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Uppingham School - Meadhurst Refurb

Drainage Strategy

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Date: 30 January 2024

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1.0 INTRODUCTION

Conisbee have been appointed by Uppingham School to prepare a Drainage Strategy to support a planning application for the proposed new boarding house at Uppingham School.

The application proposals comprise the partial demolition of an existing boarding house and replacement with new purpose-built boarding facilities alongside a new arrival courtyard, landscaping and associated works.

Flood zone mapping produced by the Environmental Agency (EA) confirms that the site is in Flood Zone 1, assessed as having a very low flood risk (less than 0.1% annual probability) of river flooding.

As the site area is less than 1 Ha and the site is located in Flood Zone 1, a site-specific flood risk assessment is not required.

The purpose of this document is to demonstrate compliance with relevant national and local planning requirements associated with flood risk and the sustainable management of surface water.

The appraisal process has consisted of a desk study, data research and consultation with regulatory bodies and third parties where appropriate.

Reference has been made to the following policy documents in the production on this FRA and Drainage Strategy:

- National Planning Policy Framework (NPPF, December 2023).
- National Planning Practice Guidance (NPPG, August 2022).
- Peterborough City Council Sustainable Drainage Design and Evaluation Guide[1] (SDD&EG, 2018).

[1] - Rutland County Council work alongside Peterborough City Council on all SuDS Schemes. Reference has therefore been made to the above Design and Evaluation Guide for the relevant technical requirements.

2.0 EXISTING SITE

2.1 Site Location

The site is located in Uppingham, within the grounds of Uppingham School, to the west of Ayston Road. National Grid Reference SD 46811 06306. Refer to Figure 2.1 below.

Figure 2.1 Site location plan

The site is bounded to the north by the Farleigh boarding house and grounds, to the east by Ayston Road, to the south by Wysteria House assisted living residence, and by a surface car park to the west.

2.2 Site Description

The site comprises a broadly rectangular parcel of land extending to approximately 0.55Ha occupied by the Meadhurst boarding house. Meadhurst is located to the east of the site and fronts directly onto Ayston Road. To the rear of the building there are areas of open garden, with a sports pitch beyond. The site is bisected by a hedgerow and a number of large mature trees which run north-south adjacent to the sports pitches.

A topographical survey of the site was undertaken in February 2023 by Aimcon Surveys, drawing ref. 01-1538-1 - 5. Refer to the survey drawing attached at **Appendix A**.

The survey shows that levels fall across the site from south-west to north-east, from a high point around 145.10m AOD at the south-west corner of the site, to a low point around 142.80m AOD at the site frontage to Ayston Road.

2.3 Geology and Hydrology

British Geological Survey (BGS) mapping indicates that the site is underlain by the Northampton Sand Formation (Sandstone, Limestone and Ironstone). There is also Whitby Mudstone Formation recorded in the vicinity. No superficial deposits are recorded.

BGS information does not contain records of any boreholes in the immediate vicinity of the site. However, several historic boreholes are recorded approximately 0.5km west of the site. The borehole records indicate that made ground was encountered up to 1.2m bgl, Northampton Sand up to 6.25m bgl and Upper Lias (Blue Clay) up to 71m bgl.

Groundwater vulnerability maps for the site show that the Northampton Sand Formation is designated as a Secondary A Aquifer. The site does not lie within a Source Protection Zone (SPZ) for local groundwater abstraction.

Ground investigation works were undertaken by EPS in September 2023. The works comprised a borehole, 3no. window samples, 3no. machine excavated trial pits (TP01-TP03) and soakage testing to BRE365 methodology.

The trial pits encountered topsoil to 0.3-0.4m bgl, overlying the Northampton Sand Formation. The Whitby Mudstone Formation was encountered at a depth of 6.4m bgl at BH01.

Infiltration test results indicate that infiltration is viable mechanism for the disposal of surface water, with a characteristic infiltration rate for design of 3.36×10^{-5} m / s at TP01 and 2.13×10^{-5} m / s at TP03. This is discussed further in Section 5.

Groundwater was encountered at the borehole and the 3no. window samples. The depths at which groundwater was struck and the resting groundwater levels recorded from monitoring standpipes are summarised in Table 2.2.

Borehole Location	Approximate Strike Depth (m bgl)	Approximate Rest Depth after 24 hours (m bgl)
BH01	3.80	-
WS01	4.04	2.85
WS02	3.91	2.56
WS03	3.27	2.65

Table 2.2: Groundwater levels from EPS Phase I & II Geo-Environmental Assessment

The report notes that groundwater appeared to be perched within the granular material of the Northampton Sand Formation. Groundwater was not encountered at the trial pit locations, which were extended to 2m bgl.

Refer to Ground Investigation Report attached at **Appendix B**.

2.4 Existing Site Drainage

Asset record information obtained from Anglian Water indicates the following sewerage assets in the vicinity of the site:

- 225mm foul sewer to the east of Meadhurst conveying flows south on Ayston Road.
- 150mm surface water sewer to the east of Meadhurst conveying flows north on Ayston Road.
- Foul and surface water drainage systems serving Farleigh Court to the west of the site. Surface water flows from this area are conveyed to the west, and foul flows to the south towards a 225mm combined sewer in South West Street.
- A combined sewer system in Richil Court to the south of the site. The system is shown to discharge to the 225mm foul sewer in Ayston Road.

Refer to AW sewer records attached at **Appendix C** for further details.

A CCTV survey of the existing foul and surface water drainage systems was undertaken by Midland Surveys in April 2023, ref. 43594/1.

The survey indicates that foul drainage to the existing Meadhurst Boarding House discharges via a combined drainage system to the 225mm foul sewer in Ayston Road at MH6901.

Surface water drainage to the site primarily discharges to the combined drainage system to the east of the building noted above. Part of the site is shown to discharge via a separate system to a soakaway located in the garden area to the east of the building.

Refer to survey drawing attached at **Appendix C** for further details.

3.0 PROPOSED DEVELOPMENT

3.1 Description

The development proposals comprise the partial demolition of an existing boarding house and replacement with new purpose-built boarding facilities alongside a new arrival courtyard, landscaping and associated works.

The scheme is to be constructed in phases, with the new purpose-built boarding facilities completed prior to the demolition of part of the existing boarding house, and subsequent completion of the new arrival courtyard and landscaping.

4.0 CLIMATE CHANGE

4.1 Background

The nature of climate change at a regional level will vary. For the UK, more frequent short duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. It is expected that sea levels will also continue to rise.

4.2 Development Lifespan

The EA Flood Risk Assessments: Climate Change Allowances 2022 dataset indicates that climate change is expected to result in increased rainfall and rising sea levels. Tables 5.1 and 5.2 below shows anticipated changes in extreme rainfall intensity in small urban catchments for the 3.3% and 1& AEP events.

3.3% AEP	Central allowance	Upper-end allowance
2050s	20%	35%
2070s	25%	35%

Table 5.1: Peak rainfall intensity allowance, 3.3% AEP

1% AEP	Central allowance	Upper-end allowance
2050s	20%	40%
2070s	25%	40%

Table 5.2: Peak rainfall intensity allowance, 1% AEP

4.3 Impact of Climate Change on the Development

The surface water drainage strategy outlined in Section 5 has been designed to accommodate run-off during all events up to and including the 100-year return period plus 40% to allow for increases in rainfall intensity due to climate change for the expected 100-year lifespan of the development; this is in line with the recommendations of the NPPF.

The site levels will be designed to ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes that minimise the risks to people and property.

5.0 DRAINAGE STRATEGY

5.1 Proposed Method of Surface Water Disposal

The Building Regulations (Part H3) and the National Planning Policy Guidance (NPPG) set out the following hierarchy for discharging surface water run-off from a development in order or preference:

- Infiltration into the ground.
- Discharge into a watercourse.
- Discharge into a surface water sewer.

As noted in Section 2.3, the site is underlain by Northampton Sand. Infiltration testing undertaken by EPS in September 2023 has confirmed the viability of infiltration techniques for the disposal of surface water.

The testing has determined characteristic infiltration rates for design of 3.36 x 10^{-5} m / s at TP01 and 2.13 x 10^{-5} m / s at TP03. Only two tests were completed at TP01, and as such a rate for design has not been provided for this location.

Refer to Ground Investigation Report, including test location plans, attached at **Appendix B**.

The Building Regulations (H3) state that '*Infiltration devices should not be built within 5 metres of a building or road or in areas of unstable land'*. This rule of thumb is to prevent surface water that infiltrates into the ground from adversely affecting building and pavement foundations.

The CIRIA fact sheet 'Using SUDs close to buildings' advises that this 5-metre rule was devised for traditional soakaways, which are relatively deep in relation to foundations and concentrate runoff into a small area. Alternative SUDs method, such as permeable paving, act as a blanket infiltration system allowing water to spread out over a large area.

It considered that blanket infiltration systems, such as permeable paving, can be located within 5 metres of building foundations, and that traditional soakaways, such as geocelluar soakaways, should be located a minimum of 5 metres from building foundations.

As noted in Section 2.3, groundwater was encountered at a depth of around 2.5m bgl. Due to the presence of relatively shallow perched groundwater, the depth of infiltration features will be limited to 1.3m bgl in order to maintain a minimum 1m distance between the base of the feature and the groundwater.

5.2 SUDs Strategy

In accordance with the NPPF and the LLFA Guidance Document, the development will incorporate a Sustainable Drainage System (SuDS) to manage rainfall on site and ensure that the risk of surface water flooding is not increased elsewhere.

It is proposed that porous surfacing is provided throughout the scheme to hard landscaped areas. The permeable paving will intercept rainfall and provide source control and water quality betterment. Temporary retention of surface water will be provided in a voided sub-base layer, providing attenuation storage prior to infiltration into the ground.

Based on the PDS FLOW calculations, a permeable sub-base 225mm in depth with a void ratio of 0.3 (30%) would provide sufficient storage for events up to and including the 1 in 100 year plus 40% allowance for climate change rainfall event.

For the colonnade area this sub-base depth is increased to 280mm to account for the additional contributing roof area.

Roof drainage from the new building will discharge to 2 no. geoceullar soakaways (SA01 and SA02) located to the north and south of the building.

The access road will be constructed with impermeable surfacing but has been designed with a crossfall towards a filter drain. The filter drain will provide temporary subsurface storage and filtration of surface water runoff before infiltrating into the ground. Excess flows will discharge to a geocellular soakaway (SA03) located within the open space to the east.

Refer to drawing 230021-CON-XX-00-DR-C-1000 attached at **Appendix D** for details of the SuDS proposed, including their location, depth, and size.

5.3 Design and Modelling Criteria

The drainage strategy has been analysed using PDS Flow hydraulic modelling software in conjunction with FEH22 rainfall parameters for 1 in 1-year, 1 in 30-year, and 1 in 100-year return period events, with an additional allowance for climate change as described in Section 4.

A volumetric co-efficient (PAF) of 1 has been applied to all proposed impermeable areas. Urban Creep has not been considered for this development.

Copies of the PDS FLOW model output files area attached at **Appendix E**.

A safety factor of 2 has been applied to infiltration rates on the permeable paving and geocellular storage.

The model results demonstrate that the system will operate without flooding for storm events up to and including a 1 in 100-year storm event with an additional 40% allowance for climate change.

5.4 Water Quality

Table 26.2 of the SuDS manual (2015) provides pollution hazard indices for different land use classifications. The relevant land uses and associated hazard indices from this table are set out in Table 7.1

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Low traffic roads and car parking with infrequent change	Low	0.5	0.4	0.4

Table 7.1: Pollution hazard indices from SuDS Manual (2015), Table 26.2

Where mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

Total SuDS mitigation index = mitigation index1 + 0.5 (mitigation index2)

Where mitigation index n = mitigation index for component n. A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations.

The following mitigation indices have been identified for the proposed SUDs components from Tables 26.3 of the SUDs Manual.

SUDs component	Total suspended solids (TSS)	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Infiltration trench	0.4	0.4	0.4
Permeable pavement	0.7	0.6	0.7

Table 7.2: Pollution mitigation indices, adapted from SUDs Manual (2015), Table 26.3

The scheme will incorporate catch-pit manholes immediately upstream of the geocellular soakaway structure to provide pre-treatment and sediment reduction.

5.5 Exceedance Flows

In accordance with the Defra Non-Statutory technical standards for sustainable drainage systems, the drainage system has been designed to accommodate the 100-year return period event, with an additional 40% allowance for climate change.

In an event where the capacity of the surface water system is exceeded, water will leave the site via overland flow.

External levels within the site will be designed to direct any overland flows away from the proposed buildings. Refer to drawing 230021-CON-XX-00-DR-C-1010 attached at **Appendix D** for exceedance flow paths.

5.6 Maintenance Strategy

An outline SuDS maintenance strategy, in line with the SuDS Manual (CIRIA C753), has been prepared for the site and is attached at **Appendix F**.

5.7 Foul Drainage

It is proposed that the on-site foul water drainage will be a private system designed in accordance to Building Regulations Part H and BS EN 752 requirements.

The proposed foul drainage system for the new system will discharge via a gravity drainage system to a pumping station to the north-east of the building. The pump chamber will include provision for storage of 24-hour inflow to allow for service disruption.

Based on daily demand of 200 l / head for residential pupils, 90 l / head for day pupils, and 150 l / head for the House Masters lodgings and tutor bedroom (Flows and Loads 4), this equates to a storage requirement of 14.1m^3 storage.

Prior to the demolition of part of the existing Meadhurst Boarding House the pump chamber will pump flows to an existing chamber on the western side of the building. During the demolition works, an over pumping arrangement will need to be put in place until the permanent connection is formed.

A section of existing foul drainage to the existing building will need to be re-laid to suit the proposed layout.

Refer to drawing 230021-CON-XX-00-DR-C-1000 attached at **Appendix D.**

6.0 CONCLUSIONS

Conisbee have been appointed by Uppingham School to prepare a Drainage Strategy to support a planning application for a proposed new boarding house at Uppingham School.

Flood zone mapping produced by the Environmental Agency (EA) confirms that the site is located in Flood Zone 1, comprising land assessed as having a less than 0.1% annual probability of river flooding. As the site area is less than 1 Ha and the site is located in Flood Zone 1, a site-specific flood risk assessment is not required.

A surface water drainage strategy has been developed utilising infiltration techniques for the disposal of surface water runoff, thereby replicating the natural infiltration mechanisms and ensuring that there is no increase to the risk of surface water flooding in line with NPPF. The drainage strategy proposes a series of SUDs features distributed throughout the development to ensure that surface water is managed close to its source.

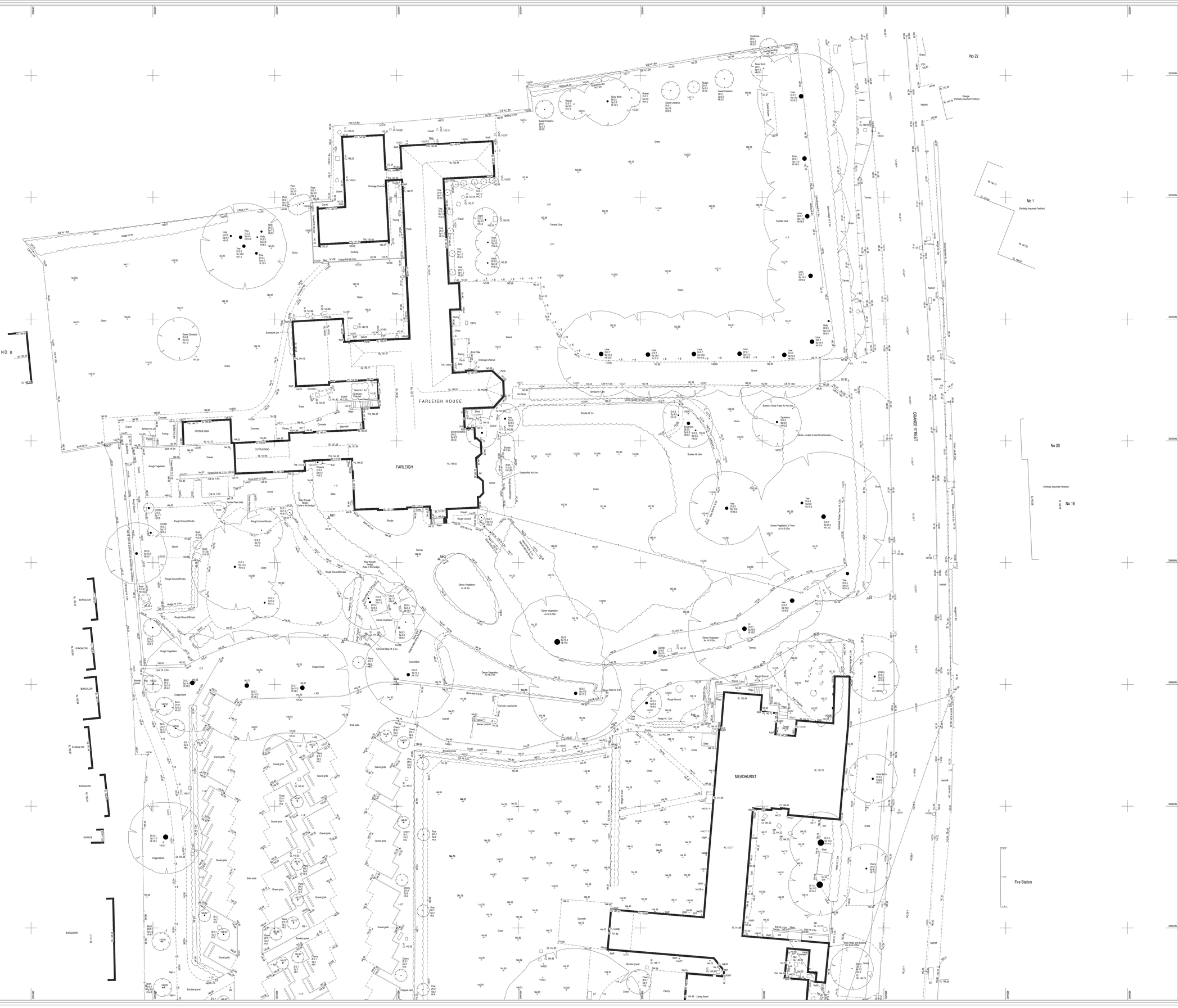
Ground investigation works, including infiltration testing in accordance with the BRE 365 methodology, groundwater monitoring and soil sampling for contamination assessment, have been undertaken and confirm the viability of the proposed strategy.

The outline drainage strategy has been designed to accommodate run-off for all events up to the 100-year return period plus 40% climate change allowance. Overland flow routes will be engineered to direct any flows from within the site and adjacent areas away from buildings towards roads, open space and the drainage features.

Assessment of the anticipated pollution hazard and mitigation indices has been undertaken and the proposed SUDs features will provide sufficient mitigation for TSS, metals and hydrocarbons.

An outline SUDs maintenance strategy has been prepared in line with recommendations of the SUDS Manual (CIRIA C753).

APPENDIX A - TOPOGRAPHIC SURVEY


FARLEIGH HOUSE
FARLEIGH
MEADHURST
ORANGE STREET
No 22
No 1
No 20
No 16
Fire Station
NO 8
Tarmac
Grass
Gravel
Asphalt
Paving
Rough Ground
Dense Vegetation
Trees
Hedge
Fence
Wall
Building
Drainage Channel
Football Goal
Timber/RSW Ht 0.5m
Timber/RSW Ht 1.5m
Timber/RSW Ht 2.0m
Brick Wall Ht 2.0m
Brick Wall Ht 3.0m
Brick Wall Ht 1.2m
Hedge Ht 1.2m
Hedge Ht 1.5m
Hedge Ht 2.0m
Hedge Ht 3.0m
Hedge Ht 4.0m
Bushes Ht 2m
Bushes Ht 3-4m
Shrubs Ht 1m
Shrubs Ht 2m
Concrete Step Ht. 0.1m
Concrete Step Ht. 0.2m
Concrete Step Ht. 0.3m
Concrete Step Ht. 0.4m
Concrete Step Ht. 0.5m
Concrete Step Ht. 0.6m
Concrete Step Ht. 0.7m
Concrete Step Ht. 0.8m
Concrete Step Ht. 0.9m
Concrete Step Ht. 1.0m
Concrete Step Ht.

APPENDIX B - GROUND INVESTIGATION REPORT

Phase I & II Geo-Environmental Assessment

Meadhurst (Uppingham School)
11 Ayston Road
Uppingham
Oakham
LE15 9RL

Prepared for:

Uppingham School Estates Department
Units 1 & 2 Pullman Trading Estate
Uppingham
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EPS Reference Number:	UK23.6614
Date Issued:	13th October 2023
Report Status:	Issue 1

MEADHURST (UPPINGHAM SCHOOL)

NON-TECHNICAL CLIENT SUMMARY

This report presents the findings of a combined Phase I Desk Study and Phase II Geo-Environmental assessment undertaken to determine ground conditions, establish if there are any geo-environmental risks associated with the site and its proposed development and to provide a geotechnical appraisal. Pertinent findings and conclusions may be summarised as follows:

- The area of investigation includes two boarding houses associated with Uppingham School. It is proposed that a new boarding house is constructed adjacent to one of these boarding houses (Meadhurst) and that the existing boarding houses are refurbished and improved.
- Historical records suggest that the site has been associated with Uppingham School since before the 1880's, although the configuration of the site has changed throughout its history. The area is considered to have a moderate environmental sensitivity due to the underlying Northampton Sand Formation being a Secondary Aquifer which is locally abstracted, while some commercial and industrial land uses including a petrol filling station have been identified nearby no off-site sources of contamination pose a risk to the site.
- The intrusive works included the drilling of boreholes and excavation of trial pits and the ground profile was found to comprise a limited topsoil overlying Northampton Sand Formation materials (medium dense to dense, gravel and layers of clay, silts and sand) with very stiff clay of the Whitby Mudstone Formation recorded from 6.4m.
- Laboratory testing of the shallow soils identified some elevated concentrations of the metal's arsenic and lead likely associated with the natural geology, and due to the recorded concentration of lead in shallow soil samples. Recommendation have been made to further assess the associated risks to determine how the risks to current and future site users potentially being exposed to lead in shallow soil can be controlled.
- Waste classification has also been undertaken and the topsoil and Northampton Sand Formation have both been classified as **Inert** for the purposes of off-site disposal, the deeper Whitby Mudstone Formation however should be classified as **Non-Hazardous** for the purposes of off-site disposal.

ENGINEERING SUMMARY

- The ground conditions across the site are considered suitable for conventional spread foundations, with allowable bearing capacities starting from 110kN/m^2 from approximately 1.0m below existing levels, information on the deeper ground conditions is also presented should a piled foundation solution be preferred / required.
- Suspended ground floor construction is recommended and a CBR value of 8% is likely to be achievable for any new areas of pavement where the Northampton Sand Formation is present at formation level.
- Infiltration testing has allowed for infiltration rates indicative of 'low to medium permeability' conditions to be calculated for the Northampton Sand Formation.
- A design sulphate of DS-1 with an ACEC classification of AC-1^d is considered appropriate for shallow buried concrete in contact with topsoil and the Northampton Sand Formation.

The above points represent a simplified summary of the findings of this assessment and **must not** form the basis for key decisions for the proposed development. A thorough review of the details is contained within the following report, or alternatively get in touch and we'll talk you through it.

On Project Reference:	UK23.6614	
Title:	Phase I & II Geo–Environmental Assessment Uppingham School, Meadhurst	
Client:	Uppingham School Estates Department	
Date:	13th October 2023	
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Status:	Issue 1	

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Consultant	Senior Consultant	Director

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If third parties have been contracted / consulted during compilation of this report, the validity of any data they may have supplied, and which are included in the report, have been assessed as far as possible by EPS however, EPS cannot guarantee the validity of these data.

Where ground investigations have been conducted, these have been limited to the level of detail required for the site in order to achieve the objectives of the investigation.

No part of this report, or references to it, may be included in published documents of any kind without approval from EPS. This report and its contents, together with any supporting correspondence or other documentation, remain the property of Environmental Protection Strategies Ltd until paid for in full.

The report has been written, reviewed and authorised by the persons listed above. It has also undergone EPS' in house quality management inspection. Should you require any further assistance regarding the information provided within the report, please do not hesitate to contact us.

The National Planning Policy Framework requires a competent person to prepare site investigation information, which is defined as a person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation. EPS considers that it fulfils these criteria and would welcome any request for staff CVs or case studies to demonstrate it.

As stated within DEFRA's Contaminated Land Statutory Guidance, with any complex risk assessment it is possible that different suitably qualified people may reach slightly different conclusions when interpreting the same information. EPS recognises this and considers the conclusions presented within this report to be robust and appropriate but input from the Local Authority and their judgement in line with this guidance would still be welcomed.

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1 INTRODUCTION

In August 2023, Environmental Protection Strategies Ltd (EPS) was commissioned by Conisbee on behalf of the Uppingham School Estates Department to complete a Phase I & II Geo-Environmental Assessment for at the Meadhurst boarding house (associated with Uppingham Uppingham School), 11 Ayston Road, Uppingham, Oakham, LE15 9RL ('the site'); see Figure 1.

The work was commissioned in order to support planning proposals for a new scheme, understood to include a new boarding house to the west of the existing Meadhurst boarding house (henceforth referred to as Meadhurst) as well as the refurbishment of the existing Meadhurst and Farleigh boarding houses. It should be appreciated that the Phase II works undertaken as part of this project focussed solely on the Meadhurst part of the site and that no intrusive investigations have been undertaken for the Farleigh boarding house as part of these works.

This report presents the findings, conclusions, and recommendations of the Phase I Desk Study and subsequent Phase II Intrusive Investigation undertaken.

1.1 Objectives

The objectives of this investigation were as follows:

a) Compile a Phase I Desk Study and Conceptual Site Model (CSM) to evaluate the potential risks the site may pose to human and environmental receptors, both currently and in future.
b) Assess potential contaminant linkages identified through the CSM by means of investigating shallow soils.
c) Determine the potential risks posed by the site and make recommendations for further work that may be required, to ensure safe development in accordance with the Environment Agency's *Land Contamination: Risk Management* (2023) and the *National Planning Policy Framework*.
d) Collect information on ground conditions and strength in order to make appropriate recommendations for geotechnical design.

1.2 Scope of Work

To perform an exploratory assessment of the site in accordance with the principles and requirements of DEFRAs '*Contaminated Land Statutory Guidance*' (2012), BS10175 – '*Investigation of Potentially Contaminated Sites*', BS 5930:2015+A1:2020 '*Code of practice for ground investigations*' and BS EN 1997 '*Geotechnical Design*', the following tasks were undertaken:

<u>Desk Study:</u>

- Collection of site records.
- Study of existing geological, hydrogeological, and historic maps of the area.
- Consultation of environmental databases, including records held by the local authority (where available).
- Review of proposed development plans.
- Development of a Conceptual Site Model (CSM) and Preliminary Risk Assessment.

Intrusive Investigation:

- Site walkover, inspection of any visual evidence of contamination, obtaining photographic records.
- Health and safety briefing/ site supervision.
- Drilling of one cable percussive (shell and auger) borehole, to a depth of 20.0m below ground level (bgl).
- Drilling of three windowless sample boreholes to a depth of 5.0m below ground level (bgl) using a track-mounted, dynamic (drop weight) percussive drilling rig and installation of combined ground gas and groundwater monitoring standpipes on a precautionary basis.
- Excavation of three trial pits to a maximum depth of 2.0m bgl, using a mechanical excavator; with 'soakaway' infiltration testing attempted in each of trial pit.
- Excavation of two hand-dug foundation exposure pits to a maximum depth of 0.77m bgl, to assess the nature and extent of the foundations of the Meadhurst building.
- In-situ testing, to assist with geotechnical design including the undertaking of five dynamic cone penetrometer (DCP) throughout the area.
- Continual logging of ground conditions including inspection of samples for visual and olfactory contamination, and laboratory analysis of selected soil samples.

Reporting:

- Data collection
- Interpretation of data including completion of Generic Quantitative Risk Assessment
- Reporting

The findings of these investigations and their conclusions are presented in the following sections.

1.3 Project Limitations and Constraints

The purpose of this report is to present the findings of a soil sampling investigation conducted at the location(s) specified. When examining the data collected from the investigations made during the assessment, Environmental Protection Strategies Ltd (EPS) makes the following statements:

No investigation method is capable of completely identifying all ground conditions that might be present in the soil or groundwater under a site. Where outlined in our report, we have examined the ground beneath a site by constructing a number of boreholes and / or trial pits to recover soil and / or groundwater samples. The locations of these excavations and sampling points are considered to be representative of the condition of the whole site subsurface however, ground conditions are naturally variable and it may be possible that the ground conditions encountered may differ to those encountered during the investigation.

No visible evidence of Japanese Knotweed was identified during the site walkover. However, this plant can be difficult to identify in the early stages of growth and therefore it is not always possible to identify its presence at certain times of the year. For this reason, EPS cannot confirm that Japanese Knotweed rhizomes do not exist and it is recommended that if it is suspected that this species, or other similarly invasive plants are present at the site, a specialist contractor should be commissioned to make a detailed assessment.

The investigation was carried out to assess the significance of contamination resulting from the use of the site as identified in this report. Unless EPS has otherwise indicated, no assessment of potential impact of any other previous uses has been made.

2 SITE CHARACTERISATION

The following section provides a summary of the information collected in relation to the site location and history.

2.1 Site Location and Description

Detail	Description
Location	The site includes both the Meadhurst and Farleigh borading houses and associated ground which are associated with Uppingham School and are present on the western side of Ayston Road in the centre of the town of Uppingham, located approximately 9km south of the town of Oakham in Rutland.
National Grid Reference	486550, 299970
Topography	While levels are largely flat on a small scale, the site area slopes down gently from the west at around 146m Above Ordnance Datum (AOD) to the east at around 142m AOD.
Description of Site	The area of investigation comprises a roughly rectangular shaped parcel of land, covering approximately 2.1 hectares. The area features two boarding houses known as Farleigh in the north and Meadhurst in the south which are part of the nearby Uppingham School. Each of these houses have associated gardens and sports pitches. Both these houses can be accessed separately from the east via Ayston Road (A6003) with another entrance located in the north being an extension of Wheatley Avenue on the adjacent side of Ayston Road. The southern entrance (directly north of Meadhurst) extends west through the centre of the site and opens into a newly built car in the south west which is accessible via an automatic barrier. A footpath provides access to a maintained area of grass and an area of concrete hardstanding to the west and south of Meadhurst respected, both of these areas are understood to be used for sports and outdoor activities. On the western side of the Meadhurst building is a small courtyard for car parking / loading and to the south is a network of paths some of coniferous hedges. Farleigh house to the north is a similar structure to Meadhurst with similar attributes such as multiple sports pitches, space for parking, public walkways and gardens. The site is well maintained with many hedgerows and areas of planting that include shrubs and bushes as well as hosting many mature and juvenile deciduous and coniferous trees raging in size from small to large.
Surrounding Land Use	The site is mostly surrounded by residential dwellings on all sides with Uppingham Fire Station and various commercial entities are located on the eastern side of Ayston Road, these include a motorcycle dealership, clinic, various food outlets and stores and a petrol filling station 74m south east.

A plan showing the site location is provided as Figure 1, the current site layout is detailed on Figure 2 and an aerial photograph is included as Figure 3. Selected site photographs are included as Appendix A and relevant extracts of the Envirocheck Report are included as Appendix B.

2.2 Geo-Environmental Setting

<table>
<tr><th>Detail</th><th colspan="2">Description</th></tr>
<tr><td>Geology</td><td colspan="2">Geological mapping indicates the site to be directly underlain by bedrock sandstone, limestone and ironstone of the Northampton Sand Formation, no superficial geology is mapped within the sites boundaries although superficial Mid Pleistocene glacial till is mapped in the wider surrounding area. Information on the site's geological context is included as Appendix C.</td></tr>
<tr><td rowspan="9">Geological Hazards</td><td>Hazard</td><td>On Site Risk</td></tr>
<tr><td>Mining Activities</td><td>No Hazard</td></tr>
<tr><td>Collapsible Ground</td><td>Very Low</td></tr>
<tr><td>Compressible Ground</td><td>No Hazard</td></tr>
<tr><td>Ground Dissolution</td><td>No Hazard</td></tr>
<tr><td>Running Sand</td><td>No Hazard</td></tr>
<tr><td>Landslide</td><td>Very Low (Low 152m NE)</td></tr>
<tr><td>Shrinking/ Swelling Clay</td><td>No Hazard (Low 32m E)</td></tr>
<tr><td colspan="2">Four British Geological Survey (BGS) recorded mineral sites are listed within 1km, the closest being 565m south west where a former opencast quarry for ironstone known as 'The Pitts' is present. All of the other recorded mineral site extracted ironstone and all have now ceased operating. No natural or man-made cavities have been recorded within 1km.</td></tr>
<tr><td>Radon</td><td colspan="2">The Envirocheck report indicates the site to lie in a location where the percentage of homes above the radon action level is in a higher probability radon area where 10% to 30% of homes are estimated to be at or above the radon Action Level.

It further reports that tfull radon protection measures are necessary in the construction of new buildings or extensions.</td></tr>
<tr><td>Hydrogeology</td><td colspan="2">Groundwater vulnerability maps for the area show that the bedrock Northampton Sand Formation is designated as a Secondary A Aquifer. The site does not lie within a Source Protection Zone (SPZ) for local groundwater abstraction. Two groundwater abstraction licenses are however reported within 1km, the closest of which is located 820m east and is operated by 'A F Carr' who abstract groundwater for general agriculture and domestic use. Groundwater vulnerability maps are included as Appendix D.</td></tr>
<tr><td>Hydrology & Flood Risk</td><td colspan="2">The nearest surface water feature is reported to be located 159m east and is possibly a drain or pond within the allotment gardens or recreation ground in this area.

Seven discharge consents are reported within 500m, the closest of which are for pumping stations operated by 'Anglian Water Services Limited' for Public Sewage: Storm Sewage Overflow which has a consent to be discharged into a tributary of the River Welland 233m north east. No surface water abstraction licenses are held within 1km.</td></tr>
</table>

<table>
<tr><th>Detail</th><th>Description</th></tr>
<tr><td></td><td>Review of the EA flood zone map for the area indicates that the site lies within Flood Zone 1, which is defined within Table 1 of the technical guidance to the National Planning Policy Framework (NPPF) as ‘the area with a low probability of flooding from rivers or the sea’. It should be noted that the EA maps do not take into account flooding from other potential sources of floodwater, such as from poor drainage or groundwater. BGS Flood GFS Data does however show that the site lies in an area with a limited potential for groundwater flooding to occur.

An indicative flood zone map is also included in Appendix D.</td></tr>
<tr><td>Known Site Drainage & Utilities</td><td>According to mains services plans sourced from relative local providers, Gigaclear Fibre optic cables run through the centre of the site and evidence of other buried utilities including manhole and inspection covers and drain covers were also noted throughout the area.</td></tr>
<tr><td>Landfill & Waste</td><td>No active or historic landfills, waste management facilities or areas of infilled land have been highlighted within 500m by the BGS, Local Authority or Environment Agency although there is a historic landfill and some infilled land present from 975m south.</td></tr>
<tr><td>Licensed Industrial Activity</td><td>There are three sites licensed for industrial activity within 1km, the closest is Central Garage (Uppingham) which is a petrol filling station 99m south east of the site, the two other licences (now surrendered) were operated by Conegrade Ltd for adhesive and powder coating processes 899m south east.</td></tr>
<tr><td>Industrial Land Use</td><td>The Envirocheck report lists many industrial land uses within 1km, all of which are summarised below.
<table>
<tr><th>Land Use</th><th>Distance (Direction)</th><th>Status</th></tr>
<tr><td>Sycamore Harley-Davidson (Garage Services)</td><td>57m (SE)</td><td>Active</td></tr>
<tr><td>B P Service Station (Petrol Filling Station)</td><td>74m (SE)</td><td>Active</td></tr>
<tr><td>Midas Medical Storage Ltd (Storage & Shelving Systems Manufacturers)</td><td>101m (S)</td><td>Active</td></tr>
<tr><td>Alan Bastick Logistics Ltd (Frozen Food Processors & Distributors)</td><td>206m (SE)</td><td>Inactive</td></tr>
<tr><td>The Laundry Basket (Ironing & Home Laundry Services)</td><td>225m (SE)</td><td>Inactive</td></tr>
</table>
A single fuel station is also recorded within 1km, this is the open and active BP petrol station recorded 74m south east of the site which is also authorised by the local authority.</td></tr>
<tr><td>Pollution Incidents</td><td>No pollution incidents to controlled waters or entries on the substantiated pollution register have been recorded within 1km. There are also no records of any prosecutions relating to controlled waters or authorised processes within 1km and similarly there are also no hazardous sites or substances including registered radioactive substances recorded within 1km.</td></tr>
</table>

Detail	Description
Sensitive Land Use	The area of investigation is reported to be located within a Nitrate Vulnerable Zone where surface water is considered to be susceptible to the leaching of nitrates from agricultural land. There are no other sensitive land use designations within 1km.
Previous Investigation or Remediation	EPS are aware of three previous investigations undertaken within the grounds of Meadhurt & Farleigh. These include some soakaway testing undertaken by David Smith Associates in January 2017 (reference: BT/17/24414/CS), a Basic Contamination Investigation Report (Project Reference: JN1237) issued by Southern Testing / ST Consult in March 2019 and a Site Investigation Report (Report Refence No. C15319) issued by Ground Engineering Limited in June 2021.

2.3 Site History

A summary of historical map data from 1885 to 2023 is summarised below. Key points are highlighted as annotations on the aerial photograph below and discussed in the subsequent bullets. Copies of relevant historic maps and any others examined during the investigation are included in this report as Appendix E.

- The site has undergone noticeable changes since records began in 1885, whilst the first school buildings of Farleigh and Meadhurst existed before 1885 they have been expanded north several times in the last century, once in 1904 and again in the 1970's. Other than the development of

these structures the only other notable edition to the site was a new car park which first appears on historic maps from 2022.

- The surrounding town of Uppingham has been developing gradually since the 1960's, a large area of allotments existed along the east of Ayston Road from 1904 to 1905 before being developed, primarily into housing, another area of allotments are shown on maps from the 1960's slightly further east, this area of allotment approximately 80m east is still partially present today but the more easterly section was converted to houses in the 1990's.
- A laundry was identified approximately 100m north which was first seen in 1904 but was later repurposed as a mill (Ayston Mill) during the 1960's, this was then demolished to make way for residential properties in the 1980's which still exist today along Willow Close.
- Several possibly infilled ponds have been identified on historic maps in the nearby area to the site, one of which was in the south western part of the site and appeared on the first historic maps from the late 1800's and was seemingly infilled during the development of the wider town in the 1970's and 1980s. The other ponds were 40m north west, 30m south west and 30m east and 130m north which were all were seemingly infilled around the same time.

3 PRELIMINARY RISK ASSESSMENT AND CONCEPTUAL SITE MODEL

In accordance with the Environment Agency's *Land Contamination: Risk Management* (LC:RM, 2023) guidance, there are three stages to managing contaminated land (Risk Assessment, Remedial Options Appraisal / Remediation and Verification). This section outlines the first tier of Stage 1, the Preliminary Risk Assessment.

The following section provides a review of the contaminant linkages that may be active at the site through examination of the potential sources that may be present as a result of historic and / or current site activities and where potential interaction between these sources and the identified human / environmental receptors may occur.

3.1 Background

A preliminary risk assessment comprises the first stage of any geo-environmental assessment, the purpose of which is to determine what potentially contaminative activities may have occurred at the property or the surrounding area which may pose an environmental or geological risk to site users, the surrounding environment or proposed development, either at present or in the future.

The method used in this investigation to assess the environmental risk posed is based on the concept of 'contaminant linkage', which considers the following three factors:

Source	The location from which an environmentally hazardous / contaminative substance is, (or was,) derived.
Pathway	A route or mechanism via which a source could come into contact with a receptor to cause significant harm.
Receptor	An environmentally sensitive object or condition e.g. person, property, controlled water, or ecological system, which may be present now or in future.

If all three factors are identified, there is the potential for a 'contaminant linkage' to be active, which could result in significant harm being caused to the environment or human health.

3.2 Source Characterisation

The following potential contaminant sources have been identified at the site and in the surrounding area:

Potential Source	Source Description	Principal Contaminants of Concern
Current & Historic Site Use	In-fill material of unknown origin (Made Ground) used to level areas beneath existing / historic buildings and hardstanding.	PAH, Metals, ACM
	Possible in-filled pond within the site boundary.	Ground Gas (CH_4, CO_2)
	Naturally elevated concentrations of metals associated with the natural geology.	Metals (Specifically Arsenic & Lead)
	Radioactive decay of natural geology.	Radon Gas
Current and Historical Surrounding Land Use	Current and historic commercial and industrial land uses including a historic laundry 100m north, fire station and motorcycle dealer adjacent to the east and a petrol filling station 74m south east.	PAH, Metals, PFAS, VOC's, SVOC's TPH (inc. MTBE & BTEX)
	Possible infilled ponds within 50m.	Ground Gas (CH_4, CO_2)
	Former and current allotment gardens on the eastern side of Ayston Road.	Metals, Herbicides & Pesticides

Notes:

PAH	Polycyclic Aromatic Hydrocarbons	ACM	Asbestos Containing Material
CH_4	Methane	CO_2	Carbon Dioxide
PFAS	Perfluoroalkyl & Polyfluoroalkyl Substances	VOC's	Volatile Organic Compounds
SVOC's	Semi Volatile Organic Compounds	TPH	Total Petroleum Hydrocarbons
MTBE	Methyl Tertiary Butyl Ether	BTEX	Benzene, Toluene, Ethylbenzene & Xylenes

3.3 Potential Receptors

A framework for the assessment of risks arising from the presence of contamination in soils has been produced by the Environment Agency and the Department for the Environment, Food and Rural Affairs (DEFRA) and is presented with the report: '*Using Science to Create A Better Place: Updated Technical Background to the CLEA Model* – Science Report SC050021/SR3'. This guidance document defines a series of standard land-uses which have been further developed into six generic land uses in the Category 4 Screening Levels project for Land Affected by Contamination (DEFRA/Contaminated Land: Applications in Real Environments (CL:AIRE) Project Report SP1010, September 2014) which form a basis for the development of the Conceptual Site Model.

Risks posed to controlled waters have been considered in line with the Environment Agency's *approach to groundwater protection* (v1.2, 2018) and associated position statements.

It is proposed that a new boarding house is constructed within the area of investigation and that the existing Meadhurst and Farleigh buildings be refurbished, no change of land us is proposed and the site is to remain in use as boarding houses and grounds associated with Uppingham School. A Residential (with home-grown produce) land use setting is considered to be the most appropriate land use setting for this site. The amount of exposure to future site users (i.e. occupiers of the boarding houses and staff) will be much less than the lifetime exposure that this land use typically considers, however given that this is the most conservative land uses which includes all of the relevant exposure pathways, it is likely to result in a more stringent risk assessment and hence is considered the most appropriate at this stage.

In view of the environmental setting, current and potential future land use of the site and surrounding sites, the potential receptors for any contaminant impact are discussed below:

Receptor	Site Specific Description
Human	Future site users, construction workers involved in the proposed redevelopment, and those working and living in the surrounding area have the potential to be at risk from exposure to potential contaminants of concern (CoCs), including from former or adjacent land uses.
Groundwater	The site is reported to be underlain by the bedrock Northampton Sand Formation which is defined by the EA as a Secondary A Aquifer. Whilst the site does not lie within a SPZ for nearby groundwater abstraction, the underlying geology does have some resource potential and therefore groundwater should initially be considered as a potential receptor to site derived contaminants.
Surface Water	The nearest surface water course is likely to be a drain or pond 159m east within the allotments or recreation ground. It is possible that site derived contaminants of concern may enter this (or other nearby) watercourses by overland flow, migration through unsaturated soils or entering shallow surface drainage/ historical land drainage which discharges to these drains. Therefore, surface waters must also initially be considered as a sensitive receptor within the conceptual site model.
Flora and Fauna	The current and future use of the site will includes areas of soft landscaping including planters and given the use of the nature of the site being used as boarding houses, it is possible that homegrown produce may also be grown. Some of the identified contaminants of concern are known to be phytotoxic and as such, the potential for this impact should be considered.
Buildings & Infrastructure	Current and future subsurface structures are likely to be present which may be adversely affected by the potential presence of contaminants from the off-site sources identified. These include building foundations and services running beneath the site, installed as part of the proposed development.
Adjacent Land	Adjacent properties including private residential dwellings to the north, west and south could also be at risk from potential contaminants found at the site.

3.4 Potential Pathways

Where contaminants may be present in soil, there are a number of potential pathways that enable human receptors to come into contact with or be exposed to them. The most direct pathways, considered under current UK legislation, can be summarised as follows:

- Direct ingestion of contaminated soil
- Ingestion of household dust
- Ingestion of contaminated vegetables
- Ingestion of soil attached to vegetables
- Dermal contact with contaminated soil
- Dermal contact with household dust
- Inhalation of fugitive soil dust
- Inhalation of fugitive household dust
- Inhalation of vapours outdoors
- Inhalation of vapours indoors

Clearly, not all of these potential pathways apply for every standard land-use. For example, ingestion of contaminated vegetables will not apply to land uses other than residential with plant uptake and allotments. However, in addition to direct exposure pathways, a number of physical transport mechanisms / pathways may also exist at a site that allow remote or less accessible contaminants in soil or groundwater to reach human or environmental receptors both at a site and beyond the site boundary. These include the following:

- Downward and lateral movement of contaminants in soil either by gravity or through being 'leached' by percolating rainwater.
- Lateral migration of contaminants dissolved in groundwater.
- Direct seepage or leaching of contaminants from soil into subsurface drains or supply pipework.
- Volatilisation of contaminants from groundwater or unsaturated soils into buildings or outdoor air.

Through examination of the standard land use and environmental setting at each site, the presence of pathways and transport mechanisms described above must be considered when assessing whether a contaminant linkage may plausibly be active, and therefore be included in the conceptual site model.

3.5 Summary of Site-Specific Contaminant Linkages

Considering the site use and environmental setting, and the proposed land use; the plausible contaminant linkages that require further investigation are summarised in the following table:

Source	Pathway	Receptor
Contaminated soil	Direct contact and inadvertent ingestion by eating or smoking with dirty hands	Construction workers during redevelopment & site users
	Inhalation of fugitive dusts	Site users
	Direct uptake and / or adherence of contaminated soil to vegetation and subsequent ingestion	
	Ingress / diffusion through permeable potable water supply pipes	
	Direct uptake via root systems	Plants

The following comments are made with respect to contaminant linkages which have been considered through development of the conceptual model, but have not been concluded as 'plausible' – i.e., through which a significant possibility of significant harm could occur to an identified receptor:

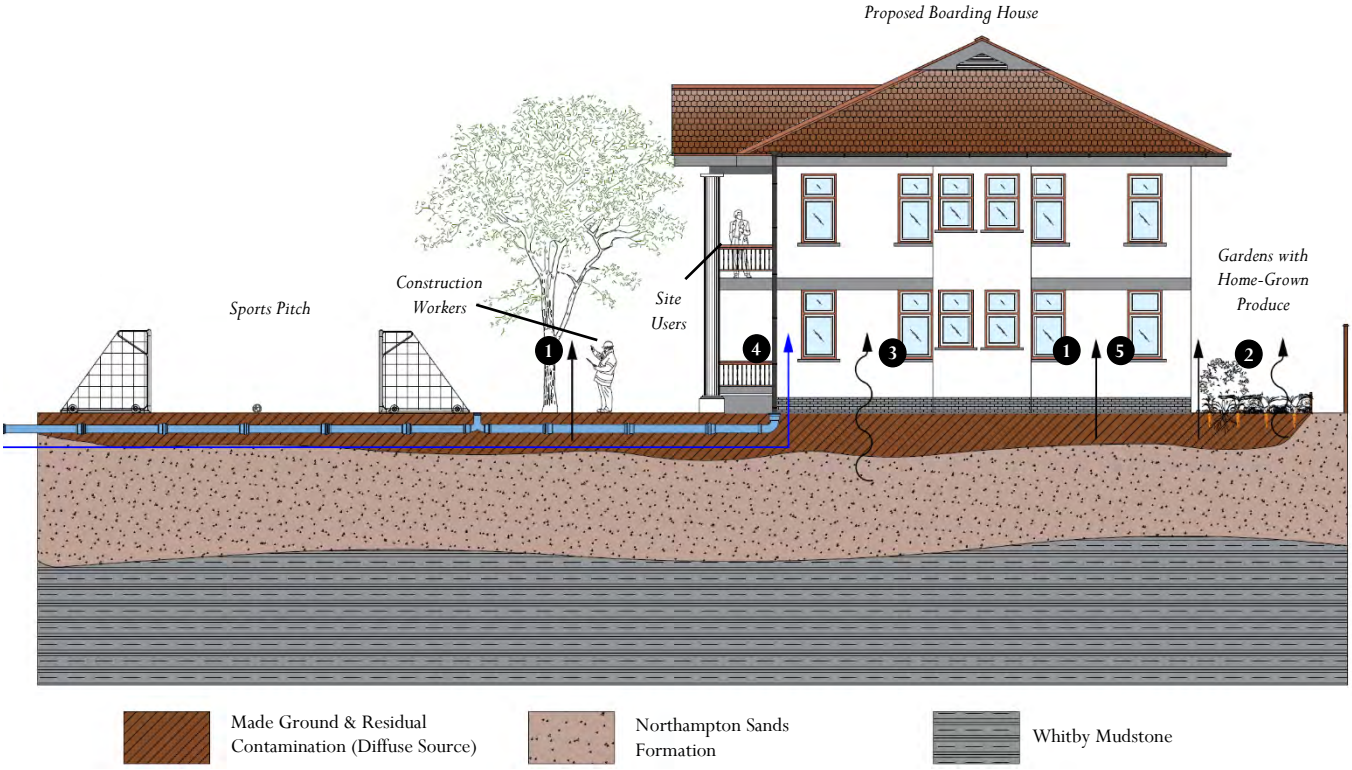
- PAH's and metals have been identified as contaminants of concern associated with the historic onsite infill, however these contaminants are considered to be relatively immobile in the environment by virtue of their very low solubility and volatility. On this basis, plausible pathways by which these potential contaminants could pose a significant risk to the underlying groundwater or nearby surface watercourses are not considered to be active.
- Whilst contaminants, including petroleum hydrocarbons, have been identified as being of concern associated with the nearby fire station, motorcycle dealer, petrol filling station 74m south east and historic laundry 100m to the north, it is not anticipated that volatile organic compounds i.e., petrol have been stored or used in significant concentrations or volumes within the sites boundaries. Therefore, with all due consideration to the nature and status of the nearby commercial and industrial land uses and the anticipated hydrogeological gradient, a plausible contaminant linkage has not been identified associated with the migration of contaminants in soil and / or groundwater and the volatilisation of contaminants to indoor and outdoor air within the sites boundaries.
- Agri-chemicals have been identified as potential contaminants associated with nearby historic and current allotments to the east. However, given the nature and scale of these allotments, it is considered highly unlikely that significant these contaminants were ever used in sigficant quantities on the adjacent land that would have affected the site and present a risk to existing or future site users.
- Whilst some small potentially infilled ponds have been identified on site and in the surrounding area, given the size and age (and therefore likely nature of fill material) of these features a

plausible contaminant linkage is not recognised associated with the migration of ground gas to indoor and outdoor air.

- Given the likely shallow nature of impacts to surface soils, no site derived contaminants of concern have been identified at the site which could pose a significant risk to the foundations of any on-site or adjacent buildings / infrastructure.

The following diagram provides an illustration of the plausible contaminant linkages that may be active at the site and which may need further investigation or control to ensure safe development:

Meadhurst (Uppingham School) – Illustrative Conceptual Site Model



Potential Pathways:

1. Direct contact with/ingestion of soil & inhalation of fugitive dusts
2. Direct uptake and / or adherence of contaminated soil to vegetation and subsequent ingestion
3. Migration of radon gas (from radioactive decay of natural geology) to indoor air
4. Ingress/diffusion through permeable potable supply pipes
5. Migration of naturally elevated concentrations of metal (Ar

4 SUMMARY OF INTRUSIVE INVESTIGATIONS

The intrusive ground investigation was undertaken between the 31st August and and 5th September 2023, in accordance with EPS standard operating procedures, copies of which will be made available on request. A summary of the site activities is presented in the following sections:

4.1 Exploratory Hole Locations

Exploratory hole locations were originally selected by the Clients structural engineers and were ultimately selected through consideration of the proposed development layout, the location of below ground utilities and as operational and health & safety considerations.

The overall objective, in terms of exploratory hole locations was to deliver an appropriate lateral and vertical coverage of the site in order to offer information relating to the nature, quality and strength of the underlying soils to the rear (west) of Meadhurst. Further rationale for each sampling location is provided within the table below:

Location	Rationale
BH01	Provide information on the nature and strength of underlying soils, particularly at depth, to assist with geotechnical (pile) design.
WS01 – WS03	Assess the nature, strength and quality of shallow soils providing detailed lateral coverage of the materials to support geotechnical design.
TP01 – TP03	Trial pits used to facilitate infiltration testing via 'soakaways' to assess the permeability of the underlying soils
FP01 & FP02	To provide information on the nature and extent of the existing foundations of the Meadhurst boarding house.
DCP1 – DCP5	Provide in-situ strength data for shallow soils, to assist with future road and pavement design parameters for the proposed new boarding house.

All exploratory hole positions were formed in accordance with standard EPS methodologies and all sub-contractors were supervised by an EPS engineer throughout the works.

Monitoring wells were installed at all three windowless sample borheole positions (WS01, WS02 & WS03) on a precautionary basis for any future monitoring requirements. The installations used 50mm diameter HDPE well casing and were fitted with bungs and gas taps. Slotted casing (1mm slot) was installed at both locations from the base of the open borehole to approximately 1.0m below the surface and the installations were completed using plain casing. A filter pack of 2-3mm of washed gravel extended from the base of the open boreholes to approximately 0.8m above the slotted section, with a bentonite seal to surface. The monitoring installations were finished at the surface with, flush forecourt rated, bolt-down steel headworks.

Upon completion the remaining boreholes (BH01) and trial pits were backfilled with soil arisings to the surface.

An exploratory hole location plan is presented as Figure 4.

4.2 In-Situ Testing & Soil Sampling

Each borehole and foundation exposure were logged for ground conditions encountered and inspected for any physical evidence of contamination, such as soil staining, odour and the presence of separate phase liquids, on a precautionary basis.

Where potentially volatile organic compounds are suspected, EPS carries a Photoionisation Detector (PID), which can be used to measure the relative concentrations of vapour associated with soil samples collected from different depths and locations at the site. PID readings are only used to provide EPS with a basic means to quantify areas of volatile organic compound in the field to help guide the investigation. However, given the absence of any visual or olfactory evidence of soils / groundwater impacted by volatile contaminants, headspace testing was not undertaken as part of this investigation.

Standard or cone penetration tests (SPT's / CPT's) were carried out in all of the boreholes using an automatic trip hammer. The number of blows required to advance a standard split spoon, (or solid 60o nose cone for the CPT test) over the final 300mm of a 450mm total drive was recorded and is shown on the borehole records as the penetration resistance ("N" value).

Soil samples were recovered from each location at regular intervals for record purposes and future laboratory testing. Selection of samples from the exploratory hole locations focused on providing an assessment of the geotechnical properties of the soils encountered, as well as the quality of sub-surface materials present across the site and their waste characteristics.

4.3 Laboratory Testing

Soil samples were obtained for analysis of selected contaminants of concern in order to identify the presence of any contamination and confirm their suitability for future use as well as their waste characteristics. Samples were submitted to Element Materials Technology of Flintshire, who hold appropriate UKAS/ MCERT accreditation for the required testing. Samples were transported in laboratory supplied containers and delivered by an approved courier.

Geotechnical testing was undertaken by Soil Property Testing, Huntingdon, a UKAS accredited laboratory.

Copies of the chain of custody documentation are held by EPS and will be made available on request. Furthermore, laboratory testing schedules detailing all samples submitted for environmental and geotechnical laboratory analysis are included within Table 1 and Table 2 respectively.

5 FINDINGS OF THE INVESTIGATION

This section of the report provides a summary of the findings of the various aspects of the intrusive investigation undertaken.

5.1 Ground Conditions

A total of four boreholes and three trial pits were formed across the site and the ground conditions encountered, from surface level, have been interpreted to comprise:

- Topsoil
- Northampton Sand Formation
- Whitby Mudstone Formation

Site specific borehole and trial pit logs are included as Appendix F and give full descriptions and depths of strata encountered. A summary of the general ground profile beneath the site is provided in the table below, with more detailed description given in the following sub-sections.

Geological Strata	Maximum Depth to Base of Strata (m bgl)	Strata Thickness (m)
Topsoil	0.4	0.3-0.4
Northampton Sand Formation	6.4 (Where Proven)	>4.2 (Where Proven)
Whitby Mudstone Formation	Not Proven (>20.0)	Not Proven

5.1.1 Topsoil

A consistent layer of topsoil, comprising dark orangish brown, slightly gravelly, slightly silty sand was identified from the surface at each borehole and trial pit location, extending to around 0.4m.

No evidence of made ground was recorded in any of the boreholes or trial pit locations which were all positioned within the area immediately west of Meadhurst that is surfaced with grass.

5.1.2 Northampton Sand Formation

Directly beneath the topsoil at all borehole and trial pit locations, materials interpreted as the mapped bedrock Northampton Sand Formation were encountered. These materials were largely recovered as medium dense to dense, dark orangish brown ferruginous sandstone gravels within a sandy silty clay matrix. Gravel content was logged as fine to coarse rounded, ferruginous limestone. Separate layers of clays, silts and sands were also present within the same unit. Some slightly looser and very dense sections were also noted, which is likely due to variability in the composition of the material and the influence of groundwater.

The most notable sections of predominantly granular soils comprising loose to medium dense gravels, were recorded in WS01 (3.0m to 5.0m). These layers were recorded beyond the full completion depth of 5.0m at WS01.

5.1.3 Whitby Mudstone Formation

Soil indicative of the bedrock of the Whitby Mudstone Formation, which is mapped in the surrounding area, was identified at BH01 below the Northampton Sand Formation which extended to a depth of 6.4m at this location. This soil was recovered as very stiff, dark greyish brown to dark grey, sometimes fissured and friable, clay. These cohesive soils progressed beyond the 20m completion depth of BH01.

5.2 Groundwater

During the intrusive works, groundwater was struck at each borehole location. The groundwater appeared to be perched within the granular material of the Northampton Sand Formation. The table below summarises the depths at which groundwater was struck at each borehole location and the resting groundwater levels recorded from the monitoring standpipes in the windowless sample boreholes approximately are also outlined in the table below:

Borehole Location	Approximate Strike Depth (m bgl)	Approximate Rest Depth after 24 hours (m bgl)
BH01	3.80	-
WS01	4.04	2.85
WS02	3.91	2.56
WS03	3.27	2.65

5.3 Physical Evidence of Contamination

No palpable evidence of contamination was encountered at any of the borehole locations formed during the ground investigation. The soils did not include any notable evidence of waste or putrefiable material, with hydrocarbon staining/ odours also absent.

5.4 Existing Foundations

Two hand-dug foundation pits were excavated adjacent to the Meadhurst building. The objective of these pits was to assess the nature and extent of the existing foundations. Made ground comprising yellowish brown, sandy, gravelly silt with fragmented brick and concrete was recovered from each foundation exposure pit and surrounded the sides of the footings as well as immediately below them before the natural soils were recorded. Descriptions of the foundations encountered at each location are presented below.

5.4.1 FP01

At FP01, which was located adjacent to the northern face of the protruding section of the Meadhurst, the vertical face of the wall was found to extend to a depth of approximately 0.24m where it was founded on a brick footing measuring approximately 0.3m thick (extending to a total depth of 0.54m). The brick footing stepped out from the wall in three tiers by a total of approximately 0.17m.

***Photo 1** - A photograph showing the thickness of foundations within FP01.*

5.4.2 FP02

At FP02, which was located against the western face of the northern part of Meadhurst, the vertical face of the wall was found to extend to a depth of approximately 0.42m where it was founded on a brick footing measuring approximately 0.35m thick (extending to a total depth of 0.77m). The brick footing was also measured as stepping out from the wall in three tiers by a total of approximately 0.17m.

***Photo 2** - A photograph showing the thickness of foundations within FP02.*

Upon completion, the foundation exposure pits were backfilled with the arisings. Illustrations of the foundation exposures are included as Appendix G and the location of the foundation exposure pits are presented on Figure 4.

5.5 Laboratory Analysis – Soil

An environmental laboratory analysis testing schedule is presented as Table 1 and all environmental soil analysis results obtained from the laboratory are included as Appendix G.

The key results of laboratory testing on environmental soil samples are summarised below.

Contaminant	No. of Samples	No of Detections	Range of Detections (mg/kg)		Highest Location & Depth (m bgl)
			Min	Max	
Arsenic	5	5	60	125.9	WS02 (0-0.4)
Cadmium	5	0	-		
Chromium III	5	5	51.1	335	WS03 (1.6-2.0)
Chromium VI	5	0	-		
Copper	5	4	19	266	WS03 (0-0.4)
Lead	5	5	19	815	WS03 (0-0.4)
Mercury	5	5	0.2	1.2	WS03 (0-0.4)
Nickel	5	5	39.1	119.7	WS03 (1.6-2.0)
Selenium	5	1	1		WS02 (0-0.4)
Zinc	5	5	64	617	WS03 (1.6-2.0)
Benzo(a)pyrene	5	1	3.23		WS03 (0-0.4)
Dibenzo(ah)anthracene	5	1	0.29		WS03 (0-0.4)
Benzo(a)anthracene	5	3	0.08	4.48	WS03 (0-0.4)
Benzo(b)fluoranthene	5	3	0.09	3.96	WS03 (0-0.4)
Chrysene	5	3	0.08	4.44	WS03 (0-0.4)
Naphthalene	5	1	0.60		WS03 (0-0.4)
PAH (Total of 16)	5	2	1.0	60.7	WS03 (0-0.4)
Total Cyanide	5	0	-		
MTBE	3	0	-		
BTEX	3	0	-		
TPH (Total Aliphatics & Aromatics)	3	0	-		
PCB's	3	0	-		
ACM (mass % of sample)	5	0	-		

***Notes*:** - Contaminant not identified above laboratory minimum instrument detection limits
PAH Polycyclic Aromatic Hydrocarbons MTBE Methyl Tertiary Butyl Ether
BTEX Benzene, Toluene, Ethylbenzene, Xylenes TPH Total Petroleum Hydrocarbons
PCB's Polychlorinated Biphenyls ACM Asbestos Containing Material

5.6 Waste Classification

Waste classification (i.e. hazardous or non-hazardous) was undertaken on representative samples of topsoil, Northampton Sand Formation and Whitby Mudstone Formation materials recovered from beneath the site; which included total concentrations of metals and hydrocarbons, using computer software provided by *HazWaste Online*™.

Waste Acceptance Criteria (WAC) testing was subsequently undertaken on one sample of each of these materials. The results of the WAC analysis are included within Appendix H and the outputs from the software are presented as a Waste Classification Report included as Appendix I.

These results, together with those of the waste classification above, are summarised in the following table:

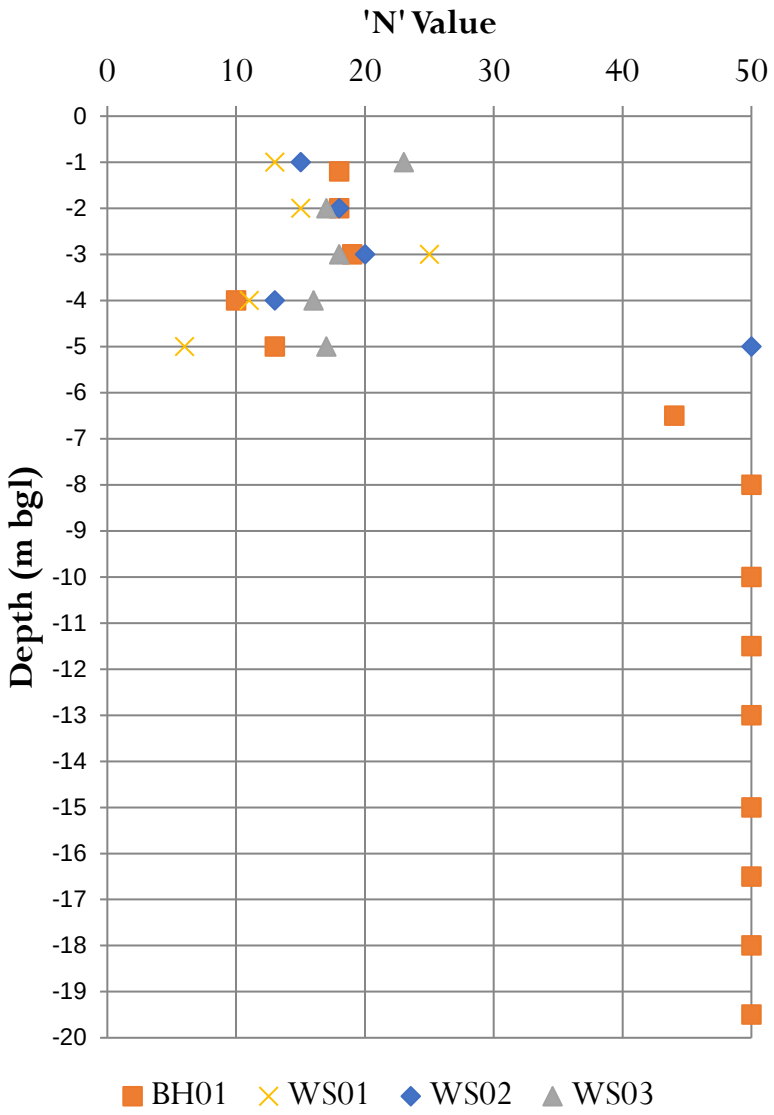
Waste Stream	Typical Depth (m bgl) and Description	Is it Hazardous?	Waste Code	Waste Acceptance Criteria	Appropriate Landfill
Topsoil	0.0 – 0.4m: Dark orangish brown, slightly gravelly, slightly silty sand.	No	17 05 04	Passed Criteria for Inert Landfill*	**INERT**
Northampton Sands Formation	0.3 – 6.4m: Dark orangish brown sandstone gravel.	No	17 05 04	Passed Criteria for Inert Landfill	**INERT**
Whitby Mudstone Formation	6.4m +: Very stiff, mottled, dark greyish brown to dark grey fissured CLAY	No	17 05 04	Failed Criteria for Inert Landfill	**NON-HAZARDOUS**

*The results of WAC testing indicate that the sample of topsoil has a Total Organic Carbon (TOC) concentration greater than the Inert Waste limit of 3%. However, '*Waste Sampling and Testing for Disposal to Landfill (2013)*' states that *"in the case of soils, a higher TOC Limit Value may be permitted by the Environment Agency at an inert waste landfill, provided the DOC value of 500mg/kg is achieved at L/S 10 l/kg, either at the soils own pH or at a pH value between 7.5 and 8.0."* In this scenario, the Dissolved Organic Carbon (DOC) value is 60mg/kg and hence below the 500mg/kg threshold. On this basis the topsoil can be classified as **INERT** for the purposes of offsite disposal. The same **INERT** waste classification can also be applied to the Northampton Sand Formation however due to elevated concentrations of sulphate, the Whitby Mudstone Formation does not meet inert landfill criteria as must be classified as **NON-HAZARDOUS** for the purposes of off-site disposal.

5.7 Geotechnical Testing

5.7.1 In-Situ Geotechnical Testing

The results of the SPT's / CPT's completed at regular intervals during the drilling of the boreholes are summarised on the graph below.



'N' values of 50 on the below graph represent technical refusals of the tests whereby the testing equipment does not achieve the full 300mm of penetration within 50 blows of the drop hammer. Overall, the data shows that there is some variability in the shallower Northampton Sand Formation with a clear decrease in the strength of these granular soils from depths of around 3m to 4m. This decrease is likely due to the soils at these depths being saturated with groundwater which can have a loosening effect on granular material.

5.7.2 Laboratory Geotechnical Testing

The results of geotechnical laboratory testing are summarised in the table below.

Strata	Range of Parameters							
	Moisture Content (%)		Plasticity Index (%)		Water Soluble Sulphate, 2:1 SO_3 (g/L)		pH	
	Min	Max	Min	Max	Min	Max	Min	Max
Northampton Sand Formation	-	40.1	-	-	0.04	0.07	6.4	6.9
Whitby Mudstone Formation	15.8	17.2	30	36	-	-	-	-

Strata	Range of Parameters							
	Particle Size Distribution						Bulk Density (Mg/m^3)	
	Fines (%)		Sand (%)		Gravel (%)			
	Min	Max	Min	Max	Min	Max	Min	Max
Northampton Sand Formation	17	38	17	36	26	61	1.95	
Whitby Mudstone Formation	-	-	-	-	-	-	1.98	2.14

The water content, liquid and plastic limits and plasticity and liquidity indexes were established for two samples of soil prepared according to BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2 and tested in line with BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:3.2, 4.4, 5.3 and 5.4.

Particle Size Distribution (PSD) testing was carried out on four samples prepared and testing in accordance with BS1377: Part 1: 2016: 8.3 & 8.4.5 and BS1377: Part2: 1990: 9.2 accordingly.

The determination of the density of three samples was also undertaken in line with test method BS EN ISO 17892-1: 2014 & BS EN ISO 17892-2: 2014.

Sulphate contents and pH values determinations were carried out by both the environmental and geotechnical laboratories the results of which are summarised in Section 6.7.

A geotechnical laboratory analysis testing schedule is presented as Table 2 and all geotechnical sample results obtained from the laboratory are included as Appendix J.

6 GEOTECHNICAL APPRAISAL

Ground conditions have been found to comprise a limited thickness of topsoil underlain by predominantly granular material of the Northampton Sands Formation with very stiff, fissured clay of the Whitby Mudstone Formation encountered from 6.4m to beyond the base of the investigation (20m).

6.1 Geotechnical Category

Geotechnical Category (BS EN 1997-1:2004)	Definition
GC1	Geotechnical Category 1 (GC1) should only include small and relatively simple structures for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations with negligible risk in terms of overall stability or ground movements and in ground conditions which are known.
GC2	Geotechnical Category 2 (GC2) should include conventional types of structure and foundation with no exceptional risk or difficult or loading conditions. Designs for structures in Geotechnical Category 2 should normally include quantitative geotechnical data and analysis.
GC3	Geotechnical Category 3 (GC3) should include structures or parts of structures, which fall outside the limits of Geotechnical Categories 1 and 2. This may include very large or unusual structures, structures involving abnormal risks, or unusual or exceptionally difficult ground or loading conditions, or structures in areas of probable site instability or persistent ground movements that require separate investigation or special measures.

It is proposed that a new boarding house is constructed within the area of investigation and that the existing Meadhurst and Farleigh buildings be refurbished. Therefore, the below assessment has been undertaken in accordance with Geotechnical Category 2 (GC2), including types of structure and foundation with no exceptional risk or difficult or loading conditions, as defined by BS EN 1997-1:*2004*.

6.2 Structural Foundations

6.2.1 Spread Foundations

As detailed above, the development is anticipated to comprise a new boarding house as well as refurbishments to the existing Meadhusrt and Farleigh boarding houses. The foundation assessment has therefore been undertaken in accordance with BS EN 1997-1:2004, to take in to account;

- Bearing Pressure (Ultimate Limit State)
- Settlement (Serviceability Limit State)

The ground conditions are considered suitable for the use of conventional spread foundations, either strip footings or pad foundations, bearing upon the underlying soils of the Northampton Sand Formation. Allowable bearing capacities have been calculated and are presented in the table below;

Foundation Depth (m bgl)	Allowable Bearing Capacity (kN/m^2)
1.0	110
1.5	140
2.0	160

The allowable bearing capacity is the permissible increase in vertical stress at the level of the underside of the foundation, above existing overburden pressure, which may be calculated on the basis of a soil density of 19kN/m^3.

At the above allowable bearing capacities, total settlements are considered unlikely to exceed roughly 15 to 20mm. Settlements in granular soils will occur rapidly as loadings increase while settlement in cohesive material will occur gradually over a longer period of time.

A minimum foundation depth of 0.90m is considered suitable for the site, below existing or proposed ground level, subject to the following provisos:

a) All foundations should fully penetrate any surfacing soils including made or disturbed ground and extend a minimum of 150mm into undisturbed natural strata.

6.3 Ground Floor Construction

Given the predominantly granular nature of the Northampton Sand Formation either suspended or ground bearing floor construction is likely to be suitable for the proposed building.

6.4 External Works

6.4.1 Pavement Design

Five dynamic cone penetrometer (DCP) tests (DCP1-DCP5) were undertaken in the area to the west of Meadhurst. The aim of these tests was to allow CBR values to be calculated for use in the initial design / consideration of future areas of pavements such as access roads and areas of car

parking associated with the proposed new boarding house. CBR values were determined from the DCP test results, and the data is displayed graphically as Appendix K with DCP test locations presented on Figure 4.

In-situ testing returned a range of CBR values from DCP1 – DCP5, generally however, the calculated CBR values exceed 8% for the majority of the soil profile within the upper 0.7m.

Taking into consideration the above sources of information, EPS's experience of the shallow soils types encountered at the anticipated formation level and the classification testing undertaken by the geotechnical laboratory, a design CBR value of 8% is suggested for the Northampton Sand Formation subject to proof rolling and testing to confirm the required values have been achieved.

Once the formation level for any new pavements has been achieved, proof rolling should be carried out using a heavy roller, and any soft or loose areas revealed should be excavated and a greater depth of sub-base provided.

Exposed subgrades will likely deteriorate rapidly on exposure to wet weather and should be shaped to shed water. Sub-base should be placed as soon as possible to minimise the exposure of the subgrade to adverse weather conditions.

6.5 Infiltration Testing

'Soakaway' infiltration testing was undertaken at the three trial pits excavated as part of these works. These trial holes (TP01, TP02 & TP03) were excavated to depths of between 2.0m, 1.9m & 1.8m respectively. The results of the infiltration testing are summarised in the table below:

Location	Depth (m bgl)	Test Number	Infiltration Rate (m/s)	Comments
TP01	2.0	Test 1	$4.61*10^{-5}$	A characteristic infiltration rate of $3.36*10^{-5}$ m/s has been calculated based the infiltration rates from Test 2 & Test 3.
		Test 2	$3.18*10^{-5}$	
		Test 3	$3.54*10^{-5}$	
TP02	1.9	Test 1	$1.20*10^{-5}$	No comments
		Test 2	$2.30*10^{-5}$	
TP03	1.8	Test 1	$5.06*10^{-5}$	A characteristic infiltration rate of $2.13*10^{-5}$ m/s has been calculated based the infiltration rates from Test 2 & Test 3.
		Test 2	$2.12*10^{-5}$	
		Test 3	$2.14*10^{-5}$	

As can be seen from the above results, the infiltration testing within the top 2m soil profile of the Northampton Sand Formation is relatively consistent. In accordance with best practise, Characteristic infiltration rates have been calculated for TP01 & TP03 by taking an average of the infiltration rates from Test 2 & Test 3 which were completed when the ground was saturated after Test 1. All of the water added to the trial pits for the infiltration tests drained by at least 75% although a third test could not be completed at TP02.

6.6 Groundworks

Whilst excavations in cohesive soils may remain stable for short periods during construction, the stability of any granular soils (which the Northampton Sand Formation is predominantly made up of) should not be relied upon, particularly when influenced by the presence of groundwater which can loosen soils causing greater instability.

Heavy plant and stockpiles of materials should not be permitted close to the edges of unsupported excavations. Further reference may be made to CIRIA Report No. 97 *'Trenching Practice'* 1992.

Excavations must not be carried out in proximity of any existing neighbouring structures / retaining features without suitable support measures in place.

Based on the findings of the intrusive works, groundwater ingress is not anticipated within shallow excavations for new foundations and services, provided they are limited to 2.0m deep with resting groundwater being recorded at depths as shallow as 2.65m.

6.7 Concrete Grade

Sulphate contents and pH value determinations were conducted by both the environmental and the geotechnical laboratory, the latter of which present results as SO_3, which must be multiplied by 1.2 to convert them to SO_4. The results of this testing are summarised in the below table as well as being presented as part of Appendices H & J.

Strata	Water Soluble Sulphate (mg/l SO_4)		pH		Total Sulphur (%)		Total Potential Sulphate (%)		Design Sulphate Class	ACEC
	Min	Max	Min	Max	Min	Max	Min	Max		
Topsoil	<1.5	7.1	7.58	7.77	-	-	-	-	DS-1	AC-1[d]
Northampton Sands	48	84	6.4	7.37	-	-	-	-		
Whitby Mudstone	265.1	717.2	7.58	7.91	2.45	2.65	7.35	7.95	DS-5	AC-4s

In accordance with Part 1 of the BRE Special Digest 1 *'Concrete in Aggressive Ground'* 2005, a design sulphate class of DS-1 with an aggressive chemical environment for concrete (ACEC) of AC-1[d] is considered suitable for concrete in direct contact with the topsoil and Northampton Sand Formation.

For the Whitby Mudstone a Design Sulphate Class of DS-5 with an ACEC of AC-4s is considered applicable, which is a particularly high concrete grade and will likely require special protective measures. However, this would only be applicable for any concrete in direct contact with the Whitby Mudstone Formation which is present at depth. Furthermore, it should be appreciated that BRE Special Digest 1 '*Concrete in Aggressive Ground*' 2005 states "*Concrete in pyritic ground which is initially low in soluble sulphate does not have to be designed to withstand a high potential sulphate class unless it is exposed to ground which is has been disturbed to the extent that contained pyrite might oxidise and the*

resultant sulphate ions reach the concrete. This may prompt redesign of the structure or construction process to avoid grounds disturbance; for example, by using precast or cast in-situ piles instead of constructing a spread footing within an excavation".

7 ENVIRONMENTAL APPRAISAL

The following section outlines the approach applied to assessing the risks posed to human health through a Generic Quantitative Risk Assessment, then identifies any sample results found by this investigation which warrant further consideration.

In accordance with the Environment Agency's *Land Contamination: Risk Management* (2023) guidance, this section represents the second tier of Stage 1, the Generic Quantitative Risk Assessment.

Risks to controlled waters have not been assessed, as potential risks to these receptors (surface water and groundwater) were dismissed as part of the Phase I risk assessment; but will be considered further if any unexpected soil impacts are highlighted in the sections below.

7.1 Human Health

7.1.1 Land Use Setting & Generic Screening Criteria

In order to screen laboratory data for concentrations of contaminants in soil with potential to cause harm to human health, a Residential (with home-grown produce) land use setting has been adopted, as it is considered the most representative in the context of the site as outlined in Section 3.3.

The technical framework used to derive the assessment criteria and the documents in which they are published are summarised as follows:

- *EA Science Reports* (SC050021/SR2, SC050021/SR3, and SC050021/SR7)
- *EA Soil Guideline Value Science Reports*
- *Suitable For Use Levels (S4ULs) for Human Health Risk Assessment* – LQM and CIEH (2015)
- *Soil Generic Assessment Criteria for Human Health Risk Assessment* - EIC/AGS/CL:AIRE (2010)
- *Development of Category 4 Screening Levels for assessment of land affected by contamination* – SP1010 – DEFRA (2013)

Category 4 Screening Levels (C4SL's) provide generic suitable for use screening values for common contaminants in a variety of land uses and are also utilised as appropriate generic screening criteria. For concentrations of Arsenic, Lead and BaP in soil, EPS has used DEFRAs C4SL as an appropriate guide for professional judgement with respect to reasonable 'low risk' levels in the context of this site and its suitability for use.

It is considered reasonable to utilise Benzo(a)pyrene (BaP) as a risk driver or marker representative of genotoxic PAHs (i.e., including dibenzo(ah)anthracene and benzo(b)fluoranthene) given the absence of any 'low risk' (C4SL) equivalent screening values for these compounds.

A summary of the screening criteria and the methodology used to derive them is included in Appendix L.

7.1.2 Assessment of Soil Results

The results of the screening process for on-site human receptors showed that adopted criteria, representative of suitability limits to future site users were exceeded for the metals arsenic and lead as detailed in the below table.

Contaminant	Screening Criteria (mg/kg)	No. of Exceedances	Exceedance (mg/kg), Sampling Location & Depth
Arsenic	37	5	110.7 (WS01, 0.0m-0.4m) 125.9 (WS02, 0.0m-0.4m) 102.5 (WS03, 0.0m-0.4m) 60 (WS03, 1.6m-2.0m) 117.7 (BH01, 6.5m-7m)
Lead	200	2	222 (WS02, 0.0m-0.4m) 815 (WS03, 0.0m-0.4m)
Dibenzo(ah)anthracene	0.24	1	0.29 (WS03, 0.0m-0.4m)

7.1.3 Discussion of Soil Results

Given that no exceedances of the PAH compound benzo(a)pyrene, which is considered to be the risk driver of other genotoxic PAH compounds, (such as dibenzo(ah)anthracene which has been recorded as marginally exceeding the relevant generic screening criteria in one soil sample) have been identified, there are not considered to be any unacceptable risks associated with this contaminant exceedance.

The identified contaminant exceedances of the metals arsenic and lead have been considered in the context of the site in order to further assess the potential risks in a qualitative manner. Firstly, reference has been made to the BGS' Contaminant Distribution in Soil dataset for Normal Background Concentrations of the metals arsenic and lead, both of which are known to be found at naturally elevated concentrations in the Northampton Sand Formation and other bedrock geologies in the surrounding area (such as the Grantham Formation). This dataset reports that the site is in an area where concentrations of arsenic are in the 95th percentile (ranging from 33.4mg/kg to 77.4mg/kg) with the site being located within 300m of an area in the 99th percentile for normal background concentrations of arsenic in soil. Similarly, the area of investigation itself lies in an area where normal background concentrations of lead are reported to be in the 50th percentile. However, within 100m, the normal background concentrations of lead are reported to be in the 75th percentile ranging from 99.5mg/kg to 242mg/kg with the normal background concentrations of lead reported to be in the 90th + percentile 550m north west. This, together with the well-established geochemistry characteristics of the Northampton Sand Formation is considered suggests that the weathering of the natural geology is the source of the elevated concentrations of the metals arsenic and lead in the existing topsoil.

In terms of the associated risks, the generic screening criteria are very conservative and with all due consideration to the context of the land use, are likely to be over conservative for this site. This over conservatism is due to the Residential (with home-grown produce) land use setting being modelled based on lifetime exposure to contaminants in shallow soil, which is not anticipated, given that the site is used as boarding houses whereby both pupils and staff will both have much less exposure than the generic screening criteria have been derived to model. Therefore, risks associated with current and future site users being exposed to shallow soils containing elevated concentrations of the metals arsenic not considered to be unacceptable given the magnitude of the arsenic exceedance.

One of the exceedances of lead however is more than four times the generic screening value and, while the generic screening criteria are likely to be overconservative based on the context of the site (as outline above), the information and soil dataset from this investigation is not considered to be sufficient to completely discount the possibility of unacceptable risks associated with current and future site users being exposed to elevated concentrations of lead in shallow soils. Therefore, some outline recommendations have been made in Section 7.2 below to further assess the risks associated with elevated levels of lead so that the most suitable and effective control measure can be implemented to reduce the associated risks to safe levels.

Nonetheless, should any new areas where home-grown produce will be grown be incorporated into the new scheme, it would be prudent to consider the associated risks to minimise the potential for arsenic and lead to be taken up by home grown produce. Further detail on this is provided in Section 7.3.

7.2 Recommendations

In the context of potentially unacceptable or acceptable risks as outlined within the Environment Agency's *Land Contamination: Risk Management guidance* (LC:RM, 2023), the risks identified by this work will require further assessment as per the below recommendation.

a) In order to further assess the risks to current and future site users being exposed to elevated concentrations of lead in shallow soils, a detailed quantitative risk assessment (DQRA) for human health could be undertaken. This would involve considering the site-specific pathways and possible exposure frequencies of current and future site users to calculate site specific screening criteria to which the recorded concentrations of lead could be compared. As part of this additional phase of risk assessment, it may be beneficial to gather additional shallow soil samples as part of a larger soil dataset. It should also be appreciated that some form of control measure is likely to be required once the risks associated with elevated lead in shallow soils have been further assessed, at this stage, this would likely involve importing and emplacing certified clean topsoil (in the region of 300mm to 600mm which may require for some of the existing topsoil to be removed to maintain current levels) in areas of soft landscaping / gardens associated with the boarding house / houses. The requirements of such control measures, including the specific areas where they would be required, would need to be confirmed in response to the outcome of an additional phase of risk assessment. EPS can provide further advice and consultation on this recommendation on request.

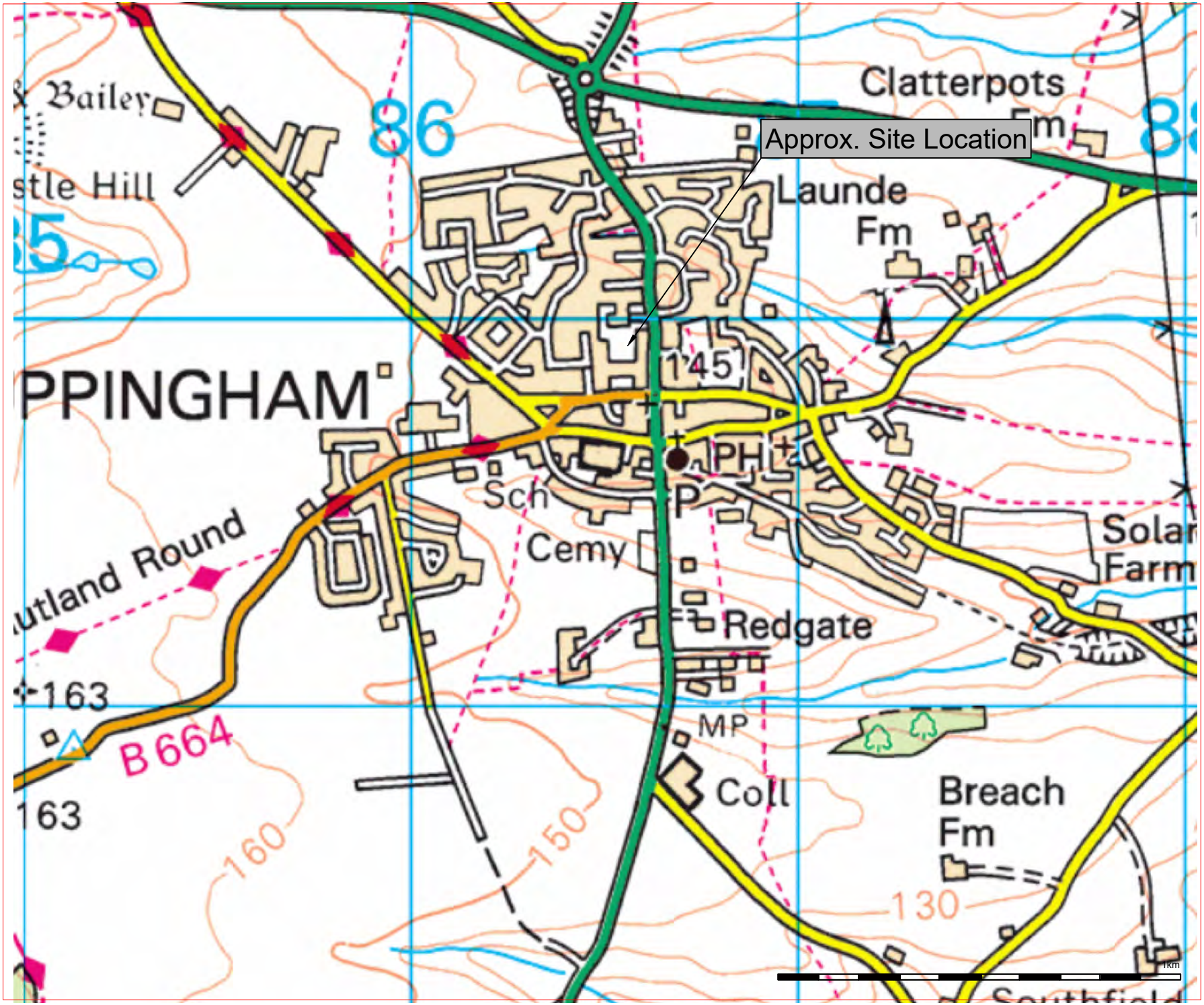
The following recommendations are also made in regards to good practise and safe development:

a) Although considered unlikely based on the findings of the EPS intrusive works, all construction workers operating at the site should be advised of the potential for contact with made ground material within shallow soils (on a precautionary basis). Appropriate health and safety precautions should be adopted during any excavation works to avoid exposure to soils. Reference should be made to relevant health & safety guidance including the following CIRIA document: *R132 Guide to Safe Working on Contaminated Sites*.

b) Should any palpable evidence of unexpected contamination be encountered during the redevelopment work, which significantly varies from the conditions described above, it should be reported to EPS so that an inspection can be made and appropriate sampling and assessment work carried out. A method statement for encountering any unexpected contamination is included as Appendix M of this report.

It is also recommended that a copy of this report be provided to the Environmental Health Department of Rutland County Council for inclusion in their land quality records and to support future planning submission.

FIGURES



N

Rev	Date	Drawn	Description	Chk'd

The Geotechnical and Environmental Engineers
www.epstrategies.co.uk

Site
Uppingham School, Meadhurst
11 Ayston Road, Uppingham, Oakham, LE15 9RL

Client
Uppingham Estates Department c/o Conisbee

Title
Figure 1 - Site Location Plan

Surveyed:		Drawn by:	MC
Checked by:	TA	Date:	October 2023
Scale [A4 Sheet]	1:50,000	Drawing Reference	UK23.6614_01
Job No	UK23.6614	Rev	01

N

KEY:

SITE BOUNDARY

Rev	Date	Drawn	Description	Ch'kd

eps

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www.epstrategies.co.uk

Site
Uppingham School, Meadhurst
11 Ayston Road, Uppingham, Oakham, LE15 9RL

Client
Uppingham Estates Department c/o Conisbee

Title
Figure 2 - Current Site Layout

Surveyed:		Drawn by:	MC
Checked by:	TA	Date:	October 2023
Scale [A4 Sheet]	Not to Scale	Drawing Reference	UK23.6614_02
Job No	UK23.6614	Rev	01

N

KEY:

SITE BOUNDARY

Rev	Date	Drawn	Description	Ch'k'd

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Site
Uppingham School, Meadhurst
11 Ayston Road, Uppingham, Oakham, LE15 9RL

Client
Uppingham Estates Department c/o Conisbee

Title
Figure 3 - Aerial Photograph

Surveyed:		Drawn by:	MC
Checked by:	TA	Date:	October 2023

Scale [A4 Sheet]	Drawing Reference
Not to Scale	UK23.6614_03

Job No	Rev
UK23.6614	01

KEY:

- SITE BOUNDARY
- EPS WINDOWLESS SAMPLE BOREHOLE WITH GROUNDWATER MONITORING PIPE
- EPS SHELL & AUGER BOREHOLE
- EPS DYNAMIC CONE PENETRATION TESTING
- EPS TRIAL PIT / SOAKAWAY
- EPS FOUNDATION EXPOSURE

Rev	Date	Drawn	Description	Ch'kd

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Site: Uppingham School, Meadhurst
11 Ayston Road, Uppingham, Oakham, LE15 9RL

Client: Uppingham Estates Department c/o Conisbee

Title: Figure 4 - Exploratory Hole Location Plan

Surveyed:		Drawn by:	MC
Checked by:	TA	Date:	October 2023
Scale [A4 Sheet]	Not to Scale	Drawing Reference	UK23.6614_04
Job No	UK23.6614	Rev	01

TABLES

Table 1 – Environmental Laboratory Testing Schedule

Sample ID	Sample Depth (m bgl)	EPS Mini Suite	EPS Waste Suite
WS01	0.0-0.4	-	1
WS02	0.0-0.4	1	-
WS03	0.0-0.4	1	-
WS03	1.6-2.0	-	1

***Notes*:**

m bgl	meters below ground level	EPS Mini Suite	Organic Matter, Cyanide, Metals, PAH's, Phenols and Asbestos Screen
1	Sample Taken	EPS Waste Suite	Waste Acceptance Criteria
-	Sample Not Analysed		

Table 2 – Geotechnical Laboratory Testing Schedule

Sample ID	Sample Depth (m bgl)	pH & Water Soluble Sulphate	Liquid & Plastic Limits	Particle Size Distribution	Bulk Density	EPS Geotechnical Suite
BH01	4.0	1	-	1	-	-
BH01	8.0	1	1	-	-	-
BH01	9.5	-	-	-	1	-
BH01	14.0	1	1	-	-	-
BH01	14.5	-	-	-	1	-
BH01	6.5	-	-	-	-	1
BH01	13.0	-	-	-	-	1
WS01	3.8-4.0	1	-	1	-	-
WS02	0.8-1.0	1	-	1	-	-
WS03	1.8-2.0	1	-	1	-	-
WS03	2.0-3.0	-	-	-	1	-

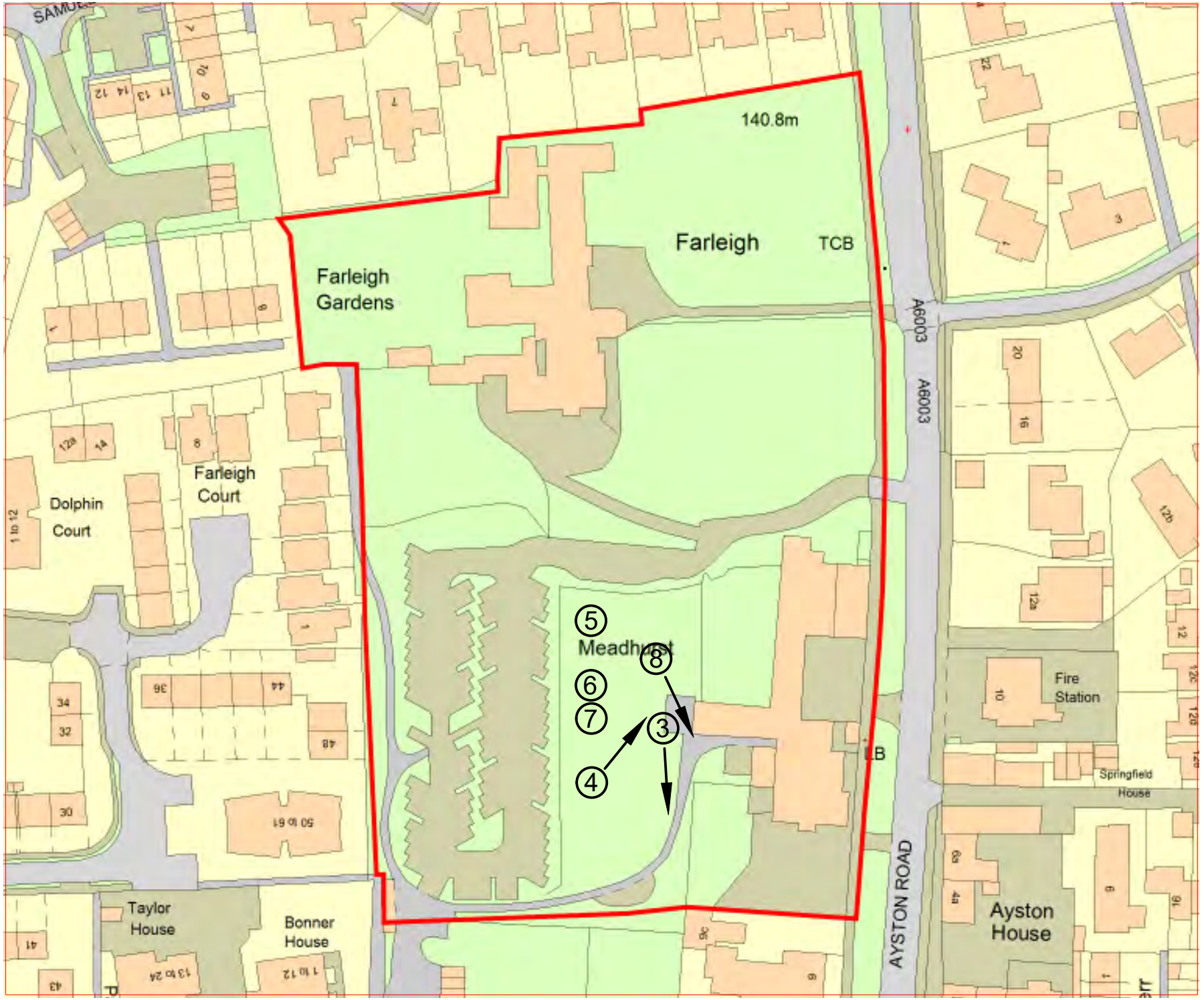
Notes:

m bgl	meters below ground level
1	Sample Taken
-	Sample Not Analysed

APPENDICES

APPENDIX A

Selected Site Photographs



N

KEY:

- SITE BOUNDARY
- DIRECTION OF SITE PHOTOGRAPH
- SITE PHOTOGRAPH NUMBER

Rev	Date	Drawn	Description	Ch'kd

The Geotechnical and Environmental Engineers
www.epstrategies.co.uk

Site: Uppingham School, Meadhurst
11 Ayston Road, Uppingham, Oakham, LE15 9RL

Client: Uppingham Estates Department c/o Conisbee

Title: Appendix A - Site Photographs

Surveyed:		Drawn by:	MC
Checked by:	TA	Date:	October 2023
Scale [A4 Sheet]	Not to Scale	Drawing Reference	UK23.6614_05
Job No	UK23.6614	Rev	01

Photo 3 – A photo looking south over the area west of Meadhurst.

Photo 4 – A photo looking north-east towards Meadhurst.

Photo 5 – A photo showing the material recovered from WS01.

Photo 6 – A photo showing the material recovered from WS02.

Photo 7 – A photo showing the material recovered from TP01 and the 'soakaway' infiltration testing.

Photo 8 – A photo showing the southern side of Meadhurst.

Job No.	UK23.6614
Date	31/08/23
Who?	MC

To be completed by consultant for all Phase I Desk Studies and completed form must be scanned/photographed and saved in job folder under 'Scanned Site Notes'. EPS Lower Risk Assessment (EPS025a) also must be completed and scanned.

Site Walkover Checklist V3.0

Geotechnical		COMMENTS
	Are there any abrupt changes in slope profiles?	None Seen
	Is there evidence of overburden on the slopes?	None Seen
	Is there evidence of excavation at the base of a slope?	None Seen
	Are there signs of landslip, such as tilting trees/posts?	None Seen
	Are there signs of subsidence?	None Seen
	Is there evidence of cracked ground?	WITHIN CONCRETE HARDSTANDING NEAR MEADOWVIEW BUILDING
	Is there evidence of compressible ground (i.e. Peat)?	None Seen
	Is there evidence of an abrupt change in ground conditions?	ONLY FROM SOFT LANDSCAPE TO HARD STANDING
	Is there evidence of high groundwater, such as areas of waterlogged ground?	None Seen
	Do signs of water loving plants such as reeds exist?	None Seen
	Are there any ponds, streams, ditches (even if dry), springs or wells?	None Seen
	What is the nature of the vegetation?	MAINTAINED LANDSCAPING HEDGEROWS GRASSES / LAWNS PLANTED SHRUBS JUNIPER TREES + SEVERAL LARGER MATURE ONES
	Species & Height of trees	LARGE = CONIFERS SMALL = DECIDUOUS POPULAR / OAK
	What is the nature and condition of vegetation on adjoining land?	SIMILAR ALL MAINTAINED
	Is there evidence of former vegetation?	None Seen

Job No.	
Date	
Who?	

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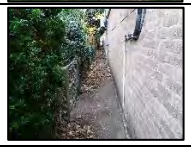
	Is there evidence of movement in any existing structures?	None Seen
	Evidence of below ground structures & services?	MULTIPLE LOCAL DRAINS + ELECTRIC CABLES/ LAMPPOSTS.
	Any evidence of mine shafts or adits? (Check Coal Authority Mapping)	None Seen
	Is there any access issues for a digger/drilling rig (slopes, height, gates etc.)?	POTENTIALLY POOR BIG RIG
Any other comments?		

Contamination		**COMMENTS**
	Evidence of ground contamination?	None Seen
	Evidence of groundwater /surface water contamination?	None Seen
	Evidence of historic site use?	SHEDS WITHIN PRIVATE GARDEN.
	Have all buildings been accessed internally, what was found?	NO BUILDINGS ACCESSED
 	Evidence of /suspected asbestos? In building fabric or on ground, describe condition and form (cement/fibrous).	None Seen UPDATE RAMS & WEAR PPE IF REQUIRED – DO NOT CLOSELY INSPECT OR DISTURB
	Any man-made surfacing present? Including bituminous road planings/scalpings. Describe condition of hardstanding.	HARDSTANDING PRESENT WITH CRACKS ROAD IN GOOD CONDITION.

Job No.	
Date	
Who?	

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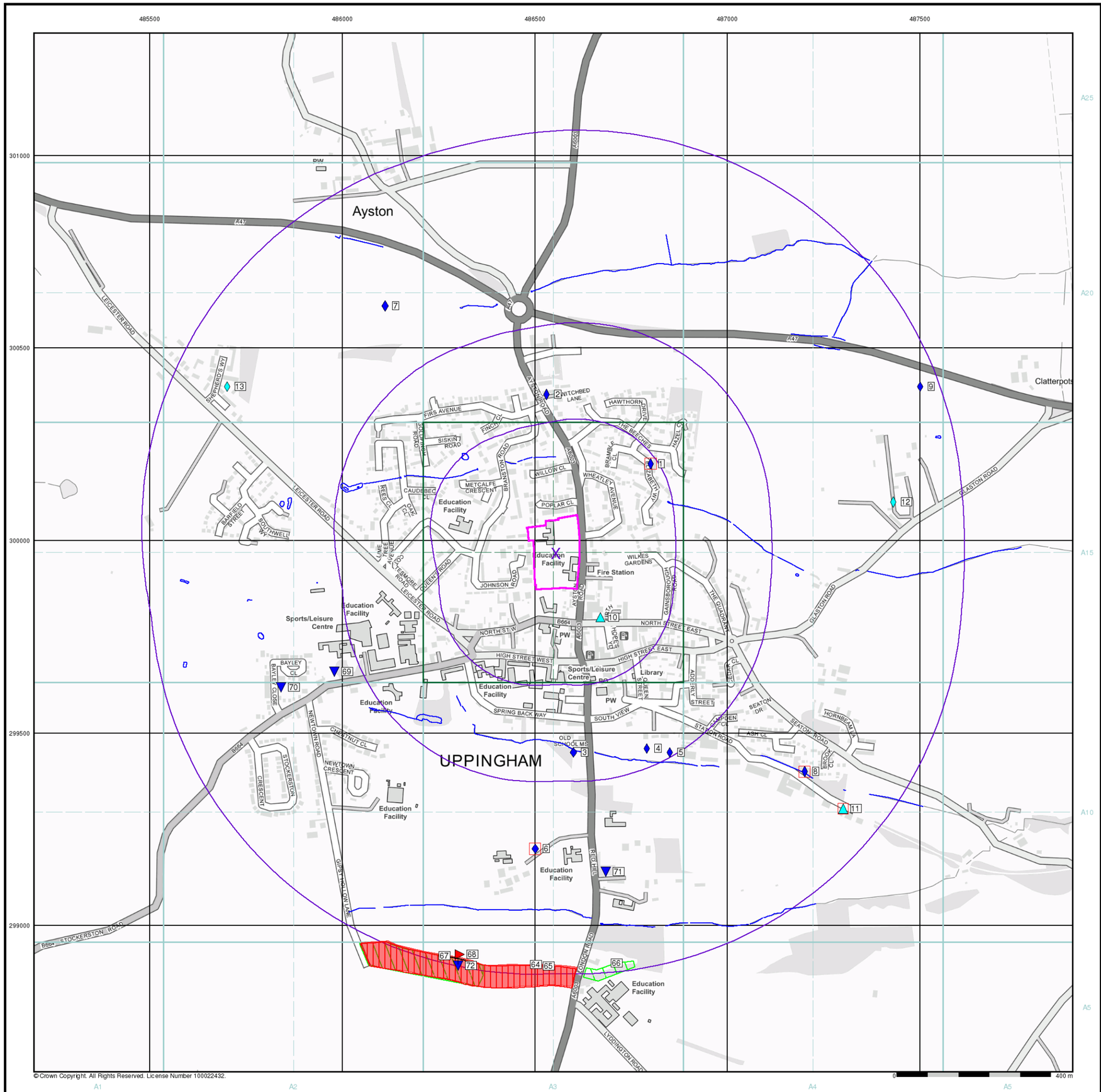
	Any fuel or oil storage? If above ground, are tanks bunded/ steel/with above ground pipe or any staining?	None Seen
	Obvious drainage features observed such as 3-chamber oil-water interceptor?	YES VARIOUS DRAINS FEATURES STRUCTURES.
	Any waste deposition observed, such as fly-tipped soils or chemical containers/ drums or areas of burning?	None Seen
	Electricity substation present, maintained/operational? Are there any warning stickers on the gates/fence regarding chemicals?	SMALL JUNCTION BOX NEAR BARRIER
	Evidence of previous investigation/remediation (e.g. old monitoring wells)?	KNOWN TO BE NEARBY BUT NOT PRESENT / VISIBLE.
	Walked around surrounding areas? Identify any off-site sources such as petrol stations, heating oil tanks.	None Seen
	Anecdotal evidence	None Seen
Any other comments?		

Air Quality (ONLY NECESSARY IF INSTRUCTED – CHECK WITH AQ TEAM)	
Completed Air Quality Walkover Checklist?	Yes/No

APPENDIX B

Surrounding Land Use



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General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Hazardous Substances

COMAH Site | Explosive Site | NIHHS Site

- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

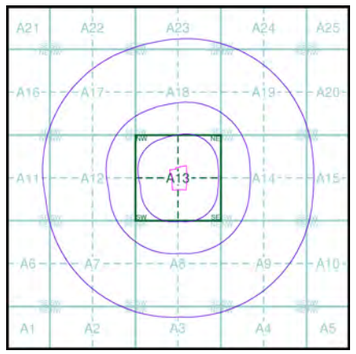
Geological

- BGS Recorded Mineral Site

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Site Sensitivity Map - Slice A



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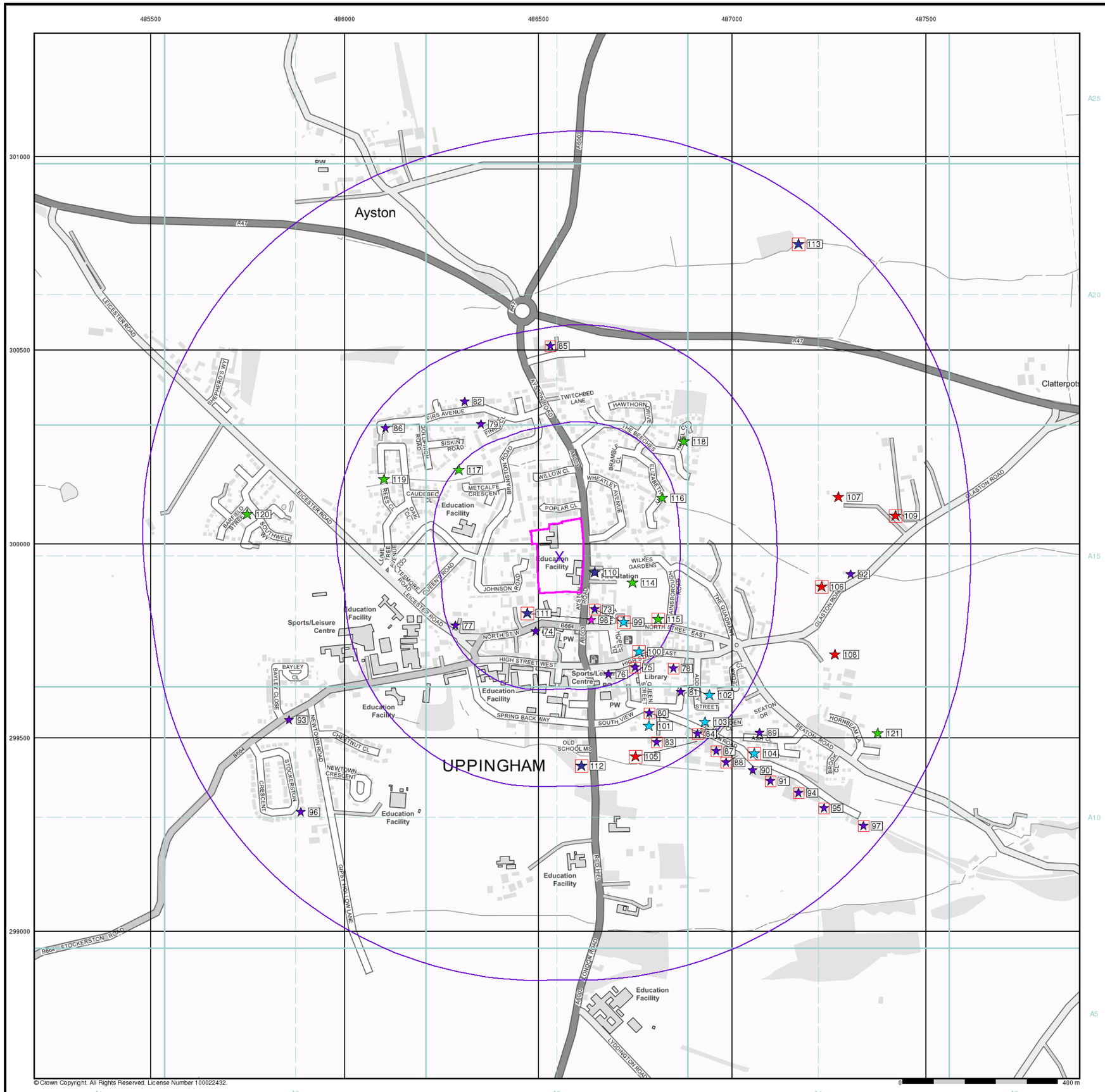
Search Buffer (m):	1000

Site Details

Uppingham School, Meadhurst, Uppingham, LE15 9RP

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Industrial Land Use Map

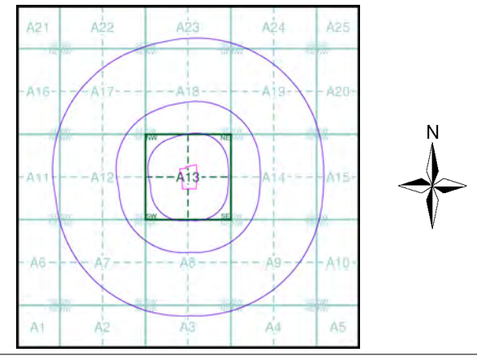
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry
- Gas Pipeline
- Points of Interest - Commercial Services
- Points of Interest - Education and Health
- Points of Interest - Manufacturing and Production
- Points of Interest - Public Infrastructure
- Points of Interest - Recreational and Environmental
- Underground Electrical Cables

Industrial Land Use Map - Slice A



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APPENDIX C

Geological Context

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	TILMP	Till, Mid Pleistocene	Diamicton	Not Supplied - Cromerian
	HEAD	Head	Clay, Silt, Sand and Gravel	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LLL	Lower Lincolnshire Limestone Member	Limestone	Not Supplied - Bajocian
	NS	Northampton Sand Formation	Sandstone, Limestone and Ironstone	Not Supplied - Aalenian
	GRF	Grantham Formation	Sandstone, Siltstone and Mudstone	Not Supplied - Aalenian
	WHM	Whitby Mudstone Formation	Mudstone	Not Supplied - Toarcian
	MRB	Marlstone Rock Formation	Limestone, Ferruginous	Not Supplied - Pliensbachian
		Faults		

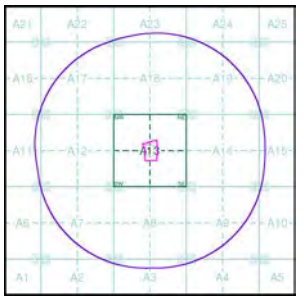
Geology 1:50,000 Maps

This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.
The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**157**
Map Name:	**Stamford**
Map Date:	**1978**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Not Supplied**
Landslip:	**Available**
Rock Segments:	**Not Supplied**

Geology 1:50,000 Maps - Slice A



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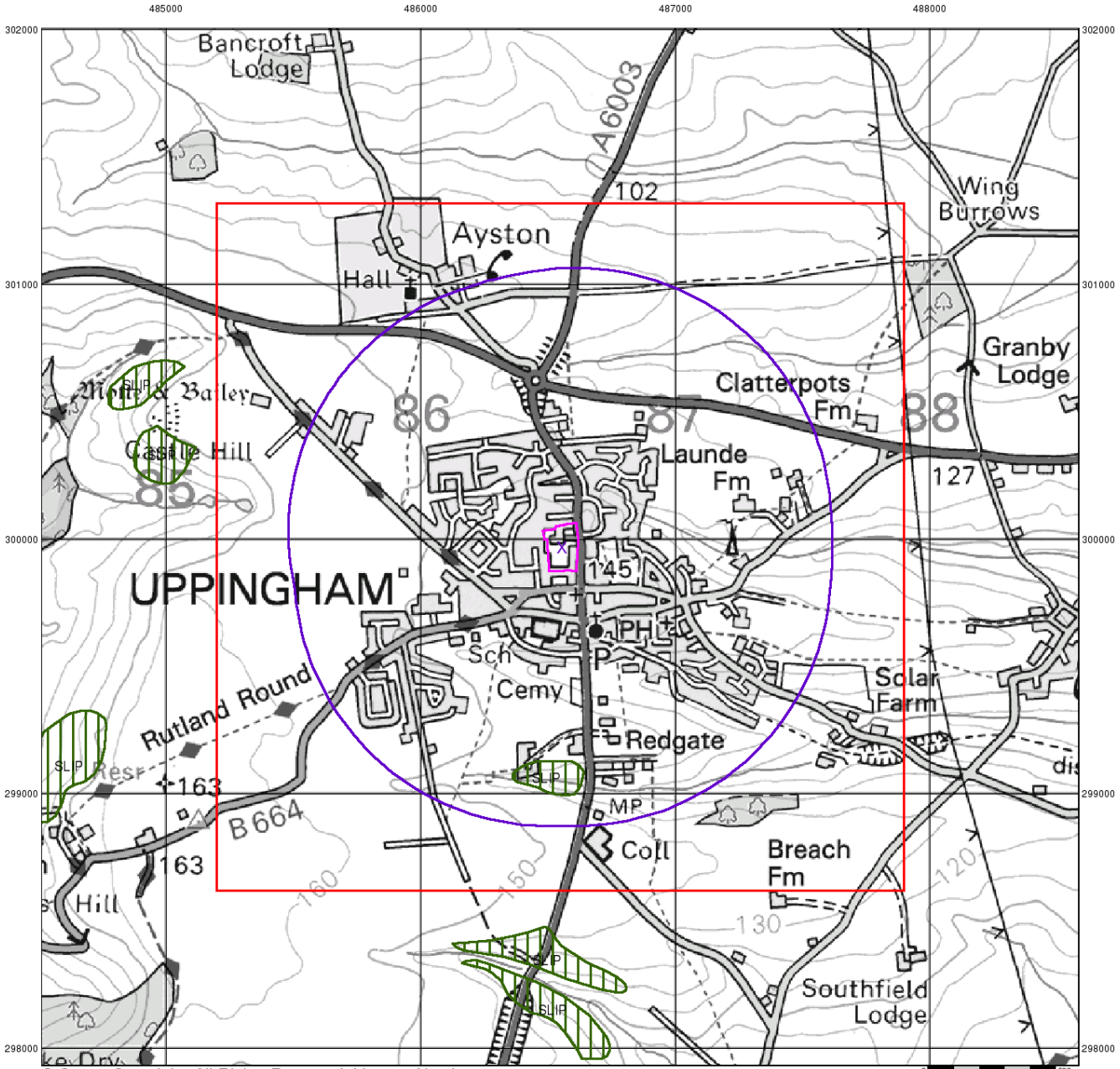

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Artificial Ground and Landslip

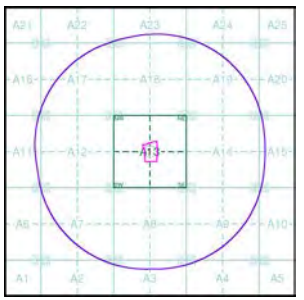
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A



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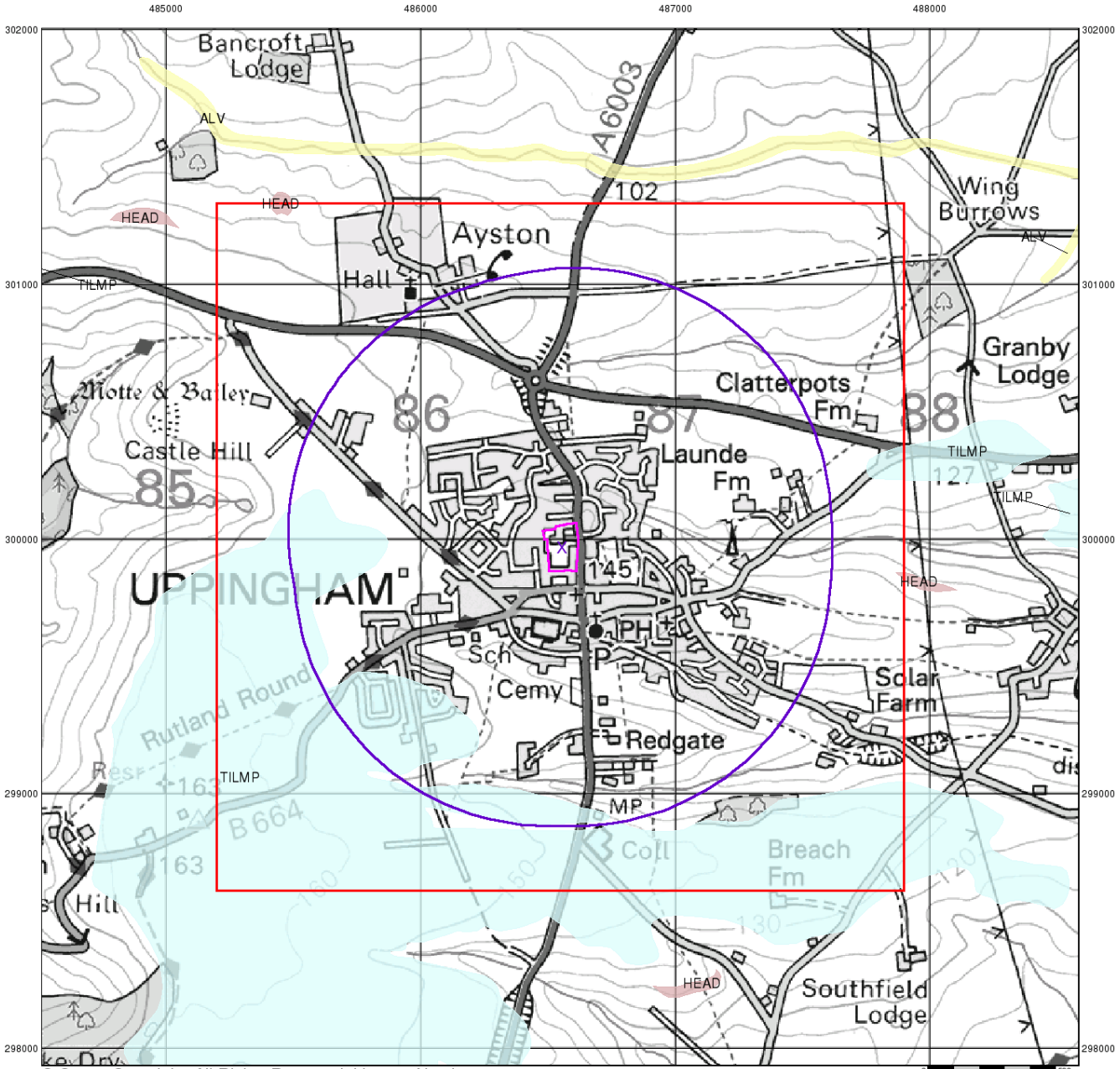

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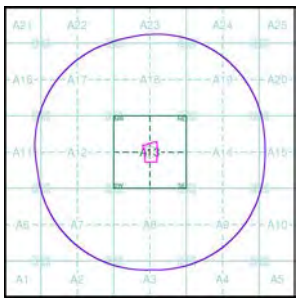
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



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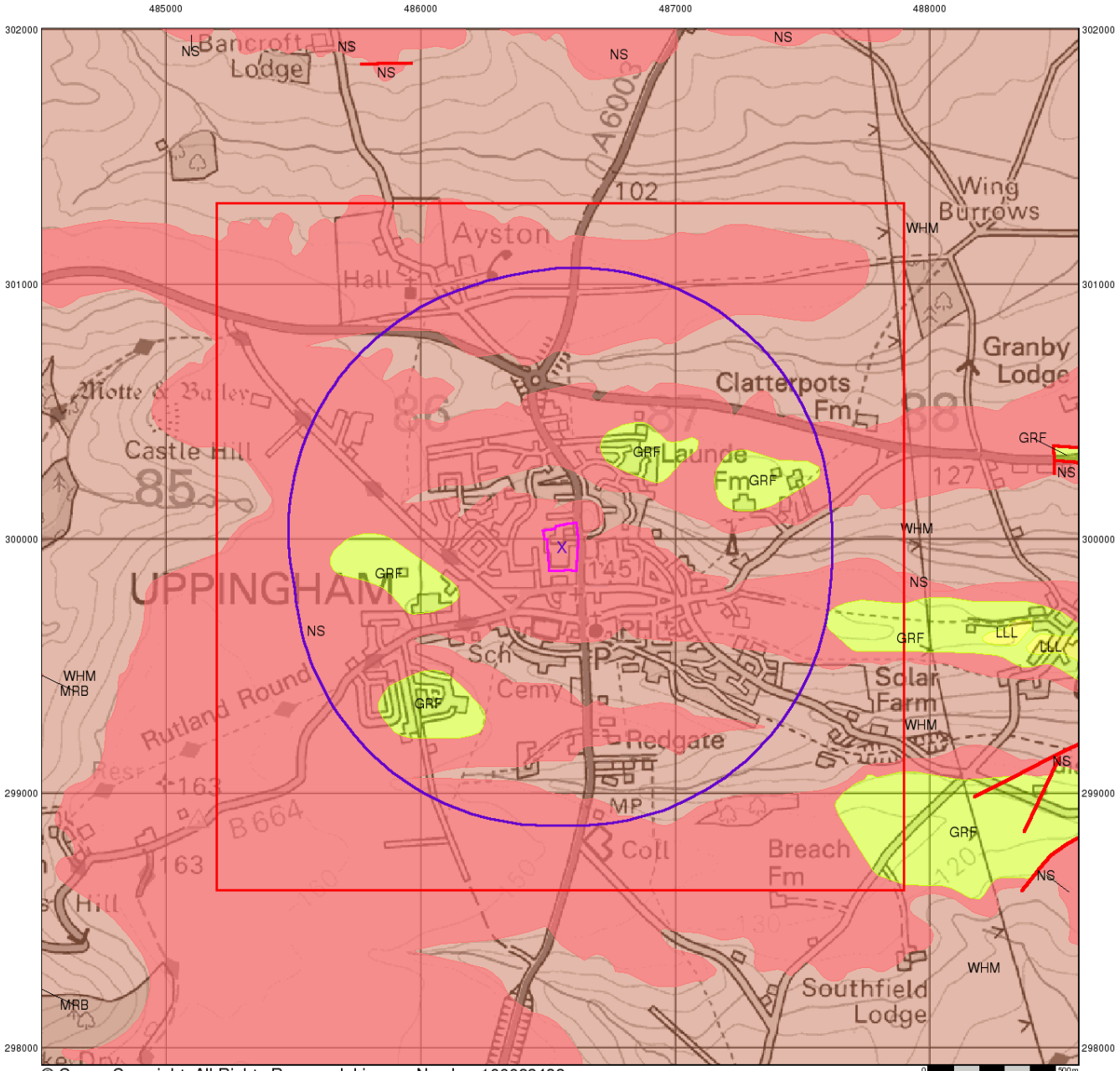


Bedrock and Faults

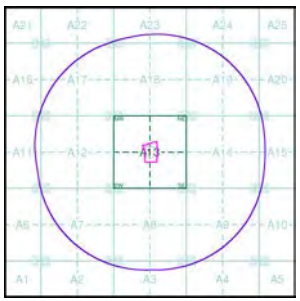
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A



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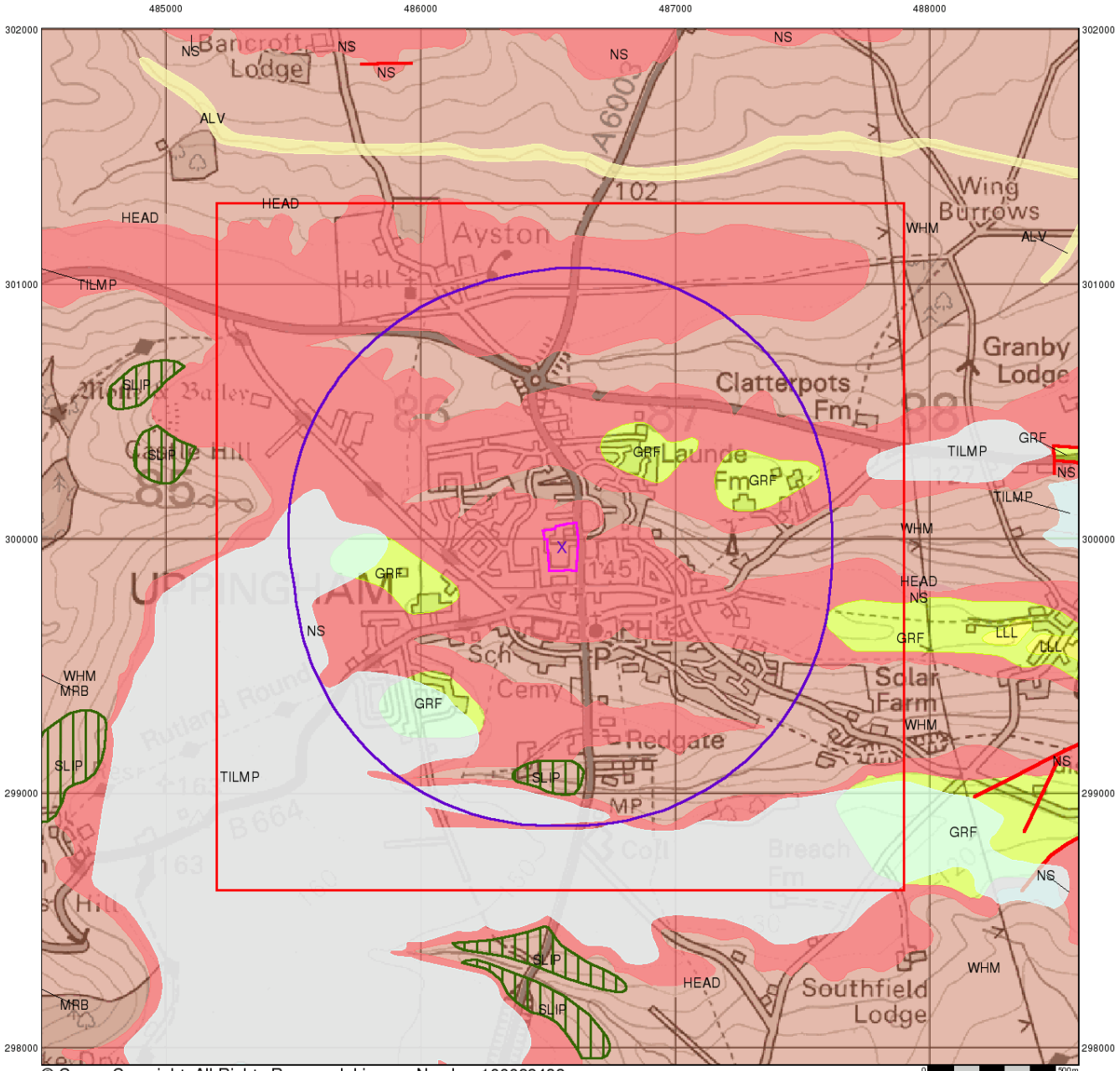

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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

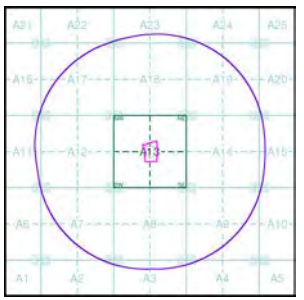
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



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Slice:	A
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Search Buffer (m):	1000

Site Details:

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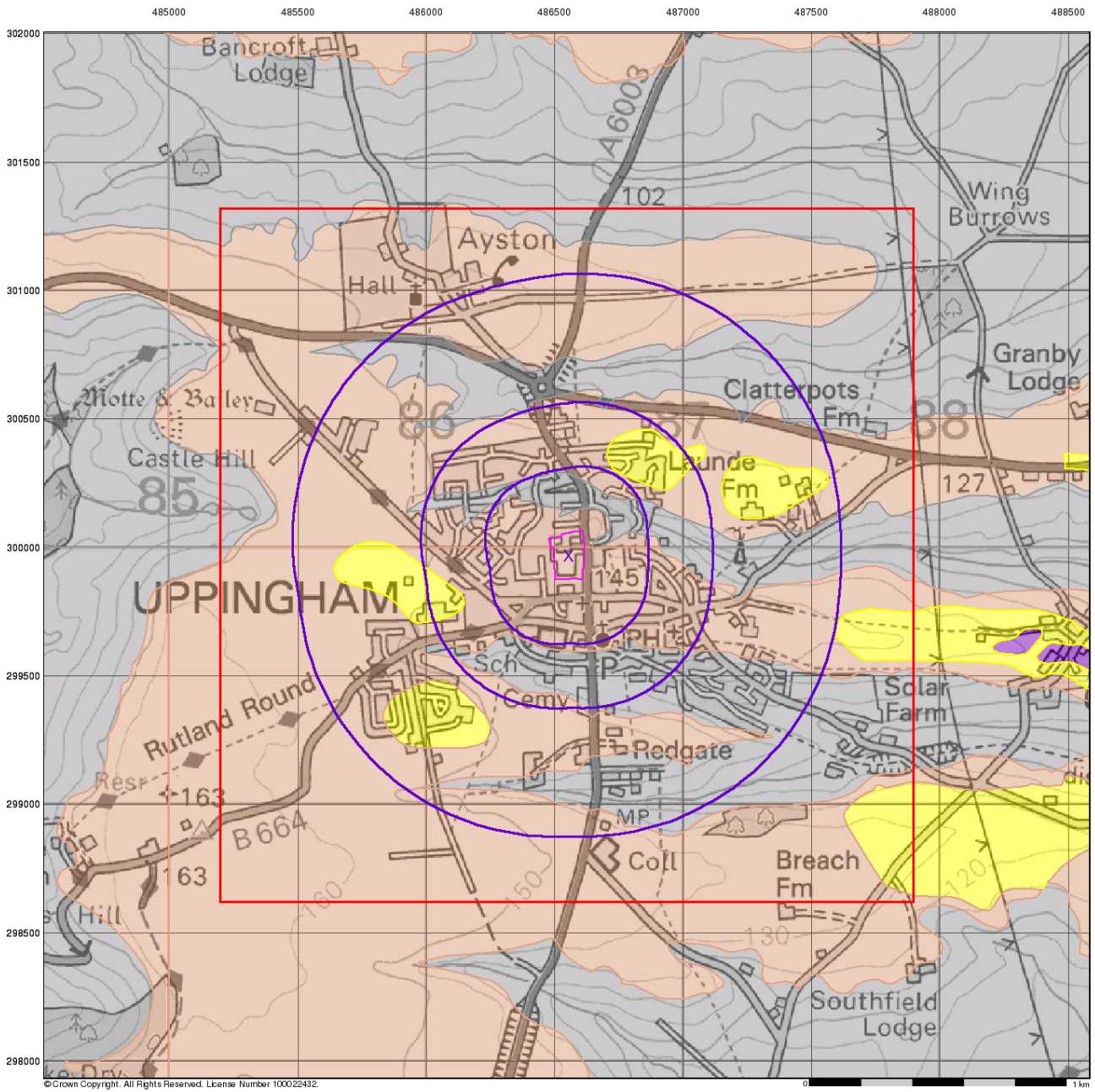
APPENDIX D

Groundwater Vulnerability and Flood Maps



Bedrock Aquifer Designation

General

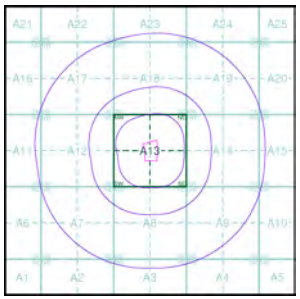
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



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Site Area (Ha):	2.1
Search Buffer (m):	1000

Site Details

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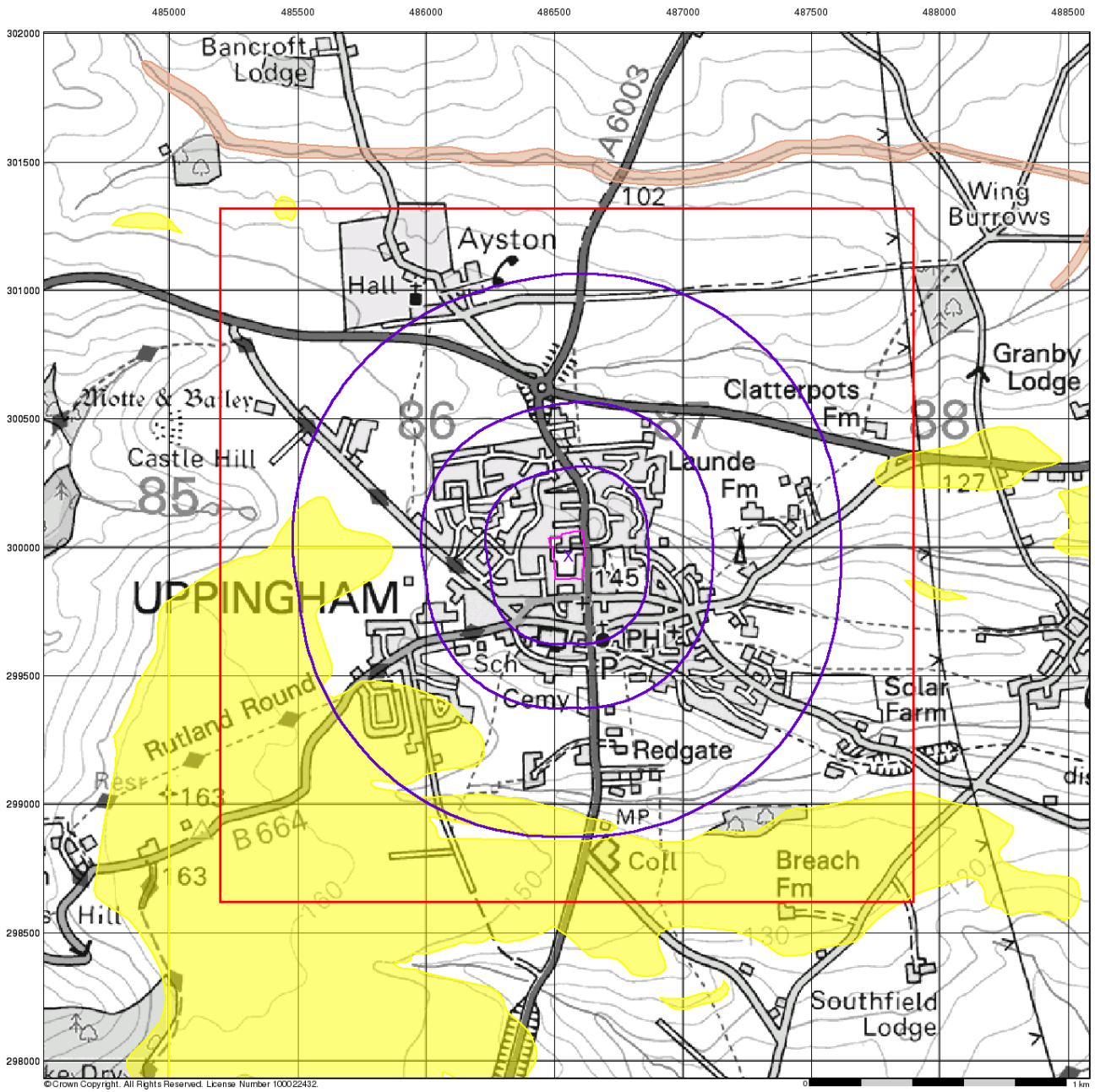


Superficial Aquifer Designation

General

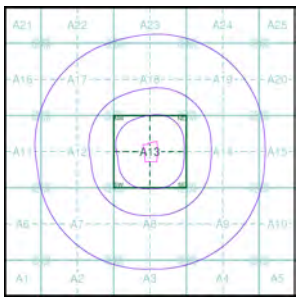
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



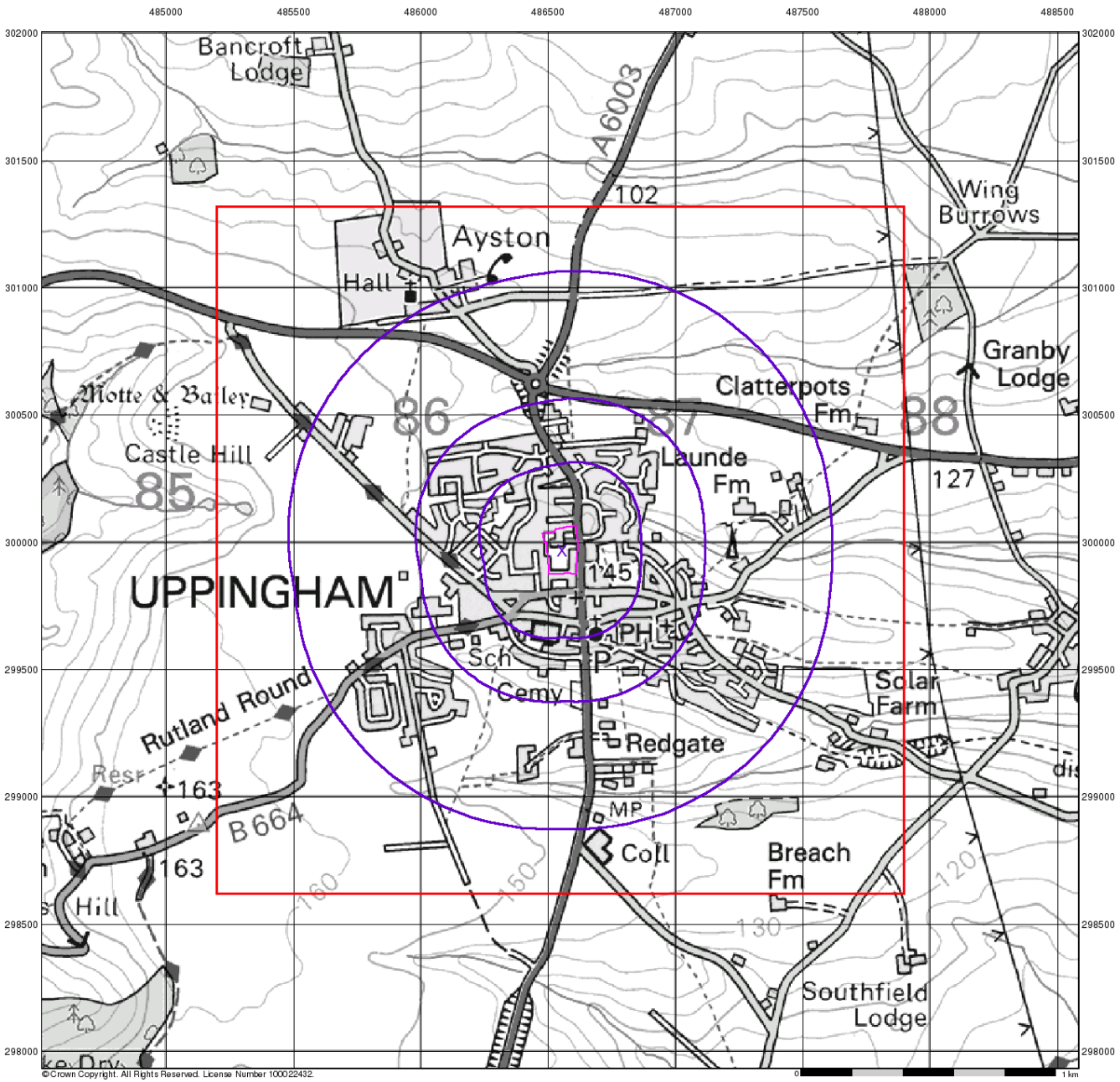
Order Details

Order Number:	315456184_1_1
Customer Ref:	UK23.6614
National Grid Reference:	486550, 299970
Slice:	A
Site Area (Ha):	2.1
Search Buffer (m):	1000

Site Details

Uppingham School, Meadhurst, Uppingham, LE15 9RP

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Source Protection Zones

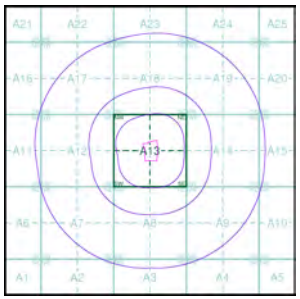
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



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