



RSK

GROUP PLC

Gascoyne Cecil Estates
Salisbury Square, Old Hatfield

Geotechnical and Geoenvironmental
Report

Project no. 241882-01(01)

March 2011

Safeguarding
your business
environment

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Correspondence with Statutory Authorities
Welwyn Hatfield Borough Council 'Hatfield Chalk Mines' Map

Appendix B Fieldwork Records

Borehole Records (drive-in window sampler and cable-percussive)
Trial Pit Records
Gas/Water Monitoring Record Sheet

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Moisture Content and Plasticity Index of Soil
Particle Size Distribution Results
Triaxial Test Results
Sulphate and pH Analysis Test Results

Appendix D Chemical Laboratory Test Records

Chemical Analysis of Soils including Sulphate and pH Analysis Test Results

Appendix E CLEA Software Output Reports**Appendix F HAS-WASTE Assessment**

DOCUMENT CONTROL

Document Title: Geotechnical and Geoenvironmental Report
Salisbury Square, Old Hatfield

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RSK STATS Geoconsult Ltd (RSK) has prepared this report in accordance with the instructions of JB Planning Associates Limited acting on behalf of Gascoyne Cecil Estates ("the Client") by letter reference PA/1040/sf, dated 14th December 2010 and under the terms of appointment for RSK. This report is confidential and non-assignable by the Client and RSK shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. Should the Client require to pass copies of the report to other parties for information, the whole of the report should be so copied, but no professional liability or warranty shall be extended to other parties by RSK in this connection without the explicit written agreement thereto by RSK.

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1. INTRODUCTION

1.1 Instructions

On the instructions of JB Planning Associates Limited, on behalf of Gascoyne Cecil Estates (the 'Client'), RSK STATS Geoconsult (RSK) has carried out a Phase 1 and 2 geotechnical and geoenvironmental investigation of the Salisbury Square area of Old Hatfield.

The project was commissioned in order to identify the potential for hazardous substances or conditions to exist on, at or near the site and therefore, via the development of a Conceptual Site Model (CSM), identify the necessity for and extent of mitigation measures to be employed in relation to the proposed improvement of Salisbury Square. There are four aspects to this improvement, as follows:

- Open up Salisbury Square by reinstating the original road through the heart of the Old Town which will reconnect the square to the surrounding streets and railway station;
- Form a new larger car park for local use providing 141 car parking spaces screened behind the new buildings;
- Some of the existing buildings are to be made more visually interesting by small architectural interventions such as enhancing the shop windows with traditional details and improved signage; and
- Provide better located accessible shops with residential accommodation. Open space is to be provided in the form of a town square off reinstated vehicular access.

1.2 Project Brief

The project was carried out to an agreed brief as set out in RSK's proposal letter of 27th September 2010.

The work undertaken included the following tasks:

(i) *Desk Study*

- The history of development and industry on the site, including a study of archival Ordnance Survey mapping and other sources of historical information as appropriate, e.g. local archives, trade directories and planning records.
- A study of local geology, hydrogeology and surface water setting.
- The identification of potential geological hazards, including radon and solution features that are known to be present in the Hatfield area.
- A review of relevant environmental data held by appropriate statutory authorities, e.g. the local Environmental Health Department and the Environment Agency, obtained in the form of a GroundSure Report and, where appropriate, through direct contact.
- A site reconnaissance survey.
- Liaison where possible with current/previous owners/occupiers of the site.
- A preliminary conceptual model of contamination on the site identifying possible pollutant linkages.

(ii) *Site Investigation*

- Forming of exploratory holes at locations to be finalised during the desk study and site reconnaissance.
- Sinking of two light cable percussive boreholes to provisionally 15m depths.
- One day of drive-in window sampler boreholes to provisionally 3m depths.
- 3No shallow hand pits in the proposed ground level car parking area (currently soft landscaping) to collect samples for contamination testing.
- Associated sampling and on site testing, including three in situ CBR determinations using the clegg hammer apparatus and the use of a photo-ionisation detector (PID) to screen for the presence of volatile organic compounds.

During the investigation, it was considered prudent to install ground gas monitoring wells owing to the thickness of fill material in certain areas of the site. As such, three monitoring wells were installed, and an allowance made for 2 no. monitoring visits after the fieldwork to provide an initial assessment of development requirements.

1.3 Standards

The project was designed generally to meet the objectives of a Preliminary (Phase 1) Investigation and an Exploratory Investigation, as defined by BS 10175:2001 "Code of Practice for the Investigation of Potentially Contaminated Sites". Exploratory Investigations usually involve only limited intrusive/analytical work in which relatively few samples are collected for contamination identification/confirmation purposes. They play a role in establishing the potential for short-term exposure or other immediate risks to health and the environment, and they are used to generate initial gas, vapour and water quality data.

The intrusive aspects of the investigation were generally carried out following guidance given in BS 5930:1999 - Code of Practice for Site Investigations.

This report adopts the technical approach presented in Contaminated Land Report 11 "Model Procedures for the Management of Land Contamination" (Environment Agency 2004) for applying a risk management process when dealing with land affected by contamination.

1.4 Limitations

This report should be considered in the light of any changes in legislation, statutory requirement or industry practices that may have occurred subsequent to the date of issue.

The "vicinity" of the site for the purposes of this report, is defined as locations situated within an approximate 250m radius of the site, although certain sources of contamination and / or sensitive targets further than 250m may also have been considered.

The opinions and recommendations expressed in this report are based on the ground conditions encountered during the site work, the results of field and laboratory testing and interpretation between exploratory holes. The material encountered and samples obtained represent only a small proportion of the materials present on-site, therefore other conditions are likely to prevail at the site which have not been revealed by this investigation.

The environmental reconnaissance survey consisted of a general external inspection of the site aimed at identifying any obvious signs of potential sources of ground contamination. A detailed internal inspection of the buildings was outside the brief for the study.

As an Exploratory Investigation, the results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The results of RSK laboratory tests are covered by UKAS accreditation, but opinions and interpretations expressed in the report and on the site work records are outside the scope of this accreditation. Where laboratory testing has been carried out at a sub-contractor laboratory, this laboratory is an approved sub-contractor in accordance with the requirements of the RSK quality management system and is UKAS accredited for the relevant range of tests undertaken.

2. SITE DETAILS

2.1 Description and Geographic Setting

The site is located at National Grid reference 523321^E 208687^N, as shown on **Figure 1**.

The site covers approximately 0.9 hectares and comprises ground-level car parking within the northern portion of the site and Salisbury Square with surrounding retail and commercial units in the south. The parade of shops separating the car park to the north from Salisbury Square to the south includes a launderette, two takeaway food outlets, a newsagent and an insurance brokers. A plan of the site is shown on **Figure 2**. The area around the site contains a mixture of both commercial and residential elements, as detailed below:

| | |
|----------------------|---|
| To the North: | A new mixed commercial and residential development at Dunhams Courtyard is located immediately to the north of the eastern part of the site. This site is partly bisected by a viaduct, which provides access to Hatfield House and Hatfield Park to the east. Commercial and recreational land-use occupies the majority of the land further to the north. The River Lea runs west-to-east some 1.2km beyond the northern site boundary. |
| To the East: | A mixture of retail, commercial and residential properties are located immediately beyond the eastern site boundary in 'Old Hatfield'. Hatfield park is situated some 200 to 250m to the northeast and east of the site. A large pond is located in Hatfield House some 500m to the east of the site. Furthermore, a number of field drains are located within the grounds themselves. An office building forms the southern part of the eastern site boundary. |
| To the South: | A number of retail and office units are located along the southern site boundary. An electricity sub station is located some 46m to the south of the site. The land further to the south occupies a mixture of retail, commercial and residential units, forming part of Old Hatfield. |
| To the West: | Great North Road (A1000) runs north-to-south immediately adjacent to the western site boundary. Hatfield railway station lies some 50m further to the west with the associated railway lines running parallel to the western site boundary immediately beyond. A number of industrial units are located immediately beyond the railway tracks to the west some 100 to 150m from the site, including unspecified 'works', factories and car servicing and repairs. |

2.2 Reconnaissance Survey

The site was visited on 13th January 2011. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination.

The characteristics of the site observed during the site reconnaissance visit and obtained from current Ordnance Survey maps are summarised in **Table 2.1**.

Table 2.1 – Site description

| Feature | Description |
|---------------------------------|---|
| Physical characteristics | |
| Area of site | Approximately 0.9 hectares. |
| Ground levels | The site generally slopes to the south with the most steeply sloping land within the car park area in the northern portion of the site. |
| Depressions in the | No large depressions were noted, however, it was noted that a number |

| Feature | Description |
|---|---|
| ground surface | of paving slabs had been slightly displaced to the south of the centrally-located shopping parade. It was noted that this could be due to root action of the mature deciduous tree within the landscaped area to the south of this location. |
| Waterlogged or marshy ground | None observed. |
| Surface water | An existing culverted watercourse runs across the southern portion of the site. The exact location and orientation is shown on the WSP Drawing No. 1458-D-001, 'Outline Foul Water and Surface Water Drainage Proposals', which is also included as part of the overall submission. |
| Trees and hedges | The majority of the northern portion of the site is covered by hardstanding (concrete), with sections of the car park separated by hedges and a small number of trees. Two large landscaped areas are located in the central part of Salisbury Square which comprises two grassed areas with a number of plants, deciduous trees and two coniferous trees. |
| Existing buildings on site | Salisbury parade is located in the central portion of the site. These four separate buildings include 7 units of deck-access maisonette residential flats located above shops. This divides Salisbury Square from the car park area to the north. The Hatfield Arms public house (to be retained) is located in the northwest corner of the site. A number of buildings are located on the eastern and western site boundaries, including a number of vacant units. |
| Basements on site | It is assumed that the historic buildings within the Salisbury Square area of the site had basements. However, there was no evidence of backfilled basements at the time of the site reconnaissance survey. |
| External hardstanding | With the exception of the raised area of soft landscaping in the centre of Salisbury Square, the majority of the site is covered by hardstanding in the form of bituminous hardstanding, pre-cast concrete slabs, and concrete paving slabs. |
| Retaining walls and adjacent buildings on or close to site boundary | A number of buildings form the site boundary, particularly within the Salisbury Square area in the southern part of the site. With the exception of the marginally raised landscaped area supported by a brick-faced wall within Salisbury Square, no retaining walls were identified. |
| Made ground, earthworks and quarrying | None observed, however, the history of development and associated phases of construction and demolition suggest that the site is underlain by made ground. |
| Potentially unstable slopes on or close to site | None observed. |
| Buried services present | There are a number of manhole covers on site, furthermore, plans provided by the client detail a number of utilities beneath the site (both active and redundant). |
| Environmental characteristics | |
| Tank storage and dispensing facilities | None observed. |

| Feature | Description |
|--|---|
| Potentially hazardous materials storage and use | None observed. |
| Asbestos-containing materials | No obvious asbestos construction materials were observed but a detailed survey of the buildings would be required to confirm the presence or otherwise of asbestos-containing materials. |
| Waste storage | Waste from the offices/retail units is stored in wheely bins. |
| Electricity sub-stations | There is an existing sub-station located within the eastern portion of the site. |
| Evidence of possible land contamination on site | None observed. |
| Potential off-site sources of ground contamination | The railway land and light industrial premises to the west of the site are the most significant potential off-site sources of contamination. However, it is noted that a number of these premises are not topographically up-gradient and the current activities are not considered to pose a significant risk to the subject site. |

No potentially significant ground contamination issues associated with the current activities on and in the vicinity of the site were identified during the site reconnaissance survey. Hydrocarbon contamination in the form of leaks and spills from parked cars could be a potential source, however, no significant surface staining was noted at the time of the site investigation.

2.3 Information from Environmental Searches

2.3.1 Environmental Database Report and Environment Agency (EA) information

Details on the presence of industries with pollution-related licences, landfill sites and pollution incidents have been obtained via an environmental database report and from a search of information publicly available on the EA website. A copy of the environmental database report is included in **Appendix A**. Salient information from these sources is as follows:

- There are no records of landfill sites (former or current) within 250m of the site (i.e. within the Planning Consultation Zone). Furthermore, there are no records of landfills within a 0.5km radius of the site.
- There are no records of facilities currently operating under an Integrated Pollution Prevention and Control (IPPC) authorisation within 250m of the site.
- There are no records of facilities currently operating under a Local Authority Pollution Prevention and Control (LAPPC) authorisation within 250m of the site.
- There are no records of pollution incidents attributable to the site and no records of prosecution or enforcement action against the site with respect to environmental issues.
- There are thirty sites recorded on the industrial data sheet within the environmental database report. These include:
 - Electricity Sub Stations;
 - Railway Station;
 - Engineering Services;

- Manufacture of concrete products;
- Vehicle Repairs and Servicing;
- Metalworkers (or Blacksmiths); and
- A number of Engineering Services and Unspecified Works (such as factory units)

2.3.2 *Local Authority Environmental Health Department Information*

The Environmental Health Department (EHD) of Welwyn Hatfield Borough Council has no records of contamination in connection with the site. However, the report notes the possibility for potential contamination issues associated with the historical legacy of the site, specifically in relation to the use of part of the site as Hatfield Brewery from approximately 1800 to 1920.

A copy of the EHD's response is included in **Appendix A**.

2.3.3 *Local Authority Planning Department Information*

Planning records held by Welwyn Hatfield Borough Council predominantly relate to the change of use of a number of the buildings surrounding Salisbury Square itself, rather than detail on the actual site area. Readily available records date back to 1989, from which point the majority of the alterations relate to the buildings surrounding Salisbury Square. The records indicate the majority of applications granted relate to the conversion of the residential properties to flats, and change in retail use of the surrounding shops.

3. DEVELOPMENT HISTORY

3.1 Sources of Information

The history of the site's land-use and development from Victorian times onwards has been researched from:

- Early Ordnance Survey (OS) maps;
- Pre-Ordnance Survey (County Series) maps;
- Information from the Local Planning Authority (see Section 2.3.3); and
- Historical Photography, including Aerial Photography (provided by JB Planning Associates Limited).

Copies of OS and County Series maps are included in the environmental database report in **Appendix A**. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

The development history of the site and surrounding area from the above sources is summarised below.

3.2 Summary of Development History

3.2.1 *The Site*

The earliest available map edition of 1879 indicates that the southern portion of the site formed part of Hatfield Brewery with small areas of soft landscaping / courtyards located adjacent to the central part of the eastern site boundary and to the extreme north. A Public House was located in the north-western portion of the site at this time, in a similar location to the present day. Great North Road encroached onto the site, along the western site boundary. A street referred to as 'Arm and Sword Yard' provided access across the site between Great North Road to the east and Park Road to the west, leading to a number of terraced residential properties in the northern portion of the site. The majority of the northern portion of the site appeared to be occupied by residential land-use at this time, with the exception of a large factory/warehouse-type building located in the north-eastern corner.

The configuration and general land-use across the site seemed to remain largely unchanged with the exception of the slight relocation of the Public House to the east up until the early 1920's. At this point, the construction of a Public Hall in the centre of the site coincided with the closure Hatfield Brewery, although a number of the buildings remained in place in the southern part of the site. A bank was also located in the far southeast corner at this stage.

By the late 1930's to 1950's, a large proportion of the site had been redeveloped. The larger buildings in the south, previously associated with the brewery, had been demolished and replaced with a number of smaller units. Furthermore, the terraced properties and warehouse-type building in the north of the site had been demolished and a number of smaller buildings had been constructed. This redevelopment was utilised as an unspecified 'Works', occupying a large proportion of the site with the exception of the Public House in the north-west and 'Viaduct Villas' in the north-east. Great North Road had been retained, running approximately north-to-south along the western site boundary.

The buildings formerly located in the central portion of the site had been demolished by the late 1960's, leaving an area of open space. The electricity sub station located within the northern part of the eastern site boundary had been constructed by this time. By the mid-1970's, Great North Road had been re-routed beyond the western site boundary and the site

had been redeveloped to a similar layout as that of the current day, with car parking and the Hatfield Arms Public House in the North, Salisbury Parade in the centre, and Salisbury Square to the south. A minor road had been replaced by car parking for Black Horse House (off-site) in the north-west corner by the mid-1990's.

3.2.2 *The Surrounding Area*

By the mid to late 1800s, Hatfield Railway Station and associated running lines had been constructed 60m to the west of the site. Immediately south of Hatfield Station was a large residential property referred to as 'The Cottage'. Undeveloped land occupied the area to the west of the railway lines during the 1870's, slowly becoming occupied with terraces of residential properties through to the latter part of the 19th Century. Hatfield Brewery extended from the site itself to the southwest and two Smithys' located some 100m and 120m beyond, respectively. A relatively small Gas Works was located further southwest, some 180m from the site, immediately west of the railway lines. Old Hatfield had been developed by this time and extended to the south and east of the site comprising a mixture of residential and commercial elements. The viaduct had been constructed by this time some 20m to the north of the site, providing access to Hatfield Park and Hatfield House to the east. The land further to the north was largely undeveloped with open fields/allotments and occasional isolated dwellings. A small pond (Reed Pond), some 50m in length was located some 180m to the southwest.

The general configuration of Old Hatfield itself appeared to remain relatively unchanged into the early 20th Century. The premises associated with Hatfield Brewery to the immediate southwest had been partially demolished by the early 1920's. A Fire Station is also marked in the Batterdale area on the map labelled 1922, some 110m to the southwest of the site. The majority of the alterations to the surrounding land into the mid-20th Century involved the continued expansion of residential land-use to the west of the railway lands and the assumed residential development of the Batterdale area to the immediate southwest of the site.

The emphasis on light industrial land-use increased into the early 1960's. Namely, unspecified 'Works' located 40m northwest, 120m south and 90m southwest (two), a garage immediately east of the eastern (south) site boundary, 120m south and 130m south, a factory 70m southwest and a builders yard beyond the railway lines around 160m southwest. A depot had also replaced the former gas works, around 180m to the southwest.

By the late 1960's, the residential and light industrial elements in the Batterdale area to the southwest had almost entirely been replaced by landscaping surrounding the St Teresa's Church area. This coincided with vast residential development beyond the viaduct to the north of the site. The residential dwellings immediately beyond the railway lines to the west of the site had also been demolished by this time and replaced by a Woodwork Factory, Printing Works, and a Tool Factory at distances of 150m northwest, 120m west and 170m southwest, respectively. The light industrial development in this particular area continued into the 1980's with additional units including Engineering Works (120m west), Heating and Ventilation Works (130m west), Meat Processing Works (130m west) and a Depot (140m southwest). The former 'Works' 40m to the northwest of the site had been demolished and replaced by a depot at this point. Furthermore, the Batterdale area had also been redeveloped with residential and commercial premises by this time. The most significant change during this period, however, was the re-routing of Great North Road to the west of the site.

The surrounding area remained largely unchanged up until the current time, with the exception of an alteration in the light industrial use of the units to the west of the railway lines to comprise units associated with Medical Equipment Supplies and Pharmaceuticals, Precision Engineers and Concrete Products.

4. GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

4.1 Geology

4.1.1 General Characteristics

The published 1:50,000 scale geological map of the area (Sheet No 239 'Hertford') indicates that the site is underlain by deposits of Glacial Gravels over the White Chalk Subgroup. According to the map referred to above, the site is very close (generally within 100m) to an outcrop of Boulder Clay, both to the west and south of the site. Furthermore, the land some 150m to the east/southeast is characterised by the absence of Quaternary Deposits.

BGS borehole logs have also been obtained from the site vicinity, specifically from the site at Hatfield Station to the west. These logs indicate a sequence of Glacial Deposits comprising Glacial Gravels and Boulder Clay to a depth of approximately 17m bgl, overlying the White Chalk Subgroup to the terminal depth of the borehole at 122m bgl. Groundwater was initially encountered within the chalk at approximately 27m bgl.

On the basis of the published geological maps of the area, the full succession of natural strata in the vicinity of the site is likely to comprise:

Table 4.1 – Conjectural Geological Succession beneath the Site

| Geological Unit | Brief Description | Anticipated Thickness |
|---|--|-----------------------|
| Superficial Soils/Drift | | |
| <i>Boulder Clay</i> (possibly in western and/or southern portion of site) | Sandy clay with flint and chalk | 5 to 10m |
| Glacial Gravels | Sand and gravels containing rounded bunter pebbles | 10 to 15m |
| Solid Geology Deposits | | |
| White Chalk Subgroup | Soft white chalk with flints | >30m |

The existing topography and history of development of the site suggests that, in addition to these natural strata, made ground is likely to be present beneath the site.

4.1.2 Chalk-related Subsidence Risk

In view of the prevailing ground conditions, with Chalk at shallow depth beneath the site, it is normal practice to consider the potential risk of ground subsidence related to the possible presence of swallow holes and other natural chalk solution features or man-made cavities.

Based on the Edmund's risk assessment model for natural dissolution features referred to in CIRIA Report C574 (2002), the site falls into the 'very low anticipated subsidence risk' category. With reference to Edmund's database of known natural and man-made chalk solution features there is a single natural solution feature within 500m of the study site, associated with a subsidence doline, some 239m to the west / northwest of the site.

4.1.3 Radon

The environmental database report indicates that the site is not located within an 'Affected Area' as defined by the Health Protection Agency (HPA) and therefore the risk of significant

ingress of Radon into structures on-site is considered to be low. This indicates that less than 1% of the homes are above the action level.

4.2 Hydrogeology

4.2.1 General Characteristics

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of a deep aquifer within the White Chalk Subgroup. Any cohesive Glacial Deposits overlying the White Chalk Subgroup are likely to act as an aquitard.

The anticipated depth to the water table in the White Chalk Subgroup, i.e. the thickness of the unsaturated zone, is in the order of 25 to 30m below ground level. However, perched groundwater may be present above any particularly cohesive lenses within the Glacial Deposits. The regional direction of groundwater flow is to the northeast.

4.2.2 Vulnerability of Groundwater Resources

The White Chalk Subgroup beneath the site classified by the Environment Agency (EA) as a Principal Aquifer (as indicated on the Environment Agency Groundwater Vulnerability Map of the area, Sheet No. 39 'West London'. Furthermore, the Glacial Gravels have been classified as a Secondary (A) Aquifer. The Principal Aquifer has been classified with a High (Urban) Vulnerability rating. Soil information for urban areas is less reliable and based on fewer observations than in rural areas. The worst case (i.e. high leaching potential) is therefore assumed until proved otherwise.

The potential presence of low permeability Boulder Clay at relatively shallow depths beneath the site, whilst restricting downwards migration, may increase the potential for lateral migration of shallow groundwater (and therefore mobile contamination, if present).

4.2.3 Licensed Groundwater Abstraction

The environmental database report indicates that there are no current licensed groundwater abstractions within a 1km radius of the site.

The Environmental Health Department of Welwyn Hatfield Council has reported that there are no public water supplies within a 2km radius of the site.

In terms of aquifer protection, the EA generally adopts a three-fold classification of Source Protection Zones for public supply abstraction wells.

- *Zone I* - or 'Inner Protection Zone' is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source.
- *Zone II* - or 'Outer Protection Zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- *Zone III* - or 'Total Catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Information obtained from the environmental database report indicates that the site lies within Zone 3 (Total Catchment) of the groundwater Source Protection Zone.

4.3 Hydrology

4.3.1 Nearest Watercourse

There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface watercourse / feature to the site (with the exception of small ponds and drainage ditches within Hatfield Park to the east) is the River Lea located approximately 1.2km to the north of the site. It should be noted that the environmental database also makes reference to an extended culvert which runs approximately southwest-to-northeast, marginally encroaching across the site boundary in the extreme northwest corner. This minor culverted channel appears to flow northwards and opens some 380m to the north of the site before eventually flowing into the River Lea.

The base flow of the River Lea is likely to be recharged by groundwater in north by both the shallow and deep aquifer in the site area. A linkage between the river and any ground or groundwater contamination beneath the site may therefore exist, however, the culvert is assumed to be in an isolated channel and therefore is not considered to present an additional pathway between the site and the River Lea.

4.3.2 Site Drainage

It is assumed that the existing surface water drainage is discharged into a combined sewerage system. However, we have not received any evidence to support this assumption.

4.3.3 Preliminary Flood Risk Assessment

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within a floodplain. This report is not intended to replace a full hydrological study and it is recommended that additional specialist studies be conducted to confirm flood risks at the site.

4.4 Mining and Quarrying

Evidence has been sought to identify any mining, quarrying and landfilling operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;
- Records held by Local Authority (Hatfield Chalk Mines Map) / Environment Agency;
- Old Ordnance Survey maps and plans (see Section 3); and
- Geological maps (see Section 4.1).

The environmental database report indicates that the site is located in an area where the likelihood of chalk mining is unlikely (some small scale mining may have occurred, but restricted in extent). Furthermore, a map of potential local chalk mines produced by Welwyn Hatfield Borough Council confirms that no known historic chalk mining occurred beneath the site itself. However, a small chalk former chalk mine is noted on the same map, some 50m to the northeast of the site (referred to as Area 25-Hill House). The Hatfield Chalk Mines map produced by Welwyn Hatfield Borough Council is included in **Appendix A**.

4.5 Landfilling and Land Reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Environmental database report;

- Records held by Local Authority / Environment Agency;
- Old Ordnance Survey maps and plans (see Section 3); and
- Geological maps (see Section 4.1).

With reference to the above data there are no recorded licensed landfills (current or historic) within a 250m radius of the site. However, with reference to the historical data there have clearly been some phases of construction and demolition on the site and therefore the presence of made ground should not be overlooked.

5. PRELIMINARY CONCEPTUAL SITE MODEL

5.1 Introduction

A CSM is a simplified written and/or visual/schematic description of the environmental conditions on a site and the surrounding area. It is developed from the individual components of the investigation at each stage to provide a depiction of likely contaminants, pathways and receptors, and highlights key areas of uncertainty.

Fundamental to the CSM is the principle of pollutant linkages, i.e. a source of contamination, a migration pathway and a receptor at risk from that contamination must all be present for a pollutant linkage to be complete. This approach is now accepted best practice in the industry but it does not take into account less scientific factors such as perceived risk, which frequently has a significant influence on land values, particularly when dealing with brownfield sites with a history of contamination. In these circumstances, the perceived risk may significantly exceed the actual levels of risk involved, particularly when residential development is considered.

The site is considered for the proposed future end use, which is understood to be a mixed commercial and residential development with surrounding areas of hardstanding and soft landscaping, and a basement car park facility.

The preliminary CSM presented below is based on the findings of the Preliminary (Phase 1) investigation and therefore contains elements of conjecture and hypothesis. The exploratory investigation reported upon herein was designed to test those hypotheses and acquire data on the actual ground conditions beneath the site, enabling the CSM to be further refined.

In the following sections, the individual components of all identified possible pollutant linkages are assessed using the information identified during the course of the Preliminary (Phase 1) investigation described above.

5.2 Sources of Contamination

The study has identified a number of potentially contaminative land uses (current and historic) on and in the vicinity of the site. These are summarised in **Table 5.1** below, together with the identified contaminants of concern typically associated with those land uses (from Environment Agency R&D Publication 66, Industrial Profiles and other sources including the walkover survey).

Table 5.1 – Potential Sources and Types of Contamination

| Potential Sources | Contaminants of Concern |
|--|---|
| On-site Historical | |
| Hatfield Brewery (c. 1800 to 1920). | Potentially petroleum hydrocarbons / fuel oils, Polycyclic aromatic hydrocarbons (PAHs), Asbestos |
| Warehouse-type building in north of site (c. late 1800's to 1930's). | Petroleum hydrocarbons, PAH, Asbestos |
| Works – (c. 1940's to c. 1970's). | Petroleum hydrocarbons, PAH, Asbestos, hydrocarbons |
| On-site Present Day | |
| Electricity Sub Station | Polychlorinated Biphenyls |
| Launderette | No current potential sources have been identified associated with this small unit, |

| Potential Sources | Contaminants of Concern |
|--|--|
| | however, potentially organic solvents if dry cleaning practices also operate. |
| Car Parking in the northern portion of the site | Petroleum hydrocarbons |
| Existing retail, office and fast-food units | No current potential sources have been identified. |
| Made Ground (i.e. fill material). | Unknown fill material (but potentially including heavy metals, ash, clinker, sulfates, polycyclic aromatic hydrocarbons (PAHs), asbestos etc.). |
| Off-site | |
| Garage (assumed automotive), immediately east of site | Fuel oils, lubricating oils, PAHs. |
| Various industrial land uses including: Smithy, 100m SW and 120m SW (c. late 1800's to 1920s), Gas Works, 180m SW (c. late 1800's to 1920's), unspecified 'works', 40m NW, 120m S, 90m SW (1960's to 1990's), Woodworks Factory, 150m NW, Printing Works, 120m W, Tool Factory 170m SW (c. late 1960's to late 1990's), Heating and Ventilation Works (c1980's to 2000's). | Fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), solvents and other common industrial contaminants. |
| Railway, 60m west of site (c. 1800s-present) | Fuel oils, lubricating oils, heavy metals, polycyclic aromatic hydrocarbons (PAHs), PCBs, ash, sulfate, herbicides and asbestos. |

The principle source of contamination associated with the historic activities across the site relate to the former use as Hatfield Brewery and 'Works', particularly in the southern portion of the site. These former land-uses also had the potential to impact upon the made ground that is likely to be present across the site. Furthermore, there is the potential for any former basements to be infilled with potentially contaminated material. The potential for the existing site operations to have a contaminative threat to the site is considered to be low owing to the widespread cover of hardstanding and generally low risk land-use.

In terms of off-site sources, the industrial activities to the west of the site (both former and current), including the railway line, have the most potential to be a contaminative threat to the site. However, the distance from the site and general topography of the surrounding area suggest that the potentially most contaminative surrounding land-uses are unlikely to impact the subject site directly.

5.3 Receptors at Risk

The risk assessment identifies potential receptors within the following four categories:

- i. end users of the site who may have acute exposure to sources of contamination on a regular and predictable basis;
- ii. controlled waters, being defined as all surface water, groundwater or perched water;
- iii. building structures and services placed in or on the ground;

- iv. other targets such as the “environment”, including any flora and fauna on or near the site and construction and maintenance workers who will have chronic but potentially higher levels of exposure than end users.

Table 5.2 below lists the main sensitive targets within these categories as follows:

Table 5.2 – Receptors at Risk

| Category | Details of receptor |
|--------------------|---|
| Current/End users | As detailed within the CLEA Model, this comprises a 0-6 year old female child with respect to the proposed residential end use. The above is considered the most sensitive receptor in view of the mixed residential and commercial end-use of the site. |
| Controlled waters | From the desk study/walkover information these generally comprise the groundwater beneath the site (Secondary A Aquifer and the Principal Aquifer and the River Lea (low risk) some 1.2km to the north. |
| Buildings/services | Buried concrete and other construction material within the ground including water supply pipes etc. The building(s) (and their occupants) may also be susceptible to gas ingress. |
| Other targets | Short term occupation by construction workers and long term but intermittent visits by maintenance workers. Vegetation and other ecological receptors may be present in the form of localised areas of soft landscaping. |

5.4 Pathways for Migration

Based on the proposed end use of the site and the anticipated ground conditions at and in the vicinity of the site, the contaminant pathways identified within **Table 5.3** are considered potentially to be present.

Table 5.3 – Pathways for Migration

| Category | Details of pathway |
|--------------------|--|
| End users | Pathways relevant to the end user are identified in the CLEA Model as ingestion, inhalation of soil / dust particulates or contaminant vapours, dermal contact (absorption through skin), and consumption of garden vegetables and fruit. |
| Controlled waters | Mobile/leachable contaminants will generally migrate vertically downward through the granular Glacial Deposits until meeting the water table after which free/dissolved phases would be expected to migrate towards the River Lea located 1.2km to the north. The potential presence of low permeability cohesive Glacial Deposits (in the form of Boulder Clay) may restrict the downward migration and promote lateral migration of contaminants. |
| Buildings/services | Buried concrete and services will be susceptible to attack via contact with aggressive/contaminated ground, especially if mobile groundwater is present. Pathways for gas migration are considered to exist through the granular Glacial Deposits between the site and the source of any potential ground gas. |
| Other targets | Pathways towards construction and maintenance workers will relate to acute exposure and as such are outside the scope of chronic risk |

| Category | Details of pathway |
|----------|--|
| | assessment methodologies. Vegetation and other ecological targets may be affected by contact with contaminated soils via plant uptake routes. |

5.5 Preliminary CSM

Based on the assumptions above, a preliminary CSM of pollutant linkages on the site has been developed from the above information and is presented as **Table 5.4**

The CSM includes a qualitative estimation of risk for each pollutant linkage, based on a comparison of the consequence of the event against the probability of its occurrence, in line with the risk classification methodology presented in CIRIA Report C552 (2001).

Table 5.4 – Preliminary Conceptual Model of Pollutant Linkages

| Sources Potentially Present | Pathways | Receptors | Qualitative Assessment of Risk |
|--|--|--|---------------------------------------|
| Car park in northern portion of the site (Points) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid | Controlled waters Human health (future site users) Human health (construction workers) Building materials | Negligible / Low |
| Made Ground across site (may include heavy metals, PAH, sulphate, asbestos, etc.) (Diffuse) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid Inhalation of contaminated dust and vapours/gases Contact with contaminated ground/liquid | Controlled waters Human health (future site users) Human health (construction workers) Building materials | Low / Moderate |
| Ground gas resultant from: <ul style="list-style-type: none">On-site made ground (Diffuse) | Inhalation of vapours/gases Ingress into building structures | Human health (future site users) Human health (construction workers) Building/structures | Low* |
| Former light industrial use of the site – Hatfield Brewery and Unspecified Works. (Point / Diffuse) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Dermal contact with contaminated soil/water/liquid | Controlled waters Human health (construction workers) Building materials | Moderate* |

| Sources Potentially Present | Pathways | Receptors | Qualitative Assessment of Risk |
|--|---|--|--|
| Electricity substations (Point) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Ingestion of contaminated soil, dust, liquid | Human health (future site users) Human health (construction workers) Controlled waters Building materials | Low* |
| Railway Land (off-site) (Diffuse) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Surface run-off (although unlikely due to distance) | Human health (construction workers) | Low – unlikely to affect controlled waters beneath the site owing to the direction of groundwater flow. |
| Various off-site sources including light industrial / manufacturing (former and current) (Diffuse) | Leakage into unsaturated zone and migration to shallow groundwater Migration via shallow groundwater flow Surface run-off (although unlikely due to distance) | Human health (construction workers) | Low - unlikely to affect controlled waters beneath the site owing to the direction of groundwater flow. |

* Based on information pertained from the previous Site Investigation Report

To summarise, the preliminary CSM has identified evidence of possible ground contamination on the site, possible pathways for contamination to migrate and sensitive receptors potentially at risk. Plausible pollutant linkages are therefore deemed to exist.

6. GROUND INVESTIGATION

6.1 Site Work

6.1.1 Rationale

The purpose of the intrusive investigation is to aid confirmation of the ground conditions and potential pollutant linkages identified within the Preliminary CSM. The techniques adopted for the investigation have been chosen considering the anticipated ground conditions and the proposed development.

With respect to ground contamination issues, the investigation was designed to target specific potential sources identified within the Preliminary CSM, and also to provide targeted and non-targeted coverage across the site in relation to the proposed redevelopment.

6.1.2 Scope of Works

The site work was carried out between 2nd and 4th February 2011, and comprised the activities summarised in **Table 6.1**, below, which includes a justification for each exploratory hole location. The investigation and the soil descriptions were carried out in general accordance with BS5930:1999 - Code of Practice for Site Investigations. The exploratory hole logs and other site work records are presented in **Appendix B**.

Table 6.1 – Summary of Ground Investigation Activities

| Investigation Type | Number | Designation | Rationale |
|---|--------|---------------|---|
| Boreholes - by light cable percussive methods | 2 | BH1 to BH2 | To prove the geological succession beneath the site, obtain geotechnical data and to determine the contamination status of the shallow soils in relation to the proposed redevelopment, to install ground gas monitoring wells. |
| Boreholes – by drive-in-sampler methods | 3 | WS1 to WS3 | To prove the geological succession, obtain geotechnical data, to determine the contamination status of the ground and install additional dual purpose groundwater and gas monitoring wells. These exploratory holes were located in the area proposed for the construction of residential dwellings (north of the site) |
| Boreholes – by drive-in-sampler methods | 1 | WS4 | To prove the geological succession, obtain geotechnical data and to determine the contamination status of the ground. |
| Monitoring well installations | 3 | WS2, WS4, BH2 | Ground gas and groundwater monitoring installations |
| Trial Pits - excavated by hand | 3 | TP1 to TP3 | To accurately log the upper strata in areas proposed for car parking as part of the proposed |

| Investigation Type | Number | Designation | Rationale |
|--|--------|---------------|--|
| | | | redevelopment, provide in-situ CBR determinations and determine the contamination status of the shallow soils. |
| PID screening of samples | All* | N/A | Detection of volatile organic compounds |
| Water level monitoring in shallow installations | 3 | WS2, WS4, BH2 | Measurement of depth to groundwater |
| Ground gas monitoring in monitoring well installations | 3 | WS2, WS4, BH2 | Measurement of ground gas emission rates |

* All shallow samples of made ground and natural underlying soils tested.

The investigation points were located approximately by reference to physical features present on the site at the time of investigation. The ground levels at the exploratory locations have not been measured.

6.2 Laboratory Testing

6.2.1 Introduction

A programme of geotechnical and chemical laboratory testing, scheduled by RSK and as detailed below, was carried out on selected samples taken from various strata. The laboratory results are presented in **Appendices C** and **D**, respectively.

6.2.2 Geotechnical Testing

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is presented in **Table 6.2**, the main purpose of which was to accurately classify the natural soils beneath the site. Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes within RSK's UKAS accredited laboratory.

Tests carried out in order to classify the concrete class required on site have been undertaken following the procedures within BRE SD1:2005 by a UKAS accredited laboratory (Structural Soils).

Table 6.2 – Summary of Geotechnical Testing Programme

| Strata | Tests undertaken | No of Tests |
|-----------------------------|-------------------------------------|-------------|
| Made Ground | Moisture Content | 1 |
| | Plasticity Index | 1 |
| | pH and water soluble sulfate | 5 |
| Boulder Clay | Moisture Content | 5 |
| | Plasticity Index | 3 |
| | Undrained Triaxial Compression Test | 2 |
| | pH and water soluble sulfate | 2 |
| Glacial Deposits (Granular) | Particle Size Distribution | 2 |
| | pH and water soluble sulfate | 2 |

6.2.3 Chemical Testing

The programme of chemical tests was undertaken on samples obtained from the intrusive investigation as presented in **Table 6.3**. The scope of the testing undertaken is based on the findings of the Phase 1 study discussed above and includes the Contaminants of Concern listed within the Preliminary CSM. Additional tests may also have been specified as a consequence of observations made from the exploratory holes during the investigation.

The testing was carried out to assess the levels of contamination within the made ground and natural soils encountered on the site with regard to identified receptors as detailed within the Conceptual Model. Testing was undertaken by a UKAS accredited laboratory (Envirolab). MCERTS accredited test methods were specified where applicable.

Table 6.3 – Summary of Chemical Testing Programme

| Strata | Tests undertaken | No of Tests |
|-----------------------------|---|-------------|
| Made Ground | Heavy Metals Suite – As, Cd, tCr, Pb, Hg, Se, wsB, Cu, Ni, Zn, pH | 14 |
| | Speciated PAH | 11 |
| | TPHCWG (Speciated TPH) | 2 |
| | Total TPH | 4 |
| | Polychlorinated Biphenyls | 1 |
| | Phenols – Total monohydric | 6 |
| | Fibre Screen | 11 |
| | Total Organic Carbon (TOC) | 4 |
| | | |
| Glacial Deposits (Granular) | Heavy Metals Suite – As, Cd, tCr, Pb, Hg, Se, wsB, Cu, Ni, Zn, pH | 2 |
| | Speciated PAH | 2 |

7. PHYSICAL GROUND CONDITIONS

7.1 Findings of Ground Investigation

7.1.1 General Succession of Strata

The exploratory holes revealed that the site is underlain by a variable thickness of made ground overlying an interbedded sequence of granular and cohesive Glacial Deposits comprising Boulder Clay and Glacial Gravels. The White Chalk Subgroup was not encountered within the terminal depth of the investigation. This generally appears to confirm the stratigraphical succession described within the Preliminary CSM. For the purpose of discussion, the ground conditions are summarised in **Table 7.1** below.

Table 7.1 – General Succession of Strata Encountered

| Strata | Exploratory Holes Encountered | Depth to top of stratum m.bgl | Thickness (m) |
|-------------------------------------|-------------------------------|-------------------------------|--|
| Made Ground | All | 0.00 | 1.8 to 4.9 |
| Granular Glacial Deposits (shallow) | BH1, BH2, WS2, WS3, WS4 | 1.8 to 4.9 | 0.50 to 3.0 |
| Boulder Clay | BH1, BH2, WS1, WS2, WS3, WS4 | 2.7 to 5.6 | 6.5 to 7.9 (thickness proven in BH1 and BH2 only) |
| Granular Glacial Deposits (deep) | BH1, BH2 | 11.8 to 13.5 | Proven to 14.5m bgl |

7.1.2 Made Ground

The exploratory holes encountered a variable thickness of made ground across the site ranging from 1.8m in the northern portion of the site to 4.9m in the southern portion of the site (within the Salisbury Square area).

In general terms, the made ground in the northern portion of the site (with the exception of BH1) comprised granular made ground deposits comprising an initial granular layer (sub-base) with variable proportions of flint and concrete overlying clayey gravelly sand with flint and brick. Decomposing organic matter was noted within the sandy deposits in WS3 at 1.6m depth.

The made ground soils in the remaining exploratory locations (generally to the south of the site, except BH1) predominantly comprised a sandy gravelly clay with variable proportions of flint, brick, concrete and occasional ash and clinker-rich soils. Locally, fragments of bitumen (TP2), chalk (TP3) and ceramics (WS1). Occasional lenses of decomposing organic matter were noted within the cohesive made ground deposits between 0.9 and 1.9m depth within WS1.

Visual/olfactory evidence of contamination was encountered in the form of ash and clinker within the made ground soils at a number of locations. On-site PID screening of disturbed samples indicated concentrations of volatile organic compounds (VOCs) at <5ppm, indicating the absence of VOCs within the samples.

Roots were generally noted in the shallow made ground soils within the exploratory holes in the areas of soft landscaping within Salisbury Square. However, it is noted that the mature deciduous trees would extend to a greater depth. Roots were also noted within the made

ground soils beneath the current car parking area to the north to 0.45m depth in WS1, at 1.6m depth in WS3, and to 1.25m depth in WS4

The measured and inferred soil parameters for the stratum are listed in **Table 7.2** below.

Table 7.2 – Summary of Soil Parameters for Made Ground

| Soil Parameters | Range | Results |
|--------------------------------|---------------|------------|
| Liquid Limit (%) | 36* | Appendix B |
| Plastic Limit (%) | 17* | Appendix B |
| Plastic Index (%) | 17* | Appendix B |
| Modified Plasticity Index (%) | 11.39* | - |
| Plasticity Term | Intermediate* | Appendix B |
| Volume Change Potential (NHBC) | Low* | - |
| Moisture Content (%) | 22* | - |
| Modified Moisture Content (%) | 33* | - |
| SPT 'N' Values | 8 - 47 | Figure 3 |

* Cohesive made ground soils

7.1.3 Glacial Gravels (*Granular Glacial Deposits*)

The granular Glacial Deposits were encountered both above and below the Boulder Clay. The shallow granular deposits were encountered in all exploratory locations with the exception of the hand-excavated trial pits and WS1. The hand-excavated trial pits did not extend into natural soils and granular soils were absent above the Boulder Clay in WS2.

The shallow granular deposits generally comprised a very loose to medium dense brown/orange silty sand with variable proportions of flint gravel.

The deeper granular deposits were encountered directly below the Boulder Clay deposits in exploratory holes BH1 and BH2 and comprised a very dense slightly clayey (BH1 only) sandy gravel.

Visual/olfactory evidence of contamination was not encountered within the granular glacial deposits. On-site PID screening of disturbed samples indicated the absence of VOCs within the samples.

The measured and inferred soil parameters for the stratum are listed in **Table 7.4** below.

Table 7.4 – Summary of Soil Parameters for Granular Glacial Deposits

| Soil Parameters | Range | Results |
|-----------------|----------------------------|----------|
| SPT 'N' Values* | 4 - 17 | Figure 3 |
| SPT 'N' Values | 90 – 105** | Figure 3 |
| Density Term* | Very Loose to Medium Dense | |
| Density Term | Very Dense | |

*Shallow granular deposits (encountered above the Boulder Clay)

**Extrapolated SPT N Values

7.1.4 Boulder Clay (Glacial Deposits – cohesive)

The Boulder Clay was generally encountered beneath an initial granular layer of Glacial Deposits, with the exception of WS1, where the shallow granular Glacial Deposits were absent.

The Boulder Clay comprised a firm to very stiff grey/dark grey sandy gravelly clay with variable proportions of flint and chalk gravels. These deposits were encountered to a maximum depth of 13.5m bgl in BH2.

Visual/olfactory evidence of contamination was not encountered in the Boulder Clay. On-site PID screening of disturbed samples indicated the absence of VOCs within the samples.

No roots were noted in the Boulder Clay at the locations investigated.

The measured and inferred soil parameters for the stratum are listed in **Table 7.3** below.

Table 7.3 – Summary of Soil Parameters for Boulder Clay (Cohesive Glacial Deposits)

| Soil Parameters | Range | Results |
|---|-------------------------|------------|
| Liquid Limit (%) | 45 – 49 | Appendix B |
| Plastic Limit (%) | 20 – 22 | Appendix B |
| Plastic Index (%) | 24 – 27 | Appendix B |
| Modified Plasticity Index (%) | 21.6 – 22.68 | - |
| Plasticity Term | Intermediate Plasticity | Appendix B |
| Volume Change Potential (NHBC) | Medium | - |
| Moisture Content (%) | 16 - 22 | - |
| Modified Moisture Content (%) | 16 - 25 | Figure 4 |
| SPT 'N' Values | 6 - 67 | Figure 3 |
| Undrained Shear Strength (kN/m ²) measured by Triaxial Testing | 236 - 273 | Figure 5 |
| Undrained Shear Strength (kN/m ²) inferred from SPT 'N' values | 26* - 288 | Figure 5 |

*Based on in-situ SPT test at the surface of the strata

7.2 Groundwater

Groundwater was only encountered in the form of a perched groundwater table on top of the Boulder Clay and at the base of the made ground soils within BH2. Subsequent monitoring has also established the standing level at this location, as shown in **Table 7.5** below.

Table 7.5 – Groundwater Results

| BH | Strata | Strike m.bgl | Rise m.bgl | Monitoring Results m.bgl |
|-----|--------------------------|-----------------|---------------|-----------------------------|
| BH2 | Made Ground | 4.9 | 4.7 | 4.16 to 4.18 |
| WS2 | Made Ground / Glacial | Dry | Dry | Dry |

| BH | Strata | Strike m.bgl | Rise m.bgl | Monitoring Results m.bgl |
|-----|--------------------------------------|-----------------|---------------|-----------------------------|
| | Deposits | | | |
| WS4 | Made Ground / Glacial Deposits | Dry | Dry | Dry / 2.41 |

The findings reflect the perched groundwater table in the deeper area of made ground in the southern portion of the site.

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. On-going monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

7.3 Ground Gas Monitoring Results

Ground gases were monitored in the well installation on 2 no. return visits to the site after the main fieldwork and the results are presented in **Appendix B**. The preliminary gas monitoring programme has detected the absence of methane, up to 3.4%vol carbon dioxide and near normal oxygen concentrations, over a monitoring period with atmospheric pressure conditions varying between 999 and 1016 m bar. The results are summarised and interpreted in **Section 8.3**.

8. GROUND CONTAMINATION CONDITIONS

8.1 Chemical Analysis of Soil Samples

8.1.1 Introduction

The findings of the investigation have been assessed in relation both to a combination of specific site characteristics, as identified within the Preliminary Conceptual Model, and the future site use proposals.

Chemical analyses have been performed on a total of 22 no. soil samples, including both fill materials and natural soils, down to a maximum depth of 4.9m below existing ground level. In addition to the chemical analyses, a total of 11 no. samples of the made ground were screened in the laboratory for the presence of asbestos fibres.

All soil samples scheduled for laboratory testing are also inspected visually on receipt at the laboratory for the presence of materials potentially containing asbestos, e.g. fragments of asbestos-cement products.

The full chemical results are presented within **Appendix D**. The results have been assessed with respect to human health, plant phytotoxicity, the performance of construction materials and water resources in the following sections. In addition petroleum hydrocarbons have been considered separately and are discussed below.

8.1.2 Summary of Soil Results with Respect to Human Health

Assessment of risk is considered as a tiered approach. Assessment based on non-intrusive means is considered a Tier 1 assessment, comparison against generic assessment criteria is a Tier 2 assessment, and the generation of and comparison with SSACs is a Tier 3 assessment and is conducted when deemed appropriate from the Tier 2 assessment.

The Tier 1 assessment is summarised in the CSM provided in **Chapter 5**. The following represents the Tier 2 assessment and an overview of the methodology applied is provided below. The Tier 2 Human Health Risk Assessment conducted on the results of the laboratory tests on soils sampled from the site were evaluated using Generic Assessment Criteria (GACs) calculated using the final updated CLEA framework, comprising the new CLEA Software (version 1.06), and supporting documents.

It should be noted that the new CLEA Software has not yet incorporated lead and therefore the former CLEA Soil Guideline Value (SGV) for lead, for a residential with and without plant uptake end use, has been used in this assessment.

The redevelopment involves the improvement of the Salisbury Square area of Old Hatfield with a mixed commercial and residential development. The proposed development specifically comprises 19 new flats, 5 terraced houses and 4 commercial units. The development is also to include a two-storey (including basement) car park within the central portion of the site. The commercial units are also to include basement level.

As such, the chemical results from exploratory holes BH1, WS2 to WS4 have been compared directly against the residential with plant uptake GACs calculated using the new CLEA software. As a conservative approach, the chemical results from exploratory holes BH2, WS1 and TP1 to TP3 have been compared directly against the residential without plant uptake GACs, in view of the proposed mixed commercial and residential units. These are considered to be the most suitable guidelines to protect the most critical targets from contaminants via all possible exposure routes.

The following parameters have been used within the CLEA model:

- Soil Organic Matter: 1%
- pH: 8

The CLEA software output reports for the site are presented in **Appendix E**.

For non-volatile contaminants the human health risk assessment has been conducted to a depth of 1m. At depths greater than 1m it is considered that no relevant pathway for human exposure to occur will be present. For volatile contaminants, the human health risk assessment may be conducted on samples collected at depths in excess of 1m as it is assumed that an inhalation pathway (i.e. from vapours) could potentially be present regardless of the depth of the contamination.

Non-volatile contaminants are considered to be those that have a Henry's Law Constant of less than 0.001 whilst volatile contaminants are considered to be those that have Henry's Law Constants greater than 0.001.

Table 8.1, below summarises the results obtained in the investigation against the calculated GACs, for those determinands where exceedances have been reported.

Table 8.1 – Data Summary Table

| Zone / Material | Determinant | Total No sample tested | Number of Non Detects As a percentage of the data set | Adopted screening value | No of exceedances | Maximum concentration (mg/kg) | |
|--|----------------|------------------------|--|-------------------------|-------------------|-------------------------------|------------------|
| | | | | | | Value | Location / Depth |
| Made Ground Southern Portion of Site | Benzo(a)pyrene | 6 | 1 | 1.0 | 1 | 2.33 | TP2, 0.5m |

Note: Lead assessed against former SGV for residential land use.

When compared to the exploratory hole for TP2, it is clear that the elevated concentrations of PAH compounds at this location are associated with bitumen and a clinker-rich horizon. As such, it is not deemed appropriate to carry out statistical analysis on the data to confirm (or otherwise) the absence of risk.

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground.

On the basis of the assessment carried out there have been no exceedances of contaminants within the soils in the vicinity of the proposed terraced residential housing when compared directly against the residential with plant uptake GACs.

A single exceedance was encountered in the southern portion of the site when compared directly against the residential without plant uptake GACs with respect to Benzo(a)pyrene. As such, remediation and / or further assessment would be required to facilitate the proposed redevelopment plans.

8.1.3 Summary of Soil Results with Respect to Plant Phytotoxicity Effects

Table 8.2 – Summary of Soil Results with Respect to Plant Phytotoxicity Effects

| Substance | Assessment value adopted (mg/kg) from The Soil Code (1998) | | | | Maximum concentration where in excess of assessment value (mg/kg) |
|-----------|--|----------|--------|-------|---|
| | pH <5.5 | pH 5.5-6 | pH 6-7 | pH >7 | |
| Boron | 3 | 4 | 5 | 6 | None |
| Copper | 250 | 250 | 250 | 250 | None |
| Nickel | 50 | 60 | 75 | 110 | None |
| Zinc | 200 | 200 | 300 | 300 | 306mg/kg TP3 |

In view of the single marginally elevated concentration of zinc encountered within the shallow made ground (0.10m bgl) in TP3 and concentrations elsewhere of generally <100mg/kg, there are not considered to be any significant risks associated with the phytotoxicity effects from the contaminants within the soils. This assumes that an appropriate depth of topsoil is placed to provide a suitable growing medium in any tree pits and areas of soft landscaping.

8.1.4 Summary of Soil Results with Respect to Performance of Building Materials

Table 8.3 – Summary of Soil Results with Respect to Performance of Building Materials

| Category of substance | Receptor at risk | Assessment value adopted | Maximum concentration where in excess of assessment value |
|-----------------------------------|--------------------------------|--------------------------|---|
| Sulfates (W Sol SO ₄) | Concrete | 500mg/l | None |
| Phenols | Potable water in plastic pipes | 5mg/kg | None |
| TPH* | Fresh concrete | 1000mg/kg | None |
| TPH* | Potable water in plastic pipes | 50mg/kg | 168 mg/kg BH2 |

*Note: TPH assessment values are based on the presence of potentially mobile petroleum hydrocarbons

Whilst no significant organic contamination has been recorded on-site, mild concentrations of petroleum hydrocarbons have been recorded within the made ground soils at the location of BH2. This residual or latent contamination may have the potential to permeate plastic potable water supplies if proposed supplies are to be orientated in this area of the site. It is therefore recommended that the water suppliers be contacted at an early stage and that barrier pipe be adopted where necessary to protect potable water supplies from this potential threat.

8.1.5 *Petroleum Hydrocarbons*

The results from all samples tested for speciated petroleum hydrocarbons (TPH-CWG) were assessed in accordance with guidance provided in “*The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils*” (Environment Agency, 2005) and compared to Generic Assessment Criteria for each of the TPH-CWG aliphatic and aromatic fractions. Concentrations of individual TPH-CWG aliphatic and aromatic fractions were not detected at concentrations in excess of the corresponding Generic Assessment Criteria.

This indicates that there is no significant risk to human health in relation to hydrocarbons at the site, assuming a residential end use.

8.1.6 *PCBs*

A single sample was selected from the exploratory hole closest to the existing electricity substation and tested for speciated PCB for the WHO-12 compounds. None of the compounds were recorded above the laboratory limit of detection.

8.1.7 *Phenols*

Six samples of the made ground were selected for laboratory testing for Phenols. The concentrations of Phenols within all samples tested were below the laboratory limit of detection.

8.1.8 *Summary*

- The chemical analyses undertaken during the investigation in the northern portion of the site did not identify any elevated concentrations of contaminants when compared directly against residential with plant uptake GACs. There is not considered to be any specific risk to any of the identified receptors in relation to the residential development in this area and, as such, no alleviation / remediation measures are considered necessary.
- The chemical analyses undertaken during the investigation in the southern portion of the site identified a single exceedance in the made ground soils with respect to Benzo(a)pyrene. This concentration is linked to bitumen and particularly clinker-rich soils identified at this depth during the site investigation. As such, localised additional sampling may be required to confirm the absence of risk to human health or the adoption of a clean cover system if this coincides with an area of landscaping.

8.2 **Chemical Analysis of Water Samples**

8.2.1 *Introduction*

An investigation of groundwater quality beneath the site was outside the scope of this investigation. Furthermore, the only groundwater encountered during the investigation was considered to be representative of a perched groundwater table within the made ground, residing above the Boulder Clay deposits.

8.3 **Ground Gas Monitoring**

8.3.1 *Introduction*

The preliminary CSM indicated a potential source of gas associated with the general made ground across the site associated with historic phases of demolition and construction. The potential for ground gas generation was considered to be low owing to the assumed partial

removal of the made ground during the construction of the basement car park and the absence of any evidence of any significant ground workings in the vicinity.

The intrusive investigation encountered a maximum thickness of made ground of 4.9m and an average thickness of around 2.3m, generally confirming the preliminary CSM. It is noted that the most significant made ground was located in the southern portion of the site and is most likely related to basements(s) associated with the former Hatfield Brewery.

8.3.2 Summary of Data

The presence of ground gases has been investigated by monitoring the well installations on two return visits to the site. The results of the monitoring of gas concentrations are summarised in **Table 8.4**.

Table 8.4 – Summary of Ground Gas Monitoring Results

| Bore-hole | Response Zone / Strata | Probable Source(s) of Ground Gas | No Monitoring Visits | Methane (%) | Carbon Dioxide (%) | Oxygen (%) | Flow Rate (l/hr) | Water Level (m bgl) | Atmospheric Pressure |
|-----------|------------------------|----------------------------------|----------------------|-------------|--------------------|------------|------------------|---------------------|----------------------|
| BH2 | MG/GD | Made Ground | 2 | <0.1 | 0.1 | 20.1-20.2 | 0.4-0.5 | 4.16-4.18 | 999-1016 |
| WS2 | MG/GD | Made Ground | 2 | <0.1 | 2.7-3.4 | 17.1-18.3 | 0.1 | Dry | 999-1015 |
| WS4 | MG/GD | Made Ground | 2 | <0.1 | 1.2-1.4 | 18.5-18.8 | 0.5 | Dry – 2.41 | 999-1015 |

Key: MG – Made Ground, GD – Glacial Deposits

The results and CSM indicate that the mild concentrations of ground gases are most likely associated with the general made ground across the site.

8.3.3 Assessment of Data

The results have been assessed in accordance with the guidance provided in CIRIA C665, "Assessing risks posed by hazardous ground gases to buildings" (CIRIA, 2007). In the assessment of risks posed by hazardous ground gases and selection of appropriate mitigation measures, CIRIA C665 identifies two types of development, termed Situation A (modified Wilson & Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the Gas Screening Value (GSV). The Gas Screening Value (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume). The GSV is calculated for both methane and carbon dioxide and the worst case value adopted.

Situation A relates to all development types except low rise housing and, by combining the qualitative assessment of risk (see preliminary CSM in Section 5) with the gas monitoring results, provides a semi-quantitative estimate of risk for a site. The method is based on that

proposed by Wilson & Card (1999), which was a development of a method proposed in CIRIA publication R149 (CIRIA, 1995). The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

Situation B is a characterisation system developed by the NHBC (Boyle and Witherington, 2006), which relates only to low rise housing development constructed with a clear ventilated underfloor void. The system provides a risk-based approach that is designed to allow an identification of gas protection for low-rise housing by comparing the measured gas emission rates to generic "Traffic Lights". The Traffic Lights include "Typical Maximum Concentrations" and are provided for initial screening purposes and risk-based GSVs for consideration for situations where the Typical Maximum Concentrations are exceeded. Based on the typical maximum gas concentrations and the GSVs, the appropriate Traffic Light, ranging from Green through Amber 1 and Amber 2 to Red, is determined from Table 8.7 of CIRIA C665.

In both Situations, it is important to note that the GSV is a guideline value and not an absolute threshold. The GSV may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to increase the Characteristic Situation or Traffic Light.

The site is to be redeveloped with a mixed commercial and residential development and therefore falls under Situation A and B. The gas monitoring data has identified the absence of methane and a maximum concentration of carbon dioxide of 3.4%. A maximum gas flow rate of 0.5l/hr has been recorded. The calculated GSV for carbon dioxide is 0.017l/hr. Based on the GSVs and maximum methane and carbon dioxide concentrations, the site is characterised as Characteristic Situation 1 for the commercial units and Green according to the NHBC traffic light assessment.

For both types of development, CIRIA C665 provides details of the typical scope of protective measures to be adopted for the relevant site characterisation.

For the proposed mixed development, Characteristic Situation 1 and Green classifications require no specific precautions to be taken in relation to ground gas owing to the negligible gas regime identified.

8.3.4 Summary

The results of the investigation and the CSM indicate that the mildly elevated concentrations of carbon dioxide encountered are likely to be associated primarily with small amounts of organic matter within the made ground soils.

Although limited data has been collected, it is considered that the gas monitoring programme carried out to-date is likely to have established the "worst case" scenario and has characterised the ground gas regime sufficient to enable the confident assessment of risk and subsequent design of an appropriate gas protection scheme(s) for the proposed development.

8.4 Waste Classification of Soils

Under the Landfill (England and Wales) Regulations 2002 (as amended) all wastes must be classified as inert, non-hazardous, stable non-reactive hazardous or hazardous wastes prior to off-site disposal. The Environment Agency technical guidance document WM2,

Interpretation of the definition and classification of hazardous waste (2003) outlines the methodology for classifying wastes.

HAS-WASTE is a waste soils characterisation assessment tool, developed by Envirolab Limited (a member of the RSK Group), which follows the guidance within WM2. The analytical results for the samples of made ground and shallow Glacial Deposits have been run through this assessment tool for potential off-site disposal of materials in the future. The results are presented in **Appendix F**.

The results indicate that the made ground and the natural soils tested would not be classified as hazardous waste. Waste Acceptance Criteria testing will be required prior to off-site disposal to classify the made ground soils across the site into inert and non-hazardous categories.

It is important to note that this initial assessment given in this report is for guidance only and it is always necessary to confirm the actual classification with prospective landfill operators prior to disposal.

Additionally, all non-hazardous soils will require pre-treatment prior to disposal at landfill. Pre-treatment is defined as a physical, chemical or biological process that changes the characteristics of the waste in order to reduce its volume / reduce its hazardous nature / facilitate its handling or enhance its recovery.

Further, it should also be noted that as an alternative to landfill disposal, the inert soils may potentially be suitable for re-use or disposal at an appropriate site, which is exempt from waste management licensing.

8.5 Site Waste Management Plans

It should be noted that the Site Waste Management Plans Regulations 2008 came into force in April 2008. The Regulations require the preparation of a Site Waste Management Plan (SWMP) for all construction projects in England with a value of more than £300,000 and a more detailed plan for projects with a value of more than £500,000. The purpose of the SWMPs is to encourage better resource utilisation and waste management practices in construction, improve environmental performance, minimise the landfilling of wastes, and reduce instances of fly-tipping.

A SWMP will therefore be required for the development and will need to consider all potential construction waste streams, including soils.

9. CONCEPTUAL SITE MODEL AND CONTAMINATION ALLEVIATION MEASURES

9.1 Conceptual Site Model (CSM)

The findings of the investigation have provided no evidence of contamination in proposed residential development. The findings of the investigation for the mixed commercial and residential development in the southern portion of the site have provided evidence of localised ground contamination and clarified the geological constraints on contamination migration pathways. The above assessment of potential health and environmental risks from contamination has been used to refine the preliminary CSM of pollutant linkages, which has been amended from that generated following the preliminary investigation.

The conceptual site contamination model of potential risks for the proposed type of development is presented in **Table 9.1**, based on a qualitative risk assessment of the findings of the investigation and with no contamination alleviation measures applied.

Table 9.1 – Conceptual Site Model of Potential Contamination Risks

| Substances present at source | | | Pathways | Receptors |
|--|--------------------------------|------------------------------|--|--------------------------------|
| Organic | | Inorganic | | |
| PAH – Benzo(a)pyrene (southern portion only) | TPH (southern portion only) | Zinc (southern portion only) | | |
| ✓ | ✗ | ✗ | Ingestion of contaminated soil, dust, liquid | Human health |
| ✓ | ✗ | ✗ | Inhalation of contaminated dust and vapours/gases | |
| ✓ | ✗ | ✗ | Uptake into home grown produce | |
| ✓ | ✗ | ✗ | Dermal contact with contaminated soil | |
| ✗ | ✗ | ✗ | Migration of contaminated groundwater/leachate from site to underlying aquifer | Groundwater |
| ✗ | ✗ | ✗ | Migration of contaminated groundwater/leachate from site to surface water | Surface Water |
| ✗ | ✗ | ✓ | Uptake into vegetation | Flora |
| ✗ | ✓ (potable water supply pipes) | ✗ | Contact with contaminated ground/liquid/vapour | Building materials/ structures |

Key:

- ✗ Based on the findings of the investigation, it is considered that these substances would **not** constitute a significant source of contamination.
- ✓ Based on the findings of the investigation, it is considered that these substances **may** constitute a source of contamination and a pollutant linkage.

To conclude, the conceptual model for the proposed type of development has identified some evidence of mild ground contamination on the site, possible pathways for contamination to migrate and sensitive receptors potentially at risk. Possible pollutant linkages therefore exist that must be either designed out in the proposed development or further investigated to determine the level of risk.

9.2 Alleviation Measures in Respect of Ground Contamination

It is understood that the proposed development will comprise a mixed commercial and residential development.

The CSM, as presented in **Table 9.1**, above indicate that there is evidence of mild localised contamination with respect to Benzo(a)pyrene (in relation to human health), Zinc (in relation to phytotoxic effects) and TPH (with respect to plastic potable water supply pipes). These are outlined below:

- The mildly elevated concentration of Benzo(a)pyrene with respect to the residential without plant uptake scenario, encountered in TP2 at 0.5m depth, is associated with bitumen and a clinker-rich horizon noted at this depth. If this location is to coincide with a proposed area of soft landscaping, further assessment should be undertaken by way of shallow soils sampling to better characterise the surrounding soils and to recommend any potential alleviation measures (i.e. a clean cover system).
- The made ground soils are not considered to pose a significant threat with regards to their phytotoxic effects in relation to the single mildly elevated concentration of zinc when compared to assessment values derived from the soil code (306mg/kg against 300mg/kg). Therefore, assuming that a suitable growing medium is provided in areas of soft landscaping, no specific alleviation measures are considered necessary.
- The concentration of TPH encountered in BH2 at 1.40m depth (168mg/kg) has the potential to permeate plastic potable water supplies if proposed supplies are to be orientated in this area of the site. It is therefore recommended that the water suppliers be contacted at an early stage and that barrier pipe be adopted where necessary to protect potable water supplies from this potential threat.

As a result of the above, appropriate contamination alleviation measures may be required. Where applicable, these have been outlined in **Table 9.2**.

Table 9.2 – Outline of Recommended Contamination Alleviation Measures

| Alleviation Measure | Area(s) of Site Likely to be Affected | | Development Considerations |
|---|---------------------------------------|----------------|---|
| | Whole Site | Targeted Areas | |
| Specialist demolition | ✓ | | Prior to demolition it is recommended that a hazardous materials survey is carried out and all necessary measures stemming from the survey implemented. |
| Treatment of potentially contaminated ground: | | | |

| Alleviation Measure | Area(s) of Site Likely to be Affected | | Development Considerations |
|---|---------------------------------------|----------------|--|
| | Whole Site | Targeted Areas | |
| Hotspot A | | Around TP2 | If this location is to coincide with an area of soft landscaping within the final site layout, it is recommended that additional targeted sampling is undertaken to assess any risk with respect to human health. If this location is to be located beneath hardstanding, no further assessment is considered necessary. |
| Dispose of any potentially contaminated materials to suitably licensed landfill site | ✓ | | |
| Remove/seal existing drains/services | ✓ | | To close off any existing drains/services ducts that could provide a pathway for contaminant migration |
| Provide hard cover with buildings and external hardstandings | | ✓ TP2 | The mild contamination encountered may be isolated below hard cover. |
| Provide a minimum 150mm thickness of topsoil to areas of communal soft landscaping to provide a suitable growing medium | ✓ | | This requirement may be locally increased based on any further assessment undertaken in the vicinity of TP2. |
| Provide a minimum 150mm thickness of topsoil in private garden areas to provide a suitable growing medium | ✓ | | |
| Use only validated sources of imported materials for use as topsoil | ✓ | | Proposed imported materials from each individual source should be validated with appropriate chemical test certificates and approved in advance of materials being delivered to site. |
| Provide clean fill in service trenches | ✓ | | Where passing through potentially contaminated ground, buried services should be placed in a service corridor and surrounded with clean uncontaminated material. |
| Take adequate health and safety measures during groundworks | ✓ | | Measures will be necessary to protect the health and safety of site workers during the works and to control any possible pollution caused by the works. |

| Alleviation Measure | Area(s) of Site Likely to be Affected | | Development Considerations |
|--|---------------------------------------|----------------|---|
| | Whole Site | Targeted Areas | |
| Monitor groundworks for previously undetected suspect materials and carry out appropriate additional testing | ✓ | | It is possible that the groundworks will encounter different conditions from those revealed by site investigation that may require special treatment or other alleviation measures. |

The alleviation methods outlined above will remove or effectively mitigate the pollutant linkages identified within the Conceptual Model of the site.

It is recommended that the Local Authority and Environment Agency be contacted at an early stage to seek their views on the remediation of contamination on the site.

10. ENGINEERING CONSIDERATIONS

10.1 Details of the Proposed Development

The redevelopment involves the improvement of the Salisbury Square area of Old Hatfield with a mixed commercial and residential development. The proposed development specifically comprises 19 new flats, 5 terraced houses and 4 commercial units. The development is also to include a two-storey (including basement) car park within the central portion of the site. The commercial units are also to include basement level.

10.2 Geotechnical Hazards

A summary of commonly occurring geotechnical hazards is given in **Table 10.1** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 10.1 – Summary of Main Potential Geotechnical Hazards that May Affect Site

| Hazard category (excluding contamination issues) | Hazard status based on investigation findings and proposed development | | | Engineering considerations if hazard affects site |
|--|--|---|--|--|
| | Found to be present on site | Could be present but not found | Unlikely to be present and/or affect site | |
| Sudden lateral changes in ground conditions | ✓ | Variation in depth of made ground – potentially associated with infilled basement(s) to the south | | Likely to affect ground engineering and foundation design and construction |
| Shrinkable clay soils | ✓ | Boulder Clay has Medium Volume Change Potential | | Design to NHBC Standards Chapter 4 or similar |
| Highly compressible and low bearing capacity soils, (including peat and soft clay) | | ✓ | With the exception of cohesive made ground soils | Likely to affect ground engineering and foundation design and construction |
| Silt-rich soils susceptible to rapid loss of strength in wet conditions | | | ✓ | Likely to affect ground engineering and foundation design and construction |
| Running sand at and below water table | | | ✓ | Likely to affect ground engineering and foundation design and construction |
| Karstic dissolution features (including 'swallow holes' in Chalk terrain) | | | ✓ - Unlikely to affect the site itself, although present in surrounding area | May affect ground engineering and foundation design and construction – refer to Section 4.1.2 |
| Evaporite dissolution features and/or subsidence | | | ✓ | May affect ground engineering and foundation design and construction |
| Ground subject to or at risk from landslides | | | ✓ | Likely to require special stabilisation measures |
| Ground subject to peri-glacial valley cambering with gulls possibly present | | | ✓ | Likely to affect ground engineering and foundation design and construction |
| Ground subject to or at risk from coastal or river erosion | | | ✓ | Likely to require special protection/stabilisation measures |
| High groundwater table (including waterlogged ground) | | | ✓ | May affect temporary and permanent works |
| Rising groundwater table due | | | ✓ | May affect deep foundations, |

| Hazard category (excluding contamination issues) | Hazard status based on investigation findings and proposed development | | | Engineering considerations if hazard affects site |
|---|--|---|---|--|
| | Found to be present on site | Could be present but not found | Unlikely to be present and/or affect site | |
| to diminishing abstraction in urban area | | | | basements and tunnels |
| Underground mining | | | ✓ - Not beneath the site itself | Likely to require special stabilisation measures |
| Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures) | ✓ | Footings associated with existing buildings on site and surrounding Salisbury Square and culvert cutting northwest corner | | Likely to affect ground engineering and foundation design and construction |
| Filled and made ground (including embankments, infilled ponds and quarries) | ✓ | Up to 4.9m in the south, probably relating to an infilled basement | | Likely to affect ground engineering and foundation design and construction |
| Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates) | See Section 10.7 | | ✓ | May affect ground engineering and foundation design and construction |

Note: Seismicity is not included in the above Table as this is not normally a design consideration in the UK.

10.3 Foundations

10.3.1 General Suitability

Terraced Housing

The ground conditions encountered in the northern area of the site do not appear suitable for the design and construction of conventional shallow spread foundations for the proposed terraced houses. However, relatively deep trench fill foundations appear technically feasible, although the depth to which such foundations will need to extend and potentially poor stability of open excavations through the extensive made ground may mean that piles will provide a more economic foundation solution. Alternatively, the near-surface ground conditions appear suitable for the use of selected ground improvement techniques that would facilitate the use of shallow spread footings supported on the improved ground.

Mixed Commercial / Residential Block with Basement Car Park

The suitability of spread foundations to support the proposed mixed commercial and residential building in the central and southern portion of the site will depend upon the structural loads and the extent of made ground remaining below the proposed basement formation level. The depth to which spread foundations will need to extend and the anticipated structural loads may mean that piles will provide the most suitable foundation solution for this aspect of the proposed development.

In view of the “very low subsidence risk” category determined by the Edmund’s risk assessment model for natural dissolution features and the absence of evidence for such features in the site investigation, the need for any special foundation design measures does not appear justified. However, there will still be a potential for chalk dissolution-related features on site and hence excavations should be carefully inspected to confirm the absence of such features beneath structures.

10.3.2 Spread Foundations

The recommendations for the design and construction of spread foundations in relation to the ground conditions are set out in **Table 10.2**.

Table 10.2 – Design and Construction of Spread Foundations

| Design/construction considerations | Design/construction recommendations |
|--|---|
| Founding stratum | Glacial Deposits – Stiff to Very Stiff Boulder Clay or Medium Dense Granular Glacial Deposits |
| Depth | Foundations should be taken to a minimum depth of 1.0m below finished ground level and at least 0.1m into the founding stratum below any overlying made ground or to any greater depth required in respect of the special design considerations given below. |
| Special design considerations | <p>Due to the presence of shrinkable soils foundations should be designed taking into account all the normal precautions, including minimum depths, to minimise the risk of future foundation movements in accordance with NHBC Standards, or similar.</p> <p>The findings of the ground investigation indicate that foundations should be designed for shrinkable soils of medium volume change potential.</p> |
| Bearing capacity (for terraced residential houses in northern portion of the site) | <p>Strip foundations with a width of up to 0.6m and constructed on the Glacial Deposits at a minimum depth of 1.0m may be designed using a net allowable bearing pressure of 125 kN/m². However, it should be noted that a significant depth of made ground was encountered in this area of the site and the footings should be taken at least 0.1m into natural strata.</p> <p>The allowable bearing capacity includes an overall factor of safety of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.</p> |
| Bearing capacity (for mixed residential/commercial block with basement) | <p>Strip foundations with a width of up to 1.5m and constructed on the medium dense granular Glacial Deposits / stiff clay Boulder Clay at a minimum depth of 1.0m or at least 0.1m into founding strata may be designed using a net allowable bearing pressure of 165 kN/m². This value may be increased to 185 kN/m² for pad foundations up to 2.5m square.</p> <p>These allowable bearing capacities include an overall factor of safety of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.</p> |
| Stability of excavations | The combination of perched groundwater was encountered in two of the exploratory holes and shallow granular deposits suggest it is possible that the foundation excavations may become unstable during construction. As such, an allowance should be made for suitable support systems. |
| Dewatering | <p>Localised perched groundwater was encountered in some of the exploratory holes. Dewatering may therefore be required to facilitate foundation excavation.</p> <p>Heavy pumping from open sumps in non-cohesive soils should be avoided as this can result in instability and general loosening of the soils at the base of the excavation. It is likely that dewatering in non-cohesive soils will require the use of well-pointing systems.</p> |
| Construction | All foundation excavations should be inspected and any made ground, soft, organic or otherwise unsuitable materials removed and replaced |

| Design/construction considerations | Design/construction recommendations |
|------------------------------------|-------------------------------------|
| considerations | with mass concrete. |

10.3.3 Piled Foundations

The recommendations for the design and construction of piled foundations in relation to the ground conditions are set out in **Table 10.3**.

Table 10.3 – Design and Construction of Piled Foundations

| Design/construction considerations | Design/construction recommendations | |
|---|---|---|
| Pile type | The construction of both bored and driven piles is considered technically feasible at this site. | |
| Possible constraints on choice of pile type | Given the close proximity of the site to other properties the use of driven piles may not be acceptable due to ground vibration and noise related problems. | |
| Temporary casing where groundwater is present | Bored piles will require temporary casing throughout the non-self supporting made ground and granular Glacial Deposits and due to the possible presence of perched groundwater. Alternatively, the use of continuous-flight-auger (CFA) injected bored piles usually overcomes this issue. | |
| Man-made obstructions | The presence of buried sub-structures or other obstructions within made ground may lead to some difficulty during piling. It is recommended that once the proposed pile layout has been determined, pre-pile probing be carried out at each of the pile positions. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction. | |
| Made Ground | 5m of made ground ignored in the calculations. | |
| Soil and pile design parameters for Boulder Clay (cohesive soils) | Adhesion Factor (α) | 0.5 |
| | Bearing Capacity Factor (N_c) | 9 |
| | Undrained Shear Strength (c_u) | 135 + 17z kN/m ² where z = depth into clay to ~15m |
| | Global Safety Factor | 2.5 |
| | Limiting Shaft Friction | 140 kN/m ² |
| | Limiting Concrete Stress | 7.5N/mm ² |
| Bored pile shafts and bases | <p>Bored pile concrete should be cast as soon after the completion of boring as possible and in any event the same day as boring.</p> <p>Prior to casting the base of the pile bore should be clean otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.</p> | |

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes **Table 10.4** gives likely working pile loads for traditional bored, cast-in-situ concrete piles of various diameters and lengths, based on the design parameters given in **Table 10.3**.

Table 10.4 – Illustration of Typical Pile Working Loads for Bored Cast-in-situ Piles

| Typical Pile Working Loads (kN) | | | | |
|--|---------------|-------|-------|-------|
| Depth of pile below existing ground level (m)* | Pile Diameter | | | |
| | 300mm | 350mm | 450mm | 600mm |
| 10 | 226 | 274 | 381 | 564 |
| 12.5 | 351 | 423 | 577 | 837 |
| 15 | 497 | 595 | 803 | 1149 |

*Pile lengths to be adjusted to take account of basement formation level as required.

10.4 Retaining Wall

It is understood that the development in the central and southern portion of the site is to involve the construction of a single storey basement structure with associated retaining structures.

The following soil parameters in **Table 10.5** are recommended for preliminary design purposes.

Table 10.5 – Retaining Wall Parameters

| Soil Type | Undrained Shear Strength c_u (kN/m ²) | Unit Weight (kN/m ³) | Short Term Characteristics | | Long Term Strength Characteristics | |
|-----------------------------------|---|----------------------------------|----------------------------|-------------|------------------------------------|-------------|
| | | | c_u (kN/m ²) | ϕ' (°) | c' (kN/m ²) | ϕ' (°) |
| Made Ground [sandy gravelly clay] | 25 | 17 | 25 | 0 | 0 | 25 |
| Glacial Deposits [Granular] | - | 18 | 0 | 32 | 0 | 32 |
| Glacial Deposits [Cohesive] | Generally >70 | 19 | 70 | 0 | 0 | 28 |

Allowance should be made in design for the build up of hydrostatic pressures behind the wall unless effective drainage measures can be ensured.

10.5 Ground Floor Slabs

The site is generally underlain by more than 600mm of existing made ground. NHBC Standards require that ground floor slabs should be suspended in areas where made ground is greater than 600mm in thickness.

10.6 Roads and Hardstanding

In-situ CBR determination were obtained from the proposed car parking areas in the southern portion of the site only. In the 0.5m to 1.0m below the proposed finished ground level the exploratory holes have revealed a soil profile comprising made ground only (cohesive and granular) The potentially poorest sub-grade material within this profile is the cohesive made ground.

In pavement design terms, the groundwater conditions are anticipated to comprise a low water table, i.e. at least 1m below the pavement formation level.

The estimated minimum, equilibrium soil-suction, CBR value for the soils and groundwater conditions described above under a completed pavement is 2 to 3%, after Table C1 in TRRL Report LR1132 (1984).

The results of in situ Clegg Hammer testing indicates that the near surface soils have a CBR value that ranges from between 2 and 28%, the results are summarised in **Table 10.6**.

Table 10.6 – Summary of CBR Values Derived from In Situ Clegg Hammer Tests

| Test Location | Material Type | CBR value determined |
|---------------|---------------|--|
| TP1 0.3m | Made Ground | 3% |
| TP1 0.5m | Made Ground | 14% (coincided with fragments of concrete below) |
| TP1 0.7m | Made Ground | 28% (coincided with fragments of concrete below) |
| TP2 0.2m | Made Ground | 2% |
| TP2 0.5m | Made Ground | 3% |
| TP2 0.8m | Made Ground | 12% |
| TP3 0.2m | Made Ground | 3% |
| TP3 0.6m | Made Ground | 7% |

The sub-grade soils in the vicinity of test locations is unlikely to be susceptible to improvement by rolling with conventional compaction plant owing to the predominantly cohesive nature of the made ground soils.

The recommended sub-grade soil CBR value for road pavement design is therefore 2%. This value assumes that during construction the formation level will be carefully compacted and any soft spots removed and replaced with well-compacted granular fill.

The sub-grade soils can be regarded as frost-susceptible, after the criteria given in Appendix 1 of TRRL Report Road Note 29 (1970). When the sub-grade is frost-susceptible the thickness of sub-base must be sufficient to give a total thickness of non-frost-susceptible pavement construction over the soil of not less than 450mm.

10.7 Chemical Attack on Buried Concrete

The results of chemical tests carried out on soil samples indicate 2:1 water soil extract sulfate contents of up to 0.28g/l with generally near neutral to alkaline pH values.

These results indicate that, in accordance with BRE Special Digest 1: 2005 *Concrete in aggressive ground*, the Aggressive Chemical Environment for Concrete (ACEC) Classification is **AC-1** with a Design Sulphate Class for the site of **DS-1**. This assumes nominally *static/mobile* groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures.

If significantly disturbed clay is likely to come into contact with concrete foundations or structures it will be necessary to carry out additional tests on the soil to investigate its total potential sulphate content. This will facilitate a re-evaluation of the ACEC Classification and Design Sulphate Class for the material, to take into consideration potential oxidation of available sulphides (e.g. pyrite), as defined in Table C2 (brownfield sites) BRE Special Digest 1: 2005.

10.8 Soakaways

The ground conditions do not appear suitable for the use of pit soakaways to discharge surface run-off water into the underlying Glacial Deposits. This is due to the significant thickness of made ground across the areas investigated, coupled with the inherent variability of the underlying Glacial Deposits.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

- Details obtained from historical mapping, Groundsure report and the Local Authority indicate that the site and surrounding area has historically been subject to a number of light industrial, commercial and residential land-uses, some of which could have contributed to the contamination of the site. Furthermore, the information provided by Welwyn Hatfield Borough Council confirm that the historic site use as a brewery is a potential source of contamination.
- The current site investigation confirmed the geological succession predicted in the preliminary conceptual model in that beneath a variable thickness of made ground, a sequence of granular Glacial Deposits and cohesive Boulder Clay was encountered. The greatest thickness of made grounds was encountered in BH2 in the southern portion of the site. This is assumed to be related to the infilling of an former basement associated with historic land-use of the site.
- No exceedances within the chemical test results were recorded when compared to the residential with plant uptake GACs in the northern portion of the site. As such, no specific alleviation measures are considered necessary to facilitate the construction of the terraced housing in this part of the site.
- A single exceedance of Benzo(a)pyrene was encountered in the southern portion of the site (TP2 at 0.5m) when compared to the residential without plant uptake GAC's. This elevated concentration can be attributed directly to bitumen and a clinker-rich horizon in the made ground soils at this depth. Therefore, no alleviation measures are considered necessary if this location is to be covered by building(s) or hardstanding. If, however, soft landscaping/public open space is to be located in this area, additional investigation of the shallow soils in the vicinity should be undertaken to fully assess the potential risk to human health.
- Whilst no significant organic contamination has been recorded on-site, mild concentrations of petroleum hydrocarbons in the made ground soils in the vicinity of BH2 may have the potential to permeate plastic water supply pipes. It is therefore recommended that barrier pipe be adopted in this area of the site to protect potable water supplies from this potential threat.
- A single elevated concentration with respect to the phytotoxic element zinc was encountered within the shallow made ground soils in the southern portion of the site (TP3 at 0.1m depth). As a result of this result being such a marginal exceedance and concentrations elsewhere being generally <100mg/kg, the made ground soils are not considered to pose a significant risk. However, it is recommended that topsoil be imported to any tree pits or areas of soft landscaping to ensure an appropriate depth of a suitable growing medium is provided.
- No specific precautions with respect to gas protection measures are considered necessary.
- The ground conditions encountered in the northern area of the site do not appear suitable for the design and construction of conventional shallow spread foundations for the proposed terraced houses. However, relatively deep trench fill foundations appear technically feasible, although the depth to which such foundations will need to extend and potentially poor stability of open excavations through the extensive made ground may mean that piles will provide a more economic foundation solution. Alternatively, the near-

surface ground conditions appear suitable for the use of selected ground improvement techniques that would facilitate the use of shallow spread footings supported on the improved ground.

- The suitability of spread foundations to support the proposed mixed commercial and residential building in the central and southern portion of the site will depend upon the structural loads and the extent of made ground remaining below the proposed basement formation level. The depth to which spread foundations will need to extend and the anticipated structural loads may mean that piles will provide the most suitable foundation solution for this aspect of the proposed development.
- The results indicate that, in accordance with BRE Special Digest 1: 2005 *Concrete in aggressive ground*, the Aggressive Chemical Environment for Concrete (ACEC) Classification is **AC-1** with a Design Sulphate Class for the site of **DS-1**. This assumes nominally *static/mobile* groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures.

FIGURES



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SITE LOCATION PLAN

Client: Gascoyne Cecil Estate

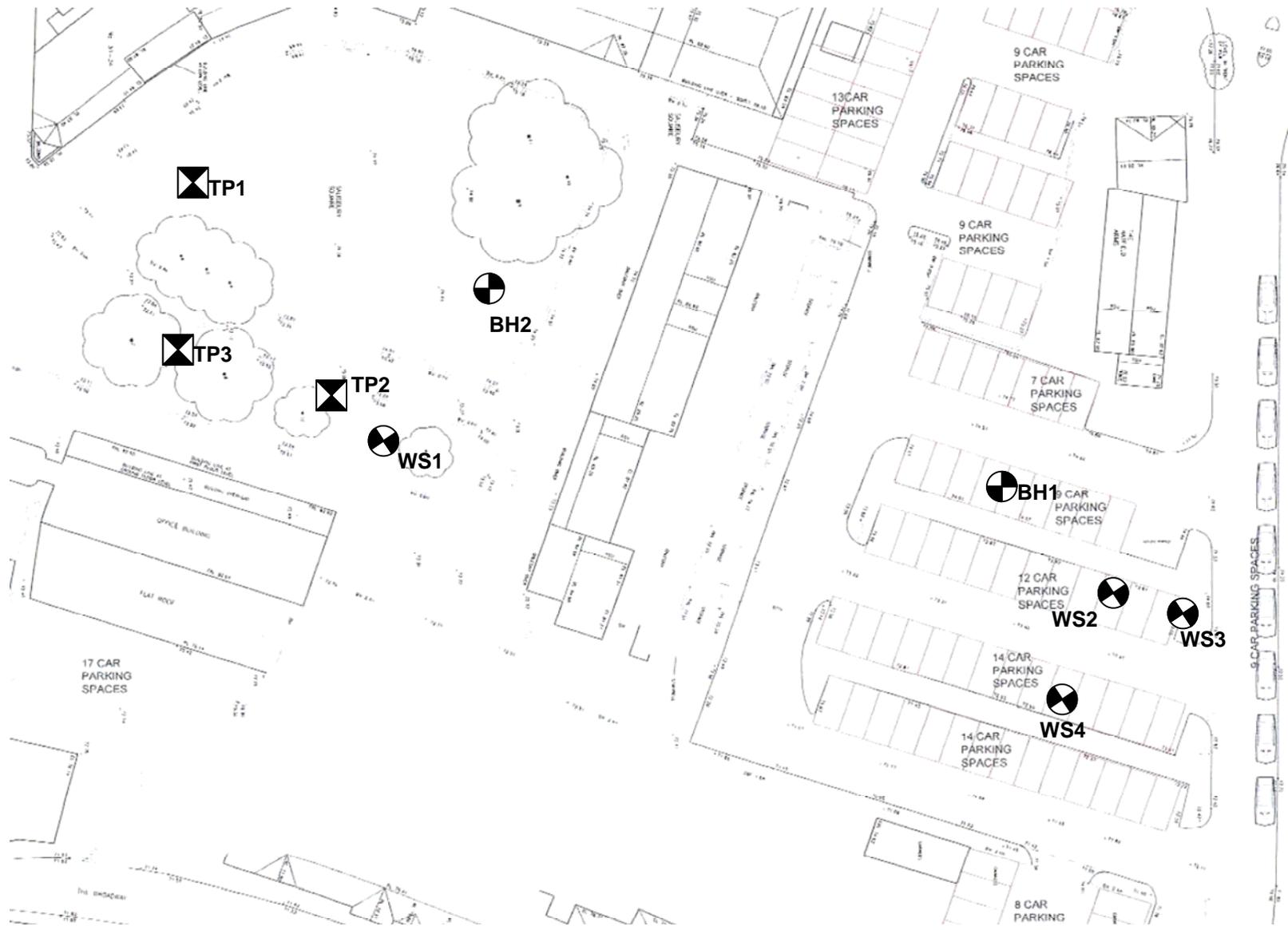
Figure No: 1

Site: Salisbury Square, Old Hatfield

Job No: 241882-01

Scale: 1:10,000 (reduced)

Source: Promap



EXPLORATORY HOLE LOCATION PLAN

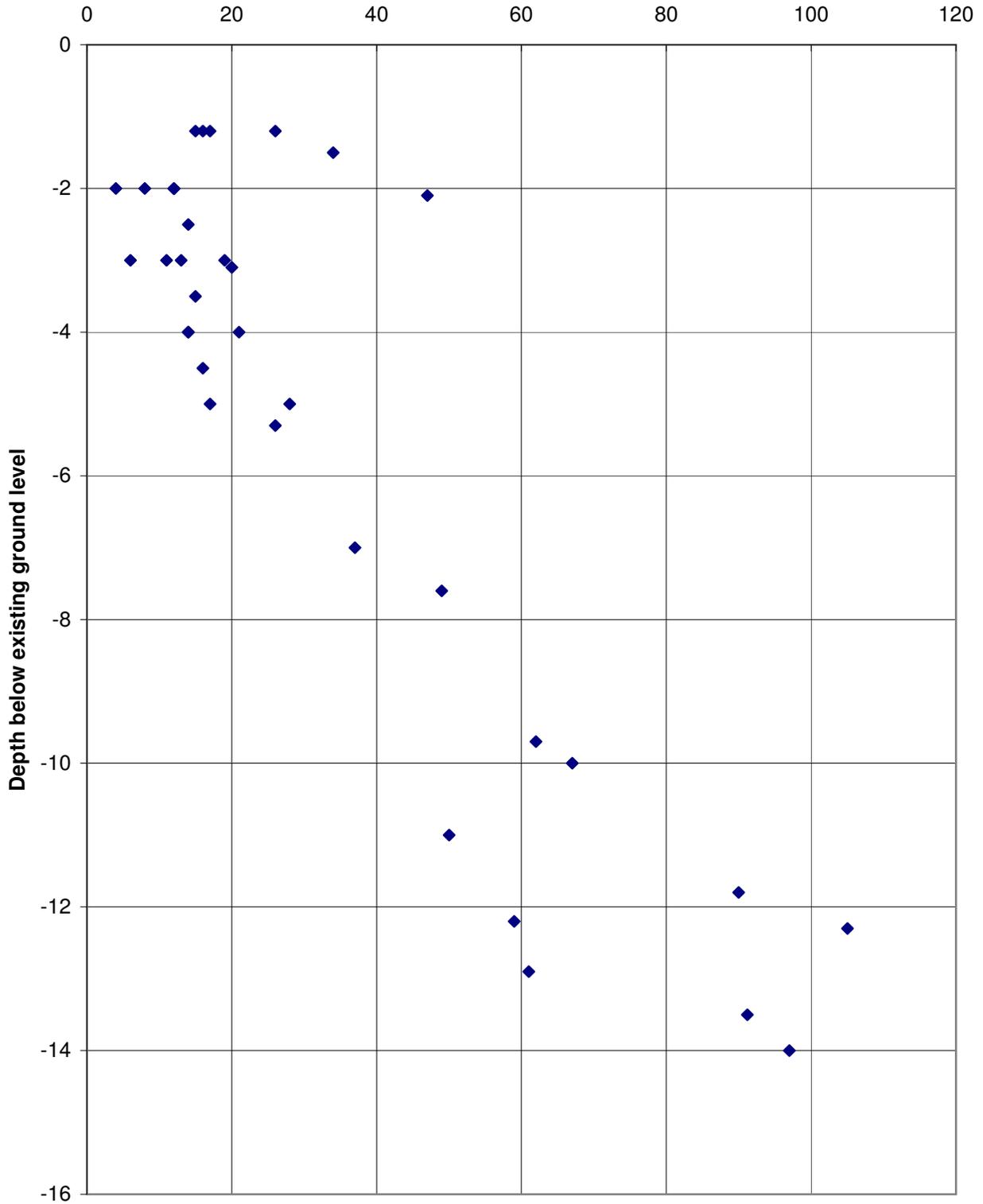
| | | | |
|----------------|--------------------------------|-------------------|-----------------------|
| Client: | Gascoyne Cecil Estate | Figure No: | 2 |
| Site: | Salisbury Square, Old Hatfield | Job No: | 241882-01 |
| Scale: | NTS | Source: | GCE Feasibility Study |

Site:
Salisbury Square, Old Hatfield

Client:
Gascoyne Cecil Estate

| | |
|-------------|--------|
| Job Number: | 241882 |
| Figure: | 3 |

SPT 'N' Value (for 300mm penetration)



APPENDIX A

Desk Study



EmapSite
, Masdar House,
Eversley, RG27 0RP

| | |
|----------------------------|--------------------|
| GroundSure Reference: | EMS-118389_155664 |
| Your Reference: | EMS_118389_155664 |
| Report Date: | Jan 12, 2011 |
| Report Delivery Method: | Email - pdf |
| Client Email: | sales@emapsite.com |

GroundSure EnviroInsight

Address: Salisbury Square, Old Hatfield, Hatfield

Dear Sir/Madam,

Thank you for placing your order with emapsite. Please find enclosed the GroundSure EnviroInsight as requested

If you would like further assistance regarding this report then please contact the emapsite customer services team on 0118 9736883 quoting the above report reference number.

Yours faithfully,

emapsite customer services team

Enc.
GroundSure EnviroInsight

GroundSure EnviroInsight

Address: Salisbury Square, Old Hatfield, Hatfield

Date: Jan 12, 2011

GroundSure Reference: EMS-118389_155664

Your Reference: EMS_118389_155664

Client: EmapSite



Brought to you by emapsite

Aerial Photograph of Study Site



Aerial photography supplied by Getmapping PLC.
© Copyright Getmapping PLC 2003. All Rights Reserved.

Site Name: Salisbury Square, Old Hatfield, Hatfield
Grid Reference: 523329, 208674
Size of Site: 0.89 ha

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

| Report Section | Number of records found within (X) m of the study site boundary | | | | | |
|--|---|------|--------|---------|----------|-----------|
| | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1000-1500 |
| 1. Environmental Permits, Incidents and Registers | | | | | | |
| 1.1 Industrial Sites Holding Environmental Permits and/or Authorisations | | | | | | |
| Records of historic IPC Authorisations | 0 | 0 | 0 | 0 | - | - |
| Records of Part A(1) and IPPC Authorised Activities | 0 | 0 | 0 | 0 | - | - |
| Records of Water Industry Referrals (potentially harmful discharges to the public sewer) | 0 | 0 | 0 | 0 | - | - |
| Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) | 0 | 0 | 0 | 0 | - | - |
| Records of List 1 Dangerous Substances Inventory sites | 0 | 0 | 0 | 0 | - | - |
| Records of List 2 Dangerous Substances Inventory sites | 0 | 0 | 0 | 0 | - | - |
| Records of Part A(2) and Part B Activities and Enforcements | 0 | 0 | 1 | 0 | - | - |
| Records of Category 3 or 4 Radioactive Substances Authorisations | 0 | 0 | 0 | 0 | - | - |
| Records of Licensed Discharge Consents | 0 | 0 | 1 | 0 | - | - |
| Records of Planning Hazardous Substance Consents and Enforcements | 0 | 0 | 0 | 0 | | |
| 1.2 Records of COMAH and NIHHS sites | 0 | 0 | 0 | 0 | - | - |
| 1.3 Environment Agency Recorded Pollution Incidents | | | | | | |
| National Incidents Recording System, List 2 | 0 | 0 | 0 | - | - | - |
| National Incidents Recording System, List 1 | 0 | 0 | 0 | - | - | - |
| 1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990 | 0 | 0 | 0 | 0 | - | - |
| 2. Landfill and Other Waste Sites | | | | | | |
| 2.1 Landfill Sites | | | | | | |
| Environment Agency Registered Landfill Sites | 0 | 0 | 0 | 0 | 0 | - |
| Landfill Data – Operational Landfill Sites | 0 | 0 | 0 | 0 | 0 | - |
| Environment Agency Historic Landfill Sites | 0 | 0 | 0 | 0 | 0 | 1 |
| Landfill Data – Non-Operational Landfill Sites | 0 | 0 | 0 | 0 | 0 | - |
| BGS/DoE Landfill Site Survey | 0 | 0 | 0 | 0 | 0 | 0 |
| GroundSure Local Authority Landfill Sites Data | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.2 Landfill and Other Waste Sites Findings | | | | | | |
| Operational Waste Treatment, Transfer and Disposal Sites | 0 | 0 | 0 | 0 | - | - |
| Non-Operational Waste Treatment, Transfer and Disposal Sites | 0 | 0 | 0 | 0 | - | - |
| Environment Agency Licensed Waste Sites | 0 | 0 | 0 | 0 | 0 | 0 |

| 3. Current Land Uses | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1000-1500 |
|---|---------|------|--------|---------|----------|-----------|
| 3.1 Current Industrial Sites Data | 1 | 2 | 27 | - | - | - |
| 3.2 Records of Petrol and Fuel Sites | 0 | 0 | 1 | 0 | - | - |
| 3.3 Underground High Pressure Oil and Gas Pipelines | 0 | 0 | 0 | 0 | - | - |

| 4. Geology | Description |
|--|-------------|
| 4.1 Are there any records of Artificial Ground and Made Ground present beneath the study site? * | No |
| 4.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site? * | Yes |
| 4.3 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section. Source: Scale: 1:50,000 BGS Sheet 239 | |

* This includes an automatically generated 50m buffer zone around the site.

| 5. Hydrogeology and Hydrology | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1001-2000 | | | | | | | | | | | | | | |
|--|--|------|--------|---------|----------|-----------|--|---------|------|--------|---------|----------|-----------|--|----|----|----|----|----|----|
| 5.1 Are there any records of Productive Strata in the Superficial Geology within 500m of the study site? | | | | Yes | | | | | | | | | | | | | | | | |
| 5.2 Are there any records of Productive Strata in the Bedrock Geology within 500m of the study site? | | | | Yes | | | | | | | | | | | | | | | | |
| 5.3 Groundwater Abstraction Licences (within 1000m of the study site). | 0 | 0 | 0 | 0 | 0 | - | | | | | | | | | | | | | | |
| 5.4 Surface Water Abstraction Licences (within 1000m of the study site). | 0 | 0 | 0 | 0 | 0 | - | | | | | | | | | | | | | | |
| 5.5 Potable Water Abstraction Licences (within 2000m of the study site). | 0 | 0 | 0 | 0 | 0 | 2 | | | | | | | | | | | | | | |
| 5.6 Are there any Source Protection Zones within 500m of the study site? | | | | | Yes | | | | | | | | | | | | | | | |
| 5.7 River Quality | <table border="1"> <thead> <tr> <th></th> <th>on-site</th> <th>0-50</th> <th>51-250</th> <th>251-500</th> <th>501-1000</th> <th>1001-1500</th> </tr> </thead> <tbody> <tr> <td>Is there any Environment Agency information on river quality within 1500m of the study site?</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> <td>No</td> </tr> </tbody> </table> | | | | | | | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1001-1500 | Is there any Environment Agency information on river quality within 1500m of the study site? | No | No | No | No | No | No |
| | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1001-1500 | | | | | | | | | | | | | | |
| Is there any Environment Agency information on river quality within 1500m of the study site? | No | No | No | No | No | No | | | | | | | | | | | | | | |
| 5.8 Detailed River Network entries within 500m of the site | 1 | 0 | 0 | 1 | - | - | | | | | | | | | | | | | | |
| 5.9 Surface water features within 250m of the study site | No | No | Yes | - | - | - | | | | | | | | | | | | | | |

| 6. Flooding | Description |
|---|-----------------|
| 6.1 Are there any Environment Agency indicative Zone 2 floodplains within 250m of the study site? | No |
| 6.2 Are there any Environment Agency indicative Zone 3 floodplains within 250m of the study site? | No |
| 6.3 Are there any Flood Defences within 250m of the study site? | No |
| 6.4 Are there any areas benefiting from Flood Defences within 250m of the study site? | No |
| 6.5 Are there any areas used for Flood Storage within 250m of the study site? | No |
| 6.6 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site? | Not Applicable |
| 6.7 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas? | Moderately High |

| 7. Designated Environmentally Sensitive Sites | on-site | 0-50 | 51-250 | 251-500 | 501-1000 | 1001-1500 |
|--|---------|------|--------|---------|----------|-----------|
| 7.1 Records of Sites of Special Scientific Interest (SSSI) | 0 | 0 | 0 | 0 | - | - |
| 7.2 Records of National Nature Reserves (NNR) | 0 | 0 | 0 | 0 | - | - |
| 7.3 Records of Local Nature Reserves (LNR) | 0 | 0 | 0 | 0 | - | - |
| 7.4 Records of Special Areas of Conservation (SAC) | 0 | 0 | 0 | 0 | - | - |
| 7.5 Records of Special Protection Areas (SPA) | 0 | 0 | 0 | 0 | - | - |
| 7.6 Records of Ramsar sites | 0 | 0 | 0 | 0 | - | - |
| 7.7 Records of World Heritage Sites | 0 | 0 | 0 | 0 | - | - |
| 7.8 Records of Environmentally Sensitive Areas | 0 | 0 | 0 | 0 | - | - |
| 7.9 Records of Areas of Outstanding Natural Beauty (AONB) | 0 | 0 | 0 | 0 | - | - |
| 7.10 Records of National Parks | 0 | 0 | 0 | 0 | - | - |
| 7.11 Records of Nitrate Sensitive Areas | 0 | 0 | 0 | 0 | - | - |
| 7.12 Records of Nitrate Vulnerable Zones | 1 | 0 | 0 | 0 | - | - |

8. Natural Hazards

8.1 What is the maximum risk of natural ground subsidence? Moderate

9. Mining

9.1 Are there any coal mining areas within 75m of the study site? No

9.2 What is the risk of subsidence relating to shallow mining within 150m of the study site? Low

9.3 Are there any brine affected areas within 75m of the study site? No

Using this Report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client. The document contains the following sections:

1. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

2. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

3. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure underground oil and gas pipelines.

4. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

5. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

6. Flooding

Provides information on surface water flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

7. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites. These searches are conducted using radii of up to 500m.

8. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence.

9. Mining

Provides information on areas of coal and shallow mining.

10. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, GroundSure provide a free Technical Helpline (08444 159000) for further information and guidance.

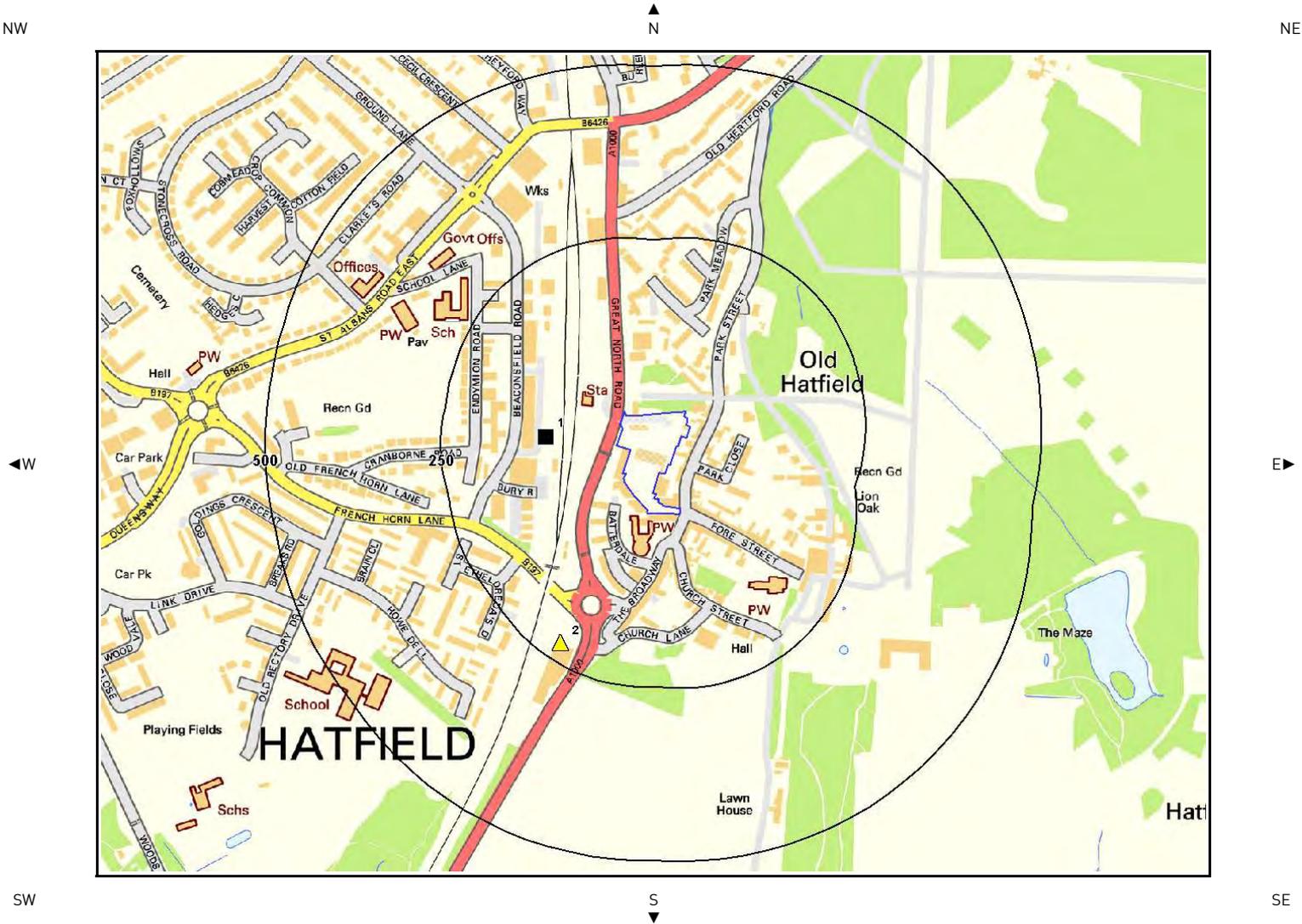
Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier "A" on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as "Not Shown".

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Environmental Permits, Incidents and Registers Map



Authorisations, Incidents and Registers Legend

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- | | | | | | |
|--|-------------------------------|--|---------------------------------------|--|--|
| | Site Outline | | Recorded Pollution Incident | | RAS 3 & 4 Authorisations |
| | Dangerous Substances (List 1) | | Dangerous Substances (List 2) | | Part A(1) Authorised Processes and Historic IPC Authorisations |
| | Dangerous Substances (List 2) | | | | Part A(2) and Part B Authorised Processes |
| | Water Industry Referrals | | Licenced Discharge Consents | | COMAH / NIHS Sites |
| | Red List Discharge Consents | | Sites Determined as Contaminated Land | | Hazardous Substance Consents and Enforcements |

1.Environmental Permits, Incidents and Registers

1.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency and Local Authorities reveal the following information:

Records of historic IPC Authorisations within 500m of the study site: 0

Database searched and no data found.

Records of Part A(1) and IPPC Authorised Activities within 500m of the study site: 0

Database searched and no data found.

Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site: 0

Database searched and no data found.

Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site: 0

Database searched and no data found.

Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site: 0

Database searched and no data found.

Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site: 0

Database searched and no data found.

Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site: 1

The following Part A(2) and Part B Activities are represented as points on the Authorisations, Incidents and Registers map:

| ID | Distance | Direction | NGR | Details |
|----|----------|-----------|----------------|---|
| 2 | 226.0 | SW | 523200, 208400 | Address: Diamond Rover Process: Petrol Vapour Recovery Process Status: Unknown Permit Type: Part B Enforcement: Data requested, not received. Date of Enforcement: Data requested, not received. Comment: Data requested, not received. |

Records of Category 3 or 4 Radioactive Substance Licences within 500m of the study site: 0

Database searched and no data found.

Records of Licensed Discharge Consents within 500m of the study site: 1

The following Licensed Discharge Consents records are represented as points on the Authorisations, Incidents and Registers map:

| ID | Distance | Direction | NGR | Details |
|----|----------|-----------|-------------------|--|
| 1 | 102.0 | W | 523180, 208700 | Address: Hatfield Railway Club, Nr Hatfield, Hatfield Railway Club, Nr Hatfi, Eld Railway Station, Hatfield, H, Erts Effluent Type: Sewage Discharges - Final/treated Effluent - Not Water Company Permit Number: CNTW.0652 Permit Version: 1 Receiving Water: Glacial Deposits Over Chalk Status: Lapsed Under Schedule 23 Environment Act 1995 Issue date: 9/8/1990 Effective Date: 9/8/1990 Revocation Date: 1/10/1996 |

Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site: 0

Database searched and no data found.

1.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: 0

Database searched and no data found.

1.3 Environment Agency Recorded Pollution Incidents

Records of National Incidents Recording System, List 2 within 250m of the study site: 0

Database searched and no data found.

Records of National Incidents Recording System, List 1 within 250m of the study site: 0

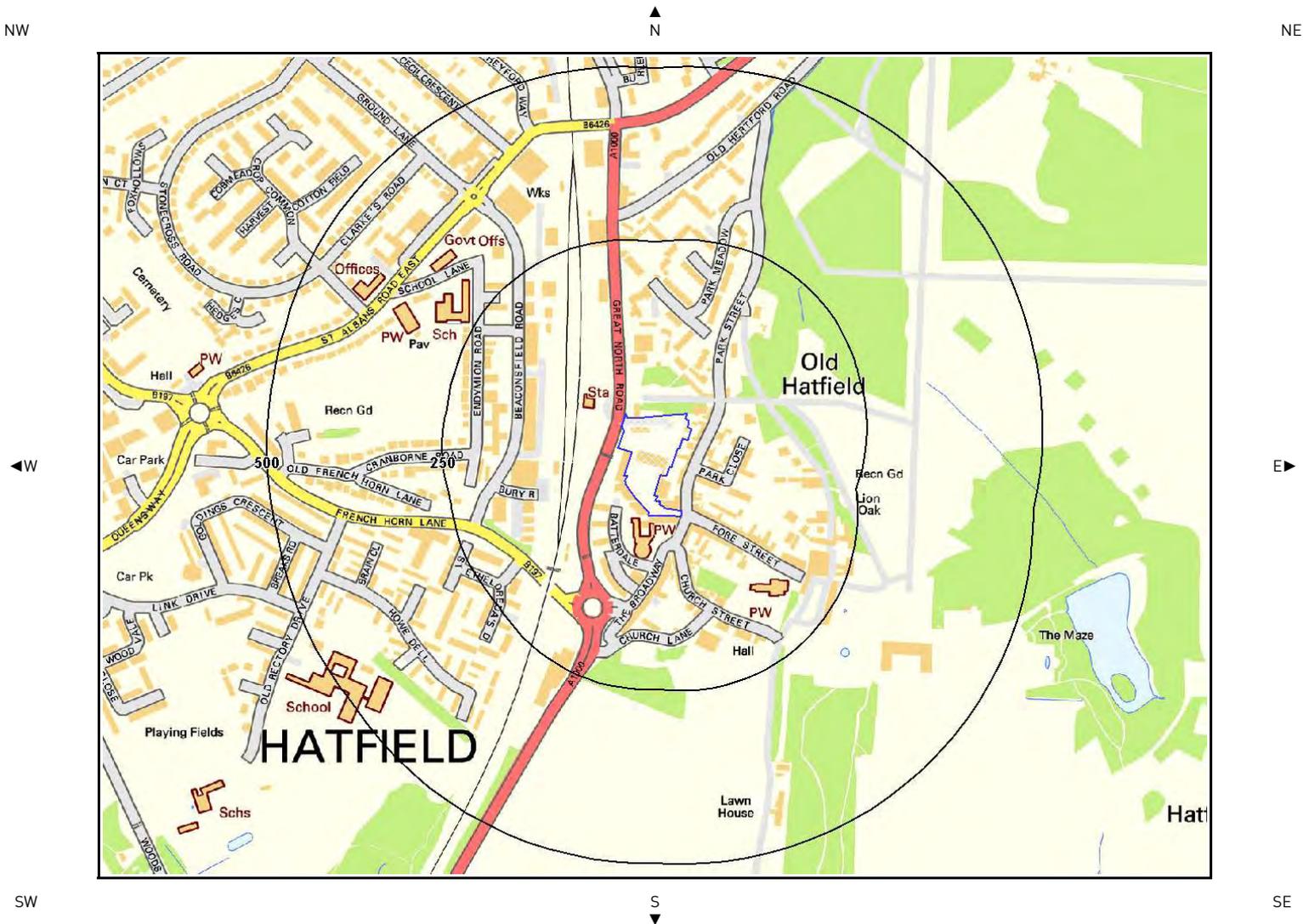
Database searched and no data found.

1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? 0

Database searched and no data found.

2. Landfill and Other Waste Sites Map



Landfill & Other Waste Sites Legend

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- | | | |
|----------------------------------|---------------------------------------|-------------------------------------|
| Site Outline | E.A. Active Landfill | Operational Waste Treatment Licence |
| Search Buffers (m) 250 500 | E.A. Historic Landfill (Area Data) | Closed Waste Treatment Licence |
| | E.A. Historic Landfill (Point Data) | REGIS Waste Licence |
| | BGS / DoE Survey Landfill | Operational Landfill |
| | Local Authority Landfill (Area Data) | Closed Landfill |
| | Local Authority Landfill (Point Data) | |

2. Landfill and Other Waste Sites

2.1 Landfill Sites

Records from Environment Agency landfill data within 1000m of the study site: 0

Database searched and no data found.

Records of operational landfill sites sourced from Landmark within 1000m of the study site: 0

Database searched and no data found.

Records of Environment Agency historic landfill sites within 1500m of the study site: 1

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

| ID | Distance | Direction | NGR | Details |
|-----------|----------|-----------|----------------|---|
| Not shown | 1446.0 | NE | 524700, 209400 | Site Address: The Broadwater, Hatfield Park, Hatfield, Hertfordshire Waste Licence: Yes Site Reference: 86/207 Waste Type: Inert, Regis Reference: - Licence Issue: 08-Aug-1986 Licence Surrendered: 31/01/1989 Licence Hold Address: - Operator: - |

Records of non-operational landfill sites sourced from Landmark within 1000m of the study site: 0

Database searched and no data found.

Records of BGS/DoE non-operational landfill sites within 1500m of the study site: 0

Database searched and no data found.

Records of Local Authority landfill sites within 1500m of the study site: 0

Database searched and no data found.

2.2 Other Waste Sites

Records of operational waste treatment, transfer or disposal sites within 500m of the study site: 0

Database searched and no data found.

Records of non-operational waste treatment, transfer or disposal sites within 500m of the study site: 0

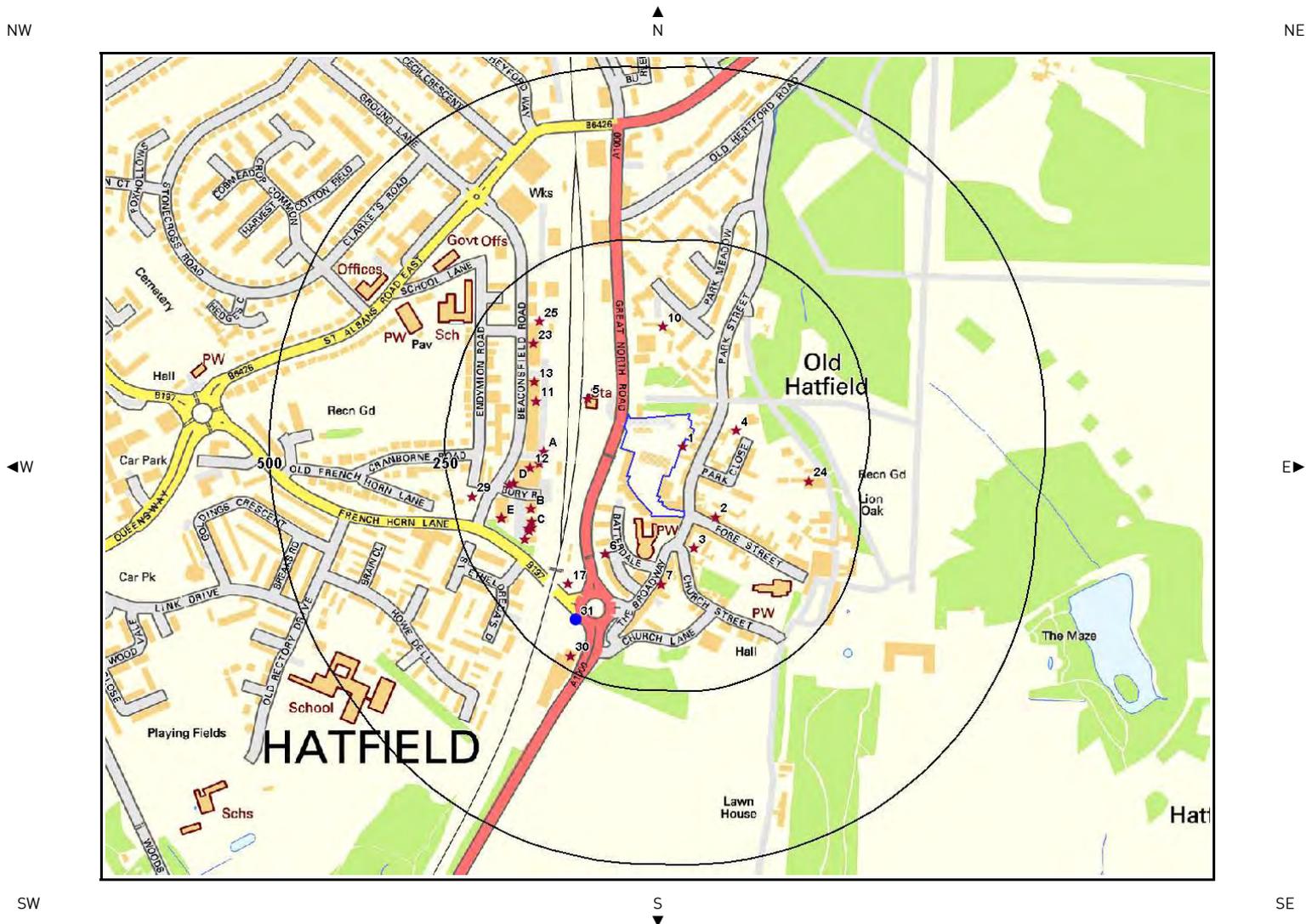
Database searched and no data found.

Records of Environment Agency licensed waste sites within 1500m of the study site: 0

Report Reference: EMS-118389_155664

Database searched and no data found.

3. Current Land Use Map



Current Land Use Legend



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-  Site Outline
-  Current Industrial Sites
-  Petrol & Fuel Sites
-  Underground High Pressure Oil & Fuel Pipelines
-  Search Buffers (m)

3. Current Land Uses

3.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site:

30

The following records are represented as points on the Current Land Uses map.

| ID | Distance | Direction | Company | Address | Activity | Category |
|------|----------|-----------|-------------------------------|--|--|-------------------------------|
| 1 | 0.0 | On Site | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 2 | 44.0 | E | Peta Shaw | 38, Fore Street, Hatfield, AL9 5AH | Clothing | Clothing And Accessories |
| 3 | 46.0 | S | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 4 | 60.0 | E | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 5 | 62.0 | W | Hatfield Station | - | Railway Stations, Junctions and Halts | Transport Access Points |
| 6 | 86.0 | SW | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 7 | 97.0 | S | Heraeus Metal Processing Ltd | Bishops Court 17a, The Broadway, Hatfield, AL9 5HZ | Metals Manufacturers, Fabricators and Stockholders | Industrial Products |
| 8A | 110.0 | W | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 9A | 119.0 | W | R E Enfield Ltd | 4, Beaconsfield Road, Hatfield, AL10 8BE | Precision Engineers | Engineering Services |
| 10 | 129.0 | N | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 11 | 132.0 | W | Aliva Ltd | 26-28, Beaconsfield Road, Hatfield, AL10 8XD | Concrete Products | Industrial Products |
| 12 | 132.0 | W | Works | - | Unspecified Works Or Factories | Industrial Features |
| 13 | 142.0 | W | Otodynamics Ltd | 36-38, Beaconsfield Road, Hatfield, AL10 8BB | Medical Equipment, Supplies and Pharmaceuticals | Industrial Products |
| 14 B | 144.0 | W | Fairway Tyres & Auto Services | 4, Bury Road, Hatfield, AL10 8BJ | Vehicle Repair and Servicing | Repair And Servicing |
| 15 B | 148.0 | W | Kirby Ltd | 7-9, Bury Road, Hatfield, AL10 8BJ | Electrical Contractors | Construction Services |
| 16 C | 151.0 | SW | Cavalry Creative Services | 11, Bury Road, Hatfield, AL10 8BJ | Published Goods | Industrial Products |
| 17 | 154.0 | SW | Gas Governor | - | Gas Features | Infrastructure And Facilities |
| 18 C | 156.0 | SW | The Herts Meter Co Ltd | 10, Bury Road, Hatfield, AL10 8BJ | Measurement and Inspection Equipment | Industrial Products |
| 19 C | 157.0 | SW | All in One Supplies | 12, Bury Road, Hatfield, AL10 8BJ | Construction Completion Services | Construction Services |
| 20 D | 161.0 | W | Design Rationale Ltd | 4, Bury Road, Hatfield, AL10 8BJ | Metalworkers Including Blacksmiths | Construction Services |
| 21 C | 167.0 | SW | Power Units Hatfield | 16, Bury Road, Hatfield, AL10 8BJ | Vehicle Repair and Servicing | Repair And Servicing |
| 22 D | 168.0 | W | Gas Governor | - | Gas Features | Infrastructure And Facilities |
| 23 | 169.0 | NW | Factory | - | Unspecified Works Or Factories | Industrial Features |
| 24 | 178.0 | E | Jumbo Games Ltd | 2 Carters Row, Hatfield Park, Hatfield, AL9 5NB | Hobby, Sports and Pastime Products | Consumer Products |
| 25 | 184.0 | NW | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 26E | 187.0 | W | Signs & Design | Westward House, Bury Road, Hatfield, AL10 8BJ | Signs | Industrial Products |

| | | | | | | |
|-----|-------|----|-------------------------|---|----------------------------------|-------------------------------|
| 27E | 187.0 | W | Recovery World | 2, Bury Road, Hatfield, Hertfordshire, AL10 8BJ | Unspecified Manufacturing | Industrial Products |
| 28E | 187.0 | W | K & I Services Ltd | 2, Bury Road, Hatfield, Hertfordshire, AL10 8BJ | Construction Completion Services | Construction Services |
| 29 | 223.0 | W | Electricity Sub Station | - | Electrical Features | Infrastructure And Facilities |
| 30 | 232.0 | SW | Citroen Hatfield | 1, Great North Road, Hatfield, AL9 5JA | New Vehicles | Motoring |

3.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site:

1

The following petrol or fuel site records provided by Catalist are represented as points on the Current Land Use map:

| ID | Distance | Direction | NGR | Company | Address | LPG | Status |
|----|----------|-----------|----------------|----------|---|----------------|----------|
| 31 | 183.0 | SW | 523217, 208440 | Obsolete | Diamond Rover Filling Station, 1, Great North Road, Great North Road Hatfield, Hertfordshire, AL9 6LB | Not Applicable | Obsolete |

3.3 Underground High Pressure Oil and Gas Pipelines

Records of high pressure underground pipelines within 500m of the study site:

0

Database searched and no data found.

4. Geology

4.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

4.2 Superficial Ground and Drift Geology

The database has been searched on site, including a 50m buffer.

| Lex Code | Description | Rock Type |
|-----------|-----------------------------|-----------------|
| KGCA-SAGR | KESGRAVE CATCHMENT SUBGROUP | SAND AND GRAVEL |

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

4.3 Bedrock and Solid Geology

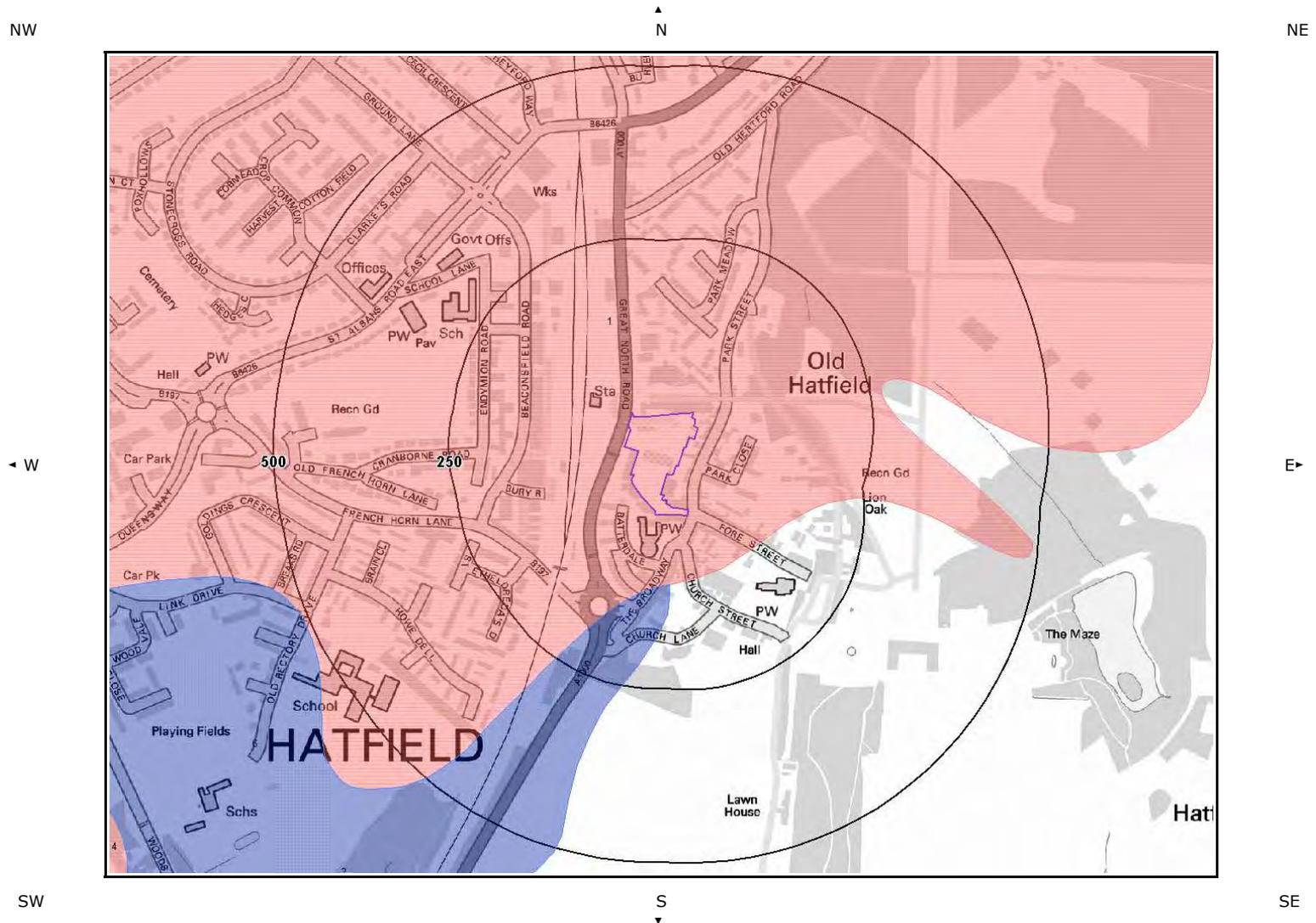
The database has been searched on site, including a 50m buffer.

| LEX Code | Description | Rock Type |
|-----------|--|-----------|
| LESE-CHLK | LEWES NODULAR CHALK FORMATION AND SEAFORD CHALK FORMATION (UNDIFFERENTIATED) | CHALK |

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

For more detailed geological and ground stability data please refer to the "GroundSure GeoInsight". Available from our website.

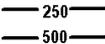
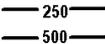
5a. Hydrogeology - Aquifer Within Superficial Geology



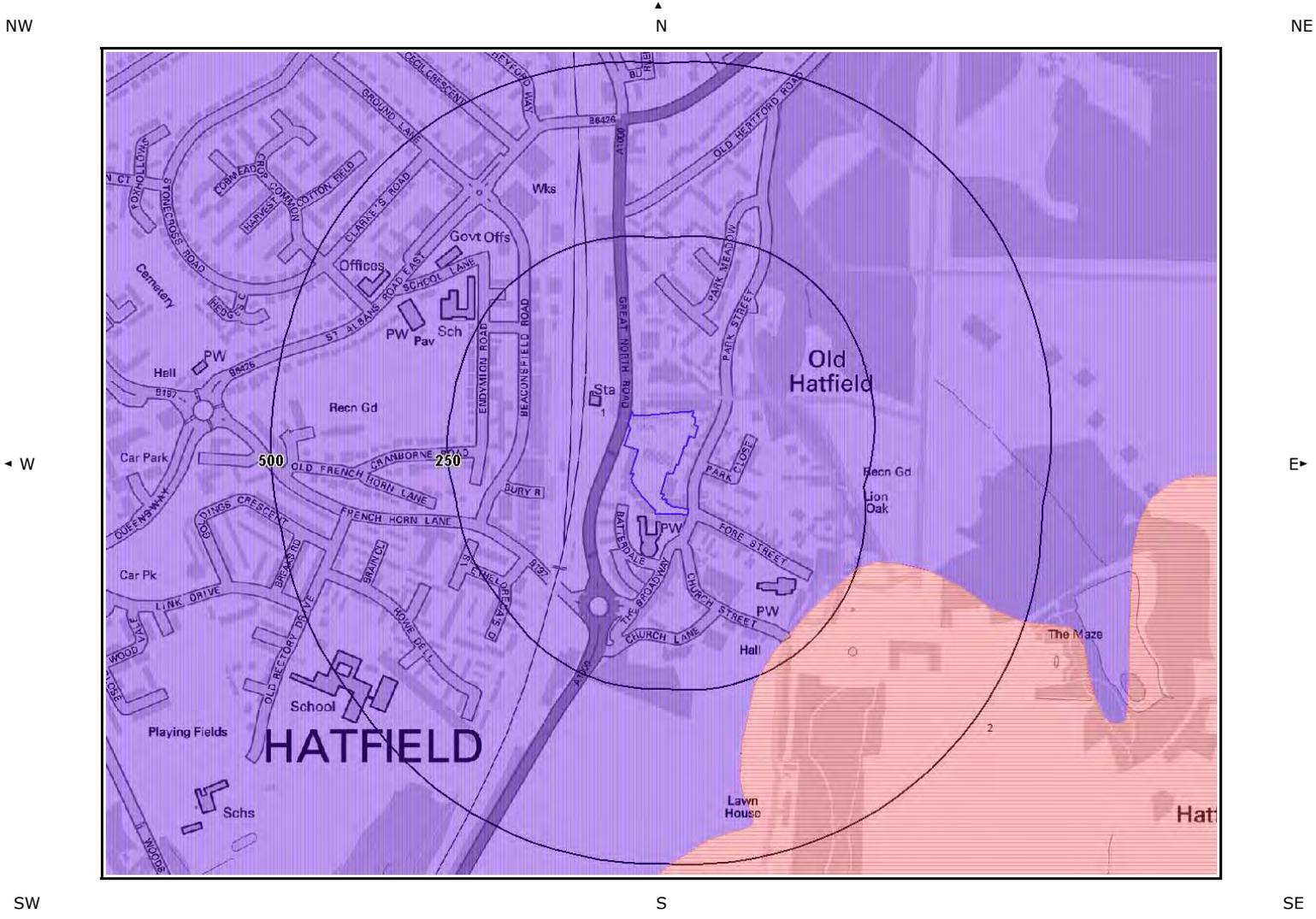
Aquifer Within Superficial Geology Legend



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| | | | | | |
|---|--------------------|---|---|--|---|
|  | Site Outline |  | Principal Aquifer |  | Secondary Aquifer - Undifferentiated Layers |
|  | Search Buffers (m) |  | Secondary (A) Aquifer - Permeable Layers |  | Unproductive |
|  | |  | Secondary (B) Aquifer - Lower Permeability Layers |  | Unknown (lakes and landslip) |

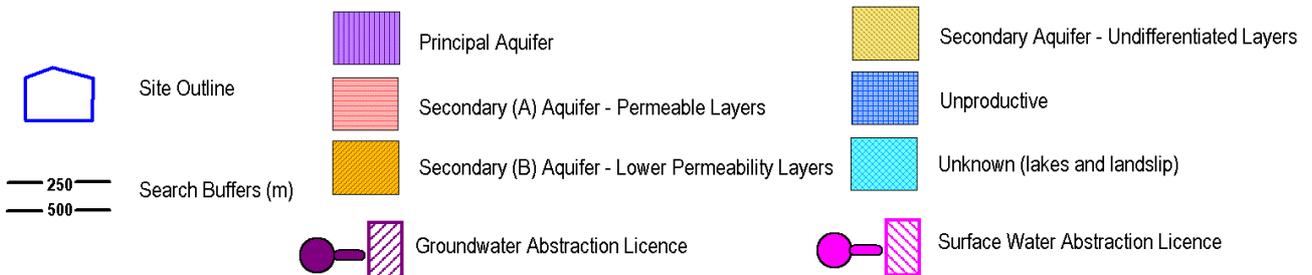
5b. Hydrogeology - Aquifer Within Bedrock Geology and Abstraction Licenses



Aquifer Within Bedrock Geology Legend



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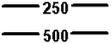
5c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses



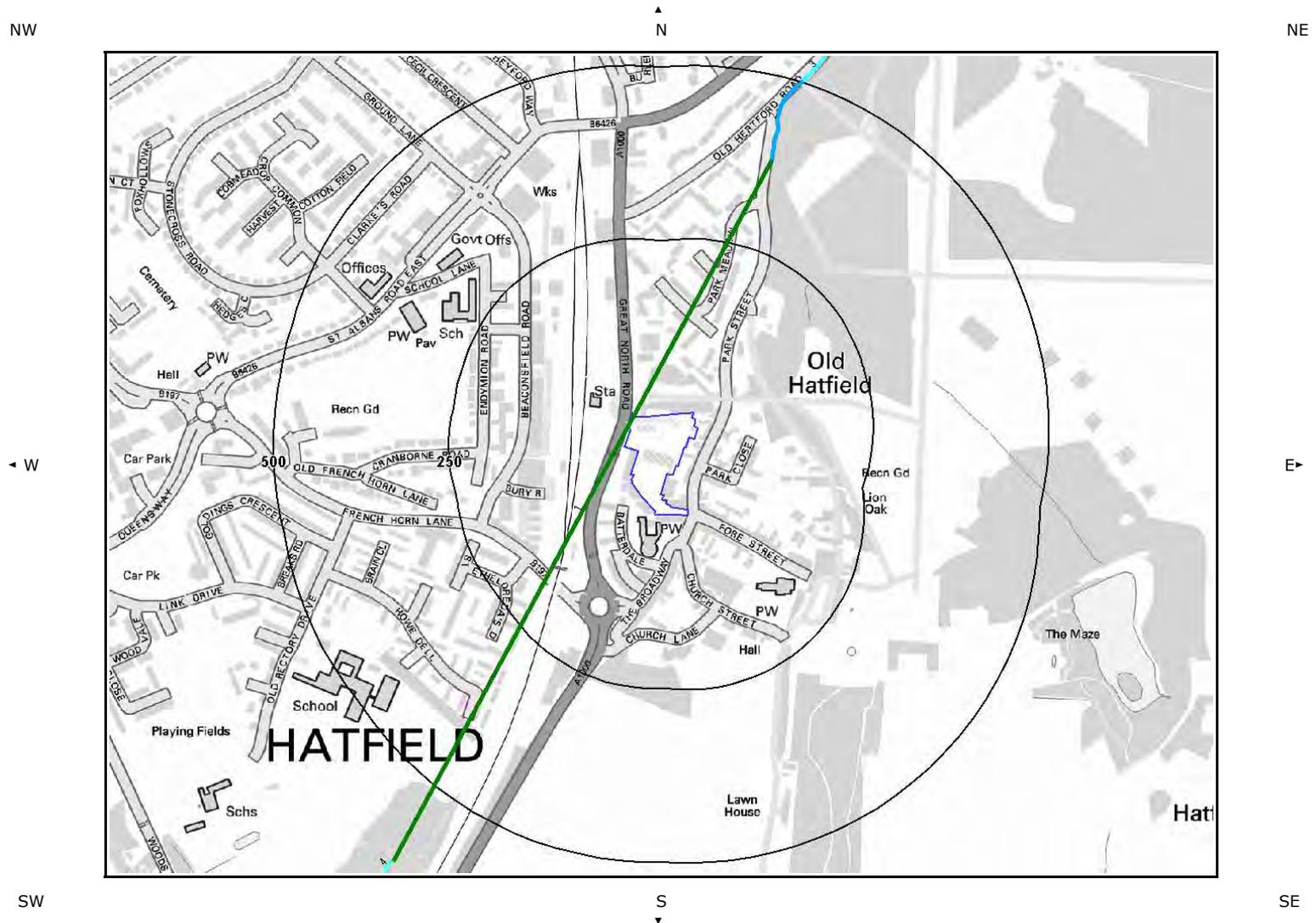
SPZ and Potable Water Abstraction Licenses Legend



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-  Site Outline
-  Source Protection Zone 1 - Inner Catchment
-  Source Protection Zone 2 - Outer Catchment
-  Source Protection Zone 3 - Total Catchment
-  Source Protection Zone 4 - Zone of Special Interest
-  Potable Water Abstraction Licence
-  Search Buffers (m)

5d. Hydrology – Detailed River Network and River Quality



Hydrology Legend

-  Primary River
-  Secondary River
-  Tertiary River
-  Lake/Reservoir
-  Underground River (inferred)
-  General Quality Assessment: Chemistry
-  Canal
-  Canal Tunnel
-  Extended Culvert (greater than 50m)
-  D/S of High Water Mark
-  D/S seaward extension
-  General Quality Assessment: Biology

Enabled by 

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5. Hydrogeology and Hydrology

5.1 Aquifer within Superficial Deposits

Are there records of productive strata within the superficial geology at or in proximity to the property? **Yes**

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (5a):

| ID | Distance [m] | Direction | Designation | Description |
|----|--------------|-----------|--------------|--|
| 1 | 0.0 | On Site | Secondary A | Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers |
| 6 | 101.0 | S | Unproductive | These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow |

5.2 Aquifer within Bedrock Deposits

Are there records of productive strata within the bedrock geology at or in proximity to the property? **Yes**

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (5b):

| ID | Distance [m] | Direction | Designation | Description |
|----|--------------|-----------|-------------|--|
| 1 | 0.0 | On Site | Principal | Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers |
| 2 | 219.0 | SE | Secondary A | Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers |

5.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 1000m of the study site? **No**

Database searched and no data found.

5.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 1000m of the study site? **No**

Database searched and no data found.

5.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site?

Yes

The following Potable Water Abstraction Licences records are represented as points, lines and regions on the SPZ and Potable Water Abstraction Licences Map (5c):

| ID | Distance | Direction | NGR | Details | |
|-----------|----------|-----------|----------------|--|--|
| Not shown | 1568.0 | SW | 522012, 207729 | Licence No: 29/38/01/0061 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Roe Green, Bishop's Rise - Borehole A Data Type: Point | Annual Volume (m ³): 3318649 Max Daily Volume (m ³): 9092.19 Original Application No: NPS/WR/002205 Original Start Date: 20/9/1966 Expiry Date: - Issue No: 101 Version Start Date: Version End Date: |
| Not shown | 1594.0 | SW | 522000, 207700 | Licence No: 29/38/01/0061 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Roe Green - Bishop's Rise Data Type: Point | Annual Volume (m ³): 3318649 Max Daily Volume (m ³): 9092.19 Original Application No: NPS/WR/002205 Original Start Date: 20/9/1966 Expiry Date: - Issue No: 101 Version Start Date: Version End Date: |

5.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site?

Yes

The following Source Protection Zones records are represented on the SPZ and Potable Water Abstraction Map (5c):

| ID | Distance | Direction | Type | Description |
|----|----------|-----------|------|-----------------|
| 1 | 0.0 | On Site | 3 | Total Catchment |

5.7 River Quality

Is there any Environment Agency information on river quality within 1500m of the study site?

No

Biological Quality:

Database searched and no data found.

Chemical Quality:

Database searched and no data found.

5.8 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site?

Yes

The following Detailed River Network records are represented on the Hydrology Map (5d):

| ID | Distance | Direction | Details | |
|----|----------|-----------|---|--|
| 1 | 0.0 | On Site | River Name: - Water Course Name: - Welsh River Name: - Alternative Name: - | River Type: Extended Culvert (greater than 50m) Catchment: - Drain: NO Main River Status: Currently Undefined |
| 2 | 381.0 | N | River Name: - Water Course Name: - Welsh River Name: - Alternative Name: - | River Type: Secondary River Catchment: - Drain: NO Main River Status: Currently Undefined |

5.9 Surface Water Features

Are there any surface water features within 250m of the study site?

Yes

The following surface water records are not represented on mapping:

| Distance to Surface Water (m) | on-site | 0-50 | 51-250 |
|--|---------|------|--------|
| Surface water features within 250m of the study site | No | No | Yes |

6. Flooding

6.1 Zone 2 Flooding

Zone 2 floodplain estimates the annual probability of flooding as one in one thousand (0.1%) or greater from rivers and the sea but less than 1% from rivers or 0.5% from the sea. Alternatively, where information is available they may show the highest known flood level.

Is the site within 250m of an Environment Agency indicative Zone 2 floodplain? **No**

Database searched and no data found.

6.2 Zone 3 Flooding

Zone 3 estimates the annual probability of flooding as one in one hundred (1%) or greater from rivers and a one in two hundred (0.5%) or greater from the sea. Alternatively, where information is available they may show the highest known flood level.

Is the site within 250m of an Environment Agency indicative Zone 3 floodplain? **No**

Database searched and no data found.

6.3 Flood Defences

Are there any Flood Defences within 250m of the study site? **No**

6.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? **No**

6.5 Areas used for Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? **No**

6.6 Groundwater Flooding Susceptibility Areas

Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site? **Yes**

What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions? **Not Applicable**

6.7 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result?

Moderately High

Notes:

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The **confidence rating** is on a fivefold scale - Low, Moderately Low, Moderate, Moderately High and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

7. Designated Environmentally Sensitive Sites Map

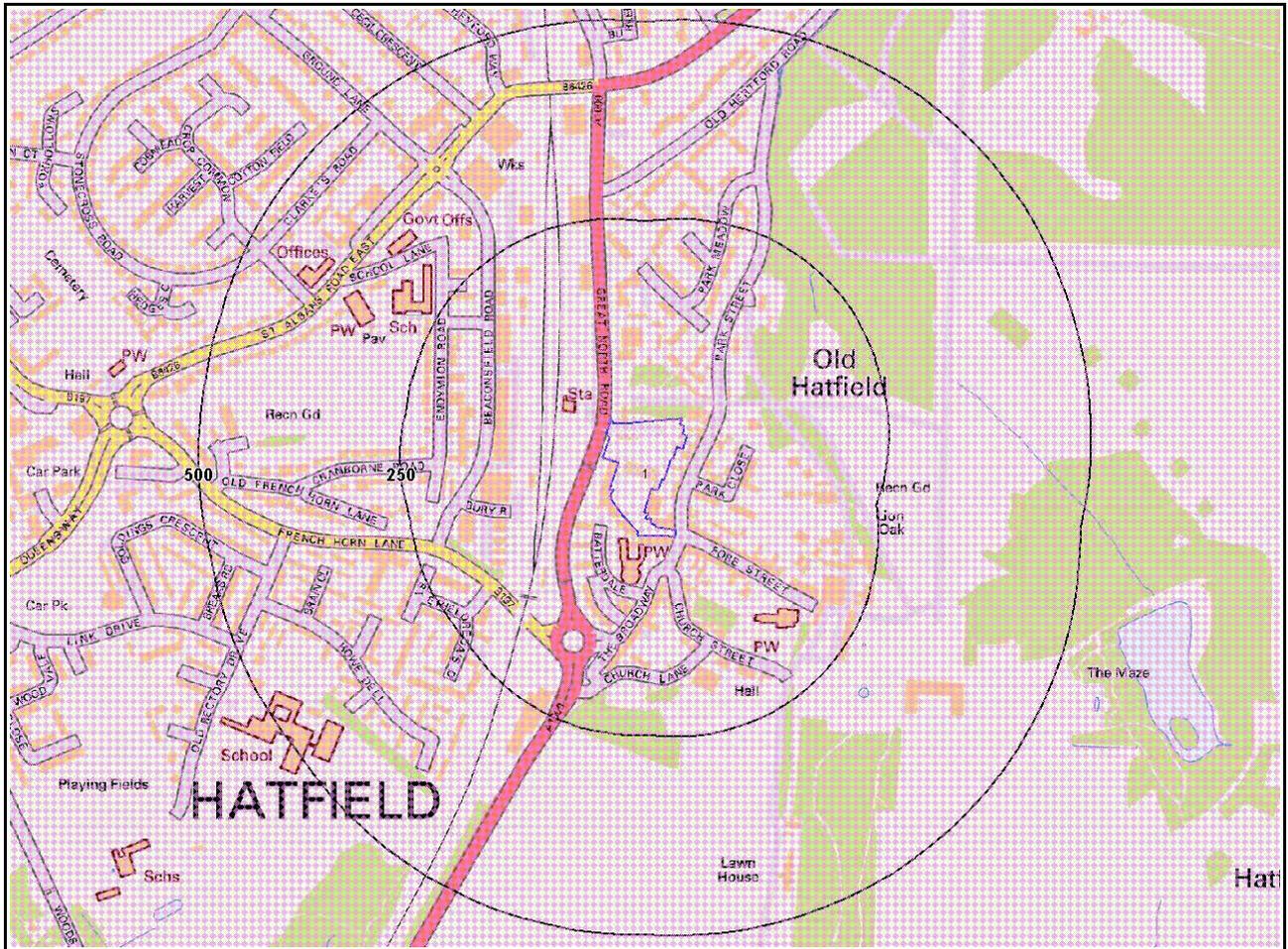
NW



NE

W

E



SW



SE

Designated Environmentally Sensitive Sites Legend



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-  Site Outline
-  SAC
-  SSSI
-  NNR
-  World Heritage Sites
-  250 Search Buffers (m)
-  500 Search Buffers (m)
-  SPA
-  Ramsar
-  LNR
-  Environmentally Sensitive Areas
-  Areas of Outstanding Natural Beauty
-  Nitrate Sensitive Areas
-  National Parks

7. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 500m of the study site? **Yes**

Records of Sites of Special Scientific Interest (SSSI) within 500m of the study site: **0**

Database searched and no data found.

Records of National Nature Reserves (NNR) within 500m of the study site: **0**

Database searched and no data found.

Records of Special Areas of Conservation (SAC) within 500m of the study site: **0**

Database searched and no data found.

Records of Special Protection Areas (SPA) within 500m of the study site: **0**

Database searched and no data found.

Records of Ramsar sites within 500m of the study site: **0**

Database searched and no data found.

Records of Local Nature Reserves (LNR) within 500m of the study site: **0**

Database searched and no data found.

Records of World Heritage Sites within 500m of the study site: **0**

Database searched and no data found.

Records of Environmentally Sensitive Areas within 500m of the study site: **0**

Database searched and no data found.

Records of Areas of Outstanding Natural Beauty (AONB) within 500m of the study site: **0**

Database searched and no data found.

Records of National Parks (NP) within 500m of the study site: **0**

Database searched and no data found.

Records of Nitrate Sensitive Areas within 500m of the study site: 0

Database searched and no data found.

Records of Nitrate Vulnerable Zones within 500m of the study site: 1

The following Nitrate Vulnerable Zone records produced by DEFRA are not represented as polygons on the Designated Environmentally Sensitive Sites Map:

| ID | Distance | Direction | NVZ Name | Data Source |
|----|----------|-----------|------------------------|-------------|
| 1 | 0.0 | On Site | No place name provided | DEFRA |

8. Natural Hazards Findings

8.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a GroundSure GeoInsight, available from our website. The following information has been found:

8.1.1 Shrink Swell

What is the maximum Shrink-Swell* hazard rating identified on the study site? Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

| Hazard |
|--|
| Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays. |

8.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

| Hazard |
|---|
| Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides. |

8.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site? Moderate

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

| Hazard |
|---|
| Very significant soluble rocks are present, with a moderate possibility of local natural subsidence due to high surface or subsurface water flow. Do not load the land or undertake building work before obtaining specialist advice. Do not dispose of drainage to the ground. Some possibility groundwater pollution. Maintain drainage infrastructure. For new build specialist site investigation and stability assessment may be necessary before construction. Construction work may cause subsidence. Increased construction costs are likely. For existing property probable increase in insurance risk due to soluble rocks. |

8.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site? Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

| Hazard |
|-------------------------------------|
| Report Reference: EMS-118389_155664 |

No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

8.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site? Null - Negligible

No indicators for collapsible deposits identified; No special actions required to avoid problems due to collapsible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with collapsible deposits.

8.1.6 Running Sand

What is the maximum Running Sand* hazard rating identified on the study site? Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

* This indicates an automatically generated 50m buffer and site.

9. Mining

9.1 Coal Mining

Are there any coal mining areas within 75m of the study site?

No

Database searched and no data found.

9.2 Shallow Mining

What is the subsidence hazard relating to shallow mining on-site*?

Low

*Please note this data is searched with a 150m buffer.

9.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site?

No

Database searched and no data found.

10. Contacts

EmapSite

Telephone: 0118 9736883
sales@emapsite.com



British Geological Survey (England & Wales)

Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143. Fax: 0115 936 3276. Email:
enquiries@bgs.ac.uk
Web: www.bgs.ac.uk
BGS Geological Hazards Reports and general geological
enquiries



Environment Agency

National Customer Contact Centre
PO Box 544
Rotherham
S60 1BY
Tel: 08708 506 506
Web: www.environment-agency.gov.uk
Email: enquiries@environment-agency.gov.uk



Health Protection Agency

Chilton, Didcot, Oxon, OX11 0RQ
Tel: 01235 822622 www.hpa.org.uk/radiation
Radon measures and general radon information and
guidance



The Coal Authority

200 Lichfield Lane, Mansfield, Notts NG18 4RG
Tel: 0845 762 6848. DX 716176 Mansfield 5
www.coal-authority.co.uk
Coal mining reports and related enquiries



Ordnance Survey

Romsey Road
Southampton SO16 4GU
Tel: 08456 050505



Local Authority

Authority: Welwyn Hatfield District Council
Phone: 01707 357000
Web: www.welhat.gov.uk
Address: Council Offices, The Campus, Welwyn Garden City,
AL8 6AE

Get Mapping PLC

Virginia Villas, High Street, Hartley Witney, Hampshire RG27
8NW
Tel: 01252 845444



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This report has been prepared in accordance with the GroundSure Ltd standard Terms and Conditions of business for work of this nature.

Standard Terms and Conditions

1 Definitions

In these conditions unless the context otherwise requires:

"Beneficiary" means the Client or the customer of the Client for whom the Client has procured the Services.

"Commercial" means any building which is not Residential.

"Commission" means an order for Consultancy Services submitted by a Client.

"Consultancy Services" mean consultancy services provided by GroundSure including, without limitation, carrying out interpretation of third party and in-house environmental data, provision of environmental consultancy advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.

"Content" means any data, database or other information contained in a Report or Mapping which is provided to GroundSure by a Data Provider.

"Contract" means the contract between GroundSure and the Client for the performance of the Services which arises upon GroundSure's acceptance of an Order or Commission and which shall incorporate these conditions, the relevant GroundSure User Guide, proposal by GroundSure and the content of any subsequent report, and any agreed amendments in accordance with clause 11.

"Client" means the party that submits an Order or Commission.

"Data Provider" means any third party providing Content to GroundSure.

"Data Report" means reports comprising factual data with no professional interpretation in respect of the level of likely risk and/or liability available from GroundSure.

"GroundSure" means GroundSure Limited, a company registered in England and Wales under number 03421028 and whose registered office is at Greater London House, Hampstead Road, London NW1 7EJ.

"Intellectual Property" means any patent, copyright, design rights, service marks, moral rights, data protection rights, know-how, trademark or any other intellectual property rights.

"Mapping" an historical map or a combination of historical maps of various ages, time periods and scales available from GroundSure.

"Order" means an order form submitted by the Client requiring Services from GroundSure in respect of a specified Site.

"Order Website" means online platform via which Orders may be placed.

"Report" means a Risk Screening Report or Data Report for commercial or residential property available from GroundSure relating to the Site prepared in accordance with the specifications set out in the relevant User Guide.

"Residential" means any building used as or suitable for use as an individual dwelling.

"Risk Screening Report" means one of GroundSure's risk screening reports, comprising factual data with interpretation in respect of the level of likely risk and/or liability, excluding **"Consultancy Services"**.

"Services" means the provision of any Report, Mapping or Consultancy Services which GroundSure has agreed to carry out for the Client/Beneficiary on these terms and conditions in respect of the Site.

"Site" means the landsite in respect of which GroundSure provides the Services.

"User Guide" means the relevant current version of the user guide, available upon request from GroundSure.

2 Scope of Services

2.1 GroundSure agrees to carry out the Services in accordance with the Contract and to the extent set out therein.

2.2 GroundSure shall exercise all the reasonable skill, care and diligence to be expected of experienced environmental consultants in the performance of the Services.

2.3 The Client acknowledges that it has not relied on any statement or representation made by or on behalf of GroundSure which is not set out and expressly agreed in the Contract.

2.4 Terms and conditions appearing on a Client's order form, printed stationery or other communication, including invoices, to GroundSure, its employees, servants, agents or other representatives or any terms implied by custom, practice or course of dealing shall be of no effect and these terms and conditions shall prevail over all others.

2.5 In the event that a Client/Beneficiary opts to take out insurance in conjunction with or as a result of the Services, such insurance shall be subject solely to the terms of any policy issued to it in that respect and GroundSure will have no liability thereon.

2.6 GroundSure's quotations/proposals are valid for a period of 30 days only. GroundSure reserves the right to withdraw any quotation at any time before GroundSure accepts an Order or Commission. GroundSure's acceptance of an Order or Commission shall be effective only where such acceptance is in writing and signed by GroundSure's authorised representative or where accepted via GroundSure's Order Website.

3 The Client's obligations

3.1 The Client shall ensure the Beneficiary complies with and is bound by the terms and conditions set out in the Contract and shall provide that GroundSure may in its own right enforce such terms and conditions against the Beneficiary pursuant to the Contracts (Rights of Third Parties) Act 1999. The Client shall be liable for all breaches of the Contract by the Beneficiary as if they were breaches by the Client. The Client shall be solely responsible for ensuring that the Report/Mapping ordered is appropriate and suitable for the Beneficiary's needs.

3.2 The Client shall (or shall procure that the Beneficiary shall) supply to GroundSure as soon as practicable and without charge all information necessary and accurate relevant data including any specific and/or unusual environmental information relating to the Site known to the Client/Beneficiary which may pertain to the Services and shall give such assistance as GroundSure shall reasonably require in the performance of the Services (including, without limitation, access to a Site, facilities and equipment as agreed in the Contract).

3.3 Where Client/Beneficiary approval or decision is required, such approval or decision shall be given or procured in reasonable time as not to delay or disrupt the performance of any other part of the Services.

3.4 The Client shall not and shall not knowingly permit the Beneficiary to, save as expressly permitted by these terms and conditions, re-sell, alter, add to, amend or use out of context the content of any Report, Mapping or, in respect of any Services, information given by GroundSure. For the avoidance of doubt, the Client and Beneficiary may make the Report, Mapping or GroundSure's findings available to a third party who is considering acquiring the whole or part of the Site, or providing funding in relation to the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.

3.5 The Client is responsible for maintaining the confidentiality of its user name and password if using GroundSure's internet ordering service and accepts responsibility for all activity that occurs under such account and password.

4 Reliance

4.1 Upon full payment of all relevant fees and subject to the provisions of these terms and conditions, the Client and Beneficiary are granted an irrevocable royalty-free licence to access the information contained in a Report, Mapping or in a report prepared by GroundSure in respect of or arising out of Consultancy Services. The Services may only be used for the benefit of the Client and those persons listed in clauses 4.2 and 4.3.

4.2 In relation to Data Reports, Mapping and Risk Screening Reports, the Client shall be entitled to make Reports available to (i) the Beneficiary, (ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate), (iv) the first purchaser or first tenant of the Site (v) the professional advisers and lenders of the first purchaser or tenant of the Site. Accordingly GroundSure shall have the same duties and obligations to those persons in respect of the Services as it has to the Client and those persons shall have the benefit of any of the Client's rights under the Contract as if those persons were parties to the Contract. For the avoidance of doubt, the limitations of GroundSure's liability as set out in clauses 7 and 11.6 shall apply.

4.3 In relation to Consultancy Services, reliance shall be limited to the Client, Beneficiary and named parties on the Report.

4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise agreed in writing with GroundSure, any other party considering the information supplied by GroundSure as part of the Services, including (but not limited to) insurance underwriters, does so at their own risk and GroundSure has no legal obligations to such party unless otherwise agreed in writing.

4.5 The Client shall not and shall not knowingly permit any person (including the Beneficiary) who is provided with a copy of any Report, (except as permitted herein or by separate agreement with GroundSure) to: (a) remove, suppress or modify any trade mark, copyright or other proprietary marking from the Report or Mapping; (b) create any product which is derived directly or indirectly from the data contained in the Report or Mapping; (c) combine the Report or Mapping with, or incorporate the Report or Mapping into any other information data or service; or (d) re-format or otherwise change (whether by modification, addition or enhancement) data or images contained in the Report or Mapping.

4.6 Notwithstanding clause 4.5, if the Client acts in a professional capacity, it may make reasonable use of a Report and/or findings made as a result of Consultancy Services to advise Beneficiaries. However, GroundSure shall have no liability in respect of any opinion or report given to such Beneficiaries by the Client or a third party.

5 Fees and Disbursements

5.1 GroundSure shall charge the Client fees at the rate and frequency specified in the Contract together, in the case of Consultancy Services, with all proper disbursements incurred by GroundSure in performing the Services. For the avoidance of doubt, the fees payable for the Services are as set out in GroundSure's written proposal, Order Website or Order acknowledgement form. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services.

5.2 Unless GroundSure requires prepayment, the Client shall promptly pay all fees disbursements and other monies due to GroundSure in full without deduction, counterclaim or set off together with such value added tax or other tax as may be required within 30 days from the date of GroundSure's invoice or such other period as may be agreed in writing between GroundSure and the Client ("**Payment Date**"). GroundSure reserves the right to charge interest which shall accrue on a daily basis from 30 days after the date of Payment Date until the date of payment (whether before or after judgment) at the rate of five per cent per annum above the Bank of England base rate from time to time.

5.3 In the event that the Client disputes the amount payable in respect of GroundSure's invoice it shall notify GroundSure no later than 28 days after the date thereof that it is in dispute. In default of such notification the Client shall be deemed to have agreed the amount thereof. As soon as reasonably practicable following receipt of a notification in respect of any disputed invoice, a member of the management team at GroundSure shall contact the Client and the parties shall use all reasonable endeavours to resolve the dispute.

6 Intellectual Property

6.1 Subject to the provisions of clause 4.1, the Client and the Beneficiary hereby acknowledge that all Intellectual Property in the Services and Content are and shall remain owned by either GroundSure or the Data Providers and nothing in these terms purports to transfer or assign any rights to the Client or the Beneficiary in respect of the Intellectual Property.

6.2 The Client shall acknowledge the ownership of the Content where such Content is incorporated or used in the Client's own documents, reports, systems or services whether or not these are supplied to a third party.

6.3 Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.

6.4 The Client acknowledges that the proprietary rights subsisting in copyright, database rights and any other intellectual property rights in respect of any data and information contained in any Report are and shall remain (subject to clause 11.1) the property of GroundSure and/or any third party that has supplied data or information used to create a Report, and that these conditions do not purport to grant, assign or transfer any such rights in respect thereof to a Client and/or a Beneficiary.

6.5 The Client and each of the parties set out in clause 4.2 are permitted to make up to 8 (commercial) or 2 (residential) printed copies of the Report only. Further copies of the Report may not be made in whole or in part without the prior written permission of GroundSure who shall be entitled to make a charge for each additional copy.

6.6 The Client shall (and shall procure that any recipients of the Report as permitted under clause 4.2 shall):

(i) not remove, suppress or modify any trademark, copyright or other proprietary marking belonging to GroundSure or any third party from the Services;

(ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;

(iii) not create any product or report which is derived directly or indirectly from the data contained in the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);

(iv) not combine the Services with or incorporate such Services into any other information data or service; and

(v) not reformat or otherwise change (whether by modification, addition or enhancement), data contained in the Services (save that those acting in a professional capacity to the Beneficiary shall not be in breach of this clause 6.6(v) where such reformatting is in the normal course of providing advice based upon the Services), in each case of parts (iii) to (v) inclusive, whether or not such product or report is produced for commercial profit or not.

6.7 The Client and/or Beneficiary shall and shall procure that any party to whom the Services are made available shall notify GroundSure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

7. Liability

7.1 Nothing in these terms and conditions shall limit GroundSure's liability for causing death or personal injury through negligence or willful default.

7.2 Save as otherwise set out in these conditions, any information provided by one party ("**Disclosing Party**") to the other party ("**Receiving Party**") shall be treated as confidential except so far as authorised by the Disclosing Party to provide such information in whole or in part to a third party.

7.3 Nothing in these conditions shall affect the statutory rights of a consumer under the applicable consumer protection legislation from time to time.

7.4 In relation to Data Reports, Mapping and Risk Screening Reports, GroundSure's liability under the Contract shall cease upon the expiry of six years from the date when the Beneficiary became aware that it may have a claim against GroundSure in respect of the Services provided always that there shall be no liability at the expiration of twelve years from the completion of the Contract. For the avoidance of doubt, any claims in respect of which proceedings are notified to GroundSure in writing prior to the expiry of the time periods referred to in this clause shall survive the expiry of those time periods provided any such claim is actually commenced within six months of notification.

7.5 In relation to Consultancy Services GroundSure's liability under the Contract shall cease upon the expiry of six years from the date the Services were completed.

7.6 GroundSure shall not be liable to the Client or any person to whom the Client provides a copy of a Data Report, Mapping or Risk Screening Report in any circumstances whatsoever unless arising out of a breach on its part of the obligations set out in the Contract.

7.7 GroundSure shall not be liable if the Data Reports, Mapping or Risk Screening Report are used otherwise than as provided or referred to in these conditions and the relevant User Guide.

7.8 Subject to the provisions of clause 7.3, GroundSure makes no representation, warranties, express or implied, as to the accuracy, reliability, completeness, validity or fitness for purpose of any Content and shall not be liable for any omission, error or inaccuracy in relation thereto unless GroundSure should reasonably have been alerted to any omission, error or inaccuracy in the Content.

7.9 Subject to the provisions of clause 7.1 and irrespective of whether multiple parties make use of the same Services the total liability of GroundSure under or in connection with the Contract, whether in contract in tort for breach of statutory duty or otherwise shall not exceed £10 million per claim or series of connected claims,

7.10 Whilst GroundSure will use all reasonable endeavours to maintain operability of its internet ordering service it will not be liable for any loss or damages caused by a delay or loss of use of such service. The Client shall use GroundSure's internet ordering service at its own risk. GroundSure shall not be responsible for any damage to a Client or permitted assignee's computer, software, modem, telephone or other property resulting from the use of GroundSure's internet ordering service.

7.11 The Client accepts, and shall use all reasonable endeavours to procure that anyone who is provided with a copy of the Report accepts, that it has no claim or recourse to any Data Provider or to GroundSure in respect of the acts or omissions of such Data Providers including Content supplied by them.

7.12 GroundSure shall provide the Services using reasonable skill and care, however, GroundSure shall not be liable for any inaccurate statement or risk rating in a Report which resulted from a reasonable interpretation of the Content.

7.13 Subject to clause 7.1, GroundSure shall not be liable to the Client, the Beneficiary or any third party in contract, tort (including, without limitation, negligence) or for misrepresentation or breach of statutory duty or otherwise in respect of any loss of profits, goodwill, revenue or opportunity, or any indirect or consequential loss (even if such loss was reasonably foreseeable).

7.14 GroundSure undertakes for the duration of the liability periods referred to in clauses 7.4 and 7.5 to maintain professional indemnity insurance in respect of its liabilities under this Contract. GroundSure shall produce evidence of such insurance if requested by the Client. A greater level of cover may be available upon request and agreement with the Client.

8 GroundSure right to suspend or terminate

8.1 In the event that GroundSure reasonably believes that the Client or Beneficiary as applicable has not provided the information or assistance required to enable the proper performance of the Services, GroundSure shall be entitled on fourteen days written notice to suspend all further performance of the Services until such time as any such deficiency has been made good.

8.2 GroundSure may additionally terminate the Contract immediately on written notice in the event that:

(i) the Client shall fail to pay any sum due to GroundSure within 28 days of the Payment Date; or

(ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an Administration Order made against it or if a Receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or

(iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or

(iv) the Client or the Beneficiary breaches any material term of the Contract (including, but not limited to, the obligations in clause 4) incapable of remedy or if remediable, is not remedied within 14 days of notice of the breach.

9. Client's Right to Terminate and Suspend

9.1 Subject to clause 10.2, the Client may at any time after commencement of the Services by notice in writing to GroundSure require GroundSure to terminate or suspend immediately performance of all or any of the Services.

9.2 The Client waives all and any right of cancellation it may have under the Consumer Protection (Distance Selling) Regulations 2000 (as amended) in respect of the Order of a Report/Mapping. This does not affect the Beneficiary's statutory rights.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination or any suspension of the Services, GroundSure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client/Beneficiary any property of the Client/ Beneficiary in GroundSure's possession or control.

10.2 In the event of termination/suspension of the Contract under clauses 8 or 9, the Client shall pay to GroundSure all and any fees payable in respect of the performance of the Services up to the date of termination/suspension. In respect of any Consultancy Services provided, the Client shall also pay GroundSure any additional costs incurred in relation to the termination/suspension of the Contract.

11 General

11.1 The mapping contained in the Services is protected by Crown copyright and must not be used for any purpose outside the context of the Services or as specifically provided in these terms.

11.2 GroundSure reserves the right to amend these terms and conditions. No variation to these terms shall be valid unless signed by an authorised representative of GroundSure.

11.3 No failure on the part of GroundSure to exercise and no delay in exercising, any right, power or provision under these terms and conditions shall operate as a waiver thereof.

11.4 Save as expressly provided in clauses 4.2, 4.3, 6.3 and 11.5, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.

11.5 The Secretary of State for Communities and Local Government acting through Ordnance Survey may enforce breach of clause 6.1 of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.

11.6 GroundSure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:

(i) the Client or Beneficiary's failure to provide facilities, access or information;

(ii) fire, storm, flood, tempest or epidemic;

(iii) Acts of God or the public enemy;

(iv) riot, civil commotion or war;

(v) strikes, labour disputes or industrial action;

(vi) acts or regulations of any governmental or other agency;

(vii) suspension or delay of services at public registries by Data Providers; or

(viii) changes in law.

11.7 Any notice provided shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

11.8 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email and on the second working day after the day of posting if sent by first class post.

11.9 The Contract constitutes the entire contract between the parties and shall supersede all previous arrangements between the parties.

11.10 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

11.11 These terms and conditions shall be governed by and construed in accordance with English law and any proceedings arising out of or connected with these terms and conditions shall be subject to the exclusive jurisdiction of the English courts.

11.12 If the Client or Beneficiary has a complaint about the Services, notice can be given in any format eg writing, phone, email to the Compliance Officer at GroundSure who will respond in a timely manner.

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EmapSite
Masdar House,
Eversley, RG27 0RP

| | |
|----------------------------|-----------------------|
| Report Reference: | EMS- 118389_155663 |
| Your Reference: | EMS_118389_155 663 |
| Report Date | Jan 12, 2011 |
| Report Delivery Method: | Email - pdf |

GroundSure GeoInsight

Address: Salisbury Square, Old Hatfield, Hatfield

Dear Sir/Madam,

Thank you for placing your order with GroundSure. Please find enclosed the **GroundSure GeoInsight** as requested.

If you would like further assistance regarding this report then please contact the emapsite customer services team on 0118 9736883 quoting the above report reference number.

Yours faithfully,

emapsite customer services team

Enc.
GroundSure GeoInsight

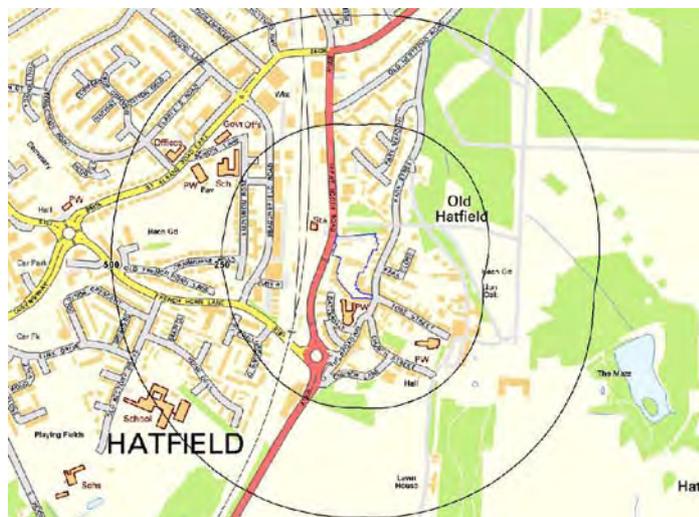
GroundSure GeoInsight

Address: Salisbury Square, Old Hatfield, Hatfield

Date: Jan 12, 2011

Report Reference: EMS-118389_155663

Your Reference: EMS_118389_155663



Brought to you by emapsite

Aerial Photograph of Study Site



Site Name: Salisbury Square, Old Hatfield, Hatfield
Grid Reference: 523329, 208674
Size of Site: 0.89 ha

Aerial photography supplied by Getmapping PLC.
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Overview of Findings

The GroundSure GeoInsight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Shallow Mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and GroundSure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

| Report Section | Number of records found within (X) m of the study site boundary |
|---|--|
| 1. Geology | Description |
| 1.1 Artificial Ground, | |
| 1.1.1 Is there any Artificial Ground /Made Ground present beneath the study site?* | No |
| 1.1.2 Are there any records relating to permeability of artificial ground within the study site* boundary? | No |
| 1.2 Superficial Geology & Landslips | |
| 1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?* | Yes |
| 1.2.2 Are there any records relating to permeability of superficial geology within the study site* boundary? | Yes |
| 1.2.3 Are there any records of landslip within 500m of the study site boundary? | No |
| 1.2.4 Are there any records relating to permeability of landslips within the study site* boundary? | No |
| 1.3 Bedrock, Solid Geology & Faults | |
| 1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section. | |
| 1.3.2 Are there any records relating to permeability of bedrock within the study site* boundary? | Yes |
| 1.3.3 Are there any records of faults within 500m of the study site boundary? | No |
| 1.3.4 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? | The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level |
| 1.3.5 Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? | No radon protective measures are necessary |

* This includes an automatically generated 50m buffer zone around the site

Source:Scale 1:50,000 BGS Sheet No:239

| 2. Ground Workings | on-site | 0-50 | 51-250 | 251-500 | 501-1000 |
|---|---------|------|--------|---------|----------|
| 2.1 Historical Surface Ground Working Features from Small Scale Mapping | 0 | 1 | 10 | - | - |
| 2.2 Historical Underground Workings Features from Small Scale Mapping | 0 | 0 | 0 | 0 | 0 |
| 2.3 Current Ground Workings | 0 | 0 | 0 | 1 | 1 |

| 3. Mining, Extraction & Natural Cavities | on-site | 0-50 | 51-250 | 251-500 | 501-1000 |
|---|---------|------|--------|---------|----------|
| 3.1 Historical Mining | 0 | 0 | 0 | 0 | 0 |
| 3.2 Coal Mining | 0 | 0 | 0 | 0 | 0 |
| 3.3 Johnson Poole and Bloomer Mining Area | 0 | 0 | 0 | 0 | 0 |
| 3.4 Non-Coal Mining* | 1 | 0 | 3 | 7 | 3 |
| 3.5 Non-Coal Mining Cavities | 0 | 0 | 0 | 1 | 2 |
| 3.6 Natural Cavities | 0 | 0 | 1 | 0 | 3 |
| 3.7 Brine Extraction | 0 | 0 | 0 | 0 | 0 |
| 3.8 Gypsum Extraction | 0 | 0 | 0 | 0 | 0 |
| 3.9 Tin Mining | 0 | 0 | 0 | 0 | 0 |
| 3.10 Clay Mining | 0 | 0 | 0 | 0 | 0 |

*This includes an automatically generated 50m buffer zone around the site

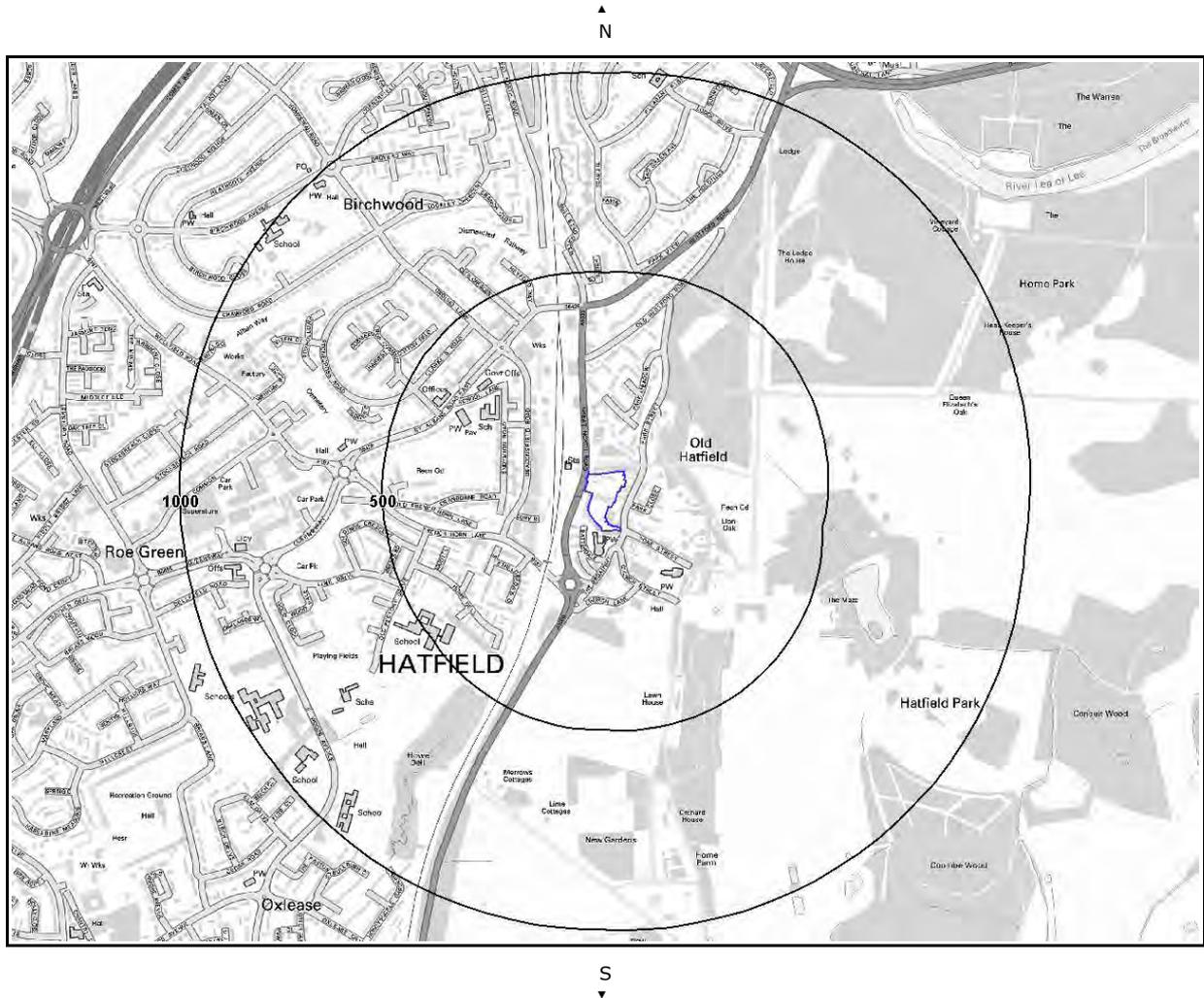
| 4. Natural Ground Subsidence | on-site* | 0-50 | 51-250 | 251-500 | 501-1000 |
|---|------------|------|--------|---------|----------|
| 4.1 Shrink-Swell Clay | Negligible | - | - | - | - |
| 4.2 Landslides | Very Low | - | - | - | - |
| 4.3 Ground Dissolution of Soluble Rocks | Moderate | - | - | - | - |
| 4.4 Compressible Deposits | Negligible | - | - | - | - |
| 4.5 Collapsible Deposits | Negligible | - | - | - | - |
| 4.6 Running Sand | Negligible | - | - | - | - |

* This includes an automatically generated 50m buffer zone around the site

| 5. Borehole Records | on-site | 0-50 | 51-250 | 251-500 | 501-1000 |
|----------------------------|---------|------|--------|---------|----------|
| 5.1 BGS Recorded Boreholes | 1 | 0 | 5 | - | - |

| 6. Estimated Background Soil Chemistry | on-site | 0-50 | 51-250 | 251-500 | 501-1000 |
|--|---------|------|--------|---------|----------|
| 6.1 Records of Background Soil Chemistry | 1 | 0 | 0 | - | - |

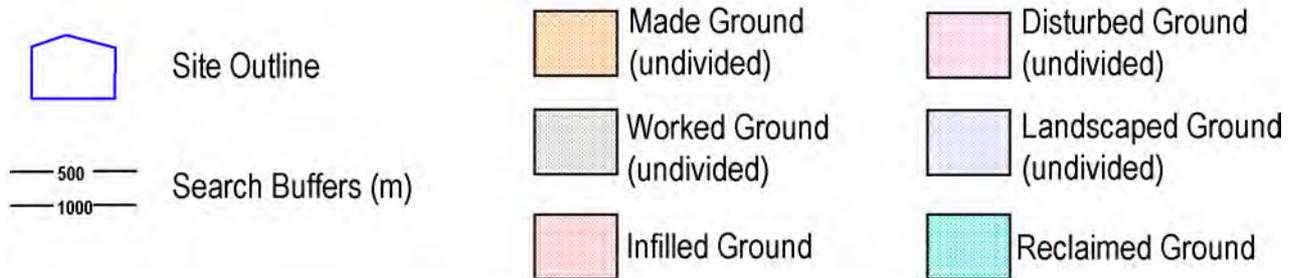
1.1 Artificial Ground Map



Artificial Ground Legend



Crown Copyright. All Rights Reserved
Licence Number: 100035207



Geological information represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:239

1.1.1 Artificial/Made Ground

Are there any records of Artificial/Made Ground within 500m of the study site boundary? **No**

Database searched and no data found.

1.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site* boundary? **No**

Database searched and no data found.

* This includes an automatically generated 50m buffer zone around the site.