to a diver measurement to ensure accurate conversion to levels; and
8. The frequency the data is required to be downloaded will be dependent upon the minimum diver or barologgers memory capacity. At a minimum it shall be at every chemical monitoring interval.

B.2. Interface Meter

Manual readings of groundwater elevation data shall be obtained during each monitoring round using an interface meter at every borehole location specified in Table A-1 and A-2 (in Appendix A.3). The boreholes shall be dipped at the precise time the divers and barologgers are taking a reading (this can be at different times for different locations) and will occur prior to any monitoring.

The monitored parameters shall include:

1. Depth at which any free phase product (NAPL) is encountered.

2. Depth at which groundwater is encountered.

3. Depth to the base of each borehole.

4. Date and time that the groundwater level reading is obtained.

B.3. Monitoring Groundwater Chemistry

Groundwater samples shall be obtained from boreholes as specified within Table A.-3 and Table A-4.

Prior to sampling each of the selected monitoring boreholes, the depth to water and the depth to the base of each borehole will be collected relative to ground level and top of borehole casing (as detailed above). Water levels will be monitored using an oil/water interface meter, capable of measuring the depth to water and also capable of detecting and measuring the thickness of any free phase hydrocarbons which may be present on the surface of the groundwater or in the base of the borehole. The water level will be recorded prior to any sampling at a point in time that coincides with a diver reading. The diver should be removed prior to sampling.

Prior to water quality sampling, the divers (if installed) must first be removed from the boreholes. To obtain a representative sample of the in situ groundwater each borehole will be purged prior to sampling for a minimum of three bore volumes using either a submersible or surface pump which must be variable speed. In situ measurement of groundwater physico-chemical properties (as a minimum: temperature, redox (E_H), pH and electrical conductivity) will be undertaken using an inline flow cell and probes and samples will be collected once hydrochemical parameters have stabilised (+/- 10%) and the sample considered representative of aquifer conditions. Should hydrochemical parameters not stabilise within a 25 minute period, this should be noted and a sample should be collected as normal. Where a limited volume of groundwater is present within a bore, a grab sample may be taken, whereby the sample is taken directly after measuring the depth to water and the depth to the base of the borehole, without measuring hydro-chemical parameters. The amount of water purged will be measured using an in-line gauge and a description of the purge water and the volume purged will be recorded on the appropriate record sheet.

The Contractor is to allow for suitable storage and subsequent disposal of the purge water. Previous monitoring on the Greenwich Peninsula has used a granular activated carbon (GAC) filter before temporary storage in a water bowser and subsequent disposal to foul sewer under suitable discharge consent. Alternatively the Contractor may explore options to tanker off site, by an approved waste Contractor, for treatment / discharge at a suitable waste water treatment facility. Temporary storage of purge water on site must be in suitable, sealed containers at the agreement of the site operative.

All monitoring equipment will be thoroughly cleaned between monitoring borehole locations to prevent cross contamination. All meters will be stored in accordance with the manufacturer’s instructions. New tubing associated with the pump will be used for each new location.

After purging, the sample tubing will be used to collect the pre-arranged volume of sample within the dedicated laboratory supplied sample containers. All bottles and caps will be rinsed in the sample water prior to being completely filled to exclude air. All samples will be stored out of direct sunlight in a cool location such as a cool box with frozen ice packs to keep samples below 4°C. Care will be taken to ensure that the brim or inside of the sampling containers is not touched. When filling any volatile organic compounds (VOC) vials the Contractor shall ensure there is no headspace by filling the inverted lid with sample as well, and set the peristaltic/bladder pump to low flow to minimise the presence of bubbles.

All sample vessels will be labelled with appropriate information for the particular borehole, as follows (minimum information; company name, site details, borehole number and date).

Samples will be clearly labelled as follows:

- site name and job number;
- date and time of sampling;
- sample location (borehole no.);
- sample number; and
- sample depth.

Water samples will be dispatched to the laboratory on the same day of sampling under full chain of custody documentation

Subsequent to monitoring and sampling, the Contractor will ensure that each borehole location and the general work environment, is left in a clean and tidy manner or as originally found.

The Contractor shall inform the relevant parties when the work has been completed and the appropriate permit / documentation will be signed off. Any equipment to be left on site overnight or following the monitoring will be agreed in advance with the site and collection arranged as soon as practicable.

B.4. Baseline Monitoring Reporting

- As a minimum, the following information will need to be obtained after each monitoring visit / event for collation and onward reporting to interested parties:
- Factual report outlining the details of the monitoring visit / event including the date and time of monitoring / sampling, atmospheric conditions pre - and during the visit, the condition of the monitoring locations at the time of the visit, tabulated manual groundwater dip data, groundwater monitoring sheets and associated tabulated physico-chemical properties.
- AGS-compatible files containing the raw diver and logger data.
- MS Excel file(s) containing a database of the corrected groundwater level data (using manual dip and logger data).
- A database containing all chemical and field test results gathered during the monitoring event in MS Excel format or similar.
- Electronic copies of all laboratory reports (AGS or MS Excel format).

Appendix C. Analytical Suite

Groundwater monitoring suites have been developed based on historical site uses identified during the Mott Macdonald (2013) Phase 1 Contamination Assessment and the Atkins (2016) Ground Investigation.

Table C-1 Analytical Suite -A

Determinand	Maximum MDL	Unit
pH	+ / - 0.1	pH units
Total Organic Carbon (TOC)	<0.1	mg/l
Arsenic (dissolved)	< 0.15	µg/l
Cadmium (dissolved)	< 0.02	µg/l
Chromium (dissolved)	< 0.2	µg/l
Lead (dissolved)	< 0.2	µg/l
Mercury (dissolved)	< 0.05	µg/l
Selenium (dissolved)	< 0.6	µg/l
Boron (dissolved)	<10	µg/l
Copper (dissolved)	< 0.5	µg/l
Nickel (dissolved)	< 0.5	µg/l
Zinc (dissolved)	< 0.5	µg/l
Vanadium (dissolved)	< 0.2	µg/l
Chromium - Hexavalent (dissolved)	<5	µg/l
Cyanide - Total	<10	µg/l
Cyanide - Free	<10	µg/l
Cyanide - Complex	<10	µg/l
Ammonium (NH_4^+)	<15	µg/l
Sulphate as SO_4	<0.03	mg/l
Sulphide	<5	µg/l
PAH - Speciated (EPA 16)	<0.01	µg/l
TPH CWG	<10	µg/l
BTEX & MTBE	<1	µg/l

Table C-2 Analytical Suite - B

Determinand	Maximum MDL	Unit
VOC	<1	µg/l
SVOC	<0.01 - <0.1 (Depending on compound	µg/l

Table C-3 Additional Analytical Suite - C

Determinand	Maximum MDL	Unit
Phenols - Speciated	<0.05	µg/l

Appendix D. Greenwich Peninsula Borehole logs

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N1A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539163.6 E 179925.3 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	5.67m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	07/09/2001
Consultant	WS Atkins			Date Completed	10/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
07/09/2001	0800	0.00	0.00	Dry	SOH
07/09/2001	1300	2.00	1.70	Dry	EOS
10/09/2001	0800	2.00	1.70	Dry	SOS
10/09/2001	1630	15.00	14.50	9.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	4.50	250	4.50
150	15.00	150	14.50
0	15.00	0	0.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Standpipe installed upon borehole completion.
4. Water strikes noted 1.70m and 8.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N1A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539163.6 E 179925.3 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	5.67m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	07/09/2001
Consultant	WS Atkins			Date Completed	10/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Brown slightly clayey very sandy sub-angular to subrounded brick, flint and medium sized concrete gravel	▩			D	0.50			
MADE GROUND: Pale green gravelly fine-coarse sand of lime. Gravel is fine-coarse brick and ash.	▩	1.70	3.97	D	1.70			
MADE GROUND: Black very gravelly fine-coarse sand. Gravel fine-coarse brick and ash.	▩	2.80	2.87	D	2.80			
Olive brown locally mottled black CLAY. Slight organic odour. Slightly contaminated (ALLUVIUM).	▤	4.50	1.17	D	4.50			
Dark brown amorphous PEAT with occasional plant remains. (ALLUVIUM)		6.00	-0.33	D	6.00			
Dark brown mottled grey organic CLAY with abundant plant remains. (ALLUVIUM).	▤	7.20	-1.53	D	7.20			
Grey brown very silty fine-medium SAND. (RIVER TERRACE DEPOSIT).	▒	8.80	-3.13	D	8.80			
		9.90	-4.23	D	9.90			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N1A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539163.6 E 179925.3 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	5.67m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	07/09/2001
Consultant	WS Atkins			Date Completed	10/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Grey fine-coarse sandy flint GRAVEL. Sand is fine-coarse. (RIVER TERRACE DEPOSIT).		14.30	-8.63	D	14.30			
Firm to stiff brown extremley closely fissured CLAY. (Weathered LONDON CLAY).		15.00	-9.33					
Cable Percussion boring complete at 15.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N1B
Header

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E 179926.9 N
Project	Greenwich Village	Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core barrel		Date Completed	21/09/2001
		Core bit	Rock Roller		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
11/09/2001	0800	0.00	0.00	Dry	SOH
11/09/2001	1730	15.00	14.80	4.00	EOH Cable
19/09/2001	0730	15.00	14.80	4.00	SOH Rotary
19/09/2001	1730	33.00	15.00	0.00	EOS
20/09/2001	0730	33.00	15.00	0.90	SOS
20/09/2001	1730	42.30	15.00	0.00	EOS
21/09/2001	0730	42.30	15.00	6.70	SOS
21/09/2001	1730	50.00	15.00	6.70	EOH

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	5.50	250	5.50
200	42.30	200	15.00
150	50.00	200	15.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
15.00	50.00	Water Mud	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Water strikes noted at 3.80m and 9.90m.
4. Rotary drilling continued to 50.00m depth.
5. Standpipe installed upon borehole completion.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N1B
Sheet 1 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E
Project	Greenwich Village				179926.9 N
		Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	21/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
MADE GROUND: Brown slightly clayey very sandy fine-coarse sub-angular to subrounded brick, flint and concrete gravel	▨	1.50	4.12				
MADE GROUND: Pale green gravelly fine-coarse sand of lime. Gravel is fine-coarse brick and ash.	▨	2.80	2.82				
MADE GROUND: Black very gravelly fine-coarse sand. Gravel fine-coarse brick and ash.	▨	4.50	1.12				
Olive brown locally mottled black CLAY. Slight organic odour. Slightly contaminated (ALLUVIUM).	≡	6.00	-0.38				
Dark brown amorphous PEAT with occasional plant remains. (ALLUVIUM)	ѱ	7.20	-1.58				
Dark brown mottled grey organic CLAY with abundant plant remains. (ALLUVIUM).	≡	8.80	-3.18				
Very soft brown very sandy CLAY. (ALLUVIUM).	≡	9.90	-4.28				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N1B
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Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E 179926.9 N
Project	Greenwich Village	Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	21/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey fine-coarse sandy flint GRAVEL. Sand is fine-coarse. (RIVER TERRACE DEPOSIT).		14.30	-8.68				
Firm to stiff brown extremley closely fissured CLAY. (Weathered LONDON CLAY).							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.	N1B
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Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E 179926.9 N
Project	Greenwich Village	Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	21/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Firm to stiff brown extremley closely fissured CLAY. (Weathered LONDON CLAY).							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N1B
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Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E
Project	Greenwich Village				179926.9 N
		Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	21/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Firm to stiff brown extremley closely fissured CLAY. (Weathered LONDON CLAY).		33.00	-27.38				
Green sandy CLAY 34.50-38.00m Fine sandy CLAY (drillers notes)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N1B
Sheet 5 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539166.8 E 179926.9 N
Project	Greenwich Village	Drilling Rig	Pilcon & HansEng	Ground Level	5.62m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	11/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	21/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green sandy CLAY		50.00	-44.38				

Borehole complete at 50.00 m.

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N2A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539332.3 E
Project	Greenwich Village				180158.3 N
		Drilling Rig	Pilcon 1500	Ground Level	5.80m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	17/09/2001
Consultant	WS Atkins			Date Completed	17/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/09/2001	0800	0.00	0.00	Dry	SOH
17/09/2001	1730	14.00	14.00	0.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	4.70	250	4.70
150	14.00	150	14.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Standpipe installed upon borehole completion.
4. Water strikes noted at 3.40m and 10.40m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N2A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539332.3 E
Project	Greenwich Village				180158.3 N
		Drilling Rig	Pilcon 1500	Ground Level	5.80m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	17/09/2001
Consultant	WS Atkins			Date Completed	17/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Tarmac		0.20	5.60				
MADE GROUND: Black / Brown fine-coarse subangular-rounded gravel. Gravel is of red & yellow brick, quartz and flint.		0.50	5.30				
MADE GROUND: Black / brown fine-coarse subangular-rounded gravel. Gravel is of ash, brick and concrete.		4.50	1.30	D 0.70 D 3.60 D 4.50			
Very soft grey CLAY with occasional yellow mottling. Clay has contaminated odour. (ALLUVIUM)		6.80	-1.00	D 6.80			
Black spongy fibrous PEAT containing rootlets and wood fragments. (ALLUVIUM)		9.80	-4.00	D 9.80			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N2A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539332.3 E 180158.3 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	5.80m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	17/09/2001
Consultant	WS Atkins			Date Completed	17/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Very soft purple grey CLAY occasional shell fragments noted. (ALLUVIUM).		10.70	-4.90					
Grey slightly sandy GRAVEL. Gravel is fine-coarse angular-subrounded chert, flint, quart and shell fragments. (RIVER TERRACE DEPOSITS).		14.00	-8.20	D	10.80			
Cable Percussion boring complete at 14.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N3A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539046.9 E 180302.5 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	6.06m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	12/09/2001
Consultant	WS Atkins			Date Completed	13/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
12/09/2001	0800	0.00	0.00	Dry	SOH
12/09/2001	1730	14.00	14.00	0.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
1.70	2.00	0.50	
2.20	2.40	0.50	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	4.50	250	4.50
150	14.00	150	14.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Standpipe installed upon borehole completion.
4. Water strike noted at 11.80m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N3A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539046.9 E 180302.5 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	6.06m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	12/09/2001
Consultant	WS Atkins			Date Completed	13/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Brown very clayey fine-coarse sandy gravel. Gravel fine-coarse angular to subrounded brick, flint and ash.				D	0.50			
		2.60	3.46	D	2.60			
MADE GROUND: Black clayey gravelly sand. Sand is fine-coarse, gravel fine-medium angular to subangular ash. Strong odour noted.								
		4.50	1.56	D	4.50			
Brown mottled black CLAY. Slightly organic and tar odour. (Contaminated ALLUVIUM).								
		7.70	-1.64	D	7.70			
Dark brown amorphous PEAT with abundant plant remains. (ALLUVIUM).								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N3A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539046.9 E 180302.5 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon 1500	Ground Level	6.06m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	12/09/2001
Consultant	WS Atkins			Date Completed	13/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Dark brown amorphous PEAT with abundant plant remains. (ALLUVIUM).		10.50	-4.44	D	10.50			
Grey CLAY with occasional plant remains, slight organic odour. (ALLUVIUM)		12.00	-5.94	D	12.00			
Grey silty very sandy angular to rounded fine to coarse flint GRAVEL. Sand is predominantly coarse. (RIVER TERRACE DEPOSITS).		14.00	-7.94					
Cable Percussion boring complete at 14.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N4A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	538827.7 E
Project	Greenwich Village				180154.6 N
		Drilling Rig	Pilcon 1500	Ground Level	6.23m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	13/09/2001
Consultant	WS Atkins			Date Completed	15/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
13/09/2001	0800	0.00	0.00	Dry	SOH
13/09/2001	1730	3.70	3.70	3.50	EOS
14/09/2001	0800	3.70	3.70	3.70	SOS
14/09/2001	1730	14.70	14.70	0.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
1.40	1.60	0.75	
2.80	3.10	0.75	
3.50	3.70	1.25	
3.70	4.20	3.25	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	4.50	250	4.50
150	14.70	150	14.70

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Standpipe installed upon borehole completion.
4. Water strike noted at 3.50m (contaminated) and 10.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N4A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	538827.7 E 180154.6 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	6.23m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	13/09/2001
Consultant	WS Atkins			Date Completed	15/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Tarmac		0.20	6.03				
MADE GROUND: Brown grey sandy gravel. Sand is fine cohesive material. Gravel is subrounded, medium-coarse concrete, brick and flint.		0.50	5.73	D 0.50			
MADE GROUND: Brown green subrounded sandy gravel. Sand is coarse subangular quartz. Gravel is subrounded medium quartz, flint and lime.		1.70	4.53	D 1.70			
MADE GROUND: Grey clayey gravel. Clay is soft. Gravel is subangular-subrounded, medium brick and flint.				D 2.60			
3.50m Gravel is coarse. Slightly contaminated.				D 3.50			
		4.20	2.03	D 4.20			
Very soft grey and black mottled CLAY, containing petroleum odour. (ALLUVIUM)		7.00	-0.77	D 7.00			
Black spongy fibrous PEAT. Contains strong petroleum odour. (ALLUVIUM)		9.10	-2.87	D 9.10			
Grey and black organic CLAY. Some fibrous peaty material. Slight organic odour. (ALLUVIUM)		10.00	-3.77	D 10.00			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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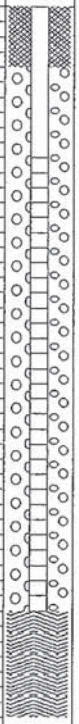
BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N4A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	538827.7 E 180154.6 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon 1500	Ground Level	6.23m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	JFK	Date Started	13/09/2001
Consultant	WS Atkins			Date Completed	15/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Grey and black organic CLAY. Some fibrous peaty material. Slight organic odour. (ALLUVIUM)		10.00	-3.77	D	10.00			
Grey & white sandy angular fine-coarse flint GRAVEL. Sand is coarse. (RIVER TERRACE DEPOSITS)		14.70	-8.47					
Cable Percussion boring complete at 14.70 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Header

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E
Project	Greenwich Village				180157.3 N
Client	English Partnerships	Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
		Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core barrel		Date Completed	27/09/2001
		Core bit	Rock Roller		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
18/09/2001	0800	0.00	0.00	Dry	SOH
18/09/2001	1730	5.50	5.50	Dry	EOS
19/09/2001	0800	5.50	5.50	Dry	SOS
19/09/2001	1730	16.50	16.50	Dry	EOS
20/09/2001	0800	16.50	16.50	Dry	SOS
20/09/2001	0800	18.20	18.20	Dry	EOH Cable
24/09/2001	1730	38.00	38.00	Dry	EOS
24/09/2001	1820	18.20	18.20	Dry	SOH Rotary
25/09/2001	0800	38.00	38.00	Dry	SOS
25/09/2001	1730	56.00	56.00	Dry	EOS
26/09/2001	0800	56.00	56.00	Dry	SOS

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
3.50	3.60	0.50	
3.80	4.00	0.75	
5.50	6.10	1.25	
17.40	18.20	2.00	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	4.50	250	4.50
200	38.00	200	38.00
150	60.00	150	56.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
18.20	60.00	Water	Good	0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Rotary drilling continued from 18.20m to 60.00m depth.
4. Standpipe installed upon borehole completion.
5. Water strike noted at 3.50m (contaminated) and 10.00m.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 1 of 6

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E 180157.3 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
Client	English Partnerships	Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	27/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
MADE GROUND: Tarmac		0.20	6.02				
MADE GROUND: Brown grey sandy gravel. Sand is fine. Gravel is subrounded, medium-coarse concrete, brick and flint.		0.50	5.72				
MADE GROUND: Brown and green subrounded sandy gravel. Sand is coarse quartz. Gravel is subrounded, medium quartz flint and lime.		2.50	3.72				
MADE GROUND: Grey clayey gravel. Gravel is subangular-subrounded, medium brick and flint. 3.50m Gravel is coarse. Slightly contaminated.		4.20	2.02				
Very soft grey and black mottled CLAY. Strong petroleum odour. (ALLUVIUM)		7.00	-0.78				
Black spongy fibrous PEAT. Contains strong petroleum odour. (ALLUVIUM)		9.40	-3.18				
Blue grey CLAY with gravel. (ALLUVIUM)		10.00	-3.78				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 2 of 6

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E 180157.3 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
Client	English Partnerships	Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	27/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Blue grey CLAY with gravel. (ALLUVIUM)		10.00	-3.78				
Brown sandy GRAVEL. (RIVER TERRACE DEPOSITS)		15.10	-8.88				
Stiff grey CLAY (driller's description) - (LONDON CLAY/LAMBETH GROUP) 16.50-17.60m Brown grey sandy GRAVEL (Scour feature?)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 3 of 6

Contract No.	F12080	Method	Cable & Rotary		Coordinates	538829.2 E 180157.3 N	
Project	Greenwich Peninsula						
		Drilling Rig	Pilcon & Edeco T6		Ground Level	6.22m AOD	
Client	English Partnerships	Drillers	GW & HJ		Orientation	Vertical	
		Logged by	JFK		Date Started	18/09/2001	
Consultant	WS Atkins	Core Barrel			Date Completed	27/09/2001	
		Core Bit	Rock Roller				

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Stiff grey CLAY (driller's description) - (LONDON CLAY/LAMBETH GROUP)		28.00	-21.78				
Green SAND (driller's description). (GLAUCONITIC/THANET SAND)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 4 of 6

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E 180157.3 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
Client	English Partnerships	Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	27/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green SAND (driller's description). (GLAUCONITIC/THANET SAND)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 5 of 6

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E
Project	Greenwich Peninsula				180157.3 N
		Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
Client	English Partnerships	Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	27/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green SAND (driller's description). (GLAUCONITIC/THANET SAND)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N4B
Sheet 6 of 6

Contract No.	F12080	Method	Cable & Rotary	Coordinates	538829.2 E 180157.3 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon & Edeco T6	Ground Level	6.22m AOD
Client	English Partnerships	Drillers	GW & HJ	Orientation	Vertical
		Logged by	JFK	Date Started	18/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	27/09/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green SAND (driller's description). (GLAUCONITIC/THANET SAND)		52.50	-46.28				
White CHALK (driller's description) (UPPER CHALK) 52.50-53.10m Hard LIMESTONE (drillers description)		60.00	-53.78				
Borehole complete at 60.00 m.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N5A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539487.8 E 179954.5 N
Project	Greenwich Village				
		Drilling Rig	Pilcon	Ground Level	5.68m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
04/09/2001	0800	0.00	0.00	Dry	SOH
04/09/2001	1730	15.00	15.00	0.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	5.00	300	5.00
150	15.00	150	15.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 3.50-5.50m.
3. Standpipe installed upon borehole completion.
4. Water Strike at 10.50m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N5A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539487.8 E 179954.5 N
Project	Greenwich Village				
		Drilling Rig	Pilcon	Ground Level	5.68m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Installation
MADE GROUND: Tarmac		0.10	5.58				
MADE GROUND: Concrete		0.30	5.38				
MADE GROUND: Brown slightly gravelly sandy clay. Gravel subangular-rounded brick and flint. Sand fine-coarse.		0.50	5.18	D 0.50 J 0.50			
MADE GROUND: Brown slightly clayey sandy subangular to rounded flint gravel		1.30	4.38				
MADE GROUND: Grey mottled black clay.				D 1.50 J 1.50			
		2.50	3.18	D 2.50 J 2.50			
MADE GROUND: Dark grey sandy gravelly clay. Gravel subangular-rounded flint and brick. Sand fine-coarse.							
		3.50	2.18	D 3.50 J 3.50			
Light brown mottled dark grey CLAY. Slight organic odour.							
		4.50	1.18	D 4.50 J 4.50			
Grey slighty sandy CLAY with occasional rootlets. Sand is fine. Slight organic odour.							
		5.70	-0.02				
Dark brown organic CLAY, with occasional relic rootlets.				D 6.00 J 6.00			
		8.30	-2.62	D 8.30 J 8.30			
Very dark grey very sandy CLAY.				D 9.80 J 9.80			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N5A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539487.8 E 179954.5 N
Project	Greenwich Village	Drilling Rig	Pilcon	Ground Level	5.68m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Very dark grey very sandy CLAY.		10.70	-5.02	D J	10.70 10.70			
Grey sandy GRAVEL (TERRACE GRAVEL).		15.00	-9.32					
Cable Percussion boring complete at 15.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N6C
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539331.4 E 179808.0 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	4.98m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	31/08/2001
Consultant	WS Atkins			Date Completed	01/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
31/08/2001	1400	0.00	0.00	Dry	SOH
31/08/2001	1730	7.50	7.50	5.00	EOS
01/09/2001	0800	7.50	7.50	6.20	SOS
01/09/2001	1730	15.00	15.00	6.20	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 2.50-4.50m.
3. Standpipe installed upon borehole completion.
4. Water Strikes noted at 5.00m, 6.20m and 9.10m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N6C
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539331.4 E 179808.0 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	4.98m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	31/08/2001
Consultant	WS Atkins			Date Completed	01/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Installation
TOPSOIL: Bark chippings and sandy soil		0.30	4.68				
MADE GROUND: Brown slightly clayey very fine-coarse sandy subangular - subrounded fine-medium brick, flint and gravel.		0.50	4.48	D 0.40			
MADE GROUND: Orange brown mottled sandy subangular to rounded concrete and flint gravel.		0.70	4.28				
MADE GROUD: Dark brown mottled orange brown sandy, slightly gravelly clay with rare concrete cobble. Sand fine-coarse. Gravel subangular-rounded flint and brick.		2.30	2.68	D 0.80 D 1.20 D 2.00			
MADE GROUND: Black very sandy ash, brick gravel.		3.90	1.08	D 3.00			
Brown mottled black CLAY. Slight organic odour.		7.00	-2.02	D 4.00 D 5.00 D 6.00 D 7.00			
Brown, grey mottled CLAY with spaced laminations of fibrous PEAT		8.00	-3.02	D 8.00			
Dark brown amorphous PEAT with occasional plant remains.		8.50	-3.52	D 8.50			
Grey slightly sandy subrounded to rounded fine-coarse flint GRAVEL. Sand is coarse.				D 9.50			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N6C
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539331.4 E 179808.0 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	4.98m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	31/08/2001
Consultant	WS Atkins			Date Completed	01/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
Grey slightly sandy subrounded to rounded fine-coarse flint GRAVEL. Sand is coarse.	○	15.00	-10.02				▨ ○
Cable Percussion boring complete at 15.00 m.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N7A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539179.4 E 179560.0 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	2.43m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	02/09/2001
Consultant	WS Atkins			Date Completed	03/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
02/09/2001	0800	0.00	0.00	Dry	SOH
02/09/2001	1730	5.00	5.00	5.00	EOS
03/09/2001	0800	5.00	5.00	6.00	SOS
03/09/2001	1730	13.20	13.20	6.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	4.00	300	4.00
150	13.20	150	13.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 2.00-4.00m.
3. Standpipe installed upon borehole completion.
4. Water Strike noted at 5.00m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N7A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539179.4 E
Project	Greenwich Village				179560.0 N
		Drilling Rig	Pilcon 1500	Ground Level	2.43m AOD
Client	English Partnerships	Driller	ID	Orientation	Vertical
		Logged by	AH	Date Started	02/09/2001
Consultant	WS Atkins			Date Completed	03/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Installation
Dark brown very clayey fine-coarse organic SAND with rare subrounded flint gravel.		13.00	-10.57	D	13.00			
Stiff grey brown CLAY with occasional rounded flint gravel.		13.20	-10.77					
Cable Percussion boring complete at 13.20 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
Header

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E
Project	Greenwich Village				179557.4 N
		Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core barrel		Date Completed	01/10/2001
		Core bit	Rock Roller		

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
19/09/2001	0800	0.00	0.00	Dry	SOH
19/09/2001	1730	5.20	5.20	Dry	EOS
20/09/2001	0800	5.20	5.20	Dry	SOS
20/09/2001	1730	17.50	13.50	13.50	EOS
21/09/2001	0800	17.50	13.50	4.30	SOS
21/09/2001	1730	26.30	24.00	4.30	EOS
24/09/2001	0800	26.30	24.00	6.10	SOS
24/09/2001	1730	26.50	26.30	6.10	EOH Cable
28/09/2001	0800	26.50	26.50	6.10	SOS Rotary
28/09/2001	1730	28.00	26.50	0.00	EOS
29/09/2001	0800	28.00	26.50	0.00	SOS

CABLE PERCUSSION DETAILS

Hard strata from depth	Hard strata to depth	Hours	Remarks
2.30	4.00	2.00	
23.70	23.80	1.00	
23.80	24.30	2.50	
26.30	26.50	4.00	
26.50	26.50	1.00	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	4.50	300	4.50
200	13.50	200	13.50
150	45.00	150	26.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
19/09/2001	0000	1.50	1.50	20	NO RISE	1.50	3.00
20/09/2001	0000	6.00	3.70	20		6.00	13.50
20/09/2001	0000	17.50	5.90	20		13.50	0.00

ROTARY DRILLING DETAILS

From depth	To depth	Flush type	Flush return	Core diameter
26.50	45.00	Water		0*

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 2.50-4.50m finishing cable percussion at 26.50m.
3. Rotary open hole follow on from 26.50 - 45.00m.
4. Standpipe installed upon borehole completion.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, hard strata time in hours

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
Sheet 1 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E 179557.4 N
Project	Greenwich Peninsula	Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	01/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
MADE GROUND: Dark brown clayey, slightly gravelly fine-coarse sand. Gravel subangular-subrounded fine-coarse flint.		0.50	2.01				
MADE GROUND: Brown slightly gravelly sandy clay. Sand is fine-coarse. Gravel subangular to subrounded flint and brick. 1.30m Concrete boulder. (driller's description)		1.40	1.11				
Soft grey CLAY (driller's description)		3.00	-0.49				
Soft brown organic CLAY. (driller's description)		3.50	-0.99				
Dark brown amorphous PEAT with occasional plant remains.		4.20	-1.69				
Grey sandy subangular-rounded fine-coarse flint GRAVEL. Sand is coarse. 8.00m Grey and brown sandy subangular to subrounded fine-coarse GRAVEL. Sand is coarse. 9.00m Occasional flint COBBLE							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
Sheet 2 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E
Project	Greenwich Peninsula				179557.4 N
		Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	01/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey sandy subangular-rounded fine-coarse flint GRAVEL. Sand is coarse.		13.20	-10.69				
Very stiff extremely fractured grey brown CLAY. Fissures randomly orientated undulose to planar, smooth occasionally slightly polished.		16.00	-13.49				
Stiff grey brown slightly sandy CLAY with occasional shell fragments. Sand is fine.		17.50	-14.99				
Grey brown fine SAND with rare shell fragments.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
Sheet 3 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E 179557.4 N
Project	Greenwich Peninsula	Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	01/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey brown fine SAND with rare shell fragments.		23.70	-21.19				
Angular coarse gravel size LIMESTONE fragments with abundant shells.		24.30	-21.79				
Very stiff extremely closely fissured grey brown CLAY with occasional shell fragments. Fissures are regularly orientated, undulose to irregular, smooth occasionally slightly polished.		26.30	-23.79				
Hard LIMESTONE (Driller's description)		28.00	-25.49				
Grey brown and green fine SAND 25.00m Abundant shells noted.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
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Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E
Project	Greenwich Peninsula				179557.4 N
		Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	01/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey brown and green fine SAND		38.00	-35.49				
Green silty fine SAND. (THANET SAND)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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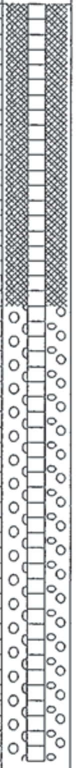
BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N7B
Sheet 5 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539177.7 E 179557.4 N
Project	Greenwich Peninsula	Drilling Rig	Dando 2000 & Edeco T6	Ground Level	2.51m AOD
Client	English Partnerships	Drillers	IP & HJ	Orientation	Vertical
		Logged by	AH	Date Started	19/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	01/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green silty fine SAND. (THANET SAND)	▨	45.00	-42.49				
Borehole complete at 45.00 m.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N8A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539570.1 E 179480.0 N
Project	Greenwich Village	Drilling Rig	Dando 2000	Ground Level	4.56m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	JFK	Date Started	23/08/2001
Consultant	WS Atkins			Date Completed	23/08/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
23/08/2001	0800	0.00	0.00	Dry	SOH
23/08/2001	1730	14.00	14.00	Dry	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
2.30	2.60	0.50	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	5.00	300	5.00
150	14.00	150	14.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
23/08/2001	0000	8.30	7.20	20.0		8.30	13.50

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 4.0-6.0m.
3. Standpipe installed upon borehole completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N8A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539570.1 E
Project	Greenwich Village				179480.0 N
		Drilling Rig	Dando 2000	Ground Level	4.56m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	JFK	Date Started	23/08/2001
Consultant	WS Atkins			Date Completed	23/08/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Brown sand and subrounded fine-coarse flint and angular ash.		0.50	4.06	D	0.50			
MADE GROUND: Dark grey-black fine sand, round medium gravel of ash, wood and occasional roots.		1.00	3.56	D	1.00			
MADE GROUND: Dark grey mottled white sandy gravelly clay. Sand is fine. Gravel is fine-coarse brick and ash.		2.00	2.56	D	2.00			
Black fibrous PEAT.		2.80	1.76	D	2.80			
Grey brown fine sandy mottled black CLAY		3.00	1.56	D	3.00			
Soft grey brown CLAY with occasional rootlets and viens of mottled black contamination.		4.00	0.56	D	4.00			
Stiff grey brown CLAY		5.00	-0.44	D	5.00			
Soft black fibrous PEAT containing wood fragments.				D	6.00			
		7.00	-2.44	D	7.00			
Grey brown and white sandy subrounded-rounded, fine-coarse flint GRAVEL. Sand is coarse.				D	8.00			
				D	9.00			
				D	10.00			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N8A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539570.1 E
Project	Greenwich Village				179480.0 N
		Drilling Rig	Dando 2000	Ground Level	4.56m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	JFK	Date Started	23/08/2001
Consultant	WS Atkins			Date Completed	23/08/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Grey brown and white sandy subrounded-rounded, fine-coarse flint GRAVEL. Sand is coarse.				D	10.00			
				D	11.00			
				D	12.00			
		13.00	-8.44	D	13.00			
Stiff grey CLAY				D	13.20			
		14.00	-9.44	D	14.00			
Cable Percussion boring complete at 14.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N9B
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539727.4 E
Project	Greenwich Village				179630.9 N
		Drilling Rig	Pilcon 1500	Ground Level	7.27m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
04/09/2001	1400	0.00	0.00	Dry	SOH
04/09/2001	1730	7.00	6.00	Dry	EOS
05/09/2001	0800	7.00	6.00	Dry	SOS
05/09/2001	1730	15.00	15.00	9.90	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
3.30	3.60	0.50	
4.20	4.70	0.75	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	6.00	250	6.00
150	15.00	150	15.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 4.70-6.70m.
3. Standpipe installed upon borehole completion.
4. Water Strikes noted at 5.90m and 9.90m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N9B
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539727.4 E 179630.9 N
Project	Greenwich Village	Drilling Rig	Pilcon 1500	Ground Level	7.27m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Installation
MADE GROUND: Brown sandy slightly gravelly clay. Gravel is subangular-subrounded flint and brick. Sand is fine-coarse.		4.80	2.47				
MADE GROUND: Brown very gravelly fine-medium sand. Gravel is fine-coarse, subangular-rounded flint, brick and limestone.		5.70	1.57	D 5.70 J 5.70			
MADE GROUND: Brown-grey mottled dark grey slightly gravelly, slightly sandy CLAY. Gravel subrounded-round brick and flint. Slight odour noted.				D 6.60 J 6.60			
		7.50	-0.23				
Black amorphous PEAT.		8.10	-0.83				
Grey slightly sandy CLAY with occasional plant remains. Sand is fine.		9.90	-2.63				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N9B
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539727.4 E
Project	Greenwich Village				179630.9 N
		Drilling Rig	Pilcon 1500	Ground Level	7.27m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	04/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
Grey slightly sandy subangular-rounded, fine-coarse flint GRAVEL. Sand is coarse.		14.80	-7.53				
Stiff grey brown slightly sandy CLAY. Cable Percussion boring complete at 15.00 m.		15.00	-7.73				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N9C
Header

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E
Project	Greenwich Village				179636.9 N
		Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Driller	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins			Date Completed	03/10/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
05/09/2001	0800	0.00	0.00	Dry	SOH
05/09/2001	1630	2.00	2.00	Dry	EOS
06/09/2001	0800	2.00	2.00	Dry	SOS
06/09/2001	1630	15.50	15.50	10.00	EOH Cable
24/09/2001	0800	15.50	15.50	10.00	SOH Rotary
24/09/2001	1730	15.50	15.50	10.00	EOS
25/09/2001	0800	15.50	15.50	7.40	SOS
25/09/2001	1730	19.30	19.50	0.00	EOS
26/09/2001	0800	19.30	19.50	2.50	SOS
26/09/2001	1730	23.00	23.00	0.00	EOS
27/09/2001	0800	23.00	23.00	5.25	SOS

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
1.80	2.00	1.25	
2.00	2.30	0.75	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	15.00	250	15.00
200	26.00	200	26.00
150	45.00	150	28.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 4.00-6.00m finishing cable percussion at 15.50m.
3. Rotary open hole follow on from 15.50 - 45.00m.
4. Standpipe installed upon borehole completion.
5. Water strike at 10.00m

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N9C
Sheet 1 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E
Project	Greenwich Peninsula				179636.9 N
		Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	03/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
MADE GROUND: Soil brick, wood and glass fill. (Driller's description)		1.30	5.24				
MADE GROUND: Clay fill with large concrete and brick obstructions (Driller's desccription)		2.00	4.54				
MADE GROUND: Clay fill with brick and concrete obstructions (Driller's description)		5.90	0.64				
MADE GROUND: Brown grey mottled dark grey slightly gravelly, slightly sandy clay. Gravel subrounded to rounded of brick and flint.		7.50	-0.96				
Black amorphous PEAT		8.20	-1.66				
Grey slightly sandy CLAY with occasional plant remains. Sand is fine.		9.90	-3.36				

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N9C
Sheet 2 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E
Project	Greenwich Peninsula				179636.9 N
		Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	03/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey and brown slightly sandy subangular to rounded fine to coarse flint GRAVEL. Sand is predominantly coarse.		15.00	-8.46				
Stiff grey fissured CLAY. (Driller's description)		16.00	-9.46				
Green grey very silty fine SAND.		19.50	-12.96				
Grey brown fine to coarse SAND (Scour feature?)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form ARIAL COMBINED LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N9C
Sheet 3 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E
Project	Greenwich Peninsula				179636.9 N
		Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	03/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey brown fine to coarse SAND (Scour feature?)		24.20	-17.66				
Grey CLAY with abundant shell fragments.		25.80	-19.26				
Grey very silty fine SAND with abundant shell fragments.		28.10	-21.56				
Green very silty fine SAND. (Glauconitic Sand)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL COMBINED LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N9C
Sheet 4 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E 179636.9 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	03/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Green very silty fine SAND. (Glauconitic Sand)		36.20	-29.66				
Grey brown silty fine SAND (Thanet Sand)							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE & ROTARY

Hole ID.
N9C
Sheet 5 of 5

Contract No.	F12080	Method	Cable & Rotary	Coordinates	539722.4 E
Project	Greenwich Peninsula				179636.9 N
		Drilling Rig	Pilcon & HansEngland	Ground Level	6.54m AOD
Client	English Partnerships	Drillers	GW & TF	Orientation	Vertical
		Logged by	AH	Date Started	05/09/2001
Consultant	WS Atkins	Core Barrel		Date Completed	03/10/2001
		Core Bit	Rock Roller		

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling & coring	Blow count to drive U100	SPT N & depth	Install-ation
Grey brown silty fine SAND (Thanet Sand)	▨	45.00	-38.46				
Borehole complete at 45.00 m.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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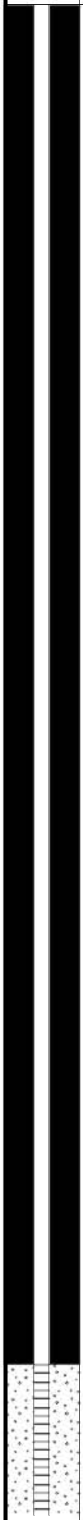
Merebrook Consulting Limited
Tel: 01773 829988
Fax: 01773 829393
email: consulting@merebrook.co.uk

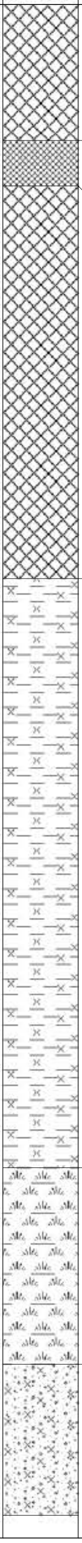
Equipment and Methods

Borehole No
BHN10C
Sheet 1 of 2

Project Name Plot MO101	**Project No.** MER00562	**Co-ords** 539917E - 179424N	**Hole Type** Cable
Location: Greenwich Peninsula Riverside South		**Level** 6.691	**Scale** 1:50
Client: Bellway Homes (Thames Gateway) Ltd		**Dates:** 09/07/2013	**Logged By** OTF



Well	Water Strike	Samples & In Situ Testing Depth (m)	Type	Results	Depth in metres (thickness)	Legend	Stratum Description
					0.90 (0.90)		MADE GROUND. Medium dense dark brown clayey gravelly fine to medium SAND. Gravel is fine to medium of flint, brick, clinker and rare ash.
					1.20 (0.30)		MADE GROUND. Orange meshed geotextile membrane over a dark brown slightly gravelly sandy CLAY. Gravel is fine to medium of flint, brick and rare clinker
					3.80 (2.60)		MADE GROUND: Stiff to firm black sandy gravelly CLAY. Gravel is fine to medium angular to sub rounded of flint, brick, clinker and ash. Sand is medium to coarse
					7.70 (3.90)		Soft to firm bluish grey CLAY
					9.00 (1.30)		Soft to stiff dark brown fibrous PEAT
							Dense greyish brown silty SAND and GRAVEL. Gravel is medium to coarse rounded to sub rounded of flint. Sand is medium to coarse. Increasing silt from 14.5m



Type | Results

Continued next sheet

Remarks: Hand dug service inspection pit to 1.0mbgl. Reduced diameter drilling, bentonite seal at 4m. Monitoring installation - 15m with a response zone between 9.0 -15.0m. Bentonite seal. Upstanding cover used

IVN - in-situ hand vane
IPP - in-situ pocket penetrometer
SPT - in-situ standard penetration test (spoon)
CPT - in-situ standard penetration test (cone)
PID - in-situ photoionization detector

D - small disturbed sample (tub)
J - amber glass jar (250ml)
V - amber glass jar (60ml)
B - bulk disturbed sample
U - U100

Merebrook Consulting Limited
Tel: 01773 829988
Fax: 01773 829393
email: consulting@merebrook.co.uk

Equipment and Methods

Borehole No
BHN10C
Sheet 2 of 2

Project Name Plot MO101	**Project No.** MER00562	**Co-ords** 539917E - 179424N	**Hole Type** Cable
Location: Greenwich Peninsula Riverside South		**Level** 6.691	**Scale** 1:50
Client: Bellway Homes (Thames Gateway) Ltd		**Dates:** 09/07/2013	**Logged By** OTF

Well	Water Strike	Samples & In Situ Testing: Depth (m)	Type	Results	Depth in metres (thickness)	Legend	Stratum Description	
					(6.00)		Dense greyish brown silty SAND and GRAVEL. Gravel is medium to coarse rounded to sub rounded of flint. Sand is medium to coarse. Increasing silt from 14.5m	11 12 13 14
					15.00		End of Borehole at 15.00 m	15 16 17 18 19
			Type	Results				

Remarks: Hand dug service inspection pit to 1.0mbgl. Reduced diameter drilling, bentonite seal at 4m. Monitoring installation - 15m with a response zone between 9.0 -15.0m. Bentonite seal. Upstanding cover used

IVN - in-situ hand vane	D - small disturbed sample (tub)
IPP - in-situ pocket penetrometer	J - amber glass jar (250ml)
SPT - in-situ standard penetration test (spoon)	V - amber glass jar (60ml)
CPT - in-situ standard penetration test (cone)	B - bulk disturbed sample
PID - in-situ photoionization detector	U - U100

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N11B
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539783.6 E
Project	Greenwich Village				179279.0 N
		Drilling Rig	Dando 2000	Ground Level	5.32m AOD
Client	English Partnerships	Driller	RK	Orientation	Vertical
		Logged by	AH	Date Started	30/08/2001
Consultant	WS Atkins			Date Completed	31/08/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
30/08/2001	1430	0.00	0.00	Dry	SOH
30/08/2001	1630	1.80	1.80	Dry	EOS
31/08/2001	0800	1.80	1.80	Dry	SOS
31/08/2001	1500	15.00	15.00	7.45	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
1.80	2.00	1.00	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	7.00	300	7.00
150	15.00	150	15.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
31/08/2001	1230	7.80	7.45	20.0	SLOW	7.80	15.00

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 5.00-7.00m.
3. Standpipe installed upon borehole completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N11B
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539783.6 E 179279.0 N
Project	Greenwich Village	Drilling Rig	Dando 2000	Ground Level	5.32m AOD
Client	English Partnerships	Driller	RK	Orientation	Vertical
		Logged by	AH	Date Started	30/08/2001
Consultant	WS Atkins			Date Completed	31/08/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
TOPSOIL: Brown gravelly sand. Gravel is subrounded-round flint.	▨	1.00	4.32	D 0.00 J 0.00 D 1.00 J 1.00			
MADE GROUND: Orange brown sandy, slightly gravelly clay. Gravel is subrounded-round flint. Sand is fine-coarse. 1.80m Concrete obstruction	▨	2.00	3.32	D 1.80 D 2.00 J 2.00			
MADE GROUND: Dark brown sandy, slightly gravelly clay. Sand fine-coarse. Gravel angular-subrounded fine-coarse brick, flint, concrete, metal, wire and tiles.	▨	4.50	0.82	D 3.00 D 4.00 J 4.00 D 4.50 J 4.50			
MADE GROUND: Olive green slightly sandy clay. Sand is coarse brick.	▨	5.40	-0.08	D 5.40 J 5.40			
Green grey mottled brown CLAY with occasional white pockets. Occasional relic rootlets. (Contaminated ALLUVIUM)	▤	6.00	-0.68	D 6.00			
Dark brown amorphous PEAT with abundant plant remains	⁂	7.00	-1.68	D 7.00 J 7.00			
Dark brown gravelly CLAY	⊖	7.80	-2.48	D 7.80			
Brown very sandy subangular-rounded, fine-coarse flint GRAVEL. Sand is coarse.	○			D 8.00 D 9.00 D 10.00			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N11B
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539783.6 E
Project	Greenwich Village				179279.0 N
		Drilling Rig	Dando 2000	Ground Level	5.32m AOD
Client	English Partnerships	Driller	RK	Orientation	Vertical
		Logged by	AH	Date Started	30/08/2001
Consultant	WS Atkins			Date Completed	31/08/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Brown very sandy subangular-rounded, fine-coarse flint GRAVEL. Sand is coarse.				D	10.00			
				D	11.00			
				D	12.00			
				D	13.00			
				D	14.00			
		15.00	-9.68	D	15.00			
Cable Percussion boring complete at 15.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N12A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539413.7 E
Project	Greenwich Village				179298.6 N
		Drilling Rig	Dando 2000	Ground Level	2.77m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	AH	Date Started	03/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
03/09/2001	0800	0.00	0.00	Dry	SOH
03/09/2001	1630	1.20	0.00	Dry	EOS
04/09/2001	0800	1.20	0.00	Dry	SOS
04/09/2001	1630	3.00	3.00	2.50	EOS
05/09/2001	0800	3.00	3.00	3.50	SOS
05/09/2001	1630	15.00	15.00	7.30	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks
1.30	1.30	0.75	
2.30	2.50	0.50	

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
300	4.50	300	4.50
150	15.00	150	15.00

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow
04/09/2001	0000	2.50	2.50	20.0		0.00	3.00
05/09/2001	0000	7.30	3.30	20.0		6.00	0.00

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 4.00-6.00m.
3. Standpipe installed upon borehole completion.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N12A
Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539413.7 E 179298.6 N
Project	Greenwich Village	Drilling Rig	Dando 2000	Ground Level	2.77m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	AH	Date Started	03/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Light grey slightly clayey sandy subangular-rounded concrete and flint gravel		1.30	1.47				
MADE GROUND: Black sandy clinker and ash gravel.		2.50	0.27				
Grey mottled dark brown organic CLAY.		5.00	-2.23				
Dark brown and black amorphous PEAT. Occasional plant remains.		6.70	-3.93				
Light green grey very sandy CLAY. Sand is fine-medium.		7.70	-4.93				
Brown sandy subangular-rounded, fine-coarse flint GRAVEL. Sand is coarse.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N12A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539413.7 E 179298.6 N
Project	Greenwich Village				
		Drilling Rig	Dando 2000	Ground Level	2.77m AOD
Client	English Partnerships	Driller	IP	Orientation	Vertical
		Logged by	AH	Date Started	03/09/2001
Consultant	WS Atkins			Date Completed	05/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling	SPT N & (U blows)	SPT type & depth	Install-ation
Brown sandy subangular-rounded, fine-coarse flint GRAVEL. Sand is coarse.		13.00	-10.23				
Grey brown silty SAND (THANET SAND)		15.00	-12.23				
Cable Percussion boring complete at 15.00 m.							

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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ACCESSION NUMBER 36895

TQ 37 NG.
1999

EASTERN LS THAMES EA. 270

GREENWICH PENINSULA (IRRIGATION)

TQ37/289 TQ37 NE

Owner ENGLISH PARTNERSHIP
Licence No.
Occupier
IGS Ref. No.
Nat. Grid Ref. TQ 3936 7934
Status
Ground Level m OD ft. OD
Level of Well Top 2·80 m OD ft. OD
Aquifer UPPER CHALK
Rest Water Level 6·50 m bwt ft. bwt
(Date 19/2/99) m OD ft. OD
Construction

Depth bwt m	Dia. mm	Linings (below well top) From m	To m	Dia mm	Type
5	915mm	0	17·2	610	plain
17·6	762	0	61·8	305	plain
61·86	444	56·0	97·0	250	slotted
100·22	300				

Summary of Geological Section	Thickness m	Depth m
Made Ground	6·5	6·5
Peat/Alluvium	3·8	10·3
London Clay	27·70	38·0
WKB	18·0	56·0
Thanet Sands	5·8	61·8
Upper Chalk	35·2	97·0

Abstraction Rates
gph
gpd
Type of Pump
Chem./Bact. Anal. YES NO
Well Driller Soil Mechanics

If insufficient space has been allowed, continue in 'Notes' overleaf.

Geo Log: Gamma/Cal/Temp/Cond

EASTERN LS   THAMES EA.   270

TQ37/289   TQ37 NE / 1999

GREENWICH PENINSULA (IRRIGATION)

Owner ENGLISH PARTNERSHIP

Licence No.

Occupier

IGS Ref. No.

Nat. Grid Ref. TQ 3936 7934

Status

Ground Level m OD ft. OD

Aquifer UPPER CHALK

Level of Well Top 2-80 m OD ft. OD

Rest Water Level 6·50 m bwt ft. bwt

(Date 19/2/99) m OD ft. OD

Construction

Depth bwt m	Dia. mm	Linings (below well top) From m	To m	Dia mm	Type
5	915mm	0	17·2	610	plain
17·6	762	0	61·8	305	plain
61·86	444	56·0	97·0	250	slotted
100·22	300				

Summary of Geological Section	Thickness m	Depth m
Made Ground	6·5	6·5
Peat / Alluvium	3·8	10·3
London Clay	27·70	38·0
WRB	18·0	56·0
Thanet Sands	5·8	61·8
Upper Chalk	35·2	97·0

Abstraction Rates

gph

gpd

Type of Pump

Chem./Bact. Anal. YES NO

Well Driller Soil Mechanics

Geo Log: Gamma/Cal/Temp/Cond

If insufficient space has been allowed, continue in 'Notes' overleaf.

Site Plan

Notes

Pumping Rate: 53m³/hr for 24hrs
RWL : 6·97m
Drawdown: 10·68m
Pump Depth: 59·0m

11/2/99 - 19/2/99

Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N13A
Header

Contract No.	F12080	Method	Cable Percussion	Coordinates	539540.4 E
Project	Greenwich Village				179000.1 N
		Drilling Rig	Pilcon 1500	Ground Level	1.21m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	21/09/2001
Consultant	WS Atkins			Date Completed	22/09/2001

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
21/09/2001	0800	0.00	0.00	Dry	SOH
21/09/2001	1730	10.00	10.00	3.00	EOS
22/09/2001	0800	10.00	10.00	3.00	SOS
22/09/2001	1300	15.00	11.50	3.00	EOH

DRILLING DETAILS

Hardbore from depth	Hardbore to depth	Chiselling hours	Remarks

CASING

Hole diam.	Max depth of hole at dia.	Casing diameter	Max depth of casing of dia.
250	3.00	250	3.00
150	15.00	150	11.50

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Flow	Casing depth at strike time	Casing depth to seal flow

GENERAL NOTES

1. Hand dug service pit to 1.20m.
2. Bentonite seal installed and redrilled 1.40-3.40m.
3. Standpipe installed upon borehole completion.
4. Water strike at 3.0m.

SPT DETAILS

Depth	Type	Incremental blow count/penetration in mm

* Seating blows only.

NB All depths in metres, all diameters in millimetres,
water strike rise time in minutes, chiselling time in hours.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.	**N13A**
	Sheet 1 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539540.4 E
Project	Greenwich Peninsula				179000.1 N
		Drilling Rig	Pilcon 1500	Ground Level	1.21m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	21/09/2001
Consultant	WS Atkins			Date Completed	22/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
MADE GROUND: Dark brown very clayey, gravelly fine-coarse sand with rootlets. Gravel is fine-medium brick.		1.00	0.21	D J	0.50 0.50			
MADE GROUND: Green grey mottled brown and black slightly sandy clay with occasional rootlets. Sand coarse brick.		2.40	-1.19	D J D	1.40 1.40 2.40			
Dark brown amorphous PEAT with occasional plant remains		3.00	-1.79	J D	2.40 3.00			
Grey brown very sandy organic CLAY. Sand is fine-medium. (ALLUVIUM)		3.40	-2.19	J D	3.00 3.40			
Grey brown coarse sandy GRAVEL. (TERRACE GRAVEL)		9.20	-7.99	J D	3.40 9.20			
Soft green grey slightly sandy CLAY with thinly spaced laminations of brown fine-coarse sand.				J D	9.20 10.00			

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

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Norwest Holst Soil Engineering Ltd.

BOREHOLE LOG - CABLE PERCUSSION

Hole ID.
N13A
Sheet 2 of 2

Contract No.	F12080	Method	Cable Percussion	Coordinates	539540.4 E 179000.1 N
Project	Greenwich Peninsula	Drilling Rig	Pilcon 1500	Ground Level	1.21m AOD
Client	English Partnerships	Driller	GW	Orientation	Vertical
		Logged by	AH	Date Started	21/09/2001
Consultant	WS Atkins			Date Completed	22/09/2001

Description of Strata	Legend	Depth Below G.L.	O.D. Level	Sampling		SPT N & (U blows)	SPT type & depth	Install-ation
Soft green grey slightly sandy CLAY with thinly spaced laminations of brown fine-coarse sand.				D J	10.00 10.00			
		15.00	-13.79					
Cable Percussion boring complete at 15.00 m.								

NB All depths in metres, all diameters in millimetres.
See header sheet for details of drilling, progress and water strikes. See legend sheet for key to symbols.

Form	ARIAL CP LOG
Version	1.00
Revised	01/10/1998

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel
Drill Fluid Polymer GS550
Orientation (°) 90
Dates Drilled **Start** 28/11/2005
End 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM 30/11/2005	an 06/12/2005	

BOREHOLE No. **BH106**

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type / TCR %	No. / SCR %	RQD %	SPT Blows /N / Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
28/11										MADE GROUND: Red tarmac.	(0.15) 0.15		
			0.30		D	1				MADE GROUND: Olive grey sandy gravel. Sand is fine to coarse, gravel is angular, fine to coarse of various lithologies.	(0.15) 0.30		
			0.30		CD/K	2				MADE GROUND: Mesh over grey brown, slightly clayey sandy gravel with occasional cobbles. Sand is fine to coarse, gravel is angular to rounded, fine to coarse of flint, brick and concrete fragments. Cobbles are brick and concrete fragments.	(0.15) 0.45		
			0.45		D	3				MADE GROUND: Soft, grey, slightly sandy, slightly gravelly silt, with a strong hydrocarbon odour. Sand is fine to coarse, gravel is angular to rounded, fine to coarse of flint, brick and concrete. Occasional fragments of black organic material.	(3.75)		
			0.45		CD/K	4							
			1.50		D	5							
			1.50		CD/K	6							
28/11	3.00	DRY											
29/11	3.00	DRY											
			3.50		D	7							
			3.50		CD/K	8							
			4.20		D	9				Soft to firm grey slightly sandy CLAY with occasional fragments of black organic material. Strong hydrocarbon odour. (ALLUVIUM)	4.20 (2.30)		
			4.20		CD/K	10							
			6.00		D	11							
			6.00		CD/K	12							
			6.50		D	13				Dark brown, spongy PEAT with a strong hydrocarbon odour. (ALLUVIUM)	6.50 (2.40)		
			6.50		CD/K	14							
			8.50		D	15							
			8.50		CD/K	16							
			8.90		D	17				Dark grey slightly silty slightly sandy GRAVEL. Sand is fine to coarse, gravel is subrounded, fine to coarse of flint. Gravel locally coated with hydrocarbon. Strong hydrocarbon odour. (RIVER TERRACE GRAVELS)	8.90		
			8.90		CD/K	18							
		(0)											

Remarks (See notes & keysheets)
1 Prior to boring a Cable Avoidance Tool (CAT) survey was carried out. An inspection pit was hand-dug to 1.20m depth and rescanned using the CAT to check for services. Services were not located.
2 Aquifer protection was carried out by sealing the base of the hole at a depth of 8.90m and 15.20m and continuing in reduced diameter casing.
3 The borehole was advanced by cable percussion means to 19.00m and then progressed by open hole means to 60.00m.
4 Groundwater was not apparent during boring.
5 See installation details on final sheet.

Scale 1:50

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (1 of 7)

Drilling Method Cable Percussion/Open Hole **Equipment** Dando 2000/Knebel **Drill Fluid** Polymer GS550 **Orientation (°)** 90 **Dates Drilled** **Start** 28/11/2005 **End** 08/12/2005	**Borehole Diameter** 400mm to 8.90m 300mm to 15.20m 200mm to 19.00m 170mm to 60.00m	**Casing Diameter** 400mm to 8.90m 300mm to 15.20m 200mm to 15.80m	**BOREHOLE No.** **BH106**
	Logged by CM 30/11/2005	**Compiled by** an 06/12/2005	**Checked by**

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type / TCR %	No. / SCR %	RQD %	SPT Blows /N / Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
										Dark grey slightly silty slightly sandy GRAVEL (See Previous Sheet)			
			11.00		B	19							
											(5.80)		
			13.00		B	20							
			14.70 14.70		D CD/K	21 22				Stiff possibly extremely closely fissured brown grey CLAY. (LONDON CLAY)	14.70		
29/11	15.50	DRY											
30/11	15.50	9.00											
											(4.30)		
			18.70		D	23							
30/11	15.80	DRY											
										Brown green and grey clayey fine and medium SAND, with rare shell fragments. (LAMBETH GROUP)	19.00		
08/12	15.80												

Remarks
(See notes & keysheets)

Scale 1:50

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (2 of 7)

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel
Drill Fluid Polymer GS550
Orientation (°) 90
Dates Drilled **Start** 28/11/2005
End 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM	an	
30/11/2005	06/12/2005	

BOREHOLE No. **BH106**

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
										Between 23.00m and 23.50m; Possible gravel layer. (Drillers observation)			
											(10.00)		
										At 25.50m; Possible gravel (Drillers observation).			
										Yellow, mottled green, clayey fine SAND. (LAMBETH GROUP) At 29.50m; Possible gravel or calcrete nodule? (Drillers observation)	29.00		
			0.00-60.00		OH								

Remarks
(See notes & keysheets)

Scale 1:50

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (3 of 7)

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel

Drill Fluid Polymer GS550
Orientation (°) 90
Dates Drilled **Start** 28/11/2005
End 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM 30/11/2005	an 06/12/2005	

BOREHOLE No. **BH106**

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type / TCR %	No. / SCR %	RQD %	SPT Blows /N / Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
											(3.00)		
										Grey clayey fine SAND, with rare gravel. (LAMBETH GROUP) Between 32.00m and 32.75m; Possible gravel layer. (Drillers observation)	32.00		
										Between 36.00m and 38.0m; Possible gravel layer. (Drillers observation)	(8.00)		
										Between 39.00m and 41.00m; Possible gravel and cobble layer. (Drillers observation)			
		(100)											
											40.00		

Remarks
(See notes & keysheets)

Scale 1:50

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (4 of 7)

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel
Drill Fluid Polymer GS550
Orientation (°) 90
Dates Drilled **Start** 28/11/2005
End 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM 30/11/2005	an 06/12/2005	

BOREHOLE No. BH106

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type / TCR %	No. / SCR %	RQD %	SPT Blows /N / Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
										Grey SAND. Sand is fine and medium. (THANET SANDS)	40.00		▨
											(10.00)		
											50.00		

Remarks
(See notes & keysheets)

Scale 1:50

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (5 of 7)

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel
Drill Fluid Polymer GS550
Orientation (°) 90
Dates Drilled **Start** 28/11/2005 **End** 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM 30/11/2005	an 06/12/2005	

BOREHOLE No. **BH106**

Date & Time	Casing Depth (m)	Water Depth (m) (Flush Return) %	Sample/Core Recovery Depth (m) From	To	Type TCR %	No. SCR %	RQD %	SPT Blows /N Core Size (mm)		Description of Strata	Depth (Thick-ness) (m)	Level	Legend
										Possibly flint GRAVEL AND COBBLES intermixed with comminuted chalk. (BULLHEAD BEDS?)	50.00 (1.50)		
										White CHALK with occasional flints.	51.50 (8.50)		
08/12	17.80												
										End of Borehole	60.00		

Remarks
(See notes & keysheets)

Scale 1:50

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (6 of 7)

Drilling Method Cable Percussion/Open Hole
Equipment Dando 2000/Knebel

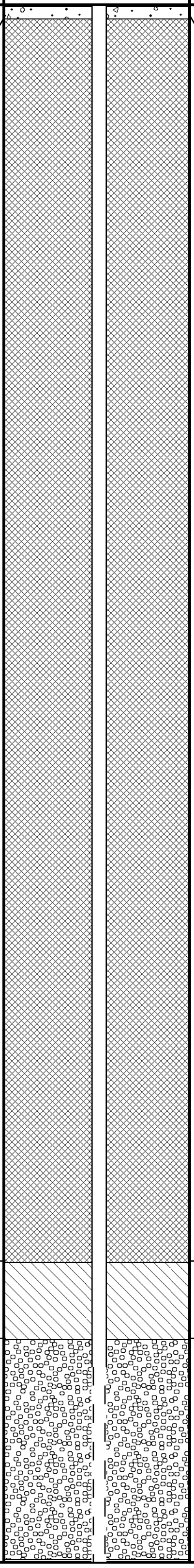
Polymer GS550 90
Dates Drilled **Start** 28/11/2005
End 08/12/2005

Borehole Diameter	**Casing Diameter**
400mm to 8.90m	400mm to 8.90m
300mm to 15.20m	300mm to 15.20m
200mm to 19.00m	200mm to 15.80m
170mm to 60.00m	

Logged by	**Compiled by**	**Checked by**
CM 30/11/2005	an 06/12/2005	

BOREHOLE No. BH106

Description	Depth (m)	Level	
Concrete	0.50		Flush lockable stopcock box cover with gas tap. Pipe diameter 75mm to 60.00m.
Cement/Bentonite Grout	48.50		
Bentonite Seal	51.50		
Gravel Filter	60.00		Base of Hole



Remarks
(See notes & keysheets)

Not to Scale

FUGRO

Project
BH106, DOME ARENA, GREENWICH
Sir Robert McAlpine Ltd
Sir Robert McAlpine Ltd

Contract No. WAL050168

Figure No. BH106 (7 of 7)

309/03

Project Name Silvertown Tunnel

Project No. TA7510
Engineer Atkins Ltd
Employer Atkins Ltd

Exploratory Hole Log

Hole ID.
EB3A
Header Page 1

Ground Level 2.92m OD
Coordinates 539240.99 E, 179656.52 N National Grid
Date Started 25/11/2014
Date Completed 10/12/2014
Inclination Vertical

Top	Base	Type	Date Started	Date Ended	Crew	Section Logged By	Core Barrel	Core Bit	Equipment	Shoring / Support	Remarks
0.00	1.20	IP	25/11/2014	26/11/2014	CC/EC	IH	NA	NA	Hand Tools		
1.20	4.00	CP	26/11/2014	10/12/2014	CC/EC	IH	NA	NA	Dando 3000		
4.00	15.45	CP	09/12/2014	10/12/2014	DA/MT	IH	NA	NA	Dando 3000		

CABLE PERCUSSION DETAILS

Hard Strata Depth from	Hard Strata Depth to	Chiselling Start time hhmm	Chiselling Duration hhmm	Remarks
9.10	9.30	NA	0030	Chiselling
11.30	11.50	NA	0030	Chiselling

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Casing depth at strike time	Casing depth to seal flow
26/11/2014	1300	1.80	1.70	5	1.80	NS
26/11/2014	1300	1.80	1.70	10	1.80	NS
26/11/2014	1300	1.80	1.70	15	1.80	NS
26/11/2014	1300	1.80	1.70	20	1.80	NS
09/12/2014	1715	5.70	4.80	5	5.70	NS
09/12/2014	1715	5.70	4.30	10	5.70	NS
09/12/2014	1715	5.70	4.20	15	5.70	NS
09/12/2014	1715	5.70	4.10	20	5.70	NS

HOLE DIAMETER / CASING

Hole diameter	Depth of hole	Casing diameter	Depth of casing
200	5.00	200	5.00
150	15.45	150	13.10

ROTARY FLUSH DETAILS

From depth	To depth	Flush type	Flush return %	Flush colour

DYNAMIC SAMPLING

Top	Base	Diameter	Time hhmmss	Recovery %

INSTALLATION DETAILS

Distance from G.L.	ID	Type	Response zone Top	Response zone Base
4.00	02	SP	1.00	4.00
15.00	01	SP	6.00	15.00

PIPE CONSTRUCTION

ID	Pipe Top	Pipe Base	Dia. of pipe	Type of pipe
02	0.00	1.00	50	Plain
02	1.00	4.00	50	Slotted
01	0.00	6.00	50	Plain
01	6.00	15.00	50	Slotted

BACKFILL DETAILS

Top of section	Base of section	Material	Remarks
0.00	0.50	Concrete	
0.50	1.00	Bentonite	
1.00	4.00	Gravel backfill	
4.00	6.00	Bentonite	
6.00	15.45	Gravel backfill	

NOTES: All depths in metres, all diameters in millimetres.
Water strike rise time in minutes, hard strata time in hhmm
For details of abbreviations, see key

FINAL Log Print Date And Time: 18/06/2015 15:19:22 Log checked by: SF 03/06/2015

SOIL ENGINEERING
Part of the Bachy Soletanche group

Project Name Silvertown Tunnel

Project No. TA7510
Engineer Atkins Ltd
Employer Atkins Ltd

Exploratory Hole Log

Hole ID.
EB3A

Ground Level 2.92m OD
Coordinates 539240.99 E, 179656.52 N National Grid
Date Started 25/11/2014
Date Completed 10/12/2014
Inclination Vertical

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
25/11/2014	0730	0.00	-	NR	Start of Hole
25/11/2014	1800	0.80	-	DRY	End of Shift
26/11/2014	0730	0.80	-	DRY	Start of Shift
26/11/2014	1800	4.00	4.00	3.50	End of Shift
09/12/2014	0730	0.00	-	NR	Start of Shift
09/12/2014	1800	6.00	6.00	4.90	End of Shift
10/12/2014	0730	6.00	6.00	5.10	Start of Shift
10/12/2014	1800	15.45	13.60	9.70	End of Hole

SPT DETAILS

Depth	Type	Incremental blow count / penetration in mm	Hammer No.	Energy ratio %	Casing depth	Water depth
1.30	SPT(C)	N=20 (3,5,5,4,5,6)	AR89	67	1.30	DRY
2.50	SPT(C)	N=11 (2,2,4,2,2,3)	AR89	67	2.50	2.30
5.60	SPT	N=26 (3,4,5,6,7,8)	AR538	75	5.60	DRY
7.00	SPT(C)	N=18 (2,3,3,4,5,6)	AR538	75	7.00	4.70
8.50	SPT(C)	N=17 (2,2,3,4,5,5)	AR538	75	8.50	4.50
10.00	SPT(C)	N=18 (1,2,3,4,5,6)	AR538	75	10.00	4.30
11.50	SPT(C)	N=17 (2,3,3,4,5,5)	AR538	75	11.50	4.60
15.00	SPT	N=30 (2,4,6,7,8,9)	AR538	75	13.60	9.70

* Seating blows only.

DEPTH RELATED REMARKS

Top Depth	Base Depth	Remarks
4.00	4.00	Contamination encountered? hole suspended.
5.00	6.00	Bentonite seal.
6.00	13.10	Water added to assist drilling.

GENERAL NOTES

1. Inspection pit excavated to 1.20m. Concrete encountered and pit terminated.
2. Borehole abandoned and backfilled.
3. Hole redrilled 0.00m to 4.00m.

NOTES: All depths in metres, all diameters in millimetres.
For details of abbreviations, see key

FINAL
Log Print Date And Time: 18/06/2015 15:19:26
Log checked by: SF 03/06/2015

SOIL ENGINEERING
Part of the Bachy Soletanche group

Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		EB3A
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 1 of 4

Ground Level	2.92m OD	Coordinates	539240.99 E, 179656.52 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	TCR	SCR	RQD		In Situ Test Details	Install-ation
MADE GROUND: Block paving. (Hardstanding)		0.05	2.87								
MADE GROUND: Yellow fine to coarse sand. (Made Ground)		0.10	2.82								
MADE GROUND: Brown silty sandy angular to subrounded fine to coarse gravel size fragments of brick, flint, concrete, granite and rare ceramics. Occasional subangular cobble size fragments of concrete and brick. (Made Ground)		(0.90)		ES 1 0.30 B 2 0.30 ES 3 0.50 B 4 0.50							
MADE GROUND: Black locally clayey gravelly fine to coarse sand. Gravel sized fragments are angular to subrounded fine to coarse of brick, concrete, flint, ceramics and rare possible ACM. (Made Ground)		1.00 (0.20)	1.92	ES 5 1.00 B 6 1.00							
MADE GROUND: Black locally clayey gravelly fine to coarse sand. Gravel sized fragments are subangular to subrounded fine to coarse of brick, flint, concrete, coal, slag and possible ACM. Occasional fine to coarse gravel sized pockets of grey and black clay. Hydrocarbon odour and black and brown tar staining. (Made Ground)		1.20 (2.10)	1.72	D 7 1.30 B 8 1.30-1.80 ES 9 2.00 D 10 2.50 B 11 2.50-3.00 ES 12 3.00						SPT(C) N=20 1.30 1.75 SPT(C) N=11 2.50 2.95	
MADE GROUND: Grey and black locally stained brown slightly sandy slightly gravelly clayey silt. Frequent pockets of brown staining and low viscosity hydrocarbon/tar. Gravel sized fragments are subangular to subrounded fine to coarse of brick, slag and concrete. Strongly contaminated with hydrocarbons. (Made Ground) at 3.50m 1 No cobble of subangular granite		3.30 (0.70)	-0.38	D 13 3.30 UF 3.50-4.00 B 14 3.50-4.00	100	7 Blows, 0% Recovery					
PEAT. (Driller's description) (Alluvium)		4.00 (0.80)	-1.08	ES 15 4.00 D 16 4.00 UTF 4.50-4.95	100	20 Blows, 0% Recovery					
Soft grey locally black slightly gravelly silty organic rich CLAY. Gravel		4.80	-1.88	D 17 4.80 ES 18 4.80 B 19 4.80-5.30							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

FINAL Log Print Date And Time: 18/06/2015 15:19:29 Log checked by: SF 03/06/2015

SOIL ENGINEERING
Part of the Bachy Soletanche Group

Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		EB3A
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 2 of 4

Ground Level 2.92m OD
Coordinates 539240.99 E, 179656.52 N National Grid
Hole Type IP+CP
Inclination Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
is subangular to subrounded fine to coarse of flint. Occasional medium to coarse gravel sized pockets of peat. (Alluvium)		(0.90)									
				D 20 5.60-6.00						SPT N=26 5.60 6.05	
Medium dense multicoloured slightly silty very sandy subangular to subrounded fine to coarse gravel of flint and chert (locally with hydrocarbon contamination). Sand is fine to coarse. (River Terrace Deposits)		5.70	-2.78	W 21 5.70 B 22 5.70-6.00							
				D 23 6.00							
				B 24 6.70-7.20							
				D 25 7.00 ES 26 7.00						SPT(C) N=18 7.00 7.45	
below 7.70m no silt				B 27 7.70-8.20							
				D 28 8.00							
below 8.50m occasional fine to medium gravel pockets of brown hydrocarbon staining				B 29 8.50-9.00 D 30 8.50 ES 31 8.50						SPT(C) N=17 8.50 8.95	
		(7.40)									
below 9.50m sand and gravel				B 32 9.50-10.00 D 33 9.50							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

FINAL Log Print Date And Time: 18/06/2015 15:19:32 Log checked by: SF 03/06/2015

SOIL ENGINEERING
Part of the Bachy Soletanche Group

Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		EB3A
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 3 of 4

Ground Level	2.92m OD	Coordinates	539240.99 E, 179656.52 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
Medium dense multicoloured slightly silty very sandy subangular to subrounded fine to coarse gravel of flint and chert (locally with hydrocarbon contamination). Sand is fine to coarse. (River Terrace Deposits)										SPT(C) N=18 10.00 10.45	
				B 34 10.50-11.00 D 35 10.50 ES 36 10.50							
				B 37 11.50-12.00 D 38 11.50						SPT(C) N=17 11.50 11.95	
				B 39 12.50-13.00 D 40 12.50 ES 41 12.50							
Stiff fissured thinly laminated brownish grey slightly sandy CLAY. Fissures are extremely closely to very closely spaced randomly orientated planar rough and smooth. Occasional thin partings of grey fine sand. Occasional patches of black staining on fissures. Rare fine to coarse sand sized selenite crystals. Frequent 2mm x 5mm burrows infilled with grey silt. (London Clay Formation)		13.10	-10.18	D 42 13.10 B 43 13.10-13.60							
				ES 44 13.40							
				UT 45 13.65-14.00	100	75 Blows, 67% Recovery					
				D 46 14.05							
		(2.35)									
below 14.50m sandy clay. No fissures				D 47 14.50							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

FINAL　Log Print Date And Time: 18/06/2015 15:19:34　Log checked by: SF 03/06/2015

SOIL ENGINEERING
Part of the Bachy Soletanche Group

Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		EB3A
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 4 of 4

Ground Level	2.92m OD	Coordinates	539240.99 E, 179656.52 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
Stiff fissured thinly laminated brownish grey slightly sandy CLAY. Fissures are extremely closely to very closely spaced randomly orientated planar rough and smooth. Occasional thin partings of grey fine sand. Occasional patches of black staining on fissures. Rare fine to coarse sand sized selenite crystals. Frequent 2mm x 5mm burrows infilled with grey silt. (London Clay Formation) below 15.00m clay is very stiff	▨	15.45	-12.53	D 48 15.00-15.45						SPT N=30 15.00 15.45	▨
Exploratory hole complete at 15.45 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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Appendix E. Silvertown Site Borehole logs

Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Header Page 1

Ground Level 2.29m OD
Coordinates 540009.95 E, 180356.33 N National Grid
Date Started 08/01/2015
Date Completed 13/01/2015
Inclination Vertical

Top	Base	Type	Date Started	Date Ended	Crew	Section Logged By	Core Barrel	Core Bit	Equipment	Shoring / Support	Remarks
0.00	1.20	IP	08/01/2015	08/01/2015	DA/RA	JR	NA	NA	Hand Tools		
1.20	30.30	CP	08/01/2015	13/01/2015	DA/RA	JR	NA	NA	Dando 3000		

CABLE PERCUSSION DETAILS

Hard Strata Depth from	to	Chiselling Start time hhmm	Duration hhmm	Remarks
7.60	7.70	NR	0030	Chiselling
9.00	9.20	NR	0030	Chiselling
23.90	25.60	NR	0400	Chiselling
29.50	30.00	NR	0100	Chiselling

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Casing depth at strike time	to seal flow
08/01/2015	0815	1.40	1.40	NR	NR	NR
08/01/2015	1345	6.60	3.10	5	6.30	NR
08/01/2015	1345	6.60	2.70	10	6.30	NR
08/01/2015	1345	6.60	2.50	15	NR	NR
08/01/2015	1345	6.60	2.30	20	6.30	NR

HOLE DIAMETER / CASING

Hole diameter	Depth of hole	Casing diameter	Depth of casing
200	20.00	200	12.70
150	30.30	150	26.00

ROTARY FLUSH DETAILS

From depth	To depth	Flush type	Flush return %	Flush colour

DYNAMIC SAMPLING

Top	Base	Diameter	Time hhmmss	Recovery %

INSTALLATION DETAILS

Distance from G.L.	ID	Type	Response zone Top	Response zone Base
10.50	02	SP	7.00	10.50
26.00	01	SPIE	24.50	26.50

PIPE CONSTRUCTION

ID	Pipe Top	Pipe Base	Dia. of pipe	Type of pipe
02	0.00	7.00	50	Plain
02	7.00	10.50	50	Slotted
01	0.00	26.00	19	Plain

BACKFILL DETAILS

Top of section	Base of section	Material	Remarks
0.00	0.50	Concrete	
0.50	7.00	Bentonite	
7.00	10.50	Gravel backfill	
10.50	24.50	Bentonite	
24.50	26.50	Sand backfill	
26.50	30.30	Bentonite	

NOTES: All depths in metres, all diameters in millimetres.
Water strike rise time in minutes, hard strata time in hhmm
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Header Page 2

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Date Started	08/01/2015	Date Completed	13/01/2015

Inclination Vertical

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
08/01/2015	0730	0.00	-	NR	Start of Hole
08/01/2015	1800	11.50	11.00	9.60	End of Shift
09/01/2015	0730	11.50	11.00	2.50	Start of Shift
09/01/2015	1800	20.00	12.70	7.10	End of Shift
12/01/2015	0730	20.00	12.70	2.50	Start of Shift
12/01/2015	1800	27.50	26.00	5.46	End of Shift
13/01/2015	0730	27.50	26.00	5.20	Start of Shift
13/01/2015	1800	30.30	26.00	NR	End of Hole

SPT DETAILS

Depth	Type	Incremental blow count / penetration in mm	Hammer No.	Energy ratio %	Casing depth	Water depth
1.20	SPT	N=6 (1,2,2,1,1,2)	AR538	75	1.20	DRY
3.50	SPT	N=3 (1,0,1,0,1,1)	AR538	75	3.50	DRY
5.00	SPT	N=2 (1,0,1,0,1,0)	AR538	75	4.50	DRY
6.90	SPT	N=20 (3,5,5,4,5,6)	AR538	75	6.40	DRY
8.50	SPT(C)	N=18 (2,4,4,5,4,5)	AR538	75	8.50	1.80
10.00	SPT(C)	N=21 (2,4,4,5,6,6)	AR538	75	10.00	1.80
12.00	SPT	N=18 (2,2,3,4,5,6)	AR538	75	12.00	5.20
13.50	SPT	N=21 (3,3,4,5,6,6)	AR538	75	12.70	8.40
15.00	SPT	N=21 (2,3,4,5,6,6)	AR538	75	12.70	9.10
16.50	SPT	N=22 (3,4,4,5,6,7)	AR538	75	12.70	9.90
18.00	SPT	N=30 (4,5,6,7,8,9)	AR538	75	12.70	8.90
19.50	SPT	N=36 (4,6,7,9,10,10)	AR538	75	12.70	7.10
21.50	SPT	N=37 (4,5,7,9,10,11)	AR538	75	21.50	DRY
23.00	SPT	50/135mm (7,10,24,26/60)	AR538	75	NR	NR
24.50	SPT	50/125mm (12,13/60,27,23/50)	AR538	75	NR	NR
26.00	SPT	50/90mm (5,11,40,10/15)	AR538	75	26.00	NR
27.50	SPT	50/75mm (12,13/50,50)	AR538	75	27.50	NR
29.00	SPT	50/225mm (5,8,14,16,20)	AR538	75	26.00	NR
30.00	SPT	50/215mm (8,11,13,17,20/65)	AR538	75	26.00	NR

* Seating blows only.

DEPTH RELATED REMARKS

Top Depth	Base Depth	Remarks
6.60	10.70	Water added to assist drilling.
19.00	20.00	Install bentonite seal.
22.70	30.00	Water added to assist drilling.

GENERAL NOTES

NOTES: All depths in metres, all diameters in millimetres.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name Silvertown Tunnel
Project No. TA7510
Engineer Atkins Ltd
Employer Atkins Ltd

Exploratory Hole Log

Hole ID.
G16
Sheet 1 of 7

Ground Level 2.29m OD
Coordinates 540009.95 E, 180356.33 N National Grid
Hole Type IP+CP
Inclination Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Dia.	Blow Count And Sample Recovery TCR	SCR	RQD		In Situ Test Details	Install-ation
MADE GROUND: Grey reinforced concrete. (Hardstanding)		(0.40)									
MADE GROUND: Dark brown slightly clayey sandy subangular to subrounded fine to coarse gravel sized fragments of bricks, concrete and flint. Sand sized fragments are fine to coarse. (Made Ground)		0.40	1.89	D 1 0.40 B 2 0.40-0.90 ES 3 0.40							
		(1.00)		D 4 0.90 B 5 0.90-1.20 ES 6 1.00							
				D 7 1.20-1.65						SPT N=6 1.20 1.65	
MADE GROUND: Dark brown sandy very clayey subangular to subrounded fine to coarse gravel sized fragments of brick, concrete and flint. Sand sized fragments are fine to coarse. (Made Ground)		1.40	0.89	B 10 1.40-1.80 D 8 1.40 ES 9 1.40							
		(0.40)									
Soft dark grey silty sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. Sand is fine to coarse. (Alluvium)		1.80	0.49	D 11 1.80							
				UT 12 2.00-2.45	100	10 Blows, 100% Recovery					
				D 13 2.45 ES 14 2.50 B 15 2.50-3.00							
		(2.10)									
				D 16 3.00							
				D 17 3.50-3.95						SPT N=3 3.50 3.95	
Dark grey and black clayey spongy pseudo fibrous PEAT. (Alluvium)		3.90	-1.61	D 18 3.90 B 19 3.90-4.40							
				UT 20 4.50-4.95	100	14 Blows, 100% Recovery					
		(1.80)									
				D 21 4.95							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 2 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Dia.	Blow Count And Sample Recovery TCR	SCR	RQD		In Situ Test Details	Install-ation
Dark grey and black clayey spongy pseudo fibrous PEAT. (Alluvium)				D 22 5.00-5.45 B 23 5.00-5.50						SPT N=2 5.00	5.45
				UT 24 5.50-5.95	100	20 Blows, 100% Recovery					
		5.70	-3.41								
Firm dark grey slightly sandy silty CLAY. Sand is fine to coarse. (Alluvium)				D 25 5.95							
		(0.90)									
				UT 26 6.40-6.85	100	25 Blows, 100% Recovery					
	▼	6.60	-4.31	W 29 6.60							
Medium dense grey slightly clayey sandy subangular to subrounded fine to coarse GRAVEL of flint. Sand is fine to coarse. (River terrace deposits)				D 27 6.85 D 28 6.90-7.35 B 30 6.90-7.40						SPT N=20 6.90	7.35
				B 32 7.90-8.40 D 31 8.00							
										SPT(C) N=18 8.50	8.95
		(4.10)									
				B 33 8.90-9.40 D 34 9.00							
				B 35 9.90-10.40							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 3 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	Blow Count And Sample Recovery (TCR / SCR / RQD)	In Situ Test Details	Install-ation
Remaining Detail : 9.90m - 10.00m : from 9.90m to 10.00m locally slightly clayey very sandy				D 36 10.00			SPT(C) N=21 10.00 10.45	
Stiff fissured thinly laminated dark grey sandy CLAY. Fissures are closely spaced randomly orientated. Sand is fine to coarse. (London Clay Formation) from 10.70m to 11.45m firm silty sandy gravelly clay from 10.70m to 11.45m with occasional rootlets		10.70	-8.41	D 37 10.70				
				UT 38 11.00-11.45	100	60 Blows, 100% Recovery		
				D 39 11.45 B 40 11.50-12.00				
				D 41 12.00-12.45 B 42 12.00-12.50			SPT N=18 12.00 12.45	
				UT 43 12.50-12.95	100	60 Blows, 100% Recovery		
				D 44 12.95 UT 45 13.00-13.45	100	60 Blows, 100% Recovery		
				D 46 13.45 D 47 13.50-13.95 B 48 13.50-14.00			SPT N=21 13.50 13.95	
				UT 49 14.00-14.45	100	60 Blows, 100% Recovery		
				D 50 14.45 UT 51 14.50-14.95	100	60 Blows, 100% Recovery		
				D 52 14.95				

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID. G16
Project No.	TA7510		
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 4 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details		Installation
				Details	Dia.	TCR	SCR	RQD				
Stiff fissured thinly laminated dark grey sandy CLAY. Fissures are closely spaced randomly orientated. Sand is fine to coarse. (London Clay Formation)				D 53 15.00-15.45 B 54 15.00-15.50						SPT N=21 15.00	15.45	
				ES 55 15.50 UT 56 15.50-15.95	100	70 Blows, 100% Recovery						
				D 57 15.95 UT 58 16.00-16.45	100	70 Blows, 100% Recovery						
				D 59 16.45 D 60 16.50-16.95 B 61 16.50-17.00						SPT N=22 16.50	16.95	
		(12.00)										
				UT 62 17.00-17.45	100	75 Blows, 100% Recovery						
				D 63 17.45 UT 64 17.50-17.95	100	75 Blows, 100% Recovery						
				D 65 17.95 D 66 18.00-18.45 B 67 18.00-18.50						SPT N=30 18.00	18.45	
				UT 68 18.50-18.95	100	75 Blows, 100% Recovery						
				D 69 18.95 UT 70 19.00-19.45	100	75 Blows, 100% Recovery						
				D 71 19.45 D 72 19.50-20.00 B 73 19.50-20.00						SPT N=36 19.50	19.95	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 5 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
Stiff fissured thinly laminated dark grey sandy CLAY. Fissures are closely spaced randomly orientated. Sand is fine to coarse. (London Clay Formation)				B 74 20.00-20.50							
				UT 75 20.50-20.95	100	100 Blows, 100% Recovery					
				D 76 20.95							
				UT 77 21.00-21.35	100	100 Blows, 100% Recovery					
				D 78 21.35							
				D 79 21.50-21.95						SPT N=37 21.50 21.95	
				B 80 21.50-22.00							
				UT 81 22.00-22.45	100	100 Blows, 100% Recovery					
				D 82 22.45							
				UT 83 22.50-22.95	100	100 Blows, 100% Recovery					
Very dense grey clayey sandy subangular to subrounded fine to coarse GRAVEL of flint. With abundant shell fragments. Sand is fine to coarse. (Harwich Formation)		22.70	-20.41								
				D 84 22.95							
				B 85 23.00-23.50						SPT 50/135mm 23.00 23.29	
				D 86 24.00							
		(2.90)									
from 24.50m to 25.00m locally very clayey gravelly sand				B 87 24.50-25.00						SPT 50/125mm 24.50 24.76	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID. G16
Project No.	TA7510		
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 6 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
Very dense grey clayey sandy subangular to subrounded fine to coarse GRAVEL of flint. With abundant shell fragments. Sand is fine to coarse. (Harwich Formation)											
Very dense dark grey clayey to very clayey fine to medium SAND. (Woolwich Formation - Laminated Beds)		25.60	-23.31	D 88 25.60							
				D 89 26.00-26.30 B 90 26.00-26.50						SPT 50/90mm 26.00 26.24	
				D 91 27.00							
		(3.20)									
below 27.50m sand is dark brown				D 92 27.50-27.80 B 93 27.50-28.00						SPT 50/75mm 27.50 27.70	
				D 94 28.50							
Very stiff dark grey sandy CLAY with abundant up to 2mm x 2mm x 3mm white to pinkish orange shell fragments. Sand is fine to coarse. (Woolwich Formation - Lower Shelly Beds)		28.80	-26.51	D 95 28.80							
				D 96 29.00-29.30 B 97 29.00-29.50						SPT 50/225mm 29.00 29.38	
				D 98 29.50							
		(1.50)									

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G16
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 7 of 7

Ground Level	2.29m OD	Coordinates	540009.95 E, 180356.33 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD			
Very stiff dark grey sandy CLAY with abundant up to 2mm x 2mm x 3mm white to pinkish orange shell fragments. Sand is fine to coarse. (Woolwich Formation - Lower Shelly Beds)		30.30	-28.01	D 99 30.00-30.30						SPT 50/215mm 30.00 30.37	
Exploratory hole complete at 30.30 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Header Page 2

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid		
Date Started	16/01/2015	Date Completed	02/02/2015	Inclination	Vertical

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
19/01/2015	0700	0.00	0.00	DRY	Start of Hole
19/01/2015	1800	10.00	10.00	3.00	End of Shift
20/01/2015	0730	10.00	10.00	1.60	Start of Shift
20/01/2015	1800	13.60	12.00	4.80	End of CP
26/01/2015	0700	13.60	12.00	2.20	Start of Rotary
26/01/2015	1800	13.60	12.00	2.20	End of Shift
27/01/2015	0700	13.60	12.00	2.80	Start of Shift
27/01/2015	1800	17.60	17.60	3.00	End of Shift
28/01/2015	0700	17.60	17.60	0.50	Start of Shift
28/01/2015	1800	25.40	25.40	2.30	End of Shift
29/01/2015	0700	25.40	25.40	1.80	Start of Shift
29/01/2015	1800	30.00	30.00	1.80	End of Shift
30/01/2015	0700	30.00	30.00	1.00	Start of Shift
30/01/2015	1800	33.00	33.00	1.30	End of Shift
02/02/2015	0700	33.00	33.00	4.00	Start of Shift
02/02/2015	1800	36.00	36.00	2.00	End of Hole

SPT DETAILS

Depth	Type	Incremental blow count / penetration in mm	Hammer No.	Energy ratio %	Casing depth	Water depth
7.70	SPT	N=14 (1,1,2,3,4,5)	AR538	75	7.60	DRY
9.50	SPT(C)	N=20 (2,2,3,5,6,6)	AR538	75	9.50	2.10
11.00	SPT(C)	N=18 (2,2,3,4,5,6)	AR538	75	NR	NR
13.10	SPT	N=22 (3,3,5,5,6,6)	AR538	75	12.00	4.80
14.60	SPT	N=42 (4,6,7,9,11,15)	CD61	58	14.60	2.80
15.60	SPT	N=34 (4,6,7,6,9,12)	CD61	58	15.60	3.00
16.60	SPT	N=47 (6,6,8,10,13,16)	CD61	58	16.60	2.30
17.60	SPT	N=51 (6,10,10,12,13,16)	CD61	58	17.60	3.00
19.10	SPT	N=37 (6,6,7,8,10,12)	CD61	58	19.10	0.80
20.60	SPT	50/290mm (7,10,11,13,13,13/65)	CD61	58	20.60	1.00
22.40	SPT	50/135mm (8,9,14,36/60)	CD61	58	22.40	2.00
23.40	SPT	50/20mm (10,15/50,50/20)	CD61	58	23.40	2.10
24.40	SPT	50/25mm (5,20/50,50/25)	CD61	58	24.40	2.00
25.40	SPT	50/25mm (8,17/35,50/25)	CD61	58	25.40	2.30
26.20	SPT	100/40mm (25/60,100/40)	CD61	58	26.20	2.00
27.20	SPT	75/50mm (11,14/70,75/50)	CD61	58	27.20	1.80
28.70	SPT	50/175mm (9,16,20,21,9/25)	CD61	58	28.70	1.60
30.00	SPT	50/165mm (10,15,20,22,8/15)	CD61	58	31.00	1.80
31.60	SPT	50/115mm (17,8/25,25,25/40)	CD61	58	31.60	2.00
33.00	SPT	50/135mm (11,15,26,24/60)	CD61	58	33.00	1.30
34.60	SPT	50/120mm (10,15/55,30,20/45)	CD61	58	34.60	1.80

* Seating blows only.

DEPTH RELATED REMARKS

Top Depth	Base Depth	Remarks
7.90	10.00	Water added to assist drilling.
10.00	10.00	Falling head test.
12.00	12.00	Falling head test.

GENERAL NOTES

NOTES: All depths in metres, all diameters in millimetres.
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 1 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	TCR	SCR	RQD	IF	In Situ Test Details	Installation
MADE GROUND: Reinforced concrete layers. (Hardstanding)		(0.50) 0.50	2.18								
MADE GROUND: Reddish brown clayey sandy subangular to subrounded fine to coarse gravel sized fragments of brick, concrete and flint. With high cobble content. Cobble sized fragments are subangular to subrounded of brick. Sand sized fragments are fine to coarse. (Made Ground)		(0.50) 1.00	1.68								
Soft dark grey silty CLAY with abundant red stained rootlets. (Alluvium)		(3.00) 4.00	-1.32								
Firm dark brown clayey sandy fibrous PEAT. Sand is fine to coarse. (Alluvium)		(0.50) 4.50	-1.82								
Firm dark grey/black pseudo fibrous PEAT. (Alluvium)				D 1 4.50 B 2 4.50-5.00							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 2 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD	IF		
Firm dark grey/black pseudo fibrous PEAT. (Alluvium)		(1.20)		UT 3 5.00-5.45 B 5 5.00-5.50	100	15 Blows, 100% Recovery					
below 5.45m clayey				D 4 5.45							
Soft dark grey moderately organic CLAY. (Alluvium)		5.70	-3.02	D 7 5.70 B 8 5.70-6.00							
				UT 9 6.00-6.45	100	15 Blows, 100% Recovery					
				D 10 6.45							
				B 11 6.70-7.20							
		(2.20)									
				D 12 7.50							
				D 13 7.70-8.15						SPT N=14 7.70 8.15	
Medium dense dark grey brown and white very sandy subangular to rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. (River terrace deposits)	▼	7.90	-5.22	W 14 7.90 D 15 7.90 B 16 7.90-8.40							
				D 17 8.90 B 18 8.90-9.40							
										SPT(C) N=20 9.50 9.95	
		(3.70)									
				D 19 9.90							

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
Part of the Bachy Soletanche Group

Project Name	Silvertown Tunnel	Exploratory Hole Log		Hole ID.
Project No.	TA7510			G15
Engineer	Atkins Ltd			
Employer	Atkins Ltd			Sheet 3 of 8
Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid	
Hole Type	TP+CP+RC	Inclination	Vertical	

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details		Dia.	Blow Count And Sample Recovery TCR	SCR	RQD	IF	In Situ Test Details	Install-ation
Medium dense dark grey brown and white very sandy subangular to rounded fine to coarse GRAVEL of flint. Sand is fine to coarse. (River terrace deposits)				B 20	10.00-10.50							
				D 21	10.90							
from 11.00m to 11.50m with occasional grey subrounded cobbles of flint				B 22	11.00-11.50						SPT(C) N=18 11.00 11.45	
Stiff grey sandy CLAY. Sand is fine to medium. (London Clay Formation)		11.60	-8.92	D 23 B 24	11.60 11.60-12.00							
				UT 25	12.00-12.45	100	70 Blows, 100% Recovery					
		(1.35)										
at 12.45m with a vertically orientated planar smooth fissure				D 26 UT 27	12.45 12.50-12.95	100	70 Blows, 100% Recovery					
Stiff thinly laminated grey sandy CLAY. Fissures are closely spaced randomly orientated planar smooth. Sand is fine to coarse. (London Clay Formation)		12.95	-10.27	D 28	12.95							
				D 29 B 30	13.10-13.55 13.10-13.60						SPT N=22 13.10 13.55	
		(0.65)										
Stiff fissured greyish brown slightly sandy silty micaceous CLAY with some white silt tubes (<1mm x 4mm). Sand is fine. Fissures are predominantly 70-90 degrees and 0-20 degrees very closely locally extremely closely spaced planar locally curved smooth locally polished. (London Clay Formation) from 13.60m to 14.00m drilling disturbed. Recovered as soft to firm		13.60	-10.92									
				13.60	14.60	102	100	NA	NA			
from 14.43m to 14.75m indistinctly fissured sandy with extremely closely to very closely spaced predominantly 0-20 degrees. Fine to coarse gravel sized lenses of brown silty fine sand from 14.60m to 14.77m assumed zone of core loss				D 32	14.60-15.05						SPT N=42 14.60 15.05	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
Part of the Bachy Soletanche Group

Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 4 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling			Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details		Dia.	TCR	SCR	RQD	IF		
Stiff fissured greyish brown slightly sandy silty micaceous CLAY with some white silt tubes (<1mm x 4mm). Sand is fine. Fissures are predominantly 70-90 degrees and 0-20 degrees very closely locally extremely closely spaced planar locally curved smooth locally polished. (London Clay Formation) at 15.25m 1 No coarse gravel sized pocket of dark grey sandy clay				14.60	15.60	102	83	NA	NA			
from 15.60m to 15.75m assumed zone of core loss from 15.60m to 16.05m locally with frequent white silt tubes (<1mm x 6mm)		(4.00)		D 34	15.60-16.05						SPT N=34 15.60 16.05	
from 15.75m to 16.08m drilling disturbed. Recovered as soft to firm				15.60	16.20	102	73	NA	NA			
from 16.37m to 17.32m sandy at 16.45m 1 No fragment of black lignite (2mm x 6mm)				16.20	16.60	102	85	NA	NA			
from 16.54m to 16.60m assumed zone of core loss from 16.60m to 17.05m very stiff with a few gravel sized fragments of black lignite (<5mm x 2mm)				D 36	16.60-17.05						SPT N=47 16.60 17.05	
				16.60	17.60	102	90	NA	NA			
from 17.52m to 17.60m with extremely closely spaced 0-10 degrees lenses of light grey silt (<6mm x 20mm)		17.60	-14.92	D 38	17.60-18.05						SPT N=51 17.60 18.05	
Stiff fissured greyish brown silty micaceous CLAY with rare white silt tubes (<1mm x 5mm). Fissures are predominantly 70-90 degrees and 0-20 degrees planar locally curved smooth locally polished. (London Clay Formation)												
from 18.12m to 18.47m fissures randomly orientated frequently polished				17.60	19.10	102	97	NA	NA			
		(2.60)										
from 19.10m to 19.25m assumed zone of core loss from 19.10m with a few burrow, infilled with light grey silt (2mm x 18mm)				D 41	19.10-19.55						SPT N=37 19.10 19.55	
				19.10	19.70	102	75	NA	NA			
from 19.78m to 19.85m 1 No fissure 45 degrees planar smooth highly												

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 5 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	TCR	SCR	RQD	IF	In Situ Test Details	Install-ation
Remaining Detail : 19.78m - 19.85m : polished				19.70 20.60	102	77	NA	NA			
		20.20	-17.52								
Stiff to very stiff fissured greyish brown slightly sandy to sandy silty micaceous CLAY with rare white silt tubes (<1mm x 8mm) and rare burrow features infilled with light grey silt (20mm x 1mm). Sand is fine. Fissures are predominantly 70-90 degrees and 0-20 degrees planar locally curved smooth locally polished locally with dusting of brown silty fine sand on fissure surfaces. (London Clay Formation) from 20.60m to 20.81m assumed zone of core loss				~~D 43 20.60-21.04~~						SPT 50/290mm 20.60 21.04	
				20.60 21.60	102	79	NA	NA			
		(2.14)									
from 21.72m to 22.34m with some locally frequent white silt tubes (<1mm x 8mm) at 21.90m 1 No coarse gravel sized fragment of black lignite				21.60 22.40	102	100	NA	NA			
from 22.28m to 22.31m 1 No very thin bed of weak light brown claystone		22.34	-19.66								
		22.40	-19.72	~~D 46 22.40-22.69~~						SPT 50/135mm 22.40 22.69	
Very stiff grey CLAY with abundant fine to coarse gravel sized white shells and shell fragments. (Harwich Formation)											
Assumed zone of core loss. (Logged from SPT) Firm to stiff brown CLAY with some fine to coarse gravel sized fragments of white shell and pockets of greyish brown fine to medium sand. (Harwich Formation)		(0.70)		22.40 23.40	102	30	NA	NA			
		23.10	-20.42								
Firm to stiff grey CLAY with a few fine to coarse gravel sized white shells and shell fragments. (Harwich Formation) from 23.10m to 23.15m drilling disturbed. Recovered as soft to firm from 23.15m very sandy with frequent fine to coarse gravel sized white shells and shell fragments		(0.27)									
		23.37	-20.69	~~D 48 23.40-23.55~~						SPT 50/20mm 23.40 23.55	
Very dense greyish brown slightly silty fine to medium SAND. (Woolwich Formation - Laminated Beds)											
		23.55	-20.87								
Assumed zone of core loss. (Woolwich Formation - Laminated Beds)		(0.45)		23.40 24.40	102	40	NA	NA			
		24.00	-21.32								
Very dense greyish brown silty fine to medium SAND. (Woolwich Formation - Laminated Beds)		(0.55)		~~D 50 24.40-24.55~~						SPT 50/25mm 24.40 24.55	
		24.55	-21.87								
Assumed zone of core loss. (Woolwich Formation - Laminated Beds)		(0.53)		24.40 25.40	102	32	NA	NA			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 6 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Dia.	Blow Count And Sample Recovery TCR	SCR	RQD	IF	In Situ Test Details	Install-ation
Assumed zone of core loss. (Woolwich Formation - Laminated Beds)		25.08	-22.40								
Brownish grey locally brown silty fine to medium SAND. (Woolwich Formation - Laminated Beds)		(0.46)		D 51 25.40-25.54						SPT 50/25mm 25.40 25.54	
		25.54	-22.86								
Assumed zone of core loss. (Woolwich Formation - Laminated Beds)		(0.60)		25.40 26.20	102	8	NA	NA	NA		
		26.14	-23.46								
Very dense greyish brown slightly gravelly slightly silty fine to medium SAND. Gravel is subrounded fine of multicoloured flint (white, grey and brown). (Woolwich Formation - Laminated Beds)				D 52 26.20-26.30						SPT 100/40mm 26.20 26.30	
		26.30	-23.62								
Assumed zone of core loss. (Woolwich Formation - Laminated Beds)		(0.84)		26.20 27.20	102	6	NA	NA			
		27.14	-24.46								
Very dense greyish brown slightly silty fine to medium SAND. (Woolwich Formation - Laminated Beds) at 27.14m 1 No subrounded coarse gravel sized fragment of black flint from 27.20m to 27.33m assumed zone of core loss				D 53 27.20-27.40						SPT 75/50mm 27.20 27.40	
		27.33	-24.65	27.20 27.70	102	90	NA	NA			
Firm thinly to thickly laminated greyish brown silty CLAY with extremely closely to very closely spaced thin and thick laminations of brown silty fine sand. (Woolwich Formation - Laminated Beds) from 27.60m to 27.70m 1 No thin bed of light brown silty fine sand		(0.64)									
		27.97	-25.29	27.70 28.20	102	79	NA	NA			
Stiff to very stiff thinly laminated fissured brownish grey and dark grey CLAY with some locally frequent fine to coarse gravel sized white shells and shell fragments. Fissures are randomly orientated very closely spaced planar locally curved smooth rarely polished predominantly 70-90 degrees. (Woolwich Formation - Lower Shelly Beds) from 27.97m to 28.08m very sandy from 28.08m to 28.32m assumed zone of core loss				28.20 28.70	102	79	NA	NA			
from 28.70m to 28.84m assumed zone of core loss				D 56 28.70-29.03						SPT 50/175mm 28.70 29.03	
from 29.00m to 29.70m hard light brown clay				28.70 29.30	102	92	NA	NA			
from 29.18m locally with abundant shells and shelly fragments		(2.83)									
from 29.58m to 29.61m 1 No very thin bed of weak light brown claystone at 29.62m 1 No coarse gravel sized articulated bivalve from 29.66m with occasional fine to coarse gravel sized brown shell				29.30 30.00	102	96	NA	NA			

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 7 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Dia.	TCR	SCR	RQD	IF	In Situ Test Details	Install-ation
Remaining Detail : 29.66m - 30.80m : fragments				D 58 30.00-30.32						SPT 50/165mm 30.00 30.32	
from 30.34m to 30.37m 1 No very thin bed of light grey fine to medium clayey sand				30.00 31.00	102	90	NA	NA			
at 30.79m 1 No coarse gravel sized pocket of greyish blue silty fine sand		30.80	-28.12								
Medium strong to strong creamish white CALCRETE. Recovered as non intact core (angular fine to coarse gravel and angular cobble sized fragments). (Reading Formation - Lower Mottled Clay)		(0.46)									
Very stiff greyish brown sandy silty CLAY. Sand is fine to medium. (Reading Formation - Lower Mottled Clay)		31.26	-28.58	31.00 31.60	102	83	NA	NA			
from 31.50m to 31.67m assumed zone of core loss		(0.41)		D 61 31.60-31.82						SPT 50/115mm 31.60 31.82	
Stiff light bluish grey mottled orangish brown very sandy CLAY. With a few subangular fine to coarse gravel sized nodules of creamish white calcrete. Sand is fine to medium. (Reading Formation - Lower Mottled Clay)		31.67	-28.99	31.60 31.85	102	68	NA	NA			
from 32.04m to 32.13m 1 No subangular cobble sized nodule of medium strong creamish white calcrete				D 62 32.05-32.35 31.85 32.40	102	100	NA	NA			
		(1.46)		32.40 33.00	102	92	NA	NA			
from 33.00m to 33.13m assumed zone of core loss				D 63 33.00-33.29						SPT 50/135mm 33.00 33.29	
Very dense light bluish green mottled orangish brown slightly clayey locally clayey fine to medium SAND. (Reading Formation - Lower Mottled Clay) from 33.13m to 33.20m and 33.31m to 33.50m 2 No thin beds of sandy silty clay		33.13	-30.45	33.00 33.50	102	74	NA	NA			
from 33.79m to 33.93m 1 No thin bed of stiff multicoloured (bluish grey, orangish brown, yellowish brown and brownish green) slightly sandy silty clay. Sand is fine to medium (LAMBETH GROUP - LOWER MOTTLED BEDS)		(0.99)		33.50 34.60	102	98	NA	NA			
Very dense light greenish grey orangish brown mottled clayey locally very clayey fine to medium glauconitic SAND. (Upnor Formation)		34.12	-31.44	D 65 34.60-34.85						SPT 50/120mm 34.60 34.85	

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

SOIL ENGINEERING
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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID.
Project No.	TA7510		G15
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 8 of 8

Ground Level	2.68m OD	Coordinates	539891.47 E, 180266.12 N National Grid
Hole Type	TP+CP+RC	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling		Blow Count And Sample Recovery				In Situ Test Details	Install-ation
				Details	Dia.	TCR	SCR	RQD	IF		
Very dense light greenish grey orangish brown mottled clayey locally very clayey fine to medium glauconitic SAND. (Upnor Formation)		(1.88)		34.60 36.00	102	100	NA	NA			
		36.00	-33.32								
Exploratory hole complete at 36.00 m.											

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G22
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Header Page 1

Ground Level	3.54m OD	Coordinates	539813.74 E, 180621.84 N National Grid		
Date Started	17/11/2014	Date Completed	05/12/2014	Inclination	Vertical

Top	Base	Type	Date Started	Date Ended	Crew	Section Logged By	Core Barrel	Core Bit	Equipment	Shoring / Support	Remarks
0.00	1.20	IP	17/11/2014	17/11/2014	DJ/JK	IH			Breaker / hand tools		
1.20	10.00	CP	04/12/2014	05/12/2014	DA/DB	JR			Dando 2000		

CABLE PERCUSSION DETAILS

Hard Strata Depth from	to	Chiselling Start time hhmm	Duration hhmm	Remarks

WATER STRIKES

Date	Time	Strike at depth	Rise to depth	Time taken to rise	Casing depth at strike time	to seal flow
05/12/2014	0845	7.10	5.50	5	7.00	NR
05/12/2014	0845	7.10	5.45	10	7.00	NR
05/12/2014	0845	7.10	5.45	15	7.00	NR
05/12/2014	0845	7.10	5.40	20	7.00	NR

HOLE DIAMETER / CASING

Hole diameter	Depth of hole	Casing diameter	Depth of casing
250	10.00	250	10.00

ROTARY FLUSH DETAILS

From depth	To depth	Flush type	Flush return %	Flush colour

DYNAMIC SAMPLING

Top	Base	Diameter	Time hhmmss	Recovery %

INSTALLATION DETAILS

Distance from G.L.	ID	Type	Response zone Top	Base
3.00	02	SP	1.00	3.00
8.50	01	SPIE	8.00	9.00

PIPE CONSTRUCTION

ID	Pipe Top	Base	Dia. of pipe	Type of pipe
02	0.00	1.00	50	Plain
02	1.00	3.00	50	Slotted
01	0.00	8.50	19	Plain

BACKFILL DETAILS

Top of section	Base of section	Material	Remarks
0.00	0.50	Concrete	
0.50	1.00	Bentonite	
1.00	3.00	Gravel backfill	
3.00	8.00	Bentonite	
8.00	9.00	Sand backfill	
9.00	10.00	Bentonite	

NOTES: All depths in metres, all diameters in millimetres.
Water strike rise time in minutes, hard strata time in hhmm
For details of abbreviations, see key

SOIL ENGINEERING

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Project Name	Silvertown Tunnel	Exploratory Hole Log	Hole ID. G22
Project No.	TA7510		
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Header Page 2

Ground Level 3.54m OD
Coordinates 539813.74 E, 180621.84 N National Grid
Date Started 17/11/2014
Date Completed 05/12/2014
Inclination Vertical

PROGRESS

Date	Time	Hole depth	Casing depth	Water depth	Remarks
17/11/2014	0730	0.00	-	NR	Start of Hole
17/11/2014	1800	1.20	-	NR	End of IP
04/12/2014	0730	1.20	-	NR	Start of Shift / CP
04/12/2014	1800	5.50	4.40	NR	End of Shift
05/12/2014	0730	5.50	4.40	NR	Start of Shift
05/12/2014	1800	10.00	10.00	4.00	End of Shift / Hole

SPT DETAILS

Depth	Type	Incremental blow count / penetration in mm	Hammer No.	Energy ratio %	Casing depth	Water depth
1.50	SPT	N=13 (3,1,2,2,4,5)	AR87	60	1.50	DRY
3.00	SPT	N=7 (2,1,1,2,2,2)	AR87	60	3.00	DRY
6.00	SPT	N=2 (0,0,1,0,0,1)	AR87	60	4.40	DRY
7.50	SPT(C)	N=11 (2,2,3,2,3,3)	AR87	60	7.50	5.90
9.00	SPT(C)	N=15 (3,3,4,3,4,4)	AR87	60	9.00	4.90

* Seating blows only.

DEPTH RELATED REMARKS

Top Depth	Base Depth	Remarks

GENERAL NOTES

NOTES: All depths in metres, all diameters in millimetres.
For details of abbreviations, see key

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SOIL ENGINEERING
Part of the Bachy Soletanche group

Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID. G22
Project No.	TA7510		
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 1 of 2

Ground Level	3.54m OD	Coordinates	539813.74 E, 180621.84 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	Blow Count And Sample Recovery TCR	SCR	RQD		In Situ Test Details	Install-ation
MADE GROUND: Strong grey concrete with 4mm x 5mm x 12mm diameter rebar. (Hardstanding)		(0.25) 0.25	3.29								
MADE GROUND: Brown gravelly fine to coarse sand. Locally with fine to medium gravel sized pockets of brown sandy clay. Gravel sized fragments are angular to subrounded fine to medium rarely coarse of brick, concrete, flint, clinker with rare glass, plastic and ceramics, shells, nails, granite, slag. (Made Ground) at 0.30m orange membrane below 0.60m slightly clayey at 0.95m 40mm x 40mm black plastic mesh at 1.15m 40mm x 40mm black plastic mesh		(0.95) 1.20	2.34	ES 1 0.30 B 2 0.50 ES 3 1.00 B 4 1.00							
MADE GROUND: Medium dense dark brown slightly sandy clayey subangular to subrounded fine to coarse gravel sized fragments of chert, flint and brick. Sand sized fragments are fine to coarse. (Made Ground)		(0.65) 1.85	1.69	D 5 1.50 B 6 1.50 ES 7 1.50 D 8 1.50-1.95						SPT N=13 1.50 1.95	
MADE GROUND: Loose slightly sandy clayey ashy subangular to subrounded fine to coarse gravel sized fragments of chert, brick rubble and flint. Sand sized fragments are fine to coarse. (Made Ground)		(1.55) 3.40	0.14	B 10 2.00 ES 11 2.00 D 9 2.00 D 12 2.50 B 13 2.50 ES 14 2.50 D 15 3.00 B 16 3.00 ES 17 3.00 D 18 3.00-3.45						SPT N=7 3.00 3.45	
Firm dark brownish grey slightly sandy silty CLAY. Sand is fine to coarse. (Alluvium)		(0.90) 4.30	-0.76	D 19 3.50 B 20 3.50 ES 21 3.50 D 22 4.00 B 23 4.00 ES 24 4.00							
Soft grey slightly sandy silty CLAY. Sand is fine. (Alluvium)				D 25 4.50 B 26 4.50 ES 27 4.50 U 28 4.50-4.95	100	8 Blows, 100% Recovery					

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

Unchecked Log Print Date And Time: 03/06/2015 16:41:27 -

SOIL ENGINEERING
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Project Name	Silvertown Tunnel	**Exploratory Hole Log**	Hole ID.
Project No.	TA7510		G22
Engineer	Atkins Ltd		
Employer	Atkins Ltd		Sheet 2 of 2

Ground Level	3.54m OD	Coordinates	539813.74 E, 180621.84 N National Grid
Hole Type	IP+CP	Inclination	Vertical

Description of Strata	Legend	Depth (Thickness)	Datum Level	Sampling Details	Sampling Dia.	Blow Count And Sample Recovery TCR	SCR	RQD		In Situ Test Details	Install-ation
Soft grey slightly sandy silty CLAY. Sand is fine. (Alluvium)				D 29 5.00							
				D 30 5.50 B 31 5.50 ES 32 5.50							
		(2.80)									
				D 33 6.00-6.45						SPT N=2 6.00 6.45	
				D 34 6.50 B 35 6.50 D 36 6.50							
Medium dense multi-coloured slightly sandy subangular to subrounded fine to coarse GRAVEL of chert and flint. Sand is fine to coarse. (River terrace deposits)		7.10	-3.56								
				B 37 7.50 ES 38 7.50 B 39 7.50-8.00						SPT(C) N=11 7.50 7.95	
at 8.50m locally sandy		(2.90)		D 40 8.50 B 41 8.50							
				B 42 9.00-9.50						SPT(C) N=15 9.00 9.45	
				D 43 9.50 B 44 9.50 ES 45 9.50 B 46 9.50-10.00							

Exploratory hole complete at 10.00 m.

NOTES: All depths in metres, all diameters in millimetres.
See header sheet for details of boring, progress and water.
For details of abbreviations, see key

Unchecked Log Print Date And Time: 03/06/2015 16:41:29 -

SOIL ENGINEERING
Part of the Bachy Soletanche Group

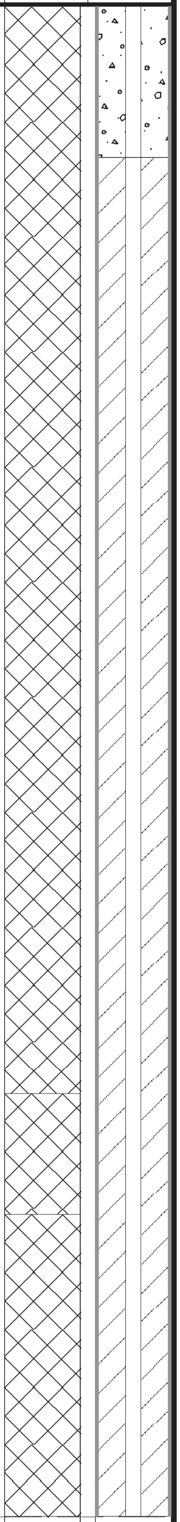
Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from	**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests / Strata



Depth	Type & No	Records	Date Casing	Time Water	Description		Depth, *Level* (Thickness)
		* *			For geology and samples refer to trial pit NIT TP01		(3.60)
			14/02/2011	0800	(MADE GROUND) CLAY and BRICK (DRILLERS DESCRIPTION)		3.60 *+1.68* (0.40)
4.00-4.85 4.00 4.00-4.45 4.00 4.00-4.45	SPT S D 1 D 2 ES 200 B 3	* N=2 (1,-/1,-,1,-) * SW=400 4 samples taken	4.00	1.20	(MADE GROUND) Soft brown slightly sandy slightly gravelly CLAY with strong odour. Gravel is angular to subangular, fine to coarse of flint, brick, quartz and rare ceramic and wood fragments (up to 5 x 20 x 40mm). Sand is fine to coarse.	4.00 m PID = 0.0 ppm	4.00 *+1.28*
4.50	ES 201	4 samples taken				4.50 m PID = 0.0 ppm	(1.00)

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
		None observed (see Key Sheet)	

Depth Related Remarks *

From	to (m)	
0.00	4.00	Magnetometer scan during excavation
0.00	8.00	Driller notes water seepages
4.00	8.90	SPT Hammer ID SM 10 (Er 54%); rod type B
4.00	8.90	Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:01

AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Sheet 1 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.		**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

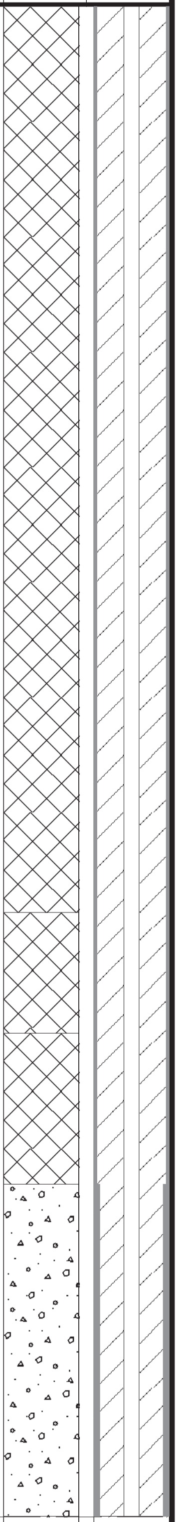
Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
5.00-5.75	SPT S	N=2 (1,-/1,-,1,-) SW=300	5.00	1.80
5.00	D 4			
5.00-5.45	D 5			
5.00-5.45	B 6			
5.00	ES 202	4 samples taken		
6.00-6.95	SPT S	N=1 (1,-/-,1,-,-) SW=500	6.00	2.70
6.00	D 7			
6.00-6.45	D 8			
6.00-6.45	B 9			
6.00	ES 203	4 samples taken		
7.00-7.58	SPT S	N=4 (1/1,1,1,1) SW=200	7.00	3.30
7.00	D 10			
7.00-7.45	D 11			
7.00-7.45	B 12			
7.00	ES 204	4 samples taken		
8.00	D 13	8.00 SPT attempted/terminated due to hammer bouncing on concrete		
8.00	D 14			
8.00-8.45	B 15			
8.00	ES 205	4 samples taken		
			14/02/2011	1800
			8.90	5.00
8.90-8.92	SPT S	50 (25 for 15mm/50 for 3mm)		
8.90	D 16	*	16/02/2011	0800
8.90	ESW 17		8.90	
8.90-10.40	0 N/A N/A	Flush: 8.90-10.40 Air-Mist, 99 %		

Strata

Description (Continued from Sheet 1)	Depth,*Level* (Thickness)
(MADE GROUND) Soft brown slightly sandy slightly gravelly CLAY with strong odour. Gravel is angular to subangular, fine to coarse of flint, brick, quartz and rare ceramic and wood fragments (up to 5 x 20 x 40mm). Sand is fine to coarse. 5.00 m PID = 0.0 ppm 6.00-7.00 m Occasional dark greyish black and possible hydrocarbon odour. 6.00 m PID = 0.0 ppm 7.00-7.45 m Intermixed with soft light grey brown silty clay. 7.00 m PID = 0.0 ppm	5.00 *+0.28* (3.00)
(MADE GROUND) Soft dark brown slightly sandy gravelly CLAY with low cobble content. Gravel is angular to subangular, fine to coarse of brick and flint. Cobbles are angular of slate (150 x 120 x 10mm). Sand is fine to coarse. 8.00 m Driller notes: concrete boulder pushed to one side with casing. PID = 0.4 ppm	8.00 *-2.72* (0.40)
(MADE GROUND) Soft dark greyish black slightly sandy clayey SILT with strong hydrocarbon odour. Rare wood fragments (5 x 10 x 40mm).	8.40 *-3.12* (0.50)
(MADE GROUND) CONCRETE and STEEL (DRILLERS DESCRIPTION)	8.90 *-3.62* (1.50)



Stratum continues to 10.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)	
8.90	60.75	SPT Hammer ID SM31 (Er 55%); rod type B
8.90	11.70	114mm Dia down hole hammer used in concrete

Chiselling

Depths (m)	Time	Tools used
8.90 -8.90	60 mins	Chisel

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02 AGS
408.24 08/06/2011 14:00:02

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Borehole Log

Soil Mechanics

Drilled	PW/NE	**Start**	14/02/2011
Logged	CT/JC	**End**	17/03/2011
Checked	SV		

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Ground Level	+5.28 mOD
Coordinates	E 539972.81
National Grid	N 180437.25
Chainage	

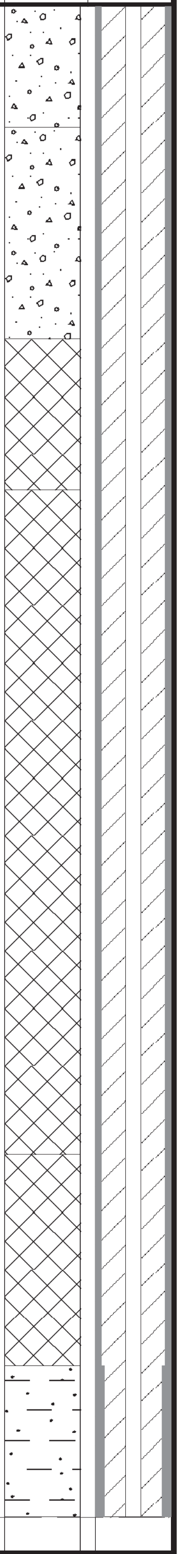
Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
				16/02/2011 8.90	1700
10.40-11.10	0 N/A N/A		Flush: 10.40-11.10 Air-Mist, 99 %	24/02/2011 11.10	0700
11.10-11.60	0 N/A N/A		Flush: 11.10-11.60 Air-Mist, 99 %		
11.70		NA NA NA	EW 300		
11.60-13.80	0 N/A N/A		Flush: 11.60-13.80 Air-Mist, 99 %		
13.80-14.50	0 N/A N/A		Flush: 13.80-14.50 Air-Mist, 99 %	24/02/2011 14.50	1700
		NA NA NA		25/02/2011 14.50	0700

Strata

Description (Continued from Sheet 2)	Depth,*Level* (Thickness)
(MADE GROUND) CONCRETE and STEEL (DRILLERS DESCRIPTION)	10.40 *-5.12*
(MADE GROUND) CONCRETE with rebar (DRILLERS DESCRIPTION)	(0.70) 11.10 *-5.82*
(MADE GROUND) BRICK FILL (DRILLERS DESCRIPTION)	(0.50) 11.60 *-6.32*
(MADE GROUND) Greyish sandy GRAVEL (DRILLERS DESCRIPTION)	(2.20) 13.80 *-8.52*
(MADE GROUND) Grey CLAY (DRILLERS DESCRIPTION)	(0.70) 14.50 *-9.22*
Firm fissured grey brown slightly fine to medium sandy CLAY. Fissures are very closely spaced, randomly orientated, predominantly horizontal to subhorizontal, smooth, mainly polished and rarely 14.58-14.65 m Occasional rounded medium to coarse black flint gravel.	(0.96)

Stratum continues to 15.46 m



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *
From to (m)

Chiselling
Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:04 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NIT BH02

Sheet 3 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.	**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
14.50-15.75	100 N/A N/A		Flush: 14.50-15.75 Water, 99 %		
15.65-15.75			D 100	25/02/2011 15.75	1700
		NA NA NA		28/02/2011 15.75	0700
15.75-17.25	100 N/A N/A		Flush: 15.75-17.25 water, 99 %		
		NA NA NA			
17.15-17.25			D 101	28/02/2011 17.25	1700
				02/03/2011 17.25	0700
			*		
17.25-18.75	0 N/A N/A	NA NA NA	Flush: 17.25-18.75 water, 99 %		
18.25-18.70			SPT S N=38 (4,5/8,8,9,13)		
18.25-18.70			D 18		
		NA NA NA			
18.75-20.25	95 N/A N/A		Flush: 18.75-20.25 water, 99 %		
		NA NA NA			

Strata

Description (Continued from Sheet 3)		Depth	Level	(Thickness)
matt. Sand is fine to coarse. Occasional brown staining on fissure surfaces. Micaceous. (LONDON CLAY FORMATION - A2)		15.46	*-10.18*	
Stiff to very stiff fissured grey slightly sandy CLAY. Fissures are very closely spaced to locally extremely closely spaced, randomly orientated, smooth, matt and rarely polished. Frequent brown staining on fissure surfaces. Sand is fine to medium. (LONDON CLAY FORMATION - A2)		16.22	*-10.94*	(0.76)
Very stiff fissured grey slightly sandy CLAY. Fissures are very closely spaced, predominatly vertical to subvertical, rarely subhorizontal, smooth, matt and polished. Sand is fine to medium. Rare foram fossils (up to 2 x 1mm). (LONDON CLAY FORMATION - A2)	16.26-16.69 m 1no. smooth matt fissure (77 degrees).	17.25	*-11.97*	(1.03)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	17.25-18.75 m 88.4mm diameter self boring pressuremeter test pocket.	18.82	*-13.54*	(1.57)
Very stiff fissured grey CLAY. Fissures are very closely spaced, subhorizontal (0 - 13 degrees), subvertical (85 - 70 degrees), smooth, matt and rarely polsihed. (LONDON CLAY FORMATION - A2)		19.40	*-14.12*	(0.58)
Very stiff fissured grey slightly sandy CLAY. Fissures are closely spaced, randomly orientated, smooth and matt. Sand is fine to medium. Occasional foram fossils (up to 5 x 1mm). Rare pockets (up to 10 x 5mm) of black fine to	19.50-19.51 m 1no. pyrite nodule (35 mm x 20 mm x 10 mm). 19.82-19.83 m 1no. pyritised lignite (80 mm x 25 mm x 10 mm).			(0.85)

Stratum continues to 20.25 m

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water		Legend	Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
17.75		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:05 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Sheet 4 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	14/02/2011
End	17/03/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Ground Level	+5.28 mOD
Coordinates National Grid	E 539972.81 N 180437.25
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
				02/03/2011	1700
20.15-20.25			D 102	20.25	
				03/03/2011	0800
				20.25	1.10
			*		
20.25-21.75	0 N/A N/A	NA NA NA	Flush: 20.25-21.75 water, 99 %		
21.20-21.65			SPT S N=40 (8,6/10,10,10,10)		
21.20-21.65			D 19		
21.75-23.25	100 N/A N/A	NA NA NA	Flush: 21.75-23.25 water, 99 %		
				03/03/2011	1800
23.15-23.25			D 103	23.25	
				04/03/2011	0800
				23.25	1.30
			*		
23.25-24.75	0 N/A N/A	NA NA NA	Flush: 23.25-24.75 water, 99 %		
24.20-24.65			SPT S N=40 (4,5/8,10,10,12)		
24.20-24.65			D 20		

Strata

Description (Continued from Sheet 4)		Depth, *Level* (Thickness)
medium sand. (LONDON CLAY FORMATION - A2)		
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	20.25-21.75 m 88.4mm diameter self boring pressuremeter test pocket.	20.25 *-14.97* (1.50)
Very stiff fissured grey CLAY. Fissures are very closely to closely spaced, randomly orientated, smooth, matt and occasionally polished. (LONDON CLAY FORMATION - A2)	21.75-21.97 m Slightly fine to medium sandy clay. Rare forams (up to 2mm). 21.97-22.27 m Rare partings of fine to medium grey sand. Rare burrows (up to 5 x 1mm) infilled with grey silt. 22.27-22.28 m 1no. lignite (30 x 5 x 5mm). 22.32-22.37 m 6no. coarse gravel size pyrite nodules (up to 30 x 20 x 10mm). 22.94-23.25 m Slightly fine to medium sandy clay. Rare foram fossils (up to 3mm).	21.75 *-16.47* (1.50)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	23.25-24.75 m 88.4mm diameter self boring pressuremeter test pocket.	23.25 *-17.97* (1.58)
Very stiff fissured grey slightly	24.83-25.05 m Sandy clay. Occasional pockets (up to 10 x 5mm) of grey sand.	24.83 *-19.55*

Stratum continues to 26.04 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
20.70		SBP test
23.70		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:07 AGS

Project	Cable Car for London - Ground Investigation
Project No.	D1002-11
Carried out for	Transport for London

Borehole

NIT BH02

Sheet 5 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.	**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
24.75-26.25	95 N/A N/A	NA NA NA	Flush: 24.75-26.25 water, 99 %		
26.15-26.25			If NA/NA/NA D 104		
			If NA/NA/NA		
26.25-27.75	7 N/A N/A	NA NA NA	Flush: 26.25-27.75 water, 99 %		
27.75-27.93 27.75			SPT S 50 (9,16 for 30mm/50) D 21		
27.75-29.25	13 N/A N/A	NA NA NA	Flush: 27.75-29.25 water, 99 %		
				04/03/2011	1800
29.15-29.25			D 105 If NA/NA/NA	29.25	
				07/03/2011	0800
				29.25	
		NA NA NA			

Strata

Description (Continued from Sheet 5)	Depth	Level	(Thickness)
sandy CLAY. Fissures are very closely spaced to closely spaced, predominatly subhorizontal, occasionally subvertical, smooth, rough and matt. Sand is fine to medium. Occasional foram fossils (up to 2mm). (LONDON CLAY FORMATION - A2) 25.40-25.80 m Occasional partings of brown and grey sand. 25.82-25.98 m Grey clay. Fissures are extremely to very closely spaced. 26.03-26.04 m Occasional pockets (up to 10 x 4mm) of dark green slightly sandy clay.	26.04	*-20.76*	(1.21)
Very stiff grey slightly sandy slightly gravelly glauconitic CLAY. Sand is fine to medium. Gravel is rounded, fine to medium of black flint. (HARWICH FORMATION - POSSIBLE OLDHAVEN MEMBER) 26.14-26.18 m 1no. shell (57 x 30 x 25mm) composed of fragments (up to 5 x 5mm). 26.18-26.25 m Rare shell fragments (up to 10 x 5mm).	26.25	*-20.97*	
Black rounded, fine to coarse GRAVEL of flint. (HARWICH FORMATION - BLACKHEATH MEMBER)	26.35	*-21.07*	
ASSUMED ZONE OF CORE LOSS 27.75 m SPT shoe contains grey gravelly fine to medium sand. Gravel is rounded, medium to coarse of black flints.	29.06	*-23.78*	(2.71)
Black rounded medium to coarse GRAVEL of flint. (HARWICH FORMATION - BLACKHEATH MEMBER)	29.16	*-23.88*	
Very stiff grey sandy CLAY. Sand is fine to medium. Rare shell fragments (up to 20 x 15mm). (POSSIBLE HARWICH FORMATION) 29.22-29.25 m Extremely closely spaced thin laminations (1mm thick) of black grey sandy clay.	29.25	*-23.97*	
ASSUMED ZONE OF CORE LOSS			(1.10)

Stratum continues to 30.35 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:09 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NIT BH02

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from		**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
29.25-30.75	27 N/A N/A		Flush: 29.25-30.75 water, 99 %		
		NA NA NA			
30.65-30.75			D 106		
			*		
30.75-32.25	0 N/A N/A		Flush: 30.75-32.25 water, 99 %		
31.80-32.14			SPT S 50 (3,6/9,25,16 for 40mm)		
		NA NA NA		07/03/2011 32.25	1800 0.70
				08/03/2011 32.25	0800
32.25-33.75	30 N/A N/A		Flush: 32.25-33.75 water, 99 %		
		NA NA NA			
33.65-33.75			D 107		
			*		
33.75-35.25	0 N/A N/A	NA NA NA	Flush: 33.75-35.25 water, 99 %		
34.75-34.82 34.75			SPT S 50 (25 for 35mm/50 for 30mm) D 22		

Strata

Description (Continued from Sheet 6)		Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
ASSUMED ZONE OF CORE LOSS				
Grey sandy to very sandy CLAY. Sand is fine to medium. Rare shell fragments (up to 3mm). (POSSIBLE LAMBETH GROUP - LAMINATED BEDS)	30.35-30.43 m Occasional laminations of black sandy clay with organic odour. 30.45-30.48 m Frequent shell fragments (up to 5mm). 30.65-30.75 m Silty sand.	30.35 *-25.07* (0.40)		
ASSUMED ZONE OF CORE LOSS PARTLY DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	30.75-32.25 m 88.4mm diameter self boring pressuremeter test pocket.	30.75 *-25.47* (2.55)		
Very stiff fissured grey CLAY. Fissures are very closely spaced, subvertical and subhorizontal, rough and matt. Occasional bands (up to 25mm thick) of very shelly clay. Shell fragments are up to 10 x 5mm. (LAMBETH GROUP - LAMINATED BEDS)		33.30 *-28.02* (0.45)		
ASSUMED ZONE OF CORE LOSS PARTLY DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	33.75-35.25 m 88.4mm diameter self boring pressuremeter test pocket. 34.75 m SPT shoe contains greenish yellow fine to medium sandy clay and grey shelly clay. 34.75-34.82 m Brown yellow	33.75 *-28.47* (1.50)		

Stratum continues to 35.25 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
31.30		SBP test
34.25		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02 408.24 08/06/2011 14:00:11 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NIT BH02

Sheet 7 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.	**Depth from / to / Diameter / Casing Depth** 0.00m / 8.90m / 250mm / 8.90m 8.90m / 14.50m / 175mm / 14.50m 14.50m / 60.75m / 146mm / 60.75m	**Ground Level** +5.28 mOD **Coordinates National Grid** E 539972.81 N 180437.25 **Chainage**

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
35.50-35.60			D 108		
35.25-36.75	100 N/A N/A	NA NA NA	Flush: 35.25-36.75 water, 99 %		
				08/03/2011 36.75	1800
				09/03/2011 36.75	0800
37.25-37.48 37.25			*SPT S 50 (20,5 for 15mm/ 25,25 for 65mm) D 23		
36.75-38.25	0 N/A N/A	NA NA NA	Flush: 36.75-38.25 water, 99 %		
			If NA/NA/NA		
38.25-39.75	92 N/A N/A	NA NA NA	Flush: 38.25-39.75 water, 99 %		
		NA NA NA		09/03/2011	1800
39.65-39.75			D 109	39.75	
				10/03/2011 39.75	0800

Strata

Description (Continued from Sheet 7)		Depth,*Level* (Thickness)
ASSUMED ZONE OF CORE LOSS PARTLY DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	mottled green grey slightly sandy gravelly SILT. Gravel is subangular to subrounded fine to medium of medium strong white calcrete. Sand is fine.	35.25 *-29.97*
Very stiff greenish blue mottled brown and grey sandy CLAY. Sand is fine to medium. Occasional pockets (up to 40 x 20mm) of moderately strong white calcrete. (LAMBETH GROUP - LOWER MOTTLED BEDS)	35.25-35.42 m Frequent calcretes. 35.60-35.62 m 1no. pocket of soft grey clay (40 x 28mm). 35.73-35.79 m 2no. pocket of firm grey clay (60 x 20mm). 35.93-35.95 m 1no. pocket of firm grey clay (20 x 10mm). 36.51-36.55 m 1no. pocket of soft grey clay (40 x 25mm). 36.52-36.75 m Frequents pockets (50 mm x 30 mm) of calcrete.	(1.50) 36.75 *-31.47*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	36.75-38.25 m 88.4mm diameter self boring pressuremeter test pocket. 37.25-37.48 m Brown grey mottle dgreen grey slightly sandy SILT. Sand is fine	(1.62) 38.37 *-33.09*
Very stiff greenish light greyish blue sandy CLAY. Sand is fine to medium. (LAMBETH GROUP - LOWER MOTTLED BEDS)		38.50 *-33.22*
Very stiff bluish green occasionally mottled dark green and brown glauconitic sandy CLAY. Sand is fine to medium. (LAMBETH GROUP - LOWER MOTTLED BEDS)		(0.75) 39.25 *-33.97*
Very stiff dark green occasionally mottled brown sandy CLAY. Sand is fine to medium. (LAMBETH GROUP - LOWER MOTTLED BEDS)		(0.50) 39.75 *-34.47*
ASSUMED ZONE OF CORE LOSS PARTLY DUE TO SELF BORING	39.75-41.25 m 88.4mm diameter self boring pressuremeter test pocket.	

Stratum continues to 42.70 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)	
37.25		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02 408.24 08/06/2011 14:00:12 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from	**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
			*		
39.75-41.25	0 N/A N/A		Flush: 39.75-41.25 water, 99 %		
40.75-41.02 40.75			SPT S 50 (10,15 for 55mm/ 25,25 for 65mm) D 24		
		NA NA NA			
41.25-42.75	3 N/A N/A		Flush: 41.25-42.75 water, 99 %		
42.75-43.01 42.75			If NA/NA/NA SPT S 50 (8,14/30,20 for 35mm) D 25		
			*		
42.75-44.25	0 N/A N/A	NA NA NA	Flush: 42.75-44.25 water, 99 %		
43.75-44.04 43.75			SPT S 50 (10,15/18,32 for 65mm) D 26		
44.25-45.25	100 N/A N/A		Flush: 44.25-45.25 water, 99 %		

Strata

Description (Continued from Sheet 8)		Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
PRESSUREMETER TEST POCKET AND SPT TEST POCKET	40.75-41.02 m Stiff blue grey mottled orage brown slightly sandy slightly gravelly galuconitic CLAY. Gravel is subangular to well rounded fine to medium of brown and dark grey flint. Sand is fine to coarse.	(2.95) 42.70 *-37.42*		
Very stiff green slightly gravelly glauconitic CLAY with occasional fine to coarse gravel size pockets of fine to coarse black and brown sand. Gravel is subrounded to rounded, fine to coarse of black and brown flint. (LAMBETH GROUP - LOWER MOTTLED BEDS)	42.75 m SPT shoe contains green very sandy clay. Sand is fine to coarse. Rare black and brown subrounded to rounded gravel of flint. 42.75-44.25 m 88.4mm diameter self boring pressuremeter test pocket.	42.75 *-37.47*		
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	43.75 m SPT shoe contains greenish grey sandy glauconitic clay. Rare subrounded to rounded, fine to medium black and brown flint.	(1.50) 44.25 *-38.97*		
Very stiff green sandy to very sandy CLAY. Sand is fine to coarse. Occasionally local fine to coarse gravel of shells and shell fragments. (LAMBETH GROUP - POSSIBLE UPNOR FORMATION)	44.32 m 1no. rounded coarse black flint. 44.46 m 1no. subrounded medium gravel of flint. 44.50 m Occasional subrounded fine gravel of flint. 44.64 m 1no. subrounded medium gravel of flint.			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Stratum continues to 45.75 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
40.25		SBP test
43.25		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:14 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 8.90m / 250mm / 8.90m 8.90m / 14.50m / 175mm / 14.50m 14.50m / 60.75m / 146mm / 60.75m	**Ground Level** +5.28 mOD **Coordinates** E 539972.81 **National Grid** N 180437.25 **Chainage**	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
45.15-45.25		NA NA NA	D 110	10/03/2011 45.25	1800
				15/03/2011 45.25	0700
45.25-45.75	70 N/A N/A		Flush: 45.25-45.75 water, 99 %		
45.65-45.75			D 111		
45.75-47.25	0 N/A N/A	NA NA NA	* Flush: 45.75-47.25 water, 99 %		
46.85-46.98 46.85			SPT S 50 (25/50 for 55mm) D 27		
47.25-48.75	100 N/A N/A	NA NA NA	Flush: 47.25-48.75 water, 99 %		
				15/03/2011	1900
48.65-48.75			D 112	48.75	
				16/03/2011 48.75	0700 3.20
48.75-50.25	0 N/A N/A	NA NA NA	* Flush: 48.75-50.25 water, 99 %		
49.85-50.03 49.85			SPT S 50 (5,18/50 for 30mm) D 28		

Strata

Description (Continued from Sheet 9)	Depth, *Level* (Thickness)
Very stiff green sandy to very sandy CLAY. Sand is fine to coarse. Occasionally local fine to coarse gravel of shells and shell fragments. (LAMBETH GROUP - POSSIBLE UPNOR FORMATION) 45.25-45.40 m AZCL 45.46 m 1no. subrounded coarse flint. 45.58 m Slightly gravelly of subrounded to rounded fine to coarse flint.	(1.50) 45.75 *-40.47*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET 45.74-47.25 m 88.4mm diameter self boring pressuremeter test pocket. 46.85 m Fine to medium grey clayey sand. Sand is fine to medium.	(1.50) 47.25 *-41.97*
Grey slightly silty to locally silty fine to medium SAND. (THANET SAND FORMATION)	(1.50) 48.75 *-43.47*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET 48.75-50.25 m 88.4mm diameter self boring pressuremeter test pocket. 49.85-50.03 m Very dense fine to medium SAND.	(1.56)

Stratum continues to 50.31 m

Groundwater Entries

No. **Struck (m)** **Post strike behaviour** **Depth sealed (m)**

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
46.35		SBP test
49.35		SBP test

Chiselling

Depths (m) **Time** **Tools used**

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02 408.24 08/06/2011 14:00:16 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NIT BH02

Sheet 10 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	14/02/2011
End	17/03/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Ground Level	+5.28 mOD
Coordinates National Grid	E 539972.81 N 180437.25
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
50.25-51.75	96 N/A N/A	NA NA NA	Flush: 50.25-51.75 water, 99 %		
51.75-53.25	0 N/A N/A	NA NA NA	* Flush: 51.75-53.25 water, 99 %		
52.85-52.95 52.85			SPT S 50 (25/50 for 25mm) D 29		
53.25-54.75	95 N/A N/A	NA NA NA	Flush: 53.25-54.75 water, 99 %		
				16/03/2011 54.75	1900
				17/03/2011 54.75	0700

Strata

Description (Continued from Sheet 10)	Depth,*Level* (Thickness)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET	
Grey slightly silty to locally silty fine to medium SAND. (THANET SAND FORMATION)	50.31 *-45.03* (1.44)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET AND SPT TEST POCKET 51.75-53.25 m 88.4mm diameter self boring pressuremeter test pocket. 52.85-52.95 m Very dense fine to medium silty SAND.	51.75 *-46.47* (1.58)
Grey slightly silty to locally silty fine to medium SAND. (THANET SAND FORMATION)	53.33 *-48.05* (1.42)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING 54.75-56.25 m 88.4mm diameter self boring pressuremeter test pocket.	54.75 *-49.47*

Stratum continues to 56.19 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)	
52.35		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:18 AGS

Project	Cable Car for London - Ground Investigation
Project No.	D1002-11
Carried out for	Transport for London

Borehole

NIT BH02

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 14/02/2011 **End** 17/03/2011	**Equipment, Methods and Remarks** 14.50m to 60.75m depth.	**Ground Level** +5.28 mOD **Coordinates National Grid** E 539972.81 N 180437.25 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
			*		
54.75-56.25	4 N/A N/A	NA NA NA	Flush: 54.75-56.25 water, 99 %		
55.85-56.08 55.85			SPT S 50 (11,14/50) D 30		
		NA NA NA			
			If NA/NA/NA		
56.25-57.75	100 58 54		Flush: 56.25-57.75 water, 99 %		
57.75-58.04 57.75			SPT S 50 (11,14/23,27 for 65mm) D 31		
58.00-60.00		60 300 940	KRH k=2.5E-7 m/s		
57.75-59.25	93 93 85		Flush: 57.75-59.25 water, 99 %		

Strata

Description (Continued from Sheet 11)

Description	Remarks	Depth, *Level* (Thickness)
PRESSUREMETER TEST POCKET AND SPT TEST POCKET	55.85-56.08 m Very dense fine to medium silty SAND.	(1.44)
Grey slightly silty fine SAND. (THANET SAND FORMATION)		56.19 *-50.91* (0.60)
Very stiff grey slightly sandy gravelly CLAY. Sand is fine. Gravel is angular to subrounded, fine to coarse of black and brown flint. Rare fine gravel size pockets of green sandy clay. (BULLHEAD BED - THANET SAND FORMATION)	56.79 m 25 x 100mm nodular flint. 56.87 m Occasional gravel of very weak to weak white chalk. 56.91-57.03 m Grey brown staining of fracture surface. 56.93 m 100 x 40mm nodular flint.	56.79 *-51.51* 56.88 *-51.60*
Very weak to weak medium density white CHALK. Fractures are closely to medium spaced (60/300/940), closed with rare grey brown staining. Occasional fine to coarse gravel size pockets of grey wispy marl. (WHITE CHALK SUBGROUP - CIRIA GRADE A2)	57.47 m 1no. 90 x 60mm flint. 57.56 m 1no. coarse gravel of flint. 57.75-57.86 m AZCL 57.86-58.18 m Zone of SPT recovered as gravel of fine to medium of chalk. Chalk is very weak of fine to coarse gravel size fragments. Locally rare fine to medium gravel of flint. 58.48 m 1no. full diameter nodular flint (50 x 100mm). 58.51 m Rare fine to medium gravel of shells. 58.82 m Rare fine gravel size shell fragments. 59.19 m Occasional orangish brown staining on possible horizontal (5 degree) fracture surface.	(2.37)
Very weak medium density white CHALK. One subvertical fracture observed (530/-/970). Infilled (0/<1/<1) with light brown clay with black speckling. Occasional fine to coarse gravel size pockets of grey wispy marl. (WHITE CHALK SUBGROUP - CIRIA GRADE B2 / B1)	59.25-59.48 m AZCL 59.68-59.71 m Occasional fine to coarse gravel of flint. 59.73 m 1no. 70 x 70mm nodular flint.	59.25 *-53.97*

Stratum continues to 60.75 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
None observed (see Key Sheet)			

Depth Related Remarks *

From	to (m)	
55.35		SBP test

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:19 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NIT BH02
Sheet 12 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV

Start 14/02/2011
End 17/03/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
Machine excavated inspection pit from GL to 3.50m depth. Cable percussion boring from 3.50m to 8.90m depth. Rotary open-hole drilling using 175mm dia Symmantix system from 8.90m to 14.50m. Rotary coring using wireline techniques and self-boring pressuremeter testing from

Depth from	to	Diameter	Casing Depth
0.00m	8.90m	250mm	8.90m
8.90m	14.50m	175mm	14.50m
14.50m	60.75m	146mm	60.75m

Ground Level	+5.28 mOD
Coordinates	E 539972.81
National Grid	N 180437.25
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
59.25-60.75	85 85 85	530 - 970	Flush: 59.25-60.75 water, 99 %	17/03/2011 60.75	1900
60.75-61.03 60.75			SPT S 50 (13,12 for 65mm/ 23,27 for 65mm) D 32		

Strata

Description (Continued from Sheet 12)	Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
Very weak medium density white CHALK. One subvertical fracture observed (530/-/970). Infilled (0/<1/<1) with light brown clay with black speckling. Occasional fine to coarse gravel size pockets of grey wispy marl. (WHITE CHALK SUBGROUP - CIRIA GRADE B2 / B1) 60.53-60.63 m Full diameter flint.	(1.50)		
EXPLORATORY HOLE ENDS AT 60.75 m	60.75 *-55.47*		

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

None observed (see Key Sheet)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NIT BH02
408.24 08/06/2011 14:00:21 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NIT BH02

Sheet 13 of 13

Borehole Log

Soil Mechanics

Drilled PW
Logged CT/JC/NE
Checked SV

Start 15/02/2011
End 02/03/2011

Equipment, Methods and Remarks
JCB 3CX / Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth.

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

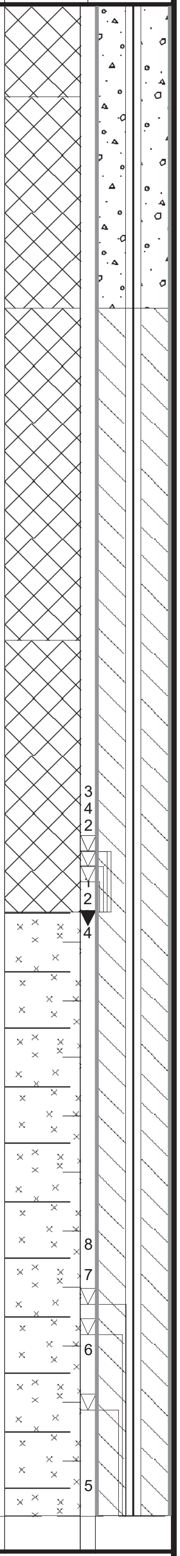
Ground Level +5.16 mOD
Coordinates E 539850.35
National Grid N 180286.36
Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.35	ES 200	* 4 samples taken		
0.40	D 1			
0.50	B 2			
0.50	ES 201	5 samples taken		
1.00	ES 202	4 samples taken	16/02/2011	1800
1.00	D 3			dry
1.00-1.10	B 4			
1.20-1.65	SPT C	* N=11 (1,3/4,3,2,2)		
1.20-1.65	B 5	*		
			17/02/2011	0800
				dry
1.50	ES 203	5 samples taken		
2.00	ES 204	5 samples taken		
2.00	D 6			
2.20-2.65	SPT S	* N=3 (1,1/1,1,1,-)	2.20	dry
2.20-2.65	D 7			
2.20-2.65	B 8			
2.50	ES 205	5 samples taken		
3.00	EW 12			
3.00	ES 206	5 samples taken		
3.00	D 9			
3.20-3.65	SPT S	N=11 (1,1/3,3,2,3)	3.20	2.80
3.20-3.65	D 10			
3.20-3.65	B 11			
3.50	D 13	*		
3.50	ES 207	5 samples taken		
4.00	D 14			
4.00	ES 208	5 samples taken		
4.20-4.65	SPT S	N=1 (1,-/-,1,-,-)	4.20	damp
4.20-4.65	D 15			
4.20-4.65	B 16			
4.50	ES 209	5 samples taken		

Strata

Description	Depth,*Level* (Thickness)
(MADE GROUND) Reinforced CONCRETE.	(0.30) 0.30 *+4.86*
(MADE GROUND) Brown very gravelly fine to coarse SAND. Gravel is angular to subangular, fine to coarse of concrete and brick. 0.50 m PID = 0.0ppm	(0.70) 1.00 *+4.16*
(MADE GROUND) Medium dense dark greyish black gravelly fine to coarse SAND of ash with pockets (up to 250mm) of soft brown slightly sandy slightly gravelly clay. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of brick, quartz and coal. 1.00 m PID = 0.6ppm 1.50 m PID = 3.5ppm 2.00 m PID = 4.9ppm 2.00-2.10 m Slightly clayey.	(1.10) 2.10 *+3.06*
(MADE GROUND) Soft brown slightly sandy slightly gravelly CLAY. angular to subrounded, fine to coarse Gravel of quartz, brick and chalk. Sand is fine to coarse. With pockets of brownish grey occasional reddish brown slightly clayey gravelly fine to medium sand. 2.50 m PID = 6.4ppm	(0.90) 3.00 *+2.16*
(MADE GROUND) Soft greenish grey slightly sandy clayey SILT with rare subangular to subrounded, fine to coarse quartz gravel. Rare wood fragments (up to 20mm). Sand is fine to coarse. 3.00 m PID = 13.9ppm 3.20-3.65 m Pockets of sandy very clayey angular to subangular, fine to coarse gravel of slag. Sand is fine to coarse. 3.20-6.00 m Hydrocarbon odour. 3.50 m PID = 0.4ppm 3.65-6.00 m Becomes slightly gravelly. Gravel is angular to subangular, fine to coarse of slag. 4.00 m Wood fragment found. 4.50 m PID = 0.5ppm	(3.00)



Depth	Type & No	Records	Date Casing	Time Water

Stratum continues to 6.00 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	3.00	Rose to 2.90 m after 5 minutes.	-
2	3.00	Rose to 2.85 m after 10 minutes.	-
3	3.00	Rose to 2.80 m after 15 minutes.	-
4	3.00	Rose to 2.80 m after 20 minutes.	3.50

Depth Related Remarks *

From	to (m)	
0.30	1.00	Driller notes material compact.
1.20	16.20	SPT hammer ID SM10 (Er 54%); rod type B
1.20		Magnetometer scan
2.20		Magnetometer scan
3.50		Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:22
AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole
NT BH02
Sheet 1 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth	**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

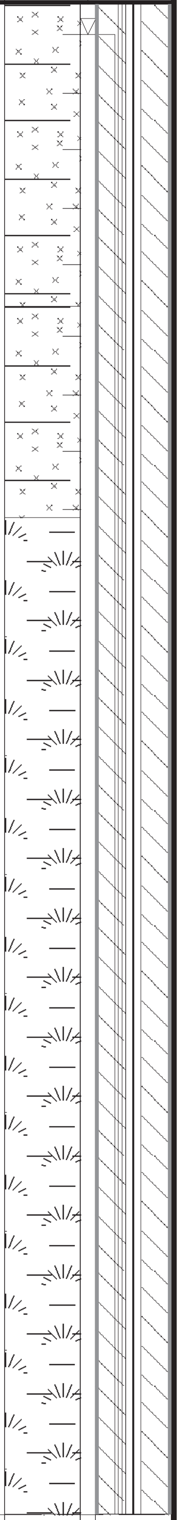
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
5.00	D 17			
5.00	ES 210	5 samples taken		
5.20-6.05	SPT S	N=2 (1,-/1,-,1,-) SW=400	5.20	damp
5.20-5.65	D 18			
5.20-5.65	B 19			
		*		
6.00	D 20			
6.00	ES 211	5 samples taken		
6.20-6.65	SPT S	N=1 (1,-/-,1,-,-)	6.20	damp
6.20-6.65	D 22			
6.20-6.65	B 23			
6.70	D 24			
6.70-7.00	B 25			
7.00	ES 212	5 samples taken		
7.20-7.65	SPT S	N=4 (1,-/1,1,1,1)	7.20	dry
7.20-7.65	D 26			
7.20-7.65	B 27			
		*		
8.00	ES 213	5 samples taken		
8.00	D 28			
8.20-8.65	SPT S	N=5 (1,-/1,1,1,2)	8.20	dry
8.20-8.65	D 29			
8.20-8.65	B 30			
9.00	ES 214	5 samples taken		
9.00	D 31			
9.20-9.65	SPT S	N=2 (1,-/1,-,1,-)	8.20	dry
9.20-9.65	D 32			
9.20-9.65	B 33			
		*		

Strata

Description (Continued from Sheet 1)	Depth, *Level* (Thickness)
(MADE GROUND) Soft greenish grey slightly sandy clayey SILT with rare subangular to subrounded, fine to coarse quartz gravel. Rare wood fragments (up to 20mm). Sand is fine to coarse. 5.00 m PID = 0.0ppm	
Soft dark greenish grey slightly sandy clayey SILT with occasional wood fragments (up to 50mm) and slight organic odour. (ALLUVIUM) 6.00 m PID = 0.0ppm	6.00 *-0.84* (0.70)
Firm brown pseudofibrous PEAT with plant remains of wood, grass and rootlets. (ALLUVIUM) 7.00 m PID = 0.0ppm 7.20-9.30 m Rare pockets of greenish grey clay. 8.00 m PID = 0.0ppm 9.00 m PID = 0.0ppm 9.30-10.00 m Frequent pockets of greenish grey clay.	6.70 *-1.54* (3.30)

Legend | Backfill/Instruments



Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
5.50		Magnetometer scan
7.50		Magnetometer scan
9.50		Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:24 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NT BH02

Sheet 2 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth.	**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

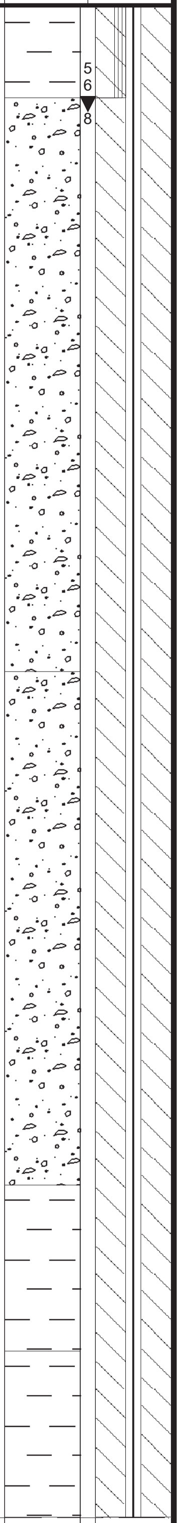
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00	ES 215	5 samples taken		
10.00	D 34		17/02/2011	1800
10.20-10.65	SPT S	* N=15 (2,3/3,3,4,5)	8.20	dry
10.20-10.65	D 35		10.30	3.90
10.30	EW 37	5 samples taken		
10.30	D 38		18/02/2011	0800
10.30-10.50	B 39			
			10.30	4.30
11.00	ES 216	5 samples taken		
11.00	D 40			
11.20-11.65	SPT C	N=17 (3,3/4,5,4,4)	11.20	7.20
11.20-11.65	B 41			
12.00	ES 217	5 samples taken		
12.00	D 42			
12.20-12.65	SPT C	N=31 (3,8/7,9,7,8)	12.20	7.30
12.20-12.65	B 43			
13.00	ES 218	* 5 samples taken		
13.00	D 44			
13.20-13.65	SPT C	N=21 (3,5/6,5,5,5)	13.20	6.90
13.20-13.65	B 45			
14.00	ES 219	5 samples taken		
14.00	D 46			
14.00-14.20	B 47			
14.20-14.65	UT 48	34 blows 350 mm rec	14.20	5.50
14.50	ES 220	5 samples taken		
14.55-14.70	D 49			
14.70-15.15	SPT S	N=20 (2,3/4,5,5,6)		
14.70-15.15	D 50		18/02/2011	1800
			14.70	5.50

Strata

Description (Continued from Sheet 2)	Depth, *Level* (Thickness)
Soft dark grey CLAY. (ALLUVIUM) 10.00 m PID = 3.4ppm	10.00 *-4.84* (0.30)
Medium dense to dense brown very sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of quartz and flint. Sand is predominately medium to coarse with occasional fine. (RIVER TERRACE DEPOSITS) 10.30-11.00 m Silty. 11.00 m PID = 0.0ppm 11.00-12.00 m Slightly silty. 12.00 m PID = 0.0ppm	10.30 *-5.14* (1.90)
Medimum dense to dense brown sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of Quartz and flint. Sand is fine to coarse. (RIVER TERRACE DEPOSITS) 13.00 m PID = 0.0ppm	12.20 *-7.04* (1.70)
Firm greenish grey slightly gravelly slightly sandy CLAY. Sand is fine to coarse. (BASAL RIVER TERRACE DEPOSITS / LONDON CLAY FORMATION) 14.00 m PID = 0.0ppm	13.90 *-8.74* (0.55)
Stiff thinly laminated brownish grey CLAY with fine sand and silt partings. (LONDON CLAY FORMATION) 14.50 m PID = 0.0ppm	14.45 *-9.29*

Stratum continues to 16.20 m



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
5	10.30	Rose to 5.10 m after 5 minutes.	-
6	10.30	Rose to 4.65 m after 10 minutes.	-
7	10.30	Rose to 4.40 m after 15 minutes.	-
8	10.30	Rose to 4.30 m after 20 minutes.	-

Depth Related Remarks *

From	to (m)	
10.20		Magnetometer scan
13.00	15.00	Bentonite environmental seal

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:25 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NT BH02

Sheet 3 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth	**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Samples and Tests

Depth	Type & No TCR SCR RQD	If	Records	Date Casing	Time Water
15.00	ES 221		5 samples taken		
				21/02/2011	0800
				14.70	6.70
				21/02/2011	1800
				16.10	6.70
			*		
				22/02/2011	0800
				16.10	7.00
16.20-16.80	67 N/A N/A	N/A N/A N/A	Flush: 16.20-16.80 water, 95 %		
16.80-17.25			SPT S N=30 (4,5/6,7,8,9)		
16.80-17.25			D 51		
		N/A N/A N/A			
16.80-18.30	67 N/A N/A		Flush: 16.80-18.35 water, 95 %		
		N/A N/A N/A			
18.35-18.80			* SPT S N=33 (4,6/7,7,9,10)		
18.35-18.80			D 52		
18.30-19.85	80 N/A N/A		Flush: 18.35-19.85 water, 95 %		
		N/A N/A N/A			
19.85-20.30			SPT S N=38 (5,6/9,8,10,11)		
19.85-20.30			D 53		

Strata

Description (Continued from Sheet 3)		Depth, *Level*	(Thickness)
Stiff thinly laminated brownish grey CLAY with fine sand and silt partings. (LONDON CLAY FORMATION)	15.00 m PID = 0.0ppm		(1.75)
Very stiff fissured brownish grey silty CLAY. Fissures are very closely spaced predominatly subhorizontal, smooth and polished. Rare to occasional localised foraminifera present. Occasional fine to coarse gravel sized pockets of fine black sand. (LONDON CLAY FORMATION - A2)	16.20-16.40 m AZCL 16.62 m 1no. subhorizontal fissure (20 degrees) 16.68 m 1no. subhorizontal fissure (5 degrees)	16.20 *-11.04*	(0.60)
ASSUMED ZONE OF CORE LOSS	16.71 m 1no. subhorizontal fissure (5 degrees) 16.71-16.73 m 1no. subvertical fissure (85 - 90 degrees) 16.80-17.25 m Stiff fissured brown slightly sandy CLAY. Fissures are extrremely closely to very closely spaced, randomly orientated rough and matt. Occasional partings of light brown fine sand.	16.80 *-11.64*	(0.65)
Stiff to very stiff brownish grey slightly sandy CLAY. Sand is fine. Occasional to locally frequent fine to coarse gravel size pockets of fine black sand. Rare foraminifera present. Mica present. (LONDON CLAY FORMATION - A2)	18.35-18.65 m AZCL	17.45 *-12.29*	(1.20)
Very stiff fissured brownish grey slightly sandy to locally sandy grey CLAY. Fissures are closely spaced, subhorizontal to subvertical, smooth and matt. Occasional to locally frequent pockets of fine black and grey sand. Occasional to locally frequent foraminifera. (LONDON CLAY FORMATION - A2)	18.87 m Locally very sandy clay with frequent forams. 19.08 m 1no. 10 mm x 5 mm lignite. 19.10 m 1no. 5 mm x 5 mm lignite. 19.58 m 1no. subhorizontal fissure (10 degrees) 19.69-19.76 m 1no. subvertical fissure (85 - 90 degrees)	18.65 *-13.49*	(1.20)
	19.85-20.30 m Stiff brown slightly sandy CLAY. Occasional partings of light brown fine sand.	19.85 *-14.69*	

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Stratum continues to 20.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
16.20	45.00	SPT hammer ID SM29 (Er 60%); rod type B
18.30	18.35	TCR 100, SCR NR, RQD NR

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:27 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NT BH02

Sheet 4 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth	**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
		N/A N/A N/A			
19.85-21.35	63 N/A N/A	N/A N/A N/A	Flush: 19.85-21.35 water, 95 %		
21.35-21.80 21.35-21.80			SPT S N=42 (5,6/8,10,12,12) D 54		
21.35-22.85	93 N/A N/A	N/A N/A N/A	Flush: 21.35-22.85 water, 95 %	22/02/2011 22.85	1800 0.00
22.85-23.28 22.85			SPT S 50 (5,7/9,12,15,14 for 50mm) D 55	23/02/2011 24.35	0800 1.20
22.85-24.35	100 N/A N/A	N/A N/A N/A	Flush: 22.85-24.35 water, 95 %		
24.35-24.77 24.35			SPT S 50 (5,7/8,12,15,15 for 40mm) D 56		
		N/A N/A N/A			

Strata

Description (Continued from Sheet 4)		Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
ASSUMED ZONE OF CORE LOSS	Occasional white foraminifera (1mm)	(0.55)		
Very stiff fissured grey slightly sandy to locally sandy CLAY. Fissures are closely spaced, subhorizontal to subvertical, smooth and matt. Occasional to locally frequent pockets of fine black and grey sand. Occasional to locally frequent foraminifera. (LONDON CLAY FORMATION - A2)	20.40-21.53 m Abundant fissures extremely closely spaced, randomly orientated, smooth and polished. 20.99 m 1no. subhorizontal fissure (5 degrees).	20.40 *-15.24* (0.87)		
Very stiff fissured grey silty CLAY. Fissures are very closely to closely spaced, predominatly subhorizontal, rarely vertical, smooth and polished. Occasional to locally rare fine to medium gravel size pockets of fine black sand. Rare light grey fine sandy clay infilled burrows. Rare forams. (LONDON CLAY FORMATION - A2)	21.27-21.33 m 1no. subvertical fissure (85 degrees). 21.33 m 1no. subhorizontal fissure (5 - 10 degrees). 21.33-21.34 m 1no. subhorizontal fissure (40 - 50 degrees). 21.34 m 1no. subhorizontal fissure (5 degrees). 21.35-21.45 m AZCL 21.37 m 1no. subhorizontal fissure (5 - 10 degrees). 21.39 m 1no. subhorizontal fissure (5 - 10 degrees). 21.46 m 1no. subhorizontal fissure (5 - 10 degrees). 21.46-21.51 m 1no. subvertical fissure (80 - 90 degrees) 21.53 m 1no. subhorizontal fissure (5 - 10 degrees). 21.53-21.89 m Abundant extremely closely spaced fissures, smooth and polsihed approx 5 mm spacing (5-10 degrees). 21.54 m 1no. subhorizontal fissure (5 - 10 degrees). 21.56 m 1no. subhorizontal fissure (5 - 10 degrees). 21.58 m 1no. subhorizontal fissure (5 - 10 degrees).	21.27 *-16.11* (1.58)		
Very stiff slightly sandy to sandy CLAY. Sand is fine to medium. Occasional fine to coarse gravel size pockets of fine black and grey sand. Rare foraminifera. (LONDON CLAY FORMATION - A2)	21.59 m 1no. subhorizontal fissure (5 - 10 degrees). 21.72 m 1no. subhorizontal fissure (5 - 10 degrees). 21.73 m 1no. subhorizontal fissure (5 - 10 degrees). 21.76-21.82 m 1no. subvertical fissure (65 degrees) 21.83 m 1no. subhorizontal fissure (5 - 10 degrees). 23.43 m 1no. coarse gravel of pyratised lignite approx 50 mm x 40 mm. 24.21 m Possible subhorizontal fissure approx 10 degrees rough and undulated.	22.85 *-17.69* (1.50)		
ASSUMED ZONE OF CORE LOSS	24.35-24.77 m Stiff to very stiff brown slightly sandy CLAY. Sand is fine to medium. Rare pockets of grey clay. Rare white foraminfera (1mm).	24.35 *-19.19* (0.75)		

Stratum continues to 25.10 m

Groundwater Entries			
No.	**Struck (m)**	**Post strike behaviour**	**Depth sealed (m)**

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:29 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH02

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth

Depth from	**to**	**Diameter**	**Casing Depth**
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Ground Level +5.16 mOD
Coordinates E 539850.35
National Grid N 180286.36
Chainage

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
24.35-25.85	50 N/A N/A		Flush: 24.35-25.85 water, 95 %		
		N/A N/A N/A			
			If N/A/N/A/N/A		
			If N/A/N/A/N/A		
25.85-26.18 25.85			SPT S 50 (5,8/15,21,14 for 30mm) D 57		
25.85-26.60	0 N/A N/A		Flush: 25.85-26.60 water, 95 %		
		N/A N/A N/A			
26.60-27.35	27 N/A N/A		Flush: 26.60-27.35 water, 95 %		
			If N/A/N/A/N/A		
27.35-27.73 27.35			SPT S 58 (2,4/8,16,25,9 for 5mm) D 58		
		N/A N/A N/A			
27.35-28.10	33 N/A N/A		Flush: 27.35-28.10 water, 95 %		
			If N/A/N/A/N/A		
		N/A N/A N/A			
28.10-28.85	25 N/A N/A		Flush: 28.10-28.85 water, 95 %		
28.85-29.10 28.85			SPT S 50 (3,7/20,30 for 20mm) D 59		
28.85-29.60	47 N/A N/A		Flush: 28.85-29.60 water, 95 %		
		N/A N/A N/A			
29.60-30.35	60 N/A N/A		Flush: 29.60-30.35 water, 95 %		
Depth	**TCR SCR RQD**	**If**	**Records/Samples**	**Date Casing**	**Time Water**

Strata

Description
(Continued from Sheet 5)

ASSUMED ZONE OF CORE LOSS

Very stiff slightly sandy to sandy CLAY. Sand is fine to medium. Occasional fine to coarse gravel size pockets of fine black and grey sand. Rare foraminifera. (LONDON CLAY FORMATION - A2)
25.47 m 1no. 5 - 10 mm dark green glauconitic band.

Very stiff locally firm grey sandy CLAY. Sand is fine. Occasional subrounded to rounded, fine to medium black and brown gravel. Occasional to locally frequent black speckling of glauconite. Occasional shells and shell fragments up to medium gravel size. (HARWICH FORMATION - POSSIBLE SWANSCOMBE MEMBER)
25.72-25.77 m Grey possible fissured slightly sandy clay.

Very stiff grey shelly sandy CLAY. Sand is fine to coarse. Shells are up to medium gravel size. Rare subrounded fine to medium gravel of black flint. (HARWICH FORMATION - POSSIBLE OLDHAVEN MEMBER)

ASSUMED ZONE OF CORE LOSS

Very dense grey slightly silty slightly gravelly SAND. Sand is fine to medium. Gravel is subrounded to rounded, fine to medium of black and rarely brown flint. Rare fine to medium gravel of light grey fine sandstone. Rare fine to coarse sand sized shell fragments. (HARWICH FORMATION - POSSIBLE OLDHAVEN MEMBER)
27.35-27.73 m Slightly silty SAND.

ASSUMED ZONE OF CORE LOSS

Very dense grey slightly clayey fine to medium SAND. Rare fine to coarse sand sized shell fragments. (LAMBETH GROUP - POSSIBLE HARWICH FORMATION)

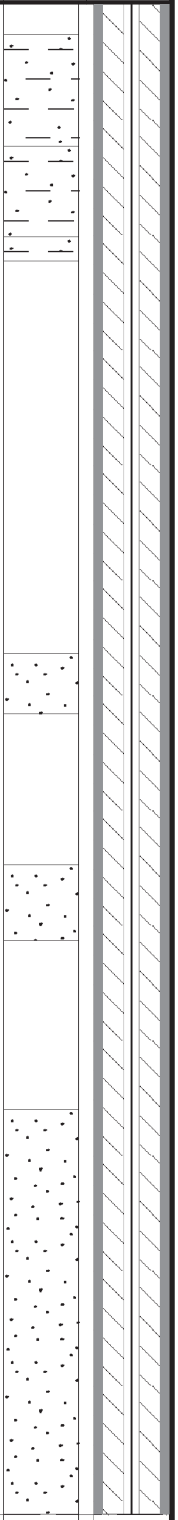
ASSUMED ZONE OF CORE LOSS

Very dense grey slightly silty fine to medium SAND. Rare fine to coarse sand sized shell fragments. (LAMBETH GROUP - POSSIBLE HARWICH FORMATION)
28.85-29.25 m AZCL
29.25-30.35 m Occasional fine to coarse gravel size pockets of clayey sand.
29.40 m 1no. subrounded medium black flint gravel.
29.48 m Localised thin wispy pockets of very weak lignite (up to 40 x 1mm).
29.60-29.90 m AZCL

Stratum continues to 30.64 m

Depth	*Level*	(Thickness)
25.10	*-19.94*	
		(0.37)
25.47	*-20.31*	
		(0.30)
25.77	*-20.61*	
25.85	*-20.69*	
		(1.30)
27.15	*-21.99*	
27.35	*-22.19*	
		(0.50)
27.85	*-22.69*	
28.10	*-22.94*	
		(0.56)
28.66	*-23.50*	
		(1.98)

Legend **Backfill/ Instruments**



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:30

AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH02
Sheet 6 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth		**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

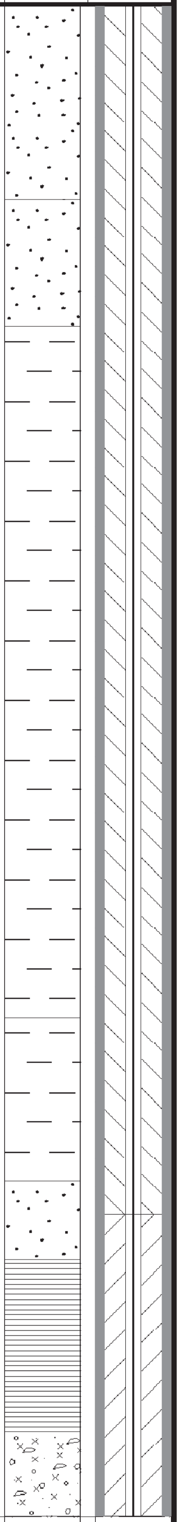
Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
30.35-30.68 30.35			SPT S 50 (4,6/11,20,19 for 30mm) D 60		
30.35-31.10	77 N/A N/A	N/A N/A N/A	Flush: 30.35-31.10 water, 95 %		
31.10-31.85	95 N/A N/A		Flush: 31.10-31.85 water, 95 %		
				23/02/2011 31.85	1800 0.60
31.85-32.24 31.85			SPT S 50 (7,13/13,13,15,9 for 10mm) D 61	24/02/2011 32.75	0800 2.00
31.85-32.75	67 N/A N/A	N/A N/A N/A	Flush: 31.85-32.75 water, 95 %		
32.75-33.35	50 N/A N/A		Flush: 32.75-33.35 water, 95 %		
33.35-33.65 33.35			SPT S 50 (4,14/19,31) D 62		
		N/A N/A N/A			
33.35-34.85	97 N/A N/A		If N/A/N/A/N/A Flush: 33.35-34.85 water, 95 %		
			34.25-34.85 0.60 m CRF		
		N/A N/A N/A			
			If N/A/N/A/N/A		

Strata

Description (Continued from Sheet 6)	Depth,*Level* (Thickness)
Very dense grey slightly silty fine to medium SAND. Rare fine to coarse sand sized shell fragments. (LAMBETH GROUP - POSSIBLE HARWICH FORMATION) 30.35-30.52 m AZCL	30.64 *-25.48*
Very dense grey thickly interlaminated grey slightly silty fine SAND with grey slightly clayey fine SAND. Occasional up to medium gravel size shell fragments. (LAMBETH GROUP - LAMINATED BEDS) 31.10-31.14 m AZCL	(0.42) 31.06 *-25.90*
Very stiff fissured grey shelly CLAY. Fissures are extremely closely spaced, randomly orientated, smooth and polished. Shells are fine to coarse gravel size. (LAMBETH GROUP - LOWER SHELLY BEDS) 31.85-32.15 m AZCL 32.75-33.05 m AZCL	(2.29) 33.35 *-28.19*
Very stiff fissured grey shelly CLAY with occasional fine to coarse gravel size pockets of fine to coarse sand. Fissures are extremely closely spaced, randomly orientated, smooth and polished. Rare pockets up to 5 mm x 5mm of green and orangish brown glauconite. Shell fragments are fine to medium gravel size. (LAMBETH GROUP - LOWER SHELLY BEDS) 33.35-33.40 m AZCL 33.74-33.89 m Becoming a slightly clayey shelly fine to coarse sand. 33.89 m MID LAMBETH HIATUS.	(0.54) 33.89 *-28.73*
Very dense bluish grey mottled orangish brown and rarely grey fine to medium SAND with rare fine to medium gravel size shell fragments. (LAMBETH GROUP - LOWER MOTTLED BEDS)	(0.26) 34.15 *-28.99* (0.57) 34.72 *-29.56*
Strong to very strong grey occasionally mottled orangish brown and bluish grey CALCRETE. (LAMBETH GROUP - LOWER	(0.30)



Stratum continues to 35.02 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NT BH02

Sheet 7 of 10

Borehole Log

Soil Mechanics

Drilled PW
Logged CT/JC/NE
Checked SV

Start 15/02/2011
End 02/03/2011

Equipment, Methods and Remarks
JCB 3CX / Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Ground Level +5.16 mOD
Coordinates E 539850.35
National Grid N 180286.36
Chainage

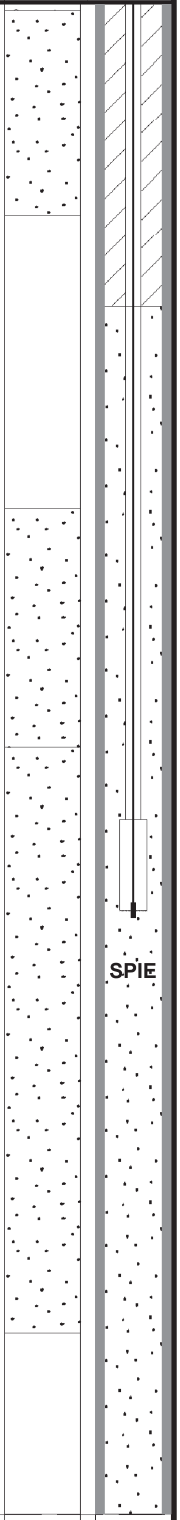
Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
34.85-35.70	100 N/A N/A	N/A N/A N/A	Flush: 34.85-35.70 water, 95 %		
35.70-35.98 35.70			SPT S 50 (6,6/21,29 for 55mm) D 63		
		N/A N/A N/A			
35.70-37.20	35 N/A N/A		Flush: 35.70-37.20 water, 95 %		
		N/A N/A N/A	37.00-37.20 m 0.20 m CRF		
37.20-37.43 37.20			SPT S 50 (6,16/50) D 64		
37.20-37.90	100 N/A N/A		Flush: 37.20-37.90 water, 95 %		
37.90-38.70	95 N/A N/A	N/A N/A N/A	Flush: 37.90-38.70 water, 95 %		
38.70-39.40	69 N/A N/A		Flush: 38.70-39.40 water, 95 %		
39.40-39.74 39.40			SPT S 50 (6,11/15,16,19 for 35mm) D 65		
		N/A N/A N/A			
Depth	**TCR SCR RQD**	**If**	**Records/Samples**	**Date Casing**	**Time Water**

Strata

Description (Continued from Sheet 7)	Depth,*Level* (Thickness)
34.15m - 34.72m : MOTTLED BEDS)	35.02 *-29.86*
34.72m - 35.02m : Very stiff to hard mottled bluish grey bluish green grey and orangish brown slightly gravelly to gravelly SILT. Gravel is angular to subrounded, fine to coarse of strong to moderately weak calcrete. (LAMBETH GROUP - LOWER MOTTLED BEDS)	(0.68)
35.48 m Rare subrounded to rounded fine to medium gravel of grey, black and brown flint.	
35.70-35.98 m Stiff brown mottled yellowish brown and light grey sandy CLAY. Sand is fine to medium.	35.70 *-30.54*
Bluish grey slightly silty fine to medium SAND. Occasional gravel predominantly fine to medium, rarely coarse gravel size of moderately weak to moderately strong calcrete. (LAMBETH GROUP - LOWER MOTTLED BEDS)	(0.97)
ASSUMED ZONE OF CORE LOSS	
Very dense bluish grey mottled orangish brown green and grey slightly clayey fine to medium SAND. (LAMBETH GROUP - LOWER MOTTLED BEDS)	36.67 *-31.51* (0.79)
Dark bluish grey mottled brown and orangish brown slightly fine to medium glauconitic SAND. Occasional to rare medium to coarse gravel size pockets of slightly clayey fine to medium sand. (LAMBETH GROUP - LOWER MOTTLED BEDS)	37.46 *-32.30*
37.90-37.94 m AZCL	(1.94)
39.32-39.35 m Rare subrounded to rounded fine gravel of brown flint.	
ASSUMED ZONE OF CORE LOSS	39.40 *-34.24*
39.40-39.74 m Very stiff dark greenish blue mottled brown and light grey sandy glauconitic CLAY. Sand is fine to coarse. Frequent pockets (upto 8mm) and partings of brown clay and grey yellow fine to coarse sand. Occasional rounded fine gravel of black and brown flint. 39.40-40.42 m AZCL	(1.02)
Stratum continues to 40.42 m	

Legend **Backfill/Instruments**



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:35 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH02
Sheet 8 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth.		**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	15.00m	250mm	15.00m
15.00m	16.20m	200mm	16.10m
16.20m	45.24m	146mm	45.24m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
39.40-40.90	30 N/A N/A		Flush: 39.40-40.90 water, 95 %		
			If N/A/N/A/N/A		
				24/02/2011	1800
				40.90	0.70
			If N/A/N/A/N/A TCR 100, SCR NR, RQD NR		
40.90-41.00					
41.00-41.26			SPT S 50 (8,14/21,29 for 30mm)	41.00	0800
41.00			D 66	25/02/2011	
				40.90	2.10
41.00-41.75	0 N/A N/A	N/A N/A N/A	Flush: 40.90-41.75 water, 95 %		
41.75-42.35	93 N/A N/A	N/A N/A N/A	Flush: 41.75-42.35 water, 95 %		
42.35-42.58			SPT S 50 (7,18/35,15 for 5mm)	42.35	
42.35			D 67		
42.35-43.10	100 N/A N/A		Flush: 42.35-43.10 water, 95 %		
		N/A N/A N/A			
43.10-43.85	36 N/A N/A		Flush: 43.10-43.85 water, 95 %		
43.85-44.18			SPT S 50 (6,11/14,15,21 for 30mm)	43.85	
43.85			D 68		
		N/A N/A N/A			
43.85-45.00	79 N/A N/A		Flush: 43.85-45.00 water, 95 %		
				25/02/2011	1800
				45.00	0.00

Strata

Description (Continued from Sheet 8)	Depth, *Level* (Thickness)
ASSUMED ZONE OF CORE LOSS	
Very stiff dark bluish grey mottled green and brown slightly gravelly sandy glauconitic CLAY. Sand is fine to medium. Gravel is subrounded to rounded, fine to coarse of brown and black flint. (LAMBETH GROUP - LOWER MOTTLED BEDS)	40.42 *-35.26* (0.30) 40.72 *-35.56* (0.28)
Very dense grey slightly silty fine to medium glauconitic SAND. Occasional fine to coarse gravel size pockets of clayey sand. (LAMBETH GROUP - LOWER MOTTLED BEDS) ASSUMED ZONE OF CORE LOSS	41.00 *-35.84* (0.75)
Very dense grey slightly silty fine to medium glauconitic SAND. Occasional fine to coarse gravel size pockets of clayey sand. (LAMBETH GROUP - LOWER MOTTLED BEDS) 41.75-41.79 m AZCL	41.75 *-36.59* (0.44)
Very dense grey slightly clayey fine to medium SAND with occasional medium to coarse gravel size pockets of slightly silty fine to medium sand. Rare shell fragments up to fine gravel size. (LAMBETH GROUP - POSSIBLE LOWER MOTTLED BEDS) 42.19 m Occasional subrounded to rounded fine to medium gravel of black flint. 43.10-43.58 m AZCL	42.19 *-37.03* (1.39)
Very stiff grey sandy CLAY. Sand is fine to medium. Rare to occasionally local fine to coarse gravel size pockets of fine to medium sand and shell fragments. Rare subrounded to rounded, fine to coarse gravel of black flint. (LAMBETH GROUP - POSSIBLE LOWER MOTTLED BEDS / UPNOR FORMATION) 43.85-44.09 m	43.58 *-38.42* (1.66)

Stratum continues to 45.24 m

Groundwater Entries			
No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *	
From	to (m)

Chiselling		
Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02 AGS
408.24 22/06/2011 12:16:36

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH02
Sheet 9 of 10

Borehole Log

Soil Mechanics

Drilled PW **Logged** CT/JC/NE **Checked** SV	**Start** 15/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** JCB 3CX / Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Broken out from GL to 0.30m depth. Hand dug inspection pit from 0.30m to 1.20m depth. Cable percussion boring from 1.20m to 16.20m depth. Rotary cored drilling using wireline techniques from 16.20m to 45.24m depth	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 15.00m / 250mm / 15.00m 15.00m / 16.20m / 200mm / 16.10m 16.20m / 45.24m / 146mm / 45.24m	**Ground Level** +5.16 mOD **Coordinates** E 539850.35 **National Grid** N 180286.36 **Chainage**

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
45.00-45.24 45.00			SPT S 50 (6,14/21,29 for 15mm) D 69		

Strata

Description (Continued from Sheet 9)		Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
Very stiff grey sandy CLAY. Sand is fine to medium. Rare to occasionally local fine to coarse gravel size pockets of fine to medium sand and shell fragments. Rare subrounded to rounded, fine to coarse gravel of black flint. (LAMBETH GROUP - POSSIBLE LOWER MOTTLED BEDS / UPNOR FORMATION)	:: 44.99m - 44.99 m 1no. 40 mm x 40 mm of pyrite.	45.24 *-40.08*		
EXPLORATORY HOLE ENDS AT 45.24 m				

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH02
408.24 22/06/2011 12:16:38 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH02

Sheet 10 of 10

PID Readings

Soil Mechanics

Hole ID	Hole Depth (mBGL)	PID Reading (ppm)	Remarks
NT BH02	0.50	0.00	
NT BH02	1.50	3.50	
NT BH02	2.00	4.90	
NT BH02	2.50	6.40	
NT BH02	3.00	13.90	
NT BH02	3.50	0.40	
NT BH02	4.50	0.30	
NT BH02	5.00	0.00	
NT BH02	6.00	0.00	
NT BH02	7.00	0.00	
NT BH02	8.00	0.00	
NT BH02	9.00	0.00	
NT BH02	10.00	3.40	
NT BH02	11.00	0.00	
NT BH02	12.00	0.00	
NT BH02	13.00	0.00	
NT BH02	14.00	0.00	
NT BH02	14.50	0.00	
NT BH02	15.00	0.00	
NT BH02	1.00	0.60	

Notes:

AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Table

NT BH02

Borehole Log

Soil Mechanics

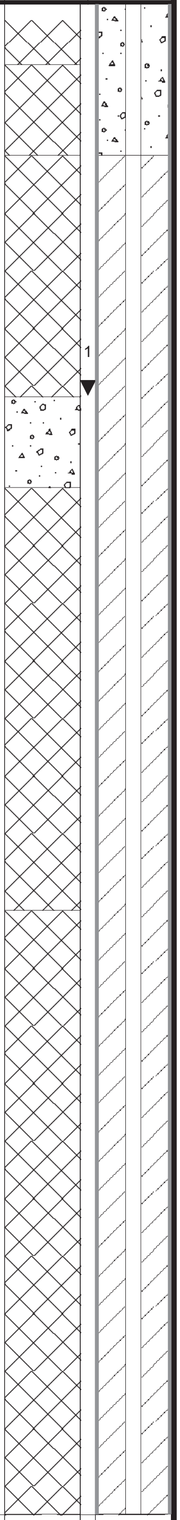
Drilled PW/SM **Logged** CT **Checked** SV	**Start** 24/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** Hydraulic Breaker / JCB 3X / Dando 175 / Magnetometer CAT scanned for services. Hydraulic breaker from GL to 0.05m depth. Hand dug inspection pit from 0.05m to 1.00m depth with breaking out from 0.20m to 0.50m depth. Machine dug trial pit from 1.00m to 2.00m depth with breaking out from 1.30m to 1.60m depth. Cable percussive boring from 2.00m to	**Depth from** 0.00m / 12.45m **to** 12.45m / 25.00m **Diameter** 200mm / 150mm **Casing Depth** 12.45m / 25.00m	**Ground Level** +4.87 mOD **Coordinates** E 540152.83 **National Grid** N 180702.12 **Chainage**

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.55	ES 200	4 samples taken		
0.60	D 1			
0.90	B 2			
1.00	ES 201	4 samples taken		
1.25	W 4	* 2 samples taken		
			24/02/2011	1800
				1.20
1.65	ES 202	4 samples taken		
1.70	D 3			
			25/02/2011	0800
1.90-2.10	B 5			1.25
2.00	ES 203	* 4 samples taken		
2.50	ES 204	4 samples taken		
3.00-3.45	SPT C	* N=0 (1,-/-,-,-,-)	3.00	1.45
3.00	ES 205	4 samples taken		
3.00	D 6			
3.00-3.45	B 7			
3.50	ES 206	4 samples taken		
4.00	ES 207	* 4 samples taken		
4.00	D 8			
4.50-4.95	SPT S	N=1 (1,-/-,1,-,-)	4.50	2.40
4.50-4.95	B 10			
4.50	ES 208	4 samples taken		
4.50-4.95	D 9			

Strata

Description	Depth,*Level* (Thickness)
(MADE GROUND) CONCRETE slab.	0.05 *+4.82*
(MADE GROUND) Yellowish brown fine to medium SAND.	0.20 *+4.67*
(MADE GROUND) Reinforced CONCRETE. 0.50 m Blue plastic membrane.	(0.30) 0.50 *+4.37*
(MADE GROUND) Brown sandy GRAVEL with medium cobble content. Gravel is angular to subrounded, fine to coarse of quartz, brick, concrete, flint and wood. Cobbles of brick, concrete and wood. Sand is fine to coarse. 0.55 m PID = 0.1 ppm 1.00 m PID = 0.4 ppm	(0.80) 1.30 *+3.57*
(MADE GROUND) Reinforced CONCRETE	(0.30) 1.60 *+3.27*
(MADE GROUND) Brown very gravelly fine to coarse SAND with medium cobble content. Gravel is angular to subrounded, fine to coarse of quartz, brick, concrete, flint and wood. Cobbles of brick, concrete and wood. 1.65 m PID = 0.0 ppm 1.70 m Dark grey. 1.90-3.00 m High cobble content. 2.00 m PID = 0.0 ppm 2.50 m PID = 0.0 ppm	(1.40) 3.00 *+1.87*
(MADE GROUND) Very soft dark brownish grey silty sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of flint, brick, siliceous slag pumice. Sand is fine to coarse. Slight sweet (?) odour. 3.00 m PID = 0.7 ppm 3.50 m PID = 0.0 ppm 4.00 m PID = 0.0 ppm 4.50-5.00 m Greenish grey.	



Stratum continues to 7.00 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	1.25	water seepage	-

Depth Related Remarks *

From	to (m)	
1.20	12.45	SPT hammer ID SM10 (Er 54%); rod type B
2.00		Magnetometer scan
3.00		Magnetometer scan
4.00		Magnetometer scan
5.00		Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A
408.24 22/06/2011 11:55:22 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NS BH01A
Sheet 1 of 6

Borehole Log

Soil Mechanics

Drilled PW/SM **Logged** CT **Checked** SV	**Start** 24/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** 25.00m depth.	**Depth from** 0.00m / 12.45m, **to** 12.45m / 25.00m, **Diameter** 200mm / 150mm, **Casing Depth** 12.45m / 25.00m	**Ground Level** +4.87 mOD **Coordinates National Grid** E 540152.83 N 180702.12 **Chainage**

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
5.00	D 11	*		
5.00	ES 209	4 samples taken		
5.50-5.95	SPT C	N=1 (1,-/1,-,-,-)	5.50	3.00
5.50-5.95	B 12			
5.50	ES 210	4 samples taken		
			25/02/2011	1800
			6.00	3.20
6.00	D 13	*		
6.00	ES 211	4 samples taken	28/02/2011	0800
			6.00	1.50
6.50-7.25	SPT C	* N=1 (1,-/-,1,-,-) SW=300	6.50	1.90
6.50-6.95	B 14			
7.00	D 15			
7.00	ES 212	4 samples taken		
7.50-8.25	SPT C	* N=1 (1,-/-,1,-,-) SW=300	7.50	3.10
7.50-7.95	B 16			
8.00	D 17			
8.00	ES 213	4 samples taken		
8.10	D 18			
8.10-8.50	B 19			
8.50-9.15	SPT S	* N=0 (1,-/-,-,-,-) SW=200	8.50	5.20
8.50-8.95	D 20			
8.50-8.95	B 21			
9.00	ES 214	4 samples taken		
9.00	D 22			
9.50-11.40	KRH	* k=0.0E+0 m/s		
9.50-9.88	SPT S	49 (1,6/10,17,22)	9.50	6.10
9.50-9.95	D 23			
9.50-9.95	D 24			

Strata

Description (Continued from Sheet 1)		Depth, *Level* (Thickness)
(MADE GROUND) Very soft dark brownish grey silty sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of flint, brick, siliceous slag pumice. Sand is fine to coarse. Slight sweet (?) odour.	5.00-5.45 m Silty very gravelly sand. 5.50-6.00 m Low cobble content. Cobbles angular of concrete. 6.00-6.50 m Greenish grey and brownish grey.	(4.00) 7.00 *-2.13*
(MADE GROUND) Dark grey sandy angular to subangular fine to coarse GRAVEL of slag, brick and quartz with occasional pockets of soft greenish grey slightly sandy gravelly clay (up to 100 mm).		(0.50) 7.50 *-2.63*
(MADE GROUND) Very loose black slightly clayey sandy angular to subangular fine to coarse GRAVEL of slag and quartz with occasional pockets of soft black slightly sandy gravelly clay (up to 120 mm). Strong odour.		(0.50) 8.00 *-3.13*
(MADE GROUND) Very soft black slightly sandy gravelly CLAY with strong odour. Sand is fine to coarse. Gravel is angular to subangular, fine to coarse of slag and brick.		8.10 *-3.23*
Plastic brown very clayey amorphous PEAT. Rare grass and wood fragments. (ALLUVIUM)	8.50-8.95 m Soft brown silty clay.	(1.45) 9.55 *-4.68*
Dense grey SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of flint and quartz. (RIVER TERRACE DEPOSITS)		

Stratum continues to 11.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
5.00		Magnetometer scan
6.00		Magnetometer scan
6.50		Magnetometer scan
7.50		Magnetometer scan
8.50		Magnetometer scan
9.50		Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A AGS
408.24 22/06/2011 11:55:23

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NS BH01A
Sheet 2 of 6

Borehole Log

Soil Mechanics

Drilled	PW/SM
Logged	CT
Checked	SV
Start	24/02/2011
End	02/03/2011

Equipment, Methods and Remarks
Hydraulic Breaker / JCB 3X / Dando 175 / Magnetometer
CAT scanned for services. Hydraulic breaker from GL to 0.05m depth. Hand dug inspection pit from 0.05m to 1.00m depth with breaking out from 0.20m to 0.50m depth. Machine dug trial pit from 1.00m to 2.00m depth with breaking out from 1.30m to 1.60m depth. Cable percussive boring from 2.00m to

Depth from	to	Diameter	Casing Depth
0.00m	12.45m	200mm	12.45m
12.45m	25.00m	150mm	25.00m

Ground Level	+4.87 mOD
Coordinates	E 540152.83
National Grid	N 180702.12
Chainage	

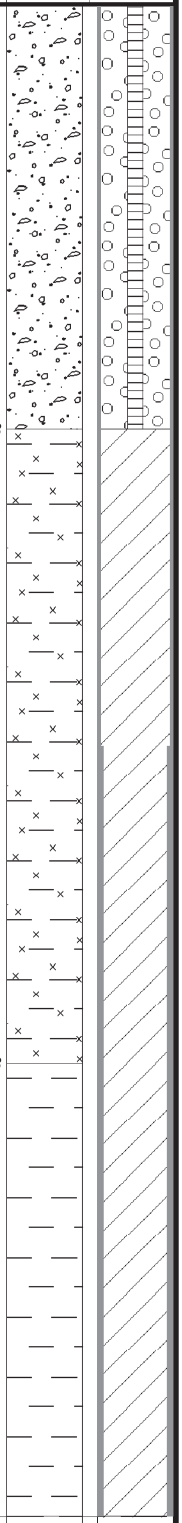
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
10.00	ES 215	4 samples taken		
10.00	D 25			
10.50-10.95	SPT C	N=49 (4,8/10,12,13,14)	10.50	6.30
10.50-10.95	B 26			
11.00	D 27			
		*		
11.50-11.95	UT 28	25 blows 400 mm rec	11.50	6.50
11.65	ES 216	4 samples taken		
11.90	ES 217	4 samples taken		
11.95-12.00	D 29			
12.00-12.45	SPT S	N=17 (2,3/4,4,4,5)	11.50	6.50
12.00-12.45	D 30			
12.00-12.45	B 32			
			28/02/2011	1800
			12.45	6.50
12.40	ES 218	4 samples taken		
			01/03/2011	0800
			12.45	5.90
13.00-13.45	UT 33	27 blows 350 mm rec	13.00	damp
13.45-13.50	D 34			
13.50-13.95	SPT S	N=22 (2,3/4,5,6,7)	13.00	dry
13.50-13.95	D 35			
14.50-14.95	UT 37	31 blows 400 mm rec	13.00	dry
14.50	D 36			
14.95-15.00	D 38			

Strata

Description (Continued from Sheet 2)	Depth, *Level* (Thickness)
Dense grey SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of flint and quartz. (RIVER TERRACE DEPOSITS) 10.50-10.95 m Sandy gravel.	(1.85)
11.40 m Firm Stiff grey slightly sandy slightly garvelly CLAY. Gravel is subangular to angular fine to coarse of quartzite and flint. (LONDON CLAY FORMATION) 12.00-12.45 m Slightly gravelly sandy clay. Sand is fine to coarse. 13.00-13.20 m Slightly sandy. Sand is fine.	11.40 *-6.53* (2.10)
Stiff to very stiff fissured grey brown and brown CLAY. Fissures are extremely closely spaced to very closely spaced, randomly orientated, rough and matt with occasional dustings of brown silt on fissure surfaces. Occasional partings of light brown fine sand and burrows infilled (upto 4mm) with dark grey clay. Rare white foraminifera (1mm). (LONDON CLAY FORMATION)	13.50 *-8.63*

Legend | Backfill/Instruments



Stratum continues to 17.95 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
11.40	12.45	Bentonite environmental seal

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A AGS
408.24 22/06/2011 11:55:25

Project	Cable Car for London - Ground Investigation
Project No.	D1002-11
Carried out for	Transport for London

Borehole

NS BH01A

Sheet 3 of 6

Borehole Log

Soil Mechanics

Drilled PW/SM **Logged** CT **Checked** SV	**Start** 24/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** 25.00m depth.	**Ground Level** +4.87 mOD **Coordinates** E 540152.83 **National Grid** N 180702.12 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	12.45m	200mm	12.45m
12.45m	25.00m	150mm	25.00m

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
15.00-15.45	SPT S	N=25 (2,4/5,6,7,7)	13.00	dry
15.00-15.45	D 39			
16.00-16.45	UT 41	36 blows 350 mm rec	13.00	dry
16.00	D 40			
16.45-16.50	D 42			
16.50-16.95	SPT S	N=26 (3,4/5,6,7,8)	13.00	dry
16.50-16.95	D 43			
17.50-17.95	UT 45	44 blows 400 mm rec	13.00	dry
17.50	D 44			
17.95-18.00	D 46			
18.00-18.45	SPT S	N=30 (3,5/6,7,8,9)	13.00	dry
18.00-18.45	D 47			
19.00-19.45	UT 49	50 blows 400 mm rec	13.00	dry
19.00	D 48			
19.45-19.50	D 50			
19.50-19.95	SPT S	N=34 (4,6/7,8,9,10)	13.00	damp
19.50-19.95	D 51			

Strata

Description (Continued from Sheet 3)	Depth, *Level* (Thickness)
Stiff to very stiff fissured grey brown and brown CLAY. Fissures are extremely closely spaced to very closely spaced, randomly orientated, rough and matt with occasional dustings of brown silt on fissure surfaces. Occasional partings of light brown fine sand and burrows infilled (upto 4mm) with dark grey clay. Rare white foraminifera (1mm). (LONDON CLAY FORMATION)	(4.45)
Very stiff brown locally structureless rarely fissured slightly sandy CLAY. Fissures are very closely spaced randomly orientated rough and mattt. Sand is fine. Locally frequent white foraminifera (1mm). (LONDON CLAY FORMATION) 19.45-19.50 m Frequent extremely closely spaced fine sand and silt partings.	17.95 *-13.08* (4.05)

Water strike 2 at 19.45

Stratum continues to 22.00 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
2	19.45	Slight water seepage	-

Depth Related Remarks *

From to (m)

Chiselling

Depths (m) Time Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A
408.24 22/06/2011 11:55:26 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NS BH01A

Borehole Log

Soil Mechanics

Drilled PW/SM **Logged** CT **Checked** SV	**Start** 24/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** Hydraulic Breaker / JCB 3X / Dando 175 / Magnetometer CAT scanned for services. Hydraulic breaker from GL to 0.05m depth. Hand dug inspection pit from 0.05m to 1.00m depth with breaking out from 0.20m to 0.50m depth. Machine dug trial pit from 1.00m to 2.00m depth with breaking out from 1.30m to 1.60m depth. Cable percussive boring from 2.00m to	**Ground Level** +4.87 mOD **Coordinates** E 540152.83 **National Grid** N 180702.12 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	12.45m	200mm	12.45m
12.45m	25.00m	150mm	25.00m

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
20.50-20.95	UT 53	52 blows 380 mm rec	13.00	damp
20.50	D 52			
20.95-21.00	D 54			
21.00-21.45	SPT S	N=36 (3,5/7,9,10,10)	13.00	damp
21.00-21.45	D 55			
22.00-22.45	UT 57	58 blows 350 mm rec	13.00	damp
22.00	D 56			
22.45-22.50	D 58			
22.50-22.95	SPT S	N=37 (3,5/7,9,10,11)	13.00	damp
22.50-22.95	D 59			
23.50-23.95	UT 61	63 blows 400 mm rec	13.00	damp
23.50	D 60			
23.95-24.00	D 62			
24.00-24.45	SPT S	N=39 (4,6/8,9,10,12)	13.00	damp
24.00-24.45	D 63			
			01/03/2011	1800
			13.00	damp

Strata

Description (Continued from Sheet 4)	Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
Very stiff brown locally structureless rarely fissured slightly sandy CLAY. Fissures are very closely spaced randomly orientated rough and mattt. Sand is fine. Locally frequent white foraminifera (1mm). (LONDON CLAY FORMATION)			
Stiff to very stiff possibly structureless dark brown slightly sandy CLAY. Sand is fine. Occasional partings of light brown fine sand and dark grey silt. Occasional white foraminifera (1mm). Occasional pockets (up to 10mm) of light grey silt. (LONDON CLAY FORMATION) 22.00-22.20 m Slightly sandy and rare shell fragments. Sand is fine.	22.00 *-17.13* (3.00)		

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A

408.24 22/06/2011 11:55:27 AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Borehole

NS BH01A

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Borehole Log

Soil Mechanics

Drilled PW/SM **Logged** CT **Checked** SV	**Start** 24/02/2011 **End** 02/03/2011	**Equipment, Methods and Remarks** 25.00m depth.	**Depth from** / **to** / **Diameter** / **Casing Depth** 0.00m / 12.45m / 200mm / 12.45m 12.45m / 25.00m / 150mm / 25.00m	**Ground Level** +4.87 mOD **Coordinates** E 540152.83 **National Grid** N 180702.12 **Chainage**	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
25.00	D 64			

Strata

Description (Continued from Sheet 5)	Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
25.00 m Slightly sandy. Sand is fine. Rare shell fragments. EXPLORATORY HOLE ENDS AT 25.00 m	25.00 *-20.13*		

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NS BH01A 408.24 22/06/2011 11:55:28 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NS BH01A

Sheet 6 of 6

PID Readings

Soil Mechanics

Hole ID	Hole Depth (mBGL)	PID Reading (ppm)	Remarks
NS BH01A	0.55	0.10	
NS BH01A	1.00	0.40	
NS BH01A	1.65	0.00	
NS BH01A	2.00	0.00	
NS BH01A	2.50	0.00	
NS BH01A	3.00	0.70	
NS BH01A	3.50	0.00	
NS BH01A	4.00	0.00	

Notes:

AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Table

NS BH01A

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 02/03/2011 **End** 05/04/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.	**Ground Level** +2.76 mOD **Coordinates** E 539868.52 **National Grid** N 180300.77 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

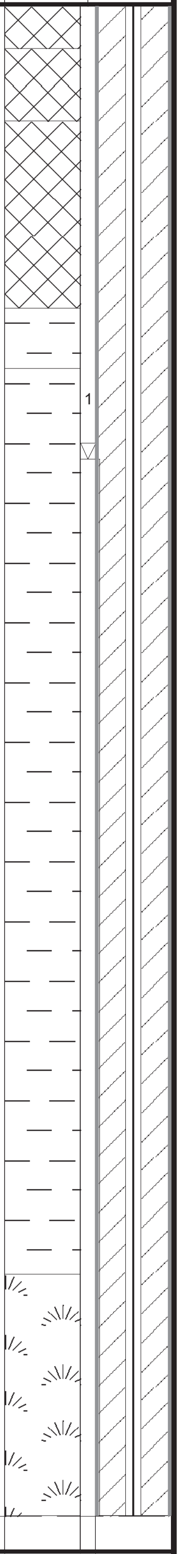
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
0.00-0.14	CC 1			
0.14-0.38	CC 2		02/03/2011	1800
				dry
0.50	D 1		03/03/2011	0800
0.50-0.60	B 2			dry
0.50	ES 200	4 samples taken		
0.75	ES 201	4 samples taken		
1.00	ES 202	4 samples taken		
1.00	D 3			
1.20-1.65	SPT S	* N=1 (1,-/-,1,-,-)		damp
1.20-1.65	D 4	*		
1.20-1.65	B 5			
1.50	ES 203	4 samples taken		
2.00	ES 204	4 samples taken		
2.00	D 6			
2.20-2.65	UT 7	* 8 blows 310 mm rec	1.70	dry
2.65	D 8			
3.00	ES 205	4 samples taken		
3.00	D 9			
3.20-3.65	SPT S	* N=5 (1,-/1,1,1,2)	3.20	dry
3.20-3.65	D 10			
3.20-3.65	B 11			
4.00	D 12			
4.00	ES 206	4 samples taken		
4.20-4.65	UT 13	* 8 blows 400 mm rec	3.20	dry
4.20-4.65	B 15			
4.65-4.70	D 14			

Strata

Description	Depth,*Level* (Thickness)
(MADE GROUND) Strong black MACADAM. 70 to 80% aggregate angular fine to medium pink granite and blue green possible limestone gravel. 5% small to medium voids. 0.25 m 5 mm rebar mesh. 0.33 m Honeycomb voids.	0.14 *+2.62* 0.38 *+2.38*
(MADE GROUND) Strong light grey CONCRETE. 70 to 80% aggregate subangular to rounded fine to medium flint gravel. 10 to 15% small to medium voids.	(0.62)
(MADE GROUND) Soft brownish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular, fine to coarse of brick, quartz, concrete and rare metal (up to 30 mm).	1.00 *+1.76*
Soft brownish grey CLAY with occasional shell fragments. (ALLUVIUM)	1.20 *+1.56*
Soft grey CLAY with rare black speckles. (ALLUVIUM)	(3.00)
Plastic brown clayey amorphous PEAT interbedded with soft grey clay. Occasional wood and grass fragments. (ALLUVIUM)	4.20 *-1.44*

Legend | Backfill/Instruments



Stratum continues to 6.10 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
1.20	9.10	SPT hammer ID SM10 (Er 54%); rod type B
1.20		Magnetometer scan
2.20		Magnetometer scan
3.20		Magnetometer scan
4.20		Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:23 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH01
Sheet 1 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 02/03/2011 **End** 05/04/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth	**Depth from** 0.00m 10.20m 12.10m	**to** 10.20m 12.10m 60.70m	**Diameter** 250mm 200mm 146mm	**Casing Depth** 10.20m 11.95m 60.70m	**Ground Level** +2.76 mOD **Coordinates** E 539868.52 **National Grid** N 180300.77 **Chainage**

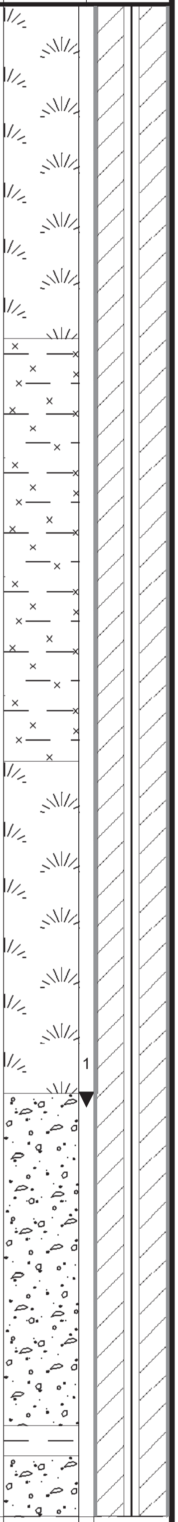
Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
5.00	D 16			
5.00	ES 207	4 samples taken		
5.20-5.65	SPT S	* N=5 (1,1/1,1,1,2)	4.90	dry
5.20-5.65	D 17			
6.00	D 18			
6.00	ES 208	4 samples taken		
6.10	D 19			
6.20-6.65	SPT S	* N=3 (1,-/1,-,1,1)	4.90	dry
6.20-6.65	D 20			
6.20-6.65	B 21			
7.00	ES 209	4 samples taken		
7.00	D 22			
7.20-7.65	SPT S	* N=5 (1,1/1,1,1,2)	6.40	dry
7.20-7.65	D 23			
8.00	ES 210	4 samples taken		
8.00	D 24			
8.20-8.65	UT 25	* 13 blows 370 mm rec	8.00	dry
			03/03/2011	1800
			8.70	1.50
8.65-8.70	D 26			
8.70	EW 27			
			07/03/2011	0800
			8.70	1.80
9.00	ES 211	5 samples taken		
9.00	D 28			
9.20-9.65	SPT C	* N=11 (3,3/3,2,3,3)	9.20	2.40
9.70	D 30			

Strata

Description	Depth	*Level*	(Thickness)
(Continued from Sheet 1)			
Plastic brown clayey amorphous PEAT interbedded with soft grey clay. Occasional wood and grass fragments. (ALLUVIUM)			(1.90)
Soft grey silty CLAY. (ALLUVIUM) 6.20-6.65 m Sandy organic material.	6.10	*-3.34*	(1.40)
Plastic brown clayey amorphous PEAT. Occasional wood and grass fragments. (ALLUVIUM)	7.50	*-4.74*	(1.10)
Medium dense grey SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of quartz and flint. (RIVER TERRACE DEPOSITS) 9.00 m PID = 0.4 ppm.	8.60	*-5.84*	(1.10)
Soft grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to	9.70	*-6.94*	
	9.80	*-7.04*	

Stratum continues to 10.20 m



Groundwater Entries No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	8.60	Rose to 1.50 m after 20 minutes. Fast Inflow	-

Depth Related Remarks *

From	to (m)	
5.20	6.20	Magnetometer scan
6.20	7.20	Magnetometer scan
7.20	8.20	Magnetometer scan
8.20	9.20	Magnetometer scan
9.20	10.20	Magnetometer scan

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:25 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 2 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE	**Start**	02/03/2011
Logged	CT/JC	**End**	05/04/2011
Checked	SV		

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	Type & No		Records	Date Casing	Time Water
10.00	ES 212		5 samples taken		
10.00	D 31				
10.20-10.65	UT 33		* 29 blows 300 mm rec	9.20	2.40
10.20	D 32				
10.20-10.50	B 35				
10.45	ES 213		5 samples taken		
10.65-10.70	D 34				
10.70	ES 214		5 samples taken		
11.00	D 36				
11.20	ES 215		5 samples taken		
				07/03/2011	1800
				11.95	damp
			*		
				23/03/2011	0800
				11.95	
12.10-12.70	100 N/A N/A	NA NA NA			
				23/03/2011	1800
12.60-12.70			D 100	12.70	
				24/03/2011	0800
				12.70	
			*		
12.70-14.20	0 N/A N/A	NR NR NR	Flush: 12.70-14.20 water, 99 %		
				24/03/2011	1700
				14.20	
			*	25/03/2011	0800
				14.20	
14.80-15.25		NA NA NA	SPT S N=30 (3,4/6,6,9,9)		
14.80			D 37		
14.20-15.70	80 N/A N/A		Flush: 14.20-15.70 water, 99 %		
Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Strata

Description (Continued from Sheet 2)		Depth, *Level* (Thickness)
9.70m - 9.80m : subrounded, fine to coarse of quartz and flint. (RIVER TERRACE DEPOSITS) 9.80m - 10.20m : Grey SAND and GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded, fine to coarse of quartz and flint. (RIVER TERRACE DEPOSITS)	10.00 m PID = 0.1 ppm.	(0.40)
		10.20 *-7.44*
Stiff fissured grey brown CLAY. Fissures are extremely to very closely spaced, randomly orientated, smooth, matt and occasionally polished with rare dustings of fine brown sand and dark brown staining. (LONDON CLAY FORMATION)	10.45 m PID = 0.0 ppm. 10.70 m PID = 0.8 ppm. 11.00 m 1no. pyrite nodule (5 mm x 20 mm). 11.20 m PID = 0.0 ppm.	(1.90)
		12.10 *-9.34*
Firm to stiff fissured grey slightly sandy CLAY. Fissures are very closely spaced, randomly orientated, smooth, matt and rarely polsihed. Sand is fine to medium. (LONDON CLAY FORMATION - A2)		(0.60)
		12.70 *-9.94*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	12.70-14.80 m 88.4mm diameter self boring pressuremeter test pocket.	(1.80)
		14.50 *-11.74*
Very stiff grey slightly sandy CLAY. Sand is fine to medium. Occasional foram fossils (up to 3 mm x 1 mm). Occasional pockets (up to 20 mm x 10 mm) of fine to medium black sand. (LONDON CLAY FORMATION - A2)	14.50-14.96 m Occasional partings of light grey fine to medium sand. 14.74 m 1no. pocket (20 mm x 20 mm) of pyrite nodules (up to 5 mm). 14.74-14.75 m 1no. pyrite nodule (20 mm x 30 mm).	(0.60)
Stratum continues to 15.10 m		

Legend

Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
10.20	11.20	Bentonite environmental seal
12.10	61.07	SPT hammer ID SM31 (Er 55%); rod type NWY
13.20		SBP test.
14.30		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:26 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 3 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	02/03/2011
End	05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
		NA NA NA			
15.60-15.70			D 101		
15.70-17.20	100 N/A N/A		Flush: 15.70-17.20 water, 99 %		
		NA NA NA			
17.10-17.20			D 102		
17.20-18.70	96 N/A N/A		Flush: 17.20-18.70 water, 99 %		
18.53-18.63		NA NA NA	D 103		
			18.63-18.70 m 0.07 m CRF		
19.40-19.50			D 104		
18.70-20.20	100 N/A N/A		Flush: 18.70-20.20 water, 99 %		

Strata

Description (Continued from Sheet 3)		Depth, *Level* (Thickness)
Very stiff grey slightly sandy CLAY. Sand is fine to medium. Occasional foram fossils (up to 3 mm x 1 mm). Occasional pockets (up to 20 mm x 10 mm) of fine to medium black sand. (LONDON CLAY FORMATION - A2)	14.77-14.82 m Rare lignite fragments (up to 15 mm x 10 mm).	15.10 *-12.34*
Very stiff fissured grey CLAY. Fissures are very closely to closely spaced, predominatly subhorizontal, smooth and matt. Occasional foram fossils (up to 3 mm x 1 mm). Rare partings of greyish brown fine to medium sand. (LONDON CLAY FORMATION - A2)	15.58-15.60 m 1no. pyrite and lignite fragment (20 mm x 30 mm).	(0.46) 15.56 *-12.80*
Very stiff grey slightly sandy CLAY. Sand is fine to medium. Occasional foram fossils (up to 3 mm). Rare to occasional partings of black and grey fine to medium sand. (LONDON CLAY FORMATION - A2)	16.08-16.30 m Locally fissured. Fissures are very closely spaced, subvertical, smooth and matt. 16.76 m Occasional lignite fragments (up to 5 mm x 3 mm x 1 mm). 17.20-17.26 m AZCL 17.56-17.58 m 1no. pyrite nodule (35 mm x 30 mm x 20 mm).	(2.40) 17.96 *-15.20*
Very stiff fissured grey CLAY. Fissures are very closely to closely spaced, predominatly subvertical, occasionally subhorizontal, smooth, matt and polsihed. Rare foram fossils (up to 2 mm x 1 mm). Rare partings of greyish brown fine to medium sand. (LONDON CLAY FORMATION - A2)	18.63-19.20 m Sand partings absent. 19.01 m 1no. pyrite nodule (5 mm x 8 mm).	(1.24) 19.20 *-16.44*
Very stiff fissured grey slightly sandy CLAY. Fissures are very closely to closely spaced, vertical to subvertical, rarely subhorizontal, smooth and matt. Sand is fine to medium. Rare to occasional foram fossils (up to 2 mm). Rare pockets (up to 5 mm x 10 mm) of black fine to medium sand. (LONDON CLAY FORMATION - A2)	19.48-19.96 m 1no. 75 degree smooth matt fissure. 19.87-19.90 m 1no. pyrite nodule (50 mm x 45 mm x 25 mm).	

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Stratum continues to 22.24 m

Legend	Backfill/ Instruments

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chisselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:27 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 02/03/2011 **End** 05/04/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level +2.76 mOD
Coordinates E 539868.52
National Grid N 180300.77
Chainage

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
		NA NA NA			
20.20-21.70	90 N/A N/A		Flush: 20.20-21.70 water, 99 %		
21.05-21.28			CS 105		
21.28-21.38			D 106		
21.79-22.01			CS 107		
22.01-22.11			D 108		
21.70-23.20	74 N/A N/A		If NA/NA/NA Flush: 21.70-23.20 water, 99 %		
		NA NA NA			
				25/03/2011 23.20	1800
				28/03/2011 23.20	0800
23.20-24.70	0 N/A N/A		Flush: 23.20-24.70 water, 99 %		
		NA NA NA			
			*		

Strata

Description (Continued from Sheet 4)		Depth, *Level* (Thickness)
Very stiff fissured grey slightly sandy CLAY. Fissures are very closely to closely spaced, vertical to subvertical, rarely subhorizontal, smooth and matt. Sand is fine to medium. Rare to occasional foram fossils (up to 2 mm). Rare pockets (up to 5 mm x 10 mm) of black fine to medium sand. (LONDON CLAY FORMATION - A2)	20.20-20.30 m Grey clay. Sand pockets absent. 20.25-20.65 m 1no. 80 degree smooth, matt fissure. 21.39-21.40 m Rare pyrite fragments (up to 10 mm x 5 mm). 21.55-21.70 m AZCL 22.11-22.24 m Green clay. Sand pockets absent. Occasional partings of brownish grey fine to medium sand.	(3.04) 22.24 *-19.48*
Very stiff grey slightly sandy slightly gravelly slightly galuconitic CLAY. Sand is fine to medium. Occasional shell fragments (up to 20 mm x 10 mm). Gravel is rounded, fine of black flint. (HARWICH FORMATION - SWANSCOMBE MEMBER)	22.24-22.27 m 1no. 56 degree smooth polished fissure. 22.26-22.28 m Occasional pockets of dark green clay (up to 50 mm x 10 mm). 22.67-22.72 m Grey sandy very shelly slightly gravelly clay. Shells are (up to 30 mm x 20 mm). Gravel is rounded, fine to coarse of black flint.	22.47 *-19.71* (0.34) 22.81 *-20.05*
Very stiff fissured grey slightly glauconitic CLAY. Fissures are very closely to closely spaced, subvertical, smooth and polished. Rare shell fragments (up to 10 mm). (HARWICH FORMATION - SWANSCOMBE MEMBER)		
ASSUMED ZONE OF CORE LOSS		(1.89) 24.70 *-21.94*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	24.70-25.70 m 88.4mm diameter self boring pressuremeter test pocket.	

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Stratum continues to 25.97 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
24.90	25.70	Borehole caved in. Collapsed after SBP pulled from hole.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:29 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH01
Sheet 5 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	02/03/2011
End	05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates National Grid	E 539868.52 N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
			*		
24.70-26.20	15 N/A N/A		Flush: 24.70-26.20 water, 99 %		
25.97-26.07			D 109		
			If NA/NA/NA		
		NA NA NA			
26.20-27.70	77 N/A N/A		Flush: 26.20-27.70 water, 99 %		
27.26-27.36			D 110		
				28/03/2011 27.70	1800
				29/03/2011 27.70	0800
		NA NA NA			
			*		
27.70-29.20	27 N/A N/A		Flush: 27.70-29.20 water, 99 %		
28.80-29.22 28.80			SPT S 50 (6,9/11,15,14,10 for 45mm) D 38		
29.10-29.20			D 111		
		NA NA NA			
29.47-29.57			D 112		
29.20-30.30	34 N/A N/A				

Strata

Description (Continued from Sheet 5)	Depth, *Level* (Thickness)	Legend	Backfill/ Instruments
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	(1.27)		
	25.97 *-23.21*		
Grey clayey fine to medium SAND. Occasional bands (up to 10 mm thick) of very stiff grey clay. Rare lignite fragments (up to 8 mm x 5 mm). Rare shell fragments (up to 10 mm x 7 mm). (HARWICH FORMATION - OLD HAVEN MEMBER)			
	26.20 *-23.44*		
Laminated grey slightly clayey fine to medium SAND with extremely closely spaced thin laminae of light and dark grey sand, black lignite and rare clay. Rare shell fragments (up to 10 mm x 5 mm). (HARWICH FORMATION - OLD HAVEN MEMBER) 27.07 m 1no. pocket (25 mm x 5 mm) of lignite.	(1.16)		
	27.36 *-24.60*		
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET 27.70-28.80 m 88.4mm diameter self boring pressuremeter test pocket. 28.80 m Stiff locally fissured grey brown CLAY. Fissures are extremely closely spaced, randomly orientated, smooth and polished. Occasional shell and shell fargments (up to 15mm). Rare pockets (up to 5mm) of fine clayey sand.	(1.53)		
	28.89 *-26.13*		
Very stiff grey shelly CLAY. Shells are up to 25 mm x 15 mm. Frequent partings of fine grey sand and light brown silt. (LAMBETH GROUP - LAMINATED BEDS / POSSIBLE LOWER SHELLY BEDS) 29.25-29.31 m Locally very closely spaced, subvertical polished fissures. 29.31-29.37 m Light brown moderately weak claystone. 29.44-29.57 m Very shelly clay.	(0.68)		
	29.57 *-26.81*		
ASSUMED ZONE OF CORE LOSS			

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water

Stratum continues to 31.19 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
25.20		SBP test.
28.30		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:31 AGS

Project	Cable Car for London - Ground Investigation
Project No.	D1002-11
Carried out for	Transport for London

Borehole

NT BH01

Sheet 6 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	02/03/2011
End	05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

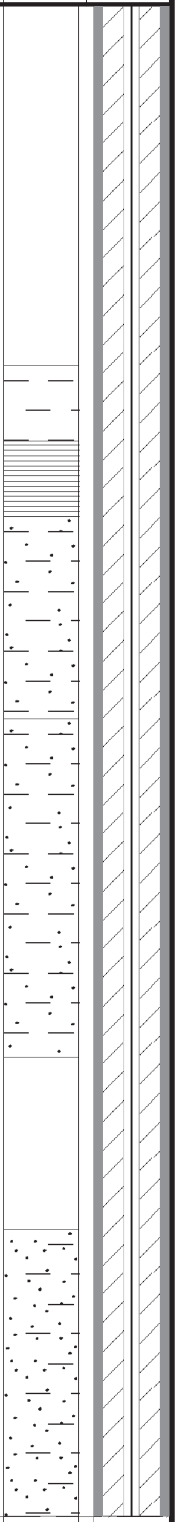
Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
		NA NA NA			
			Flush: 29.20-32.20 water, 99 %		
			*		
30.30-32.20 31.30-31.73 31.30	53 N/A N/A		SPT S 50 (25,-/50 for 50mm) If NA/NA/NA D 39		
			If NA/NA/NA		
		NA NA NA		29/03/2011	1700
32.10-32.20			D 113	32.20	
				30/03/2011	0700
32.42-32.72			If NA/NA/NACS 114	32.20	
32.72-32.82			D 115		
32.20-33.50	98 N/A N/A		Flush: 32.20-33.50 water, 99 %		
		NA NA NA			
33.50-33.80 33.50			SPT S 50 (9,13/20,30) D 40		
		NA NA NA			
			*		
33.50-35.20	68 N/A N/A		Flush: 33.50-35.20 water, 99 %		

Strata

Description (Continued from Sheet 6)		Depth	*Level*	(Thickness)
ASSUMED ZONE OF CORE LOSS	30.30-31.30 m 88.4mm diameter self boring pressuremeter test pocket.	31.19	*-28.43*	(1.62)
Recovered as very soft shelly CLAY. Shells and shell fragments up to 20 mm x 10 mm. (LAMBETH GROUP - POSSIBLE LOWER SHELLY BEDS)	31.44 m MID LAMBETH HIATUS	31.44	*-28.68*	
Very strong light grey CALCRETE recovered as subrounded to subangular fine to coarse gravel. (LAMBETH GROUP - LOWER MOTTLED BEDS)	31.88-31.98 m 1no. subrounded cobble of calcrete.	31.69	*-28.93*	
Very stiff blueish grey mottled brown and rarely red sandy CLAY. Sand is fine to medium. Occasional pockets (up to 20 mm x 20 mm) of white calcrete. (LAMBETH GROUP - LOWER MOTTLED BEDS)		32.36	*-29.60*	(0.67)
Very stiff blueish grey mottled brown and rarely red very sandy CLAY. Sand is fine to medium. (LAMBETH GROUP - LOWER MOTTLED BEDS)	32.42-32.71 m Clayey fine to medium sand.	33.48	*-30.72*	(1.12)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	33.50-34.50 m 88.4mm diameter self boring pressuremeter test pocket.	34.05	*-31.29*	(0.57)
Dark blueish green mottled brown and rarely red very clayey to clayey fine to medium SAND. (LAMBETH GROUP - LOWER MOTTLED BEDS)				



Stratum continues to 36.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
30.80		SBP test.
34.00		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:32 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 7 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 02/03/2011 **End** 05/04/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.	**Ground Level** +2.76 mOD **Coordinates** E 539868.52 **National Grid** N 180300.77 **Chainage**

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
35.07-35.17			D 116		
		NA NA NA	35.17-35.20 m 0.03m CRF		
35.58-35.88			CS 117		
35.20-36.40	100 N/A N/A		Flush: 35.20-36.40 water, 99 %		
35.88-35.98			D 118		
				30/03/2011 36.40	1700
				31/03/2011 36.40	0700
		NR NR NR	*		
36.40-38.20	43 N/A N/A		Flush: 36.40-38.20 water, 99 %		
37.40-37.70 37.40			SPT S 50 (6,10/18,32) D 41		
			If NA/NA/NA		
			37.87-38.20 m 0.33m CRF		
38.05-38.15		NA NA NA	D 119		
38.20-39.40	100 N/A N/A		Flush: 38.20-39.40 water, 99 %		
38.86-39.16		NA NA NA	CS 120		
39.16-39.26			D 121		
		NR NR NR	*		

Strata

Description (Continued from Sheet 7)		Depth, *Level*	(Thickness)
Dark blueish green mottled brown and rarely red very clayey to clayey fine to medium SAND. (LAMBETH GROUP - LOWER MOTTLED BEDS)		36.40 *-33.64*	(2.35)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	36.40-37.40 m 88.4mm diameter self boring pressuremeter test pocket.	37.43 *-34.67*	(1.03)
Very dense green slightly clayey slightly sandy rounded fine to coarse GRAVEL of brownish black and red flint. (LAMBETH GROUP - LOWER MOTTLED BEDS)	37.67-37.87 m Occasional brown mottling.	37.67 *-34.91*	
Mottled blue and green clayey fine to medium slightly glauconitic SAND. Rare rounded to subrounded, fine to coarse gravel of brown flint. (LAMBETH GROUP - LOWER MOTTLED BEDS)	38.17 m 2no. shell fragments (up to 10 mm x 8 mm).	38.58 *-35.82*	(0.91)
Grey mottled greenish grey clayey fine to medium glauconitic SAND. Rare to occasional pockets (up to 10 mm x 5 mm) of grey clay. (LAMBETH GROUP - LOWER MOTTLED BEDS)		39.40 *-36.64*	(0.82)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	39.40-40.40 m 88.4mm diameter self boring pressuremeter test pocket.		(0.89)

Stratum continues to 40.29 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
36.90		SBP test.
39.90		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:34 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 8 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	02/03/2011
End	05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
39.40-41.20	51 N/A N/A		Flush: 39.40-41.20 water, 99 %		
40.40-40.68 40.40			SPT S 50 (10,14/19,31 for 50mm) D 42		
40.78-41.08			CS 122		
41.08-41.20		NA NA NA	D 123		
41.66-41.96			CS 124		
41.20-42.40	72 N/A N/A		Flush: 41.20-42.40 water, 99 %		
41.96-42.06			D 125		
				31/03/2011 42.40	1700
				01/04/2011 42.40	0800
		NA NA NA	*		
42.40-44.20	57 N/A N/A		Flush: 42.40-44.20 water, 99 %		
43.40-43.59 43.40			SPT S 50 (17,8/50 for 35mm) D 43		
43.80-44.10			CS 126		
44.10-44.20			D 127		
		NA NA NA			
44.20-45.40 44.85-45.15	98 N/A N/A		Flush: 44.20-45.40 water, 99 % CS 128		

Strata

Description (Continued from Sheet 8)	Depth, *Level* (Thickness)
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET	40.29 *-37.53*
Very dense dark grey very clayey fine to medium glauconitic SAND. Rare shell fragments (up to 15 mm x 5 mm). Rare rounded fine to medium gravel of black flint. Occasional pockets (up to 25 mm x 5 mm) of grey clay. (LAMBETH GROUP - UPNOR FORMATION)	(1.77) 42.06 *-39.30*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET 42.40-43.40 m 88.4mm diameter self boring pressuremeter test pocket.	(1.12) 43.18 *-40.42*
Very dense grey to brownish grey slightly clayey fine to medium SAND. Rare wispy black mottling. (THANET SAND FORMATION) 44.20-44.23 m AZCL	(2.22)

Stratum continues to 45.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
42.90		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:36 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 9 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE **Logged** CT/JC **Checked** SV	**Start** 02/03/2011 **End** 05/04/2011	**Equipment, Methods and Remarks** Dando 175 / Beretta T51 / Magnetometer CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.					**Ground Level** +2.76 mOD **Coordinates** E 539868.52 **National Grid** N 180300.77 **Chainage**

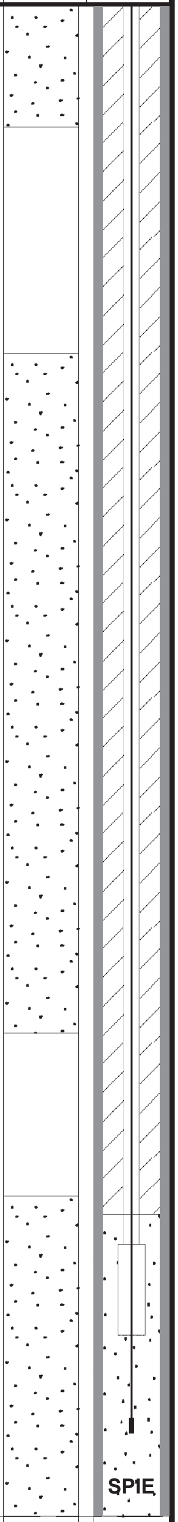
Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
45.15-45.25			D 129		
		NA NA NA	*		
45.40-47.20	58 N/A N/A		Flush: 45.40-47.20 water, 99 %		
46.40-46.55			SPT S 50 (15,10 for 25mm/ 50 for 50mm)		
46.40			D 44		
46.75-47.05			CS 130		
47.05-47.20			D 131		
		NA NA NA			
47.65-48.00			CS 132		
47.20-48.40	76 N/A N/A		Flush: 47.20-48.40 water, 99 %		
				01/04/2011	1700
48.30-48.40			D 133	48.40	
				02/04/2011	0700
				48.40	
		NA NA NA	*		
48.40-50.20	79 N/A N/A		Flush: 48.40-50.20 water, 99 %		
49.40-49.55			SPT S 50 (12,13 for 30mm/ 50 for 45mm)		
49.40			D 45		
49.48-49.78			CS 134		
49.78-49.90			D 135		

Strata

Description (Continued from Sheet 9)	Depth, *Level* (Thickness)
Very dense grey to brownish grey slightly clayey fine to medium SAND. Rare wispy black mottling. (THANET SAND FORMATION)	45.40 *-42.64*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET 45.40-46.40 m 88.4mm diameter self boring pressuremeter test pocket.	(0.75) 46.15 *-43.39*
Very dense grey slightly silty fine to medium SAND. Rare to occasional black wispy mottling. (THANET SAND FORMATION) 47.20-47.33 m AZCL	(2.25) 48.40 *-45.64*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET 48.40-49.40 m 88.4mm diameter self boring pressuremeter test pocket.	(0.54) 48.94 *-46.18*
Very dense grey slightly silty fine to medium SAND. Rare to occasional black wispy mottling. (THANET SAND FORMATION)	



Stratum continues to 51.40 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
45.90		SBP test.
48.90		SBP test.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:38 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 10 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV
Start	02/03/2011
End	05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
50.61-50.91			CS 136		
50.20-51.40	100 N/A N/A		Flush: 50.20-51.40 water, 99 %		
50.91-51.01			D 137		
		NA NA NA			
				02/04/2011 51.40	1700
				03/04/2011 51.40	0800
52.00-52.23 52.00			SPT S 50 (15,10 for 50mm/ 24,26 for 25mm) D 46		
51.40-53.20	67 N/A N/A		Flush: 51.40-53.20 water, 99 %		
52.50-52.80			CS 138		
52.80-52.90			D 139		
		380 380 380			
53.20-54.70	25 25 25		Flush: 53.20-54.70 water, 99 %		
		NA NA NA			
54.70-55.11 54.70			SPT S 49 (5,8/10,13,15,11 for 35mm) D 47		

Strata

Description (Continued from Sheet 10)	Depth, *Level* (Thickness)
Very dense grey slightly silty fine to medium SAND. Rare to occasional black wispy mottling. (THANET SAND FORMATION)	(2.46) 51.40 *-48.64*
ASSUMED ZONE OF CORE LOSS DUE TO SELF BORING PRESSUREMETER TEST POCKET 51.40-52.00 m 88.4mm diameter self boring pressuremeter test pocket.	(0.60) 52.00 *-49.24*
Very dense grey silty fine to medium SAND. Rare black wispy mottling. (THANET SAND FORMATION) 52.34-53.07 m Rare fine to medium gravel of flint and lignite.	(1.07) 53.07 *-50.31*
Grey clayey sandy GRAVEL. Gravel is angular to subangular fine to coarse of flint. Sand is fine to medium. Frequent pyrite nodules (up to 2 mm x 2 mm). 1no. cobble of flint. (BULLHEAD BEDS - THANET SAND FORMATION) 53.50-53.58 m Frequent flints (up to 65 mm x 35 mm x 30 mm).	53.20 *-50.44* (0.38) 53.58 *-50.82*
Weak medium density white CHALK. No fractures observed. (WHITE CHALK SUBGROUP - CIRIA GRADE B1)	
ASSUMED ZONE OF CORE LOSS Driller notes: Core loss due to flint jammed in core barrel.	(1.12) 54.70 *-51.94*
Weak medium density white CHALK. Fractures are widley spaced (70/780/1090), rarely closed and 54.70-55.05 m Recovered as silt of chalk damage due to SPT.	

Stratum continues to 61.07 m

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)	
52.00		Unable to drill beyond with SBP due to ground conditions.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:39 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 11 of 13

Borehole Log

Soil Mechanics

Drilled	PW/NE
Logged	CT/JC
Checked	SV

Start 02/03/2011
End 05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level	+2.76 mOD
Coordinates	E 539868.52
National Grid	N 180300.77
Chainage	

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
55.10-55.43			CS 140		
54.70-56.20	73 73 73		Flush: 54.70-56.20 water, 99 %		
56.55-56.88			CS 141		
56.20-57.70	80 80 75		Flush: 56.20-57.70 water, 99 %		
				03/04/2011 57.70	1530
57.70-58.06 57.70		70 780 1090	57.64-57.70 m 0.06m CRF SPT S 50 (8,10/15,20,15 for 60mm) D 48		
				04/04/2011 57.70	0700
57.70-59.20	100 100 100		Flush: 57.70-59.20 water, 99 %		
58.56-58.87			CS 142		
59.94-60.25			CS 143		
59.20-60.70	100 100 100		Flush: 59.20-60.70 water, 99 %		

Strata

Description
(Continued from Sheet 11)

infilled (0/<1/<1) with chalk silt with occasional pockets (up to 60 mm x 30 mm) of light grey wispy marl. (WHITE CHALK SUBGROUP - CIRIA GRADE B1)

55.05-55.10 m Occasional flints (up to 85 mm x 65 mm x 35 mm).

55.35-55.79 m Occasional flints (up to 80 mm x 40 mm x 30 mm).

55.60 m 1no. shell fragment (10 mm x 10 mm).

55.80-56.20 m AZCL

56.20-57.29 m Occasional shell fragments (up to 40 mm x 25 mm).

56.88-57.03 m Frequent flints (up to 85 mm x 75 mm x 65 mm) with associated core damage.

57.34-57.64 m AZCL

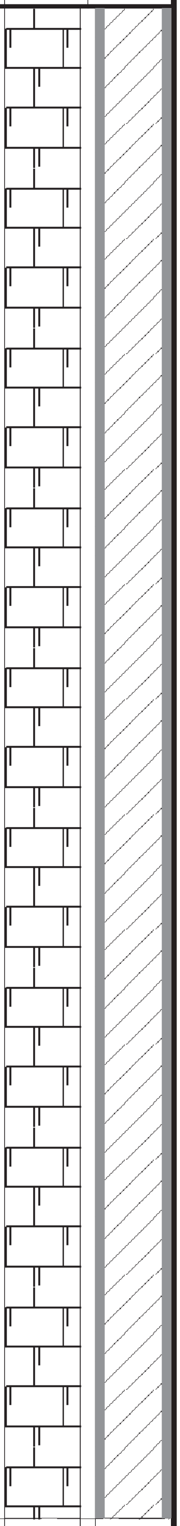
58.22-58.30 m Flints (up to 65 mm x 45 mm x 40 mm) with associated core damage.

58.90-58.97 m Frequent flints (up to 60 mm x 60 mm x 50 mm) with associated core damage.
58.98-59.00 m Frequent pockets (up to 10 mm x 5 mm) of grey clay.

59.54 m 2no. shell fragments (up to 5 mm x 5 mm).
59.64-59.68 m 1no. flint (30 mm x 40 mm x 70mm).

Stratum continues to 61.07 m

Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
(6.37)		



Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)

Depth Related Remarks *

From	to (m)

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:41 AGS

Project	**Cable Car for London - Ground Investigation**
Project No.	**D1002-11**
Carried out for	**Transport for London**

Borehole

NT BH01

Sheet 12 of 13

Borehole Log

Soil Mechanics

Drilled PW/NE
Logged CT/JC
Checked SV

Start 02/03/2011
End 05/04/2011

Equipment, Methods and Remarks
Dando 175 / Beretta T51 / Magnetometer
CAT scanned for services. Concrete cored from GL to 0.38m depth. Hand dug inspection pit from 0.38m to 1.20m depth. Cable percussive boring from 1.20m to 12.10m depth. Rotary cored drilling using wireline techniques from 12.10m to 60.70m depth. SPT from 60.70m to 61.07m depth.

Depth from	to	Diameter	Casing Depth
0.00m	10.20m	250mm	10.20m
10.20m	12.10m	200mm	11.95m
12.10m	60.70m	146mm	60.70m

Ground Level +2.76 mOD
Coordinates E 539868.52
National Grid N 180300.77
Chainage

Samples and Tests

Depth	TCR SCR RQD	If	Records/Samples	Date Casing	Time Water
60.70-61.07			SPT S 50 (8,12/12,15,23 for 65mm)		
60.70			D 49		
				04/04/2011	1700
				60.70	

Strata

Description (Continued from Sheet 12)	Depth,*Level* (Thickness)	Legend	Backfill/ Instruments
Weak medium density white CHALK. Fractures are widley spaced (70/780/1090), rarely closed and infilled (0/<1/<1) with chalk silt with occasional pockets (up to 60 mm x 30 mm) of light grey wispy marl. (WHITE CHALK SUBGROUP - CIRIA GRADE B1) 60.25-60.38 m Frequent marl and pockets (up to 30 mm x 20 mm) of grey clay.	61.07 *-58.31*		
EXPLORATORY HOLE ENDS AT 61.07 m			

Groundwater Entries
No. **Struck (m)** **Post strike behaviour** **Depth sealed (m)**

Depth Related Remarks *
From **to (m)**

Chiselling
Depths (m) **Time** **Tools used**

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:25

NT BH01
408.24 22/06/2011 12:15:42 AGS

Project Cable Car for London - Ground Investigation
Project No. D1002-11
Carried out for Transport for London

Borehole
NT BH01
Sheet 13 of 13

PID Readings

Hole ID	Hole Depth (mBGL)	PID Reading (ppm)	Remarks
NT BH01	9.00	0.40	
NT BH01	10.00	0.10	
NT BH01	10.45	0.00	
NT BH01	10.70	0.80	
NT BH01	11.20	0.00	

Notes:

AGS

Project Cable Car for London - Ground Investigation

Project No. D1002-11

Carried out for Transport for London

Table

NT BH01

Mark Marshall
Atkins Limited
Woodcote Grove
Epsom
KT18 5BW

Email: Mark.Marshall@atkinsglobal.com
Telephone: 01372 75 6708

Appendix G. Construction Noise and Vibration Mitigation Scheme

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Construction Noise and Vibration Mitigation Scheme

April 2017

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

Table of Contents

List of Abbreviations

The following abbreviations are created:

Abbreviation	Definition
The Contractor	Transport for London

Definitions

The following terms are used within this document:

Term	Definition
A-weighted	Is the A-weighted level, expressed as “dB(A)”, allows for the frequency dependent characteristics of human hearing. Corrections are applied for each octave frequency band, and the resultant values summed, to obtain a single overall level.
Best Practicable Means	This means that every practicable mitigation has been applied to reduce noise and vibration produced by the Works to as low a level as reasonably practicable. Best Practicable Means (BPM) is defined under Section 72 of the Control of Pollution Act 1974 as those measures which are ‘reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to financial implications’
Claimant	Means an owner or occupier of an eligible building who accepts an offer made under this Construction Noise and Vibration Mitigation Scheme.
Construction	Includes demolition, excavation, and tunnelling
Contiguous façade	Means a façade of a building that is horizontally separated from other facades by a stairwell, corner or some other discontinuity.
Contractor	The Contractor will be the construction entity through which the Project Company would deliver the design and construction of the Scheme and includes anyone who directly employs or engages construction workers or manages construction work, including sub-contractors, or any individual self-employed worker or business that carries out, manages or controls construction work.

Term	Definition
decibel (dB)	Is the ratio of sound pressures which we can hear – a ratio of 10^6 (one million: one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
eligible building	Dwelling lawfully used by Claimants for habitation within the limitations and subject to the exceptions set out in regulation 7 of the Regulations.
Eligible room	Means a living room or a bedroom having a qualifying door or a qualifying window in an eligible building.
Equivalent continuous sound pressure level (L_{eq})	Another index for assessing overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level. The A-weighted L_{eq} is denoted as L_{Aeq}.
Façade	Means an outer wall of a building.
Insulation work	Means work carried out to insulate an eligible room against noise which will include provision of adequate ventilation and may include blinds.
Pre-existing ambient noise	Means the level of ambient noise, expressed as a level of L_{Aeq} determined with respect to the relevant time period and the relevant L_{Aeq} averaging time, prevailing one metre in front of relevant windows or doors in a façade of a dwelling, immediately before commencing any works which could affect the prevailing noise climate.
Qualifying door	Means an external door opening directly into an eligible room which is in that part of the façade in respect of which the relevant noise level satisfies the requirements of Appendix A of this document or meets the criteria for a contiguous façade as set out in Appendix B.
Qualifying window	Means a window in an eligible room which is in that part of the façade in respect of which the relevant noise level satisfies the requirements of Appendix A of this document or meets the criteria for a contiguous façade as set out in Appendix B.
The Noise Insulation Package	Means the package of works set out in part 3 of this document.
The Regulations	Means the Noise Insulation Regulations 1975.

Term	Definition
The relevant specifications	Means the items in Part I of Schedule 1 to the Regulations except where they are amended by the provisions of this document, such of the items in Part II of Schedule 1 to the Regulations as may be approved by The Contractor and such of the specifications set out in Part III of Schedule 1 to the Regulations as are applicable in the circumstances of the case or items whose performance is equivalent thereto.
Section 61 agreement	Prior agreement from a council - under Section 61 of the Control of Pollution Act 1974 - for construction works where Best Practicable Means has been demonstrated to be applied.
The Works	The construction activities required for the construction of the Scheme.

1 Introduction

1.1.1 The Contractor will seek to control the effects of construction noise and vibration arising from the Scheme using the Best Practicable Means (BPM) mitigation measures secured in the Noise and Vibration Management Plan. Nevertheless, there may be circumstances in which noise impacts arise that will need to be mitigated still further. In certain circumstances, explained below, the Contractor will offer to either provide and install free of charge, or provide grant aid for a claimant to install, noise insulation. In certain cases where the level of noise created by construction activity is predicted to exceed the qualifying criteria outlined within this document the Contractor will contact potential Claimants to offer to arrange temporary rehousing, or help Claimants to arrange it for themselves and recoup the costs from the Contractor.

1.1.2 The Contractor has adopted a set of noise and vibration thresholds in relation to the provision of noise insulation and, if appropriate, temporary rehousing. These thresholds follow the precedents established by recent and similar major transport schemes.

1.1.3 The purpose of this document is to explain both how the noise insulation and temporary rehousing schemes work, and what Claimants should do next if they think that they may be eligible for either scheme.

2 Eligibility

2.1.1 Construction noise insulation and temporary rehousing arrangements apply to dwellings and other buildings lawfully used for residential purposes.

2.1.2 To be eligible a Claimant must own or occupy a private dwelling and the dwelling must be one in which the predicted or actual construction noise exceeds the relevant ‘noise trigger level’ (as shown in Appendix A) for one or more of the following:

- a period of 10 or more days of working in any 15 consecutive days;
- a period of 3 or more nights of working in any 7 consecutive nights; or
- for a total of 40 days or more in any 6 consecutive months.

2.1.3 The rooms to which this scheme applies, eligible rooms, are defined as living rooms or bedrooms having a qualifying door or a qualifying window in any eligible building. .

2.1.4 Eligibility for the scheme depends on the predicted noise level following the construction noise assessment that will be carried out for that purpose once detailed construction plans are in place,. If those noise predictions indicate that a property is eligible, the offer of noise insulation will be made by the Contractor and, if accepted and all necessary approvals obtained, the insulation installed before the Works (with the potential to exceed the noise trigger levels) commence. Full details of the noise trigger levels, for both noise insulation and temporary rehousing are set out in Appendix A.

2.1.5 Some buildings and/or their occupants will be treated as special cases, and will therefore be considered on a case by case basis. These include:

- Night workers;
- those needing a particularly quiet home environment to work in, or
- those that have a medical condition which will be seriously aggravated by construction noise,.

3 The Noise Insulation Package

3.1.1 The package will consist of:

- Secondary glazing or thermal double glazing (see also sections 5.1, 5.2 and 5.5) for living room and bedroom windows on eligible facades, plus additional ventilation if required under the relevant specifications.
- Blinds, for south facing windows (windows in an aspect falling anywhere within a 270 degrees arc between the bearings of 45 degrees and 315 degrees from true north).
- Acoustic insulation treatment for external doors on eligible facades.

3.1.2 Depending on the type of window already existent at an eligible building, secondary glazing will usually comprise another pane of glass in its own frame (wood, metal or plastic) 100-200 mm inside the existing window. This can be opened for cleaning or ventilation.

3.1.3 Secondary glazing works best when closed – so additional ventilation is usually required. The package includes an electric ventilator fan in a slim metal cover, fitted inside the room in question, to an outside wall (a 75-100 mm hole is drilled through the wall, through which the fan draws in air from the outside). Such ventilation shall comply with the specification required by the Regulations.

3.1.4 On a south facing window secondary glazing may make the room too hot. As set out under the relevant specifications, subject to the agreement of the claimant, blinds will be fitted between the main window and the secondary glazing to minimise this effect. If the Claimant chooses not to accept blinds as part of the noise insulation package the possible impacts of this will be explained to them, blinds will not be retrofitted post installation of the noise insulation package should the claimant change their mind at a later date.

3.1.5 The Contractor may be able to install a “secondary” door to improve noise insulation. If the design of a Claimant's property prevents this, other methods can be used, such as sealing strip between the existing door and its frame.

3.1.6 There may be circumstances in which it is not possible to fit secondary glazing. Such cases will be considered on a case by case basis. Where eligibility is confirmed, appropriate mitigation measures will be adopted. The sorts of measures that will be considered include works management methods (e.g. adopting quiet times, rescheduling works, and imposing noise limits), or temporary rehousing even if the Temporary Rehousing thresholds (as set out below) are not exceeded.

3.1.7 Thermal double glazing can be provided instead of secondary glazing only if it is specifically requested by the Claimant. The Claimant will be made aware of the potential shortfall in sound insulation performance of the thermal double glazing compared to the secondary glazing.

3.1.8 There will be no obligation to repair, maintain or make any payments in respect of repairing or maintaining any equipment or apparatus installed under the application of this document or to pay for the running costs, which will be minimal for mechanical ventilation units. Notwithstanding this, should equipment such as the ventilation units fail after installation of the noise insulation package through no fault of the Claimant, and this occurs during the Works, the failed apparatus will be repaired or replaced as necessary.

3.1.9 If a Claimant is an occupier but not the owner of the property, it is the occupier’s responsibility to obtain the owner’s (landlord or freeholder) consent to install the Noise Insulation Package and demonstrate this to the Contractor.

3.1.10 If the occupier or owner (landlord or freeholder) of the private dwelling refuses the Noise Insulation Package or does not provide adequate access, temporary rehousing will not be offered, unless the Temporary Rehousing thresholds are exceeded.

4 Delivery of the Noise Insulation Package

4.1.1 Once the Contractor has conducted the assessment set out in paragraph 2.1.4 above and the details of the insulation for a property are agreed with a Claimant, the Contractor will either offer to deliver the Noise Insulation Package at its expense, or offer grant aid for the Claimant to carry it out.

4.1.2 The Contractor will ask Claimants to ensure that they provide adequate access for the survey and installation (as detailed in paragraph 4.1.8 below); and if they should incur expense in arranging access, the Contractor will reimburse them provided it has agreed the amount before the cost is incurred.

4.1.3 In the cases where the Contractor offer Claimants a grant so that they can undertake the noise insulation work themselves, the grant would be made on the following conditions:

i. 3 independent written quotations being obtained by the Claimant.

ii. The work must comply with the relevant specifications.

iii. the quote that represents the cheapest price for complying with point ii must be chosen.

iv. The amount of the grant will be for whichever is the lesser amount of the selected quote, or the actual cost of the installation.

v. The Contractor may pay 10% of the estimated cost in advance, and the balance when the work is satisfactorily completed.

vi. The work must be completed within 12 months of any advance payment, or before completion of the construction works for which insulation is needed, whichever is the earlier. If this condition is not complied with, no further grant will be paid, and any payments already made will have to be repaid to the Contractor or its agent.

vii. the consent of any other person or body that may be required to permit the carrying out of insulation work (e.g. a landlord or local authority) must be obtained prior to the work taking place.

- The amount of the grant payable for the installation of thermal double glazing will be no more than the cost of installing the secondary glazing package specified in this document. If the Claimant arranges for the work to be carried out themselves, the amount paid in reimbursement will be for no more than the cost that would have been incurred if the secondary glazing package specified in this document had been installed.

4.1.4 The Noise Insulation Package will not be able to be used for work needed to remedy existing building defects.

4.1.5 The Noise Insulation Package will cover the making good of the existing fabric and decoration (not including curtains) after the installation of secondary glazing, ventilation equipment, and second doors, including the adaptation of any existing pelmet and curtain rack.

4.1.6 A decision to accept an offer of a Noise Insulation Package must be made no later than 6 months after the date it is made in writing to a Claimant or one month before the Contractor intends to install the other noise insulation at eligible properties affected by the same construction works, whichever is the sooner. In the latter case, Claimants will receive notice of the cut-off date for acceptance at the time the offer is made or shortly thereafter. If a Claimant does not respond within the time-frame due to circumstances beyond their control, the Contractor will give due consideration to their case but the Works will continue as programmed. If a Claimant chooses not to accept the offer of a Noise Insulation Package there is no scope for a Claimant to change their mind at a later date. However, if the noise levels change during the course of the works such the Claimant would be eligible for noise insulation/temporary rehousing, then the process set out in paragraphs 7.1.3 to 7.1.8 will apply.

4.1.7 If upon determining that a property would be eligible for the Noise Insulation Package, it is discovered that a Claimant's property has already had insulation work carried out or a grant for such work in respect of another public works scheme (such as a road or earlier railway works) or privately, the Claimant's property will not be eligible for further work or grant under this scheme unless the existing noise insulation is not in a state adequate to attenuate the construction noise for the Scheme. If it is not, the Works will be carried out or a grant made to have them carried out to bring the installed noise insulation package up to the appropriate standard.

4.1.8 The carrying out of insulation work and the making of grants shall be dependent upon compliance with the following conditions;

(a) a Claimant who accepts an offer to carry out insulation work shall;

(i) if he is the occupier of or entitled to occupy the building, afford to the Contractor such access to the building as it may reasonably require for the purpose of carrying out and inspecting the work to ascertain whether it complies with the relevant specifications; or

(ii) if he is not the occupier of nor entitled to occupy the building, procure the occupier or person entitled to occupy the building to afford the Contractor such access;

(b) a Claimant who accepts an offer to make a grant in respect of the cost of the noise insulation work shall carry out the work or secure that it is carried out in accordance with the relevant specifications and complete it before the expiration of 24 months from the date of acceptance and;

(i) if he is the occupier of or entitled to occupy the building, afford to the Contractor such access to the building as it may reasonably require for the purpose of inspecting the work to ascertain whether it complies with the relevant specifications; or

(ii) if he is not the occupier of nor entitled to occupy the building, procure the occupier or person entitled to occupy the building to afford the Contractor such access

i.

5 The Temporary Rehousing Package

5.1.1 If, following the assessment that will be carried out for that purpose once detailed construction plans are in place, the predicted construction noise level exceeds the trigger level for temporary rehousing as set out in Appendix A, the Contractor will notify Claimants that they are eligible for alternative temporary accommodation. There are two options:

Option A: The Contractor to arrange temporary alternative accommodation to meet the Claimant's agreed needs.

Option B: The Contractor to provide information and guidance to help the Claimant arrange temporary alternative accommodation

5.1.2 The acceptance of any offer of temporary rehousing is discretionary.

5.1.3 If the Claimant chooses Option A, the services provided by the Contractor will include arranging for:

- Temporary alternative accommodation (which, where appropriate, could be a local hotel or guest house).
- Relocation of personal effects.
- Storage and insurance of personal effects.
- Insurance for the vacated property.
- Where appropriate for pets to go into kennels, catteries etc.
- Where appropriate the disconnection and later reconnection of gas, water, electricity etc.

5.1.4 If a Claimant chooses Option B then, instead of actually identifying the alternative accommodation and making the arrangements for them, the Contractor will supply the Claimant with information and guidance on all the matters listed above, to enable them to make the arrangements themselves; and the Contractor will also help the Claimant ensure that the costs the Claimant incurs can be agreed and paid to them as soon as practicable.

5.1.5 Whether Option A or Option B is chosen, the Contractor will bear (or reimburse) the reasonable costs associated with temporary rehousing together with the continuing, unavoidable costs of the Claimant maintaining their own house whilst they are away. However, these will be paid less the costs that the Claimant would have paid if they had stayed in their own house over the same period.

5.1.6 The type of rehousing offered will depend on the duration of the relocation. For short durations hotel accommodation may be appropriate. For longer periods, alternative rented accommodation would be more suitable. In all cases account will be taken of a Claimant's existing accommodation as far as possible.

5.1.7 The offer of temporary accommodation will be in addition to a Claimant's current home. As such, they will still be responsible for the rent, bills and other outgoings at their current home and will still be a tenant there.

5.1.8 If a Claimant's tenancy agreement expires during the relocation it should be renewed with the landlord in the normal way. If a Claimant chooses not to renew their tenancy, the grant to meet the cost of the alternative accommodation will cease when the tenancy expires.

6 Temporary Rehousing and Noise Insulation

6.1.1 The noise generated by the Works will vary over the course of the Works. In some areas, the noise may mean that a eligible building qualifies for temporary rehousing for one period, and noise insulation only for a different period. In these circumstances a Claimant would receive a temporary rehousing offer for one period and a noise insulation offer for the other period. In other areas, a Claimant's property may qualify for temporary rehousing for a given period, but outside that period the noise may not trigger a separate noise insulation offer. In such a case, a temporary rehousing offer only would be made and noise insulation would not be offered.

6.1.2 If a Claimant's property qualifies for temporary rehousing but not noise insulation, a Claimant does not have to accept the offer of rehousing and may request noise insulation instead. In such cases, a Claimant will be made aware of any shortfall in sound insulation performance of the noise insulation in relation to the thresholds presented in Appendix A and that the degree of disturbance could be high even with the noise insulation in place. If a Claimant chooses to adopt this approach and noise insulation is provided, they will not be able to later request temporary rehousing. .

7 Procedure for noise insulation and temporary rehousing

7.1.1 The procedure comprises 7 steps.

i. The Contractor will carry out a construction noise assessment based on the final construction plans, so as to predict what the noise levels will be and will discuss and agree the findings with the relevant local authority, as part of the Noise and Vibration Management Plan required by the CoCP.

ii. The Contractor will then notify owners or occupiers of buildings which, on the basis of the assessment, the Contractor considers qualify, and accordingly which type of assistance (noise insulation or temporary rehousing) they are eligible for. The Contractor will also send an application form at this stage.

iii. The notice and application form, should be completed and returned to the Contractor or its agent. The Contractor will then assess the application and if acceptable notify the Claimant in writing.

iv. The Contractor will then arrange to visit a Claimant in order to discuss the application ; view the property and in the case of noise insulation take any necessary measurements; and identify any special issues or requirements (such as any other approvals that may be required in the case of noise insulation).

v. The Contractor will then assess the Claimant's case in detail and, if it is accepted, notify them of:

- any further survey likely to be needed at the Claimant's property, and (in insulation cases) the work the Contractor thinks should be done and its offer to do it; or
- (in rehousing cases) either its proposals to re-house the Claimant temporarily or the information and guidance the Claimant needs to make its own rehousing arrangements. In either case the proposals will be discussed with the Claimant and the Claimant will not be under any obligation to accept the offer.

vi. Assuming the Claimant agrees, the noise insulation package or temporary rehousing plan (as the case may be) is then put into effect.

vii. The Contractor reimburses the Claimant for any agreed costs, which they have incurred or (in grant cases) pays the balance of the grant. Alternatively, the Contractor pays for noise insulation or removal/rehousing costs where it or its agent has done the work. A noise insulation package will not be offered if the noise trigger level is only exceeded whilst the Claimant is in temporary alternative accommodation (however see section 7.6 above).

7.1.2 Further technical information describing the process for predicting eligibility, particularly in relation to cut-off points on long facades such as terraced housing, is presented in Appendix B.

Claims after the start of construction

7.1.3 The trigger levels for eligibility for noise insulation/temporary rehousing involve both noise levels and durations (temporal criteria). There are two possible cases that may arise:

i. The predictions do not identify that noise insulation/temporary rehousing thresholds will be exceeded, but in practice they are and this is expected to continue for a period of time sufficient to exceed the temporal criteria.

ii. The predictions identify that the noise insulation/temporary rehousing thresholds will be exceeded but will not carry on for a sufficient duration to trigger the temporal criteria. However, in practice the works go on for longer and the temporal criteria are triggered.

In both cases the approach will essentially be the same.

7.1.4 If a person claims, after the start of construction work, that the noise levels actually experienced are such as to cause eligibility for noise insulation/temporary rehousing where none was predicted, or that received noise levels are sufficient for eligibility for noise insulation/temporary rehousing where this was predicted, and that the noise has continued, or seems to them likely to continue for longer than the temporal triggers where that had not been predicted, the claim will be considered by the Contractor according to the following process.

7.1.5 A claim after the start of construction will inevitably take the form of a complaint or formal representation to the nominated undertaker. On receipt of the claim, The Contractor will review the works being undertaken that have generated the claim and assess whether it is likely that the claim is valid. Where the Contractor considers there is a potentially valid claim short-term site monitoring will be undertaken to identify whether the noise insulation/temporary rehousing trigger levels are indeed being exceeded. Whether or not monitoring is undertaken the Contractor will discuss the results of the review with the claimant and explain the findings and any actions that have been taken.

7.1.6 At the same time, the Contractor will inform the local authority that approved the Noise and Vibration Management Plan about the claim and what actions are being taken to address it.

7.1.7 If the short-term noise monitoring identifies that the noise insulation/temporary rehousing thresholds are being exceeded, but that operations are being performed in accordance with the terms of the Noise and Vibration Management Plan, the Contractor will identify whether the activities causing those levels will carry on for longer than a period of 10 or more days of working in any 15 consecutive days or for 3 or more nights of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months. If they are not, then no further action is required. The findings will be made known to the local authority who approved the Noise and Vibration Management Plan and discussed with them.

7.1.8 If the works causing noise levels above the noise insulation/temporary rehousing thresholds are projected to go on for longer than a period of 10 or more days of working in any 15 consecutive days or for 3 or more nights of working in any 7 consecutive nights or for a total of days exceeding 40 in any six consecutive months, but the construction works are being carried out in accordance within the terms of Noise and Vibration Management Plan, then the Contractor will require action to be taken to reduce the level of noise being caused, or offer noise insulation and/or temporary rehousing to the affected property as appropriate. Works will not cease during the organisation and installation of the noise insulation. However, if appropriate, temporary rehousing will be offered to cover the period during which the noise insulation is installed. The temporary rehousing will be withdrawn:

- once the noise insulation is installed; or
- if the claimant unnecessarily delays obtaining any necessary consents in accordance with paragraph 4.1.3 (vii). If it is not possible to fit secondary glazing appropriate measures will be considered on a case by case basis (see paragraph 3.1.6).

If the complainant is not satisfied by the response of the Contractor following a claim under section 7.1.5 above, they may register a complaint in accordance with the project's complaints procedure (to be determined prior to the start of the main construction works).

8 Appendix A - Criteria for Eligibility for Noise Insulation or Temporary Re-housing

(To be read in conjunction with Section 2 above.)

8.1 Noise Insulation

8.1.1 A dwelling will be eligible where noise insulation does not already exist that is of a standard that will mitigate the impacts of the scheme as identified by the re-assessment of construction noise impacts; and the total noise level due to construction of the works (pre-existing ambient plus airborne construction noise), measured or predicted at a point one metre in front of the most exposed of any windows and doors in any façade of a building which is an eligible dwelling, exceeds whichever is the higher of either: a) any of the following criteria in Table 1:

Table 1: Noise Insulation Trigger Level Table Time	**Relevant Time Period**	**Averaging Time T**	**Noise Insulation Trigger Level dB LAeq, T**
Monday to Friday	07:00 – 08:00	1 hr	70
	08:00 – 18:00	10 hr	75
	18:00 – 19:00	1 hr	70
	19:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Saturday	07:00 – 08:00	1 hr	70
	08:00 – 13:00	5 hr	75
	13:00 – 14:00	1 hr	70
	14:00 – 22:00	3 hr	65
	22:00 – 07:00	1 hr	55
Sunday and Public Holidays	07:00 – 22:00	1 hr	65
	22:00 – 07:00	1 hr	55

or

(b) the pre-existing airborne noise level for the corresponding times of day (i.e. the Relevant Time Periods presented in column 2 of Table 1);

8.2 Temporary Rehousing

8.2.1 Occupiers of a dwelling will be eligible for re-housing where the total noise level due to construction of the works (pre-existing ambient plus airborne construction noise), measured or predicted at a point one metre in front of the most exposed of any windows and doors in any façade of an eligible dwelling, exceeds whichever is the higher of either (a) or (b) or if criteria (c) is met:

(a) 10 dB above any of the noise levels in Table 1 above or

(b) 10 dB above the pre-existing airborne noise level for the corresponding time of day (i.e. the Relevant Time Periods presented in column 2 of Table 1);

and in the case of both (a) and (b) this occurs for a period of 10 or more days of working in any 15 consecutive days or for a period of 3 or more nights (22:00-07:00) of working in any 7 consecutive nights or for a total number of days exceeding 40 in any six consecutive months.

8.3 Interpretation of the trigger levels

8.3.1 In interpreting and applying the trigger levels in Table 1, two conventions will be adopted. The first is that in interpreting the noise insulation/temporary rehousing policy where eligibility arises if noise levels in Table 1 are exceeded, a resolution of 0.1 dB will be applied. For example, a value of $L_{Aeq,T}$ of 55 dB (with pre-existing ambient at least 5 dB lower) will not trigger eligibility. A value of 55.1 dB will trigger eligibility.

8.3.2 The second convention relates to the choosing of minimum one-hour $L_{Aeq,T}$ levels at night to define the pre-existing ambient, given that a series of survey results often shows different minima over a series of nights. The approach will be to select a 7-day survey period during which favourable weather conditions existed (wind speed not more than 5,/s and no precipitation) and select the lowest one hourly value from that data set.

9 Appendix B - Eligibility Assessment

9.1 Introduction

9.1.1 As explained in the main body of this appendix , eligibility for noise mitigation arises under the Scheme when whichever is the higher of the following two requirements is met (i) the total predicted (or actual) noise level due to construction works (pre-existing ambient plus airborne construction noise) exceeds a trigger level or (ii) the margin between the construction noise level plus the pre-existing ambient and the pre-existing ambient is at least 5 dB and also (iii) the temporal requirements (10 out of 15 days of working etc) are met.

9.1.2 If the eligibility requirements were applied strictly this could lead to anomalies whereby some dwellings in a terrace might be included and not others or it might result in dividing the facades of apartment blocks into eligible and ineligible properties.

9.1.3 The procedure to be followed by the Contractor in implementing the Scheme so as to avoid dividing facades in a manner likely to be contentious for residents is set out below.

9.2 Procedure for Administering the Policy

9.2.1 While construction noise predictions made using a noise model such as SoundPlan can be presented using contours that will indicate a finite value for any location of interest, the same is not true of eligibility. The principal reason for this is that measured baseline noise levels are of necessity carried out at discrete locations. While interpolation between discrete values is possible in theory, it is in many circumstances impracticable.

9.2.2 The procedure will normally identify a single representative noise measurement location per façade, except for long facades. Sometimes a noise measurement location may serve as a surrogate for other comparable facades as well. Measurement locations should generally be towards the centre of the façade or façade section that they represent. The noise measurements from these locations may well be rounded.

9.2.3 The predicted noise including the contribution from the construction works will then be made for the worst affected window in the façade under consideration.

9.2.4 Whether a property is eligible for noise mitigation or not will then be determined using this predicted level. This determination will be applied to all the dwellings for which the measurement location was taken as representative.

9.2.5 In the case of a very long façade, it may be appropriate to utilise more than one noise measurement location. However, since measured values will vary slightly with quite small movements in position, a protocol needs to be established to avoid anomalous results as described above. The solution is to determine that more than one measurement location will be adopted for the same continuous facade only if the results from different noise measurement locations alongside the same façade differ by at least 3dB. For a façade at right-angles to a noise source such as a road or railway, this broadly means a doubling of distance from the source and would therefore normally only apply to long facades.

9.3 Protocol for Determining Eligibility

1) Establish baseline L_{Aeq} for relevant time of day for appropriate monitoring locations.

2) Assign monitoring results to facades according to the following rules:

a. Monitoring results to apply to whole façade where there is only one monitoring location for that façade. The monitoring location is to be as near as possible to the centre of the façade.

b. Monitoring results to apply to whole façade where another façade is used a surrogate.

c. Where more than one monitoring location exists for the same façade, only if the L_{Aeq} levels for any period differ by 3 dB or more shall the façade be divided, in which case façade areas around the location to be apportioned equally (i.e. as far as practicable each monitoring location to be in the centre of the area assigned to it).

d. The definition of a façade of a building is one that is horizontally separated from other facades by a stairwell, corner or some other discontinuity, as set out in section 2 of this document.

3) The predicted noise levels including construction noise to be utilised for the whole facade are those for the worst affected window/door in any façade.

Appendix H. Outline Ecology Management Plan

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SILVERTOWN TUNNEL

Outline Ecology Management Plan

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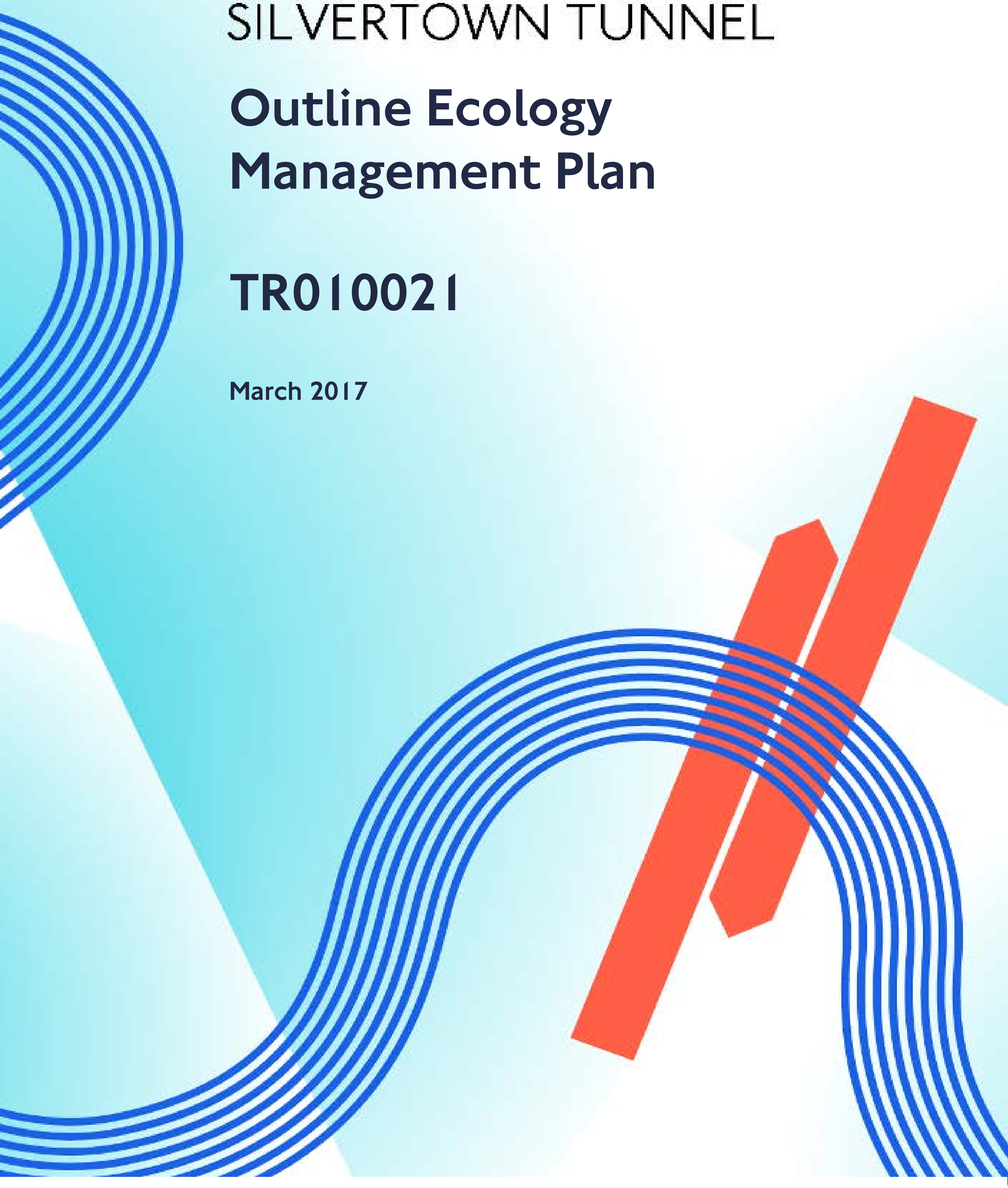

MAYOR OF LONDON

TRANSPORT
FOR LONDON
EVERY JOURNEY MATTERS

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Silvertown Tunnel

Outline Ecology Management Plan (OEMP)

Author: *Transport for London*

Rev.	Date	Approved By	Signature	Description
0	06/03/2017	David Rowe (TfL Lead Sponsor)	[redacted]	Outline Ecological Management Plan

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1. INTRODUCTION

1.1 Ecology Management Plan

1.1.1 This Outline Ecology Management Plan (OEMP) supports the application for a Development Consent Order (DCO) for the Silvertown Tunnel (“the Scheme”). It forms part of the Code of Construction Practice (CoCP) and sets out the broad ecological management measures which Transport for London (TfL) (the ‘Applicant’) will require the Contractor to adhere to and implement for the construction of the Scheme.

1.1.2 The detailed Ecology Management Plans (EMP) for each worksite will be developed by the Contractor to be in substantial accordance with this OEMP, but taking into account the detailed design and local ecological issues at each worksite (North and South). The detailed EMPs will also be prepared in consultation with Natural England (NE) and submitted for approval to the relevant planning authority north and south of the Scheme (London Borough of Newham and Royal Borough of Greenwich).

1.1.3 This OEMP, and the subsequent detailed EMPs, should be read in conjunction with Chapter 9 of the ES, Terrestrial Ecology (APP-031).

2. SUMMARY OF THE ECOLOGICAL BASELINE WITHIN THE ORDER LIMITS

2.1.1 The following ecological receptors have been identified as having the potential to be present and adversely affected within the worksites:

- Habitats including: plantation woodland, scrub, trees, grassland, tall ruderal vegetation, standing water, bare ground and ephemeral short perennial vegetation (some of which are components of brownfield habitat which is present on site). In addition, potential impacts from dust on East India Dock Basin Site of Interest for Nature Conservation (SINC) have been considered; and
- Species and species groups, specifically notable terrestrial invertebrates; breeding birds (including black redstart), and commuting and foraging bats.

2.1.2 Japanese Knotweed and other non-native invasive plant species are also known to be present within the worksites.

3. GENERAL SITE PRESCRIPTIONS – PRE AND DURING CONSTRUCTION

3.1 Introduction

3.1.1 Detailed method statements will be developed and implemented by the Contractor for mitigation where required as detailed in the detailed EMPs. For the purposes of this document, outline method statements have been provided for receptors.

3.2 Governance / Other Relevant Documentation

3.2.1 The Contractor will be required to follow general principles for good working practice and site operations as outlined in this document, the CoCP and any other supporting subsidiary plans required by the CoCP.

3.2.2 At the inception of the project, a suitably qualified ecologist (SQE) will brief the site team of the ecological restrictions on the site and inform the site team of any works which require supervision by SQE or are subject to a specific method statement.

3.3 Statutory Licenses

3.3.1 As agreed in the Statement of Common Ground (SoCG) with NE (REP3-009), there are no requirements for terrestrial protected species licenses based on the existing information provided in the ES (APP-031). However this position will be reviewed and updated as the detailed design progresses and the necessary licences obtained if required.

3.4 Pre-Construction Surveys

3.4.1 A pre-construction survey will be undertaken a maximum of two years prior to commencement of construction works by the Contractor. This should include an extended Phase 1 habitat survey followed by targeted surveys for protected species that may be using the worksites (if required). This could include (for example) updated reptile surveys should the status of any habitats present on site have changed. This will prevent impacts on mobile species in the unlikely event that new species move into the area and/or the status of the worksites change.

3.4.2 Non-native invasive species will also require updated mapping as they may have spread since the 2015 surveys (i.e. any occurrences of non-native invasive species listed on Schedule 9 of the WCA or listed on the London

Invasive Species Initiative). This also includes an updated tree survey to BS 5837:2012 (Trees in relation to design, demolition and construction) – Recommendations).

3.5 General Method of Working

3.5.1 This section includes generic best practice that will be implemented throughout the site, specific mitigation for dedicated habitats and species is presented in Section 4.

3.5.2 In addition to pre-construction surveys, all site staff will be informed about the species and habitats that may be present on site via toolbox talks provided by the SQE. Toolbox talks will be tailored to the specific ecological issues relevant to the Scheme including Black redstarts and will focus on sensitive receptors, their characteristics and mitigation requirements.

3.5.3 The SQE must be present onsite during the clearance of vegetation if it’s undertaken during the breeding bird season (end of February to mid-August). The detailed EMPs will detail which construction activities will require a SQE to be present.

3.5.4 Any site clearance would take account of seasonal constraints and will be carried out in accordance with a Site Clearance Plan (which will form part of the detailed EMPs) which will be provided prior to carrying out the works.

3.5.5 Worksites must be screened where necessary to reduce adjacent disturbance.

3.5.6 To prevent a potential impact from dust on East India Dock Basin Site of Interest for Nature Conservation (SINC) , which is within 50m of a construction traffic track-out route, dust attenuation measures will be used and agreed with local authorities as part of the Air Quality Management Plan, as is required by the CoCP.

4. HABITAT MITIGATION

4.1 Habitats of Value

4.1.1 All habitat, including trees, will be retained and protected where possible. Areas of temporary land occupation will be returned to their previous state, condition and owner following completion of construction.

4.1.2 The habitats listed below were identified in the Phase 1 Habitat surveys (October 2015) within the land to be temporarily occupied during construction of the Scheme.

- Brownfield (open mosaic habitat) Habitat;
- Plantation Woodland and Scattered Trees;
- Dense Scrub;
- Grassland; and
- Standing Water

4.1.3 Site clearance will take account of seasonal constraints and as part of the EMP, the contractor will provide details of site clearance and restoration.

4.1.4 Following the completion of the works, all land temporarily occupied will be examined by a Suitably Qualified Ecologist (SQE) to ensure habitats have been returned to their previous state and condition.

4.2 Trees

4.2.1 All reasonably practicable measures will be implemented to minimise the loss of trees.

4.2.2 A detailed Arboricultural Impact Assessment (AIA) will be undertaken once the full details of the construction compounds and detailed construction methodology are known and will be based upon an updated tree survey if required. This assessment will lead to the production of a schedule of trees to be retained and removed with accompanying maps.

4.2.3 A Tree Impact and Protection Plan and Arboricultural Method Statement will be produced by the Contractor and will be appended in the detailed EMPs. This will confirm the location of the fencing required to protect the Root

Protection Areas (RPA’s) of trees to be retained. An example of a preliminary Arboricultural Method Statement is presented in Appendix B .

5. SPECIES MITIGATION

5.1 Black Redstarts

5.1.1 Black redstart monitoring will be undertaken weekly, during the construction period in areas that are suitable for black redstart, from April to July.

5.1.2 If black redstart is recorded, a SQE will determine whether there is a need for additional mitigation in accordance with the scale of the potential impact, and will prescribe the measures to be taken.

5.1.3 Potential additional mitigation measures the SQE may suggest include, but are not limited to, more frequent monitoring during the breeding season and during construction, demarcation of exclusion zones or whether discrete elements of the works, proximate to the recorded sighting area and which may give rise to local disturbance, are required to stop temporarily until the birds have left the area (i.e. following the breeding period).

5.2 Terrestrial Invertebrates

5.2.1 In order to mitigate for notable invertebrates, the CoCP provides for other subsidiary plans to prevent adverse impacts from construction, such as the Air Quality Management Plan (AQMP) for dust pollution, timing recommendations to avoid core activity periods, and pollution prevention measures following Environment Agency guidelines.

5.3 Non-native invasive plant species

5.3.1 Areas containing non-native invasive species will be demarcated with an appropriate buffer to ensure no spread of these species.

5.3.2 If Japanese Knotweed, or any other WCA Schedule 9 invasive species (such as Virginia Creeper or Cotoneaster), is located within the Order Limits then special measures will be used to deal with this vegetation. These measures will include classification and disposal of the waste as a 'controlled waste' under the Environmental Protection Act 1990 (c. 43) (as amended in 1996 and 1999). Further to this, non-native invasive species will be prevented from spreading in accordance with the latest Government guidance. Buddleia/Butterfly-bush, while not a WCA Schedule 9 prohibited species, is listed by the LISI as undesirable, and has dominated much of the Scheme area. It will be removed from within the Order Limits during construction.

5.3.3 .

5.3.4 Appropriate measures, based on latest Government guidance, will be implemented to prevent the spread of non-native invasive species during construction. This will include appropriate tool box talks to communicate the potential presence and appearance of such species.

Appendix A. PRE CONSTRUCTION, & CONSTRUCTION, SURVEY METHODOLOGY AND TIMINGS

Table A-1 Survey Details

Habitats/Species	Survey Methodologies	Timing
Extended Phase 1 survey	In order to determine if the status of the site is broadly as reported in the ES, an extended Phase 1 habitat survey will be conducted if the construction commences more than 2 years subsequent to the surveys conducted in October 2015. It will follow the methodology set out in the 'Handbook for Phase 1 Habitat Survey - Technique for Environmental Audit' JNCC 2010. The locations of all habitats larger than 0.5ha will be mapped, alongside any smaller, but ecologically significant habitats. The habitat types mapped will be based on the colour coding system detailed in the handbook for the Phase 1 habitat survey (JNCC, 2010). Any incidental observations of the presence, or potential presence, of protected species would be recorded to inform the need for further survey (if the status of the site has changed). Target Notes will detail any unusual habitats, species signs or areas too small to map. Invasive species will be mapped if observed.	In accordance with the 'Handbook for Phase 1 Habitat Survey - Technique for Environmental Audit' JNCC 2010
Trees	Prior to construction when details of working corridors are confirmed a detailed Arboricultural Impact Assessment will be undertaken to BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations. The subsequent Tree Impact and Protection Plans will highlight the trees to be lost or retained. All trees to be retained will be protected by appropriate fencing as will be detailed in a dedicated Arboricultural Method Statement.	At any time of year (Prior to construction)

Habitats/Species	Survey Methodologies	Timing
Black redstart	Methodology: Black Redstart Action Plan Working Group http://www.blackredstarts.org.uk/pages/sitesurvey.html • In areas suitable for black redstart, the site will be monitored in the breeding season; from April to August (with the core period being May to July) during construction. • At least once a week a survey should be undertaken under favourable weather conditions (warm, windless days) in the early hours of the morning.	Monitoring to take place in areas with black redstart potential weekly April to August (during construction)

Appendix B. PRELIMINARY METHOD STATEMENT – TREES

B.1 Overview

B.1.1 This Preliminary Arboricultural Method Statement provides generic best practice measures to be adopted in order to protect retained trees during the development process. It has been prepared in order to inform the OEMP and should be updated once the construction methodology and detailed design are known.

B.2 Protective Fencing

B.2.1 The purpose of this fencing is to provide protection to the RPA of retained trees/groups and to protect trees and hedgerows prior to their translocation. The details of the actual type of fencing to be used shall be appropriate to the level of adjacent construction activity and shall be agreed with the Local Authority. Weather-proof notices shall be attached to any protective fencing located adjacent to retained trees displaying the words “Construction Exclusion Zone” and listing restrictions which apply. All personnel must be made aware of these restrictions.

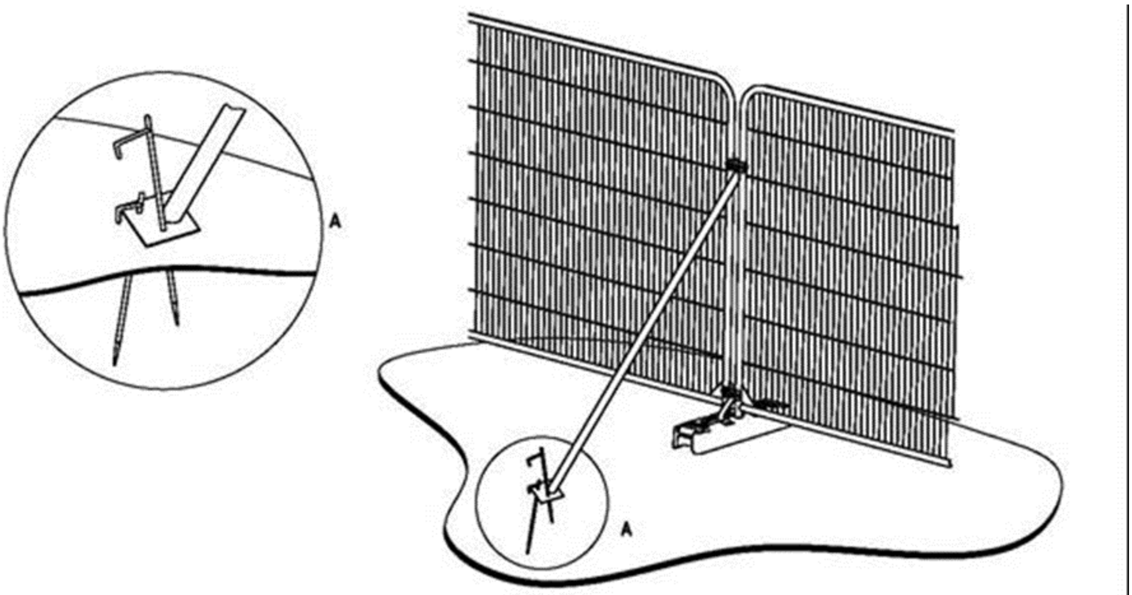
B.2.2 It is anticipated that three specifications for fencing would be employed during construction. The below gives an indication of the potential types of fencing that could be used:

B.2.3 Low-use areas: The system illustrated in Figure B-1 is one example of a type of adequate fencing which can define areas of protected vegetation and exclude traffic. This example comprises Cleft Chestnut Pale Fence in accordance with BS 1722 Part 4: Specification for cleft chestnut pale fences (British Standards Institution, 1991) supported by 150mm wooden stakes and assembled with galvanized 14 gauge (2 mm) wire, four strands per row, peeled and pointed one end and with approximate spacing of pales of 75 mm.

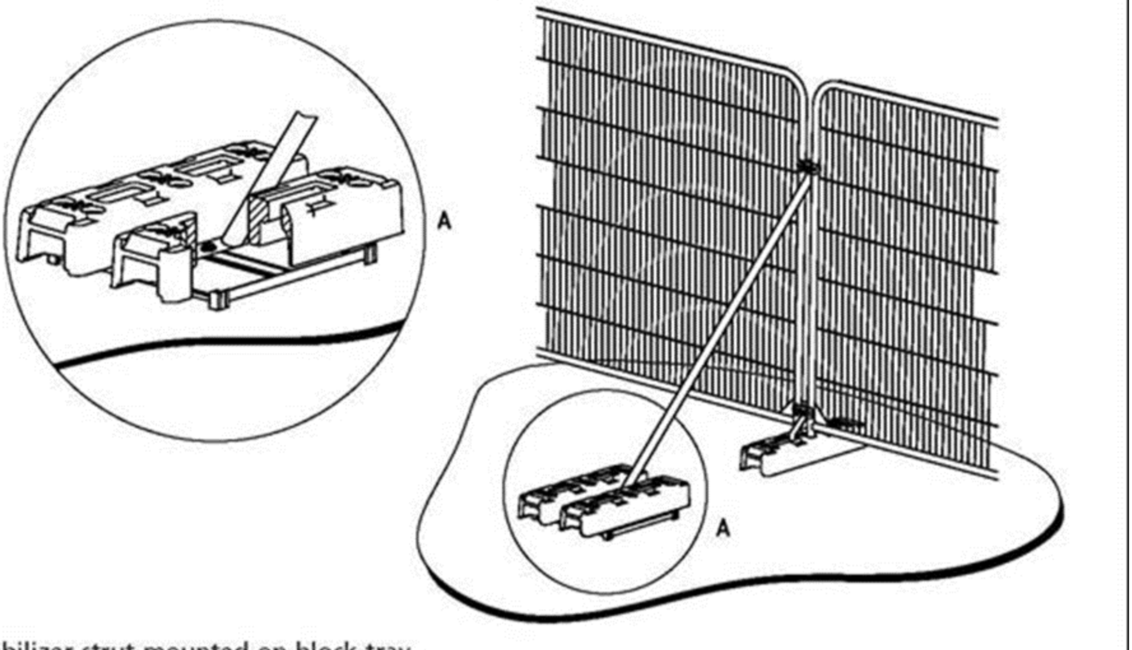
Figure B-1 Tree Protection fencing example for low use areas

B.2.4 Medium-use areas: An example of such a system could comprise anti-climb weldmesh panels (‘heras’) connected by clamps and supported by rubber or concrete bases and bracing struts. The system is illustrated in Figure B-2 and is based on BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations (British Standards Institution, 2012) (Ref 1) guidelines. This kind of system is robust enough to withstand occasional knocks by plant machinery.

Figure B-2 Tree Protection fencing specification



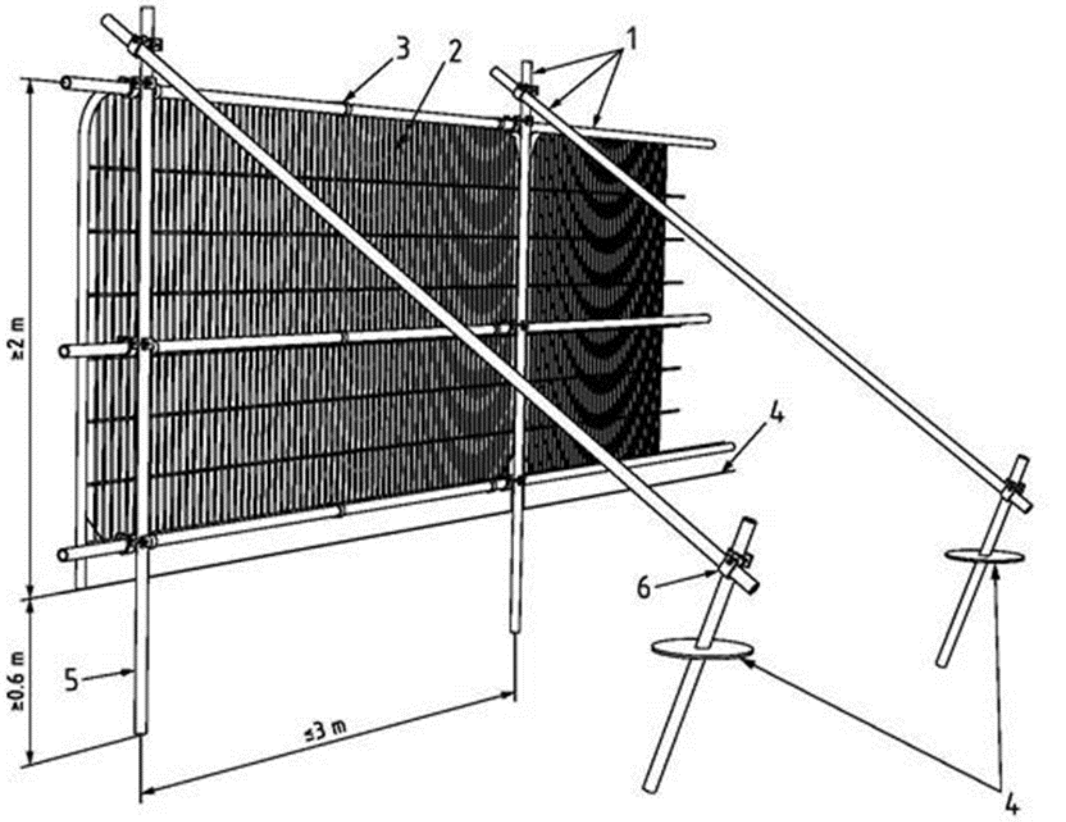
a) Stabilizer strut with base plate secured with ground pins



b) Stabilizer strut mounted on block tray

B.2.5 High-use areas: An example of such a system could involve driving scaffold poles into the ground, onto which are affixed horizontal scaffold poles and diagonal bracing struts. Anti-climb weldmesh panels could then be secured to this scaffold framework using standard scaffold clips or wire. The system is illustrated in diagram Figure. B3 and is based on BS 5837:2012 Trees in relation to design, demolition and construction – Recommendations (British Standards Institution, 2012) guidelines. .

Figure B-3 Tree Protection fencing specification (extract from BS 5837)



Key

1 Standard scaffold poles
2 Heavy gauge 2 m tall galvanized tube and welded mesh infill panels
3 Panels secured to uprights and cross-members with wire ties
4 Ground level
5 Uprights driven into the ground until secure (minimum depth 0.6 m)
6 Standard scaffold clamps

B.3 Construction Exclusion (CEZ)

B.3.1 The Construction Exclusion Zone (CEZ) is the area identified by an arboriculturist in the AIA to be protected during development, including site clearance and construction work, through the use of barriers and/or ground protection fit-for-purpose to ensure the successful long-term retention of a tree. The area within the construction exclusion zone will be protected during the construction works.

B.3.2 All areas excluded by protective tree fencing shall be treated as CEZs, and the following restrictions shall apply:

- No construction activity whatsoever must occur within these areas.

- No tree works, without the written consent from the Local Authority.
- No alterations of ground levels or conditions.
- No chemicals or cement washings.
- No excavation.
- No temporary structures.*
- No storage of soil, rubble or other materials.
- No vehicles or machinery to be used or parked without appropriate ground protection measures as per BS5837 recommendations. This will require the use of a proprietary system of reinforced concrete slabs/steel road plates on a compressible layer, or side butting scaffold boards/ 18mm plywood sheets on a compressible layer. The type of ground protection used shall be appropriate for the likely loading applied.
- No fixtures (lighting, signs etc.) to be attached to trees.
- No fires within 10 metres of the canopies of any tree or hedgerow.

*Temporary structures are acceptable provided they are of the Jack Leg type, can be sited to act as ground protection for the duration of the construction.

B.4 General construction activity

B.4.1 Since the canopies of retained trees may be in close proximity to areas of crane operation, the following restrictions will apply, all cranes will be sited outside the defined RPAs of retained trees / groups, and the Contractor will ensure all relevant personnel shall be briefed on the location of trees and the need to avoid causing damage to them.

B.4.2 Should additional tree removal or pruning be required above and beyond those previously agreed the Local Authority Tree Officer shall be contacted and the scope of works agreed in writing.

B.4.3 All materials will be stored within designated areas and no materials shall be stored within any RPA.

B.5 Hazardous Materials

B.5.1 Any mixing of cement-based materials is to take place outside the RPAs of all trees. Provision shall be made to ensure that the mixing area is contained so that no water runoff enters the RPAs of any trees. All mixers and barrows shall be cleaned within this dedicated mixing area.

B.5.2 All other chemicals hazardous to tree health, including petrol and diesel, are to be stored in suitable containers as specified by the Control of Substances Hazardous to Health (COSHH) Regulations (2002) (Ref 4), and kept away from the RPAs.

Appendix C. JAPANESE KNOTWEED ON CONSTRUCTION SITES

C.1.1 There are several species of plant that are considered to be invasive in the UK, including Japanese Knotweed. Japanese Knotweed can cause significant delays and costs to development of brownfield sites and can spread rapidly causing damage to hard surfaces and buildings. It is therefore important that Japanese Knotweed is identified as early as possible so that an effective control programme can be implemented.

C.1.2 Japanese Knotweed is covered by two main pieces of legislation in the UK. The Wildlife and Countryside Act (Schedule 9) makes it unlawful to ‘plant or otherwise cause Japanese Knotweed to grow in the wild’ and under the Environmental Protection Act 1990 Japanese Knotweed is classified as a controlled waste and thus must be accompanied by the relevant Duty of Care documents when transported and, as such must be disposed of at a licensed landfill site.

C.1.3 The vigorous growth can cause damage to buildings and hard surfaces. Once established underneath or around the built environment, it can be particularly hard to control. Japanese Knotweed produces a network of underground stems called a rhizome. Only a very small piece of Japanese Knotweed rhizome (less than a cm) is needed to start regrowth. It is important that the rhizome is not transported to other parts of the site or onto another site.

C.2 Demarcation and Exclusion Zones around Japanese Knotweed

C.2.1 As an initial measure, any stands of Japanese Knotweed should be identified and demarcated by the Contractor to create an exclusion zone (a minimum of 7m) and an accompanying risk register/ toolbox talk provided to the team on the ground so that people are aware of its presence and understand that no ground breaking works can be undertaken in the vicinity without appropriate management and mitigation. If Japanese Knotweed is identified as being present in the area appropriate specialist management advice must be sought.

C.2.2 Possible methods for the eradication of Japanese Knotweed that may be utilised by the Contractor include, but are not limited to:

- **Stockpiling of Excavated Material and Herbicide Treatment**: Potentially suitable for larger development/ construction sites. The area impacted by Japanese Knotweed can be excavated and stockpiled in another area of the site for subsequent herbicide treatment/ spraying. This allows the development of the originally contaminated area to proceed immediately.

- **Excavation and Mechanical Segregation**: Considered to be a more environmentally friendly treatment method as it does not require the use of herbicides to eradicate the Japanese Knotweed; this method comprises the excavation and mechanical segregation/ sifting of the excavated soil to remove the Japanese Knotweed material.
- **Excavation and Disposal Onsite**: Where significant construction activities are taking place there is an opportunity to bury Japanese Knotweed waste on site.
- **Excavation and Disposal to Landfill**: This treatment method is quick and effective at ensuring the Japanese Knotweed is removed from site. However, Japanese Knotweed is classed as 'controlled waste' under the Environmental Protection Act 1990 and the costs of haulage and disposal costs associated with this treatment method are high and is considered to be a less sustainable treatment method.
- **Prevention of Spread of** Japanese Knotweed : During any works around JK, rigorous contamination control must be implemented, that is, no cross contamination of machinery or personal protection equipment should be allowed. No soil material should be taken off site, wheel washing, spade cleaning and boot cleaning before movement of personnel or equipment off site must be undertaken.

C.2.3 Further details around Japanese Knotweed management and eradication can be found in CIRIA report C679, 2008 ‘Invasive species management for infrastructure managers and the construction industry’ and the Environment Agency ‘Managing Japanese knotweed on development sites’ (version 3 amended in 2013).