West Southall Masterplan

Remediation Strategy
October 2008

On behalf of:
National Grid Property Limited

West Southall
Remediation Strategy Document

Former Southall Gas Works Site

For

National Grid Property

October 2008 – V13

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FOREWORD (Explanation of the Planning Application Development)

Planning Submission

This Report is one of a series of documents that have been prepared on behalf of National Grid Property Limited (NGPL), to support an outline planning application with details of all proposed accesses submitted in full for the comprehensive redevelopment of 44.7 hectares of land known as the Southall Gas Works site ('the Application Site'). This Report should be read in conjunction with the drawings and other documents submitted as part of this application, as follows:

- Environmental Statement, including a Non-Technical Summary
- Design and Access Statement (including Landscape and Accessibility Strategy)
- Development Specification
- Planning Statement
- Transport Assessment
- Framework Travel Plan
- Retail Assessment
- Sustainability Strategy
- Energy Strategy including Renewables
- Regeneration Strategy
- Housing Strategy
- Health Impact Assessment
- PADHI Report
- General Management Strategy
- Statement of Community Involvement

Local Planning Authority

The application is submitted to both the London Borough of Ealing (LBE) and the London Borough of Hillingdon (LBH) as the Application Site straddles the borough boundaries.

Application Proposals

The proposals are for a high quality residential-led mixed use development comprising the following:

An outline application for the demolition of the following properties: 16-32 (even) The Crescent; 1-11 (odd) Randolph Road; 137-143 (odd), 249 and 283 Beaconsfield Road; 30 The Grange; the remediation of the land and the redevelopment of the site to deliver a mixed use development for up to: 320,000sqm of residential, up to 14,200sqm for non-food retail, up to 5,850sqm of food retail, up to 1,750sqm of Class A3-A5 uses, up to 9,650sqm of hotel, up to 3,000 sqm of conference and banqueting, up to 4,700sqm of leisure forming a cinema, up to 2,550sqm of health care facilities, up to 3,450sqm of education facilities, up to 3,500sqm of office/studio units, up to 390sqm of sports pavilion, up to 600sqm of energy centre, up to 24,450sqm of multi-storey car park and associated car and cycle parking, landscaping, public realm, open space and children's playspace; and

Details are submitted for full approval (layout, scale, appearance and landscaping) of the following accesses:

- **Pump Lane Link Road – New access road from the Hayes bypass to the Application Site for vehicle, cycle and pedestrian access, including drainage and a flood relief pond.**

- **Eastern Access – New access road from Southall centre to the site, including land currently occupied by properties on The Crescent.**
- **Minet Country Park Footbridge – Central pedestrian and cycle access to the Minet Country Park, bridging over the Canal and Yeading Brook.**
- **Springfield Road Footbridge – Northern pedestrian and cycle access to Minet County Park and Springfield Road.**
- **Widening of South Road across the railway line - Widening of south road over the railway line for the creation of a bus lane.**
- **Accesses (3no.) onto Beaconsfield Road.**

The development shall be carried out in accordance with the Development Specification and the Parameter Plans appended to that document. An illustrative Masterplan (Drawing Ref. 0317_P1017Rev 00) has been devised to demonstrate how the application proposals could be delivered. Further details of the Application Site and proposed development are set out in the Design and Access Statement and Planning Statement accompanying the outline planning application.

Application Site

The Application Site lies to the north of the Wales and Great Western Mainline Railway (with commercial uses beyond), to the south east of the Grand Union Canal (with Minet Country Park beyond) and to the south of residential developments in Southall, extending off Beaconsfield Road. A Grade II listed water tower is now in residential use, located adjacent to the south eastern corner of the Application Site. A retained operational gas works compound is located approximately mid-way along the southern boundary of the site. This comprises one working gasholders that creates the principal landmark within the Application Site. Please refer to the Design and Access Statement for further details

Remediation Strategy in Respect to 2005 / 2008 Applications

This Remediation Strategy was developed in detail and consulted on in detail prior to the 2005 application. This enhanced document for the 2008 application presents the same strategy which remains fully relevant and appropriate and, as such, the detail and the consultations remain valid.

There has been some additional land added, the west decommissioned holder compound and car park reception area, both of which are lesser contaminated than areas to the west and north. The strategy is applicable to these areas with the special characteristics of large holder bases in particular as discussed in Section 7.13.

There has been some additional information, the groundwater treatment feasibility trials and a further round of groundwater monitoring discussed in Section 8.0 and the additional ground investigation to the north of the foot/cycle bridges discussed in Section 5.0.

0.0 Executive Summary

Site Description	A former gas works (the Main Site of 33.9 hectares) demolished to ground level now used for car parking and storage with an adjacent operational single gas storage holder and control compound currently operated by NGG. Bounded to the north west by the Paddington Branch of the Grand Union Canal, to the north by residential development, the south by the main west coast railway – the canal and railway meet to form a triangle type pinch on the western boundary.
History	From the late 1800's a gas production plant with associated chemical works. Some quarrying for brick production preceded these activities.
Geology Hydrogeology Hydrology	Made Ground over alluvial/Taplow Gravels (some brickearth) over London Clay. Chalk at depth. The gravel deposits classified as a major aquifer but recognised as area impacted. Groundwater flow is variable dependant upon seasons but identified as flowing generally westwards to the river but locally to the east. Generally 1.5m-3.0m below surface level but variable. Canal on the northern boundary beyond which is the Yeading Brook at lower level. The Canal is identified as not being recharged by the area groundwaters whilst the Brook is recharged.
Contamination Profile	Extensive on-site investigations and quantitative risk assessment have identified the following; • Soils identified as variably contaminated principally with hydrocarbons. • Groundwater is variably contaminated with a range of contaminants including phenols, hydrocarbons, ammonium and some metalloids. • Landgases present include carbon dioxide and methane but only in limited quantities and isolated zones. Quantitative risk assessment methods have been employed to identify baseline risks to the environment and human health. Appropriate remediation criteria have subsequently been developed to facilitate the design of appropriate levels of remediation.
Remediation Strategy	<u>Soil</u> Controlled excavation identified *primary source materials* followed by their on site treatment, mainly by bio-remediation, and re-use wherever possible. Minimised disposal off site; the subsequent validation of the excavations and backfill quality to confirm their effectiveness; the supplementary backfilling of voids re-using treated materials and the minimum of imported materials; the regrading and removal of obstructions only where necessary; additional consideration of the ground conditions as appropriate to prepare where possible for development works. <u>Groundwater</u> It is intended to generally address contamination below the water table using in-situ groundwater treatment techniques although as required some ex-situ pump and treat would also be used. Groundwater treatment trials have been completed to confirm a range of impacts are treatable.

	The remediation works are to be undertaken reflective of the proposed end uses and in agreement with the Environment Agency and Environmental Health Officer of the London Borough of Ealing.
Environmental Monitoring and Controls	Remediation works will be undertaken with appropriate monitoring to ensure that potential adverse impacts are identified and control measures established to reduce impact. These include monitoring of dusts (air), groundwaters, noise and vibration. Subsequent foundation and ground works, including piling, will be undertaken by methods to ensure remnant conditions have minimised further impact.
The above executive summary is not intended as a detailed engineering assessment and reference should be made to supporting documentation for technical details.	

1.0 INTRODUCTION

The development site at West Southall currently comprises a former gas works (the Main Site) demolished to ground level now used for airport car parking, new car storage and preparation with an adjacent operational single gas storage holder and control compound currently operated by NGG. The Main Site is 33.9 hectares (excluding the single NGG compound and associated off site development access areas). Access to the airport parking area is via the Brent Road underpass, and access to the vehicle preparation area is from Beaconsfield Road and/or The Straight – See Plan 504.

It is identified that parts of the Main Site, by virtue of its variable industrial historical development has a greater contamination profile than the four access areas and as such is described in the greatest detail within this document. However for completeness, discussion is also offered on the access routes (Sections 3.2 and 5)

From a historical perspective the site has been extensively industrially utilised in a changing profile for a period in excess of 150 years with key impacts of this sequence (including the principal gasification/chemical processes) occurring in specific zones. Other areas, in comparison, record relatively low impact on ground conditions. Table 1 presents a summary of major historic activities and site processes. See plan 802.

Table 1 – Summary of Historic Activity / Process Zones

Apprx. Date	Activity / Process
Mid 19th Century	Brick works
1868 – 1895	Oil works
1869 – 1960	Coal Gas Manufacture
1895 – 1963	Norwood Chemical Works
1895 – 1935	Aldgate Chemical Works
1918 – 1960	Benzole Manufacture
	Tar Manufacture
1960 – 1970	Oil gas Manufacture
1970 – present	Natural Gas Storage
1990 – present	Secure Vehicle Storage

1.1 Aim of this Statement

The aim of this Remediation Strategy is to provide an overview of the complex and varied ground conditions and their proposed remediation to facilitate development i.e. remediation that takes account of both the proposed types of human end uses as envisaged within the Parameter Plans for both human health issues and those appropriate to address environmental setting of the Main Site.

Within this document is a summary of the site history, the ground conditions as characterised by extensive physical ground investigation and assessment supported by the outcome of qualitative and quantitative risk assessments. It further discusses the developed remediation strategy for mitigating the risks posed by the contamination and describes appropriate environmental controls for the proposed works and the regulator consultations within which it is being developed. This is not intended as a fully detailed remediation design document, but to assist all stakeholders in understanding the principles of approach, achievement and appropriate human and environmental protection.

The Main Site is widely impacted by ground contamination that requires extensive remediation to reduce the identified risks to a level which is acceptable within the guidance framework developed by the UK government, its regulators and the requirements of the local authority and the developers. This has been assessed using quantitative risk assessment techniques feeding into overall professional judgement.

The document draws on detailed zoned ground and groundwater investigation reports, QRA reports and groundwater treatment trial reports. The environmental statement also presents ground and water issues.

2.0 GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

2.1 Geology

The geology has been extensively investigated as detailed in several supporting reports and its profile can be summarised as follows.

2.1.1) Made Ground

Site investigation data indicates made ground present at various depths across the majority of the site but generally to a maximum depth of 3.5m such deeper areas coinciding with areas of brickearth removal or deep former structure bases generally remaining in place. Locally, often in former structure remnants, it can be deeper. This is generally and dominantly comprised of rubble, with bricks, soil and waste materials, including rags, glass, paper and coke/coal residues. Occasional asbestos remnants are evident.

Groundwater levels are recorded between 1.5m – 3.0m below current ground levels and are variable both seasonally and due to inherent ground conditions.

2.1.2) Brickearth

Site investigation data indicates the Brickearth comprises of firm orange/brown clayey silt, organic in parts. This is not present across significant areas of the site with its absence often as a result of historic quarrying excavation for brick manufacture.

2.1.3) Taplow Gravels

Site investigation data indicates that the gravel generally comprises medium dense flint gravels and sand. The indicative thickness of the Taplow Gravel varies from less than 3.0m to a maximum identified thickness of 6.9m.

Off site and to the west of the Grand Union Canal in an area of land known as the Minet Tip, third party investigations have proven the virtual absence of Taplow Gravels when compared to the thicknesses identified on the Main Site itself, the “space” generally filled with impermeable waste material. This is assessed as generally impeding groundwater flow. It is thought this is as a result of extraction and the use of the deposits in the construction of the embankment onto which the canal has been constructed at an elevated level.

2.1.4) London Clay

The London Clay is present across the site and comprises of stiff dark brown silty clay with blue/grey mottling becoming a dark blue/grey clay with depth. It gently undulates at around 6m–7m depth. Selenite crystals and concretions are also found in the less weathered parts of the formation. Local well records indicate that the clay is present to a thickness of some 50m.

The London Clay is underlain by the Reading Beds below which is the Upper Chalk and acts as an aquiclude to these lower layers.

See SK600 for a schematic summary of the above ground profile.

2.2 Hydrogeology

2.2.1 Groundwater beneath the site has been extensively monitored and reported in detail in ground investigation reports and further discussed in the Environmental Statement. In summary, the Taplow Gravels are classified by the Environment Agency (EA) as a major aquifer (Groundwater Vulnerability Map, Sheet 39) indicating a significant groundwater resource able to support large abstractions. However, the EA recognise significant historical impact to the water body in this area of West London and it is currently considered of lower sensitivity than other major aquifers.

2.2.2 Groundwater flow within granular material comprising some of the made ground, brickearth / alluvium and the Taplow Gravel is a function of intergranular flow with the permeability controlled by the fine material, especially clays and silts, occupying the pore spaces between the larger sand and gravel particles.

2.2.3 Groundwater flow directions are influenced by the fact that the subsurface to a significant depth is not homogenous, the naturally occurring fabric significantly disturbed by both the quarrying of strata (gravel / brickearth) and the presence of significant subsurface man made obstructions. Furthermore, off-site material contained in the off site Minet Tip is believed to impede water flow in the area within the gravel layer (as clay has been inserted into gravel extraction void). The overall extent of the site and the variable presence of hardstanding are assessed as having a partial restraining effect on rainfall infiltration and hence groundwater recharge sufficient to locally distort groundwater flow patterns. The presence of major in-ground physical obstructions such as the in-filled dock in the north western area of the site is also assessed as significantly affecting groundwater flow.

2.2.4 Despite the local variations across the Main Site groundwater flow is recorded to generally be towards the Yeading Brook in the western and central site areas with apparent local variance to this general trend in the extreme eastern areas of the site where a general southerly flow is recorded in some seasons. The gradient is very shallow, sometimes near static, and seasonally variable.

2.2.5 It is assessed that some constrained potential exists for the recharging of the Yeading Brook from the Taplow Gravel aquifer and the assessment strategy herein accepts this as the primary off-site receptor (as agreed with the EA).

2.3 Hydrology

2.3.1 Surface water courses adjacent to the site comprise the Grand Union Canal (level with the site and believed to be in a clay lined channel) and Yeading Brook (approximately 2-3m below the level of the site) which are both located beyond the north western boundary.

2.3.2 The Yeading Brook bounds the site to the northwest, beyond the Grand Union Canal, and is at a topographic level approximately 2m lower than the Canal. Investigation of the geological and corresponding hydrogeological characteristics below the site indicates that groundwater within the gravel is in hydraulic continuity with the Brook (be it all constrained by Minet Tip characteristics) such that flow would to some extent be influenced by groundwater levels beneath the site. Additional influences are identified as via man made conduits such as sewers e.g. the White Street Sewer and the canal overflow cascade.

2.3.3 The Grand Union Canal has been constructed at a topographic level commensurate with the Main Site. Measurements of the site groundwater surface as compared against those in the Canal indicate that the Canal water level is higher and is unlikely to be recharged by groundwaters. Canal waters are considered more likely to be seeping into the groundwater. The volume of leakage would be dependant upon the integrity of the canal clay lining which is likely to be variable.

2.3.4 The results of extensive monitoring indicate very little evidence of dissolved contamination in the Brook or the canal as a result of the site, especially in the area context. The Brook has been recorded as impacted as it enters the general geographic area of the site and not reducing in quality further as it passes the site. Historically, some leakage from former canal basins into the Canal has been recorded but these issues are understood to have been addressed by clay separation plugs inserted at basin mouths (which will be verified during remediation works as fully functional).

2.3.5 Yeading Brook

The Yeading Brook flows generally in a north to south direction and is located to the west of the Grand Union Canal. It is likely that alluvial deposits along the bed associated with the Brook would provide an attenuation layer minimising hydraulic continuity between the surface water and the groundwater in the gravels although a hydraulic gradient in the direction of the Brook especially in the central and southern area of the Main Site has been identified confirming recharge potential.

2.3.6 The Yeading Brook is classed as a Fair (Class C) watercourse.

2.3.7 Surface water samples recovered and analysed for a suite of determinands including metals and oils did not record any elevated concentrations of contaminants assessed as likely to have been associated with the site although the biological oxygen demand analysis did record slightly elevated readings. This was assigned to natural breakdown of organic matter.

2.3.8 Grand Union Canal (Paddington Branch)

The Grand Union Canal flows generally in a north to south direction and the back of towpath forms the western boundary of the Main Site. Historical information suggests that the canal was constructed using brick side walls locally repaired in later years with sheet piles to form the banks, with the base sealed from the underlying Taplow Gravels by a clay lining. Three basins and docks in the site historically provided access from the canal into the Gas Works. These are understood to have been infilled between 1966 and 1979 using demolition and hardcore material sealed with steel sheet piles and subsequently end clay plugs near the canal wall.

2.3.9 The Canal is classed generally as a Poor (Class E) water course.

2.3.10 Surface water samples recovered in 1996 and analysed for a suite of determinands, including metals and oils did not record any elevated concentrations of contaminants assessed as likely to be associated with the Main Site, given the area context.

2.3.11 Sediment samples recovered at the same time did, though, record elevated concentrations of several metals including cadmium, copper, chromium, lead, nickel and zinc. Additionally the sediment samples were recorded as having a high organic content.

3.0 GROUND INVESTIGATION RESULTS

3.1 Main Site

3.1.1 Ground investigations were undertaken on the site during the period 1989-1997 and complementary and more comprehensive ground and groundwater investigation was undertaken by WYGE between 2000 and 2003 with recent groundwater monitoring in 2007.

3.1.2 A synopsis of ground conditions encountered and recorded is presented below and geological cross sections of the site are presented on drawing WYGE/E0357/806. Zones referred to are illustrated on drawings WYGE/E0357/801.

Soils: Zone A is generally less significantly impacted than the remainder of the site. However, elevated general gasworks contaminants (including hydrocarbons, cyanides, sulphate, ammonium and metals) are locally present. Slightly elevated arsenic and locally elevated PAH, TPH and BTEX are recorded in Zone B. Generally elevated metals, particularly arsenic and some localised BTEX and PAH contamination in Zone C. Widespread and variable gasworks associated contamination comprising of metals, organics, inorganics and phenols in Zone D.

Leachate: Tests indicate the potential to leach, locally, elevated general gasworks contaminants in areas of the Main Site where elevated soil contamination has been identified.

Groundwater: River Terrace Deposits identified as impacted with hydrocarbon contamination (sheen noted coating the gravel). Dissolved phase TPH, PAH and Ammonium contamination identified across the Main Site with locally occurring elevated metals and inorganics. LNAPL identified locally and DNAPL has apparently migrated down through the gravels and pooled on the London Clay in thin variable localised ponds.

Landgases: Elevated concentrations of carbon dioxide and methane and / or depleted oxygen have been identified intermittently from across the Main Site. Elevated concentrations are generally associated with areas of identified or observed contamination impact. VOCs were recorded as trace concentrations intermittently across the site.

3.2 Access Routes

3.2.1 Pump Lane

British Waterways undertook a site investigation on the Minet Tip site in 1998 and have provided copies of the trial pit and borehole logs and certain chemical test data assisting assessment of this access area and generally informing Main Site influences.

Geology is described as a thickness of Made Ground comprising soft, black odorous clay, listed as ‘Probable gasworks waste’ (note; this is the description is as advised on the log of the trial hole but unsubstantiated) interbedded with a layer of probable ‘canal dredgings’ underlain by Alluvium, overlying a remnant thin layer (0.1m on average) of River Terrace gravels, overlying London Clay.

Further review of the British Waterways data indicates that the gravels beneath a large part of the central and northern part of the island have historically (circa 1800) been excavated and re-deposited to provide the embankment on which the canal has been constructed. The subsequent voids were used for deposition of the 'waste' materials.

3.2.2 Eastern Access

No specific site investigations have been undertaken with relation to this access. However, geological conditions, with the exception of the thickness of made ground or filled material anticipated to be significantly less, are expected to be similar to those recorded beneath the Main Site. No significant contamination influences are noted.

3.2.3 Springfield Road and Minet Park Foot/Cycle Bridges

Site investigation to characterise ground conditions adjacent to the Yeading Brook have been undertaken in December 2007 and indicate limited contamination impact, excepting the central support to the Minet Bridge which is located on the end of the former British Waterways tip.

4.0 PROPOSED DEVELOPMENT

See Foreword

5.0 PROPOSED ACCESS ROUTES

As described in the Foreword to this report, the proposed redevelopment of the former Southall Gas Works comprises five planning application areas. Of these, the planning application for the redevelopment of the Main Site is made in outline, with four detailed planning applications submitted for the proposed accesses (Springfield Road and Minet Park Foot/Cycle Bridges, Pump Lane Link Road and the Eastern Access).

5.1 Springfield Road Foot/Cycle Bridge

The Springfield Road Bridge is proposed to connect the Main Site at its northwest extremity westwards across Minet Island, linking to the Beaconsfield Road (Hayes) merging into the Springfield Road.

The Springfield Road Bridge would be mainly elevated on a light bridge structure above the level of the Yeading Brook, the northern part of Minet Island and the Grand Union Canal. It would be suspended over Minet Island (with one column support only), an area assessed as of low risk in terms of potential contamination.

The area west of Yeading Brook is also recorded as having a low risk of contamination clarified by investigation where the last bridge support would be constructed and an earth ramp constructed to level out the access.

Flood risk and ecological studies have been completed and are presented in complementary planning application reports.

5.2 Minet Foot/Cycle Bridge

The Minet Footbridge crosses the Grand Union Canal, Minet Island and the Yeading Brook as a light suspended structure to link the Main Site with Minet Country Park at a location just to the west of the current canal overflow channel Pump Lane Link Road.

The footbridge would link to Minet Country Park, crossing the Minet Island just within the northern most extent of the predicted edge of the known tipped deposits. Whilst there is considered to be little risk from contaminated materials requiring remediation north of the Yeading Brook where the bridge lands and ramps out in a bank to existing levels, a single column support on the island will encounter contamination. Piling methods will be chosen to maintain current equilibrium conditions, and minimise arisings, which will then be disposed of in line with duty of care.

Flood risk and ecological studies have been completed and this would be confirmed by investigation prior to construction.

5.3 The Pump Lane Link Road would traverse an area to the west of the Main Site, crossing the Canal and the Yeading Brook and a flood relief channel. It would traverse land owned by Network Rail and Hillingdon (the Minet Country Park) adjacent to the Minet Tip to link the Pump Lane/Hayes Bypass further to the west.

The Pump Lane Link Road would be formed through the construction of an embankment elevating the road above the level of the Yeading Brook, Minet Island and the Grand Union Canal. The Brook and relocated flood relief channel would be clear span bridged over.

Works to the west of the Brook would be generally in anticipated non-contaminated material. Works between the Brook and the Canal will be over the historical tip area. Material will be removed to a metre below formation level (and treated on main site if possible) and the remainder geotechnically improved and sealed below a compacted impermeable layer prior to embankment construction. This will be subject to detailed pre-construction assessment.

Flood risk and ecological studies have been completed and are presented in complementary planning application reports

5.4 Eastern Access

At its eastern end, a link road would emerge from the Main Site to link around The Crescent and rise up to join South Road just north of the existing bridge structure. This bridge structure will subsequently be widened by a new parallel structure.

Given its construction footprint outside of the area of the Main Site it is anticipated that ground conditions would not have been significantly impacted and as such there is a low risk of contamination and little contamination remediation is expected to be required.

6.0 QUANTITATIVE RISK ASSESSMENT (QRA)

6.1 Environmental (Controlled Waters)

The contamination results and geotechnical data arising from the series of investigations have been input into a Quantitative Risk Assessment (QRA) model in order to assist in deriving the basis for and agreeing appropriate remediation criteria for soils and groundwater in an environmental risk context.

The results of initial Tier 1 screening assessments highlighted that a number of contaminants potentially posed a risk to the local watercourse, specifically the Yeading Brook.

To allow more detailed development of the strategy a QRA was undertaken and agreement gained from the Environment Agency to the scope of the model.

The results of the environmental QRA (focused on controlled waters to meet the aim stated in 1.0) show that four specific species of organic contaminants represent a potential risk to the controlled waters of the Yeading Brook focused particularly on areas of the site to the south west (these being the former production areas) and on site tip areas. Additionally, ammonia was also identified as a contaminant which has been considered.

The QRA was further used to derive site specific remediation target criteria for the four organic species, enabling subsequent detailed consideration of the scope for the environmental remediation strategy. A practicality and cost benefit analysis has been undertaken for the ammonia and the results subject to ongoing consultation.

The remediation criteria tables are contained in Annex B relating to four organic species of Napthalene, Benzene, Acenapthylene and PRO (C5-C10).

6.2 Human Health

Data used in the development of the above described risk assessment was also used in the model to assess risks to human health. Actual modelling was undertaken using the CLEA model, supplemented as required by RBCA (i.e. in the absence of specific TOX reports).

A detailed scoping and interim assessment letter was submitted for agreement to the Environmental Health Officer (London Borough of Ealing) for their information prior to the commencement of the study with regular updates throughout. It was agreed at progress meetings to proceed on this basis as recorded in contaminated land consultation group meeting minutes.

In accordance with the proposed end uses three risk scenarios were adopted model reflecting variable sensitivities;

- Residential with plant uptake (the highest sensitivity)
- Residential without plant uptake and various managed landscape scenarios
- Commercial (the lowest sensitivity)

Two contaminant sources were modelled. To a depth of 1m (as required by the model) the made ground as a source was modelled incorporating the pathways of ingestion (soil particles, dust and home grown vegetables) and vapour inhalation and the groundwater, incorporating the pathway of vapour inhalation only.
The results confirm both the sources and the pathways complete the pollutant linkage for the receptors.

With relation to specific contaminants, three species of organic contaminants represent a risk to Human Health (from inhalation) whilst arsenic and to a lesser extent chromium represent inorganic species posing a risk (from ingestion). These are principally from areas of the site to the south west (the former production areas) and correspond to a large extent to areas identified as posing a risk in the controlled waters modelling exercise.

The remediation criteria tables are contained in Annex B.

The main areas of focus of the resulting remediation works would be very plot specific and as such would be considered prior to individual developments.

It should be noted that the human health risk assessment has been undertaken on the basis of the current soil conditions, providing conservatism to the modelling process. In order to be more representative of the prevailing conditions immediately following environmental remediation the modelling will be re-appraised to ensure that the appropriate level of remediation is undertaken.

7.0 PROPOSED SOIL REMEDIATION STRATEGY

The following discussion provides an overview of the philosophy and objectives of the soil remediation works. These works will be detailed in terms of technical logistics in the remediation specification.

7.1 Summary

7.1.1 Overall the strategy would be; the controlled excavation from the ground of identified *primary source materials* followed by their treatment on site and re-use wherever possible and minimised disposal off site; the subsequent validation of the excavations and backfill quality to confirm their effectiveness; the supplementary backfilling of voids if needed using the minimum of imported materials; the removal of obstructions only where required and their crushing and re-use and further consideration of individual end use elements of the site as necessary to prepare where possible for development works (e.g. private garden areas).

Given the size of the Main Site remediation works are expected to be phased taking fully into account the groundwater improvement context, key source areas and working practicalities so that completed works are not at risk from areas subsequently to be addressed. The general east to northwest groundwater flow will be utilised in this approach.

7.1.2 The remedial strategy has been developed to utilise good industry practice and guidance documentation produced by recognised bodies such as Construction Industry Research and Information Association (CIRIA) as well as National Grid and our own extensive experience of similar sites.

7.1.3 In order to maximise the effectiveness of on site remediation treatment techniques, and hence reduce the volume of material which would have to leave the site, viability studies would be used just prior to works to assess the applicability of alternative remediation techniques (based on likelihood of success, cost and programme implications). In light of the results of the assessment to date, including the confirmation of four organic species requiring remediation, bioremediation is likely to be the favoured technique, possibly supplemented through soils washing or stabilisation.

7.1.4 An extensive program of on site groundwater feasibility trials has already been completed and summarised herein.

7.1.5 Where it is necessary to remove former structure obstruction materials for these works and they are suitable for on site re-use (e.g. concrete foundations, floor slabs) these would be sorted screened and crushed and incorporated into the on site cycles of the remediation activities. Subject to confirmation of chemical suitability this process would form a key component to the remediation strategy.

7.1.6 Anticipated soil remediation zones to reduce environmental risks, by removal and treatment are shown in Drawing 804. These zones have been evaluated by applying the remediation criteria developed by the QRA to chemically analysed samples of soil. It should be noted that a similar process is also to be applied for remediation criteria developed for human health QRA with additional zones requiring to be added to those already plotted (dependant on final end use). By necessity, however, it is not possible to do this currently as the development of the human health criteria is an iterative process using as a basis the improved situation post remediation works undertaken for environmental remediation. However, wherever possible the works will be complementary and undertaken in sequence in a single remediation phase.

7.2 Excavation Strategy

The majority of the former coal gas manufacturing plant was located in the north western areas of the site and the chemical testing results and visual observations to date confirm the dominant presence of gasworks impact in this zone.

Unacceptable areas of *primary source* contamination would be subject to strictly controlled excavation. Soils would be excavated to the depth at which either any sample from the site investigation did not exceed the remediation criteria or the groundwater whichever is the sooner. This statement reflects the fact that some soil samples were recovered at the time of their investigation from beneath the current level of the water table and that the water in itself is considered to represent a source of contamination. Subsequently it is assessed that the analytical results from these samples may not be reflecting the true chemistry of the soil, more the groundwaters.

During remediation however each and every case within which excavation below the water table is considered would be assessed on its own merit and a decision made to continue deeper either by excluding the water (e.g. sheet piling, over-pumping) and excavating or excavating within features holding water (e.g. former tank bases).

7.3 Validation of Soil Voids

Validation sampling would be undertaken from the faces of subsequent voids to monitor compliance with the strategy of the remedial criteria. Areas still recording exceedances of the remedial criteria would generally be advanced and retested in minimum 500mm increments until compliance is achieved or a risk assessment is undertaken on the residual concentrations (subject to practical constraints such as live services, boundary conditions, structures etc, and to an appropriate assessment of the risks posed). Subject to acceptance, the excavations shall be backfilled to general ground levels with chemically and geotechnically acceptable infill materials, the majority of which will be derived from site treatment and profiling works.

7.4 On-Site Assessment

7.4.1 Excavated (*primary source materials grossly exceeding criteria*) would be subject to outset assessment by an experienced site based Engineer and either be transferred to a securely lined and bunded holding area for further testing and assessment / grading / treatment or be designated for screening and then direct disposal off-site to a suitably licensed facility in accordance with current UK Duty of Care Regulations (and Waste Management Directives). As mentioned above and subject to the outcome of more detailed feasibility testing (taking into account latest advances at the time of the works themselves), bioremediation is the favoured option for on site treatment.

7.4.2 Any inground features "containing" unacceptable materials would be excavated of contents as required during the remediation works. The removal of the features such as below ground tank bases would be subject to inspection by the Engineer prior to determining whether or not they should be broken out or punctured or further considered to assist with groundwater regime re-establishment.

7.4.3 Excavated soils (*secondary source materials in the approximate order of criteria*) would be subject to preliminary assessment by the Engineer, and would either be transferred to the appropriate bunded and lined holding area for chemical testing at a frequency of 1 per 250m^3 and/or screening and sorting, or where only strictly impractical to treat designated for removal to licensed landfill. Assessment as to whether soils exceeding the criteria are suitable for bioremediation (or other appropriate remediation technology) would be made based on chemical results and engineering judgement to maximise reuse on site after treatment using a fully sustainable approach.

7.4.4 Soils *not* exceeding the criteria, or soils treated (after primary screening) elsewhere to become compliant with the criteria, would be transferred to a dedicated processing area where they would be subject to further screening/processing to achieve geotechnical compliance for use as infill material.

7.5 Soil Remediation Below Water Table

7.5.1 It is not intended that any excavations, except very significant severe sources, would progress below the prevailing water table. Contamination in these zones would generally be dealt with as part of the groundwater remediation strategy. However should incidences of high perched water levels (generally above the prevailing regularly monitored level), an assessment would be made for the local removal of the water followed by soils removal.

7.5.2 Contamination below the water table would generally be addressed using in-situ groundwater treatment techniques although as required some ex-situ pump and treat would also be used. However, in certain circumstances, with unacceptable contamination below this level (in deeper ground structures or where practical to address gross local zones) excavation may occur as discussed above.

7.5.3 A program of on site groundwater treatment feasibility trials has been completed focused on i) LNAPL removal (often light hydrocarbon fuels etc.) and water quality improvements and, 2) DNAPL reduction (often represented by viscous tar which has settled to top of London Clay levels collecting in natural geological undulations).

7.5.4 Results from the trial indicate quality improvements can be made. See Section 8.0

7.5.5 A reactive day to day approach dealing directly with issues as they warrant is a key part of this strategy. During remediation each and every case within which excavation below the water table would be assessed on its own merit and a decision made to continue either through excluding the water by control techniques or excavating within water.

7.5.6 Prior to undertaking soils excavation below the groundwater level a reassessment would be made relating to the risks, the severity of the contamination, initially based on visual 'on site' judgements but as required using laboratory assessment techniques. Such a severity assessment would be one where contamination that is easily identifiable (blue staining, tar/hydrocarbon streams) is assessed as being of high severity. Following this assessment engineering considerations, cognisant in particular not only of health and safety but also the potential for cross contamination from impacted groundwaters, would be assessed and the appropriate action taken.

7.6 Obstructions & Remnant Below Ground Features

7.6.1 Obstructions (generally former below ground foundations and infrastructure) may need excavation in the areas designated for remediation. These would be broken out of the excavations and transferred to a processing area where they would be crushed in order to achieve geotechnical criteria. Crushed concrete etc. materials would be subject to chemical testing at a frequency of 1 per 250m^3. Crushed materials recording exceedances of the agreed criteria would either be reprocessed or, failing all other options, be removed from site in a manner appropriate to the materials classification.

7.6.2 Obstructions may also be removed to facilitate development (e.g. in semi-basement or basement car parking areas or to facilitate piling). They would be dealt with in a similar manner. However, obstructions would not be removed wholesale – only where known to be required.

7.6.3 Perched waters within excavations and below ground structures would be pumped, if necessary, to a specially constructed water holding tanks or lagoons fitted with silt and product traps where they would be sampled and analysed. These may then be treated prior to re-use or discharged to foul, subject to licensed approval.

7.6.4 Where below ground structures contain significant unacceptable gasworks waste residues (such as tars) then the contents shall be removed in a controlled manner and dealt with as above to the depth of the structure. The structure would then be pierced or removed as necessary to help re-establish groundwater equilibrium.

7.6.5 Redundant voided pipe-runs, where encountered within the remediation excavations, shall be removed and evacuated of contents and plugged with appropriate sealing material at the vertical edge of the excavation and further considered in respect of the development footings.

7.6.6 Pipe-runs containing significant contaminated residues or liquids shall be drained, filled at regular locations across the site up to site boundaries (subject to evaluation of other constraints) with appropriate 'blocking' material and sealed at the vertical face of the excavation.

7.7 Existing Gas Pipe and Equipment Constraints

Live gas mains are present across certain areas of the development site and works around these would require National Grid Gas approvals and attendance. Any residual contaminated material left in place beneath and adjacent to live gas mains in areas designated for remediation but left for safety reasons, would be capped with low permeability clay or similar in order to reduce future infiltration and consequent potential leaching of residual contamination.

In addition, health and safety considerations of the proximity of gas storage and control activities have been taken into account, including the remaining holder consultation distance (60m single zone) and restriction on use zone (inner/middle/outer) of high pressure pipelines (varies in relation to pipe construction). These are generated by the HSE PADHI methodology (Planning Advice for Developments near Hazardous Installations) covered in other reports.

7.8 Backfill Compaction

All material which is utilised for backfill of the voids, either from treatment processes or site regrading, would be compacted to a reasonable standard to achieve a typical external infrastructure classification generally in line with the Highways Authority's guidelines. Specific material zones (new, replaced, existing, etc.) across the site would have differing geotechnical characteristics and broad classifications would be considered generally to ensure appropriate compaction regimes are applied to achieve these general criteria.

7.9 Re-Use Criteria

Material excavated for its specific and unacceptable hydrocarbons characteristics which exceed the remediation criteria would generally be taken to treatment facilities and material for re-use generated. Sampling of the output material would be undertaken and the criteria reassessed not only for validation but also to assess other residual soil chemical characteristics. In line with the Government strategy for sustainable approach to ground contamination remediation, this would be re-used and from a risk perspective the tests would be assessed against the original soil remediation criteria.

However, it is appreciated that at the time of writing of this strategy, chemical criteria related to current waste licensing assessment has not been sufficiently developed to officially permit such re-use in certain situations. The UK governance has recognised this and ongoing development of a new waste assessment system is being progressed which is expected to be in place before the likely start date of the remediation works. This strategy, therefore, considers that re-use of the majority of treated material would be applicable, either through exemption, negotiation or changing legislation rationale.

7.10 Access for Works

7.10.1 The site currently has only restricted road access for the import and export of soil materials and although some limited movements through either the current eastern or southern accesses may be possible, this is expected to be subject to both planning authority and public concern. The strategy therefore currently envisages that the Pump Lane Link Road would be established early on to facilitate improved access, subject to the finalisation of all the necessary agreements.

7.10.2 A new suspended structure would be established oversailing the Yeading Brook and the canal with the remaining road being built on embankment. The strategy assumes that work on this link road would commence at the same time as the first phase of remediation work and would become available for viable access after a period of circa 6-9 months into the contract. Temporary stockpiling of certain materials, including any that would need to be taken to landfill, would be organised on a strictly controlled basis in the western area of the site to deal with arising materials during this period.

7.10.3 Assessments have been undertaken on using alternative transport routes for the movement of material including the local canal and rail network. The outcome of these considerations has concluded that, whilst usage of the canal may assist in the import of clean material, at present the movement of contaminated material (from both cost and an environmental protection basis) precludes their effective use.

7.10.4 Further feasibility studies on the viability of the local canal network for potential use within the remediation phase of the works would be completed prior to the finalisation of detailed design and methodology.

7.11 Ground Profiling

During the remediation works initial cut and fill works would also be progressed where appropriate to facilitate known subsequent primary items such as semi basement or basement car parks and landscape zones taking into account timing, site protection and surety of plans.

7.12 Landscape Areas

The reused soil would retain certain generally acceptable levels of contamination but these may not be suitable for growing media criteria. Any currently present and suitable for use topsoil (limited) would be retained for re-use.

The land strategy has identified to date all key types of landscaping requiring consideration in relation to interface with the retained soil conditions on site.

a) *Rough Scrub Growth* – In peripheral areas where it is desirable to establish a more naturally regenerated landscape character, it is envisaged that suitably selected reused or treated soils can be used with possible organic seed germination encouragement. The risk of plant uptake and human behaviour associated with these areas would be fully considered.

b) *General Grassed/Bushed Areas* – In these zones, which would extend over large areas, it is envisaged that the remediated soil would initially be left at a lower level and a general clay-bound soil laid followed by a relatively thin top soil layer at construction stage.

c) *Intensive Growth/Bushed/Treed Area* – In these areas a managed "trench" of good top soil would be created and this would sit inside either a clay-lined area or an area lined with a suitable membrane heading in best overall value. The areas would require active irrigation and drainage. In general, these zones would be extended but in the case where individual trees are envisaged (for example, the boulevard) individual soil pods in terms of maintenance would be constructed in a similar manner.

d) *Private Residential Gardens* – Wherever external growing areas are considered which may have the potential for vegetable growth or areas intensively used by children such as primary school play areas, then the highest level of separation protection from the residual soil (clay or membrane) would be utilised with 1200mm of topsoil placed over.

7.13 Decommissioned Gas Holder Areas – Additional Development Land

7.13.1 Since the original remediation strategy submission, additional land for redevelopment of approximately 3 hectares has become available. It consists of Area D7 (the former gas works office and reception area now used for the car parking reception area) and the west NGG decommissioned gas holder area Area D8 (consisting primarily of two smaller gas holder bases currently filled with rainwater and two larger northern gas holders. Whilst these are redundant from any gas storage function, they currently retain the superstructure and below ground gas holder pits, these being water filled for sealing purposes).

7.13.2 Both areas have been investigated in common with the remainder of the Main Site, although clearly for safety reasons frequency of investigation points in the western gas holder compound (as gas was live when investigations were undertaken in 2003) were necessarily more limited.

7.13.3 Contamination results within the soil show a relatively lesser impact than the immediate areas to the west and north as would be expected, this being primarily a gas storage area rather than a gas production facility. However, certain impacted soils have been identified with leaching potential which will need to be addressed as part of the strategy.

7.13.4 In terms of groundwater the impact is more significant and, once the remaining live eastern NGG gas holder compound is isolated (see 7.14 below), the majority of the area will be subject to targeted groundwater remediation in line with the strategy discussed in 8.0.

7.13.5 With regard to the gas holder bases themselves, once the superstructure has been removed the bases will be evacuated of water used to seal the holders which will be by controlled disposal to the foul drainage after agreement as it is impacted by hydrocarbons. In addition, tarry sludge expected to be present at the base of the holder will also be removed ultimately creating a low risk voided area, although this is subject to monitoring of groundwater inflow etc. The work will be undertaken by an experienced National Grid team who have been progressing around the UK, decommissioning such structures over the past 20 years.

7.13.6 In regard to the two formerly redundant southern holder bases, the water is expected to have had limited quality impact but for prudence sake will be disposed to the foul water system as part of the overall process after testing.

7.13.7 These inground voids (after development levelling works) form an important resource and will be used for either deposition of suitable materials excess to the development requirements or for the underground storage of development requirements. Woodchips storage for the renewable and CHP energy system is currently identified as a likely use. The majority of the structures underlie the park area whilst settlement characteristics will be assessed and predicted. Certain parts of the water retaining structure will be broken out such that the groundwater regime within the area can re-establish itself whilst also avoiding the potential for water ponding below ground in former features.

7.14 Operational NGG Gasholder Area

The eastern gas holder and control compound remains outside the development site and fully functional. However, it is recognised that operational gas storage areas adjacent to the site may contain similar contamination requiring remediation which is not practical at this time due to safety reasons of the operational infrastructure. The risk to the remediated site would be contained, therefore, using a bentonite or hydraulic cut off wall around that site boundary and these control works would be undertaken outside current planning considerations as part of the remediation works.

It may be noted that Blue-NG is currently submitting an application for a renewable energy turbo expander scheme within this area which will require complementary remediation works.

7.15 Below Ground Construction Methodology

7.15.1 Due to the variable characteristics of the upper ground on the site, it is envisaged that either the gravel layer or the underlying London Clay layer would be used as the main geological support media. This would require the utilisation of short piles or impermeable ground improvement techniques into the gravel or longer piles into the London Clay. It is not envisaged at any stage that the London Clay, due to its thickness, would be penetrated thereby mitigating any potential risks of the deeper chalk aquifer layers being impacted by site conditions.

7.15.2 In addition, the possibility of the use of rafted foundations would be considered (this being critically dependent on type, shape and loading of the superstructure and its semi-basement characteristics) and, where suitable, this would introduce minimum disturbance to below groundwater level layers thereby introducing global remediation advantages.

7.15.3 Clean protected service trenches provisioning the site are envisaged around the network with primary routes being adjacent to primary roads. These would be constructed in a trench which, for general utilities, would be lined with either clay or a membrane and backfilled with a clean soil media. This would allow future amendments to the services to be undertaken in “clean” conditions for the life of the development.

7.15.4 Certain services would fall outside the services trenches, for example deeper sections of the waste water gravity drainage system and where the surface water system requires oversized pipes, up to 2.5m in diameter, which would be utilised as storm water storage. In these cases, contaminant resistant material and joints would be used to ensure longevity in the prevailing ground conditions.

7.15.5 Various other facilities may need footings or underground ducts to facilitate their construction and a similar philosophy to that envisaged above would be adopted throughout the site.

8.0 PROPOSED GROUNDWATER REMEDIATION STRATEGY

8.1 Groundwater remediation to address and reduce identified risks to the controlled waters receptors will be progressed on site to complement soil remediation described above. As both soil and groundwater contamination is influential on human health risk, both matters would be considered together. Provided the development details are adequately finalised at the time of remediation, the combination of the works would be determined to facilitate such an end use type. In the event of change, the final works would be reviewed to ensure the remediation objective is fully met.

8.2 The groundwater present in the gravels and lower made ground layers in the main has been impacted to various degrees both by light organics generally in solution but locally as light free product and by dense free product in local patches collected at depth in the natural undulations on the London Clay interface. The degree of impact varies from negligible to significant in differing zones of the site. Differing degrees of remediation and differing methodologies will be required to address each zone's characteristics and remediation will be targeted and adaptable.

8.3 A groundwater remediation feasibility trial has been completed within which a series, or trains, of alternative treatment systems were installed and their remediation efficiency alongside the associated value achieved was assessed.

8.4 The results of the trial indicate that a combination system involving steam injection (to mobilise and extract some of the heavy tars) alongside in-situ air sparging, to address the lighter organics, would provide the most cost effective environmental solution. Where waters are abstracted from the aquifer, these would be treated ex-situ before being discharged to sewer if not agreed suitable for re-injection with the EA.

8.5 The remediation works would target areas of significant contamination as opposed to a single site wide scope of works. To this end it is envisaged that mobile plant would be established that will move from location to location reflecting general improvement progress to the northwest following area groundwater flow.

8.6 Works would be completed on a risk reduction basis and results progressively reassessed by modelling until receptors risk has been appropriately reduced. Remediation criteria will practically be a combination of betterment, timescale and chemical level objectives to achieve the strategy.

8.7 It is recognised that for the dense free product it is a well recognised fact that total removal is unachievable. Thereby, some volume reduction will be targeted and achieved, with the focus of this element being to reduce the more available organic content which has a greater potential to impact groundwater quality into the future.

8.8 It is also recognised that given the size of the site and the need to progressively address zones, inter-zone influence would remain and create post treatment conditions which would gradually reach equilibrium again, but the objective of significant risk reduction and improvement in quality having been achieved.

8.9 All of the specific detail of the groundwater treatment works would be subject to detail design agreement with regulators, especially the EA, and be permitted / licensed in accordance with the requirements of those bodies.

9.0 ENVIRONMENTAL MONITORING AND SITE CONTROLS

The remediation strategy for the site has been designed to take into account the risk of potential mobilisation of contaminants during remediation works in particular and monitoring of ground and surface waters, landgases, odours, noise and dusts will be undertaken at strategic times prior to and throughout the site remediation works (including monitoring of waters post works) to complement the monitoring already undertaken to date.

In addition, a series of robust control measures would be an integral part of the works to mitigate or prevent or actively mitigate this risk of mobilisation. The monitoring would further allow reaction to and methodology enhancement in the event of unacceptable results. Full details will be presented within the pre-construction remediation specification.

9.1 Ground and Surface Water

Four sample points along the Grand Union Canal and the Yeading Brook shall continue to be monitored using the frequency below.

In addition, thirty groundwater monitoring wells within the site, including boundary locations (many adjacent to the river/canal boundary), shall be similarly monitored during the period of the soil remediation works and samples recovered for subsequent chemical analysis.

- Baseline – although several years of monitoring data exist this would be clarified by monthly sampling for a minimum of three months prior to commencement of each phase of the remediation works.
- Interim – fortnightly during the works
- Completion – upon completion of the soil remediation works monthly for 3 months and at 6 months and 12 months.

The results would be used to assess both the effectiveness of the remediation works and also the potential for contaminant migration. Remediation works by their nature must disturb current equilibrium and overall improvement will be the judging criteria rather than single results. The frequency has been discussed with the EA and “in principle” agreement to the above has been achieved.

Response plans to unacceptable results would be in place to be promptly activated if circumstances demand such.

9.2 Landgases

The same wells monitored for groundwater quality shall also be monitored at the same frequency for the gases; methane, carbon dioxide, oxygen and Volatile Organic Carbon’s.

Additionally the first round of landgas monitoring shall also include hydrogen cyanide and hydrogen sulphide occasionally present on gaswork sites. If these gases are identified monitoring shall continue.

9.3 Odours

Remediation of gas works occasionally produces pungent odours and these would be assessed regularly by site observations at each excavation area. Prompt reaction plans for suppression would be in place. Where proximity of the public and wind direction demands, odour suppression measures would be put in place and operated as required.

9.4 Dusts

Robust dust suppression measures would be put in place prior to any works / activities commencement which have generation potential.

The ambient level of dust present in the atmosphere throughout the period of remediation works would be monitored. This would generally take the form of 'frisbee' dust gauges, monitored (collected and analyzed) weekly in proximity to active works and assessed against trigger levels agreed with the local environmental health officer. Furthermore static gauges would be installed up and down wind of the works adopting a pump to actively pull dust into the measuring equipment.

9.5 Vibrations and Noise

Monitoring would be undertaken on an as required basis bearing in mind the nature and scope of the works and in the case of noise the prevailing wind direction. Threshold levels for noise and hours of generation would be agreed with the local EHO.

9.6 Health, Safety and Environment Site Management Plan

The site would operate only after a comprehensive site HSE plan has been prepared, agreed and measures put in place. This would adopt a preventative strategy first and foremost using monitoring to validate that prevention is being successful. Where disturbance or environmental impact is not practical to prevent, a strict approach of minimisation would be used.

9.7 Waste Management Plan

To reflect the commitment to a sustainable minimised waste solution to remediation, a fully detailed site waste management plan will be prepared, in consultation, and regularly monitored for compliance.

9.8 Consultation

A full program of consultation will form part of the overall environmental monitoring and control plan with all stakeholders including close and regular liaison with the Environmental Health Offices of the local authorities.

10.0 ASSOCIATED ISSUES

10.1 Ecology

A series of ecological studies have assessed the impact of the proposed Main Site development and associated access zones. This information has been used to establish the baseline conditions and value of the ecology on the Main Site and surrounding areas that may be impacted, and protection and mitigation works.

For full details, see the ecological reports, mitigation plan and environmental statement.

10.1.1 Main Site and Eastern Access

The Main Site itself is assessed as having limited ecological value and is predominantly composed of hard-standing with ephemeral, commonly found plant species (bearing in mind the composition of the surface) and mature tree lines around the periphery of the site. Additionally, the Eastern Access area offers limited opportunities from an ecological perspective. As such, these areas were assessed as being of negligible value in terms of nature conservation.

The site development would seek to enhance this situation using effectively the open space planned and this strategy would seek to ensure such areas are not adversely affected by residual site ground conditions.

10.1.2 Pump Lane Link Road, Springfield Road and Minet Park Foot/Cycle Bridges

The Minet Country Park to the north west of the Main Site and the adjacent Grand Union Canal and the Yeading Brook over which three of the accesses cross forms the key area of attention. The Grand Union Canal has been designated as a Site of Metropolitan Importance and survey work highlighted this watercourse as a commuting and foraging route for bats. The Minet Country Park itself has been designated as a Site of Borough Importance in terms of nature conservation value and is host to a mosaic of habitats that could potentially support grass snakes and a number of bird species. Additionally the Yeading Brook passes adjacent to the park and provides opportunities for breeding birds as well as a good wildlife corridor for migratory species. This corridor is however heavily infested with invasive plant species including Japanese knotweed, giant hogweed and Himalayan balsam and these plants significantly detract from the ecological value of the area.

The assessment therefore attributes to the Springfield Road & Minet Park bridges and the Pump Lane Link Road areas and the associated Yeading Brook as being of District/Borough Value in terms of nature conservation value and the Grand Union Canal as having County/Metropolitan Value.

All of these three proposed access corridors to the west of the Main Site would include bridges that span the Yeading Brook and Grand Union Canal and pass through a small proportion of the habitats present within the Minet Country Park. It is predicted that negative effects resulting from the construction and operation of these access corridors would be no more than moderate – minor in significance. Proposed measures are in place for reducing, avoiding and mitigating negative impacts associated with this infrastructure and, as such, the residual impacts are predicted to be negligible with resulting added benefit.

10.2 Utilities

A detailed study of the utility requirements of the new development and their availability within the region, including any phased requirements, has been undertaken. This is set within an overall sustainable energy strategy generating an element of demand requirements through renewable technologies.

It has been established that gas, water and telecom facilities currently exist in significant quantities to serve the development. This would be kept under review with the utility companies as such capacity may be amended by other regional developments being added or deleted from the network between now and the start of construction on this site.

It is currently identified that immediately adjacent electricity sources are insufficient for the development. A detailed study of provision of additional facilities from areas approximately a kilometre from the site to the south west, and provision from on-site renewable or highly efficient sources, is therefore under consideration and is discussed in complementary documents. It is hoped that on site sustainable electricity generation will mean this grid connection is of secondary importance.

The distribution of utilities throughout the site would be in dedicated clean service trenches and services would be laid in a coordinated minimum impact and juxtaposition. The trenches would be lined and filled with clean material such that any future amendment to the services can be safely undertaken in a “clean” environment.

In terms of the overall energy requirement for the site, it is intended that at least 20% of this would be progressively provided through renewable sources, see complementary reports.

10.3 Drainage

The Main Site has historically drained its surface water through a complex system of gullies and pipes with the ultimate outfall generally being directed towards the canal or river. Many of these systems have become inoperational following demolition of the gasworks etc. Some remain live and currently drain hard surfaced areas used for car parking and storage. As part of the works immediately prior to construction, a full survey of all known drains would be undertaken and these would be appropriately blocked or prevented from discharge to control any potential environmental affects of construction run off. There are no proposals to utilise any of the existing surface water system, except the existing White Street sewer running past the holder compound to the Brook (serving residences to south of railway as well) which would be upgraded and partially diverted as an element of the surface water works.

In terms of the existing waste water system, there is a minor connection from the car preparation unit to the northern boundary. A major system remains from the west decommissioned holder compound where formerly gas holder sealing water (which is often oily in nature) was discharged into a triangular holding tank and then ultimately to the public combined sewer running beneath the Brent Road under tunnel.

A drainage strategy has been prepared to assess solutions to encompass the requirements of the development with relation to waste and surface water drainage. This has involved a series of detailed consultations with Thames Water and the EA, a capacity study and detailed modelling of likely outputs from the development, throughout its phased construction history.

In addition to the use of conventional drainage techniques, the use of Sustainable Urban Drainage Systems has been considered and used where appropriate noting the major constraint of undesirable filtration through remnant ground contamination.

The outcome of the drainage strategy report can be summarised as follows:

- Wastewater (foul) drainage to connect to the existing Thames Water Utilities system.

- Surface water all discharged to the Yeading Brook, the on-site system incorporating oversized pipe storage and flow limiting devices for attenuation to limit on-flow rates to "agricultural" rates, with petrol interceptors where appropriate.

- The inapplicability of many aspects of SUDS due to a number of considerations not least the levels of residual contamination within the ground.

10.4 Sustainability

Sustainable solutions to all design approaches have been considered throughout the development of the Parameter Plans and associated strategies. This is summarised in the Sustainability Strategy Document.

In relation to this strategy, clearly reuse of former industrial land is a key aspect of sustainable development. However, this strategy and its approach to remediation further considers the sustainability of the approach. For example, a "dig and dump" approach has been avoided wherever possible and maximum treatment of materials and reuse on site is at the heart of the strategy. Other aspects such as the consideration of appropriate aspects of SUDS drainage, the approach to energy requirements for the site, and the potential use of canal transport as practical for the import of clean material have also been embraced.

10.5 Flooding

The site itself is outside the zone of influence of flood potential but the Yeading Brook has a significant flood plain and construction of the access corridors across this area has been considered in detail and reported upon.

The Springfield Road and Minet Park bridges have been designed as a predominantly suspended structure on stilts and so the flood impact is negligible. The Pump Lane Link Road has been designed partially suspended and partially on embankment, with the embankment reflecting the "blockage" of the Yeading Brook corridor already present to a greater degree due to the GWR railway embankment. The footprint of the embankment itself would take certain flood plain capacity away and the approach to this has been discussed in detail with the Environment Agency with the provision of a compensatory "hollow" area just outside the flood corridor, both for engineering reasons and to enhance the Minet Country Park habitat provision.

The construction of all three of these links introduces a temporary risk to the flood zone and a full construction plan with flood mitigation measures would be prepared prior to works commencing, and is discussed in principle within the EIA.

11.0 CONSULTATIONS

Consultation with regulators is acknowledged as a key part of developing any remediation strategy. This project has been subject to extensive consultation to date, and the intention is to continue this through the planning and remediation works process.

In terms of the total site redevelopment, consultations with both the Environment Agency and the Environmental Health Officer of the local authorities have been undertaken on several occasions. These were originally within the form of the contaminated land working group sessions (4 meetings completed prior to the first planning application) which have been minuted and the general support of both the EA and the LBE has been recorded. LB Hillingdon has also been engaged with this consultation and specific information issued in response to requests.

Since the pre-application 2005 consultations the 2008 application retains the same strategic approach to remediation and, as such, consultation remains relevant. The 2008 application has some enhancements (additional investigation near bridges and results of on-site groundwater treatment trials) and some added land (the west decommissioned holder compound with investigation available where conditions are generally less impacted compared to surrounding land) on which consultees have been issued updated details; see in particular 7.13.

12.0 SUMMARY

12.1 Contaminants, particularly those associated with the historic manufacture of coal gas, have been recorded in soils and groundwater variably across the Main Site, with the most heavily impacted areas being the western and central areas.

12.2 Large identified zones of sub-soil to workable depths, containing contamination in excess of the QRA derived remediation criteria, shall be excavated and shall in the main be transferred to stockpiles for further screening, chemical testing and classification and then forwarded for on site treatment, primarily by bio-remediation. Certain complex soils not exceeding the agreed criteria, but excavated for access or probing purposes, would be processed as required to attain geotechnical compliance for reuse as infill material. The resultant voids shall be backfilled with chemically and geotechnically acceptable material mainly generated from on-site soil improvement activities.

12.3 Only where soils have conditions too complex or varied to successfully treat on site would export to a licensed waste facility occur and then in strict accordance with duty of care regulations and in compliance with an agreed logistics plan.

12.4 Where remnant below ground structures contain significant unacceptable gasworks waste residues (such as tars), then the contents shall be removed in a controlled manner and dealt with as above to the depth of the structure. The structure would be pierced or removed as necessary.

12.5 All site works shall be undertaken and monitored in accordance with current good practice, including HSE guidance for working on contaminated sites.

12.6 All void faces and bases shall be subject to audit testing to monitor compliance with the agreed remedial criteria and the work “validated” to have met the remediation strategy objectives.

12.7 Groundwater treatment would be undertaken in tandem with, and may continue beyond completion of, the soil remediation works, with the objective of practically reducing potential risks to identified primary controlled water receptors. The strategy is based on successful groundwater treatment trials on site.

12.8 All works will be completed under a comprehensive environmental management plan and shall be comprehensively documented and a record completion report presented. The appropriate Statutory Authorities would be consulted at all stages during the project.

13.0 REPORT LISTING WEST SOUTHALL

The following reports are submitted as part of the formal planning application relating to the redevelopment of the West Southall scheme.

WYGE, *Ground Conditions Report (Including Summary of Previous Site Investigations*)of the Southall Former Gasworks Site for BG Property Holdings Ltd, August 2000, (Ref: REPORT/E0357/JC/OCT00/GCR/V3(S), V3.

White Young Green, *Environmental Assessment Site Investigation* Factual Report of the site at Southall, Middlesex, (Mentor no, 15125) for Lattice Property Holdings Ltd, Volumes 1-13, December 2002.

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Pertinent information relating to encountered ground conditions and the environmental impacts of the proposed development are presented in the following chapters of the West Southall Environmental Statement:

Chapter 10: Ecology
Chapter 12 Ground Conditions (V3)
Chapter 13 The Water Environment (V4)
Chapter 17 Operational Waste

ANNEX A

DRAWINGS

ANNEX B

SOIL AND GROUNDWATER REMEDIATION CRITERIA

CONTAMINANTS AND CONSTITUENTS OF CONCERN

Constituents of Concern - West/north and east submodels	Contaminants of Concern – east and west submodels	Soil Target value (remediation value) mg/kg	
		East model♣	West Model♣
Phenol*		Not reqd	Not reqd
Naphthalene**	Napthalene	**58**	**99**
Benzo(a)pyrene***		Not reqd	Not reqd
Cyanide		Not reqd	Not reqd
Ammonium		Not reqd	Not reqd
Arsenic		Not reqd	Not reqd
Cadmium		Not reqd	Not reqd
Mercury		Not reqd	Not reqd
Selenium		Not reqd	Not reqd
Copper		Not reqd	Not reqd
Nickel		Not reqd	Not reqd
Zinc		Not reqd	Not reqd
Benzene****	Benzene	Not reqd	**3.3**
Toluene****		Not reqd	Not reqd
Ethylbenzene****		Not reqd	Not reqd
	Acenapthylene	**120**	

* Phenol is the *Risk Indicator* for phenolic compounds.

** Napthalene was modelled as it represents the primary PAH recorded in groundwater at the site due to its relative solubility in comparison to the other priority PAH's.

*** Benzo (a) pyrene is a known carcinogen and was therefore modelled although it has a relatively low solubility.

**** Benzene, Toluene and Ethylbenzene were modelled as the primary **Risk Drivers** for BTEX.

♣ Refer to Quantitative Risk Assessment (Ref. E0357/LH/OCT2003/QRA/V1) for technical detail.

Note 1: Relating to validation testing only: In cases where tests for each and every determinant listed above are at least 90% compliant (i.e. the trigger value is not exceeded by more than 10%), these will be regarded as acceptable results.

Note 2: The above criteria will be considered alongside risk assessment for significance of effects where appropriate.

Note 3: If validation test results detect chemical concentrations within 20% over the above criteria, leachate testing will be used to assess risk and acceptability of validated contamination.

Groundwater Remediation Criteria for Yeading Brook Receptor
with dilution using half EQS values (as agreed with EA)

	Yeading Brook		Grand Union Canal
	West Area	North Area	East Area
	mg/l	**mg/l**	**mg/l**
Ammonia*	**11.613**	None Required	None Required
Benzene*	None Required	None Required	**16.214**
PRO (C5-C10)	**0.232**	None Required	**5.405**
Napthalene (C12)	**0.232**	None Required	**5.405**

Note: the above values will be further evaluated prior to construction using results of the groundwater remediation feasibility trials, through an enhanced quantitative risk assessment.

National Grid Property Limited

Beyond Green

Capita Lovejoy

Cyril Sweett

Hakes Associates

Hunt Dobson Stringer

Make

Marks Barfield Architects

PPS Group

RPS

Savell Bird & Axon

Savills

White Young Green