12 GROUND CONDITIONS

12.1 Introduction

12.1.1 The Site proposed for the West Southall Scheme has a mixed industrial heritage associated with its historic land use and as a result, issues relating to contamination and ground conditions have been identified as environmentally significant. However, the environmental risks associated with the Site have been studied over a number of years through several extensive investigations and assessments, and are well understood.

12.1.2 Ground conditions associated with this former gasworks site have been identified as being of reduced chemical quality in certain areas as a result of historic gas production, associated operations, and other industrial activities. These ground conditions represent a potential risk to the groundwater and subsequently to nearby surface water bodies, as well as to any development, and require remediation to mitigate the risk.

12.1.3 This Chapter details the methodologies used to assess the risks as well as identifying the associated effects and their significance relating to the development. Mitigation proposals have been outlined to reduce risks to the identified receptors.

12.1.4 The environmental aspects of ground conditions are closely linked with the issues relating to groundwater. For example, the potential contamination within the overlying soils may influence underlying groundwater quality. Therefore, reference should be made to Chapter 13: The Water Environment for associated implications on ground and surface water features.

12.1.5 This chapter should also be read in conjunction with all other chapters that relate to works involving ground disturbance, namely Chapter 5: Construction and Phasing and Chapter 15: Archaeology and Built Heritage.

12.1.6 The assessment of ground conditions has been undertaken by White Young Green Environmental (WYGE).

12.2 Planning and Legislative Context

12.2.1 Current, key environmental legislation with respect to contaminated land includes the Environment Act (1995) [(12.1)], Water Resources Act (1994) [(12.2)], Environment Protection Act (1990) [(12.3)], Health and Safety at Work Act (1994) [(12.4)], Town and Country Planning Act (1990) [(12.5)] and the Building Regulations (1985) [(12.6)].

12.2.2 The Environment Act 1995 (Section 57) makes provisions for a risk based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000 and are aimed at ensuring that actions taken with respect to contaminated land are directed by a technically well-founded assessment of risk that considers the source/pathway/receptor scenario, sometimes referred to as the 'pollutant linkage'.

12.2.3 The European Council (EC) Landfill Directive (1991/31/EC) [(12.7)] was adopted in July 1999. It sets out operational, regulatory and technical requirements for the landfilling of waste. This was adopted in the UK as The Landfill (England and Wales) Regulations 2002 [(12.8)] which implements the regulatory and technical aspects of the Directive. Council Decision 2003/33/EC [(12.9)] sets out criteria and testing procedures to be adopted and the Waste Acceptance Criteria (WAC) for landfills. This legislation is applicable to the removal for disposal to landfill of contaminated materials originating from the Site.

National Planning Policy

12.2.4 The new regime for the regulation of contaminated land is described in Part IIA of the Environmental Protection Act 1990 introduced by Section 57 of the Environmental Act 1995 and qualified by the associated Statutory Guidance and various special regulations.

Planning Policy Statement 23 (PPS23): Planning and Pollution Control - Annex 2: Development on Land Affected by Contamination (1994) [12.10]

12.2.5 PPS23 provides guidance on how the Government's policies for contaminated land are to be reflected in land use planning. It embodies the Government's commitment to the regulation and remediation of land affected by contamination and requires that developers of brownfield sites will need to satisfy the local authority that any identified unacceptable risks from contamination will be successfully addressed through remediation without undue environmental impact during and following the development.

12.2.6 PPS23; Section 25 states that:

"The remediation of land affected by contamination through the granting of planning permission (with the attachment of the necessary conditions) should secure the removal of unacceptable risk and make the site suitable for its new use. As a minimum, after carrying out the development and commencement of its use, the land should not be capable of being determined as contaminated land under Part IIA of the EPA 1990."

Regional Planning Policy

The London Plan consolidated with amendments since 2004 (2008) [12.11]

12.2.7 Policy *4A.16* states that *"Bringing contaminated land into beneficial use; - 'The Mayor will work with strategic partners to identify best practice mechanisms to enhance remediation of contaminated sites and bring the land into beneficial use."*

Local Planning Policy

Ealing's New Plan for the Environment (saved policies)(2001) [12.12]

12.2.8 The Council will be required to replace the current UDP with a Local Development Framework (LDF). Section 2.7 of LB Ealing's Unitary Development Plan (UDP), sets out the Council's intentions for land and development from 2002 to 2017. It forms the basis for dealing with planning applications. However, LB Ealing have also published a separate document entitled the 'Contaminated Land Strategy', revised in June 2006 [12.13], which sets out how LB Ealing intend to inspect the whole Borough to determine priority areas that require more detailed assessment. The strategy details how the authority will take a rational, ordered and efficient approach to this inspection.

12.2.9 The contaminated land Strategy presents LB Ealing's priorities in dealing with contaminated land. They are as follows:

- Protect human health;
- Protect controlled waters;
- Protect designated ecosystems;
- Prevent damage to property;

- Prevent any further contamination of land;
- Encourage voluntary remediation; and
- Encourage re-use of brownfield land.

Hillingdon's Unitary Development Plan (1998) *(12.14)*

12.2.10 LB Hillingdon will also be required to replace the current UDP with a Local Development Framework (LDF). LB Hillngdon's Saved Policies document indicates that the UDP has recently dropped two policies relating to ground conditions (OL24 and OL25). The draft revised Local Development Scheme is currently being submitted to the Government Office for London for approval. The existing Supplementary Planning Guidance (SPG): Land Contamination (2004), which is presently a material planning consideration, will be brought into the LDF in the form of a Supplementary Planning Document. This document provides guidance and sets out parameters for the consideration of land contamination as it relates to development proposals. The existing SPG, adopted in 2004, will continue to be used until the estimated date of adoption of the SPD (July 2008).

12.2.11 The current SPG aims to provide planners and developers with guidance on when land contamination issues should be considered and the investigation and assessment required to satisfy a contaminated land condition.

12.2.12 LB Hillingdon also has a Contaminated Land Inspection Strategy which was published in July 2001 with revisions in 2005. The Strategy details how LB Hillingdon will carry out its duties in collating and reviewing information on land, which may have contamination issues, in order to identify contaminated land in the borough.

12.3 Methodology & Significance Criteria

12.3.1 The methodology for the assessment of ground conditions comprises identification of site-specific chemical and geological baseline data followed by a detailed assessment of the environmental implications posed by the proposed Scheme (both qualitatively and quantitatively) as a result of the ground conditions. This assessment is then used as the basis for developing an appropriate remediation strategy to mitigate the potential effects of the identified contamination.

12.3.2 The Site has been subject to a programme of historic Site Investigation (SI) work, principally by White Young Green Environmental (WYGE) with earlier stages of investigation by third parties since around 1989, as outlined in Table 12.1. Whilst information contained within the earlier stages of investigation has been assessed it has not been incorporated into the final assessments as a result of the changes in investigation, analytical and assessment techniques.

Table 12.1 Site Investigation works carried out on the Site

Year	Details of Investigations
1999	13no. boreholes with associated chemical testing.
2001	52no. boreholes, 323no. Trial Pits with associated chemical testing to soil, leachate, ground and river water and land gases. Aquifer characteristics and geotechnical testing
May 2003	Groundwater monitoring of 46no. existing boreholes and river and canal waters with associated chemical testing.
September 2003	15no. trial pits with specialist petroleum hydrocarbon banding analyses to soils (in all areas of the Site).
October 2007	A further round of groundwater monitoring of 16no. of the total 56no. recorded borehole locations from the previous investigations were monitored. The remaining 40no. boreholes were either lost or inaccessible through on-site operations or damaged.

12.3.3 Information relating to the ground conditions on the Site has been sourced from the following documents:

- Ground Conditions Report (including summary of previous SI and desk top information) – Refer to Section 12.8 and Appendix 12.1

- Remediation Strategy – refer to Appendix 12.2

These are the 'key' reports and assessments. There are a number of other documents relating to the contamination potential of the former land uses. However, these have not been reproduced in this Environmental Statement, as the information within them is summarised in the reports listed.

Consultations

12.3.4 WYGE has consulted the Environment Agency (EA) as detailed in the above reports and has held ongoing meetings with representatives of LB Ealing, LB Hillingdon and British Waterways.

Site Investigation (SI)

12.3.5 The Site has been thoroughly investigated, largely through the use of boreholes (converted to long-term monitoring wells) and through the excavation of trial pits/trenches.

12.3.6 The works carried out on the Main Site are summarised in Table 12.1 (also refer to Figures 12.1 and 12.2).

12.3.7 The SI's were designed to recover information on the ground conditions cognisant of a number of factors including those listed below:

- To characterise the extent if any of contamination resulting from the past use of the Site, specifically investigating those areas known to have a potential for contamination to occur (using historical layout plans as a basis);

- To characterise geological and hydrogeological conditions in order that an accurate conceptual plan could be developed;

- To provide a sufficient level of information to determine significant risks posed by the Site by adopting the pollutant linkage risk scenarios; and

- To provide a sufficient level of information to develop a comprehensive and effective remediation strategy that addresses risks identified from the above three processes.

12.3.8 Soil, groundwater, surface water and land gas samples were recovered from the SI works to assess and interpret the prevailing geological and chemical ground conditions.

Other Survey Work

12.3.9 The mounding in the vicinity of Pump Lane Link Road is referred to as the Minet Island. This mounding is known to comprise waste materials from tipping activity undertaken on this area between 1935 and 1966. Ground investigation works were undertaken by British Waterways on the area of the Minet Island and were made available to WYGE for the purposes of this EIA (refer to Section 12.8). In addition, CL Associates, on behalf of British Waterways, undertook a ground investigation on the Minet Island in 2004 which comprised 4 boreholes to 15-20mbgl and 27 trial pits (refer to Section 12.8). These reports have not been reproduced in the appendices.

12.3.10 Additional SI's were also undertaken in December 2007 on the sites of the landing positions of Springfield Road and Minet Park Footbridge. Soil, leachate and groundwater chemical analysis was undertaken from samples retrieved from these locations. The SI's comprised the following:

- Minet Park Footbridge – 2 boreholes (BH1 & BH2) to 10mbgl
- Springfield Road Footbridge – 1 borehole (BH3) to 10mbgl and 1 trial pit (TP1) to 1.3mbgl

Quantitative Risk Assessment (QRA)

12.3.11 The results of the chemical analyses from the detailed investigations for the Main Site were input into a QRA model to derive the basis for agreeing the appropriate remediation criteria for soils and groundwater. A QRA adopts a tiered hierarchy that determines the level of theoretical modelling required to evaluate the risks posed to the receptor and the corresponding level of remediation required.

12.3.12 The results of initial Tier 1 screening assessments (i.e. the comparison of chemical results arising from a SI against generic criteria, 'Tier one criteria', in order to determine the degree of contamination - undertaken on the SI's available up to 2001) highlighted that certain contaminants posed a potential risk to the local watercourse, specifically the Yeading Brook. This assessment formed the basis of subsequent consultations with the EA and also a further QRA to allow more detailed development of the remediation strategy. A detailed scoping and interim assessment letter was submitted to the EA prior to the commencement of the study.

12.3.13 Whilst there are three QRA tiers, modelling for the Site was only considered necessary to Tier 2 for the Main Site, this approach was discussed and agreed with the EA. Tier 3 QRA was undertaken however for the Yeading Brook. A Tier 2 assessment uses a generic computer model to assess potential contaminant flows at the Site. A Tier 3 assessment comprises a detailed site specific model to assess the likelihood of contamination of identified human health and environmental receptors.

12.3.14 QRAs were also undertaken to ascertain the risks posed to human health based on the uses proposed for the Scheme. The Contaminated Land Exposure Assessment model (CLEA) was used to assess potential risks for constituents for which a 'Tox' report has been published by the Department for the Environment, Food and Rural Affairs (DEFRA). In the absence of a Tox report, values were derived utilising RBCA software modified to be compliant with the CLEA framework where possible. The modelling primarily utilised data collected, measured or recorded in-situ to allow a robust representative 'site specific' model to be developed.

12.3.15 It should also be noted that the Canal flowing immediately adjacent to the Site's northern boundary was not included within this stage of risk assessment in recognition of the fact that groundwaters do not act to re-charge the Canal (due to the presence of a clay lining and differences in groundwater/surface water levels). This has been agreed with the Environmental Health Officer (EHO) of LB Ealing and the Environment Agency (surface water team).

Mitigation Strategy

12.3.16 A Remediation Strategy was prepared by WYGE in January 2008 and submitted to LB Ealing for approval (see also Appendix 12.2). This separates the Site into different contamination areas, relating to the historical and proposed land uses, and identified remediation targets for each area. The actual methods of remediation will be confirmed prior to commencement of these works, and will take account of the best available and most appropriate technology at the time of implementation. The remediation works will be completed prior to construction of the proposed development.

12.3.17 The impact of the remediation works on the ground quality at the Site has been assessed within the Construction Assessment. The initial assessment of likely significant effects has been completed as if the remediation were not completed, with a significance assigned to these 'without remediation'

effects. The Remediation Strategy has been offered as mitigation of these effects (described in Section 12.6) and then the overall significance of these effects identified.

12.3.18 The assessment of the operation and occupation of the Proposed Assessment assumes that the remediation works have been completed and that the soils underlying the Site are 'fit for use'

Significance

12.3.19 Following the appraisal of the baseline and review of the historically available information, assessments of the effects of the Proposed Development on subsurface soils, local geology and geomorphology are presented. The assessment of the magnitude of potential effects has been identified qualitatively using professional judgement and/or by applying predictive techniques (with reference to regulatory standards and industry practice).

12.3.20 The Significance Criteria outlined in Chapter 2: ES Scope and Methodology ES have been applied throughout this chapter to classify the significance of the various effects identified. Table 2.2, which presents these significance criteria, has been reproduced as Table 12.2 below.

Table 12.2 Significance Matrix

	Magnitude of Impact			
Sensitivity/value of receptor	High	Medium	Low	Negligible
High	Substantial	Substantial	Moderate	Minor
Medium	Substantial	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

12.4 Baseline Conditions

Main Site

History

12.4.1 Planning records from LB Ealing and LB Hillingdon, historical maps, site layout plans, aerial photographs of the Site and surrounding area and site operator records have been reviewed to determine the past land uses and operations that may have affected the Site.

12.4.2 A composite summary plan detailing the main historical stages of development and associated infrastructure on the Site is reproduced at Figures 12.3 and 12.4.

12.4.3 In summary the historical development of the Site is outlined in Table 12.3 below

Table 12.3 Historical Development of the Site

Year	**Description**
1868	The Site was originally occupied by farmland and later developed into brickfields and an oil works before being purchased by the Brentford Gas Company in 1868.
1869	Gas was first produced by Christmas of 1869.
1885	By 1895 three new holders had been built. The plant expanded so that by 1885 it included a sulphate of ammonia plant.
During World War I	During World War 1 chemical plants were constructed to produce oil gas tar, coal tar and crude benzole. These are tentatively identified as formerly located in the far western area of the Site with approximate localities indicated on the detailed historical development drawing

Year	Description
	Figures 12.3 and 12.4. Additionally, a benzole rectification plant was constructed.
Early 1920's	The central part contained the main works in retort houses, purifiers and holders. There was a storage area and railway sidings to the west. Employee housing was located to the east. The chemical works were present to the north, along with gravel pits and a brickworks.
1935	By 1935, the chemical works had closed and had been replaced by a newer, smaller works further to the east. The Site of the old works became a chemical storage ground.
After World War II	After World War II oil gasification began increasing the efficiency of the plant.
1960	From 1960 coal was superseded as a feedstock by liquid petroleum gas (LPG).
1962	Coal carbonization ceased fully in 1962. As a consequence, rationalisation of buildings occurred due to the change in the feedstock type e.g. storage facilities. Whereas coal could be stockpiled, LPG had to be stored in tanks.
1963 & 1964	In 1963 catalytic reforming plants, having a total capacity of 60 million cu.ft per day were installed, two going into production in late 1963, the other two in early 1964. Later that year LPG capacity was increased to 216,000 gallons.
1973	With the advent of natural gas supplies the works closed in 1973 leaving gas distribution and storage as the main on-site functions.

Manufacturing Processes Used on Site

12.4.4 The Site has a complex industrial history and has been subject to multiple phases of development as indicated above. A range of potentially contaminating manufacturing processes have been historically utilised on-site, and where details of these are known they are presented in Table 12.4 - Manufacturing Processes Utilised on Site, and depicted on Figure 12.5:

Table 12.4 Manufacturing Processes Utilised On-site

Area (Refer to Figure 12.5, for zone designations)	Approx Date	Activity / Process	Potential Associated Contamination
C3	1868	Brick Works	Limited
D2	1868 - 1895	Oil Works	Hydrocarbons
D3, D4, D5, D7	1886 - 1960	Coal Gas Manufacture	Hydrocarbons (BTEX, PAH), phenols, cyanides, ammonium, sulphate, metals
C1	1895 - 1963	Norwood Chemical Works	Hydrocarbons
D2	1895 - 1935	Aldgate Chemical Works	Hydrocarbons
D5, D6	1918 - 1960	Benzole Manufacture	Hydrocarbons
		Tar Manufacture	
D1 – D7	1960 - 1970	Oil Gas Manufacture	Hydrocarbons (BTEX, PAH)
NGG Site	1970 - present	Natural Gas Storage	Limited
B, C1 – C3 and D1 – D7	1990 - present	Secure Vehicle Storage	Localised hydrocarbons in vehicle preparation areas

Site Investigation Findings

12.4.5 The SI works were referred to in order to characterise the size, extent and depth of remnant below ground site features and the magnitude (area/extent and significance) of contamination issues. Very limited technical construction information is available relating to specific site features, however based on knowledge of similar sites the following general assumptions have been made:

- It is considered remnant below ground features (i.e. old footings and gas production infrastructure) are present at varying depths primarily within Made Ground;

- Certain structures have, by necessity, been practically engineered to a significant depth during historic site development; and

- The high groundwater levels and large development area of the Site are both factors which appear to have resulted in above ground construction being a favoured development option for features that would commonly be placed below the ground on similar sites.

General Ground Profile

12.4.6 The SI's completed to-date recorded that Made Ground was encountered in all survey positions to a maximum thickness of 2.8m in the central eastern area of the Site. However, deeper Made Ground in and around historic underground features is also thought to exist. The Made Ground was variable in composition with sandy gravels to sand, some clay, with varying proportions of rubble, glass, brick, flint and clinker. Contamination was also visually identified in certain areas and depths within the Made Ground.

12.4.7 Below the Made Ground an inconsistent layer of Brickearth and occasional isolated lenses of Alluvium have been identified. Brickearth has historically been extracted for associated brick manufacture. This attained a maximum thickness of 1.1m and consisted predominately of slightly sandy, silty clay with occasional gravels and sand lenses. Occasionally, a fine grained black organic and anaerobic material was encountered which, although not indicated on BGS maps, appears to be more representative of Alluvium than Brickearth. The Brickearth was generally absent from the northern and central eastern areas of the Site. Contamination was visually identified within certain locations in the Alluvium / Brickearth as well as within the Made Ground.

12.4.8 Below the Brickearth a consistent layer of Terrace Gravels was identified (identified as the Taplow Gravels). The precise boundary between the Brickearth and the Gravels was difficult to assess as the lowest deposits of the Brickearth are gravelly in nature. The Gravels attained a maximum thickness of 6.9m and consisted predominately of fine to coarse sub-angular flint gravel with sand and minor lenses of clay. Contamination was visually identified within certain locations in the Gravels. London Clay was identified in all locations below the gravel.

12.4.9 The results of the Site Investigations for different areas of the Main Site are described in detail below; these section should be read in conjunction with Figure 12.6 for a pictorial representation of the zones.

Soils – Zone A

12.4.10 Zone A is located to the extreme east of the Main Site and is characterised by an absence of historical gas production infrastructure; it was previously used as a playing field/sports ground.

12 4.11 Chemical testing of soil samples identified that contamination is limited to traces of heavy metals (principally arsenic). However, the concentrations are not considered significant. To the west of the zone further metals are identified, including copper, lead and zinc.

12.4.12 The levels of arsenic found, with the exception of those samples recovered from the boundary area with Zone B, are considered to be resultant of activities other than the direct contamination from the former gasworks. Background arsenic levels that occur naturally within London Clay have been found to vary between 5 and 50mg/kg and these are considered to be as a result of atmospheric fall-out from domestic and industrial coal fires.

Soils – Zone B

12.4.13 Zone B comprises the north eastern area of the Main Site. It is, like Zone A, characterised by an absence of historical gas production infrastructure, although some activities in the form of gravel and

clay extraction (subsequently backfilled) and coal plus coke storage have been carried out previously on this land.

12.4.14 The extraction areas and their associated thicknesses were observed during the SI's, representing the material used to infill the pits. Geological logs of the area indicate a generally inert soil matrix with variable contents of ash and clinker, plastics, timber and general refuse. Observations of occasional contamination including tars and solvent odours were also recorded.

12.4.15 Arsenic is again present in this zone, although concentrations remain generally low with the exception of a single location which is identified as being 'significant', (i.e. exceeds Tier One criteria). Organic contaminants were recorded, with polyaromatic hydrocarbons (PAH's) being the most prevalent, but also with total petroleum hydrocarbons (TPH) and volatile hydrocarbons (BTEX) being identified in a limited number of locations. On the whole, contamination appears to be restricted to the top 1.0m of material in the Made Ground in Zone B.

12.4.16 The contamination profile assessed across this zone suggests that the infilling of old brickpits mixed waste materials is in part responsible for some of the more significant concentrations.

Soils – Zone C

12.4.17 This zone occupies the north western section of the Main Site and was historically characterised by the presence of coal and coke storage areas and a chemical works. An infilled dock delineates the southwest boundary.

12.4.18 The contamination profile is dominated by metals, in particular arsenic. The concentrations, although elevated, are not considered to be significant in relation to proposed gardens or open space uses. Some localised contamination by BTEX and PAH has also been recorded. The contamination is generally present to a depth of 1.5m within the Made Ground, although in a number of locations it has been identified to a depth of 3.0m, corresponding to samples recovered from the gravels or brickearth where present.

Soils - Zone D (inclusive of Gasholder West Area)

12.4.19 Zone D represents the location of the main production plant of the former gasworks plus the three redundant gasholders, extending from the centre of the Site to its western end. Contamination has been identified as widespread and variable, comprising of metals (toxic and phytotoxic), Organic (PAHs) and Phenols. In general, the contamination is contained within the Made Ground (to a depth of 1.5m) although in localised instances it extends deeper.

12.4.20 The contamination in this area is characteristic of the use of the Site for gas production. Much of the infrastructure representing a greater risk of contamination, for example tar and fuel tanks, was sited to the northwest of the zone, between the gasholders and the Canal. This area exhibits some of the more significant contamination profiles. The Site Investigations indicate that much of the below ground infrastructure associated with the Site's former operations remains present. This represents not only a significant consideration for the proposed Scheme but also a potential for 'contained' sources of contamination.

Leachate

12.4.21 The potential for the leaching of contamination has been identified in areas where locally elevated soil contaminants, which are potentially mobile or soluble, have been recorded.

Groundwater

12.4.22 The River Terrace Deposits (Taplow Gravels) are identified as having been contaminated with hydrocarbons (generally as a sheen coating the gravel). Dissolved phase TPH, PAH and

Ammonium contamination have also been identified across the Site with locally occurring elevated metals and inorganic compounds. Additionally, free-phase hydrocarbons have also been identified floating on and in the groundwater.

Land Gas

12.4.23 Elevated concentrations of carbon dioxide and methane and / or depleted oxygen have been identified across the Main Site. Elevated concentrations are generally associated with areas of identified or observed contamination impact. Volatile Organic Compounds (VOCs) were recorded as trace concentrations intermittently across the Site.

Results of Quantitative Risk Assessment

Controlled Waters

12.4.24 The Risk Based Corrective Action (RBCA) Tier 3 QRA modelling was undertaken to assess potential risks to the Yeading Brook (located 41m from the western boundary of the Site). This is the primary Controlled Water receptor as the Canal along the western boundary of the Site is not in hydraulic continuity with the groundwater as explained previously.

12.4.25 Other identified receptors were also modelled, as follows:

- Sentinel borehole (500m from the southern boundary of the Site).
- The Grand Union Canal (1.1km from the southern boundary of the Site).

12.4.26 The modelling primarily utilised data collected, measured or recorded in-situ to allow a robust and representative 'site specific' model to be developed.

12.4.27 In order to facilitate a manageable model the Site was split into sub areas, reflecting the size of the Site; the large dataset of information; inconsistencies in the hydrogeological regime; and, the soil contaminant profile.

12.4.28 The results of the environmental QRA show that four species of organic contaminants (ammonia, benzene, petrol range organics and naphthalene) represent a potential risk to the controlled waters of the Yeading Brook principally from areas of the Site to the southwest (the former gas production areas, i.e. Zone D). Tables 12.5 and 12.6 below outline the results of the QRA modelling for groundwater and soils respectively.

Table 12.5 Groundwater Remediation Criteria for Yeading Brook Receptor with Dilution using Half EQS Values (as agreed with EA)

	Yeading Brook		Grand Union Canal
	West Area (Zone D1-7 & SW part of C1)	**North Area (ZonesC2&3 & NW part of C1)**	**East Area (Zones A, B and remainder of C1)**
	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

Table 12.6 Quantitative Risk Assessment (Controlled Waters) - Soils

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
Naphthalene	Napthalene	58	99
Benzene	Benzene	None Required	3.3
	Acenapthylene	120	None Required

Human Health

12.4.29 QRA modelling was also undertaken to assess the potential risks to the human health of future end users of the Site. QRA modelling identified limited metal contamination combined with organic contaminants (Benzo-a-Pyrene, Benzene and Naphthalene in the soil, and organics only in the groundwater) posed a potential risk to human health. The QRA modelling determined the Contaminants of Concern (CoC) for each distinct area of the Site. These are shown in Table 12.7.

Table 12.7 Quantitative Risk Assessment (Human Health)

	Soil			Groundwater		
	West Area Sub Model	**North Area Sub Model**	**East Area Sub Model**	**West Area Sub Model**	**North Area Sub Model**	**East Area Sub Model**
Residential (with Plant Uptake	Benzo(a)pyrene, Benzene, Naphthalene, Arsenic	Benzo(a)pyrene, Naphthalene, Cadmium, Arsenic, Benzene,	Benzo(a)pyrene, Arsenic, Cadmium, Benzene, Naphthalene,	Aliphatic >C8-C10, Benzene	Benzene, Aliphatic >C8-C10, Aromatic >C5-C7, Aromatic >C10-C12	Benzene, Aliphatic >C*-C10, Aromatic >C5-C7, Aromatic >C8-C10, Aromatic >C10-C12
Residential (Without Plant Uptake)	Benzo(a)pyrene, Benzene, Arsenic, Aromatic >C5-C7	Benzo(a)pyrene, Arsenic, Benzene, Mercury, Naphthalene, Aromatic >C5-C7	Benzo(a)pyrene, Arsenic, Benzene, Naphthalene, Mercury, Aromatic >C5-C7			
Commercial	Benzene, Benzo(a)pyrene, Arsenic, Aromatic >C5-C7	Benzo(a)pyrene, Naphthalene, Benzene, Arsenic	Benzo(a)pyrene, Napthalene, Benzene, Aliphatic >C8-C10, Aromatic >C5-C7, Aromatic >C8-C10	Benzene, Aliphatic >C8-C10, Aromatic >C5-C7	Benzene	Benzene, Aliphatic >C8-C10, Aromatic >C5-C7, Aromatic >C8-C10

Pump Lane Link Road

History

12.4.30 The mounding in the vicinity of Pump Lane Link Road is referred to as the Minet Island, this mounding is known to comprise waste materials and present a potential risk. The historical review indicates that mounding, associated with the deposition of material on to Minet Island, commenced between 1935 and 1966. Other than this mounding, the land along the proposed route of the road has consistently remained as undeveloped agricultural (pasture) land.

Site Investigation

12.4.31 The British Waterways (BW) SI on the Minet Tip site in 1998 and the CL Associates SI in 2004 have been reviewed to inform the following analysis.

General Ground Profile

12.4.32 The 1998 Site Investigation included five sample locations within 100m north of the proposed Pump Lane Link Road whilst the 2004 investigation included a further five. Of these trial pits, two were excavated; these recorded Made Ground comprising soft, black odorous clay, listed as 'probable gasworks waste' (note: this is the description as advised on the log of the trial hole but unsubstantiated). The four samples closest to the proposed road indicate a layer of domestic or construction waste at the surface and a number are recorded as having a layer of probable 'canal dredgings'. The logs on lower ground do not show the presence of Made Ground but show Alluvium, overlying a thin layer (0.1m on average) of River Terrace gravels, overlying London Clay. It would therefore seem logical that elevated areas shown on the Ordnance Survey map are the areas of raised, potentially contaminated Made Ground. To the west of the Yeading Brook the geomorphology can be characterised as flat and featureless.

12.4.33 Generally, the geology conforms to the anecdotal evidence of disposal of various wastes, underlain by naturally occurring River Terrace gravels and then into the London Clay. By developing a geological cross section from the BW data it can be seen that the waste materials deposited onto Minet Island thin out to the north eastern and south western corners, corresponding with the physical configuration of the island itself.

12.4.34 Near surface soil contamination (i.e. <1mbgl) was recorded in the 2004 investigation as elevated concentrations of Arsenic and occasionally elevated concentrations of Lead, Cyanide, Benzene, Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbon (PAH) compounds were recorded. Widespread, elevated concentrations of Arsenic, Boron, Copper, Zinc were recorded at depths corresponding with gasworks wastes. Cyanide compounds, Cadmium, Lead and Nickel were also recorded at elevated concentrations in this waste on a less frequent basis. PAH and TPH (typically in the diesel and mineral oil range) compounds were also recorded on a localised basis. The presence of asbestos was also recorded within the 'probable gasworks waste' materials. Samples recovered from the canal dredging wastes comprised elevated concentrations of metalloid constituents (Arsenic, Lead, Cadmium, Chromium, Nickel, Copper and Zinc) and TPH (predominantly diesel-range compounds). Only limited impact was recorded in the natural gravel and clay strata underlying the Minet Island.

12.4.35 Further review of the BW data indicates that the gravels beneath a large part of the central and northern part of the island have historically 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.

Leachate

12.4.36 The majority of constituents recorded at elevated concentrations within the unsaturated soil samples were not found to be leachable at concentrations exceeding the relevant quality standards.

Groundwater

12.4.37 Elevated concentrations of Nickel, Chromium, Cadmium, Copper, Zinc, Thiocyanate and Total Cyanide and TPH (predominantly diesel-range compounds) were recorded in the shallow aquifer during the 2004 investigation indicating some degree of groundwater contamination to the northeast of the Proposed Link Road.

Land Gas

12.4.38 Standpipes installed during the CL Associates ground investigations were monitored for the presence of land gases on two separate occasions. In the borehole nearest to the Proposed Pump Lane Link Road route elevated concentrations of Carbon Dioxide were recorded at around 4% to 17% (v/v). Depleted concentrations of Oxygen were also recorded. The elevated land gases are likely to be the result of the breakdown of organic materials both naturally occurring (alluvial clays and silts deposited as dredgings) and those produced as a consequence of the gas/chemical production process.

Minet Park Footbridge

History

12.4.39 The landing position of the Footbridge, to the west of Yeading Brook, remained undeveloped throughout the reviewed history (1868 – present day). The Minet Island in this location has been subject to historically contaminating activities, comprising a tip area (see above). The Footbridge is located just inside the northern extent of this former tip area.

Site Investigation

12.4.40 Two boreholes drilled in the landing position of the bridge to the west of Yeading Brook and two trial pits within Minet Island are considered representative of this ground.

General Ground Profile

12.4.41 At the landing position of the Minet Footbridge, the two boreholes indicate the ground profile to comprise 0.4m of topsoil over re-worked River Terrace Gravels (RTG) to a depth of 1.8mbgl and 2.5mbgl. The RTG comprises gravely silt/clay beneath which London Clay was encountered to the depth of the excavation. Contamination testing of soils in this location revealed slightly elevated Arsenic (46mg/kg) at 0.5mbgl. The logs within the Minet Island indicate that there is approximately 3.5m of Made Ground comprising construction waste and canal dredgings and some contamination. Contamination testing indicates limited heavy metal (slightly elevated Arsenic at 20mg/kg) and some Hydrocarbon contamination (Carbon band 21-35) present. From a contamination perspective, the quality of the soil does not appear to have been significantly impacted.

Leachate and Groundwater

12.4.42 To the west of the Yeading Brook, no elevated concentrations of leachate were recorded. However, slightly elevated Anthracene and Ammonia were recorded in the groundwater. Slightly elevated total concentrations of heavy metals and hydrocarbons were encountered in soils within the Minet Island. However, no leachate or groundwater testing was undertaken on samples from this location.

12.4.43 Contaminated material of increased significance is known to the southwest of the proposed route of the Minet Park. It is considered that migration of associated leachate and groundwater would tend to be towards the Yeading Brook in this case.

Land Gas

12.4.44 Given the presence of deposits of potentially contaminated material to the southwest and the presence of canal dredgings and other fill of an organic nature in the location of the proposed Footbridge, there is a potential that land gases may be produced from the Minet Island area. No land gas chemical analysis has been made available for the purposes of this assessment, however, to the west of the Yeading Brook, land gas monitoring was undertaken but no gases were recorded above detection levels.

Springfield Road Footbridge

History

12.4.45 The landing position of the Springfield Road Footbridge, to the west of Yeading Brook has remained undeveloped throughout the reviewed history (1868 – present day). Additionally, where the bridge crosses the Minet Island at this northern point, there is no significant evidence of potentially contaminating activity.

Site Investigation

12.4.46 The one borehole and one trial pit excavated by WYGE are considered to provide representative ground conditions for the landing area of the Springfield Road Footbridge, to the west of Yeading Brook.

General Ground Profile and Contamination Conditions

12 4.47 The recent Site Investigation revealed topsoil overlying RTG (gravely silt/clay) to a depth of 3.2m, below which London Clay was encountered. No elevated contaminants were encountered within the soils tested. However, slightly elevated Copper (14µg/l), Lead (45µg/l) and Zinc (34µg/l) at 1-1.3mbgl were recorded in leachate. Some limited groundwater impact was recorded from slightly elevated Ammonia and Anthracene, however, elevated land gas was not recorded. It is considered, that in the absence of contaminating activities, the quality of the soil is unlikely to have been significantly impacted within the Minet Island where this bridge crosses, although there may be some migration of impacted groundwater from the tip area to the south or the Main Site to the east.

Eastern Access

History

12.4.48 No potentially contaminating industries are recorded for this access route.

Site Investigation

12.4.49 To date, no below ground investigation has been made available to this assessment. However detailed knowledge of the subsurface conditions (including an assessment of groundwater flow directions) of the Main Site has helped inform the interpretation of contaminant migration risk to this area.

General Ground Profile

12.4.50 A review of the history of the area indicates that geology is likely to comprise an element of Made Ground passing into natural geology. It is considered that in the absence of contaminating activities the quality of the soil would not have been reduced.

Leachate, Groundwater and Landgas

12.4.51 Due to the absence of likely contamination along the route, it is assessed that the risk posed from the generation of leachate, contaminated groundwater and land gas is low.

12.5 Assessment of Effects - Construction

Main Site

Soil

12.5.1 The biological and chemical quality of the soil has been found to be adversely affected to varying degrees through historical on-site operations and the subsequent release or deposition of contaminants. The presence of contamination has been assessed as representing an unacceptable risk both to the environment (groundwater, surface water, ecology) and, in certain areas, to the proposed development and its users unless appropriate remediation/ mitigation is employed. Potential adverse effects of the soil chemistry will be reduced either through direct remediation (i.e. contaminant stabilisation or removal) or by the introduction of appropriate mitigation measures within the design of the buildings and/ or landscaped areas of the proposed development. Remediation is proposed in two stages prior to the construction with those zones where the risk from contamination has been identified as unacceptable.

12.5.2 The first stage will be to excavate the contaminated soils and relocate these to treatment centres established on-site. In certain cases where the contamination is deemed untreatable on-site the excavated soils will be disposed of in an off-site landfill or processing facility. Contaminated soils present below the water table will be subject to in-situ groundwater treatment, as outlined in the Remediation Strategy at Appendix 12.2.

12.5.3 Following treatment, the soil will be re-deposited on the Site. Generally, the removal of the soil would not interfere with the current groundwater equilibrium except in those areas where it is deemed necessary to excavate below the water table. This would, therefore, result in localised effects on the level of the watertable at worst.

12.5.4 Made Ground has been identified across the majority of the Site, much of which contains significant concentrations of organic (Hydrocarbon) contaminants. The proposed treatment of this material would effectively reduce contamination levels so that the soil is suitable for use.

12.5.5 Excavation activities during construction or once the Site is occupied may disturb contaminants currently immobilised within the soil profile to create new, or extend existing, pathways. This would introduce additional contaminant sources with new or faster pathways to identified receptors. Potential health effects could occur including ingestion of toxic heavy metals and skin irritation caused by contact with hydrocarbons. These human health pathways and effects are most likely to concern on-site workers, with limited exposure to off-site receptors.

12.5.6 As with all construction and development projects, contamination to soils could be introduced during the operation of machinery or fuel /chemical storage and handling activities during construction or operation of the Proposed Development. Further impacts are also possible through air borne or dust release of contaminated soils during excavation and stockpiling activities. However, normal good practice construction techniques will minimise these risks, including procedures set out in the Framework Construction Environment Management Plan (CEMP), see Chapter 6: Construction and Phasing for further details.

12.5.7 Uncontrolled remediation and construction during wet periods may result in surface water run-off into local watercourses. If the runoff were contaminated by soils or spilt materials, this could result in impacts on the quality of the water. These impacts will be of lesser significance during the first stage of remediation and construction due to the greater distance from the canal and Yeading Brook of this part of the Site.

12.5.8 Given the relatively short duration of the remediation works in relation to the total length of time for the construction phase, many of the effects associated with contaminated soils are considered to be temporary in their nature. The magnitude of effects will also be related to climatic conditions (e.g.

hot dry spells would promote the generation of dust unless properly managed) as well as the actual physical progression of the works. The significance of the likely effects are described below.

12.5.9 Remediation works will need to be managed in accordance with best practice and controls measures used during these works so as to reduce the likely significant effects as identified above. If no measures are introduced, the existence of contaminated land at the Site is identified as potentially causing **moderate adverse** effects to local receptors (local controlled waters, construction workers and local residential areas). The first remediation phase covers the north eastern area of the Site (Zones A, B and C) and is planned for the period 2009 to 2014. This area of the Site is closest to existing residential land use and therefore effects to local residents could be of greater concern during this phase if not properly controlled. These effects primarily include noise and air-borne emissions (dusts, odours, vapours) and are considered in separate chapters (Chapter 9: Noise and Vibration and Chapter 10: Air Quality of this ES).

12.5.10 Following the remediation of soils and groundwaters underlying the northeastern section of the Main Site, remediation and construction works in the western area (Zone D) could potentially re-introduce contamination into the remediated areas. The assessed flow of groundwater (and therefore contamination) underlying these areas show that groundwater flows away from the northeastern area and therefore it is unlikely that significant re-introduction would occur. The reduction in contaminant load on the Main Site will have a **moderately beneficial** impact locally.

12.5.11 The second stage remediation in the west of the Site (Zones A, B and D) will address the the rest of the contamination at the Site, including the most affected Zone D. Once completed, the Main Site will be classified as 'remediated'. These works should be completed in circa 2015 and will result in a reduction in likely contamination effects to all receptors, particularly controlled waters. The undertaking of remediation works are considered to cause **substantially beneficial** effects overall.

Geological

12.5.12 The historical removal of geological resource (brickearth and gravel in some areas) could result in adverse effects due to the finite nature of mineral resources. This would also affect the hydrogeological regime in the vicinity of the Site. However removal of these materials will be minimised during the remediation works since these are generally saturated (i.e. below the water table) and there are provisions within the specification to minimise excavation below the water table, as outlined in the Remediation Strategy at Appendix 12.2. As such the effects on the brickearth and gravels are considered to be of a **minor adverse** significance.

12.5.13 As a result of piled foundations, very small volumes of London Clay will be removed. Given the homogenous nature of the Clay and its persistence across large geographical areas this is considered result in **negligible** effects to geological resources as a result of the proposed Scheme.

Geomorphological

12.5.14 No features of geomorphological interest have been noted on the Main Site and have therefore not been considered further in this assessment.

Land Gases

12.5.15 Land gases have been identified in limited quantities in certain areas across the Main Site. Inhalation of these gases could affect construction workers (below ground) and the proposed Scheme. In the absence of measures to control these effects, as described in the Framework CEMP, land gases could cause a **moderate adverse** effect.

12.5.16 The presence and potential for generation of land gases will be mitigated during the remediation/ construction phases. Source materials will be removed during remediation works and the re-introduced soils monitored to ensure that there is no residual contamination that could generate land

gases. Additional protective measures (such as hard surfacing) will be constructed and implemented within the proposed development. The overall effects are, therefore, considered to be **negligible**.

Pump Lane Link Road

Soil

12.5.17 The land to the west of the Yeading Brook comprises natural geology. The construction of the road would result in the removal of structurally unsuitable sub-surface soils (where required) along the road footprint, and the deposition of clean imported soils between bridges for construction of embankments. During excavation works, damage to the soil structure to the ground used as transportation routes could occur if inappropriate machinery and methods are used or if movements are carried out when the soil is too wet. Top soils may become mixed with less fertile sub-soils, damaging the soil profile, which can affect the natural drainage channels and porosity. Damaged top soils may also have a reduced water retention capacity, thus reducing water availability to plants.

12.5.18 The creation of embankments could increase soil erosion and surface water run-off unless a stabilising top layer is provided. Displaced surface water from hardsurfacing may flood other areas, particularly if the soil has been damaged (compacted) in these areas. These issues are addressed in further detail in Chapter 13: The Water Environment.

12.5.19 The movement of soil for the creation of foundations and embankments for the Pump Lane Link Road will affect the natural soils in the western part of the Site. A temporary road will be used for construction vehicles access to the Main Site and will increase the area of land affected. This will result in wider spread effects from the use of heavy earth moving machinery on-site. However, since these effects will be temporary in nature, this is considered to be a **minor adverse** effect.

12.5.20 To the east of the Yeading Brook, the area referred to as the Minet Tip site, Site Investigations have identified organic (Hydrocarbon) and Heavy Metal contamination from 'canal dredgings' and 'probable gasworks wastes' within Made Ground following gravel/ brickearth quarrying. As for the Main Site, contaminated soils will either require excavation and treatment on-site prior to its re-use in the proposed development or, if untreatable, disposal off-site via a licensed water contractor. Treatment of this material will enhance the biological nature of any 'usable' soils. As described in 12.5.5, there is a possibility that excavation activities during construction may disturb immobile contaminants within the soil profile to create new or extend existing contaminant pathways. However, such effects would be temporary in nature and would be unlikely during occupation of the Site since all contaminated soils will have been remediated. Therefore, the overall effects of the remediation works in this area are considered to have **moderately beneficial** effect.

12.5.21 Generally the removal of soil would not interfere with the current groundwater equilibrium except in those areas where it is deemed necessary to excavate below the water table. As with the Main Site, excavation below the water table would only occur where severe contamination visibly extends below that level and where in-situ treatment is inappropriate. In this instance, the excavated soils would be treated as described in 12.5.20. It is therefore considered that there is a potentially **minor adverse** on local groundwater. This is described further in Chapter 13: The Water Environment. .

12.5.22 The flood relief channel to the west of Yeading Brook will be diverted to enter into an enlarged brook channel to the north of its existing course, as part of the Pump Lane Bridge development work. Soil contamination is not anticipated in this area and the effects will be as those described above in 12.5.17-19. The effect on water resources of these diversion works are described in Chapter 13: The Water Environment.

Geological

12.5.23 The potential effects upon the solid geology of the Yeading Brook during construction of the Pump Lane Link Road are considered to be **negligible**. There are no diversion works required to this water course, or to the flood drainage channel and associated embankments, which were

constructed in 1985 - 1995. The most significant influence upon the local geology during the Pump Lane Bridge development will be the excavation works to divert the flood relief channel and create a flood compensation storage area. The removal of this material and also during foundation and embankment construction and road levelling works are considered to have **minor adverse** effects. This effect will be more apparent than for the footbridges (see below) due to the scale of these structures.

Geomorphological

12.5.24 The Yeading Brook is the main feature of geomorphological interest in the vicinity of the Pump Lane Link Road. In the absence of controls on construction activities, the bank could be damaged during construction of the road bridge crossing this feature and by inflow of soils into the watercourse. The potential effects will be managed through the use of the CEMP. However, it is still considered that these activities could cause **minor adverse** effects.

12.5.25 Works associated with the construction of the Pump Lane Bridge, the creation of the flood compensation storage area (to accommodate flood waters from the road embankment and supports) and diversion of the flood relief channel (to minimise the length of culvert required as per the Environment Agency's preference and provide a larger span bridge to minimise the number of crossings required) will alter this natural floodplain feature to the west of Yeading Brook. Therefore, effects are considered to be **minor adverse**.

12.5.26 To the east of Yeading Brook, the footprint of the embankments will require levelling of both the natural mounding and that produced during the historic deposition of materials. This has been assessed as a **moderate adverse** effect on the equilibrium between surface water run off, infiltration and visual amenity.

Minet Park Footbridge

Soil

12.5.27 The construction of the twin long span bridge will not require extensive removal of sub-surface soils. The exception to this is to the west of the Yeading Brook where the bridge descends to ground level via a small earth embankment. The effects associated in this area are therefore considered to be **minor adverse** in nature. Otherwise, soil deposition works are considered to be **negligible** for the Minet Park Footbridge works.

12.5.28 Uncontrolled activities during wet periods may result in excess surface water run off discharging into local watercourses. This water, if contaminated, could affect the quality of the water. The flood risk regime will be considered through the CEMP. With these measures in place, and due to the likely temporary nature of any effects, these are considered to be **minor adverse**. This is discussed further in Chapter 13: the Water Environment.

12.5.29 Remediation and construction activities will be very limited in this area and managed within the same CEMP as the Main Site. However, there will always be a potential for the minor release of contaminants or redistribution of elements already within the soil profile during these activities. Potential health effects may include ingestion of toxic heavy metals, exposure to skin irritants, and the inhalation of dust. Due to the likely management measures in place, these effects are considered to be **minor adverse** at the local level. It is noted that remedial works to address contaminated soils are considered overall to be **substantially beneficial**.

Geological

12.5.30 The construction of this bridge would require the removal of sub-surface material for the construction of foundations and local re-profiling of the ground. These effects are considered to have **minor adverse** effects at the local level.

Geomorphological

12.5.31 The footprint of the Minet Park Footbridge would result in **negligible** effects as the bridge will be raised on piers, thus not altering the natural topography. There will, however, be a **minor adverse** effects on the floodplain during construction activities with the temporary land required for construction plant causing a slight loss of capacity.

Springfield Road Footbridge

Soil

12.5.32 Due to its elevation above ground level, there will be minimal removal of sub-surface soils during construction of this bridge. The only subsurface part of the structure will be foundations and supports for the bridge, which are expected to be very localised. The removal of this soil is considered to have a **minor adverse** effect at the local level.

12.5.33 The creation of access embankments for the bridge may increase soil erosion and surface water run-off. The displaced surface water may flood other areas, particularly if the soil has been damaged. The effects on the water environment and flooding are considered in Chapter 13: The Water Environment.

Geological

12.5.34 The extraction described above would comprise minor volumes of River Terrace Gravels and Alluvium, resulting in a **minor adverse** impact on local geological resources due to the small footprint area and volume of the bridge footings. The embankment foundations would be placed into the natural geological strata causing **minor adverse** effects on a local scale both with respect to the homogeneity of the strata and their geotechnical characteristics. The latter refers specifically to issues of permeability in the Terrace Gravels and the changes in the established equilibrium through the introduction of foundation materials in the subsurface. This is discussed in Chapter 13: The Water Environment.

Geomorphological

12.5.35 The Footbridge would result in **negligible** effects as the bridge will be raised on piers, thus not altering the natural topography. There will, however, be a **minor adverse** effect on the floodplain during construction activities with the temporary land required for construction plant causing a slight loss of capacity.

Eastern Access

Soil

12.5.36 The construction of the Eastern Access would result in some removal of sub-surface soils along the road footprint. In the main, these works will require some reqrading and deposition of clean material imported from other parts of the Site. This would have a **minor adverse** effect at the local scale on the natural soils. Soil damage may occur if inappropriate working practices and conditions are permitted to occur. These effects should be minimised through use of the CEMP.

12.5.37 The first phase of constructing the access route will involve road improvements to the area north west of the existing bridge structure. These are likely to have a greater impact on the underlying soils than the second phase of the works which will predominantly involve the bridge widening. The bridge widening will have a more localised impact as construction of the spanning structures is considered to have a **negligible** to **minor adverse** effect.

Geological

12.5.38 The removal of material during construction works is considered to be a **minor adverse** effect. During construction of the Eastern Access route, minor volumes of the River Terrace Gravels and Brickearth (where present) will be extracted during foundation installation. This is considered to be a **locally adverse minor** impact.

Geomorphological

12.5.39 No features of geomorphological interest have been noted in this area and have therefore not been considered further.

12.6 Assessment of Effects - Principal Assessment Year

12.6.1 It has been assumed that remediation activities would have been carried out across the Site as detailed within Chapter 5: Construction and Phasing. On completion of the remediation, the soils underlying the Site will be deemed to be remediated to a standard suitable for their intended use and environmental situation.

12.6.2 No impact is considered to arise on the geology from the operation or occupation of the proposed Scheme. As such the effects are considered to be **negligible**.

12.6.3 The presence, and significance, of land gases will be assessed following the removal of contaminated materials (as these should be the main source of gas identified during the Site Investigations). If concentrations remain significant (i.e. that they still pose a risk to the proposed development), protective measures will be included into the Scheme design, for example safe venting measures. Implementing such measure would reduce the effects to **negligible**.

Main Site

12.6.4 Generally, construction will progress from east to west across the Site. Therefore, the operational/occupied effects described below will spread across the Site in this manner over time. The earlier developments (i.e. from the east) will impact the environment over a longer time period than the later developed stages in any given timeframe.

Soil

12.6.5 Remedial activities will be undertaken as described in Section 12.5 and in the Remediation Strategy (Appendix 12.2). Remediation will be zoned to account for the identified and potential contamination resulting from various historic uses and the different sensitive and non-sensitive end land-uses. Depending on these factors, remediation of different zones will be to different specifications and will result in variations in the residual concentrations present in the sub-surface following these works. Residual contamination risks will also be reduced through the introduction of development features, such as clean service trenches.

12.6.6 A Site file will be prepared that documents any residual contaminated risks. This will be supplied, as appropriate, to those undertaking works that may put them into contact with the residual contaminants, for example excavation of service trenches. Overall, there will be **negligible** effects from the soils associated with the operational/occupied phase.

Geomorphological

12.6.7 Following construction phase activities, the Site will be slightly elevated compared with the existing Site level. The surface level will be reduced in areas where basement parking is proposed. The

proposed Scheme includes areas of landscaping and environmental improvement, which are considered to result in locally **beneficial** effects to the geomorphology. These are effects are considered in more detail in Chapter 11: Landscape and Visual Effects

Pump Lane

Soil

12.6.8 Limited heavy metals from exhaust fumes, motor oils, and salt (from winter de-icing) may be deposited on the soils adjacent to the new road, in common with any road. This is considered to be a **minor adverse** effect compared to the current situation. Following the construction of the embankments for the bridge, natural processes will re-establish steady state conditions, both in terms of settlement (geotechnical loading) and natural permeability equilibriums.

Geomorphological

12.6.9 The Pump Lane Link Road will introduce several new geomorphological features into an otherwise predominantly flat featureless terrain. These include the road embankment; the new flood relief channel; infilling of part of the former channel; and the flood compensation storage area. When taken in the context of the wider area and environmental benefits of the proposed development, it is considered that, overall, these effects would be of **minor beneficial** significance and local in nature.

Minet Park and Springfield Road Footbridges

Soil

12.6.10 The Footbridges will be used for pedestrian and cycle access only and as such there are anticipated to be no effects to the soil from their operational use.

Geomorphological

12.6.11 There would be **negligible** effects on the geomorphology of the areas as a result of the Footbridges, since these will be raised on piers and minor access embankments.

Eastern Access

Soil

12.6.12 During the operational phase airborne emissions from vehicles using the Eastern Access would have locally **minor adverse** effects on the soil chemical quality in the immediate vicinity of this route.

Geomorphological

12.6.13 The Eastern Access will not result in significant changes to the existing topographic levels. The proposed Scheme includes areas of landscaping and environmental improvement. Overall, it is considered that these works represent locally **minor beneficial** effects for the operational/ occupied phase.

12.7 Mitigation and Enhancement

12.7.1 The primary effects identified in Section 12.5 (Assessment of Construction Effects) relate to the removal, redistribution and remobilisation of contaminants currently within the ground profile. These effects are most likely to be realised during excavation works as part of the Site's remediation and construction phases. Various contaminants have been identified, that could potentially impact upon the environment (groundwater and surface water bodies) and human health receptors, both on and off-site. The following section describes the works to be completed to reduce or completely mitigate the potential effect of this existing contamination at the Site.

12.7.2 The Remediation Strategy was prepared in January 2008 (Appendix 12.2) and submitted to LB Ealing and LB Hillingdon for approval. The Strategy details the technical logistics, control measures, monitoring, sampling, and stakeholder liaison relating to the remediation phase. These works will be completed prior to construction of the West Southall Scheme. In summary, the Strategy comprises:

- Controlled excavation from the ground of identified primary source materials, as supported by quantitative risk analysis, followed by their treatment on-site and re-use wherever possible;
- Validation sampling and analysis of the excavation extremities and treated material to confirm that sufficient affected material is removed and the effectiveness of the treatment;
- Backfilling of voids using treated material where possible. A minimum of imported materials and re-grading will be used as necessary; and
- Appropriate groundwater treatment to improve quality of local controlled waters, including modelling following completion.

12.7.3 The Strategy has been developed to address the environmental and re-development requirements and utilising good industry practice and guidance documentation produced by competent authorities such as CIRIA and the EA.

12.7.4 To maximise the effectiveness of on-site remediation treatment techniques, and reduce the volume of material leaving or imported to the Site, further detailed viability studies would be prepared just prior to remediation works to assess alternative remediation techniques (based on likelihood of success, benefit, practicality and programme implications). In light of the results of the assessment to date, bioremediation is currently seen as the strongly favoured technique.

12.7.5 The scope of remediation will depend on the proposed end usage (e.g. residential, open land, landscaping etc.). This will lead to soil and groundwater remediation geared towards likely risks, in consideration of broad 'suitable for end use' guidance, as discussed within Part IIA of the Environmental Protection Act.

Soil Remediation

12.7.6 The Remediation Strategy will be developed in detail in a practical manner prior to site works. This way construction features and requirements can be combined into an effective, efficient and sustainable approach.

12.7.7 The remediation areas would be extensively probed to better characterise features potentially holding gasworks residues (e.g. tanks) which constitute the most significant areas of risk. The estimated remediation areas are identified on Figures 12.7, 12.8 and 12.9. Detailed mitigation plans for each distinct area will be developed and implemented. In order to mitigate direct pathways the area may need to be capped with impermeable material to limit percolation and potential mobilisation of subsurface contamination.

12.7.8 An impermeable, or semi permeable vertical barrier or groundwater control system would be constructed below ground level (bgl) to surround the reduced size National Grid Gas operational depot (east area). The purpose of this feature would be to prevent the migration of necessarily retained contaminated groundwaters into remediated areas, thereby reducing the risk of re-contamination of treated soils.

12.7.9 All treatment will be completed in isolated areas to reduce the likelihood of cross contamination. Barriers and surface coverings will be used to reduce the effects of air and transport movements of pollutants and surface water runoff.

12.7.10 The areas of residential development will utilise the least contaminated soils due to the sensitive nature of the end use. The ground condition requirements for mixed developments are less sensitive than for residential uses. There will be a stringent programme of re-evaluation to ensure that the soil quality meets these thresholds.

12.7.11 Subsurface control barriers will be installed around the Pump Lane Link Road area as required, to minimise any potential for unremediated land to affect remediated areas, for example to prevent mobilisation of contaminated groundwater into remediated soils. These would be keyed into the London Clay to reduce groundwater movement from the west to the east of the Site.

12.7.12 Below ground features (i.e. buried gas tanks and associated gas infrastructure) and soils exceeding site specific criteria will either be removed or decommissioned in-situ where appropriate. The impermeable surfacing will be re-established as part of the proposed development, and in order to reduce the potential for infiltration to result in pathways between the subsurface and controlled waters.

12.7.13 The location of on-site treatment areas would be selected bearing in mind the prevailing wind directions and engineering considerations relating to site management. Protocols and procedures would be enforced to both monitor and assess the potential for dust/odour generation and measures taken to prevent uncontrolled release and mitigate any identified effects. These are detailed within the Framework Construction Environmental Management Plan at Appendix 6.1.

Old Canal Docks

12.7.14 There are three backfilled former canal docks which are thought to traverse the Site, on the southern boundary of Area C3 to the west of Area C1 (see Figure 12.4). These in effect form containment structures similar to the others identified on-site. Tests have been undertaken on both soil and groundwater chemical quality contained within the old docks and fed into the QRA modelling. This identified that no specific remediation would be required for these areas within the proposed development. As per the rest of the Site, their physical characteristics will be assessed against specific development plans when confirmed.

12.7.15 Although believed to exist, there are no validated records of the impermeable clay plugs reportedly installed at the basin mouths during the 1980s. These would effectively separate the waters of the canal docks from the canal. As part of preliminary on-site preparation works the presence of the clay plugs would be investigated. If the locations of the plugs are identified, additional tests on their integrity will be completed, and further reinforcement installed if necessary to ensure effective separation.

Access for Works / Temporary Storage

12.7.16 There is only very restricted access to the Site. This will be difficult for the efficient import and export of soil materials, although it is thought that some limited movements will be possible through either the current southern access and the proposed Eastern Access. This is not the preferred solution and the Remediation Strategy assumes that a further access would be established early in the remediation works along the line of the Pump Lane Link Road.

12.7.17 Feasibility studies have been undertaken regarding use of the local rail and canal network for the transportation of construction materials. The rail connection would only be possible if a new rail siding were constructed. This has been shown to be cost and time prohibitive, not withstanding logistical issues with using the main west coast rail route which is the closest route to the Site. For the canal, concerns have been raised with relation to increased environmental risks of 'double handling' material from the Site onto the barges and from the barges into trucks at the offloading point. From a regional environmental perspective little or no benefit would be gained from adopting this option. However, it is recognised that from a local perspective decreased lorry movements would have a temporary effect. A more detailed assessment on issues of traffic movements and their effects is presented in Chapter 8: Transport and Movement.

12.7.18 Temporary stockpiling may be required for certain materials to be taken to landfill. This would be strictly controlled and located in the extreme western area of the Site, furthest from existing residential landuse.

Environmental Controls

12.7.19 The remediation works will be undertaken in line with good industry practice but taking into account the site specific environmental location and proposed scope of works. These would include designated 'clean' and 'dirty' areas separated by health and safety hygiene units, odour mitigation systems, wheel wash and sheeting facilities for vehicles, induction programs for contractors and site visitors, and environmental controls similar to those detailed within the Health & Safety Executive documentation HSG66.

12.7.20 The existing residential areas to the north and east of the Main Site, as well as groundwater underlying the Site, have been identified as being sensitive receptors. Adequate measures will be introduced prior to the commencement of remediation and construction works to prevent the uncontrolled migration of noise, dust and odours to these areas. Permanent monitoring stations, augmented by hand held monitoring devices, would be positioned in strategic locations around the Site. Personnel would be trained to be aware of the potential for dust and odour generation and to implement appropriate controls should they consider a potential for nuisance developing.

12.7.21 Ongoing monitoring for noise, dust, groundwater impact and odour etc. would be undertaken for the duration of the remediation and construction works. Details of the monitoring and environmental controls, including temporary storage of soils and groundwater on-site, are described further in the Remediation Strategy (Appendix 12.2) and the Framework CEMP (appendix 6.1).

12.7.22 A dedicated, independent Resident Engineer would be in full-time attendance at the Site to oversee and monitor the works, to ensure that the Contractors meet the specification and to ensure that all works are undertaken with appropriate Duty of Care.

12.7.23 Material transport to and from the Site would be strictly controlled and fed into the road network at pre-agreed rates and times. Movements to and from the majority of the works would benefit from the new proposed Pump Lane Link Road and associated highway improvements.

12.7.24 Consultation with regulators is acknowledged as a key part of developing any remediation strategy. This project has been subject to extensive consultation to date, which would continue as the planning and remediation works process. Further details are included within the Remediation Strategy (Appendix 12.2).

12.8 Residual Effects

12.8.1 The recorded contamination on the Site is considered to present the most significant effects associated with ground conditions. The planned remediation works have been designed to mitigate the identified risks posed by the presence of this contamination. It is recognised that, overall, the

remediation will have **substantially beneficial** effects upon the ground conditions of the Site and in the locale.

12.8.2 In addition to the actual remediation works, measures will be put in place to limit the potential for release of contaminants during the remedial and construction works, as described in Section 12.6, the Remediation Strategy and the Framework CEMP (Appendix 6.1). This will minimise the potential contamination impacts in the form of dust, odours, vapours, landgases, leachate, surface run-off etc. Adoption of these measures are considered to reduce the potential effects to **minor adverse.**

12.8.3 The residual effects, presented in Table 12.8, consider the effect of implementing the identified mitigation measures and the corresponding reduction in effects. It notes that although some disturbance may still occur, these will generally be temporary in nature and on a significantly reduced scale.

Table 12.8 Residual Effects associated with Ground Conditions following Mitigation

Environmental topic	Impact identified	Significance	Mitigation measure	Residual impact	Residual significance
Historic contamination of soils underlying the Site	Reduced soil and groundwater quality underlying the Site Leaching of contaminants to controlled waters.	Substantial adverse	Excavation and on-site treatment of contaminated soils. Wherever possible, remediated soils will be replaced in void space	Clean subsurface material with limited potential to cause harm to human and environmental receptors	Substantially beneficial
Mobilisation of contaminants during remediation & construction works	Contamination of watercourses, human health, adjacent property	Locally Moderate Adverse Impact	Controlled remediation works prior to commencement of construction – i.e. suppression measures, in-ground barriers, location & type of treatment methodologies	Some temporary redistribution of contaminants within the Site, controlled at Site boundaries, emissions to be suppressed although minimal escape of dust, odours etc may occur.	Locally Minor Adverse Impact & Temporary

References

12.1 HMSO (1995) Environment Act

12.2 HMSO (1994) Water Resources Act

12.3 HMSO (1990) Environment Protection Act

12.4 Health and Safety Executive (1994) Health and Safety at Work Act

12.5 HMSO (1990) Town and Country Planning Act (1990)

12.6 Department of Communities and Local Government (1985) Building Regulations

12.7 The European Council (1999) Landfill Directive (1991/31/EC) was adopted in July 1999.

12.8 HMSO (2002) Statutory Instrument 2002 No. 1559: The Landfill (England and Wales) Regulations 2002

12.9 European Commission (2003) Council Decision 2003/33/EC: establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC

12.10 Department for Communities and Local Government (1994) Planning Policy Statement 23 (PPS23): Planning and Pollution Control - Annex 2: Development on Land Affected by Contamination

12.11 Greater London Authority (2008) The London Plan consolidated with amendments since 2004

12.12 London Borough of Ealing (2001) New Plan for the Environment (saved policies)

12.13 London Borough of Ealing (2006) Comtaminated Land Strategy for Ealing (revised June 2006)

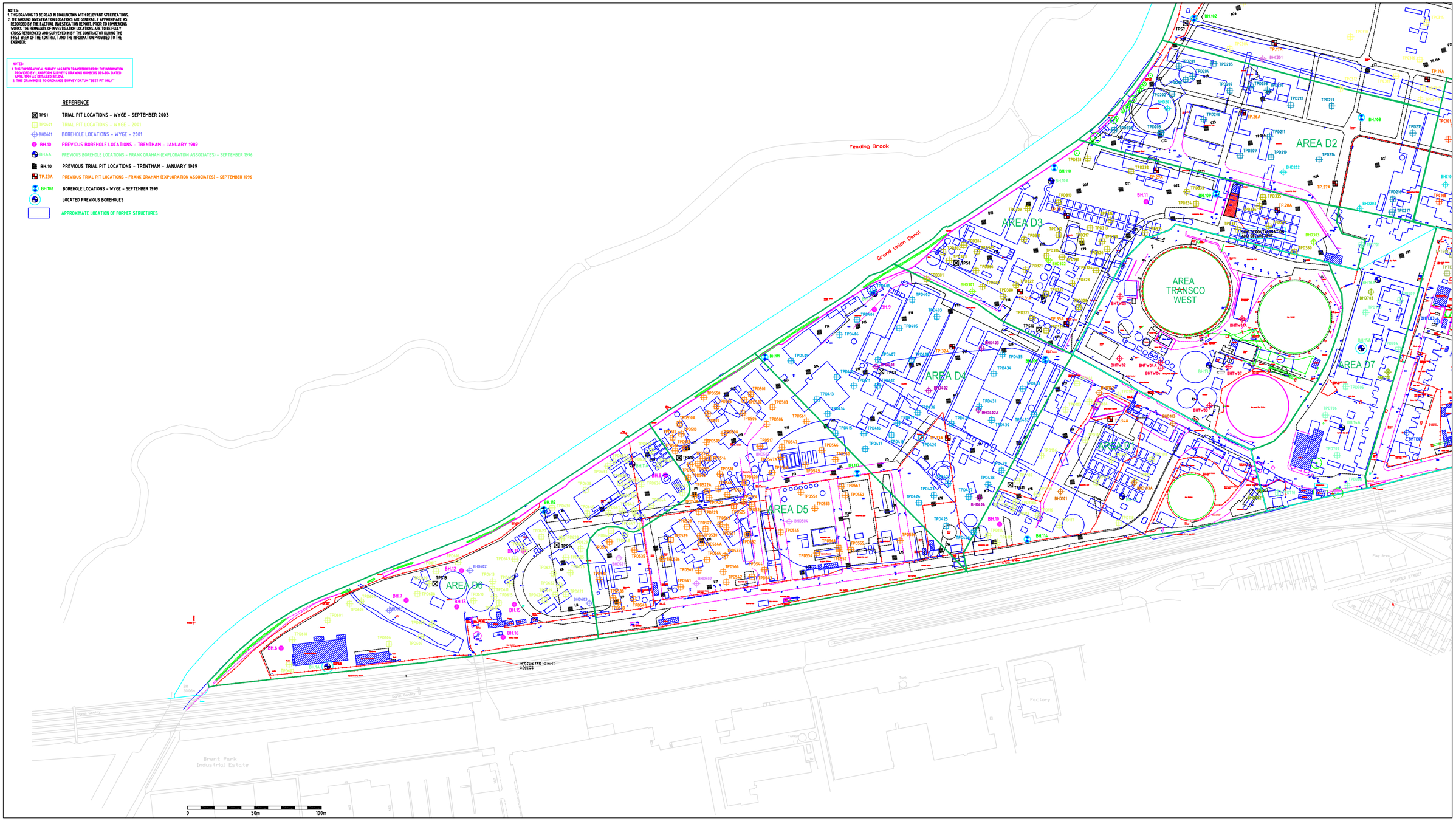
12.14 London Borough of Hillingdon (2007) Unitary Development Plan (saved policies)

NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. THE GROUND INVESTIGATION LOCATIONS ARE GENERALLY APPROXIMATE AS RECORDED BY THE FACTUAL INVESTIGATION REPORT. PRIOR TO COMMENCING WORKS THE REMNANTS OF INVESTIGATION LOCATIONS ARE TO BE FULLY CROSS REFERENCED AND SURVEYED IN BY THE CONTRACTOR DURING THE FIRST WEEK OF THE CONTRACT AND THE INFORMATION PROVIDED TO THE ENGINEER.

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LANDFORM SURVEYS DRAWING NUMBERS 001-004 DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

REFERENCE

- TP51 TRIAL PIT LOCATIONS - WYGE - SEPTEMBER 2003
- TP0601 TRIAL PIT LOCATIONS - WYGE - 2001
- BHD601 BOREHOLE LOCATIONS - WYGE - 2001
- BH.10 PREVIOUS BOREHOLE LOCATIONS - TRENTHAM - JANUARY 1989
- BH.4A PREVIOUS BOREHOLE LOCATIONS - FRANK GRAHAM (EXPLORATION ASSOCIATES) - SEPTEMBER 1996
- BH.10 PREVIOUS TRIAL PIT LOCATIONS - TRENTHAM - JANUARY 1989
- TP.23A PREVIOUS TRIAL PIT LOCATIONS - FRANK GRAHAM (EXPLORATION ASSOCIATES) - SEPTEMBER 1996
- BH.108 BOREHOLE LOCATIONS - WYGE - SEPTEMBER 1999
- LOCATED PREVIOUS BOREHOLES
- APPROXIMATE LOCATION OF FORMER STRUCTURES



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

North

Scale N.T.S.

Site Investigation Location Plan Western Area

Figure 12.1

Drawing No: WYGE - E0357-801W

NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. THE GROUND INVESTIGATION LOCATIONS ARE GENERALLY APPROXIMATE AS RECORDED BY THE FACTUAL INVESTIGATION REPORT. PRIOR TO COMMENCING WORKS THE REMNANTS OF INVESTIGATION LOCATIONS ARE TO BE FULLY CROSS REFERENCED AND SURVEYED IN BY THE CONTRACTOR DURING THE FIRST WEEK OF THE CONTRACT AND THE INFORMATION PROVIDED TO THE ENGINEER.

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LAMPORN SURVEYS DRAWING NUMBERS 001-004 DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

REFERENCE

- TPS1 — TRIAL PIT LOCATIONS – WYGE – SEPTEMBER 2003
- TPA01 — TRIAL PIT LOCATIONS – WYGE – 2001
- BHA01 — BOREHOLE LOCATIONS – WYGE – 2001
- BH.10 — PREVIOUS BOREHOLE LOCATIONS – TRENTHAM – JANUARY 1989
- BH.4A — PREVIOUS BOREHOLE LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.10 — PREVIOUS TRIAL PIT LOCATIONS – TRENTHAM – JANUARY 1989
- TP.23A — PREVIOUS TRIAL PIT LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.108 — BOREHOLE LOCATIONS – WYGE – SEPTEMBER 1999
- LOCATED PREVIOUS BOREHOLES
- APPROXIMATE LOCATION OF FORMER STRUCTURES

AREA C3
AREA C2
AREA D2
AREA C1
AREA A
AREA B
AREA D3
AREA D7
AREA TRANSCO WEST
AREA TRANSCO EAST
SHOP LOCATION TRANSFORMER AND SECURE UNIT
Hayes Bridge Primary School
BEACONSFIELD ROAD
GRANGE ROAD
SPENCER STREET
QUEENS ROAD
0 50m 100m

WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

North

Scale N.T.S.

Site Investigation Location Plan Eastern Area

Figure 12.2

Drawing No: WYGE - E0357-801E

NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. ONLY THE LOCATION OF STRUCTURES AS RECORDED BY AVAILABLE HISTORICAL INFORMATION ARE SHOWN AND THESE POSITIONS ARE APPROXIMATE ONLY AND CANNOT BE GUARANTEED IN EITHER LOCATION OR PRESENCE. FURTHER OTHER FORMER STRUCTURES, AND LESSER FEATURES SUCH AS PIPES, VALVE PITS, ETC. ARE ALMOST CERTAIN TO EXIST AND DUE ALLOWANCE SHOULD BE MADE FOR SUCH. FOR A DETAILED REVIEW OF THE HISTORICAL INFORMATION REFERENCE SHOULD BE MADE TO THE WYGE ENVIRONMENTAL ENGINEERING ASSESSMENT REPORT.
3. WHERE INVESTIGATION HAS LOCATED EVIDENCE OF FORMER STRUCTURES, THESE ARE ANNOTATED ASTERISKED ON THE PLAN AND FURTHER DETAILS CAN BE SEEN IN THE ABOVE MENTIONED REPORT.

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LANDFORM SURVEYS DRAWING NUMBERS 891-004 DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

REFERENCE

L0 APPROXIMATE LOCATION OF FORMER STRUCTURES

HISTORICAL FOCUS AREAS

1. OILWORKS FROM < 1868 TO < 1895
2. ALDGATE CHEMICAL WORKS < 1895 TO < 1935
3. SPENT OXIDE STORAGE & RAILWAY SIDINGS < 1935 TO APPROX. 1960
4. LOS STORAGE FACILITY & OTHER INFRASTRUCTURE ASSOCIATED WITH GAS PRODUCTION FROM LIQUID PETROLEUM
5. DECOMMISSIONED APPROX. 1973

CANAL DOCK CONSTRUCTED PRIOR TO 1868

TANKS < 1895 TO 1964

GASHOLDERS < 1935 TO < 1963
2 PROBABLY DECOMMISSIONED IN EARLY 1970's

DOCK No.1 KNOWN TO HAVE BEEN OPERATIONAL c.1951.

1. FORMER POND < 1868 IN SOUTHERN AREA
2. RETORTS & ASSOCIATED COAL
120 - No.1 RETORT HOUSE (1869) FEEDSTOCK INFRASTRUCTURE
123 - COKE GRADING
130 - No.3 RETORT HOUSE (1890's?)
141 - No.5 RETORT HOUSE
144 - CWG PLANT
RETORTS ON SITE UNTIL EARLY 1960's WHEN BUILDINGS MAY HAVE BEEN REUSED IN GAS MANUFACTURE FROM LIQUID PETROLEUM DISTILLATE

ASSORTED LAND USE: TOOL SHEDS, BOILER HOUSE, MACHINE SHOPS, PAINT SHOPS, STORES, < 1890's TO <1960's

TAR STORAGE WORKS, SOME ASSOCIATED PRODUCT MANUFACTURE/ STORAGE INCLUDING BLACK VARNISH. THOUGHT TO HAVE BEEN ACTIVE FROM APPROX. WORLD WAR ONE & DECOMMISSIONED PRIOR TO THE 1960's.

DOCK No.3 KNOWN TO HAVE BEEN OPERATIONAL c.1951, SUSPECTED DECOMMISSIONING c.1960

LPG STORAGE TANKS PROBABLY INSTALLED IN THE EARLY 1960's & DECOMMISSIONED EARLY 1970's

BENZENE & RELATED PRODUCT MANUFACTURE & STORAGE FACILITIES, THOUGHT TO HAVE BEEN ACTIVE FROM WORLD WAR ONE & DECOMMISSIONED PRIOR TO THE 1960's

RAILWAY SIDING
1. FIRST INTRODUCED < 1897 & EXPANDED GREATLY BETWEEN 1914 & 1935, POSSIBLY DECOMMISSIONED EARLY 1960's WITH THE DECLINE OF COAL AS A FEEDSTOCK
2. CENTRAL AREA THOUGHT TO HAVE BEEN USED AS A COAL STORE < 1897 TO EARLY 1960's
3. CATALYTIC RICH GAS PLANT, FURNACE & MEDIUM OIL FUEL TANKS THOUGHT TO HAVE BEEN ADDED EARLY 1960's TO 1970's (WHEN DECOMMISSIONED) POSSIBLY ASSOCIATED WITH PETROLEUM AS A FEEDSTOCK.

BLENDING & HOPPERS FOR TREATMENT OF RAW COAL

1. FORMER POND
2. FORMER SMALLER POND < 1914
3. RESERVOIR < 1935
4. 2 x LARGE TANKS < 1964 (POSSIBLY MEANING PURIFIERS)
5. < 1964, TO EARLY 1970's GAS PURIFIERS

GAS STORAGE FACILITIES CONSTRUCTED BETWEEN 1869 & 1895. THE TWO SOUTHERLY HOLDERS WERE PROBABLY DECOMMISSIONED AROUND 1973. THE TWO NORTHERLY, LARGER HOLDERS ARE STILL OPERATIONAL

RESIDENTIAL PROPERTIES CONSTRUCTED BETWEEN 1868 & 1895, IDENTIFIED AS HOUSING FOR SITE WORKERS

RESTRICTED HEIGHT ACCESS

Grand Union Canal

Yeading Brook

AREA D2
AREA D3
AREA D4
AREA D5
AREA D6
AREA D7
AREA TRANSCO WEST

0 50m 100m

WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

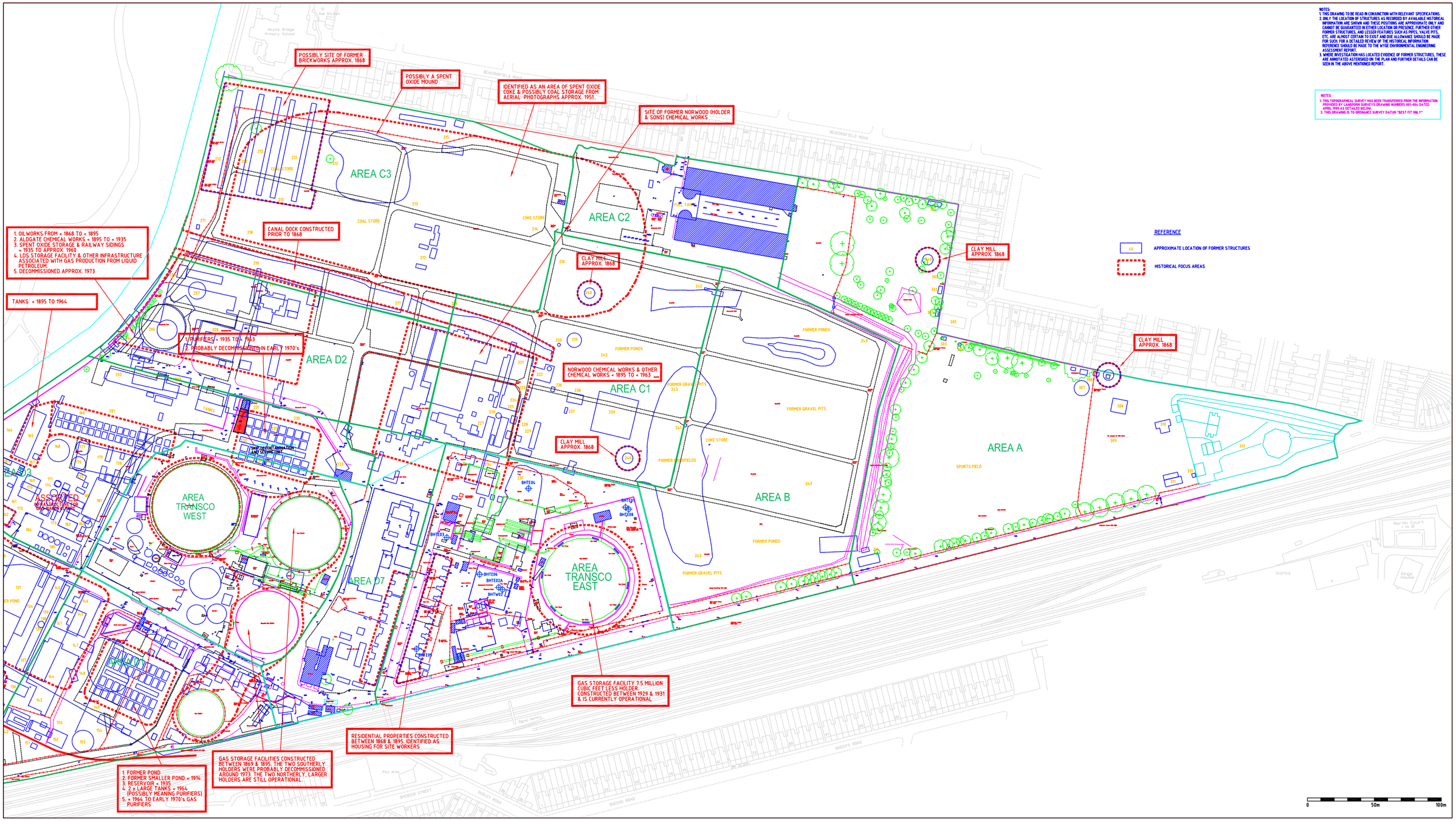
North

Scale N.T.S.

Known Historical Site Features Western Area

Figure 12.3

Drawing No: WYGE - E0357-802W



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

North

Scale N.T.S.

Known Historical Site Features Eastern Area

Figure 12.4

Drawing No: WYGE - E0357-802E

SITE AREAS	
A	3.074 ha
B	2.836 ha
C1	2.923 ha
C2	1.623 ha
C3	2.952 ha
D1	1.698 ha
D2	2.144 ha
D3	2.496 ha
D4	2.191 ha
D5	2.938 ha
D6	2.151 ha
D7	1.399 ha
GW	2.2 ha

PRIMARY SCHOOL

POSSIBLE LOADING BAY

RESIDENCES

C3

C2

D2

C1

B

A

D3

GASHOLDER WEST (GW)

D7

D4

YEADING BROOK

GRAND UNION CANAL

D5

D1

APPROXIMATE BOUNDARY OF PHASE 1 DEVELOPMENT AREA

D6

WEST COAST RAIL TRACKS

RESTRICTED HEIGHT ACCESS

0 100m 200m

REFERENCE

SITE ZONING BOUNDARIES

GUARDED TENANT ACCESS ROADS (TEMPORARY)

TRANSCO RETAINED LAND

DETAILED SITE ZONING FOR REMEDIATION - LAYOUT PLAN

WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

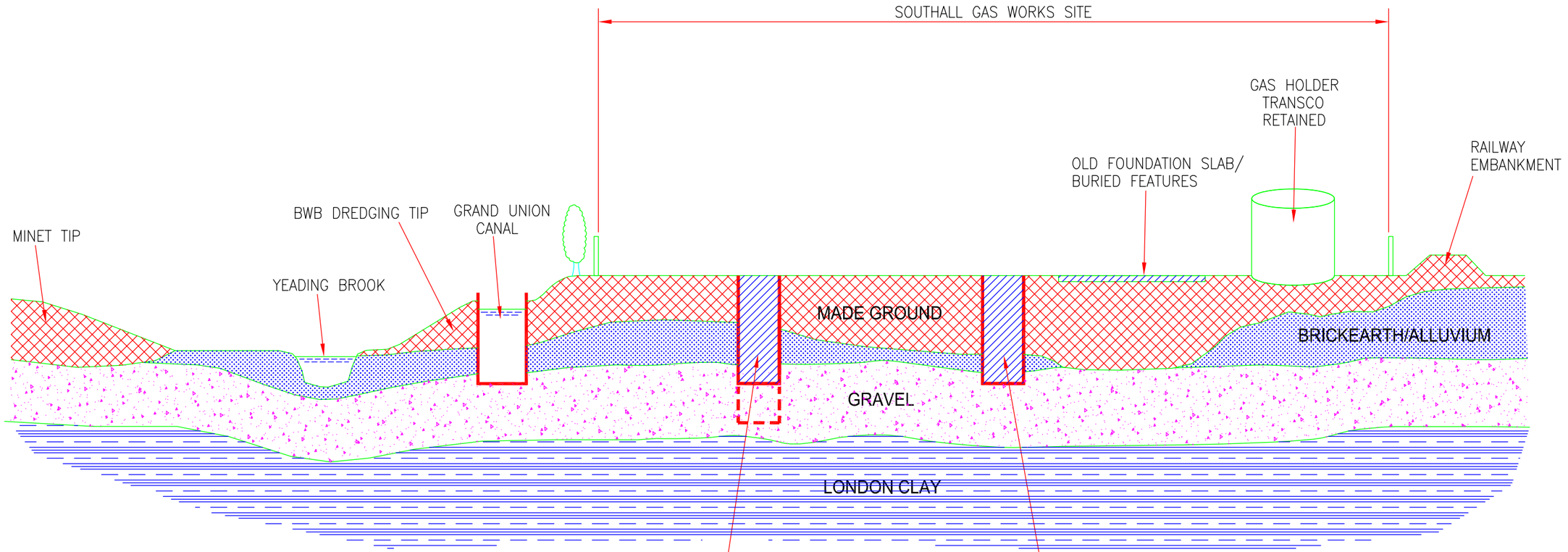
North

Scale N.T.S.

Detailed Site Zoning for Remediation Layout Plan

Figure 12.5

Drawing No: WYGE - E0357-SK.19



REFERENCE

- MADE GROUND
- BRICKEARTH/ALLUVIUM
- GRAVEL
- LONDON CLAY

SCHEMATIC GROUND PROFILE OF THE FORMER SOUTHALL GAS WORKS AND SURROUNDING AREA

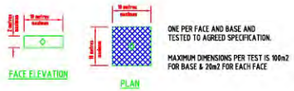
WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Scale N.T.S.

Schematic Ground Profile Southall Gasworks and Surrounding Area
Figure 12.6

Drawing No: WYGE - E0357-SK.20

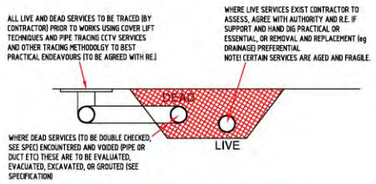
NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. ZONES FOR EXCAVATION ARE DERIVED FROM AVAILABLE INVESTIGATION. EXCAVATION IS TO COMMENCE AT THE INVESTIGATION POINT AND BE SAFELY VISUALLY/ODOURLY TRACED TO ACHIEVE AN APPROPRIATE REMOVAL VOLUME IN CONJUNCTION WITH THE ENGINEER. THE RECTANGLES/AREAS SHOWN ARE APPROXIMATE ALLOWANCES ONLY AND WORKS ARE TO BE CONFIRMED ON SITE.
3. ALL FACES OF THE EXCAVATION REQUIRE AUDIT TESTING ON COMPLETION AND ACCEPTANCE PRIOR TO PERMANENT BACKFILLING IN ACCORDANCE WITH THE SPECIFICATION. ADDITIONAL EXCAVATION AND RETESTING MAY BE REQUIRED DEPENDING ON 5 DAY TURN-ROUND RESULTS.
4. THE ACTUAL BOUNDARIES OF THE EXCAVATION WILL DEPEND ON ENCOUNTERED SITE CONDITIONS AND CANNOT BE TOTALLY PREDEFINED.
5. FOLLOWING THE GROUND INVESTIGATION THE IDENTIFIED ZONAL REMOVAL STRATEGY APPROPRIATELY REDUCES THE TOTAL CONTAMINANTS ON SITE TO A LOWER LEVEL. HOWEVER, BECAUSE IT IS IMPRACTICABLE TO INSPECT ALL AREAS OF THE GROUND, FUTURE EXCAVATIONS FOR DEVELOPMENT WORK IN AREAS NOT EXCAVATED FOR REMEDIATION MAY ENCOUNTER LOCALLY GROUND CONDITIONS REQUIRING CONSIDERATION IN LINE WITH THE REMEDIATION STRATEGY.
6. REMEDIATION OF ABANDONED PIPEWORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE WYGE SPECIFICATION AND WILL ALSO BE SUBJECT TO ENCOUNTERED SITE CONDITIONS.
7. RE-USE OF MATERIAL: WHERE GROUND IS FOUND TO BE VISUALLY UN-CONTAMINATED IT SHOULD BE STORED & TESTED IN READINESS FOR BACKFILLING EXCAVATIONS. RECORDS OF AMOUNTS TREATED IN THIS MANNER NEED TO BE MAINTAINED.



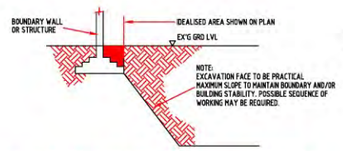
ONE PER FACE AND BASE AND TESTED TO AGREED SPECIFICATION.

MAXIMUM DIMENSIONS PER TEST IS 100m2 FOR BASE & 20m2 FOR EACH FACE

AUDIT TESTING DETAIL



SERVICE EXCAVATION AND TRACING DETAIL 3



BOUNDARY/BUILDING ZONAL EXCAVATION DETAIL 2

EXCAVATION DETAIL 1

REFERENCE

- TPS1 — TRIAL PIT LOCATIONS - WYGE - SEPTEMBER 2003
- TPD601 — TRIAL PIT LOCATIONS - WYGE - 2001
- BHD601 — BOREHOLE LOCATIONS - WYGE - 2001
- BH.10 — PREVIOUS BOREHOLE LOCATIONS - TRENTHAM - JANUARY 1989
- PREVIOUS BOREHOLE LOCATIONS - FRANK GRAHAM (EXPLORATION ASSOCIATES) - SEPTEMBER 1996
- BH.10 — PREVIOUS TRIAL PIT LOCATIONS - TRENTHAM - JANUARY 1989
- TP.23A — PREVIOUS TRIAL PIT LOCATIONS - FRANK GRAHAM (EXPLORATION ASSOCIATES) - SEPTEMBER 1996
- BH.108 — BOREHOLE LOCATIONS - WYGE - SEPTEMBER 1999
- LOCATED PREVIOUS BOREHOLES
- APPROXIMATE LOCATION OF FORMER STRUCTURES
- LIKELY SOIL REMEDIATION ZONES BASED ON SOIL TESTING
- LIKELY SOIL REMEDIATION ZONES BASED ON KNOWN HISTORICAL STRUCTURES

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LANDFORM SURVEYS DRAWING NUMBERS 001-004, DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

Rev	Description	By	Chk	App	Date
C	ZONES ADDED IN NONE DEVELOPMENT AREA	PJT	LS	DMF	27-04-07
B	TITLE REVISED. ISSUED FOR INFORMATION.	DJB	JA	DMF	19-05-05
A	ZONAL EXCAVATION TABLES REMOVED.	DJB	GM	JA	26-11-03

FOR INFORMATION

Client:
SecondSite Property

White Young Green Environmental Ltd.
Sunley House Tel: 020 8649 6600
Bedford Park Fax: 020 8649 6629
Croydon Surrey e-mail: envio.london@wyg.com
CR0 2AP
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
SOUTHALL GASWORKS
SOUTHALL

Drawing Title:
ZONAL REMOVAL EXCAVATIONS - ESTIMATED LOCATIONS FOR ENVIRONMENTAL RECEPTORS
WESTERN AREA

Scale at A0	Drawn By	Date	Checked By	Date	Approved By	Date
1 : 750	D. J. B.	OCT. 2003	G. M.	OCT. 2003	J. A.	OCT. 2003

Project No	Office	Type	Drawing No	Revision
E0357	40	ENV	Figure 12.7	

NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. ZONES FOR EXCAVATION ARE DERIVED FROM AVAILABLE INVESTIGATION. EXCAVATION IS TO COMMENCE AT THE INVESTIGATION POINT AND BE SAFELY VISUALLY/ODOURLY TRACED TO ACHIEVE AN APPROPRIATE REMOVAL VOLUME IN CONJUNCTION WITH THE ENGINEER. THE RECTANGLES/AREAS SHOWN ARE APPROXIMATE ALLOWANCES ONLY AND WORKS ARE TO BE CONFIRMED ON SITE.
3. ALL FACES OF THE EXCAVATION REQUIRE AUDIT TESTING ON COMPLETION AND ACCEPTANCE PRIOR TO PERMANENT BACKFILLING IN ACCORDANCE WITH THE SPECIFICATION. ADDITIONAL EXCAVATION AND RETESTING MAY BE REQUIRED DEPENDING ON 5 DAY TURN-ROUND RESULTS.
4. THE ACTUAL BOUNDARIES OF THE EXCAVATION WILL DEPEND ON ENCOUNTERED SITE CONDITIONS AND CANNOT BE TOTALLY PREDEFINED.
5. FOLLOWING THE GROUND INVESTIGATION THE IDENTIFIED ZONAL REMOVAL STRATEGY APPROPRIATELY REDUCES THE TOTAL CONTAMINANTS ON SITE TO A LOWER LEVEL. HOWEVER, BECAUSE IT IS IMPRACTICABLE TO INSPECT ALL AREAS OF THE GROUND, FUTURE EXCAVATIONS FOR DEVELOPMENT WORK IN AREAS NOT EXCAVATED FOR REMEDIATION MAY ENCOUNTER LOCALLY GROUND CONDITIONS REQUIRING CONSIDERATION IN LINE WITH THE REMEDIATION STRATEGY.
6. REMEDIATION OF ABANDONED PIPEWORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE WYGE SPECIFICATION AND WILL ALSO BE SUBJECT TO ENCOUNTERED SITE CONDITIONS.
7. RE-USE OF MATERIAL: WHERE GROUND IS FOUND TO BE VISUALLY UN-CONTAMINATED IT SHOULD BE STORED & TESTED IN READINESS FOR BACKFILLING EXCAVATIONS. RECORDS OF AMOUNTS TREATED IN THIS MANNER NEED TO BE MAINTAINED.

REFERENCE

- TPS1 — TRIAL PIT LOCATIONS – WYGE – SEPTEMBER 2003
- TPD601 — TRIAL PIT LOCATIONS – WYGE – 2001
- BHD601 — BOREHOLE LOCATIONS – WYGE – 2001
- BH.10 — PREVIOUS BOREHOLE LOCATIONS – TRENTHAM – JANUARY 1989
- BH.4A — PREVIOUS BOREHOLE LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.10 — PREVIOUS TRIAL PIT LOCATIONS – TRENTHAM – JANUARY 1989
- TP.23A — PREVIOUS TRIAL PIT LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.108 — BOREHOLE LOCATIONS – WYGE – SEPTEMBER 1999
- LOCATED PREVIOUS BOREHOLES
- APPROXIMATE LOCATION OF FORMER STRUCTURES
- LIKELY SOIL REMEDIATION ZONES BASED ON SOIL TESTING
- LIKELY SOIL REMEDIATION ZONES BASED ON KNOWN HISTORICAL STRUCTURES

AREA C1/1
AREA C1/2
AREA C3/1
AREA C3
AREA C2
AREA A/1
AREA D2/1
AREA D3/3
AREA D3/A
AREA D3/B
AREA D3/C
AREA D3/2
AREA D3/D
AREA D3/E
AREA D3/1
AREA D3
AREA D2
AREA C1
AREA D4/A
AREA D4/1
AREA D5/3
AREA D5/1
AREA D4
AREA D7
AREA B
AREA B/1
AREA D1
AREA D5
AREA D5/2
AREA D5/B
AREA D7/2
AREA D8/4
AREA D7/1
AREA D8/3
AREA D8/2
AREA D8/A
AREA D8/B
AREA D8/1
GASHOLDER AREA WEST (D8)
GASHOLDER AREA EAST (D9)
NON DEVELOPMENT AREA
Yeading Brook
Grand Union Canal
Signal Gantry
Subway
Play Area
SPENCER STREET
DUDLEY ROAD
QUEENS ROAD
The Cottage
Balfour Business
Tank
Factory
0 50m 100m

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LANDFORM SURVEYS DRAWING NUMBERS 001-004 DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

Rev	Description	By	Chk	App	Date

FOR INFORMATION

Client:
SecondSite Property

White Young Green Environmental Ltd.
Sunley House Tel: 020 8649 6600
Bedford Park Fax: 020 8649 6629
Croydon Surrey e-mail: envlondon@wyg.com
CR0 2AP

Environmental Consultancy
CMI Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
SOUTHALL GASWORKS
SOUTHALL

Drawing Title:
ZONAL REMOVAL EXCAVATIONS - ESTIMATED LOCATIONS FOR ENVIRONMENTAL RECEPTORS WESTERN AREA

Scale at A0	Drawn By	Date	Checked By	Date	Approved By	Date
1 : 750	P. J. T.	OCT. 2007	L. S.	OCT. 2007	D. F.	OCT. 2007

Project No.	Office	Type	Drawing No.	Revision
E00357	40	ENV	Figure 12.8	

NOTES:
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH RELEVANT SPECIFICATIONS.
2. ZONES FOR EXCAVATION ARE DERIVED FROM AVAILABLE INVESTIGATION. EXCAVATION IS TO COMMENCE AT THE INVESTIGATION POINT AND BE SAFELY VISUALLY/ODOURLY TRACED TO ACHIEVE AN APPROPRIATE REMOVAL VOLUME IN CONJUNCTION WITH THE ENGINEER. THE RECTANGLES/AREAS SHOWN ARE APPROXIMATE ALLOWANCES ONLY AND WORKS ARE TO BE CONFIRMED ON SITE.
3. ALL FACES OF THE EXCAVATION REQUIRE AUDIT TESTING ON COMPLETION AND ACCEPTANCE PRIOR TO PERMANENT BACKFILLING IN ACCORDANCE WITH THE SPECIFICATION. ADDITIONAL EXCAVATION AND RETESTING MAY BE REQUIRED DEPENDING ON 5 DAY TURN-ROUND RESULTS.
4. THE ACTUAL BOUNDARIES OF THE EXCAVATION WILL DEPEND ON ENCOUNTERED SITE CONDITIONS AND CANNOT BE TOTALLY PREDEFINED.
5. FOLLOWING THE GROUND INVESTIGATION THE IDENTIFIED ZONAL REMOVAL STRATEGY APPROPRIATELY REDUCES THE TOTAL CONTAMINANTS ON SITE TO A LOWER LEVEL. HOWEVER, BECAUSE IT IS IMPRACTICABLE TO INSPECT ALL AREAS OF THE GROUND, FUTURE EXCAVATIONS FOR DEVELOPMENT WORK IN AREAS NOT EXCAVATED FOR REMEDIATION MAY ENCOUNTER LOCALLY GROUND CONDITIONS REQUIRING CONSIDERATION IN LINE WITH THE REMEDIATION STRATEGY.
6. REMEDIATION OF ABANDONED PIPEWORK IS TO BE UNDERTAKEN IN ACCORDANCE WITH THE WYGE SPECIFICATION AND WILL ALSO BE SUBJECT TO ENCOUNTERED SITE CONDITIONS.
7. RE-USE OF MATERIAL WHERE GROUND IS FOUND TO BE VISUALLY UN-CONTAMINATED IT SHOULD BE STORED & TESTED IN READINESS FOR BACKFILLING EXCAVATIONS. RECORDS OF AMOUNTS TREATED IN THIS MANNER NEED TO BE MAINTAINED.

REFERENCE

- TPS1 — TRIAL PIT LOCATIONS – WYGE – SEPTEMBER 2003
- TPA01 — TRIAL PIT LOCATIONS – WYGE – 2001
- BHA01 — BOREHOLE LOCATIONS – WYGE – 2001
- BH.10 — PREVIOUS BOREHOLE LOCATIONS – TRENTHAM – JANUARY 1989
- BH.A.A. — PREVIOUS BOREHOLE LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.10 — PREVIOUS TRIAL PIT LOCATIONS – TRENTHAM – JANUARY 1989
- TP.23A — PREVIOUS TRIAL PIT LOCATIONS – FRANK GRAHAM (EXPLORATION ASSOCIATES) – SEPTEMBER 1996
- BH.108 — BOREHOLE LOCATIONS – WYGE – SEPTEMBER 1999
- LOCATED PREVIOUS BOREHOLES
- APPROXIMATE LOCATION OF FORMER STRUCTURES
- LIKELY SOIL REMEDIATION ZONES BASED ON SOIL TESTING
- LIKELY SOIL REMEDIATION ZONES BASED ON KNOWN HISTORICAL STRUCTURES

AREA C3/1
AREA C1/1
AREA C1/2
AREA A/1
AREA C3
AREA C2
AREA C1
AREA A
AREA B
C3/1
D2/1
AREA D2
D3/A
D3/3
GASHOLDER AREA WEST (08)
AREA D7
NON DEVELOPMENT AREA
GASHOLDER AREA EAST (D9)
AREA B/1
AREA B/2
AREA D8/A
AREA D8/B
AREA D8/3
AREA D8/C
AREA D8/4

0 50m 100m

NOTES:
1. THIS TOPOGRAPHICAL SURVEY HAS BEEN TRANSFERRED FROM THE INFORMATION PROVIDED BY LANDFORM SURVEYS DRAWING NUMBERS 001-004 DATED APRIL 1999 AS DETAILED BELOW.
2. THIS DRAWING IS TO ORDNANCE SURVEY DATUM "BEST FIT ONLY"

Rev	Description	By	Chk	App	Date
C	ZONES ADDED IN NON DEVELOPMENT AREA	PJT	LS	DMF	27/04/07
B	TITLE REVISED. ISSUED FOR INFORMATION.	DJB	JA	DMF	19/05/05
A	ZONAL EXCAVATION TABLES REMOVED.	DJB	GM	JA	26/11/03

FOR INFORMATION

Client:
SecondSite Property

White Young Green Environmental Ltd.
Sunley House
Bedford Park
Croydon Surrey
CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: envio.london@wyg.com

Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
SOUTHALL GASWORKS
SOUTHALL

Drawing Title:
ZONAL REMOVAL EXCAVATIONS - ESTIMATED LOCATIONS FOR ENVORONMENTAL RECEPTORS
EASTERN AREA

Scale at A0	Drawn By	Date	Checked By	Date	Approved By	Date
1 : 750	D. J. B.	OCT. 2003	G. M.	OCT. 2003	J. A.	OCT. 2003

Project No.	Office	Type	Drawing No.	Revision
E0357	40	ENV	Figure 12.9	

13 THE WATER ENVIRONMENT

13.1 Introduction

13.1.1 The water environment within influence of the Site comprises the adjacent surface water features of the Yeading Brook and the Grand Union Canal and the groundwater beneath the Site within the Taplow River Gravels and the Chalk. Quality, drainage, flooding, flow, speed and direction and other such aspects are important considerations of this environment.

13.1.2 This chapter evaluates the current water quality within the surface water and groundwater in and around the Site and assesses the potential effects that the proposed development may have upon the existing hydrological and hydrogeological conditions.

13.1.3 Any effects on hydrological systems associated with the proposed Scheme could have direct and cumulative effects on other components of the ecosystem that interact with the water environment, therefore this chapter should be read in conjunction with Chapter 5: Construction and Phasing, Chapter 12: Ground Conditions and Chapter 14: Ecology.

13.2 Planning and Legislative Context

13.2.1 The Environment Agency (EA) has statutory powers and duties for the protection and monitoring of the quality of controlled waters. Controlled waters are defined as all waters, either above or below ground, which are neither in the drinking water supply pipe nor the sewerage network. The EA aims to promote a sustainable water environment by means of quality control combined with resource management. As such there is a requirement for the EA to be consulted on any development which could impact upon the quality or level of flow, of both surface water and groundwater features.

13.2.2 British Waterways (BW) is the public body which maintains and develops the network of inland waterways and canals in a sustainable manner in order for them to fulfil their full economic, social and environmental potential.

Legislation

13.2.3 Current environmental legislation in respect of the protection of controlled waters includes the Environment Act 1995[13.1], Water Resources Act 1994[13.2], Environment Protection Act 1990[13.3], Health and Safety at Work Act 1994[13.4], Town and Country Planning Act 1990 [13.5] and Building Regulations 1985 [13.6].

13.2.4 The Environment Act 1995 (Section 57) makes provisions for a risk based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000 and are aimed at ensuring that actions taken with respect to contaminated land are directed by a technical assessment of risk that exists in the source/pathway/receptor scenario (pollutant linkage). This extends to preventing the contamination of controlled waters.

13.2.5 The EA has established a number of policies that relate to the conditions for developments within various important groundwater zones. In particular, the EA Groundwater Protection Policy provides the greatest level of guidance to developers on the approach needed to secure the integrity of key water resources.

13.2.6 The Groundwater Protection Policy was first issued in 1992 and has been periodically updated to include the latest changes in legislation and the changing focus of the EA. Published Groundwater Vulnerability Maps and Groundwater Protection Zones, which have been established in areas around key groundwater resources, underpin the policy. Developments within these areas may be restricted or in extreme cases severely curtailed depending on the nature and specifications of the Development design.

13.2.7 In addition to groundwater, important surface water features are protected from development impacts through a range of policies and guidance notes on pollution prevention during construction and also best practice guidance for potentially polluting operations. Where discharges to the surface waters are expected or intended as part of the construction or operation of the site, permits or authorisations are are required and strictly controlled by the EA.

National Planning Policy

Planning Policy Statement 25 (PPS 25)[13.7]: Development and Flood Risk

13.2.8 PPS25 sets out the Government's policies on development and flood risk. It aims to ensure that flood risk is taken into account at all stages of the planning process in order to prevent inappropriate developments in areas at risk of flooding and direct development away from areas that are at the highest risk.

13.2.9 The policies within PPS25 and the accompanying annexes are to be taken into account by Regional Planning Bodies (RPBs) and Local Planning Authorities (LPAs) in preparing Regional Spatial Strategies (RSSs) and Local Development Documents (LDDs).

13.2.10 PPS25: Section 26, advises that:

"*LPAs are required to consult the Environment Agency on all applications for development in flood risk areas (except minor development), including those in areas with critical drainage problems and for any development on land exceeding 1 hectare outside flood risk areas."*

Regional Planning Policies

London Plan (2008): Spatial Development Strategy for Greater London Consolidated with Alterations since 2004 [13.8]

13.2.11 The London Plan (2008, consolidated with alterations since 2004) addresses flood risk in Policy 4A.12. It states that "*In reviewing their DPDs, boroughs should carry out strategic flood risk assessments to identify locations suitable for development and those required for flood risk management. Within areas at risk from flooding (flood zones) the assessment of flood risk for development proposals should be carried out in line with PPS25*."

13.2.12 Sustainable drainage is also discussed within the London Plan under Policy 4A.14. The Policy encourages management of surface water run-off in line with the following drainage hierarchy:

- Store rainwater for later use.
- Use infiltration techniques, such as porous surfaces in non-clay areas.
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse.
- Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse.

- Discharge rainwater direct to a watercourse.

- Discharge rainwater to a surface water drain.

- Discharge rainwater to the combined sewer.

13.2.13 The policy outlines that sustainable urban drainage systems (SUDS) should be used within schemes unless there are practical reasons for not doing so. "*Such reasons may include the local ground conditions or density of development. In such cases, the developer should seek to manage as much run-off as possible on site and explore sustainable methods of managing the remainder as close as possible to the site*."

13.2.14 The London Plan also addresses the Blue Ribbon Network of which the Grand Union Canal is a member. Policy 4C. 2: Context for Sustainable Growth states that "*Development and use of the water and waterside land along the Blue Ribbon Network should respect resource considerations and natural forces in order to ensure that future development and uses are sustainable and safe."*

13.2.15 Policy 4C.4: Natural Landscape encourages the protection and enhancement of open space alongside and surrounding the Blue Ribbon Network with paragraph 4.152 recognising that some of these open spaces may act as mitigating features to flood risk.

Local Planning Policies

LB Ealing's New Plan for the Environment (adopted 2004) Saved Policies, 2007 [13.9]

13.2.16 Chapter 2.5: Water – Drainage, Flood Prevention and Environment of the LB Ealing's New Plan for the Environment outlines that before planning permission is granted for a development, LB Ealing will ensure that there is sustainable water infrastructure management in place. This will be based on drainage infrastructure and capacity; flood risk; surface water run-off; surface water re-cycling.

13.2.17 This chapter also states that LB Ealing will not grant permission for any development or intensification of development which would result in an increased flood risk, either in the vicinity or downstream, unless shown to be acceptable by a formal Flood Risk Assessment.

13.2.18 LB Ealing also request the application of sequential testing to examine the need for the development in a location where flood risk is an issue.

13.2.19 LB Ealing will seek measures to conserve water in new development, including grey water recycling and rainwater harvesting. Any development likely to pollute or adversely affect the quality of groundwater or rivers, or surface water, will not be permitted.

LB Hillingdon's Unitary Development Plan (adopted 1998) Saved Policies, 2007 [13.10]

13.2.20 LB Hillingdon's policies relating to flooding and flood alleviation comes under the heading '*Surface Water Drainage and Flood Prevention*'.

13.2.21 Policy OE7 states that *"In the areas liable to flooding, permission will not be granted for new development or the intensification of existing development unless a developer is prepared to implement flood protection measures as part of the proposed development to a standard satisfactory to the council, in consultation with the Environment Agency and where appropriate, other drainage bodies."*

13.2.22 OE8 outlines that in the event that the surface water regime of the proposed development which results in an increase of flood risk to a site, the developer would be required to include appropriate

attenuation measures within the proposed Scheme which should be agreed with the EA and LB Hillingdon.

13.2.23 Policies OE9 and OE10 address flooding from foul and surface water sewerage systems.

13.3 Methodology & Significance Criteria

13.3.1 The methodology for the assessment of water resources comprises identification of site specific chemical and geological data followed by a detailed assessment of the environmental implications posed by the Site (both qualitatively and quantitatively) as a result of these ground conditions. This assessment is then used as the basis for developing an appropriate remediation strategy to mitigate the potential effects of the identified contamination.

13.3.2 Contamination of groundwater is closely linked to potential contamination within soils. For all contamination issues; reference should also be made to the Ground Conditions Chapter (Chapter 12) which considers this aspect in greater detail.

Consultations

13.3.3 Consultations have been conducted with the following statutory authorities:

- Environment Agency;
- LB Ealing;
- LB Hillingdon; and
- British Waterways.

13.3.4 Information relating to the ground conditions investigated on the Site has been sourced from the following documents:

- Ground Conditions Report (including summary of previous Site Investigation and desk top information) – see Appendix 12.1;
- West Southall Development, Remediation Strategy Statement, V10 Jan (2008): see Appendix 12.2;
- Groundwater Sampling and Monitoring Interpretative Report (White Young Green Environmental, 2003);
- Groundwater Feasibility Trials;
- Baseline Groundwater Conditions – see Appendix 13.1
- West Southall Flood Risk Assessment, March 2008 – see Appendix 13.2

13.3.5 The above documents are the 'key' reports and assessments, there are a number of other documents relating to the contamination potential of the former land uses. These have not been referenced within this ES, as the information within them is either summarised in the reports listed (reproduced in the appendices), or provided from other readily available databases.

Magnitude

13.3.6 There are no published standard procedures for assessing potential hydrological effects, although these effects can be assessed qualitatively using professional judgement. Quantitative assessment can be applied using guidance derived for the identification of environmental effects associated with road and infrastructure works, taken from the Design Manual for Roads and Bridges (DMRB) 'Water Quality and Drainage' and the Department of Environment [13.11] , Transport and the Regions (DETR) 'Guidance on the New Approach to Appraisal' [13.12]. These documents outline methodologies for identifying and predicting the significance of hydrological-related effects and the sensitivity of receptors.

13.3.7 Potential effects have been assessed qualitatively using professional judgement and/or by applying predictive techniques (with reference to regulatory standards and industry practice) to predict the magnitude of each effect in a systematic manner. The following general impact prediction methodology has been applied throughout this chapter to determine the significance of the various effects identified.

Table 13.1 Estimating the Magnitude of an Impact on a Receptor (DMRB, May 2006)

Impact Description	Criteria
Major Adverse	The change is likely to cause a permanent adverse effect on the integrity of a receptor.
Moderate Adverse	The change adversely affects the valued receptor, but there would probably be no permanent effect on its integrity.
Minor Adverse	Measurable change on the integrity of the receptor is identified.
Negligible	The change is of insufficient magnitude to affect the integrity of the receptor.
Minor Beneficial	The change is likely to benefit the receptor in terms of its overall status, but not so far as to be termed favourable.
Moderate Beneficial	The change is likely to result in a moderate improvement of the receptor quality.
Major Beneficial	The change is likely to restore a receptor to favourable status, or to create a feature of recognisable value.

Sensitivity

13.3.8 Sensitivity or the value/importance of a receptor is determined in terms of geographical extent and/or the importance of a receptor based on statutory designations. Receptors such as individual properties or small watercourses have been generally considered to be of local importance. The sensitivity of receptors is determined according to the definitions outlined in Chapter 2: ES Scope and Methodology.

Assessment of Impact Significance

13.3.9 Table 13.2 (as reproduced from Table 2.7) outlines the interaction of magnitude and sensitivity and how this is interpreted as levels of significance of an environmental effect.

Table 13.2 Significance Matrix

	Magnitude of Impact			
Sensitivity/value of receptor	Major	Moderate	Minor	Negligible
High	Substantial	Substantial	Moderate	Minor
Medium	Substantial	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

13.4 Baseline Conditions

13.4.1 The full baseline conditions of the Site are detailed in Appendix 13.1. This section summarises the baseline conditions outlining any significant issues present on the Site and surrounding areas.

13.4.2 The Site has been subject to extensive investigation since c. 1998 by White Young Green Environmental (WYGE) and third parties. The following baseline conditions have been reported either through the extensive site investigation/survey works, from existing environmental databases and information provided by statutory authorities and consultees. For full details of the historic use of the Site refer to Chapter 12: Ground Conditions.

Site Investigations (SI)

Main Site

13.4.3 Site Investigations on the Main Site have included the installation of 70no. boreholes / monitoring wells and four rounds of detailed ground and surface water quality monitoring.

Table 13.3 Site Investigation works carried out on the Site

Year	Details of Investigation
1999/ 2000	14Boreholes installed with associated groundwater chemical testing.
2001	56 Boreholes installed with associated groundwater chemical testing and surface water quality testing
2003	Groundwater monitoring of 56 existing boreholes and river and canal waters with associated chemical testing.
2007	In October 2007 16 previously installed borehole locations were monitored. 40 of the original boreholes were either lost or damaged or inaccessible through onsite operations. The results of this monitoring round are discussed in section 13.4.

13.4.4 Ground investigation works undertaken by BW on the area of the Minet Tip (the mounding in the vicinity of Pump Lane Link Road) have been made available for EIA (report title "Draft Factual Report of Site Investigation at Minet Land between Yeading Brook and Grand Union Canal, Hayes, Contamination Study Volume 2, Trial Pit Logs; reference 98525391", dated January 1999). In addition, ground investigation was undertaken on the Minet Site in 2004 which comprised drilling of four boreholes to 15-20mbgl and extraction of 27 trial pits. These reports have not been reproduced in the appendices.

13.4.5 Furthermore, detailed knowledge of the subsurface conditions (including an assessment of groundwater flow directions) of the Main Site has been key in relevant interpretations relating to impact and migration. This assessment has been utilised as the basis for developing an appropriate remediation strategy to mitigate the potential effects of the identified contamination on and in the soils and groundwaters at the Site.

Springfield Road Footbridge

13.4.6 WYGE undertook ground investigation works at the proposed location of the northwestern landing position of the proposed Springfield Road Footbridge, to the west of the Yeading Brook in December 2007. The physical groundworks comprised installation of one borehole to 10mbgl and extraction of a shallow trial pit to a maximum depth of 1.3mbgl. Soil and groundwater samples were retrieved for chemical analysis and groundwater and landgas monitoring undertaken. Groundwater was encountered within the borehole location at approximately 0.25mbgl.

13.4.7 In addition, two trial pits were excavated out by CL Associates in the location of a footing between the Yeading Brook and the Canal.

Minet Country Park Footbridge

13.4.8 During December 2007 two boreholes were also installed to a depth of 10mbgl at the northwestern end of the proposed Minet Country Park Footbridge. Groundwater was encountered within these boreholes at 0.49mbgl and 0.6mbgl.

Pump Lane Link Road

No site investigations were undertaken around this area.

Flood Potential

13.4.9 The EA is the regulator in relation to flood risk and detailed consultation has been completed both historically and recently in relation to the potential for flooding.

13.4.10 The Main Site is elevated approximately 3 - 4 metres above the Yeading Brook is 100-year flood plain so flood potential of the Main Site has not been considered further.

13.4.11 The Proposed Access Routes, Pump Lane Link Road, Minet Country Park Footbridge and the Springfield Road Footbridge are to be constructed partly within or span over the Functional Floodplain Zone 3b (and land where water has to flow or be stored in times of flood, has between a 1 in 100 and 1 in 1000 annual probability of flooding) of the Yeading Brook. The flood risk zones are shown on Figures 13.1 and 13.2.

Pump Lane Link Road

13.4.12 The Pump Lane Link Road will be located over both the Yeading Brook and its associated Functional Floodplain), the Canal and also over the flood relief channel.

Springfield Road Footbridge

13.4.13 This proposed pedestrian and cycle route will span the Brook and the Canal and lie within Flood Zone 3, however it will be outside of the functional flood plain.

Minet Country Park Footbridge

13.4.14 The Minet Country Park Bridge will span the Canal, Brook and the Yeading Brook floodplain. The footings for this structure are all located in Flood Zone 1 (Low risk land currently assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year <0.1%).

Groundwater Regime

13.4.15 The groundwater regime at the Main Site has been identified complex. The regime is of very gradual gradient and variable and is likely to be strongly influenced by the underground structures, services and past mineral extraction activities, as well as by the prevailing natural geological conditions. A diagrammatical interpretation of groundwater flow during the site monitoring is presented in the interpretive report. This monitoring shows general low gradients towards the Yeading Brook, which flows in a northeast to southwest direction and is located to the north of the Grand Union Canal, with associated mounding in the centre of the Site.

13.4.16 The Site influences two bodies of Groundwater; perched groundwater in the Made Ground and shallow groundwater in the Terrace Gravel deposits. Deep groundwater at the Site, present in the Chalk deposits, has not been investigated due to the thickness, and the low permeability, of the

overlying London Clay. Subsequently groundwater within the Chalk is not considered to be at significant risk from contamination originating from the former gasworks site.

13.4.17 Shallow groundwater flow directions are estimated to be generally towards the Yeading Brook. The flow is slow and sensitive to changes in weather and seasons etc. A locally radial flow is seen towards the southeastern boundary of the former Gasworks, in the general direction of the Grand Union Canal, 1km to the south.

13.4.18 As a result of the differences in the levels of water in the Canal and those within the ground it is considered in agreement with the EA and BW, that groundwaters beneath the Site will not recharge those within the Canal. As a result of the thinning of the lining within the Canal, waters contained therein are assessed likely to leak into the aquifer. However, general groundwater movement is proven towards the Yeading Brook.

13.4.19 Brickearth has been historically extracted in the central areas (Area D, Figures 12.1 and 12.2) and northeastern areas (Area B) of the Main Site. Subsequent backfilling to permit historical development with higher permeability material, appears to have resulted in localised sumps.

13.4.20 Leakages into service drainage pipes are anticipated in these areas and are considered possible sources of variation within groundwater flow. A former canal dock, now infilled, is thought to traverse the Site, on the southern boundary of Area C3 to the west of Area C1 (see Figure 12.4). It is likely that this has had a significant effect on the groundwater flow patterns in this area of the Site.

13.4.21 The groundwater levels were recorded as highest in February, as is expected after characteristic groundwater re-charge over the winter months. As a result, the hydraulic gradient across the Site is steeper around this time and the flow of groundwater is likely to be increased, although at a very slow rate.

Surface Water Regime

13.4.22 The relationship between the Canal and the Yeading Brook is illustrated on the schematic conceptual cross section of the site presented in Figure 13.3. The Canal is clay lined and set at a higher level than the Brook, therefore it is likely to be hydraulically isolated from groundwater in the gravel and surface water in the Brook. Past flow into the Canal has been reportedly observed from the infilled docks, on-site, and overland across the towpath. However, no evidence for ongoing contamination has been identified from the results of this monitoring or observations.

13.4.23 The results of recent monitoring indicate very little evidence of significant contamination in the Yeading Brook or the Canal as a result of the Main Site.

Groundwater Contamination

Main Site

13.4.24 Groundwater impacted by phenols and to a lesser extent Polycyclic Aromatic Hydrocarbons (PAH's) has been identified over large areas of the Site. The results of SI works undertaken by WYGE and others confirmed the presence of these two contaminants, though at relatively different concentrations and at slightly differing geographic localities. This is to be expected given the dynamic nature of groundwater and the time elapsed between the various surveys.

Pump Lane Link Road

13.4.25 Chemical analysis of groundwater samples indicates some degree of groundwater impact to the northeast of the Proposed Access due to the presence of traces of Nickel, Chromium, Cadmium, Copper, Selenium Zinc, Thiocyanate, Total Cyanide, PAHs and TPH (predominantly diesel-range compounds). The contaminants were found in certain zones within the shallow aquifer only.

Springfield Road Footbridge

13.4.26 Some limited groundwater effects were detected through slightly elevated copper and zinc recorded in groundwater (see appendix 13.1).

Eastern Access

13.4.27 No SI was completed along this alignment. However based on the historical land uses in this area it is considered unlikely that significant areas of contamination exist along the route.

Minet Country Park Footbridge

13.4.28 Some limited groundwater effects were encountered with slightly elevated sulphate, anthracene, lead and zinc (see Appendix 13.1).

Surface Water Conditions

13.4.29 The summary of the results during the recent Site Investigation and the location of sampling points for the Canal and the Yeading Brook are illustrated in Figure 13.4.

Grand Union Canal

13.4.30 Samples of canal water collected in February and June 2000 (indicated on Figure 13.4 and discussed in Appendix 13.1) recorded a slight presence of phenol. Samples of Canal water collected during October 2007 in the three locations (upstream, downstream and adjacent to the Site) also indicate slightly elevated concentrations of heavy metals, copper, lead and zinc, total ammonium and total cyanide and iron.

Yeading Brook

13.4.31 Samples from the Yeading Brook were collected in February 2000. These samples showed levels of ammonium significantly above the EA's environmental quality standard (EQS). Cyanide was also detected in one sample.

13.4.32 In March 2002 the chemical and biological oxygen demand (COD & BOD) of the water bodies fell mostly within the EQS guidelines. However, BOD was in slight exceedance in one instance during this sampling and during sampling carried out in May 2003. These exceedences indicate that the river could potentially be eutrophic although the oxygen levels are not likely to be excessively depleted. Levels up and downstream of the Site are below levels of concern, indicating that any problem could be influenced by the former gasworks site.

13.4.33 Chemical analysis of surface water samples taken from the Yeading Brook at locations up, adjacent to and downstream of the Site during October 2007 indicate chemical effects from copper, lead, zinc and dissolved iron both up and down stream of the Site. Notable levels of speciated PAHs were identified in samples taken from the Yeading Brook, particularly in the downstream sample which may indicate effects from on-site sources.

Quantitative Risk Assessment (QRA)

13.4.34 The results of the chemical analyses from the detailed investigations were input into a QRA model, the output indicated those pollutants which exceed recommended concentration thresholds. These results were then used to determine potential environmental risk to controlled water receptors in accordance with latest UK guidance.

13.4.35 The QRA exercise identified that the western area of the Main Site represented a risk to the Yeading Brook from contamination with PAH's, aliphatic and aromatic Total Petroleum Hydrocarbons (TPH's) and ammonium. Additionally, Phenols, BTEX and cyanide were identified in the east of the Main Site with potential to impact the Yeading Brook The QRA indicated the Grand Union Canal may be at risk from concentrations of benzene and aromatic TPH band C8-C21 in the eastern part of the Site where a gravel pit was formerly located.

13.4.36 No investigation data was available for the access routes when the QRA was undertaken. Therefore it did not include for these although their influence compared to the effect on the Main Site are considered to be negligible.

13.4.37 Summary tables indicating which 'Contaminants of Concern' the QRA identified for each distinct area in a site specific context, are presented later in this Chapter.

13.5 Assessment of Effects

13.5.1 A variety of impacts could arise from the proposed development works on the Site if no remedial or mitigation measures are put in place. Principally these can be as described follows:

Construction Phase

Surface Water Features

- Temporary reduction in aquifer base-flow rate during groundwater abstraction for remediation works (on the Main Site only) reducing surface water flow.

- Potential reduction of surface water quality by spillages, leaking tanks and remobilisation of existing soil contamination through site works.

- Potential increased sediment load in the adjacent watercourses from erosion, vehicles and road wear .

- Potential reduction of surface water quality through increased concentration of pollutants associated with vehicular emissions, resulting from increased traffic movements.

- Potential increased risk of flooding following the loss of floodplain due to the Proposed Access Routes and associated embankments.

Groundwater Quality

- Long-term quality improvement to groundwater as a response to groundwater remediation measures.

- Potential reduction of groundwater quality as a response to spillages or leaking tanks (once remediation works are completed) and remobilisation of existing soil contamination, during remediation works.

- Potential increased pathways for contaminant migration into groundwater via intrusive groundworks such as piling.

- Potential reduction of groundwater quality through increased concentration of pollutants associated with vehicular emissions, resulting from increased traffic movements.

Groundwater Movement

- The groundwater remediation scheme on the Main Site would temporarily reduce groundwater recharge rates.

- A possible reduction, as a response to loading and foundation construction, in the natural permeabilities of the Gravel deposits beneath the area of the embankments.

Remediation Phase

13.5.2 Remediation of the water environment would lead to a minor reduction in aquifer recharge and surface water base-flow due to contaminated water being removed from the regime and discharged to sewers, or re-injected into the aquifer following treatment (subject to appropriate agreements and licenses). The effect of any such groundwater remediation would have a **moderate adverse** effect during the period of treatment (prior to construction) on the water environment. However, this effect would be off-set by the **major beneficial** effects from the increase in the quality of the groundwater regime following completion of these works.

Main Site

13.5.3 The biological / chemical quality of soils and groundwater on the Site has been proven to be adversely affected by historical site uses. The levels of contamination are considered to present unacceptable risks to groundwater and surface water receptors. In order to facilitate the Development it is necessary to reduce the potential adverse effects of the soil / groundwater chemistry on the receptors either through direct remediation (i.e. contaminant stabilisation or removal) or by the introduction of appropriate mitigation measures within the design of the buildings and or landscaped areas.

13.5.4 Remediation works are identified, if not managed in accordance with detailed specifications, as having a significant potential to generate **moderate adverse** effects on receptors. The first remediation phase is planned over the period circa 2009 to 2014 and covers the northeastern portion of the Main Site. Following remediation of the northern part of the Site there will be a shift in the contaminant profile and the western portion of the Site will become the more significant contamination source. The reduction in contaminant load on the Main Site overall will have a **moderate beneficial** effect.

13.5.5 The second stage of remediation works (circa 2015) will address the most significant portion of historic contamination. There will be significant beneficial effects on receptors, particularly controlled waters, as the contaminant load is reduced to appropriate levels. The overall effect of undertaking the remediation works is considered to be of **major beneficial** significance.

13.5.6 Generally it is considered that the removal of soils would not interfere with the current groundwater equilibrium except in areas where it is deemed necessary to excavate below the water table, which would result in local effects. Remediation of the water environment would lead to a temporary minor reduction in aquifer recharge and surface water base-flow as contaminated water would be removed from the regime and discharged to sewers, or re-injected into the aquifer (subject to appropriate agreements and licenses). The affect of any such groundwater remediation would have a **moderate adverse** effect during the period of treatment (prior to site construction) on the water environment. However, this effect is greatly counter balanced by the **substantially beneficial** effects resultant by increasing the quality of the groundwater regime for the future.

13.5.7 Given the finite time period during which construction would be undertaken in each location, many of these effects would be related to climatic conditions (wetter periods or when rainfall affects working conditions). Long dry periods whereby de-watering is required may effect the base flow of the Yeading Brook. These effects have the potential to be **moderate** adverse**.** However they would be avoided from an early point in the overall development through the implementation of a Construction

Environmental Management Plan (CEMP) discussed further in the mitigation section and Chapter 5: Construction and Phasing.

13.5.8 Due to the proximity of the Grand Union Canal and the Yeading Brook, construction procedures have the potential to effect surface runoff and sediment loading of potentially contaminated materials to the watercourses through uncontrolled run-off.

13.5.9 The Influx of quantities of fine-grained particulates within surface water ecosystems can cover vegetation inhibiting pathways for light and oxygen, limiting photosynthesis and leading to a diminished population. Additionally large quantities of sediment entering into the water body may lead to the oxidation of the organic content, resulting in a reduction in the level of oxygen within the water body. These effects have a potential **moderate adverse** significance as fish and invertebrate populations are at risk through deoxygenation of the water.

13.5.10 Considerable quantities of nutrients may also be released into the groundwater and surface water through the disturbance of soils, leading to enrichment of water bodies at a distance downstream from the Site (eutrophication). The effect of eutrophication can last for a number of years and can have **substantially adverse** effects on aquatic ecosystems some distance from the Site.

13.5.11 Spillages during construction can cause pollution, especially when on-site pumps and storage tanks of petroleum products are located near to watercourses. Therefore there is the potential for **minor adverse** environmental effects to result if filling, emptying or storage practices are not carried out properly. These effects are considered to be temporary in nature. The choice of foundation design and methods for piling or penetrative groundworks are key in determining if any effects arise from contaminating sources. Overall the potential for pollution to groundwater and surface water by spillage and remobilisation during construction is considered to result in a **major adverse** effect if works are completed without mitigation.

13.5.12 Any abstraction of groundwater for groundwater remediation or construction procedures, may temporarily depress the local water table in and around that area. The resultant effluent may be discharged by agreement to the foul sewer with a resultant loss of the water to the catchment hydrology. The magnitude of the associated effects are primarily dependent upon the prevailing climatic conditions and are likely to be very localised (i.e. **minor adverse**) in nature. The effects will be dependant upon the location of the water abstraction point, discharge into the foul sewer and operation during the drier summer months.

13.5.13 Should any contaminated waters, entering or being dispelled from the existing drains, escape into the underlying groundwater during the drainage upgrade, this may result in localised **minor adverse** effects of the water environment.

Construction Stage Flood Risk

13.5.14 Since the Access Routes will be constructed within the floodplain, a full Flood Risk Assessment (FRA) (see Appendix 13.2) has been completed to address the hydrological and hydraulic implications of these identified access routes. The FRA considers the construction and operational phases of each of the access route and therefore have not been assessed here.

Springfield Road Footbridge

13.5.15 The effects associated with the installation of the foundations to support the spans to the Footbridge would be limited. Minimal removal of subsurface soils may marginally disturb surface infiltration and interrupt the floodplain, thereby increasing the flood potential, however this would result in **minor adverse** effects. Additionally the decrease in residence time and increase in sediment load, surface runoff and soil erosion, associated with the construction of the ramp embankment could have an adverse effect on surface water quality, although this is considered to be **minor adverse** and temporary in nature. The creation of access embankments may also increase soil erosion and surface water runoff in these areas and any displaced waters may flood other areas.

Eastern Access

13.5.16 The construction of the Eastern Access would not cause any significant effects to the water environment. As such a **negligible** effect is considered.

Minet Country Park Footbridge

13.5.17 Construction phase activities for the Minet Country Park Footbridge would follow closely those effects described for the Springfield Road Footbridge. They would be limited with minimal removal of subsurface soils marginally disturbing surface infiltration and interrupting the floodplain thereby increasing the flood potential resulting in a **minor adverse** effect. Additionally the decrease in residence time and increase in sediment load, surface runoff and soil erosion, associated with the construction of the ramp embankment could have a **minor adverse** effect on surface water quality. Works will be planned to respect the flood risk regime identified.

13.5.18 There will be a **minor adverse** effect on the floodplain (slight loss of capacity) during construction works due to the temporary land take required for construction plant.

Pump Lane Link Road

13.5.19 The use of imported soils between bridges for the construction of the embankments has the potential to migrate via surface run-off into the adjacent watercourses causing **minor adverse** effects.

13.5.20 The creation of embankments may increase soil erosion and surface water run-off in these areas, and displaced surface water may flood other areas, particularly following damage to the soil matrix. These effects of are considered to be of **minor adverse** siginificance on surrounding surface waters.

Principal Assessment Year (Occupied Phase)

Main Site

13.5.21 It has been assumed that for the Principal Assessment Year remedial activities would have been undertaken on the Site facilitating the proposed development as detailed within Chapter 3: Site and Proposed Development.

13.5.22 The proposed Scheme would increase the total area across the Site occupied by good integrity hard-standing (currently the hard-standing is 'patchy' and low grade with many areas of semi-permeable surfacing). This would result in the most significant effects during summer when naturally low groundwater levels would be accentuated and may cause low flows in the Yeading Brook.

13.5.23 The catchment area for the Yeading Brook upstream of the Brookside Park gauge is calculated to be 43km2 (Source: Centre for Ecology and Hydrology, National River Flow Archive). Given that the Site is downstream of this gauge, the upstream catchment area associated with the Site is expected to be greater still. The Main Site has an area of approximately 33.4ha; this represents only a small proportion of the catchment area available for groundwater recharge. Therefore, due to the size of the Site and its contribution to groundwater recharge on a catchment-wide basis, the magnitude of this is considered to be minor adverse.

13.5.24 The predominantly hard-surfaced nature of the proposed development is considered to alter the local river flow regimes. Precipitation infiltration would be limited to certain acceptable areas of parks, gardens and other open spaces, with the remainder directed to surface water sewers and their holding tanks and their controlled discharge points, the Yeading Brook. The residence time of water, which takes this route before joining surface water, is much shorter than rain percolating down into the groundwater. The potential alteration in the flow regime would include a reduction in its baseflow and a faster response to a rainfall event so that the risk of flash flooding downstream is increased. However, the existing land cover of the site must be taken into account in order to assess potential

changes to baseline conditions. It is understood that overall the proposed development would significantly increase the total area occupied by hardstanding to approximately 70-80% of the Site. The potential effect of the proposed Scheme upon land drainage and flood issues is assessed as potentially having a **moderate adverse** significance upon the local flow regime, particularly during times of flood.

13.5.25 The access routes together with the associated increase in traffic load, have the potential to cause a **moderate adverse** effect on water quality with an increase in sediment load and pollutants such as oils, bitumen, rubber, de-icing salt, pesticides, herbicides and metals. Where the road drain enters the general urban drainage network or where service areas are present there may also be microbiological contamination.

13.5.26 Effects upon water quality may also occur from the day–to-day operation of the Site and by any emergency situations or accidental spillages. The most susceptible areas would be the ground under and around any storage tanks and during loading/unloading of substances in particular fuel/oil areas where, without adequate protection measures, a **major adverse** effect may arise from the escape of 'liquids' or chemicals being delivered on-site.

13.5.27 Given the relatively high groundwater (between 0.4m and 3.2mbgl) any spillages that are able to penetrate to the underlying ground would be expected to enter the groundwater relatively quickly and would migrate to the northwest. The high groundwater and the close proximity of the Yeading Brook would indicate that both are in continuity and as such any spillage on the Site entering the underlying groundwater would also enter the Yeading Brook, potentially causing a **substantially adverse** effect. However, given the proposed mix of uses (residential and commercial) on the Site, the nature of these 'liquids' or chemicals are not likely to be in large volumes or generally of a toxic nature. The effect of future pollution events have therefore been assessed as potentially being of **minor adverse** significance.

Proposed Western Access Routes

13.5.28 The proposed crossings (Pump Lane Link Road and the two footbridges) on the western boundary of the Site will increase the area of impermeable surface cover within the Yeading Brook floodplain by approximately 4,800m^2.

Pump Lane Link Road

13.5.29 The installation of the Link Road embankment will reduce the potential volume of flood storage by approximately 2,000m^3 within the functional floodplain. This comprises the majority of the above 4,800m^2 of new impermeable area, thereby potentially leading to heightened frequency, velocities and volume of precipitation runoff with subsequent soil erosion in the future. Refer to Appendix 13.2 for further details of the FRA undertaken to assess the effects of the presence of the access roads.

13.5.30 It is recognised that the existence of the embankments supporting the road would have a **minor adverse** effect on the capacity of the Yeading Brook flood plain to retain flood waters.

13.5.31 The residence time of runoff during flooding events is less than that following groundwater percolation, therefore chemicals within the road runoff have less potential for dilution, dispersion and degradation resulting in a **minor adverse** effect on the water quality.

13.5.32 The western section of the link road has an existing drainage system which discharges into the Yeading Brook. It is considered that this will be maintained with some gullies relocated as required. Therefore, the discharges from this link road are considered to have a **negligible** effect on surface waters.

Springfield Road Footbridge

13.5.33 The approach embankment to the pedestrian / cycle bridge will create around 200m^2 of impermeable surface cover on the northern end of the bridge. The overall effects from this on drainage are anticipated to be **negligible**.

13.5.34 The conditions relating to other features of the access crossings of the flood plain are detailed elsewhere within this statement, including such factors as construction effects.

13.5.35 The Springfield Road Footbridge would not have a contaminating influence on any runoff or interfere with river flow. The narrow deck and relatively high clearance would minimise the effects on the ecology of the flood plain therefore resulting in **negligible** effects. However, in the event of a storm the bridge has the potential to cause **minor adverse effects** with regard to quality and flow regime.

Minet Country Park Footbridge

13.5.36 The effects from the presence of the pedestrian / cycle route are considered to be **negligible** in relation to flood risk potential and surface water flow regime. A ramp of approximately 55m is required to bring the footway down to existing ground level.

13.5.37 The Footbridge is a pedestrian only access from which surface run off would not show effects from contamination. Interference with river flow and the narrow deck together with relatively high clearance would minimise impact on the ecology of the flood plain below As such there would be a **negligible** effect.

Eastern Access

13.5.38 Run-off from the road would be directed into the upgraded existing local drainage system and discharged to surface water outfall, passing first through features as described under the following section. As such there is considered to be a **negligible** effect.

13.6 Mitigation and Enhancement

Main Site - Remediation

13.6.1 Groundwater contamination has been recorded in varying degrees across the Main Site in the underlying shallow gravels although little impact has been recorded in the surface water courses in the local area. The degree of impact recorded varies from negligible to substantial and, therefore, differing degrees and methodologies of remediation will be used to address impacts are characterised as unacceptable. On-site groundwater treatment works would be undertaken in tandem with, and subsequent to, the soil remediation works. The objective of the treatment would be to reduce potential risks to identified sensitive receptors as detailed in the QRA.

13.6.2 The results of the groundwater remediation feasibility trials 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 preferred environmental solution. Where waters are abstracted from the aquifer, these would be treated ex-situ before being discharged to sewers if not suitable for an agreed regime of re-injection.

13.6.3 Perched waters within excavations and remnant below ground structures would be pumped to a specially constructed water holding facility fitted with silt and product traps. Discharge via gravity through a Granular Activated Carbon (GAC) Filtration Unit to foul sewer with Thames Water approval is likely to result.

13.6.4 The remediation strategy approach to the Site will target areas of significant contamination as opposed to proposing a single site-wide scope of works. The treatment plant will mobilise between locations reflecting general improvement progress to the north west following the areas groundwater flow. Treated waters would be remediated to a level at which they no longer pose a risk to the Site.

13.6.5 An impermeable, or semi permeable vertical barrier (groundwater control system) would be constructed below ground level to encompass the National Grid retained (east area) land. The purpose of this installation would be to prevent the migration of retained contaminated groundwaters into remediated areas of the Main Site, mitigating the risk of re-contamination.

13.6.6 Land less effected to the northeast of the Main Site will be targeted first (Remediation North Phase) allowing it to be released for phased development with a subsequent remediation phase in the west, targeting more impacted areas.

13.6.7 Extensive monitoring would be undertaken to ensure the effectiveness of the remediation scheme until the risks to receptors have been appropriately reduced.

Main Site – Construction

13.6.8 Where water is to be abstracted from surface water or groundwater a licence will be obtained from the EA. Where discharges are required to controlled waters or sewers, consent will be obtained from the Environment Agency or the statutory sewerage undertaker as applicable. De-watering operations will also require registration and/or a permit and this will be obtained from the EA.

13.6.9 Works in, over or under a the Canal or Yeading Brook or works altering or repairing any structure in, over or under these or any other watercourse, and works within the Land Drainage Byelaw margin of the watercourse will require Land Drainage Consent from the EA.

13.6.10 All potentially polluting substances will be stored on impermeable surfaces with controlled drainage, away from storm water sewers, grids, channels, watercourses and ditches or adequate measures will be taken to protect against pollution.

13.6.11 All hazardous substances on site will be controlled in accordance with COSHH Regulations. The storage compound will be fenced off and locked when not in use to prevent theft and vandalism.

13.6.12 All water run off from designated refuelling areas will be channelled to an oil separator or an alternative treatment system prior to discharge.

13.6.13 Spill kits will be held on site with a variety of absorbent materials to be used in the event of a spill of fuel, oil or chemicals.

13.6.14 Approval from the EA and other appropriate bodies will be obtained for crossing of, diversions to and work within statutory buffer zones for watercourses.

13.6.15 Measures will be taken to ensure that run off from earthworks does not enter drains, watercourses or ditches; this may include the use of silt fences.

13.6.16 Areas of exposed ground and stockpiles will be minimised to reduce silty runoff. Geotextiles will be used as necessary to shield spoil mounds.

13.6.17 Areas of hard standing and surface roads will be swept regularly to prevent the build up of material which could be washed into water courses.

13.6.18 Where periods of prolonged or heavy rainfall are forecast, appropriate additional measures will be taken to control surface run-off and move potentially polluting activities out of any areas susceptible to flood risk.

13.6.19 The Construction Environmental Management Plan (CEMP) (see Appendix 6.1) outlines the construction mitigation measures fully.

Main Site - Principal Assessment Year /Operational

13.6.20 Monitoring of the hydrogeological and hydrological regime would allow for reactive measures to ensure that effects are controlled. During operational / occupied phases mitigation measures would include for the safe handling of materials, as required by their individual duty of care practices alongside management plans developed to encompass accidental discharges.

13.6.21 It is recognised that the proposed development would entail the construction of a significant proportion of hard-standing that would have the effect of decreasing current infiltration rates and subsequently increasing run-off rates. The use of Sustainable Urban Drainage Systems (SUDS) has been considered but in the main deemed unsuitable on the basis that residual levels of soil contamination pose a risk to remediated groundwaters if leachate is permitted to be generated through general filtration of surface water. Very minor areas of the site are, however, considered appropriate for the use of infiltration techniques / SUDS. The density of development phases will greatly influence the SUDS methods chosen at the detailed design stage. The following table from "SUDS-A Practical Guide" illustrates how the most sustainable solution should be adopted.

- Petrol / oil interceptors will be installed on non adoptable car parking areas and service yards upstream of the connection into the adoptable surface water sewer.

- A lined wetland area of approximately 1100m2 is included within the masterplan to perform the dual objective of creating a bio diverse wetland area whilst accommodating as much stormwater (from storms of up to 1 in 30 year return period) as possible.

- Rainwater harvesting will be installed on buildings where it is both practical and economically viable, to reduce mains water consumption and reduce the risk of available capacity in the below ground drainage systems being exceeded during extreme storms.

- Green roofs are proposed for central areas within the proposed flats. Such installations provide some attenuation and improve rainwater quality. Pervious paving will be used where appropriate allowing rainwater to soak straight into the sub base layer (no fines aggregate) which acts as a storage tank. This layer will be separated from the residual contamination by an impermeable liner.

Table 13.4. Hierarchy of Sustainable Urban Drainage Systems

Most Sustainable	SUDS Techniques	Flood Reduction	Pollution Reduction	Landscape & Wildlife Benefit
↑	**Living roofs**	√	√	√
↑	**Basins & Ponds** - wetland - balancing pond - detention basin - retention pond	√	√	√
↑	**Filter Strips & Swales**	√	√	√
	Infiltration - soakaways - infiltration	√	√	√

	trenches - infiltration basin			
↓	**Permeable Surface & Filter Drains** - gravelled areas - paving blocks - porous paving	√	√	
↓	**Tanked Systems** - oversized pipes & box culverts - storm cells	√		
↓ **Least Sustainable**				

13.6.22 The negative effects of increased surface water run-off would be mitigated through the emplacement of attenuation features and treatment processes within the drainage design, mainly within the pipework itself.

Pump Lane Link Road and Springfield Road and Minet Country Park Footbridges

13.6.23 It is considered that specific groundwater remediation would not be required for these western access routes. Measures taken during the construction phase, would ensure that the effects to the hydrological and hydrogeological regimes are controlled. During the operational / occupied phase, effects arising from the discharge of reduced quality surface run-offs would be mitigated through the use of appropriate design features including retention tanks and interceptors.

Springfield Road and Minet Country Park Footbridges Flood Risk Mitigation

13.6.24 Although the two pedestrian / cycle bridges constructed across the Yeading Brook and its floodplain will be cited within either flood zone 1 or flood zone 3 (but outside of the functional floodplain), flood mitigation measures are not considered necessary. At these locations, the effects / interference with river flow and overall flood plain storage have been assessed as being **negligible** and the very minor loss of flood plain storage will be accounted for elsewhere through mitigation measures.

13.6.25 Storm water flow considerations to minimise potential effects with regard to quality and flow regime, in the event of a storm, will be in built into the final design.

Pump Lane Flood Risk Mitigation

13.6.26 The existing flood relief channel (Photo 13.1 right) would be diverted, as part of works for the Pump Lane Access in the west of the Site, to enter into a larger brook channel to the east of its existing channel. The works will effectively result in the diversion of 225m of concrete lined channel to 125m of a new open natural water course plus 170m combined channel with the Yeading Brook. To compensate for the loss of floodplain storage area (approximately 2000m3 for the construction of the road bridge embankment), a volume of 260m3 will be contained within the upper section

of the abandoned flood relief channel to allow for surface water discharges. Approximately 9600m3 of material will be excavated above the predicted flood level for Pump Lane to provide level for level compensatory storage for the embankment (Figure 13.5). The compensatory storage will account for some very minor floodplain loss for other access routes. Therefore, the effects relating to flood risk associated with the Pump Lane Link Road are considered to be effectively mitigated by this provision.

13.6.27 Both ground and surface waters would be largely protected from the effects of reduced quality road surface run-off by in-built design features. The western section of the access route has an existing drainage system discharging into the Yeading Brook, which will be maintained with some relocation of gullies where required. It is intended that the area from the edge of the carriageway to the Canal will be drained to the low point in the region of the existing by-pass channel. The discharge flow will need to match greenfield runoff rates for a 1:100 year return period; this will require 260m2 of storage. The proposed storage will be contained within the upper section of the abandoned flood relief channel.

13.6.28 Areas to the east of the canal will drain into the Site's main drainage system. The drainage design will channel surface waters from the road into a retention feature (hydrobrake) and then into a petrol interceptor (to remove gross contamination) before discharge to surface waters. Although this can be considered very locally as a **minor adverse** effect, within the greater context of surface water flow regimes the overall effect will be **negligible**. Similar effects are also assigned to the local groundwater regime.

Flood Relief Channel Diversion

13.6.29 The proposed diversion of the relief channel avoids the need for culverting. The channel diversion replaces 225m of existing, highly engineered low biodiversity character channel from use. The channel will be diverted to the east of the existing channel into an open natural feature water course and converges with the brook just upstream of the link road. This creates a **substantially beneficial** effect on the water and ecological value of the local area.

13.6.30 The diversion of the flood relief channel will cause a water level rise of between 20mm and 40mm. However, this is considered negligible as the backwater effect will result in unchanged water levels within a short distance upstream. Sensitively detailed rock armour will be placed at bends and junctions to reduce long term erosion. In time and following naturalisation this will provide a large area of gravel bed (Figure 13.6).

Eastern Access

13.6.31 Surface water run-off from this access would be directed into local enhanced existing drainage systems and subjected to control and protection features in built into these systems.

Flooding From Overland Flow

13.6.32 The topography of the Site is relatively flat and, if existing drainage systems are overwhelmed, overland flow will be shallow and widespread over an area. General property protection will be gained with the construction of floor levels above the general level of the surrounding ground.

Flooding from Artificial Drainage Systems

13.6.33 Flooding can occur following failure of pumping systems or the blockage or overloading of pipes during heavy rainfall events. The likelihood of flooding from this source is minimised by incorporating good design.

Development Drainage

13.6.34 The Scheme proposes a significant reduction in impermeable surfacing due to the landscaping and development proposals. Therefore the peak surface water discharge rate from the Site will be reduced. In order to positively minimise discharge of surface waters into public sewers and rivers, the discharge will, as far as is practicable, be restricted to that of a 1 year event typically between 2 and 8l/s/ha depending on soil type and topography.

13.6.35 Foul drainage will require connection to the public foul sewer within the Site. Approval from Thames Water will be required as foul flows generated by the future development will be greater than the current flows.

Flood Risk to Others

13.6.36 The proposed Scheme will increase the area of impermeable surface cover across the Site. As a result, an increase in surface water flow is anticipated and the associated flood risk to adjacent/ downstream properties is increased accordingly.

13.6.37 The proposed development will not alter the flow path of the Canal or the Yeading Brook. It is therefore anticipated that development of the site will not alter the potential risk of flooding to up or downstream properties.

Environmental Controls and Monitoring

13.6.38 The remediation works will be undertaken in line with good industry practice under appropriate site set-up facilities. These would include designated 'clean' and 'dirty' areas separated by health and safety hygiene units, odour mitigation systems, wheel wash and sheeting facilities for vehicles, induction programs for contractors and site visitors, and environmental controls similar to those detailed within the Health & Safety Executive documentation HSG66.

13.6.39 The effects resulting from the escape of liquids or chemicals used/stored on site can almost wholly be mitigated through the Scheme and implementation of an Construction Environmental Management Plan (CEMP) and the construction of dedicated tank containment features such as bunding.

13.6.40 The Canal and the Yeading Brook shall continue to be monitored in addition to 30no. groundwater monitoring wells across the Main Site including boundary locations (particularly adjacent to the canal / river boundary). Monitoring will take place during remediation works with subsequent sampling to assess the effectiveness of the remediation works and the potential for contaminant migration. Response plans will be developed and implemented if conditions required such.

13.7 Residual Effects

Construction

13.7.1 It is considered that there will be a negligible effect on the Yeading Brook, the Canal and groundwater generated, during the construction due to the use of good site practices as outlined in the Framework CEMP

13.7.2 Good site practices will reduce the likelihood of leakage of fuels, oil and chemicals during construction thereby having a negligible effect on groundwater and the Yeading Brook / the Canal. The likelihood of silt entry will also be reduced thereby having a **negligible adverse** effect on water resources.

Operational / Occupied Phase

13.7.3 The introduction of oil interceptors in areas susceptible to oil contamination will ensure a negligible effect on water quality. The risk of contamination of waters through foul water discharge will also be **negligible** as sewage effluent will not be discharge to controlled waters.

13.7.4 Sustainable features of the proposed Scheme will limit the outflow rates from the Site to ensure that discharges from the site are no greater than existing levels.

Potential Impact	Phase	Impact Type	Duration	Magnitude	Significance	Mitigation	Residual Significance after Mitigation
Mobilisation of identified contamination to off-site receptors	Construction	Adverse	Temporary	High	Substantial	Remediation of groundwaters to remove source contaminants.	Minor
Reduction in residence time for contaminants due to increased surface water run off.	Operational / Occupied	Adverse	Permanent	Low	Minor	New, improved drainage system, including retention features and interceptors.	Minor
Leakages during refurbishment of the White Street Sewer and other site drainage.	Construction	Adverse	Permanent	Negligible	Minor	New, improved drainage system including retention features and interceptors.	Minor
Increased sediment load from erosion, vehicles, road wear	Construction	Adverse	Temporary	High	Substantial	Avoid creation of steep slopes. Install drainage to direct water away from slopes. Install appropriate remediation techniques Construction vehicles should work at regulated distance from the river and the Canal. Discharge of silty water from excavations should be stored in tanks and removed from site or settled prior to discharge.	Minor
	Operational / Occupied	Adverse	Permanent	Low	Moderate	Surface water from roads and parking areas to be passed through oil/grit separator.	Minor
Pollution of surface water and groundwater by spillages and leaking tanks etc and remobilisation of existing soil contamination	Construction	Adverse	Temporary	High	Substantial	Minimal and appropriate exposure of ground to limit contaminant mobilisation. Formulation of an emergency response plan Construction staff to be observant of any signs of existing contamination.	Minor
	Operational / Occupied	Adverse	Permanent	Low	Moderate	Careful design and maintenance of fuel and chemical tanks, refuelling points and refuse storage areas. Appropriately designed bunded fuel and chemical tanks. Pipelines to be protected from corrosion.	Minor
Decommissioning of drains and lagoons	Construction	Adverse	Temporary	Medium	Minor	Appropriate disposal of water and sediments.	Minor
Loss of flood plain retention capacity	Operational / Occupied	Adverse	Permanent	Low	Minor	Construction of compensatory retention features.	Minor

References

13.1 HMSO (1995) Environment Act

13.2 HMSO (1994) Water Resources Act

13.3 HMSO (1990) Environment Protection Act

13.4 HMSO (1994) Health and Safety at Work Act

13.5 HMSO (1990) Town and Country Planning Act 1990

13.6 DCLG (1985) Building Regulations

13.7 HMSO (2006) Planning Policy Statement 25 (PPS 25) Development and Flood Risk

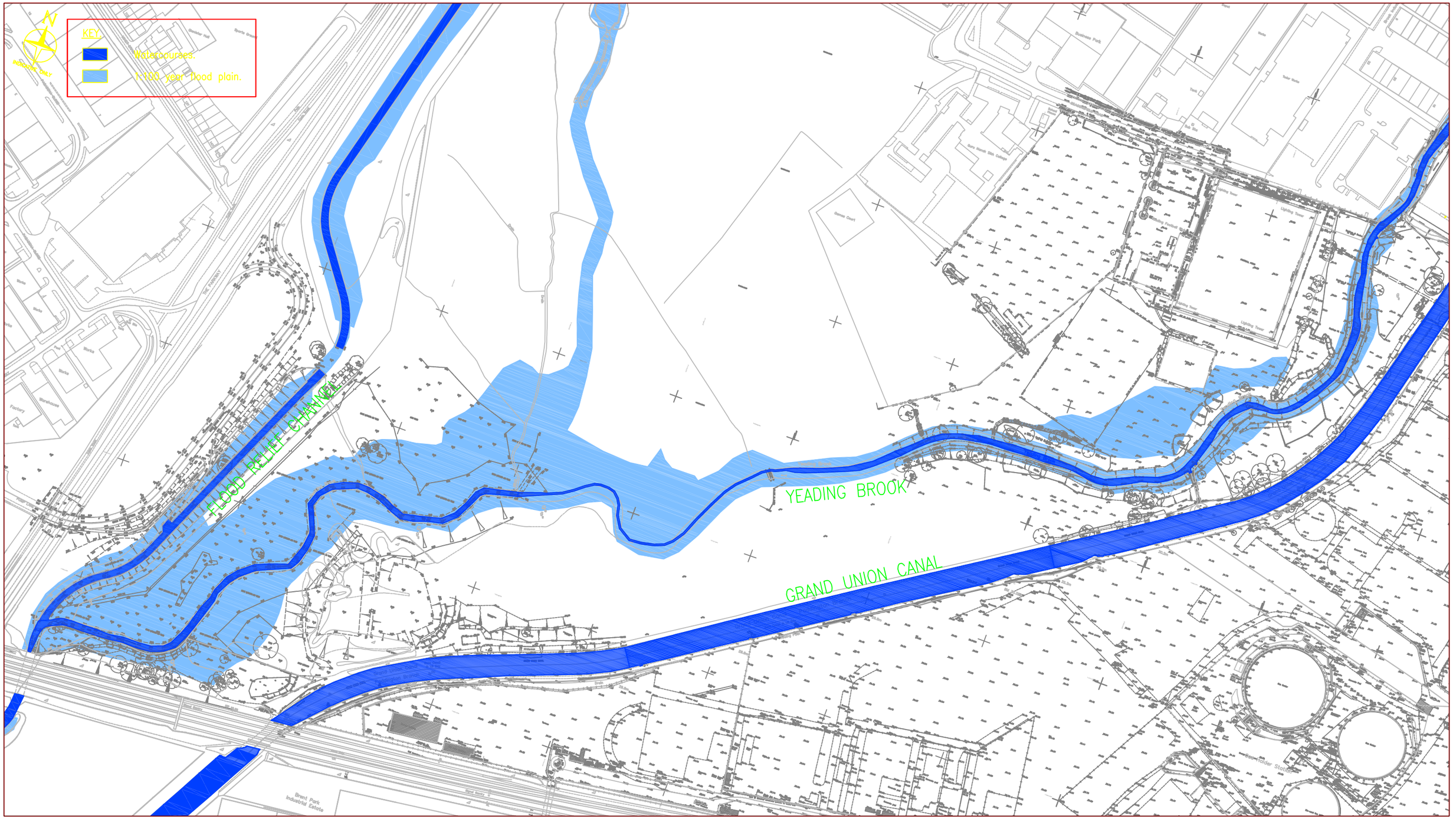
13.8 Greater London Authority (2008) The London Plan: Spatial Development Strategy for Greater London Consolidated with Alterations since 2004

13.9 London Borough of Ealing (2007) New Plan for the Environment (adopted 2004) Saved Policies.

13.10 London Borough of Hillingdon (2007) Unitary Development Plan (adopted 1998) Saved Policies.

13.11 Highways Authority (1994) Design Manual for Roads and Bridges (DMRB): Volume 11 Water Quality and Drainage

13.12 Department for Environment, Transport and the Regions (DETR) Guidance on the New Approach to Appraisal



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

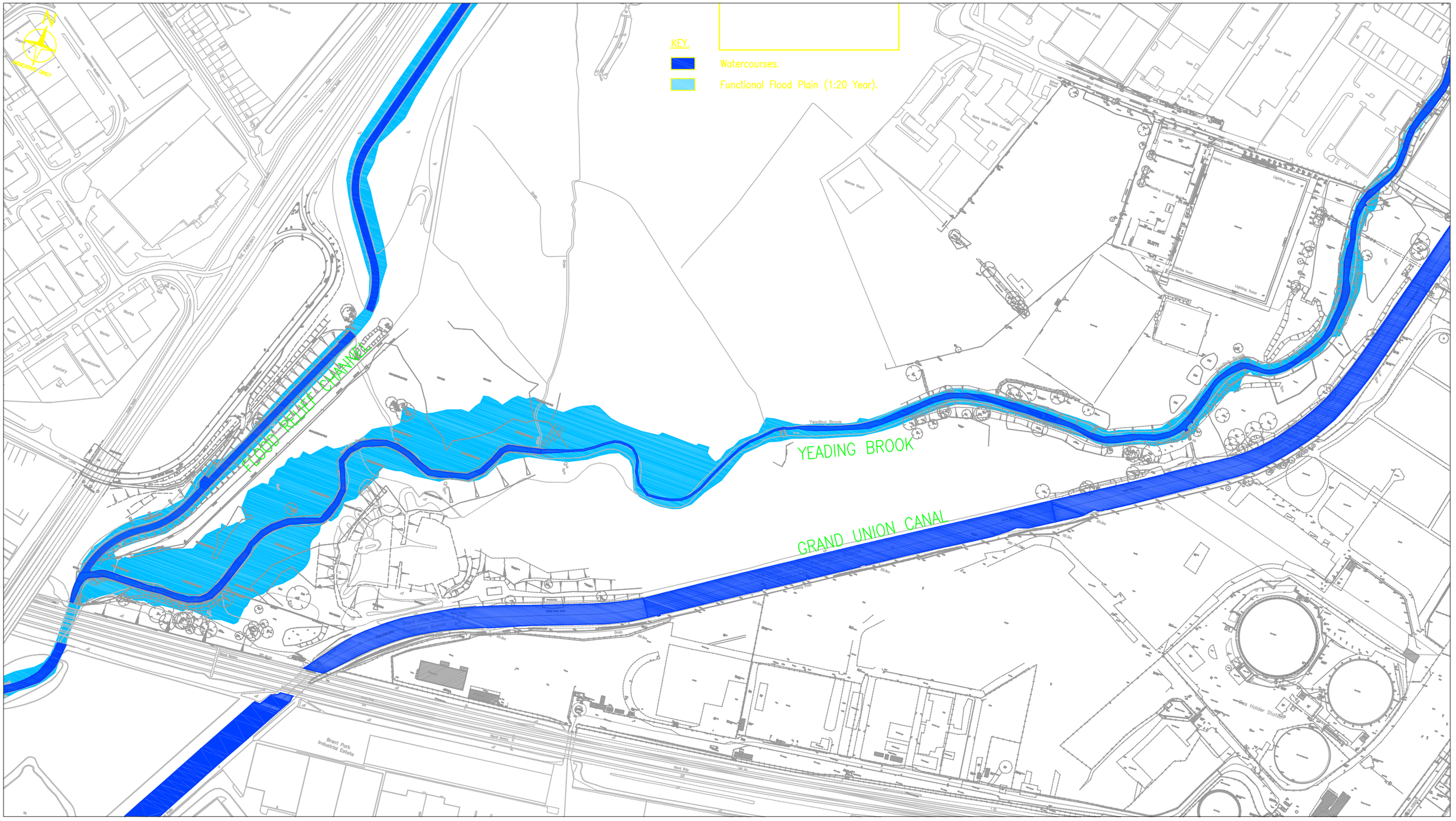
North

Scale N.T.S.

Flood Plain Map.

Figure 13.1

Drawing No: WYGE - A012564_644_RevA



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

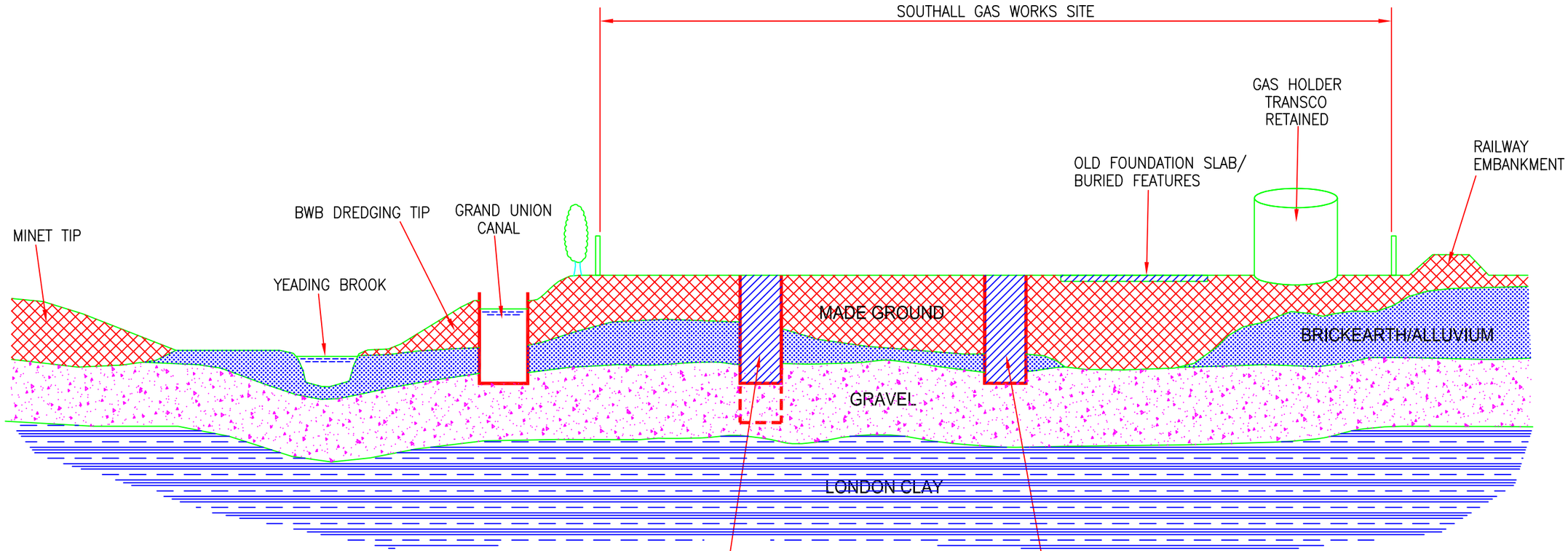
North

Scale N.T.S.

Functional Floodplain.

Figure 13.2

Drawing No: WYGE - A012564_644_RevA



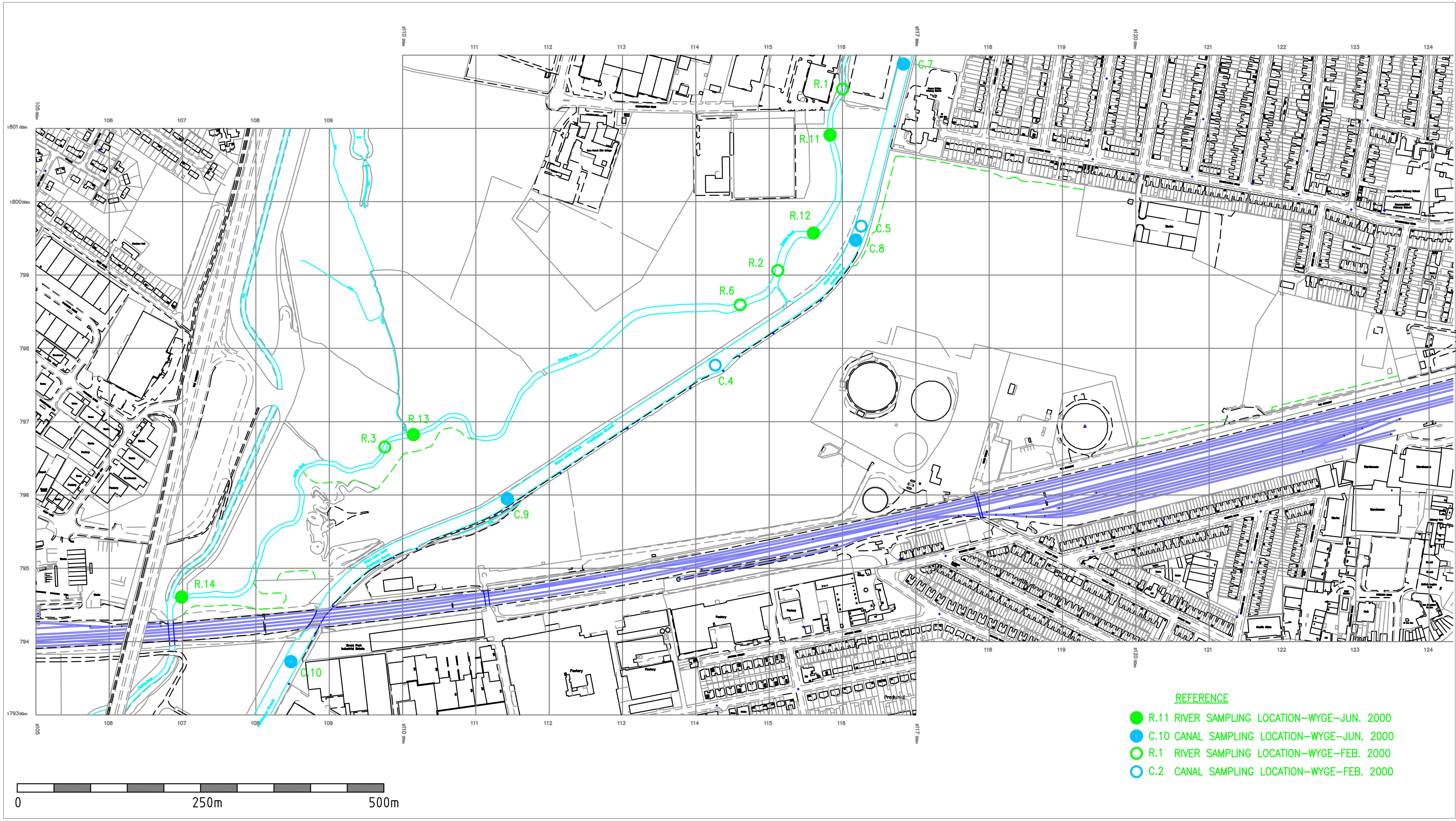
SCHEMATIC GROUND PROFILE OF THE FORMER SOUTHALL GAS WORKS AND SURROUNDING AREA

WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Scale N.T.S.

Schematic Ground Profile Southall Gasworks and Surrounding Area
Figure 13.3

Drawing No: WYGE - E0357-SK.20



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com

White Young Green

Environmental Consultancy

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

North

Scale N.T.S.

River and Canal Sampling Location Plan

Figure 13.4

Drawing No: WYGE - E0357-SK.18

KEY.

Watercourses.

1:100 year flood plain.

INDICATIVE ONLY

Compensatory storage area

Springfield Footbridge

FLOOD RELIEF CHANNEL

Flood Relief Channel Diversion

YEADING BROOK

GRAND UNION CANAL

Minet Footbrige

WYG Group Ltd.

Sunley House
4 Bedford Park
Croydon CR0 2AP

Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com

White Young Green

Environmental Consultancy

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

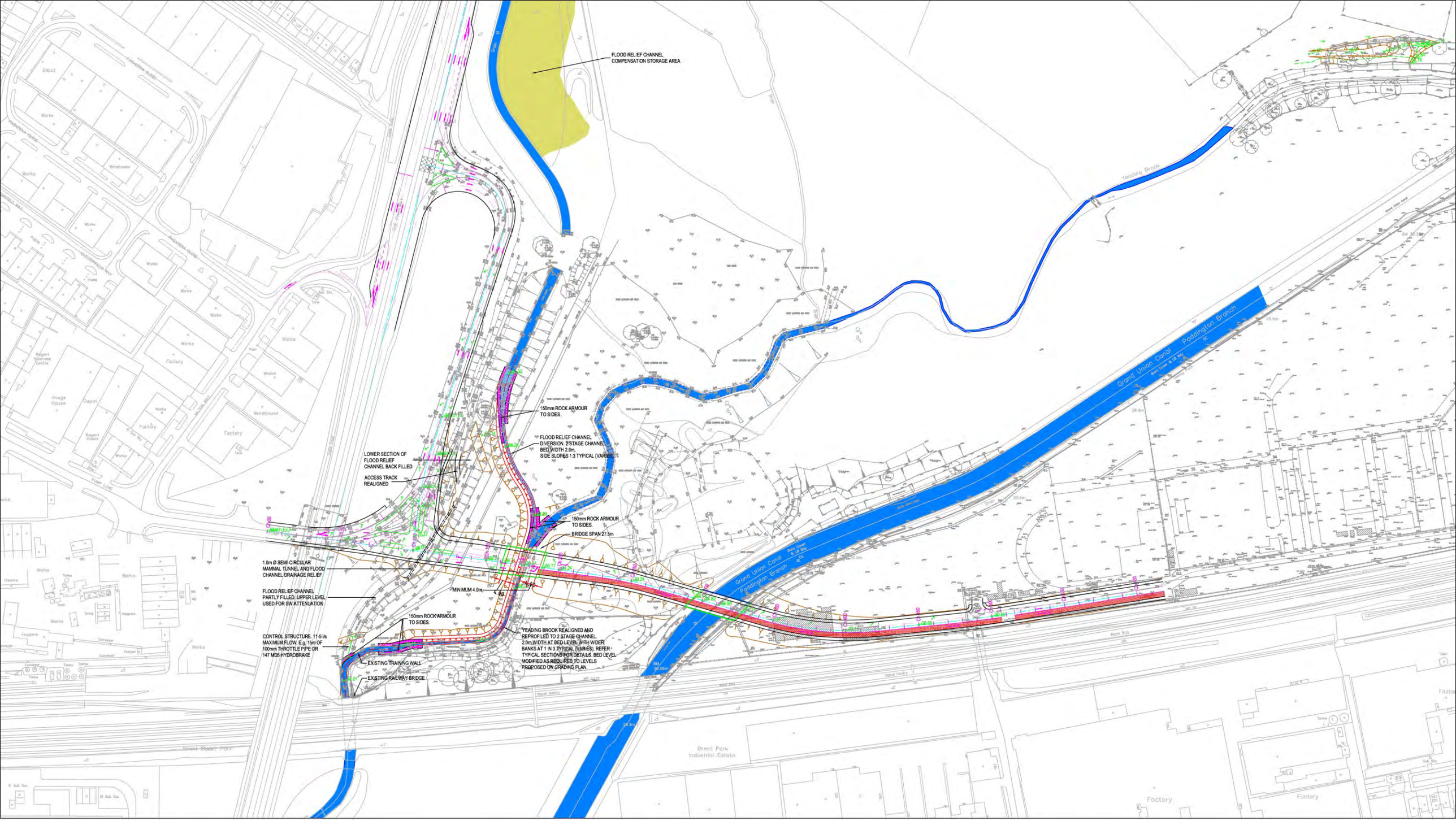
North

Scale N.T.S.

Bridge Compensatory Flood Storage Areas

Figure 13.5

Drawing No: WYGE - A012564_644_RevA



WYG Group Ltd.
Sunley House
4 Bedford Park
Croydon CR0 2AP
Tel: 020 8649 6600
Fax: 020 8649 6629
e-mail: enviro.london@wyg.com
White Young Green
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

North

Scale N.T.S.

Flood Relief Channel Diversion.

Figure 13.6

Drawing No: WYGE - A012564_644_RevA

14 ECOLOGY

14.1 Introduction

14.1.1 This chapter provides an assessment of the likely effects of the proposed development and associated access routes on the ecology and nature conservation value of The Site and its surrounding areas. It assesses:

- The conservation value of species and communities within the impact area of the proposed Scheme;
- the likely ecological effects of the proposed development;
- mitigation measures to be taken to avoid or minimise these impacts; and
- how the overall biodiversity of the area can be maintained and enhanced.

14.1.2 As noted above, this assessment considers areas beyond the Site boundaries as the proposed infrastructure and access routes associated with the proposed Scheme may result in direct and indirect impacts on the wider area.

Site Description

14.1.3 A full description of the existing conditions on the Site are presented in Chapter 3: Site and Proposed Development. To summarise, land uses currently consist of extensive vehicle storage that occupies the majority of the Main Site, bounded by a 2-3m high security fence or wall, except along the railway near the southern boundary. Many of the habitats are ephemeral and comprise opportunistic species in addition to dense scrub that is focused at the periphery. The land to the extreme eastern part of the Site consists of overgrown briar, scrub and some trees. It is understood that regular spraying of vegetation with herbicides has resulted in limited floral diversity.

14.1.4 To the west of the Site lies the Minet Country Park and two watercourses, the Canal and Yeading Brook. Although these features and land uses are primarily beyond the boundaries of the Site, they have the potential to be affected by the Proposed Access Routes and Main Development. A flood relief channel is also present as a separate aquatic feature adjacent to the Hayes by-pass.

14.1.5 The access routes comprise Springfield Road Bridge, Minet Park Bridge, Pump Lane Bridge and the Eastern Access linking to South Road.

14.2 Planning and Legislative Context

14.2.1 Current key ecological legislation with respect to protected species includes the Wildlife and Countryside Act (1981, as amended) [(14.1)], The Conservation (Natural Habitats, &c.) Regulations (1994, as amended) (the 'Habitats Regulations' - which transposes the EU Habitats Directive into UK law) [(14.2)], the Countryside and Rights of Way Act (2000) [(14.3)], The Natural Environment and Rural Communities Act (2006) [(14.4)] and the Protection of Badgers Act (1992) [(14.5)].

Bats and Great Crested Newts

14.2.2 Great crested newts and all seventeen British bats are listed in Schedule 5 of the Wildlife and Countryside Act and under Schedule 2 of the Habitats Regulations as a European protected species. Furthermore, the Countryside and Rights of Way Act, (Schedule 12, Paragraph 5) has amended Section 9 of the Wildlife and Countryside Act to include a provision for 'recklessness', and although the recent (August 2007) amendment to the Habitat Regulations removes the clauses relating to 'disturbance' and 'sale', between the two elements of legislation, European protected species remain fully protected.

14.2.3 This makes it an offence to:

- Intentionally kill, injure or take any bat or great crested newt as well as;
- intentionally or recklessly damage, destroy or obstruct the access to the place of shelter or protection, or disturb the animal whilst it is occupying it; and
- damage or destroy a breeding site or resting place of such animals.

This legislation applies to all life stages. Where development is likely to cause an offence a licence from Natural England will be necessary. These are granted where the proposed development has over-riding public interest, it can be demonstrated there is no satisfactory alternative to the Scheme, and the Scheme will not negatively impact the nature conservation status of bats or great crested newts in their wider range. In this way, a scheme of mitigation to prevent any impact on these species is must be agreed prior to the commencement of development for a licence to be granted.

Birds

14.2.4 All birds, their nests and eggs are protected by the Wildlife and Countryside Act, Part 1. It is thus an offence to intentionally:

- Kill, injure or take any wild bird;
- take, damage or destroy the nest of any wild bird while it is in use or being built;
- take or destroy the egg of any wild bird; and
- intentionally or recklessly disturb any wild bird listed on Schedule 1 while it is nest building, or at a nest containing eggs or young, or disturb the dependent young of such a bird.

Reptiles

14.2.5 All native reptiles are protected in Britain under the Wildlife and Countryside Act and its subsequent amendments. It is an offence to intentionally or recklessly kill, injure or sell (or advertise to sell) any of the six native species.

Water Vole

14.2.6 Water voles receive full protection through their inclusion in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). This makes it an offence to:

- Intentionally kill, injure or take water voles;

- posses water voles alive or dead; and

- intentionally or recklessly damage, destroy or obstruct a place used for shelter or protection or disturb a water vole occupying such a place.

Where a development is likely to cause an offence a Natural England license will be required. Licences are unlikely to be issued unless a scheme of mitigation is agreed prior to development commencing.

Badgers

14.2.7 Badgers in the UK receive a high level of legal protection following a history of persecution, with individual elements of legislation drawn together under the Protection of Badgers Act 1992

This makes it a criminal offence to:

- wilfully kill, injure, take, possess, or cruelly ill-treat a Badger, or attempt to do so;

- interfere with a sett by damaging or destroying it;

- obstruct access to, or any entrance of, a Badger sett; and

- to disturb a Badger when it is occupying a sett.

Although the distance is not set in statute, this legislation prevents development on or within 30m of a site occupied by badgers, unless a licence has been issued from Natural England and mitigation agreed and carried out prior to construction works.

Invasive Plants

14.2.8 Japanese knotweed and giant hogweed are included in Schedule 9, Part II of the Wildlife and Countryside Act. Under Section 14 of the Act it is an offence to "*plant or otherwise cause to grow in the wild any plant which is included in Part II of Schedule 9*".

14.2.9 The spreading or relocation of either plant material or contaminated soil around the Site, for example via vehicle tracks and wheels to areas not currently infected, would "*cause to grow*" and consequently constitute an offence.

14.2.10 All parts of these plants must be considered as controlled waste under the Controlled Waste Regulations, 1992 [14.6]. Rhizomes may spread several metres from the parent plant and soil within this distance would also be treated as controlled waste.

National Planning Policy

14.2.11 Planning Policy Statement 9: Biodiversity and Geological Conservation [14.7] gives guidance on how the Government's policies for the conservation of our natural heritage are to be reflected in land use planning. It embodies the Government's commitment to sustainable development and to conserving the diversity of our wildlife.

14.2.12 This guidance (PPS9 Section 15) states that:

"*Plan policies and planning decisions should aim to maintain, and enhance, restore or add to biodiversity and geological conservation interests. In taking decisions, local planning authorities should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; and to biodiversity and geological interests within the wider environment".*

Regional Planning Policy

London Plan (2008): Spatial Development Strategy for Greater London Consolidated with Alterations since 2004. (14.8)

14.2.13 London Plan Policy 3D.10 Metropolitan Open Land. This policy states that "The Mayor will, and boroughs should, maintain the protection of Metropolitan Open Land (MOL) from inappropriate development. Policies should include a presumption against inappropriate development of MOL and give the same level of protection as the green belt. Essential facilities for appropriate uses will only be acceptable where they do not have an adverse impact on the openness of MOL.

14.2.14 Policy 3D.14 of the London Plan - Biodiversity and nature conservation states that the Mayor will work with partners to ensure a proactive approach to the protection, promotion and management of biodiversity in support of the Mayor's Biodiversity Strategy. The planning of new development and regeneration should have regard to nature conservation and biodiversity, and opportunities should be taken to achieve positive gains for conservation through the form and design of development. Where appropriate, measures may include creating, enhancing and managing wildlife habitat and natural landscape and improving access to nature.

14.2.15 The Secretary for the Environment, Transport and the Regions' guidance on the arrangements for strategic planning in London (GOL Circular 1/2000, June 2000) (14.9) states that:

"*London's green space and open land are essential to maintaining the quality of its urban environment, and to its future well being. Many serve highly valued recreational uses. They are also often of ecological importance. Because of the constraints on land supply in London, they are likely to remain under continual development pressure. The Spatial Development Strategy (SDS), in conjunction with the Mayor's Biodiversity Action Plan where appropriate, should include policies for the protection and enhancement of the capital's natural and open environment, and in particular should*:

- *Set out policies for the protection and enhancement of the green belt in accordance with PPG2;*
- *take forward the concept of the Metropolitan Open Land that is, land within London of a predominantly open character which has more than logical significance and set out policies for its protection;*
- *set out policies for the role, provision and protection of open land within the capital generally, and identify opportunities for enhancing the quality, management and, where appropriate, the accessibility of this land*
- *include policies for the protection of sites of major ecological importance, including all sites subject to national and international designations, and include policies for their protection, having regard to PPG9; and*
- *broadly identify and promote opportunities for "green chains" and ecological corridors of strategic importance."*

Local Planning Policy

LB Ealing's New Plan for the Environment (adopted 2004) Saved Policies, 2007 [14.10]

14.2.16 LB Ealing "*New Plan for the Environment*" was adopted in October 2004. This Unitary Development Plan (UDP) sets out the Council's intentions for land and development from 2002 to 2017.

14.2.17 Chapter 3 of this plan addresses planning for the public, private and community open spaces, outdoor activities, nature conservation and issues which are critical to the amenity and natural environment of the Borough. The strategy policy states:

"*To maintain the system of major open areas linked by the green corridors, to protect green space in Ealing, to preserve and enhance biodiversity and nature conservation, to provide new outdoor recreation opportunities in areas of need and to improve open space wherever possible*."

14.2.18 The key issues raised by the plan that are relevant to this ecological assessment are as follows:

- Green Belt, Metropolitan Open Land and locally important open space (including green corridors and other wildlife habitats) should be protected;
- new open space should be created where there is inadequate provision. Along with this there is a clear encouragement of brownfield land development;
- it is important to enhance and protect green space in urban areas;
- there should be positive actions to achieve the targets set out in national and local biodiversity action plans through planning decisions; and
- priority should be given to protecting areas designated for their intrinsic nature conservation value, their landscape quality or their cultural importance. Important species should be protected and public access to nature promoted.

LB Hillingdon's Unitary Development Plan (adopted 1998) Saved Policies, 2007 [14.11]

14.2.19 The London Ecology Unit (LEU) identified areas of importance within LB Hillingdon for nature conservation. The LEU stresses the importance of particular corridors through urban areas, such as the Canal and Yeading Brook, which provide wildlife links from the open countryside to more heavily urbanised areas. The whole of the Canal is included as a Site of Metropolitan Importance for Nature Conservation.

14.2.20 The LB Hillingdon UDP contains a number of policies referring to Sites of Metropolitan Importance for Nature Conservation including EC1 which outlines that the Council will not permit development which would be unacceptably detrimental to Sites of Metropolitan or Borough (Grade i). However if development is proposed on or in the near vicinity of such sites an ecological assessment should be submitted, where considered appropriate by the Council, to demonstrate that the proposed development will not have unacceptable ecological effects. Policy EC3 requires development proposals in the vicinity of sites of nature conservation importance to have regard to the potential effects of changes in the water table and of air, water, soil and other effects which may arise from the Proposed Development.

14.2.21 Additionally, it states that priorities for sites of local importance should take account of biological components and their potential as a source of enjoyment in the context of recreational, educational and social needs of the local community. Steps will be taken to further the co-existence of natural communities alongside other land uses.

LB Hounslow Unitary Development Plan (adopted 2003) Saved Policies, 2007 [14.12]

14.2.22 West Southall does not fall within Hounslow. However, the Grand Union Canal and Yeading Brook cross into LB Hounslow and thus their UDP has been considered in this context. The Hounslow UDP is similar in its objectives for the environment to those of LB Hillingdon and LB Ealing. It aims to protect, maintain, and improve the open nature, amenity, ecological value, recreational value and quality of green belt, metropolitan open land, local opens space, heritage land, historic parks (and gardens), green corridors, green chains and other open spaces.

14.3 Methodology & Significance Criteria

Desk Top Review

14.3.1 A review of readily available ecological information was undertaken and this provided the overall ecological context for the Site and the surrounding environs.

14.3.2 The review included an overview of the Phase 1 and Phase 2 habitat surveys of the Main Site, undertaken in accordance with the Joint Nature Conservation Committee (JNCC) methodology [14.13]. Surveys of flora, fauna and general habitats were undertaken and the information from a resulting report reviewed and used within this chapter (see 14.3.5-15 for details of the surveys undertaken during this assessment).

Consultation

14.3.3 The following statutory and non-statutory nature conservation organisations were consulted:

- English Nature
- The Environment Agency
- London Ecology Unit (now part of the Greater London Authority (GLA))
- The London Wildlife Trust
- A Rocha UK (a local charitable trust) linked to the friends of Minet Park
- The London Bat Group
- The Hertfordshire and Middlesex Bat Group
- The local Amphibian and Reptile Group

14.3.4 Significant comments have been referred to within this Chapter.

Surveys

14.3.5 The following section details the survey work that has been carried out to date.

14.3.6 An ecological constraints walkover was undertaken in 2002 and August 2003 by White Young Green (WYGE) (see section 14.4) to establish the potential for protected or notable species and highlight any features of particular ecological value within the boundaries of the Site and local vicinity.

14.3.7 A full Phase 1 habitat survey was undertaken in 2000 by the London Ecology Unit with an update survey undertaken in 2007 by WYGE of those areas with particular nature conservation interest where impacts from the proposed development were considered to be significant. The 2007 survey report is included in Appendix 14.1. Phase 1 surveys of other notable areas, particularly the Access Road Sites, were also carried out and are included in Appendix 14.1.

14.3.8 Habitats were identified using the standard extended Phase 1 methodology [(14.13)] with target notes describing any valuable or interesting features (see Figure 14.1a and 14.1b).

14.3.9 Nomenclature for vascular plants (grasses and herbs) follows that of Stace [(14.14)]. This includes vernacular (English) names, but these may differ from the Latin names listed in the Phase 1 Habitat Handbook.

14.3.10 The timing (July) was considered optimal for carrying out botanical survey work. Although it should be noted that some early flowering species might not have been apparent, it is not thought likely that this would significantly alter the description or assessment of any habitat identified during this survey.

14.3.11 Protected and valuable species surveys were undertaken to identify the likely presence of species protected by statute (e.g. bats), and unprotected species that constitute a valuable part of the areas biodiversity. After the phase 1 survey, the following surveys were carried out; a bat activity survey, an entomological (insect) study, a water vole survey, a tree survey and a river corridor survey. All surveys met with standard recommended methodologies, specifically those summarised in Table 14.1.

Table 14.1 Survey Methodologies for Protected Species on the Main Site

Protected Species	Survey Methods
Badgers (*Meles meles*)	The Survey established whether badgers were inhabiting, or foraging on the Site. Such evidence of activity would include the identification of setts themselves, grubbed up grassland (caused by the animals digging for insects), latrines, hairs and paw prints.
Bats (*Chiroptera*)	Surveys aimed to identify features suitable for housing bat roosts. Such features include mature trees with holes and buildings. Additionally, suitable foraging and commuting habitats were identified where present.
Great crested newt (*Triturus cristatus*)	An assessment was carried out to identify any potential habitats that may support great crested newts. Suitable aquatic and terrestrial habitats are required and these include generally small, still ponds or water bodies and woodland or grassland areas where there is optimal invertebrate potential.
Reptiles	The Potential for reptile species on the Site was assessed during the walkover survey. Possible species include the grass snake (*Natrix natrix*), smooth snake (*Coronella austriaca*), adder (*Vipera berus*), common and sand lizards (*Lacerta vivipara* and *L. agilis*) and the slow worm (*Anguis fragilis*). These native reptile species generally require open areas with low, uneven height vegetation (such as heathland), with adjacent grassland or scrub. Suitable well drained and frost free areas are needed so they can survive the winter.
Otter (*Lutra lutra*)	Otter potential was assessed by looking for clean, running water with an abundant and varied food supply, plenty of bankside vegetation and secluded areas free of human disturbance for their holts.
Water voles (*Arvicola terrestris*)	Water vole potential was assessed by looking for ditches, rivers, dykes and lakes with holes and runs along the banks. Latrines or piles of food were also noted.
Birds	The potential for breeding and feeding birds was assessed by looking for trees, scrub, and other suitable habitat.

Invertebrates	The potential for notable invertebrate species was assessed by looking for a mosaic of dry, warm and open habitats.
Other Fauna - Biodiversity Action Plan (BAP) Species	During the course of the survey, effort was made to establish the potential for the Site to support BAP Species. These comprise organisms listed on the UK and local BAPs which are considered of conservation merit. Although they are not protected by statute, effort should be taken to ensure that, where possible, they are not impacted upon.

14.3.12 Due to the potential of the Main Site and surrounds to support roosting, foraging and commuting bats, a bat activity survey was carried out to establish its value for these animals. This was undertaken according to good practice guidelines and methodologies and the findings have been summarised within this assessment. Surveys were also carried out for water voles, invertebrates and trees and the findings of these surveys are also summarised within the Baseline Section below (14.4).

Valuation Criteria

14.3.13 The Institute of Ecology and Environmental Management (IEEM) (2006) valuation criteria were used which are based on Ratcliffe (1977), which was also consulted. Descriptions of value do not include exhaustive species lists, and only include those that are of particular interest. Specific criteria against which the value of the sites has been evaluated include:

- Habitat size, shape, diversity (eg mosaics, mono-cultures) and connectivity;
- Physical conditions (eg natural, semi-natural, buildings/hard standing);
- Biodiversity, including species richness, range and populations of plant and animals communities;
- Rarity and typicalness of plant and animal communities;
- Stage/stability of ecological succession and habitat development trajectory;
- Typicalness of the physical environment;
- Position in an ecological or geographical unit; and
- Potential and intrinsic value, re-creatability.

14.3.14 Values were categorised in the following geographical context, in accordance with the guidelines:

- International;
- UK;
- National (i.e. England in this case);
- Regional;
- County;
- District (borough-level);

- Local or Parish; and

- within zone of influence only (i.e. the project site)

Assessment of Effects

14.3.15 Effects to nature conservation from developments can be divided into two main types: direct and indirect. Direct effects occur when a habitat or species is affected by the footprint of the proposed Scheme itself or its associated infrastructure. Indirect effects may occur when factors related to the proposed development, but not part of the Scheme itself, influence ecology or nature conservation value of adjacent habitats or remote species.

14.3.16 Additionally, this assessment evaluates effects in the short, medium and long term, with secondary, cumulative and temporary effects also assessed using these timescales. Positive, or beneficial effects on the ecological condition and biodiversity of the Site have also been evaluated.

Prediction of Magnitude

14.3.17 Impacts have been assessed according to IEEM guidelines as summarised in Table 14.2.

Table 14.2 IEEM Classification of Impacts

Impact Description	Criteria
Adverse	The change adversely affects the valued ecological receptor, with either a temporary or permanent effect on its integrity.
Negligible	Effects of very little or no effect
Beneficial	The change is likely to benefit the receptor in terms of its conservation status, either partially or restoring it to favourable status.

N.B. Integrity can be defined as the coherence of ecological structure and function that enables the feature to be maintained in its present condition.

14.3.18 Note that the description of the effects relates only to their physical effects. It is, to an extent, independent of nature conservation value of the each feature.

14.3.19 Impact significance of both the construction stages and the Principal Assessment Year have been determined using the broad terminology outlined in Table 14.3 which has been adopted throughout this Environmental Statement.

Table 14.3 Definitions for Level of Impact Significance

Level of Significance	Definition
Substantial significance	Impacts of the proposed development of greater than local scale (adverse impacts on receptors of national or international value).
Moderate significance	Impacts of the proposed development that may be judged to be important at a local scale, i.e. in the planning context (adverse impacts on receptors valued from local or parish, district [or borough], county or regional level).
Minor significance	Impacts of the proposed development influence common species not outside the site boundary (adverse impacts on receptors valuable within the zone of influence only)
Negligible significance	Impacts with not enough significance to affect the decision-making process.

Phasing of Development and Impact Assessment

14.3.20 The proposed Scheme is envisaged to be constructed over approximately 15 years as described in Chapter 6: Construction and Phasing in this ES. Three consecutive stages of construction have

been considered to give a summary of the effects associated with each stage (please also refer to Figure 6.1).

14.3.21 The following scenarios were assessed:

- Stage 1 (2009-2014) includes phases 1-4 on Figure 6.1. Stage 1 includes the construction and remediation of the Pump Lane Bridge access corridor and construction of the Eastern Access will commence in this stage. Remediation of the northern part of the main site will be carried out. Retail and residential development comprising approximately 810 dwellings within the eastern and northern areas of the Site will be constructed.

- Stage 2 (2015-2019) includes phases 5-9 on Figure 6.1. This stage would see the completion of the school complex and the hotel in the centre of the Site. Improvements to South Road Railway Bridge would also be conducted early in this stage. The remainder of Stage 2 comprises residential development comprising approximately 1815 dwellings within the central and western part of the Site, and the construction of the Minet Park bridges. The central park and public realm along the Canal frontage, between the two pedestrian bridges would also be implemented.

- Stage 3 (2020-2025) includes phases 10-13 on Figure 6.1. Stage 3 would conclude the overall proposed Scheme with the construction of approximately 875 residential dwelling along the southern boundary and south western corner of the Site together with the new public realm along the Canal frontage.

- Principal Assessment Year is the year at which the proposed Scheme will be operational, this has been assumed to be 2025 subject to market conditions.

14.4 Baseline Conditions

14.4.1 Baseline conditions are those which will prevail at the commencement of the proposed development, currently envisaged to be in 2009/2010. Generally these will be the same as those prevailing at the current time (2008), except for traffic which will need to accommodate background growth and townscape factors.

Consultation

14.4.2 Full consultation responses as received are attached in Appendix 14.1 and have been considered when assessing the value of the overall Site. Records obtained from the consultees provide a context in which recent ecological surveys have been assessed and provides an alternative source of ecological data.

Designations

14.4.3 English Nature has confirmed that there are no statutory designated sites within the local vicinity of the Site and access zones.

14.4.4 The London Wildlife Trust has supplied information concerning non-statutory designated sites within the local vicinity of the Site. Within London there are three grades of non-statutory Site of Importance for Nature Conservation (SINC): Metropolitan, Borough (Grade I and II), and Local. Within a 1 km radius search area around the Site, there are two Metropolitan and one Borough (Grade 1) sites. The north-south Canal Paddington Branch (TQ 040909) to the north-west of the Main Site is of Metropolitan Importance.

14.4.5 The Main Site is adjacent to, and the Proposed Access Roads and Bridges transverse, adopted London Green Belt land to the northwest of the Site.

14.4.6 Part of this Green Belt which is enclosed by the Hayes Bypass, Yeading Brook and the industrial estate to the north (TQ 111798), was recently identified by LB Hillingdon and local charitable groups to create the Minet Country Park. Although not designated with an official local or regional status, it should be considered of significant local value. Minet Country Park is illustrated on Figure 2.2.

14.4.7 A Rocha UK (a charitable trust), has collected wildlife information on Minet Country Park for a number of years and produced ecological reports documenting their results in 1999 and 2002. Additional information is also available on their website regarding work undertaken on the area more recently.

14.4.8 The 1999 and 2002 reports also note the known history of the area: the area west of Yeading Brook is recorded as being pasture on an 1861 map and the British Waterways land to the south in between the brook and the canal was used for the deposition of canal dredgings and waste. Prior to the country park status, the Site received only limited management and is reported to have been used as a dumping ground for rubbish and burnt out cars.

14.4.9 Consultation with LB Hillingdon confirmed that there are no Tree Preservation Orders (TPOs) within Minet Country Park or access zone areas.

14.4.10 Consultation with the LB Ealing confirmed that there are no TPOs on the Main Site, although the Canal is designated as a conservation area and the trees on the banks of the canal may be afforded some protection through this designation.

Biodiversity Action Plans

14.4.11 The London Biodiversity Partnership has developed a Local Biodiversity Action Plan (LBAP) for Greater London, which includes the Main Site and surrounding area. The habitats and species action plans and species statements noted in Table 14.5 are specifically relevant to the conservation status and needs of London and in particular the Main Site. The Priority Species Action Plans provide more detailed information on threats facing some species, and the opportunities for maintaining and enhancing their populations. Detailed actions are set out for a number of organisations to achieve the targets for these species. Priority Habitat Action Plans provide more detailed descriptions for specific habitats that can be undertaken by a number of agencies in order to safeguard and enhance them.

Table 14.5 Biodiversity Action Plans relevant to the Main Site and surrounding area

Action Plan Type	Information included within Action Plan
Habitat Action Plans	• Urban • Wasteland • Woodland • Churchyards and Cemeteries • Private gardens • Canals • Parks • Squares and Amenity Grassland.
Species Action Plans	• Bats • Stag Beetle (*Lucanus cervus)* • Water vole (*Arvicola terrestris*) • Reptiles • House sparrow (*Passer domesticus*) • Bull finch (*Pyrrhula pyrrhula)* • Song Thrush (*Turdus philomelos)* • Kingfisher (*Alcedo atthis)* (UKBAP Species of Conservation Concern) • Tower mustard (*Arabis glabra*) • Sand Martin (*Riparia riperia*)

Action Plan Type	Information included within Action Plan
Species Statements	• The 'Humble Bumble' • House Martin

Species Records

14.4.12 Species data provided by The London Wildlife Trust is summarised in Table 14.6 below.

Table 14.6 Species Records on Main Site and Surrounding Area

Species	Survey type	Location	Date	Status
Lesser Marsh Grasshopper *Chorthippus albomarginatus*	London Orthoptera	TQ 112798 (200m, SW of site)	08/2002	-
Meadow Grasshopper *Corthippus parallelus*	London Orthoptera	TQ 112798 (200m, SW of site)	08/2002	-
Long-winged Conehead *Conocephalus discolor*	London Orthoptera	TQ 112798 (200m, SW of site)	08/2002	RDB *–
Roesel's Bush Cricket *Metrioptera roeselii*	London Orthoptera	TQ 112798 (200m, SW of site)	08/2002	Nationally notable
Brown Long-eared Bat *Plecoytus auritus*	Bat Feeding Areas	TQ 1280 (200m, E of site)	09/1987	W&CA*
Bats *Vespertilionidae*	Bat Feeding Areas	TQ114797 (150m, SW of site)	07/1986	W&CA*
Pipistrelle *Pipistrellus pipistrellus*	Bat General	TQ117802 (30m, N of site)	08/1994	W&CA*
Pipistrelle *Pipistrellus pipistrellus*	Bat General	TQ116799 (just off S boundary of site)	08/1994	W&CA*

* RDB = Red Data Book Species, W&CA = Wildlife and Countryside Act

14.4.13 A Rocha, as noted previously, have undertaken ecological recording work at Minet Country Park. Their reports note that the Park comprises a range of habitats and a diverse flora and fauna. A number of schemes are currently ongoing, including a butterfly transect programme, bat walks for the public, and a bird-ringing initiative.

14.4.14 The following ecological features of note have been identified:

- Although the Site does not contain any nationally rare plants, it is likely to support locally uncommon species;
- 11 species of dragonfly and 21 species of butterfly;
- common frog and smooth newt in the ponds to the north of the Country Park site;
- grass snake in the grassland to the north of the survey area and between Yeading Brook and the Canal (Pump Lane Bridge study area);
- records indicate slow-worm is known from many sites in the Borough of Hillingdon, and may be present in the Minet Country Park;
- 94 bird species have been recorded within Minet Country Park between 1998 and 2002, 35 of which are known to breed regularly on the Site;

- bats are known to use the area for foraging, but roosting sites are unknown; and

- other common species of mammal have been recorded (e.g none of which are protected).

14.4.15 The bird-ringing programme has been ongoing for a number of years and includes kingfisher (UKBAP), reed bunting (UKBAP), song thrush (breeding) (UKBAP), bullfinch (breeding) (UKBAP), skylark (UKBAP), linnet (UKBAP), common whitethroat (breeding), blackcap (breeding), garden warbler (breeding), chiffchaff (breeding), lesser whitethroat (breeding), willow warbler (breeding) and several other warblers (breeding) (UKBAP: These are UK Biodiversity Action Plan Priority Species).

14.4.16 The Hertfordshire and Middlesex Badger Group stated they do not have any records of badger activity within the survey area. In addition, in their opinion badgers are very unlikely to be present.

Water Quality

14.4.17 The study area includes two watercourses, the Canal and the Yeading Brook. The Environment Agency (EA) has provided chemical and biological data for both of these watercourses, this is shown in Table 14.6.

14.4.18 The General Quality Assessments (GQA) are the EA's national method for classifying water quality in rivers and canals, and are based on a range of chemical and biological factors.

Table 14.7 Water Quality Grades for the Yeading Brook and Grand Union Canal

	Biological Quality	**Chemical Quality**
Grand Union Canal –Paddington Branch	E – Poor (Biology restricted to pollution tolerant species)	E – Poor (Impoverished ecosystems)
Yeading Brook	E – Poor (Biology restricted to pollution tolerant species)	C – Fairly Good (Natural ecosystems)

Description of Site Ecology and Valuation

14.4.19 The following section describes the habitats identified within the study area and is based on the findings of WYGE site surveys from 2007, also drawing on the survey carried out by the London Ecology Unit in August 2000.

14.4.20 It consists of the following JNCC Habitats**:**

- Buildings (J3.2)

- Hardstanding (J4)

- Tall Ruderal (C3.1)

- Poor Semi-improved Grassland (B6)

- Dense Continuous Scrub (A2.2)

- Amenity Grassland (J1.2)

- Running Water (G2)

14.4.21 Reference is made to the 2007 Phase 1 survey map (shown in Figure 14.1a) and the associated target notes (Figure 14.1b).

Fauna

14.4.22 The following describes the potential of the Site to support protected fauna (based on the 2007 Phase 1 survey results and subsequent protected species surveys):

Badger (*Meles meles*)

14.4.23 No evidence of badgers was found and no part of the Main Site is deemed suitable to support badgers. However, badger field signs were noted in the Minet Country Park in late 2007 as part of a site walkover by WYGE and a survey of both the Springfield Road Bridge and Pump Lane Bridge areas was undertaken in February 2008. These surveys did not find any badger setts or badger activity that would constitute a constraint to development. Therefore, the Main Site can be classified as valuable **within the zone of influence only** as badger habitat, but areas in the Minet Country Park have potential to support badgers and thus are classified as of **local or parish** value.

Bats

14.4.24 Bat activity surveys were undertaken in October 2004 and June 2007; survey reports are included as Appendix 14.2.

14.4.25 An extensive daytime walkover survey was undertaken using close-focusing binoculars to identify any potential temporary or permanent roosting sites and emergence holes. These could be on trees or buildings within the development area and along boundaries where access roads are proposed. Any trees with cracks and crevices, loose bark, holes (including rot holes, boss holes and woodpecker holes) or splits were taken account of. Additionally, any absence of branches and vegetation immediately below and surrounding the cavity entrance was noted.

14.4.26 Activity surveys were undertaken using handheld bat detectors to assess the value of potential roosting areas identified during the daytime, and lasted for 1 hour 25 minutes, commencing a few minutes before sunset. The weather was dry with negligible wind and the air temperature approximately 11°C. Handheld detectors are able to gauge general bat activity and foraging behaviour within the survey area. If a potential roost site was identified during the daytime survey, an ecologist was situated nearby for the dusk survey so an estimate of bat numbers could be generated. To identify species, time-expansion Pettersson D240x bat detectors were used linked to a recording device which captured bat echolocation calls, and the recordings used for subsequent species identification with the BatSound (Petterson Elektronik) analysis software.

14.4.27 Although some mature trees were present on the Main Site, none of them offered visible opportunities for roosting bats. No other likely bat habitats were identified during the daytime survey.

14.4.28 Activity survey revealed high bat activity along the western boundary of the Main Site near Springfield Road Bridge and Pump Lane Bridge areas. A total of 43 bat passes were detected along the Canal belonging to two species of bat, Pipistrelle (*Pipistrellus pipistrellus*) and *Myotis spp*. (possibly daubenton's bat *Myotis daubentonii*). In addition, feeding buzzes were recorded indicating that the area was used for foraging.

14.4.29 The level of activity recorded was relatively high, averaging one bat pass every two minutes. This activity index in conjunction with the feeding buzzes recorded, indicate the far western boundary and the Canal are being used as commuting corridors and foraging sites for bats.

14.4.30 No bat activity was recorded in any other areas.

14.4.31 No bats were seen entering or leaving the trees or buildings identified as potential roosts, suggesting the Site does not support roosting bats.

14.4.32 Overall, the canal and the area of the canal path adjacent to the Site is a clear commuting route for bats, and is determined as being **district (or borough)** value for commuting bats. All other areas are identified as valuable **within the zone of influence only**.

Great Crested Newts (*Triturus cristatus*)

14.4.33 There are no standing water bodies within 500m and no suitable terrestrial habitat, therefore the area has no potential as newt habitat.

Reptiles

14.4.34 During Phase 1 survey the majority of habitats within the Site were considered valuable for reptiles due to large expanses of hard standing. The Pump Lane Bridge and Springfield Road Bridge areas were not considered to be of value due to a lack of structural diversity within the vegetation and a lack of suitable refugia. Within the Site an area of grassland to the west contained a diversity of vegetation structure including open areas for basking, grassland for foraging and large piles of debris and soil that would serve as ideal refugia, and this area was considered to be potential reptile habitat.

14.4.35 Surveys for reptiles were undertaken in June-July 2007, covering areas of suitable habitat (mainly areas of tall ruderal vegetation and open grassland) within the Main Site. The survey report is included in Appendix 14.4.

14.4.36 Artificial refugia were placed and monitored over 7 visits between 27th June 2007 and 13th July 2007 for colonising reptiles. Refugia were checked between 10:00am and 11:00 am when temperatures were below 18°C and weather conditions overcast; thus reptiles used the refugia to warm up for foraging and it was at this time they were recorded.

10.4.37 No reptiles were recorded during surveys. Therefore if reptiles are found during remediation or construction works then populations will be small. The site is considered to be of value to reptiles **within the zone of influence only**.

Breeding Birds

14.4.38 Scrub around the borders of the Site, and habitats along the Canal and Yeading Brook, are highly likely to support nesting birds. Scattered trees within the Site are also likely to support them

14.4.39 A breeding bird survey of the proposed Pump Lane Bridge area, conducted in three visits in June and July 2008, revealed a diversity of breeding birds associated mainly with edges of scrub habitat and along the Yeading Brook.

14.4.40 No Wildlife and Countryside Act schedule 1 species were observed. The site is considered to be of **district (or borough)** value to breeding birds.

Water Vole (*Arvicola terrestris*)

14.4.41 The Yeading Brook was considered to have the potential to support water voles due to the good depth and slow flow of the water, steep but soft banks and well established vegetation.

14.4.42 Surveys to establish the potential presence of water voles were undertaken in October 2004 and June 2007. The survey report is included in Appendix 14.3. No evidence of water voles was observed during the survey and therefore the potential of the brook to support these animals is considered to be low. The timing was considered optimal and therefore the confidence level in the survey work is considered to be high. Water voles, therefore, have not been considered a constraint to this proposed development.

Invertebrate Survey Work

14.4.43 In view of the Springfield Road Bridge area having the potential to support interesting and notable invertebrate species, an entomological study was undertaken in September 2004. This survey report is included in Appendix 14.5.

14.4.44 Invertebrates were located and collected by grubbing, sweep netting and beating into trays. Flowers, leaf surfaces, bare ground, logs and tree trunks were examined by visual searching. Voucher specimens of all but the most common and characteristic species were kept.

14.4.45 The survey concentrated on the following major groups: Coleoptera (beetles), Diptera (flies), Hemiptera (bugs, froghoppers etc), Hymenoptera (bees, wasps and ants) and Lepidoptera (butterflies and moths). Some examples of other groups were noted if seen.

14.4.46 Most of the insects seen or collected during the survey were common species, and might be expected on virtually any plot of open land in England. However, three were uncommon or otherwise unusual and worthy of comment.

14.4.47 *Agrilus sinuatus* (Olivier), a small pink jewel beetle (family Buprestidae), which is nationally scarce (Notable A). The larvae bore characteristic winding burrows in the bark of dead Hawthorn branches and trunks and leave distinctive D-shaped exit holes on their emergence. It seems especially widespread in the London area.

14.4.48 *Rhyzobius chrysomeloides* (Herbst), a tiny red ladybird (family Coccinellidae). This tiny red beetle is extremely similar to a very common species, *R. litura* (Fabricius), and its occurrence in Britain was only recognized in 2000 when it was found in several Surrey localities. It is classified as 'very local', possibly a new arrival in Britain and has so far been monitored in Surrey, Kent, Middlesex and Berkshire.

14.4.49 *Stictopleurus abutilon* (Rossi), a medium-sized leaf bug (family: Rhopalidae). In 1948, it was regarded as being extinct, however during 1996 it was found in several localities in southern England and appears to have successfully re-colonised Britain. Since then it has been recorded on many occasions.

14.4.50 Based on the survey findings, the Springfield Bridge area is of **county** value for invertebrates. Construction of the Springfield Bridge will impact upon a linear plot of existing habitat although the effect on invertebrate fauna is likely to be minimal if the majority of the existing habitat is retained and fragmentation kept to a minimum. As far as is practical, large trees should be protected.

Flora

Trees

14.4.51 A full arboricultural survey was carried out in May 2008 to identify trees of value and recommend preservation where possible. This Survey Report is included in Appendix 14.6.

14.4.52 Of the 214 trees within the study area, only 2 were considered of overriding value, and both of these were found in Minet Country Park. Eighty-one further trees were considered to have some value, including a row of late/middle-age London plane and accompanying sycamore/silver maple that form

a distinctive landscape feature. These trees have amenity value and potential to screen the proposed development from its surroundings. Value can be expected to increase to high if retained to maturity. The other main group of moderate value trees were middle-age oaks and a lesser number of ash and sycamore within the Country Park. Some of these trees already have amenity value, particularly those that can be seen from the Canal, this and their ecological value will increase as they mature. The final group have some value trees is the short row of late middle-age grey poplars adjacent to the football ground. This row has some amenity value that will increase as the trees mature. Overall trees were thought to have **district (or borough)** value.

River Corridors (Yeading Brook and Flood Relief Channels)

14.4.53 Surveys followed standard methodologies defined by the Environment Agency. The survey of the Yeading Brook and the Canal was carried out in December 2005, with the flood relief channel near Pump Lane surveyed in January 2006. A further river corridor survey was carried out in April 2008. Whilst it is recognised that winter is not an ideal time of year for such surveys, dominant plant species, vegetation structure and physical habitat features were identifiable, and therefore the surveys are considered adequate for assessing the habitat quality of the river corridor. The full survey findings are included in Appendix 14.7.

14.4.54 The habitat of greatest value within the river corridors is the scrub/woodland/rank grassland mosaic on the bank-tops, within the Minet Tip owned by British Waterways. This habitat provides a good variety of common plant species and complex structure that can support a range of common and notable fauna. Added to this, these areas are relatively undisturbed as the dense vegetation structure does not encourage intensive recreation. It is recommended that areas not affected by bridge development are preserved and sympathetically managed as per the recent Management Plan produced by 'A Rocha Living Waterways' (Conroy 2004) [(14.17)]. The greatest existing threat to these areas is the extensive growth of invasive plant species such as Giant Hogweed and Japanese Knotweed. These require urgent and on-going control.

14.4.55 The Yeading Brook's channel itself is a valuable local feature with a relatively well-preserved meandering plan-form. Rivers are dynamic habitats and the processes of erosion and deposition that have created this current form should be allowed to continue. The in-channel habitat quality of the Yeading Brook, is however, limited due to significant quantities of litter and, to a lesser extent, the level of shading by trees and scrub. The Yeading Brook is considered to be of **county** value.

14.4.56 The flood relief channel, being of concrete open culvert form, is of very low habitat quality with very limited aquatic diversity. The emphasis should therefore be on enhancement rather than conservation, as significant works are required to provide any valuable habitat. The flood relief channel is considered to be of value **within the zone of influence** only.

14.4.57 Litter in both the Yeading Brook and the flood relief channels is a significant problem.

Evaluation of Ecology

Main Site and Eastern Access

14.4.58 The overall value of the Main Site for nature conservation is considered **within the zone of influence only** due to limited wildlife interest and existing habitats being common and widespread throughout the UK. Common habitats of moderate quality exist in localised areas, but all of the existing habitats are low in biodiversity, easily re-creatable, uniform in nature, have little potential for improvement and offer no significant amenity benefits to the local community. Additionally, the potential for rare or protected species is limited. It should be noted however, that the Site is certainly used by feeding and nesting birds, and consequently prone to some degree of impact.

Springfield Road, Pump Lane and Minet Park Bridges

14.4.59 All three areas are of **district (or borough)** value for nature conservation. Despite being of considerable extent, they are not large enough to attribute significant value alone. A number of different habitats are present, both terrestrial and aquatic, but species diversity is not high and they are not considered to be particularly good examples of their type. The scrub and grassland habitats are not especially fragile but do provide semi-natural habitats which have established on a previously undeveloped greenfield site. As such, these habitats would take considerable time to recreate in redeveloped areas, but due to the opportunistic nature of scrub and grassland, they would certainly regenerate after construction damage. However, a number of controlled, invasive or hazardous plants are found in abundance, primarily along the Yeading Brook corridor, namely Japanese knotweed, Himalayan balsam and giant hogweed. These species detract from the overall value of the Site and will need to be removed responsibly as part of the PD.

14.4.60 Additionally, it should be noted that consultation has highlighted the recorded presence of common reptiles (grass snake) by others within the boundaries of the Pump Lane Bridge study area. However, there was little optimal reptile habitat evident at the time of the 2007 survey.

Areas Bordering Minet Country Park

14.4.61 Areas where the Site borders Minet Country Park are considered to be of **district (or borough)** value. The park has been designated a Site of Borough Importance for Nature Conservation within the LB Hillingdon and parts are used frequently by the public for recreational activities. Therefore, it holds some intrinsic value particularly considering the urban nature of the surrounding land.

Yeading Brook

14.4.62 Yeading Brook is considered to be of **county** conservation value. It is one of the most valuable ecological features present and, being an aquatic system, is prone to adverse impact. This is a dynamic system currently with little human influence (that has been dredged in the past) although it is understood that upstream of the Site there are likely to be sources of water pollution leading to suboptimal biological and chemical water quality in the vicinity of the site. The Yeading Brook gives the Site continuity with other similar habitats up and downstream, and acts as a valuable ecological corridor for more mobile species and notable birds (e.g. kingfisher has been observed in the vicinity). It has a low to negligible potential to support water voles although the Brook corridor is recorded as providing foraging and commuting habitat for bats.

Grand Union Canal

14.4.63 The Grand Union Canal is an important ecological receptor of **county** value. It passes along the eastern site boundary and is designated a Site of Metropolitan Importance for Nature Conservation. Bats regularly use the canal as a commuting and foraging area (as identified in surveys), likely accessing habitats in Minet Country Park and further a field by navigating along the canal. Thus the Canal is a significant landmark for bats in the area.

Flood Relief Channel

14.4.64 The flood relief channel is predominantly hard engineered and has value **within the zone of influence only**.

Summary

14.4.65 Table 14.8 below presents a summary of the values for each ecological receptor within the Site and surrounding area.

Table 14.8 Summary of Ecological Value of the Site

Ecological receptor/habitats	Level of value
The Main Site	Within the zone of influence only
Springfield Road, Pump Lane and Minet Park Bridges	Local or parish
Areas bordering Minet Country Park	District (or borough)
Yeading Brook	County
The Canal	County
Flood relief channel	Within the zone of influence only

14.5 Environmental Effects and Mitigation Measures

14.5.1 The key impacts associated with remediation, construction phases and Principal Assessment Year of the proposed Scheme are discussed below.

Invasive species

Main Site and Access Points

14.5.2 The proposed development and access area proposals include a scheme to eradicate Japanese Knotweed and Giant Hogweed which will significantly benefit the Site's ecology and that of the local area. These are invasive plants that suppress the growth of native species and offer little value for native wildlife. Additionally, the sap from Giant Hogweed is toxic to the skin when exposed to sunlight and causes significant blistering and injury, while presence of Japanese Knotweed may cause severe damage to buildings and infrastructure. The removal of these species would be beneficial, and a **beneficial** residual impact to the natural environment, of **moderate** significance, and control measures will be in place to avoid any further spread due to construction .

Habitat Loss

Main Site

14.5.3 Few valuable habitats exist on the Main Site as this is mostly hard standing. The proposed development will result in the majority of the Main Site being permanently lost during the construction phase, however, the impact on ecological features in the local area will be **negligible**. Where possible, habitats on the site boundary (including mature trees) will be retained, particularly along the north-western boundary close to the Canal.

Access Points

14.5.4 The bridges forming the Pump Lane Bridge (western access) to the Site require bridge infrastructure (abutments, embankments, pilings) to be located on the banks of the Canal and Yeading Brook. However the route of this access road has been designed to minimise loss of valuable habitats by confining it to the far south-western corner of the Minet Country Park and Minet Tip. Some of the existing habitat will be retained, with those lost being a mixture of scrub/tall ruderal vegetation and invasive giant hogweed (which will be eradicated – a beneficial impact). These areas are of lower value than adjacent dense scrub within the park, mainly due to the presence of giant hogweed.

14.5.5 The footbridges will require a small (less than half a hectare) land-take within the Minet Country Park and Minet Tip for construction and associated landings, pilings and infrastructure. At Pump Lane ~1.5ha of land will be required, spread across the Minet Tip and Minet Country Park. Thus **adverse** impacts will occur in the absence of mitigation, and these impacts will be of **moderate** significance.

14.5.6 Mitigation for habitat loss at access points will be by a mixture of compensatory habitat creation and features incorporated within their design. To maintain a wildlife corridor of ecological value along the Canal and adhere with requests from the EA, a 4 metre undeveloped vegetated buffer strip will be retained along the majority of the Canal. The buffer will maintain connectivity along the eastern bank of the canal and will be seeded with native grasses during landscaping, left to colonise naturally, and managed to maintain ecological value. Bridge abutments will also be similarly set back from the Canal to give continuity.

14.5.7 The design of the Bridges will include features to benefit to local wildlife. These include bat roosting boxes within the bridge abutments to encourage bats to use these structures. Bat boxes of the Schwegler type made of woodcrete (wood chippings in a concrete matrix) and each abutment will carry 4 boxes.

14.5.8 A drainage holding pond is proposed in an abandoned area of the former flood relief channel. Elsewhere the opening out of the engineered flood channel into a natural watercourse will offer ecological benefit by serving as a wetland feature and improving biodiversity within the area. The features will include irregular banks and will be planted with native wetland flora, in order to maximise ecological return. Also, enhancements to the Yeading Brook (e.g. management of vegetation, regarding banks, creation of inline reedbeds) will be considered to compensate for habitat loss associated with access points.

14.5.9 Residual impacts of habitat loss after mitigation will be **negligible**.

Yeading Brook and Grand Union Canal

14.5.10 Watercourses may be affected through shading as a result of the buildings which have the potential to cause local loss of aquatic plants and the loss of habitat for aquatic species in the Yeading Brook and the Canal. A solar shading assessment (see Chapter 14: Microclimate) identifies a degree of shading along the Canal, considered an **adverse** effect, of **moderate** significance. The effects of this shading, however, will be minor as the area will only be in shade for a small part of the day. For most of the year, it is anticipated that the Canal would be overshadowed in the morning, move out of shadow by midday and be in full sunlight through the afternoon. As such, the integrity of the canal's ecology is unlikely to be affected.

14.5.11 Shading from bridges will also have an impact, but current bridge designs are for an open structure for footbridges and 4-lane crossing for the Pump Lane Bridge. These are considered to potentially have an **adverse** impact on ecology of the water courses, of **minor** significance.

14.5.12 The construction of multi-storey buildings adjacent to water courses will cause shading impacts and reduced light levels that in turn potentially have an adverse impact upon aquatic biodiversity and water quality. Waterside buildings for the proposed development (although only at outline stage at present) have been designed with these impacts in mind and have been configured to reduce shading of the water courses. There are a number of residential apartments between six and eight storeys high proposed for the eastern bank of the Grand Union Canal. Buildings along this boundary will be set back by at least 8m and are spaced so that shading effects will be minor and breaks in buildings will provide light to reach the canal (a comprehensive study of shading by Make Architects accompanies this plan).

14.5.13 It is inevitable that bridge crossings will result in some degree of shading at certain times during the day. To reduce the magnitude of shading, bridges have been designed with relatively open structures and as high as practically feasible relative to the water level, taking into consideration other limiting factors such as structural aspects, visual and noise impacts, traffic safety, etc. It is considered that, with these measures, the extent of shading resulting from the completed bridges is minor (refer to the associated Environmental Statement for a more detailed assessment) and will not effect the ecological integrity of the watercourses or the conservation status of any species present.

14.5.14 Some shading of watercourses will still occur, but will only result in **adverse** residual effects, of **minor** significance. Enhancement of the Yeading Brook will compensate for any residual impacts of shading on water courses.

Fragmentation of Habitats

Main site

14.5.15 Although the Site is in continuity with a number of valuable ecological features, the main Site is not considered to be used by mobile species. Loss of habitats during the construction activities and operation in the Principal Assessment Year will therefore not result in the fragmentation of habitats.

Access Points

14.5.16 The construction of the Bridges will lead to fragmentation of valuable habitats in and around the Minet Country Park and along the Canal. The bridges themselves may be a constraint to bat commuting routes along the Canal and the Yeading Brook, fragmenting their habitat. This will result in **adverse** impacts of **moderate** significance to the ecology of the area.

14.5.17 The design for these bridges will include a number of features to reduce effects on migratory species and allow their movement. A vegetated corridor of 4m width has already been discussed, along with provision of bat boxes on bridge abutments. Both these measures will help alleviate fragmentation by encouraging animals to use areas crossed by bridges. Where the Pump Lane bridge causes fragmentation, a mammal tunnel will be installed to allow animals to migrate between fragmented habitats. The link and associated bridge will be constructed upon a raised embankment next to the south-west corner of the Minet Country Park and a mammal tunnel will be installed within this embankment to allow the safe passage of commuting and migratory animals.

15.5.18 A single tunnel will be provided, located close to the central area of the embankment rather than adjacent to the watercourses where wide bank top access is already provided. It is important to ensure mammals can easily reach the tunnel, and fencing will be installed to help direct animals towards the pipe entrance. Additionally, planting will be used for the same purpose and initially trails of syrup and peanuts will be laid to bait some mammals (e.g. badgers) through the tunnels in order to habituate them to these routes. Both plastic and concrete pipes can be used for mammal tunnels. However engineering or highways constraints may dictate the size of pipe that can be used. Tunnels will be partially filled with soil to provide a natural substrate on which mammals are comfortable, necessitating pipes wider than the actual required diameters for mammal passage These measures are outlined fully within the Ecological Mitigation Strategy (Appendix 14.8) for the accesses. During the construction phase, working practice will be guided by an Ecologist to ensure that damage to habitat is kept to an absolute minimum. The extent of this will be limited by the adoption of a Construction Environmental Management Plan (CEMP) and adherence to guidelines such as BS5837:2005 -Trees in relation to construction [(14.15)], (to avoid damage to peripheral trees). Further details of relevant standards are provided in the CEMP.

14.5.19 The Pump Lane Bridge will, during construction and operation, present a barrier isolating a small area of scrub habitat in the far south-western corner of the Minet Country Park along the banks of the Yeading Brook. However it should be noted that the A312 Hayes Bypass (running north-south) and railway mainline (running east-west) already present more significant barriers to migration, and this area has been ecologically isolated for over 100 years (by the railway line). Landscaping will seek to provide habitat connectivity through planting trees and other plants to reduce any further fragmentation of the area, and proposed mammal tunnels will link the area to the Minet Country Park for terrestrial animals.

14.5.20 Residual impacts of habitat fragmentation at access points will be **negligible**.

Habitat Damage

Main Site and Access Points

14.5.21 Peripheral habitats within the Main Site will be retained where possible but construction activities may result in local removal and limited trampling damage to vegetation. The extent of this will be limited by the adoption of a Construction Environmental Management Plan (CEMP) and adherence to guidelines such as BS5837:2005 -Trees in relation to construction (to avoid damage to peripheral trees). Further details of relevant standards are provided in the CEMP.

14.5.22 The removal of vegetation may lead to soil erosion and damage to habitats where heavy machinery is frequently used, as soil will become compacted restricting vegetation redevelopment. These impacts are will be **adverse** on the Main Site and in the Minet Country Park where bridge abutments are to be constructed, with **minor** significance. Construction machinery and materials could also cause indirect habitat damage to site boundary habitats and the Minet Country Park when bridges are under development. Construction Environmental Management Plan (CEMP) will reduce residual impacts to **negligible**.

Species Disturbance

Main Site

14.5.23 The existing habitats within the Main Site do not support notable or protected species and the potential for impacts from disturbance are **negligible**. Some of the peripheral vegetation to be retained may be of value to nesting birds, but as the setting lies within an urban context high in ambient light, construction activities that cause vibration, noise, dust and lighting are unlikely to further disturb birds when they are nesting.

14.5.24 The direct effects of disturbance associated with the Principal Assessment Year include increased light pollution, increased public pressure and increased noise and vibration from traffic. Currently the Site is relatively quiet and free from general public access. The operation of the Scheme would therefore increase activity levels. Increases in noise and vibration associated with increased traffic would result in general impacts like trampling due to public access. Due to the limited ecological value of the Main Site however, impacts on wildlife are likely to be **negligible**.

Access points

14.5.25 Access points are of much higher value to wildlife than the Main Site, and disturbance of species in these areas will, overall, constitute a **negative** effect, of **moderate** significance, mostly because of impacts on bats. Levels of disturbance will increase both during the construction and operation phases of access routes and feeding and nesting birds are likely to be affected, especially in the scrub habitats along the Yeading Brook and south-west of the Minet Country Park. Additionally, grass snakes have been recorded in the Pump Lane Bridge area which, if present, could be affected by the construction of access points.

14.5.26 Increased noise and vibration will occur during operation of the proposed Scheme, predominantly from increased traffic on the local road network. There may also be an increase in recreational activity on the adjacent Minet Country Park, effects associated with this include trampling and noise. The Canal corridor supports foraging and commuting bats, which are active between dusk and dawn and should not be disturbed by construction activities. If construction were to extend into the evening there may be some potential for effects upon foraging bats.

14.5.27 To mitigate for impacts on bats any construction activity will be restricted outside the hours of 0800 and 1800 with exceptions to this needing prior agreement/approval from the Local Planning Authority.

14.5.28 Also lighting will be configured to minimise disturbance to bats and bat boxes on bridge abutments will encourage them to keep using the area. Excessive lighting not only causes light pollution and consumes energy but also impacts upon the natural environment by affecting the activity rhythms of both plants and animals. Bright light may reduce bats social flight activity and cause them to move away from the illuminated area to area darker environment. Illuminating a bat roost creates disturbance and may cause the bats to desert the roost. Bat activity associated with the proposed development is focused along the water courses, in particular the Canal, and the peripheral areas of the Minet Country Park. As such, in order to avoid adverse effects upon the local bat population, sensitive lighting design in line with current good practice guidelines is proposed for the Pump Lane Link Road.

14.5.29 It should be noted that brighter mercury lighting attracts large numbers of invertebrates. Whilst this may in turn attract some bat species, such enhanced light intensity would have an overall negative affect on the presence of bats. As such, in order to maintain the value of the area for all bat species, low pressure sodium lamps are considered to be the most appropriate, subject to human and road safety. Further details of mitigation for disturbance effects on bats is included in the Ecological Mitigation Plan (Appendix 14.8). Residual impacts on bats are expected to be **negligible.**

Direct Species Mortality

14.5.30 Direct mortality can result from increases in traffic within the boundaries of a development (direct) and from the local road network (indirect), and would primarily affect ground-dwelling animals such as small mammals. However, the effects on protected species are considered to be **negligible** as no ground-dwelling animals covered by statute were identified on the Site or surrounding areas.

Pollution

14.5.31 Atmospheric pollutants can affect vegetation and animals directly, or indirectly through environmental changes such as those in the chemistry of the soils and waters resulting from acidic deposits. Also, light pollution (already discussed above) may disrupt bat behaviour close to the Canal and in the Minet Country Park.

14.5.32 Construction and operational activities are likely to result in an increase in traffic volume within the Site and on the local road network. This could lead to an increase in atmospheric pollutants which may cause chemical and physical stress to plants and animals, particularly in the Minet Country Park. However, it is expected that with advances in technology, vehicular emissions are likely to reduce over time, refer to Chapter 8: Transport for details of these predictions.

14.5.33 The Canal and the Yeading Brook support a variety of terrestrial and aquatic life. Construction activities and preventions in the Principal Assessment Year could potentially affect these systems through accidental spillage or disposal of waste products, while water quality could decline through increases in turbidity as well as dissolved pollutants, extractions and discharges associated with the proposed development. Pollutants released from contaminated land may enter water courses which would constitute a significant ecological impact. Water pollution is particularly detrimental in aquatic ecosystems and wetlands.

14.5.34 Overall the potential impacts of pollution could be **adverse**, with **moderate** significance. However, the agreed CEMP would impose a number of strict processes and procedures to prevent accidental spillages and discharges to the watercourses which would control the potential for pollution to effect watercourses and terrestrial habitats in the area. Thus, with introduction of the CEMP, residual impacts will be **negligible**. The potential effects on these watercourses during construction activities are discussed further in Chapter 13: Water Environment.

Damage to or Loss of Trees

14.5.35 Forty trees require felling due to their condition, irrespective of the development proposals. These include dead trees, re-growth on the stumps of felled trees, trees with significant decay that put them

at risk of structural failure and fire-damaged trees. Also, six groups of trees require felling because of their condition irrespective of the development proposals. These included small groups of defective trees and shrubs, and groups that interfere with the growth and development of better trees, such as the natural regeneration of sycamore and hawthorn below a row of London plane. It should be noted that the recommendation to fell assumes that some development will take place in their vicinity. Dead and defective trees in the Minet Country Park with no public access could otherwise be left to decay naturally providing valuable wildlife habitat. Also, dead wood from felled trees would be left in place to provide habitat for invertebrate and therefore food for mammals and birds. The above measures represent a **beneficial** ecological impact of **minor** significance.

14.5.36 A number of higher quality trees are also present and these must be taken into consideration during construction (refer to Figures 14.2 a,b,c and d). Within the Main Site these trees are concentrated on and close to the southern boundary and represent a small proportion of the overall area. They are unlikely to be affected by the proposed Scheme. Thus overall impacts on high quality trees will be **negligible**.

Summary of Impacts and Mitigation

Table 14.9 Impacts on Ecological Resources Associated with Development, Mitigation and residual impacts.

Effect	Description	Significance	Mitigation	Residual Significance
Invasive species	Eradication of Japanese Knotweed and Giant Hogweed	Moderate beneficial	None.	Moderate beneficial
Habitat Loss	Permanent, direct loss of existing habitats within the Main Site boundary.	Negligible	None.	Negligible
Habitat Loss	Loss of ~1.5ha of scrub, ruderal and grassland habitats from the Minet Country Park and Minet Tip due to construction of the Pump Lane Bridge.	Moderate adverse	Wildlife corridor along the watercourses, bat roosts on bridge abutments, creation of drainage holding pond with planting for wildlife, enhancements of the Yeading Brook.	Negligible
Habitat Loss	Loss of habitats in water courses adjacent to the Site due to shading by the Pump Lane Bridge.	Minor adverse	Design bridges with open structures where possible, compensate for shading by enhancing the Yeading Brook.	Minor adverse
Habitat Fragmentation	Main site habitats.	Negligible	None	Negligible
Habitat Fragmentation	Permanent fragmentation of habitats along the watercourses and in Minet Country Park due to the Pump Lane Bridge. This will particularly affect commuting and foraging bats	Moderate adverse	Bat boxes incorporated in bridges, lighting focussed to reduce impacts on bats.	Negligible
Habitat Fragmentation	Isolation of a small area of scrub in the Minet Country Park at the Pump Lane Bridge site.	Negligible	Landscaping to provide habitat corridors, mammal tunnels.	Negligible
Habitat Damage	Short–term damage, and soil erosion within habitats on the Main Site and access points, and potential damage to trees in these areas	Minor adverse	Adoption of a CEMP to prevent damage to habitats.	Negligible
Species Disturbance	Potentially long-term, direct effects of construction and operation on the existing habitats to be retained on the Main Site and its protected species.	Negligible	None.	Negligible
Species Disturbance	Long-term, indirect impacts of construction and operation (particularly increased recreational activity) on the Minet Country Park and habitats at Access Points.	Moderate adverse	Restriction of construction times, focussing of lighting to avoid disturbance to bats.	Negligible
Direct Species Mortality	Indirect, long-term impact from increased traffic on the road network.	Negligible	None.	Negligible
Pollution	Indirect, long-term impact of atmospheric pollutants during construction and operation phases.	Moderate adverse	Adoption of measures within the CEMP.	Negligible
Pollution	Direct, potentially long-term effects resulting from extractions or discharges associated with	Moderate adverse	Adoption of measures within the CEMP.	Negligible

Effect	Description	Significance	Mitigation	Residual Significance
	the proposed development and adjacent watercourses.			
Pollution	Contamination associated with the historical land use.	Moderate adverse	Adoption of measures within the CEMP.	Negligible
Damage to or loss of trees	Felling unsafe trees	Minor beneficial	None.	Minor beneficial
Damage to or loss of trees	As part of construction on the Main Site and Pump Lane Bridge area.	Negligible	None.	Negligible

14.6 Enhancement

14.6.1 Enhancement of public open space (and therefore habitat creation) to the north of the Main Site is being discussed as part of the overall strategy for the Scheme. This may involve the planting of semi-formal vegetation. Additionally, enhancement of the existing peripheral vegetation which is to be retained will provide benefits to local wildlife, particularly birds. A formal wetland area is proposed within the south western area of the proposed development, which will also attract a variety of species and function as an on-site educational resource.

14.6.2 The design proposals include pockets of green space that are linked across the majority of the Site through landscaping and tree lines, therefore providing ecological continuity within the proposed development area. A detailed landscape plan has been developed with provision of habitats and enhancement of ecological value of the site as one of its core values. Additionally, the proposed landscaping links with offsite ecological features including the Canal, the Minet Country Park and the railway corridor to the south, therefore enhancing ecological continuity within the local area.

14.6.3 The central transport route (the High Street) of the proposed development will provide an opportunity to act as a 'green corridor' for wildlife. This corridor will be tree-lined, providing important benefits for commuting birds and other wildlife.

14.6.4 A number of best practice measures would be adopted in order to maintain and enhance the existing nature conservation value of the Site and surrounds. A detailed ecological mitigation plan specifically covering the access areas, Pump Lane Bridge and the footbridges has been developed by WYGE and is included as Appendix 14.8. The Construction Environmental Management Plan (CEMP) (at appendix 6.1) also details mitigation measures to be adhered to during remediation and construction activities giving specific regard to ecological receptors. Key mitigation is detailed below along with a summary table indicating residual impacts after mitigation and enhancements that will be implemented as part of the proposed Scheme.

Compliance with Wildlife Legislation

14.6.5 The Wildlife and Countryside Act protects all nesting birds (including their eggs). Tree and scrub clearance will be avoided from March to July in order to minimise disturbance to breeding birds.

14.6.6 The Wildlife and Countryside Act also makes it illegal to spread Japanese Knotweed and Giant Hogweed (details outlined in Para 14.2). Failure to comply with legislation or appropriately dispose of any material containing Japanese Knotweed or Giant Hogweed may lead to prosecution under Sections 33 and 34 of the Environment Protection Act, 1990 and Section 14 of the Wildlife and Countryside Act. As such, it is important that the correct methodology and guidance (such as the Environment Agency Code of Practice, 2001) is followed when handling and disposing of these plants. Depending on the eradication technique, the timescale for effective removal may be over an extended period. No destructive works that could potentially lead to the spread of these plants can be undertaken until the method of control/eradication has been proposed and accepted.

14.6.7 Although the potential for roosting bats within existing trees at the Site is considered low, care should be taken when felling mature trees. If a bat roost is identified during destructive works then the work must cease and an experienced ecologist consulted. Further consultation with relevant statutory authorities may also be required if a bat roost is identified.

14.6.8 The Environment Agency's Pollution Prevention Guidelines (PPG 5) [(14.18)] for works in, near or liable to affect watercourses will be followed at all times during construction of the proposed Scheme to achieve the potential effect on the Canal and the Yeading Brook. Following these guidelines should minimise the risk of pollution occurring but liaison with the local Environment Agency office will also be undertaken to ensure appropriate site wide protection s given as required.

Summary of Mitigation and Enhancement – Main Site

14.6.9 Removal and/or control of Japanese Knotweed (discussed above) and protection of valuable trees where appropriate (the design of the proposed Scheme has taken account of the value of particular trees for ecological, screening and amenity value) and border habitats through British Standards guidelines will provide sufficient mitigation for this area.

14.6.10 Provision of green space has been proposed within the design of the proposed development, with an emphasis on providing community and recreational benefit. Where possible, the new landscaping will involve planting of locally sourced, native trees, shrubs and grasses to maintain and enhance the overall ecological value of the proposed development. Within these green spaces and new habitat areas, landscape management will encourage structural diversity and varied density to compensate for any loss of habitats that currently support feeding and breeding birds.

14.6.11 Provision of suitable bat and bird boxes will contribute to enhancing habitat within the development area.

Summary of Mitigation and Enhancement – Bridges

14.6.12 A detailed plan of mitigation has been developed for these area and is included as Appendix 14.8. Its contents are summarised below.

14.6.13 Flood relief channel diversion works in the access zones will produce a channel with greater ecological value than at present by providing a river bed suitable for plants and invertebrates, vegetated banks with ledges for mammals to use as runs and a monitoring program to ensure features develop correctly and are protected in the long term.

14.6.14 Bridge crossings and their associated bank side habitats along the Canal and Yeading brook will be protected by several design measures. A 4 metre wide vegetated buffer strip between the majority of the proposed development and the top bank of the water courses will be maintained and bridge abutments will be set back this distance to provide a wildlife corridor. At Pump Lane mammal ledges and tunnels will be provided to allow migratory animals to move through the area and into the Minet Country Park, preventing fragmentation of land to the south-west of the park by the Pump Lane Bridge. Bat roosts will be incorporated into the bridge structures by placement of bat boxes to increase the usage of the area by bats.

14.6.15 The Yeading Brook will be impacted by construction of access bridges. The channel bordering the Minet Country Park will be improved to enhance the current character of the channel. The Brook receives very little light due to overhanging riparian trees (common alder *Alnus glutinosa* etc) and these will be thinned along both banks to allow sunlight to penetrate the Brook. This will stimulate plant growth within the channel, trapping sediment at the margins and increasing flows through the middle of the channel. In addition, coarse gravel will be introduced as streambed substrate. This is ideal invertebrate habitat and aims to make the channel more shallow, increasing flow rates and discouraging silt deposition. Consequently the ecological value of the channel should be improved. Re-grading of banks and creation of inline reedbeds to diversify channel features will further improve its value, and flow deflectors will also be put in place to encourage areas of fast and slow flowing water, improving physical diversity and therefore the ecological value of the stream. These measures will be designed and implemented in consultation with the Environment Agency.

14.6.16 Buildings will not reach the water front of the Canal and have been limited in height to avoid excessive shading.

14.6.17 Wetland features will be created on the Main Site to provide habitat enhancement and improve the ecological value to the proposed development.

14.6.18 Any artificial external lighting associated with the proposed Scheme close to the watercourses would be directional and focused with cowlings where possible to minimise any disturbance to bats using

the river corridor, and the invertebrates upon which they feed. Any opportunities to place bat boxes in the Minet Country Park and along the Canal/Yeading Brook should be taken.

Additional Mitigation and Compensation

14.6.19 During the construction phase of the proposed Scheme, measures would be adopted to protect wildlife and prevent unnecessary damage to retained habitats. These measures include the installation of fencing to protect sensitive areas and the provision of access tracks through areas of less ecological value. A CEMP will be submitted to LB Ealing and LB Hillingdon, and consulted upon with the relevant regulatory bodies prior to commencement of the works. The CEMP will comply with the Construction Design & Management (CDM) Regulations and will also include prohibited or restricted operations such as locations, hours, construction traffic routing etc and proposals for monitoring and record-keeping of relevant data and analysis to comply with the key environmental conditions in the planning permission (e.g. noise and dust monitoring, findings of contamination surveys and analysis).

14.7 Monitoring

14.7.1 General monitoring of the Site by a qualified ecologist will be carried out throughout the construction of the Scheme to monitor damage to trees, presence of Japanese Knotweed and other invasive plants, and any departure from the baseline ecological conditions outlined in this study. A simple walkover survey will be sufficient for this purpose. However, those working on the Site will be made aware of the possibility of spreading Japanese Knotweed and their observations should be a form of monitoring for invasive species.

14.7.2 Bat activity surveys spanning at least two evenings should be conducted yearly along the Canal and Yeading Brook to assess the effect of bridge construction and operation on these animals. These surveys will provide data on changes in bat usage of the Canal and Brook and allow further mitigation measures to be put in place if necessary to preserve them and their habitat.

References

14.1 HMSO (1981) Wildlife and Countryside Act (1981, as amended)

14.2 HMSO (1994) The Conservation (Natural Habitats, &c.) Regulations (1994, as amended)

14.3 HMSO (2000) Countryside and Rights of Way Act

14.4 HMSO (2006) The Natural Environment and Rural Communities Act

14.5 HMSO (1992) Protection of Badgers Act

14.6 HMSO (1992) Statutory Instrument 1992 No. 588: The Controlled Waste Regulations

14.7 Department of Communities and Local Government (2005). Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS 9).

14.8 Greater London Authority (2008) London Plan: Spatial Development Strategy for Greater London Consolidated with Alterations since 2004.

14.9 Government Office for London (2000) Circular 1/2000: Strategic Planning in London, June 2000

14.10 London Borough of Ealing (2007) New Plan for the Environment (adopted 2004) Saved Policies, 27th September 2007

14.11 London Borough of Hillingdon (2007) Unitary Development Plan (adopted 1998) Saved Policies, 27th September 2007

14.12 London Borough of Hounslow (2007) Unitary Development Plan (adopted 2003) Saved Policies, 28th September 2007

14.13 Joint Nature Conservation Committee (1993). Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit. JNCC, Peterborough.

14.14 Stace, C (2001) New Flora of the British Isles, Second Edition, Cambridge University Press, Cambridge.

14.15 Ratcliffe, D. A. (ed.) (1977). A Nature Conservation Review. Cambridge University Press, Cambridge.

14.16 Institute of Ecology and Environmental Management (2006) Guidelines for Ecological Impact Assessment in the United Kingdom. IEEM, Winchester.

14.17 Conroy, C. (2004) Minet Country Park, Hayes Management Plan 2005 – 2009, A Rocha Living Waterways, Southall.

14.18 The Environment Agency (2007) Pollution Prevention Guidelines 5: Works and maintenance in or near water, October 2007.