6.34 The application of Best Practice Management, noted above, will include such procedures as:

(i) Switching off plant and equipment when it is not in use for long periods of time;

(ii) Noise emitting equipment required to be operated continuously, or at night, shall be electrically powered;

(iii) Positioning plant and equipment to be as far as practicable from sensitive properties, or screened from direct view of them i.e. use of temporary noise screens or partial enclosures around particularly noisy equipment such as pneumatic breakers used in close proximity to dwellings etc;

(iv) Establishment of agreed site working hours for "normal" construction activities;

(v) Establishment of agreed criteria whilst undertaking significantly noisy or vibration-causing operations near to receptors;

(vi) Programming works such that the requirement for working outside of normal working hours is minimised;

(vii) Ensuring that all staff and operatives are briefed on the requirement to minimise nuisance from site activities;

(viii) Regular plant maintenance;

(ix) The use of quieter methods and/or plant items; and,

(x) The implementation of a complaints procedure.

6.35 BS 5228 provides further guidance on methods of reducing noise and vibration levels using a variety of methods; in particular, Part 4:1992 provides suggested measures in reduction of vibration levels from construction activities.

6.36 Mitigation measures to be employed by the contractor, that include but are not limited to the above, are likely to reduce noise levels to an acceptable level.

Operational Fan Noise

6.37 Operational noise emissions generated from the headhouse will be designed to the criteria in Table 6.04 and as such, no further mitigation would be required.

Summary and Conclusions

6.38 A noise and vibration assessment has been carried out for the St Pancras Substation site. The assessment considers the effect and likely impact of increased noise and vibration levels relating to the construction and operation of the headhouse and its associated spur tunnel and shaft upon sensitive receptors.

6.39 The assessment has identified that the completely unmitigated impacts of construction noise and vibration is likely to have an adverse effect on the nearest noise-sensitive receptors at the Site. However, contractors will be obliged, to comply with National Grid's requirements and implement a project EMP, to implement

appropriate Best Practice Measures to minimise the noise and vibration effects of the construction works arising from the Project to an acceptable level.

6.40 With implementation of the measures suggested within this Chapter, in agreement with the London Borough of Camden, the effects are not likely to be significant, and any effects remaining are likely to be minimal and of short duration.

6.41 Vibration effects from the spur tunnelling should not result in adverse significant effects.

6.42 The tunnel ventilation fans will be designed to ensure that operational noise will not result in significant adverse effects and will meet the London Borough of Camden's requirements.

ENVIRONMENTAL STUDY

CHAPTER 7
GROUND SETTLEMENT

7. GROUND SETTLEMENT

7.1 The potential for ground settlement is a concern often raised by those who live and work above tunnels. Certain structures are more susceptible to, or have a higher perceived impact from, settlement than others. Rail lines, particularly those carrying highspeed traffic, London Underground tunnels and structures and other deep level infrastructure such as cable tunnels, sewers, water supply tunnels etc and structures founded on piles are perceived to be sensitive. The utilities which tend to be close to the surface can also be damaged through settlement. Listed buildings may also be sensitive to settlement as they often are of less then robust construction.

7.2 Calculations undertaken in relation to the proposed infrastructure in the area of the St Pancras Substation site show that no significant effects from settlement are likely to be experienced by above ground structures, surface level utilities and rail lines as a result of the proposed works described in Chapter 2, Description of the Project.

ENVIRONMENTAL STUDY

CHAPTER 8
FLOOD RISK AND SURFACE WATER

8. FLOOD RISK AND SURFACE WATER

Introduction and Scope of Topic

8.1 This Chapter assesses the likely effect of the proposed Project on flood risk and surface water at St Pancras Substation Site. This assessment takes into consideration the hydrogeological conditions as outlined in Chapter 9, Hydrogeology.

8.2 The assessment focuses on the flood risk and drainage implications for the proposed above-ground headhouse at the Site, including the implications of the shaft entrance as a potential flood flow pathway. This is due to the headhouse being the primary route for flood waters to enter the spur tunnel and associated facilities, and the primary location with the potential to affect off-site flood mechanisms. Where applicable the effect of the shaft location on the surface water environment has also been considered.

8.3 The Chapter identifies existing surface water and drainage features and characteristics of the Site and the vicinity. The potential impact of the Project on these features is assessed against the baseline conditions.

Policies and Guidelines

Planning Policy Statement 25 (PPS 25) – Development and Flood Risk (December 2006)

8.4 Planning Policy Statement 25: Development and Flood Risk (PPS 25) advises that a strategic approach should be adopted to flood risk in keeping with the Government's aims to ensure that new development is sustainable. Notably it introduces:

(i) The concept of classification of vulnerability of development to flood risk;

(ii) The need to conform to the requirements of the "Exception Test" in circumstances where it is deemed necessary to locate new development in "high risk" zones;

(iii) The need to apply the Strategic Flood Risk Assessment to decisions taken at all levels of planning; and,

(iv) The concept of flood risk reduction, particularly where development has been sanctioned on the basis of the "Exception Test".

8.5 Annex D of PPS 25 outlines the Exception Test. Here it is stated that decision makers should apply the Exception Test only after the Sequential Test has been applied. The Exception Test is necessary where "more vulnerable" development, such as housing, is proposed for Zone 3. The Exception Test is that:

(i) The development provides wider sustainability benefits to the community that outweigh flood risks;

(ii) The development is on developable previously developed land or where there are no reasonable alternative sites on developable previously developable land; and,

(iii) A Flood Risk assessment (FRA) must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Development and Flood Risk: A Practice Guide to PPS 25, DCLG

8.6 The Practice Guide provides advice on the practical implementation of PPS 25, and provides additional guidance on what is required at regional and local level. The document provides supporting information on:

(i) Preparing regional spatial strategies, sustainability appraisals and local development documents and the roles and responsibilities for those managing individual planning applications and the planning process;

(ii) Additional guidance in the contents of Regional Flood Risk Assessments (RFRA), Strategic Flood Risk Assessments (SFRA) and FRAs;

(iii) The application of the sequential approach and Sequential and Exception Tests;

(iv) Surface water management and implementing sustainable drainage;

(v) Measures to reduce flood risk to acceptable levels; and,

(vi) How to manage residual risks.

London Plan

8.7 The London Plan, made final in February 2004 (amended 2006 and 2008), is a spatial development strategy to 2020 replacing Regional Planning Guidance (RPG) 3, RPG3a, and RPG3b, which previously provided strategic and supplementary guidance for London Planning Authorities, and in particular on the review of their UDPs and emerging (LDFs). In particular the policy on sustainable development requires the consideration of flood risk in all future developments in the city.

8.8 Guidance on surface water is provided in a wider context:

(i) Policy 4A.13: London's drainage and sewerage infrastructure should be sustainable; and,

(ii) Policy 4A.15: Boroughs should develop policies that include the impacts of climate change, in particular with regards to the increased risk of tidal flooding.

8.9 The London Plan identifies the Blue Ribbon Network which includes the River Thames, the canal network and the other rivers and streams within London and London's open water spaces such as docks reservoirs and lakes. It includes culverted (or covered over) parts of the rivers, canals and streams. The London Plan provides specific planning guidance for the River Thames and its tributaries replacing RPG 3a and RPG 9b. Key policies include:

(i) Policy 4C.6: Boroughs should identify areas at risk from flooding. Development within these areas should require assessments in line with PPG 25; and

(ii) Policy 4C.8: Surface water runoff should be managed close to the source, with the promotion of Sustainable Urban Drainage Systems (SUDS), unless this is impractical.

Review of SFRA

8.10 The London Boroughs of Hackney, Waltham Forest, Haringey, Islington, and Camden combined along with neighbouring councils to produce the North London Waste Plan[1], which provided the mechanism for the Strategic Flood Risk Assessment (SFRA) for the region to be prepared, and was finalised in August 2008.

8.11 The objectives of the North London SFRA were predominantly informed by PPS 25, which requires decision makers involved in the planning process to consider regional and local flood risk issues when planning development. The SFRA aims are summarised below:

(i) Identify zones in North London that are at risk of flooding for all Flood Zones identified in Table D1 in PPS 25 and within Flood Zone 3, the variations in the actual flood risk including the effect of any formal or informal flood defences;

(ii) Identify the risk of flooding due to surface water either in the form of flash flooding due to surface water runoff, rising groundwater, inadequate drain/sewer maintenance;

(iii) Identify the likely effects of climate change on flood risk;

(iv) Provide the basis for allocating sites including, if necessary, applying the Sequential Test approach to site allocation within the indicative flood plain; and,

(v) Recommend policy options for dealing with the range of flood risk and provide guidance for developers.

8.12 All forms of flooding were investigated in the SFRA, largely by compiling and reviewing relevant information provided by a wide variety of sources, primarily the Environment Agency (EA), the London Boroughs, and Thames Water.

Approach to Assessment

Overview

8.13 The methodology involves a first stage review of the baseline conditions relating to the hydrological environment. The second phase of the assessment considers the impact potential of the construction and operational conditions associated with the proposed headhouse and the shaft entrance as a potential flood flow pathway. These impacts exclusively relate to the potential for degradation or improvement to the hydrological environment and the risk to receptors on and off-site as a result of the Project. The assessment considers the impact of the Project on each potential source of flooding, and assigns a significance based on the importance (or strength of change) on the receptor (e.g. a large fluvial floodplain could be considered of very high strength); and how frequently the Project will affect the receptor. A series of mitigation measures will then be identified to ameliorate any adverse impacts of the Project.

8.14 Consultation was undertaken with the EA in March 2008 to agree the assessment methodology.

[1] http://www.nlwp.net/

8.15 The main sources of information used to inform this assessment are:

(i) Thames Water asset plans (sourced from Thames Water Utilities Limited);

(ii) LiDAR topographic information; and

(iii) EA Flood Zone Maps including associated consultation.

Assessment Methodology

8.16 Qualitative screening assessments have been undertaken to address each of the different types of flood risk identified in PPS 25 at the Site.

8.17 To assess the fluvial flood risk at the Site, EA Flood Zone Maps have been reviewed. The EA Flood Zones describe the extent of flooding that would occur on the basis that no defences were in existence. Essentially they describe the extent to which the land under scrutiny is afforded protection by the presence of defences.

8.18 Due to the location of the Site, tidal flood risk is not considered a significant issue; however checks were made against the tidal extent of the River Thames. Any breach in the tidal defences is not anticipated to reach the headhouse.

8.19 To assess surface water, drainage plans were received from Thames Water showing the existing foul and surface water discharge locations. Key issues requiring consideration include whether discharge from the Site is to combined surface water and sewerage or separate systems and to consider the Site's impermeability. Topographic data (LiDAR) has been used to assess overland flow paths across the Site and provide a qualitative screening as to whether the headhouse and shaft are potentially at risk from this source of flooding.

8.20 Flooding from artificial sources is not identified on the Flood Zone Maps, therefore consultation with British Waterways has been undertaken to obtain any relevant data. In this instance artificial sources of flooding are most likely to be from London canals. The Site is not located close to the canal network and British Waterways have confirmed that they do not hold any records of flooding at the Site and that flooding from a canal to the surrounding land is a rare event.

8.21 The implications of the spur tunnel on groundwater is discussed in detail in Chapter 9, Hydrogeology. The potential risk from groundwater flooding of the headhouse is discussed in this Chapter.

Description of Baseline Conditions

Overview of Baseline Conditions

8.22 The headhouse and associated shaft are the only access points to the spur tunnel and beyond, therefore surface water will only enter the tunnel if there is flooding at the headhouse and shaft when open during construction. The baseline conditions are assessed on the basis of this principle. Details on the baseline groundwater conditions are provided within Chapter 9, Hydrogeology.

8.23 Initial screening has indicated the Site is in Flood Zone 1 (land assessed as having less than 1 in 1000 year probability of flooding from fluvial or tidal sources).

8.24 PPS 25 states that the Sequential Test should be applied to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed. According to Table D.2 of PPS 25 the Project ("strategic utility infrastructure") is most appropriately classified as 'Essential Infrastructure'. Table D.3 of PPS 25 indicates the types of land uses appropriate within each Flood Zone. Essential infrastructure is compatible within all Flood Zones.

8.25 The Site is located in the lowest probability flood zone and therefore considered to pass the PPS 25 Sequential Test.

Fluvial Flood Risk

8.26 Initial screening demonstrates the Site is located in Flood Zone 1 (low probability of flooding and not significant). This zone is land assessed as having less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1 %). Therefore, a more detailed review is unwarranted.

Artificial Sources

8.27 The Site is located within 50 m of the Regents Canal, the flooding from artificial sources such as a canal is considered low risk (not significant), British Waterways do not hold records of flooding events.

8.28 British Waterways has advised that the set back distance of structures from the canal edge is 5 m (horizontally). British Waterways require that the waterway corridor is not interfered with during the construction or the completed development. Any buildings, excavations, or other works can be constructed, operated, maintained and eventually demolished without affecting the waterway.

Groundwater Flooding

8.29 The proposed spur tunnel route will be through impermeable Lambeth Group / London Clay, meaning the potential for groundwater flooding is considered low. Chapter 9, Hydrogeology, provides further details on baseline groundwater conditions.

Surface Water Runoff

8.30 Surface water flooding occurs when runoff from high intensity storms (often with a short duration) is unable to be infiltrated into the ground or be drained by drainage systems. The pathway for surface water flooding is dictated by the blockage or overflow of the drainage system and potential failure of sluice outfalls and pump systems.

8.31 Surface water flooding is more likely to be severe and of longer duration in low lying areas but local problems may result in all areas as a result of very heavy rain or infrastructure failure.

8.32 The assessment of the baseline for surface water runoff involved an initial screening of the Site in relation to local topography using LiDAR data. The local topography indicated that the headhouse location is not situated within a localised low point and is therefore considered to be at significant risk from surface water runoff.

Tidal Flood Risk

8.33 Due to the distance of the Site from the tidally influenced part of the River Thames, tidal flood risk is not considered a significant risk to the shaft site.

Identification and Assessment of Likely Impacts and Effects

8.34 The main hydrological impact requiring consideration at the Site during both the construction and operation of the Project is related to surface water runoff from off-site areas as well as that generated on-site.

Impacts of the Construction Phase

8.35 Construction of the Project will be undertaken within the next five years, therefore the effects of climate change on fluvial flood risk to the Site is considered minimal. Although there remain uncertainties in hydraulic model outputs, this effect has been assessed as low during construction.

8.36 The main impacts to be assessed at the Site from construction will be a response to site preparation, site compound construction, temporary buildings and the physical construction of the headhouse and shaft.

8.37 Additional impacts during construction are:

(i) Increased surface water runoff and changes to the flow regime due to construction of temporary site tracks and buildings; and,

(ii) Changes to surface water regime due to excavation, stockpiling and construction of foundations during site preparation.

8.38 The construction impacts considered relate to the temporary nature of construction.

8.39 Construction of the Project will involve the use of heavy plant and machinery; therefore, there is potential for compaction of the ground surface, which will reduce the overall permeability at the Site, potentially increasing volume and runoff. However, due to the current impermeable nature of the Site, this effect is considered to be negligible and therefore not significant.

8.40 Storm events during construction will generate overland flow with increased sediment loads, with sediment size and load increasing with the severity of the storm. Increased sediment loads in overland flow will have the potential to silt up and block the existing drainage for the surrounding area, therefore decreasing the capacity of the drainage system and increasing the risk of flooding for storms with lower return periods. Properties in the vicinity of the Site would have the potential to be at increased risk from flooding therefore this indirect effect has been assessed as potentially significant and requiring mitigation.

8.41 There is the potential for hydrocarbons to enter the aquatic system as a result of construction activities and potential spillages of fuels, including oils and lubricants. The potential for hydrocarbons to infiltrate into the ground and move off-site is considered to be potentially significant and requiring mitigation.

8.42 Excavated materials, stockpiles and demolition materials on-site have the potential to create significant ponding and create diversions of existing flow paths, which could increase surface water flood risk to off-site receptors. This effect is assessed to be potentially significant and requiring mitigation.

8.43 During extreme storm events, water on-site could collect in a potentially short space of time causing a potential hazard to construction workers. The direct effect is assessed to be potentially significant and requiring mitigation.

Operation Impacts

8.44 The risk of groundwater flooding at surface level is considered low, however there may be increased overland flow. In addition, there are number of 'typical' operation considerations, such as foul drainage, that need to be considered as part of the operation phase. These considerations are presented in the mitigation section.

Mitigation and Residual Effects

8.45 The risks and mitigation associated with groundwater intrusion are considered in Chapter 9, Hydrogeology.

Construction

8.46 The best practice approach embodied in the Project EMP will mitigate the potential adverse significant effects. The following paragraphs set out some of the measures to be employed.

8.47 The control of sediment loads at the Site will be undertaken at source, by covering stockpiles on-site to prevent additional sediment being released into the drainage system. On-site balancing facilities will also aid the de-watering of site runoff; the settled sediment will then be disposed of under suitable licence. This effect can then be considered not significant.

8.48 To mitigate the effects of spillages on the Site, any hydrocarbon products with appropriately sized secondary containment will be stored in accordance with the EA's Pollution Prevention Guidelines and relevant regulations[2]. This effect can then be considered not significant.

8.49 To mitigate diversion of flows to off-site receptors, the selective placement of stockpiles will be detailed in the contractor's method statement. The topography will be taken into consideration when channelling water across the Site. Particular regard will be given to ensuring surface water runoff is kept away from the shaft entry during construction at the Site. This effect can then be considered not significant.

[2] The Control of Pollution (Oil Storage) (England) Regulations, Environment Agency, 2001

8.50 Ground finishes of any areas outside the headhouse site but within the contractors working areas will be returned to their original state condition or better. Due to the commitment to return to original or betterment this effect can then be considered to be not significant, and a slight betterment.

Operation

8.51 To mitigate the effect of overland flow and ponding at the Site entry points should be raised 150 mm above surrounding ground levels. The effect of overland flow can then be considered not significant.

8.52 A surface water drainage system will be designed and provided to collect rainwater from all shaft headhouse buildings and roofs and from hard standing areas around the Site. To mitigate against poor water quality all surface water will pass through a suitably sized Class 1 oil interceptor before discharging to the public sewer. The effect on surface water drainage can then be considered not significant.

8.53 The surface and foul water drainage and the output from the tunnel pumps shall discharge to the public sewer by means of gravity drainage. The drainage design will comply with the requirements of internal National Grid guidance, Building Regulations, Thames Water and the EA.

8.54 The area of impermeable cover is proposed to remain the same post-development. The surface water runoff generated will remain similar to the existing runoff generated and as such this effect of increased surface water runoff is considered not significant.

Residual Flood Risk

8.55 The residual flooding impacts are those that still remain after sufficient mitigation measures have been implemented within the Project.

8.56 No residual flood risk has been identified.

Summary and Conclusions

8.57 The proposed headhouse and shaft site is located in Flood Zone 1 and at low risk of flooding from fluvial or tidal sources. As such, the Project will have a negligible effect on the surface water environment.

8.58 The shaft entrance will require temporary protection in the event of extreme rainfall events leading to surface water flooding occurring during construction. The adherence to the Project EMP and appropriate construction management will mitigate against adverse effects such as flow path change and sediment loading.

ENVIRONMENTAL STUDY

CHAPTER 9
HYDROGEOLOGY

9. HYDROGEOLOGY

Introduction and Scope of Topic

9.1 This Chapter assesses the likely significant effect of the proposed Project on hydrogeology at the St Pancras Substation site. Where appropriate this Chapter interfaces with aspects of both Chapters 8, Flood Risk and Surface Water and 10, Land Contamination.

9.2 Baseline conditions associated with both the shallow and deep aquifer systems are described, together with discussion on potential impacts from the construction and operation of the headhouse (including associated shaft and spur tunnel) on each of the groundwater systems.

9.3 Any residual effects, together with proposed mitigation measures or approaches, are outlined towards the end of this Chapter.

Policies and Guidelines

9.4 Key water environment legislation against which this assessment has been made, and upon which EA policy and guidance is based includes the following:

(i) *Groundwater Directive (80/68/EEC)* – requires protection of all groundwater from entry of List I substances or pollution by List II substances. This is being progressively superseded by a new *Groundwater Directive (2006/118/EC)* – elaborating on the requirements of the Water Framework Directive (see below) for the assessment of the chemical status of groundwater bodies, trend reversal and the prevention / limitation of inputs of pollutants to groundwater;

(ii) *Water Resource Act 1991* – makes it an offence to knowingly permit poisonous, noxious, or polluting matter to enter controlled waters. Defines 'controlled waters' to include 'groundwaters', and defines groundwater as '*any water contained in underground strata'* (meaning above and below zone of saturation). Requires licensing of groundwater abstractions over 20 m^3/day (with the exception of dewatering for mining, quarrying or engineering purposes);

(iii) *Groundwater Regulations 1998* – enables authorised release of direct or indirect discharges to groundwater (or ground) providing no List I substances are released to groundwater, and the release of List II substances is minimised;

(iv) *Water Framework Directive (WFD) (2000/60/EC)* – requires that all water bodies (both groundwater and surface water) achieve (or show progress towards achieving) 'good' status by 2015. In the case of groundwater, status is defined in terms of both quality and quantity. Surface water status is defined by quality (chemical & biological), ecology and hydromorphology. Implementation of the requirements of WFD in England is through the preparation of River Basin Management Plans (RBMPs) outlining an identified programme of measures to enable achievement of good status in the future, together with the definition of target Threshold values for groundwater quality.

RBMPs are currently being drafted, aiming to consult during 2009 with final submission to Defra in Sept – Dec 2009; and,

(v) *Water Act 2003* – amends parts of the Water Resources Act 1991, requiring that all forms of abstraction (including dewatering for engineering works) become licensable such that the EA can work towards the achievement of a sustainable water balance for a catchment or region over time.

Environment Agency Groundwater Protection: Policy and Practice, Part 4

9.5 *Groundwater Protection: Practice and Policy (GP3), Part 4* (September 2008) describes how the EA, as a statutory body, implements the legislation (together with other pertinent environmental legislation on land contamination and waste disposal as highlighted in other chapters within this report) described above. Policy statements set out within GP3 outline the EA position on where they seek to influence others in relation to activities that can affect groundwater, but where there is no legislation or where legislation is implemented by other responsible bodies.

9.6 Policies pertinent to this environmental assessment include:

(i) *P1-1: Wherever legislation allows,* [The EA] *will use a tiered, risk-based approach to* [their] *regulation of activities that may impact groundwater resources and to the prevention of pollution.*

(ii) *P1-2: Where the potential consequences of a development or activity are serious or irreversible* [The EA] *will take a precautionary approach*[1] *to the management and protection of groundwater, particularly in the absence of adequate information with which to conduct an assessment.*

(iii) *P1-3:* [The EA] *expect developers and operators to assess the area of influence of their activities and to take account of groundwater uses and dependent ecosystems within this area during planning, construction and operation;*

(iv) *P1-4:* [The EA] *expect developers and operators to provide adequate information to statutory bodies such as the Environment Agency when submitting their proposals so that the potential impact on groundwater resources and quality can be adequately assessed. In particular, where new techniques, operations, products or substances are involved, developers or operators should be prepared to supply specific relevant data where groundwater is at risk.*

(v) *P1-5:* [The EA] *expect site owners, developers and operators to comply with any relevant statutory codes of good practice. This applies particularly to the handling, use, storage and treatment of substances that can potentially result in an unacceptable release to groundwater.*[2]

(vi) *P1-10:* [The EA] *expect best practice regarding the backfilling of any abandoned shaft, well, borehole, tunnel or adit in order to prevent pollution or loss of water resources.*

[1] Precautionary principle is defined as "*Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*" (Guidelines for Environmental Risk Assessment and Management. Defra, 2000)

[2] *An unacceptable discharge to groundwater may comprise the entry of hazardous substances (List I under the Groundwater Directive – 80/68/EEC) to groundwater in a discernable quantity or concentration or the entry of any other substance or heat into groundwater that may result in pollution.*

(vii) *P2-1:* [The EA] *will use Source Protection Zones (SPZ) as initial screening tools to show –*

(a) *Areas where* [they] *would object in principle to certain activities; and*

(b) *Areas where additional controls or restrictions on activities may be needed to protect water abstracted for human consumption.*

(viii) *P2-2:* [The EA] *will only consider a relaxation from a policy applied within an SPZ if additional site specific information clearly shows that the risks to groundwater and water supplies are acceptable. Any relaxation will be site specific and not set a precedent for the general application of* [their] *policy.*

(ix) *P2-4:* [The EA] *will assign all other groundwater sources where the water abstracted is intended for human consumption, not covered* [by a SPZ] *with a default SPZ1 and SPZ2. The default SPZ1 will be a circle of radius 50 m with the centre at the abstraction point. The default SPZ2 is a circle of radius 250 m centred on the abstraction point. In some circumstances we may use a more appropriate regular shape for either or both zones.*

(x) *P6-7: Developers proposing schemes that pose a risk to groundwater resources, quality or abstractions must provide an acceptable hydrogeological risk assessment (HRA) to* [The EA] *and the planning authority. Any activities that can adversely affect groundwater must be considered including physical disturbance of the aquifer. If the HRA identifies unacceptable risks then the developer must provide appropriate mitigation. If this is not done or is not possible* [The EA] *will recommend that the planning permission is conditioned or object to the proposal.*

(xi) *P6-8: Within SPZ1* [The EA] *will normally object in principle to any planning application for a development that may physically disturb an aquifer.*

(xii) *P6-9:* [The EA] *will object to proposals where the obstruction of groundwater flow is likely to cause an unacceptable change in groundwater levels or flow, unless measures to mitigate any effects can be agreed.*

(xiii) *P6-11: For any proposal which would physically disturb aquifers, lower groundwater levels, or impede or intercept groundwater flow,* [The EA] *will seek to achieve equivalent protection for water resources and the groundwater dependent environment as if the effect were caused by a licensable abstraction.*

Environment Agency London Catchment Abstraction Management Strategy

9.7 Catchment Abstraction Management Strategies (CAMS) are an EA water resource management tool used to quantify and manage the state of the water resources in a catchment. They can inform a prospective abstractor or developer on whether a catchment or 'Water Resource Management Unit' (WRMU) is classified as being:

(i) *Water available* – water is likely to be available at all times of the year for additional abstraction licences.

(ii) *No water available* – no water available for further abstraction licences at certain times of the year.

(iii) *Over-licensed* – if existing licences were used to their full allocation, they would have the potential to cause unacceptable environmental impact in some parts of the catchment.

(iv) *Over-abstracted* – existing abstraction is causing unacceptable environmental impact at certain times of the year.

9.8 To return a WRMU to a more sustainable balance, in line with WFD objectives, the EA may seek to revoke or reduce maximum licensed volumes, or refuse abstraction licences (e.g. for engineering dewatering) in over-licensed and over-abstracted catchments in the future. The London Catchment Abstraction Management Strategy (London CAMS) – April 2006 indicates that the area through which the Tunnel will be constructed is in an over-licensed WRMU.

Local Planning Policy

9.9 Local Authority planning policies with respect to groundwater, predominantly focused on pollution potential associated with the re-development of brownfield sites, are outlined in Chapter 10, Land Contamination.

Approach to Assessment

9.10 The approach to assessment has involved two phases of assessment: an initial appraisal of baseline hydrological and hydrogeological conditions based upon publicly available information, previous ground investigations and results available from site investigations in the vicinity of the Site during 2008. The current conceptual understanding of the groundwater system (and its interactions with surface water) is summarised in the Section 'identification of baseline conditions'.

9.11 The second phase of this assessment considers the severity (or strength) and likelihood (or frequency) of potential impacts associated with the construction and operation of the Project, against the sensitivity of potential groundwater receptors to establish a level of hydrogeological significance. This has been undertaken in accordance with the 'Judging Significance' methodology outlined in Annex GEN.02.

9.12 Consultation regarding the hydrogeology assessment has been undertaken with the Environment Agency (EA) (Jenny Thomas, Regional Hydrogeologist, October 2008) to agree the assessment methodology and to obtain information regarding private water abstractions.

9.13 The main sources of information used to inform this assessment (December 2008) are:

(i) Envirocheck Reports: *St John's Wood to Hackney* (November 2006);

(ii) Donaldson Associates Limited. Tunnel and shaft construction plans;

(iii) British Geological Survey Sheet No. 256 (1:50,000), *North London* (1993);

(iv) Geological Memoir No. 256 *North London* (1925);

(v) British Geological Survey boreholes (TQ38NE102; TQ38NE3; TQ38NE315; TQ38NW621; TQ38NW276; TQ38NW132; TQ38NW468; TQ38NW91; TQ38NW626; TQ39NW8; TQ38NW509; TQ38NW608; TQ38NW124; TQ38NW484; TQ38NW123; TQ28SE1207; TQ28SE1491; TQ28SE1480; TQ28SE233; TQ28SE1565; TQ28SE1190; TQ28SE303; TQ28SE302; TQ28SE1569);

(vi) National Grid 'Hackney – St John's Wood' ground investigation drillers logs, groundwater quality and groundwater level records (July – October 2008) (CP(C)12, CP24B, RC30, CP30, CP25, CP29B, CP28, CP26C, CP18, CP18A, CP15, CP17, RC12, CP11, CP10 and CP09);

(vii) Donaldson Associates Limited *London Tunnels Feasibility Studies Phase 1 reports for Tottenham to St John's Wood and St John's Wood to Hackney*. (January 2007);

(viii) Donaldson Associates Limited *London Tunnels Feasibility Studies Phase 1 report Hackney to St John's Wood.* (January 2008);

(ix) EA Groundwater Vulnerability Sheet 40, *Thames Estuary* 1:100,000 (1995);

(x) Environment Agency GARDIT[3] Report (2007), *Groundwater Levels in the Chalk-Basal Sands Aquifer of the London Basin – June 2007*;

(xi) British Geological Survey Technical Report WD/97/34. *The Physical Properties of Major Aquifers in England and Wales* (1997);

(xii) EA London Catchment Abstraction Management Strategy *(April 2006)*; and

(xiii) EA Groundwater records *(2003 – 2008).*

Identification of Baseline Conditions

Geology

9.14 The tunnel route of the wider scheme comprises the general geological sequence of drift deposits (Alluvium and River Terrace Gravels) giving way to London Clay, Lambeth Group (formerly known as the Woolwich and Reading Beds), Thanet Sands and ultimately the Cretaceous Chalk. A summary of the regional geology is detailed in Table 9.01 below.

[3] General Aquifer Research Development and Investigation Team

Table 9.01: Summary of Regional Geology

Geological Unit		*Description*	*Thickness*
Quaternary	Made Ground, Alluvium and River Terrace Gravels	Grey to yellow soft, silty alluvium with beds of sandy to pebbley sandy gravels. Some poorly sorted gravels with chalk and flint pebbles.	0 – 10 m
Palaeogene	London Clay	Blue/grey fine, sandy, silty clay with a glauconitic base	10 – 100+ m
Palaeogene	Lambeth Group:- Woolwich and Reading Beds	A complex sequence of laterally discontinuous sands, clayey sands and clays, ranging in colour from green to mauve and yellow. Clays are often mottled in colour.	5 – 30 m
Palaeogene	Thanet Sands	Pale yellow-brown fine grained sand which can be clayey or glauconitic	0 – 30 m
Cretaceous	Upper Chalk	White chalks with beds of flints, nodular chalks, hardgrounds and marl seams	60 – 100+ m

9.15 Geological records (borehole logs obtained via the boreholes undertaken as part of the 2008 site investigations CP(C) 12, RC12 and CP13 (combined with historic borehole records TQ28SE1207 and TQ28SE1491) indicate that when compared to the depth of the St Pancras spur tunnel (invert level -14.26 m AOD) and the base of the shaft (34 m below ground level), the spur tunnel will lie wholly within the Lambeth Group.

9.16 In addition to the above, borehole log CP13 indicates that the Site is underlain by several metres of Made Ground overlying London Clay (to approximately 32.9 m below ground level). Below the London Clay the predominantly clay rich Lambeth Group (with a sand channel pocket noted 33.1 m and 35.8 m below ground level) is observed at a depth of approximately 46 m below ground level.

9.17 Annex HYD.01 shows the stratigraphic units, depths and potential thicknesses along the spur tunnel route adjacent to the Site.

Hydrogeology

9.18 The groundwater system is characterised by two separate systems – the shallow drift aquifer system (locally interacting with surface water courses in some places), separated from the deep aquifer (Thanet Sands / Chalk) by the London Clay and Lambeth Group.

9.19 The shallow aquifer system is located in the superficial drift deposits of the River Terrace Gravels and is generally absent in the vicinity of the Site.

9.20 The vertical alignment of the spur tunnel and shaft does not effect the deeper aquifer of the Thanet Sands or Chalk hydrogeological units within the Site, and as such the hydrogeology of these deeper deposits are not considered further as part of this chapter.

9.21 Rising head permeability tests undertaken in the Lambeth Group and London Clay as part of the site investigation confirm their lower permeability nature, with results ranging from 10^{-7} to 10^{-9} m/sec (10^{-2} to 10^{-4} m/day).

Groundwater Vulnerability Classification

9.22 The main aquifers that may be affected by the Project are the Lambeth Group and the overlaying London Clay.

9.23 The Lambeth Group is currently classified by the EA as a Minor Aquifer[4] being defined as formations with variable permeability that can be '*fractured or potentially fractured rocks which do not have a high primary* permeability*, or other formations of variable permeability including unconsolidated deposits. Although these aquifers may seldom produce large quantities of water for abstraction, they are important both for local supplies and in supplying baseflow to rivers*'.

9.24 Minor Aquifers will be re-classified as either Significant Drift Aquifers (defined as aquifers where '*significant groundwater resources occur within the drift overlying unproductive strata*') or as a Secondary Aquifer (defined as '*aquifers which have significant water resources, but which also have aquifer properties that limit their use*[5]'). In accordance with CSL professional judgement it is considered that the Lambeth Group is likely to be considered as a Secondary Aquifer. Therefore, for the purposes of this assessment the Lambeth Group has been assigned a sensitivity classification of *Medium* (where it is predominantly sand rich) to *Low* (where it is predominantly clay rich).

9.25 The London Clay is currently classified by the EA as a Non-Aquifer, these being defined as formations of negligible permeability '*which are generally regarded as containing insignificant quantities of groundwater. However, groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use and provide base flow to rivers'*. In due course, Non Aquifers are to be re-classified as either Unproductive Strata (defined as being strata that is '*generally unable to support water use and are unlikely to have surface water and wetland ecosystems dependent upon them*') or as a Secondary Aquifer (as defined above). Due to the hydraulic properties and characteristics of the aquifer it likely that the London Clay beneath the Site would be re-classified by the EA as Unproductive Strata. As such, the London Clay is considered to be the least sensitive groundwater receptor, assigned a sensitivity classification for this assessment of *Low*.

9.26 There are no significant licensed abstraction points within 250 m of the Site, nor does the site or spur tunnel fall any modelled or default SPZs.

[4] Groundwater Vulnerability 1:100,000 Map, Sheet 40, Thames Estuary (1995)
[5] Environment Agency (September 2008) – *Groundwater Protection: Policy and Practice*. Parts 1 and 2

Groundwater Quality

9.27 Groundwater quality information from the closest monitoring well to the Site (RC12[6] at 40 m sample depth) indicates a near neutral to alkaline chemistry with elevated levels of Sulphate (1,400 mg/l), Chloride (310 mg/l) and Ammonia (0.8 mg/l) all of which are above Drinking Water Quality standards. Trace metal and organic concentrations tend to be low or below detection limit suggesting no sign of contamination at depth.

Identification and Assessment of Likely Impacts and Effects

9.28 The following section outlines impacts on the water resource environment that may potentially occur as a result of activities associated with the construction and operation of the St Pancras Substation headhouse, ventilation shaft and spur tunnel, both in terms of quality and quantity (e.g. groundwater flow, abstraction well yield). Following the guidance set out in Annex GEN.02, the strength and frequency of potential impacts is considered together with the sensitivity of the surrounding groundwater receptor in order to assign an environment significance level.

9.29 This section considers impacts associated with the spur tunnel separately from those associated with the shaft (both in terms of construction and operation).

Spur Tunnel – Construction Impacts

Release of List I+II Substances into Groundwater from Unknown Existing Deep Contamination

9.30 Desk study information, together with site investigation data from boreholes closest to the Site, does not reveal any known deep contamination within the London Clay or Lambeth Group that may potentially be disturbed during tunnelling operations, and that may lead to the mobilisation of List I and II substances into groundwater (more detailed information regarding likely sources of contamination are presented in Chapter 10, Contaminated Land).

9.31 On the basis of the above and the information contained within Chapter 10 the strength and frequency of change on the groundwater receptor are both considered to be *Low*. The sensitivity of the Lambeth Group is classified as *Medium* and therefore the environmental effect for releasing List I and II substances from unknown deep contamination into the Lambeth Group is likely to be not significant.

Release of List I and II substances into groundwater from spur tunnel construction materials and activities

9.32 There are a number of materials that could potentially contain List I and II substances. These include:

(i) Hydraulic fluids, oils and greases from the tunnelling shield and excavator;

(ii) Hydrocarbons associated with transporting tunnel arisings and construction materials;

(iii) Cement grout injected into the lining rings and in gaps between rings; and

[6] National Grid Reference (NGR) 529155, 184041.

(iv) Tail Sealant.

9.33 The design of the TBM is such that it restricts the possibility of hydraulic fluid escape, while the machine is operating within normal parameters. However if the machine broke then there could potentially be a release into the surrounding area.

9.34 On the basis of the above the frequency of impact is likely to be low. Given the medium sensitivity of the groundwater receptor at the Site the environmental effect of releasing List I and II substances as a result of the spur tunnel construction is not likely to be significant.

Reduction in Groundwater Quality Due to Increased Turbidity

9.35 The tunnelling process will possibly involve the generation of higher volumes of suspended sediments in the form of crushed and disturbed material that is not captured by the TBM recovery system, leading to a possible increase in groundwater turbidity. The possible increase in turbidity could result in increased suspended solids being drawn towards the abstraction points and possible clogging the pumps or reducing the quality of the water abstracted. This impact is more commonly associated with tunnelling through Chalk (which will not be encountered by the St Pancras spur tunnel). In addition given that the TBM will counter-balance groundwater pressures, it is considered unlikely that a hydraulic gradient will develop that would lead to turbid waters flowing out from the tunnel into the surrounding aquifer.

9.36 In the vicinity of the Site where tunnelling will be through the Lambeth Group and does not encounter the Thanet Sands (or the hydraulically connected Chalk), such an effect is consisted to have a Low strength and frequency on a receptor of Low sensitivity to this impact. This effect is therefore judged to be not significant.

Sealing of Fractures / Derogation of Water Supplies

9.37 The spur tunnel will be supported by grouted concrete rings, lined with a tightly fitting trapezoidal segment skin and tail sealant to prevent groundwater ingress into the tunnel. The presence of this structure below groundwater levels may act as a barrier to groundwater flow which in turn may result in groundwater backing up against the tunnel (if perpendicular to flow) up-gradient and reducing flow down-gradient. This effect may reduce the amount of water flowing to licensed abstraction and may potentially effect groundwater flowpaths in the surrounding area.

9.38 The spur tunnel lies within the Lambeth Group where groundwater tends to occur in lenses and has limited lateral or vertical hydraulic connections. Therefore it is considered unlikely that tunnelling through these deposits with limited connection to the deep aquifer will have anything other than a *Low* impact (in terms of strength and frequency of change, and sensitivity of receptor) on either groundwater flow paths or abstraction well yield in the local area. As such the environmental effect of sealing fractures / derogations of water supplies is likely to be not significant.

Creation of New Fracture Sets or Pathways

9.39 In the vicinity of the Site the spur tunnel lies within the Lambeth Group where groundwater tends to occur in lenses with limited lateral or vertical hydraulic connections. Therefore it is considered likely that tunnelling through these deposits with limited connection to the deep aquifer will have a *Low* impact (in terms of strength and frequency of change, and sensitivity of receptor) on either groundwater flow paths or abstraction well yield in the local area. As such this effect is judged to be not significant.

Loss of Groundwater from Catchment Water Resource Balance

9.40 When tunnelling below groundwater, wet excavated material will be collected and transported to surface for passing through settlement lagoons prior to re-use / disposal. Groundwater within the excavated deposits, that previously would have been part of the catchment water resource balance, will be separated during this process and then disposed to sewer. Under the Water Act 2003 such wet excavation could be potentially classified as an abstraction, and given that water is not returned to ground or a nearby groundwater supported surface water course would be a net loss of water to the catchment water resource balance.

9.41 Groundwater volumes extracted with the excavated material will, however, be small in comparison to the total catchment water resource balance and therefore the net impact is considered to be negligible (therefore both strength and frequency of impact are considered to be *Low*). Given that the Lambeth Group does not supply significant quantities of groundwater for public supply, receptor sensitivity is considered to be *Low* and as such the environmental effect is considered not significant.

Spur Tunnel and Shaft – Operational Impacts

Degradation of Grout and Sealants Leading to Release of List I and II Substances into Groundwater

9.42 The potential always exists for construction materials (including grouts and sealants) to degrade over time. Potentially, this may lead to groundwater ingress or mobilisation of List I or II substances (if grouts / sealants contain such substances). However, the materials chosen would be non-polluting in nature (leading to a strength of change classification of *Low*), and the likelihood of impact occurrence is also considered to be *Low*. Signs of groundwater ingress would be noted (and remedied) earlier than any noticeable release of pollutants. Given that the Lambeth Group does not supply significant quantities of groundwater for public supply, receptor sensitivity is considered to be *Low* and as such the environmental effect is likely to be not significant.

Shaft – Construction Impacts

Creation of Vertical Pathways Resulting in Release of List I and II Substances into Groundwater from Existing Shallow or Deep Contamination

9.43 The creation of vertical pathways during shaft construction between the near surface deposits, shallow, and deep aquifer systems may potentially release List I and II substances to controlled waters, providing they are present in the overlying strata.

Desk study information and site investigation data received to date does not indicate the presence of any significant contaminative sources. As such the strength and likelihood of change are both considered to be *Low* to *Medium* with respect to the Site (more detailed information regarding contamination is available in Chapter 10, Land Contamination).

9.44 Given a sensitivity of *Low* to *Medium* with respect to the Lambeth Group, and a *Low* sensitivity with respect to the London Clay, the environmental effect of creating new vertical pathways resulting in the release of List I and II substances is likely to be not significant.

Release of List I and II Substances into Groundwater from Shaft Construction Materials and Activities

9.45 Associated with the shaft construction there are a number of materials that could potentially contain List I and II substances. These include:

(i) Hydraulic fluids, oils, diesel and greases from the excavator;

(ii) Grout injected into ground where dewatering required to complete shafts;

(iii) Cement grout injected into the lining rings and in gaps between rings; and

(iv) Lubricants.

9.46 No machinery (containing hydraulic fluids, oils or diesel) will be down the shaft unless it has been dewatered. Excavators will be fuelled and maintained at surface, away from the shaft opening. With an absence of water to mobilise potential contaminants, particularly with advance grouting associated with dewatering of high groundwater deposits, the likelihood of contaminant migration to sensitive aquifers is reduced.

9.47 Bentonite cement grouts, and bentonite gel lubricant used will contain natural non-polluting materials with no leachable List I substances.

9.48 With respect to the potential release of List I and II substances to groundwater from shaft construction materials (considered to be *Low* in terms of strength and likelihood of change), given a sensitivity of *Low* to *Medium* with respect to the Lambeth Group (and a *Low* sensitivity with respect to the London Clay) the environmental effect of releasing List I and II substances into groundwater from shaft construction materials and activities is likely to be not significant.

Sealing of Fractures / Pore Spaces

9.49 The nature of the wet caisson construction method (see Chapter 2, Description of the Project) results in a low permeability vertical hollow tube (approximately 12.5 m in diameter) placed within groundwater flow paths.

9.50 Within the Lambeth Group (where the discontinuous nature of its sandier deposits minimises lateral groundwater flow) and the London Clay (where low permeability prevents the majority of groundwater flow), flow impacts associated with the presence of a vertical low permeability shaft are considered to be *Low* and therefore the environmental effect is deemed not significant.

Wet excavation - Loss of Groundwater from Catchment Water Resource Balance

9.51 When excavating below groundwater, wet arisings will be collected and transported to surface for passing through settlement lagoons prior to re-use / disposal. Groundwater within the excavated deposits, that previously would have been part of the catchment water resource balance, will be separated during this process and then disposed to sewer. Under the Water Act 2003 such wet excavation could be potentially classified as an abstraction, and given that water is not returned to ground or a nearby groundwater supported surface water course, there would be a net loss of water to the catchment water resource balance.

9.52 Groundwater volumes extracted with the excavated material will, however, be small in comparison to the total catchment water resource balance and therefore the net impact is considered to be negligible (therefore both strength and frequency of impact are considered to be *Low*). Given that the Lambeth Group does not supply significant quantities of groundwater for public supply, receptor sensitivity is considered to be *Low* and as such the environmental effect of loss of groundwater from the catchment water resource is likely to be not significant.

Dewatering – Loss of Groundwater from Catchment Water Resource Balance

9.53 Dewatering, with discharge of abstracted water to sewer, will also represent a loss to groundwater from the catchment water resource balance. However the volumes to be dewatered, reduced by the use of grouting to minimise groundwater ingress into the shaft, when compared to the catchment water resource balance are likely to be minimal. As such the net impact is therefore considered to be negligible (therefore both strength and frequency of impact are considered to be *Low*). Given that the Lambeth Group does not supply significant quantities of groundwater for public supply, receptor sensitivity is considered to be *Low* the environmental effect of dewatering is likely to be not significant.

Mitigation and Residual Effects

9.54 A review of the information provided above illustrates that all potential impacts at the Site are likely to be not significant and as such no further consideration is given to mitigation or residual effects.

Summary and Conclusions

9.55 The Site is underlain by London Clay overlying Lambeth Group deposits, both of which are aquifers of *Low* to *Medium* sensitivity. Contamination has not been identified within the underlying strata.

9.56 The construction methodology and design of the Project are such that it is unlikely that the construction and / or operation of headhouse, shaft and spur tunnel will release List I and II substances into sensitive groundwater resources or negatively affect the catchment resource water balance.

9.57 The effect of the construction of the Project at the Site on hydrogeology is likely to be not significant.

10. LAND CONTAMINATION

Introduction and Scope of Topic

10.1 This Chapter assesses the likely significant effect of the proposed Project on ground contamination at the St Pancras Substation Site. The relevant component parts of the Project will be designed to withstand the effects from ground contamination.

10.2 Baseline conditions at the Site are described to identify the potential for a Source–Pathway-Receptor linkage. In doing so the assessment identifies potential sources of contamination, such as historical land use, pathways of contaminant migration, and sensitive receptors that may be affected by contamination as a result of the Project. Where a significant adverse effect is likely, appropriate mitigation measures are identified.

10.3 In order to assess the environmental effects of ground contamination it is also necessary to consider the interrelationship with hydrogeology. Further details regarding hydrogeology are presented in Chapter 9, Hydrogeology.

Policies and Guidelines

National Legislation, regulations and policies

10.4 There are several regimes that regulate land (and groundwater) contamination. These include those related to environmental protection, planning and development control, waste management and pollution control and prevention.

10.5 Specific regimes that relate to contaminated land and groundwater contamination include Part IIA of the Environmental Protection Act 1990 (EPA) and the Groundwater Regulations 1998 (more specific legislation relating to groundwater is included within Chapter 9, Hydrogeology), the Town and Country Planning Act 1990; the Contaminated Land (England) Regulations 2000; and the Groundwater Regulations 2000. Part IIA of the EPA being the principal legislation dealing with historically contaminated land.

10.6 Part IIA of the EPA, which is introduced by Section 57 of the Environment Act 1995, provides a statutory definition of contaminated land that is applicable for sites in respect of their current condition and usage, which can also be applied if site usage changes. It requires an overall risk-based approach to dealing with contaminated sites, which is consistent with the general good practice approach to managing land contamination.

10.7 DETR Circular 02/2000 of 20th March 2000 ('Contaminated Land: Implementation of Part II of the EPA 1990') provides guidance on Part IIA and places a duty on all Local Authorities to determine whether the land in their areas is 'contaminated'. The legislation further provides a statutory definition of contaminated land which involves the Local Authority considering whether, due to substances in on or under the land, that:

(i) Significant harm is being caused or there is a significant possibility of such harm being caused; and / or

(ii) Pollution of controlled waters[1] is being, or is likely to be, caused.

10.8 The legislation also describes a risk assessment methodology for the identification of 'significant pollutant linkages' where the following have to be identified:

(i) A contaminant source;

(ii) A receptor; and,

(iii) A pathway that might result in significant harm, or the significant possibility thereof, being caused to the receptor by the contaminant source.

10.9 All three elements of the Source-Pathway-Receptor methodology must be present for land under the remit of the investigation to be determined as *contaminated land*.

10.10 A number of statutory guidance notes have also been published by the former Office of the Deputy Prime Minister (ODPM), Defra, the former Department of the Environment, Transport and the Regions (DETR) and the EA, as well as local authorities dealing with activities relating to developments on sites affected by contamination. These include PPS 23 - Planning and Pollution Control.

10.11 PPS 23 provides information regarding remediation of contamination in particular in the context of the redevelopment of a site or other alterations that fall under the planning regime. The local authorities may require remediation works to be undertaken as part of the redevelopment of the land for the new land use. These works usually start with a desk study, possibly followed by a site investigation and, if appropriate, remediation works.

Local Planning Policy

10.12 All councils are in the process of updating the approach to planning as a result of 'The Planning and Compulsory Purchase Act' that came into force in September 2004. The Act introduces major changes to the system of planning for the development and use of land. As a consequence the UDPs are being progressively replaced by a group of documents called a Local Development Plan (LDP) that define planning strategy and policy.

10.13 In general, the planning policies of the LB of Camden require that potentially contaminated sites are investigated, assessed and remediated as a prerequisite for any proposed development.

Approach to Assessment

10.14 This assessment evaluates the significance of ground contamination resulting from the Project for a number of receptors including construction workers, controlled waters, and those who will visit the Site during the future operation of the headhouse.

[1] Controlled Waters" are defined within the Water Resources Act 1991, but essentially include all groundwaters, rivers and surface water features such as ponds and lakes

10.15 Significance of an effect upon a receptor is determined by assessing the sensitivity of the receptor in relation to the strength and duration / frequency of change and has been undertaken using the 'Judging Significance' guidance presented in Annex GEN.02.

10.16 For the purposes of this assessment the value and resilience (sensitivity) of key receptors has been defined in accordance with any legal protection and local or national importance pertaining to the receptor, which for those specific to the Project, are defined below:

(i) Groundwater present within the Lambeth Group (Minor Aquifer) has been assessed as possessing a 'Low' to 'Medium' sensitivity;

(ii) Construction operatives are considered as 'High' sensitivity receptors;

(iii) The future users of the headhouse, such as maintenance workers, have been assessed as possessing a 'Medium' sensitivity;

(iv) In-ground structures such as foundations and buried services have been assessed as possessing a 'Medium' sensitivity; and

(v) The plants grown on or within the immediate vicinity of the headhouse have been assessed as possessing a 'Low' sensitivity.

10.17 To classify the magnitude of change and duration / frequency of change on receptor to a sensitive receptor is assessed utilising the standard Source-Pathway-Receptor methodology[2]. This methodology is used to evaluate qualitatively any likely contaminant-fate transport mechanisms.

10.18 Factual information for this assessment has been primarily based upon the following:

(i) Landmark Information Group, 'Envirocheck Report', dated November 2006;

(ii) Landmark Information Group, 'Envirocheck Report', dated April 2007;

(iii) British Geological Survey's (BGS) Solid and Drift 1:50,000 Geological Map (Sheet 256 North London);

(iv) National Rivers Authority (1994): Policy and Practice for the Protection of Groundwater, 1:100,000 scale Groundwater Vulnerability Map, (Sheet 40 - Thames Estuary); and

(v) Donaldson Associates Ltd (2008/9): Site Investigation Report

10.19 Consultation for this assessment has been undertaken with the EA in March 2008 to agree assessment methodology in relation to the sensitivity of controlled waters to contamination.

[2] This tiered contamination assessment approach was developed using the method outlined in the EA (2000) Research and Development Publication Number 66

Identification of Baseline Conditions

10.20 A baseline conditions study has been undertaken to identify the likely contamination status of the Project involving the review of readily available public records and historical mapping, on soil and groundwater contamination.

10.21 A summary of the baseline study is provided below:

Spur Tunnel

10.22 An assessment of the geology has identified the main solid geology along the spur tunnel is Lambeth Group with some London Clay. The London Clay is a Non Aquifer[3] and is likely to provide protection to the underlying more sensitive deposits from the vertical migration of contaminants.

Shaft Site

10.23 The Site is located within a property utilised as an existing electricity substation, which is predominantly covered by hardstanding. The surrounding land use comprises of mixed residential and light industrial premises. There is some limited potential for the contamination of the near surface strata from current and historical land uses. The underlying London Clay (Non Aquifer) is likely to reduce the potential for the lateral and vertical migration of any contamination into sensitive water bodies.

10.24 A Site Investigation comprising one window sampler hole plus associated sampling and testing was carried out by Donaldson Associates Ltd in July and August 2008. Four soil samples were collected and sent to a certified laboratory for chemical analysis of a range of commonly occurring contaminants of concern, including Polychlorinated Biphenyl (PCB). The results of the analysis were screened against Generic Assessment Criteria (GAC) derived for a commercial end-use. The GAC used were derived using modelling software (CLEA1.03b and CLEA 1.04) in accordance with current EA/DEFRA guidance documents (SR2, 3, 4 and 7).

10.25 The results indicated that one of the four soil samples tested contaminant concentrations of benzo (a) pyrene and dibenzo(a,h) anthracene were above the assumed human health assessment criteria for each contaminant. The soil sample that exhibited the elevated contaminant concentration was collected at depth (1.20 m bgl), no soils above or below this sample location recorded results above GAC for any contaminant of concern.

10.26 Monitoring for soil gas carried out during the Site Investigation did not identify elevated concentrations of carbon dioxide or methane. Site Investigation results for the Site are included as Annex CON.01.

10.27 No asbestos was specifically found on Site.

[3] There are 3 types of aquifer: Major Aquifers, Minor Aquifers and Non Aquifers. A Major Aquifer is defined as strata with high permeability, and may be able to support large abstractions for public supply and other purposes. A Minor aquifer is defined as strata of variable permeability, where groundwater may be used as a local source for water supply but is unlikely to produce sufficient water for large abstractions. A Non Aquifer is generally regarded as containing insufficient quantities of groundwater to act as a water supply.