

1st March 2024

13508 – Havant Phase 2: - Engineers Response to planning condition 30

Application Summary: -

Reference: APP/22/00172

Proposal: Nature and Extent of Contamination on site.

Condition 30 requires the following:

Prior to the commencement of each phase of development hereby approved (other than any above ground site clearance, demolition of above-ground structures, or consequential works for the purpose of ensuring structural stability of retained construction-), an assessment of the nature and extent of contamination at the site, whether originating from within or outside the curtilage, shall be submitted to and approved in writing by the Local Planning Authority for that phase.

Phase 2 Considerations:

The intrusive site investigation carried out by Applied Geology has observed no visual or olfactory evidence of any gross contamination on site.

No elevated metals, phenols or BTEX have been detected in any of the samples tested.

No exceedances of TPH compounds were recorded in the samples tested, however one sample recorded a concentration of Total TPH >1000mg/kg within CP03 at 0.2m, with a concentration of 5000mg/kg. The trace was indicated in the TPH chromatogram from the laboratory as complex and does not match any standard petroleum product profile. There was no visual or olfactory evidence of contamination noted within the borehole. This sample was taken directly beneath the asphalt surfacing and was concluded that the sample may have contained fragments of asphalt which may be the source of the TPH.

Semi- Volatile Organic Compounds (SVOCs) were also recorded above the limit within the same sample as the highest TPH, taken from CP03 at 0.2m depth and also from the sample taken from within DCS02 at 0.2m bgl. It was also considered likely that fragments of asphalt was present in the samples of Made Ground sub-base which may be the source of SVOCs.

As the existing asphalt on site will be removed during the development of the site and existing site levels will be raised by circa 1.2m, this will act as a cover layer to mitigate the risk to end users and hence the hydrocarbon impacted soils are considered to pose low risk to end users. There is no indication the localised TPH had any impact on the underlying groundwater, and therefore this also poses negligible to low risk to controlled waters based on the context of the site and the proposed redevelopment.

The GA risk assessment has indicated a low risk to Human health and Controlled Waters receptors based on the proposed development. Therefore, no further action is considered warranted.

The Site Investigation Report carried out by Applied Geology, Report ref: AG3544-23-AR52 can be found appended to this note.

**REPORT ON
GROUND INVESTIGATION
AT
LANGSTONE TECHNOLOGY
PARK, HAVANT – PHASE 2**



REPORT STATUS SHEET

Client:	Havant S.a.r.l
Report Title:	Report on Ground Investigation at Langstone Technology Park, Havant – Phase 2
Report Number:	AG3544-23-AR52
Report Status:	Validated Issue 1
Date:	February 2024



		Date	Signed for and on behalf of Applied Geology Limited
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- Exploratory Hole Location Plan, Dwg No AG3544-23-02
- Langstone Phase 2 Proposed Site Plan, by PRC Dwg No 11629/PL004 Rev A, dated January 2024
- Proposed Levels Plan, by Baynham Meikle Dwg No. 13508-120 Rev P02 dated December 2023
- Topographical Survey by Greenhatch Group, Dwg. No. 38869D_T Rev 1 dated September 2023
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- Groundsure Report
- BGS Archive Borehole Records

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- Driven Continuous Sampling Borehole Logs
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FIELD MONITORING AND IN SITU TEST RESULTS

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LABORATORY TEST RESULTS & DATA SHEETS

- Chemical Test Results Summary Sheets
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APPENDIX F

STANDARD FIELDWORK AND ASSESSMENT PROCEDURES

1.0 INTRODUCTION

1.1 Objectives and Scope of Investigation

An area of land at Langstone Technology Park, Havant (the site) known as Phase 2, is being considered for redevelopment by Havant S.a.r.l (the Client). The proposals for the site comprise the construction of three new industrial units with associated service yards and car parking.

The Langstone technology park has been subject to a previous desk study by Delta-Simons in 2019 and subsequent intrusive investigations and reports by Clancy Consulting in 2019/2020. Applied Geology has also previously undertaken a supplementary geotechnical ground investigation across an adjacent area of the Langstone Technology Park to the west, reported in AG3286-21-AM72 v1 dated August 2021 for a different client.

Applied Geology was appointed by the Client to undertake a desk study/Phase I assessment and Phase II ground investigation in order to:

- assess the potential for hazardous substances or conditions to exist at the site that might warrant mitigation or remediation appropriate to the intended end use proposed by the Client.
- establish geological conditions and geotechnical parameters to assist in the safe and economic engineering design of the proposed development.
- support the planning application (outline planning has been granted for the development of the wider Technology Park ref APP/22/ 00172).

The terms of reference/brief for the works were mutually developed between Baynham Meikle (the Client's Engineer) and Applied Geology and are outlined in our proposal and estimate reference AG23-8468let002 dated 27th July 2023.

The scope of works undertaken by Applied Geology comprised:

- A site inspection and walkover survey
- A review of the following desk study sources:
 - ❑ GroundSure – GeoInsight & EnviroInsight environmental databases.
 - ❑ GroundSure – MapInsight historical maps.
 - ❑ British Geological Survey (BGS) - published information & on-line borehole database.
 - ❑ Online aerial images.
 - ❑ Previous 3rd party reports:
 - Delta-Simons, Phase I Environmental Assessment Project No. 15-0754.07, initially dated May 2019 and updated in November 2020;
 - Clancy, Geo-Environmental Appraisal Report ref. 10/1425/001, dated October 2019;
 - Clancy, Supplementary Site Investigation Report ref. 10/1425/004 Rev 00, dated September 2020;
 - Clancy, Remediation Strategy Report ref. 10/1425/005 Rev 00, dated November 2020.

- Ground investigation together with sampling, monitoring and a programme of laboratory testing.
- Assessment and reporting of the results of the works.

Underground service plans for the site were obtained by Applied Geology on 18th October 2023. A topographic survey drawing was undertaken by Greenhatch Group Dwg. No. 38869D_T Rev 1 dated September 2023 and was provided for review.

1.2 Report Layout

This report presents a brief description of the site, the desk study data and the factual results of the intrusive investigations carried out. An interpretation of the ground conditions and a discussion/assessment of the findings is presented in the later report text sections. The main text of the report has been produced in a concise format, including the use of data tables to summarise key information where possible. The report should be read in conjunction with the general procedures detailed in Appendix F and General Notes given at the end of the main text, which provide details of investigation techniques, assessment methodology and standards, health & safety and limitations and exceptions of the report. Drawings and factual data including exploratory hole records, laboratory testing results and desk study records are presented in the other Appendices.

2.0 SITE DESCRIPTION AND PROPOSALS

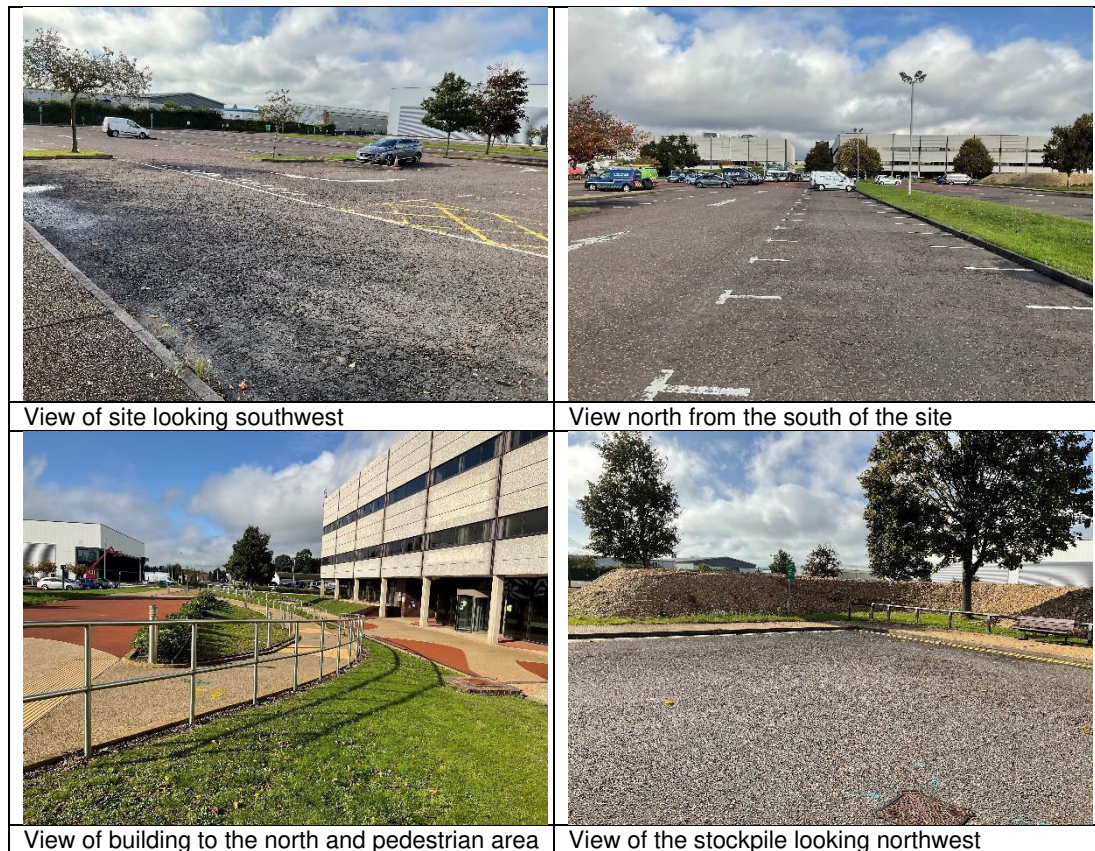
2.1 Site Description

The proposed development site (Phase 2) is located in the southeast of Langstone Technology Park, and is accessed via unnamed access roads leading off Langstone Road in the east and Brookside Road in the west. The site is c.1km south-west of Havant town centre and the Ordnance Survey grid reference for the centre of the site is approximately 471343 105557 as shown on the Site Location Plan (AG3544-23-01) in Appendix A.

The site is roughly rectangular shape in plan and measures c.130m and c.100m at the longest and widest extents, covering an area of approximately 1.1Ha. The topographical survey (undertaken by Greenhatch Group) indicates site levels of between c.4.2m AOD in the south and c.5.3m AOD in the north with a stockpile/ earth mound on site in the north c. 1.5m high, and some small landscaped mounds in the east c. 0.3-0.5m high.

A site walkover was carried out on the 20th of October 2023 and at the time of the walkover and subsequent intrusive works, the site remained an active ground level car park for the adjacent industrial units with a capacity for around 500 vehicles. However, the car park seemed to mostly be disused with the exception of a handful of vehicles during the visit.

The majority of the car park was laid to asphalt surfacing with some new resin bound gravel surfacing in the north in a pedestrianised area. Grassed landscaped areas were present dispersed throughout the car park and around the perimeter, with a larger grassed area in the north which was occupied by a stockpile of soil. Semi mature to mature trees were also located intermittently around the landscaped areas. Electrical lighting was noted around the perimeter of the site, and several manholes for underground services were also noted.



To the north of the site was an industrial building (Building 6000), to the east was an access road with an area of woodland beyond, to the south was Endeavour Business Park comprising a complex of commercial/industrial units and car parking, and to the west was the car park for the recently constructed Industrial Units 3 and 4 beyond.

2.2 Site Proposals

The proposals comprise the redevelopment of the existing car park site in the south-east of the Langstone Technology Park (known as Phase 2) with the construction of three new commercial/industrial units, together with associated yard/loading areas, car parking and some soft landscaping - mainly along the northern, eastern and southern boundaries of the site. The proposed location and layout of the intended development is detailed on PRC Architecture and Planning's drawing referenced 11629/PL004 Rev A, dated January 2024, presented in Appendix A.

Finished floor levels are proposed to be 5.5mAOD as it is understood that site levels will need to be raised in the order of 0.6-1.2m due to flood risk issues. Short sections of retaining wall will also be incorporated into the design, including a section c.39m long and 0.7m high at the southern boundary and another 5m long and 0.45m high at the northwest boundary, as shown on 'Proposed Levels Plan' by Baynham Meikle, Dwg No. 13508-120 rev P02 dated December 2023, presented in Appendix A.

3.0 DESK STUDY INFORMATION

3.1 Desk Study Summary Table

The desk study findings are summarised in the table below with the full Groundsure Report and selected Historical Ordnance Survey Maps included in Appendix B.

Site History	▪ 1869 – The Phase 2 site is shown as undeveloped fields with a drainage channel/watercourse crossing the northern area of the site, trending E-W. Another drainage channel/watercourse is shown to cross the northwest corner of the site and continue 10m north of the site. Mill Stream is shown 45m east trending roughly N-S with a flow to the south. Sluices are shown 20m west and 50m east. Another watercourse is shown 60m south. ▪ 1897-1898 – No notable change to the site. An aqueduct is labelled 50m west. ▪ 1909 to 1968 – No notable changes to site. A sewage works was present 150m north by 1909 with filter beds and an Engine House. This was expanded by 1932 and again by 1952 with additional tanks and filter beds. Allotment gardens are shown adjacent to the north of the site in 1952 but are shown as overgrown scrubland by 1968. Residential development occurred to the east of the Mill Stream by 1968. ▪ 1972-1975 – An unspecified works has been developed in the northern half of the site extending offsite to the west. An electric substation is shown on site in the west. An access road is present along the northern boundary. The southern half of the site remains undeveloped although may be hardstanding for car parking. The drainage channels on site are no longer shown and may have been infilled, diverted or culverted. Additional works have been constructed on land north of the site with slopes shown around the buildings indicated the site has been raised to create a development platform. A pumping station is shown 220m east and a plastics factory is shown 225m west. Additional residential development has occurred east of the Mill Stream. ▪ 1987 – The works on site have been demolished and the site has been developed as a car park which extends offsite to the west. An additional building has been constructed on the works site to the north. The electric substation on site is no longer shown. ▪ 1990-1993 – No notable changes to site. Several additional works buildings are shown c.180m west with a sewage works beyond. Three round tanks are shown c.180m west. ▪ No further significant changes to present day. Aerial imagery from 1999 shows the site developed as a car park with some discrete grassed areas and occasional trees dotted around the site. There are no further changes to the present day with the exception of the trees increasing in size. Additional works buildings were developed on land south of the site by 2004.
Anticipated Geology and Ground Conditions	▪ The Published BGS Map indicates the development site to be underlain by a sequence of superficial deposits comprising Alluvium (clay, silt sand and gravel), overlying Head deposits (clay and gravel) and then River Terrace Deposits (sand, silt and clay). The Superficial deposits overlie Solid Geology of the Lewes Nodular, Seaford, Newhaven, Culver, and Portsdown Chalk Formations (Undifferentiated), herein after referred to as Undifferentiated Chalk. A variable thickness of Made Ground is anticipated from previous development. ▪ The nearest BGS archive borehole is located in the north of the development site (ref. SU70NW107) and indicates topsoil overlying firm dark grey calcareous silty clay with gravel to 1.14m below ground level (bgl), dense becoming very dense flint gravel with grey sand to 3.58m underlain by firm light grey and brown sandy clay with chalk to 4.3m bgl overlying chalk to 8.5m bgl where the borehole terminated. Water was encountered at 2.6m bgl. ▪ The ground conditions encountered during previous investigations are described in Section 3.3.

Radon	The site is not in a radon affected area, with between 1% and 3% of homes above the Action Level. No radon protection measures are required for new properties.
Mining/Quarrying	- The site not indicated to be within area of underground coal or other mining. - There are 23 No. surface ground workings recorded within 250m of the site, mainly associated with the sewage works. An unspecified heap is recorded 11m north. - The site is recorded to be in an area at risk of soluble rocks, although no natural cavities are recorded within 250m. The presence of superficial deposits over chalk beneath the site could indicate the potential for natural cavities.
Hydrology	- The nearest surface watercourse is a river 45m east noted to be called the Mill Stream on historic maps but is noted to be called the Lavant Stream on recent mapping and on websites for the local area. The watercourse drains into the harbour 880m south. Several other drainage channels and small watercourses are record within 250m of the site. - Water quality data available for the Lavant Stream indicates a Poor overall rating (ecology-poor, chemical -fail) in 2019. - There are no surface water abstractions within 500m of site. - There are no current licensed discharges with 500m of site. - The site is outside of any floodplain for rivers or seas, however, there is a risk of surface water flooding in the south-west of the site (1 in 100yr, 0.1-0.3m) and a high risk of groundwater flooding across the southwest area of the site and a moderate to high risk in the north and east.
Hydrogeology	- The Superficial Deposits underlying the site are classified as a Secondary A Aquifer. The Undifferentiated Chalk is a Principal Aquifer. The area is considered to have a high vulnerability. - The nearest groundwater abstraction license is 795m north for potable water supply at a max daily volume of 137,000m³. - The site is not within a Source Protection Zone, however, an Inner Catchment Source Protection Zone for a potable water supply is located 435m northeast. - Localised groundwater is likely to flow to the east/south-east towards the River. However, more regional groundwater flow direction is likely to the south, towards the harbour.
Other Environmental data	- There are no historical or current landfills within 250m. The nearest historical landfill is 'Land South of Budds Farm' located 370m southwest. No further details are available. - A waste transfer station was recorded 170m north associated with a historic planning application for construction of a waste compactor housing and consumables store. A former WEEE treatment facility is also recorded 172m northwest, but the license was surrendered in 2013. - There are 34No. current industrial land uses recorded within 250m. Of relevance to the site, there is an electricity substation 15m south, as well as an electrical repairs facility 31m south and a marine engineers 32m south. - There are no current or former recorded petrol/fuel sites or garages within 250m. There are c.4No unspecified tanks recorded on historical maps within 100m of the site, located at 57-59m north and 73-75m east. - An electricity substation was recorded on site between 1972 and 1984. - There are no recorded pollution incidents within 250m. - The site is within a Nitrate Vulnerable Zone. - There are no other environmentally sensitive ecological designations within 250m of the site. Langstone Harbour, 335m south is recorded as a SSSI, RAMSAR and SPA.
Geohazards	- There is a moderate risk of compressible deposits in the area of the site. - There is a low risk of shrink-swell clays, running sands and collapsible deposits. - There is a very low risk of landslides and ground dissolution.
Railways and tunnels	There are no current or historical railways or tunnels within 250m of the site.

3.2 Unexploded Ordnance (UXO) Risk

The Zetica UXO risk map indicates a moderate risk of UXO in the area of the site.

A Detailed UXO Risk Assessment was undertaken for the wider Technology Park by 1st Line Defence as part of the initial Phase I Environmental Assessment, undertaken by Delta Simons. The report identified a medium risk of German aerial delivered UXO and anti-craft UXO and a low to medium risk of Allied Ordnance. The report confirmed that it was necessary to employ on-site UXO risk mitigation measures during the intrusive works, consisting of supervision of the investigation works by a Specialist UXO contractor (which was done by EOD Contracts Ltd), including downhole magnetometer surveys of the boreholes.

3.3 Previous Reports

The wider Langstone Technology Park and some discrete areas within the park intended for recent and future redevelopment have previously been the subject of a desk study and subsequent phases of intrusive investigation. A Remediation Strategy Report has also been produced. Copies of the reports listed in Section 1 have been made available (without reliance) to Applied Geology Ltd for review, in order to inform the current assessment with respect of the proposed redevelopment.

In addition to the reports listed previously, further 3rd Party reports are understood to have been produced for the wider Technology Park site, however copies of these reports have not been made available to Applied Geology. They are, however, briefly summarised within the Phase I Environmental Assessment produced by Delta-Simons.

- Soils Limited Ground Investigation, dated 1994;
- STATs Site Investigation Report, dated 2003;
- WSP, Phase 1 Environmental Assessment, dated 2005.

All reports are summarised in chronological order below:

Soils Limited Ground Investigation, dated 1994.

The Delta-Simons report included extracts only with no site plans or context of the assessment. However, it noted that the investigation was for land off site to the south of the Technology Park.

Significant contamination was not identified in soil samples. Faecal coliforms were identified in one groundwater sample, likely associated with the off-site sewage works or damaged foul drainage pipe. No significant elevated ground gases were recorded. A landfill was noted as being located to the west (this possibly relates to Budds Farm historical landfill located 370m southwest of the Phase 2 site).

A piled or ground improvement foundation solution was recommended.

STATs Site Investigation Report, dated 2003.

The report relates to the north-western corner of the Technology Park (outside the current area of intended redevelopment) in relation to a proposed paved car parking area and roundabout, which does not appear to have ever been constructed.

The assessment comprised a combined Phase I desk study and Phase II ground investigation comprising the excavation of thirteen trial pits and eight dynamic cone penetration tests. No exploratory hole location plan was provided.

An underground concrete tank was encountered assumed to be associated with the former sewage works, which was found to be in-filled with clayey sand and demolition-type rubble. Notable concentrations of copper and zinc were recorded, although below the Delta-Simons screening criteria and all contaminants were found to be below screening criteria adopted by STATS.

The geotechnical hazards reported included shrinkable clay soils, compressible soils, sub-surface obstructions, Made Ground and silt-rich soils.

The report identified that buried concrete should be designed to Sulphate Class DS-1, with an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1.

An equilibrium CBR value of 6% was recommended for the site, although it is not understood whether this was assigned to one particular stratum.

The report considered the site to be of a “moderately low subsidence risk” from potential chalk dissolution features/cavities and stated that the Edmund’s database of known natural and man-made chalk solution features, did not identify any such features within the boundaries of the Technology Park or the immediate area of the site.

WSP, Phase 1 Environmental Assessment, dated 2005.

The report was commissioned as part of a due diligence exercise during the purchase of part of the Technology Park. Potentially contaminative activities identified during a site walkover were limited to the storage of diesel in two above ground tanks (total capacity 3,000l) and the storage of waste materials.

The WSP report also reviewed other previous reports including:

- An Environmental Monitoring Program by CASELLA Ltd in 1999 which recorded potential issues associated with low concentrations of Toluene and hydrocarbons from effluent monitoring, chlorinated solvents in groundwater, and copper contamination in concrete slab. It was noted by WSP that the effluent treatment facility had been decommissioned, the groundwater contamination was outside of the site boundary and the concrete slab had been remediated. This report has not been seen by AG and we are unsure if it relates to the site or adjacent land;
- An initial ground investigation by Soil Consultants Ltd in 1999, which identified potential issues associated with elevated levels of cadmium within 2 boreholes, and elevated levels of arsenic, lead, copper, zinc and mercury within one borehole, however WSP noted that the soil guidance values used were obsolete;
- An addendum site investigation report undertaken by STATS in 2004 identified potential elevated ground gas within Made Ground, however this was based on one monitoring event only with no flow rate recorded.

No geotechnical issues were identified with the current use and layout of the wider site.

The report confirmed that a Building Control Officer at Havant Borough Council was contacted as part of these works and indicated that ground levels at the site were previously raised in order to reduce the possibility of flooding. The Officer also confirmed that whilst they were unaware of any ground stability issues at the site (or within the immediate area) several of the buildings within the Technology Park were known to have been piled.

Delta Simmons, Phase I Environmental Assessment Project No. 15-0754.07, dated May 2019 and updated November 2020.

Delta-Simons undertook a Phase I Environmental Assessment of the entire Technology Park, reported initially in May 2019 and updated in November 2020, under the instruction of Havant S.a.r.l.

The report identified that the site was undeveloped until the early 1900s when a large sewage works, and engine house occupied the north-eastern corner of the site. Between the late 1930s and 1960s this facility underwent significant expansion. In the mid-1950s an allotment garden occupied the central regions of the site. By the mid-1970s the site had undergone a large-scale redevelopment, resulting in the construction of many of the existing commercial/industrial units currently present on site today. Slopes were also shown surrounding the majority of the buildings, suggesting site levels were raised as part of the redevelopment. During this time, a large-scale building and electrical sub-station occupied the southern half of the park, however, by the early 1990s the building and sub-station were replaced with a car park, although several tanks and an electricity sub-station remained in the west.

The report identified that the surrounding area was historically a mix of undeveloped and industrial land uses comprising mills, sewage plants, works, industrial units and retail parks with associated infrastructure.

Based on the available BGS archival plans and the previous phases of investigation undertaken at the site, the desk study report indicated that the site was likely underlain by Superficial Deposits of Alluvium (clay, silt, sand and gravel) over River Terrace Deposits (sand, silt and clay). A small area of Head Deposits (clay and gravel) was noted to be present between the Alluvium and River Terrace Deposits in the south-west of the site only. The underlying Bedrock was noted to comprise Undifferentiated Chalk.

The Conceptual Site Model identified the following:

- A moderate risk to maintenance workers during subsurface works from direct contact, ingestion and inhalation of contaminated soils at the site;
- A low to moderate risk to groundwater beneath the site from leaching of contaminants;
- A low to moderate risk to water supply pipes from contact with hydrocarbon contaminants;
- A low to moderate risk to off-site receptors from lateral migration of contaminants through groundwater;
- A low to moderate risk to site users and buildings from ground gas.

All other pollutant linkages were assessed as low risk. Additional intrusive investigation was recommended to further assess the CSM and site geology.

A Detailed UXO Risk Assessment by 1st Line Defence was undertaken as part of these works in May 2019. The report identified a medium risk of German aerial delivered UXO and anti-craft UXO and a low to medium risk of Allied Ordnance. A UXO briefing and UXO specialist supervision was deemed necessary for any intrusive works undertaken at the site, together with a magnetometer survey in any boreholes during drilling.

The updated Phase I Environmental Assessment (dated November 2020) provided a review of the ground investigations undertaken by Clancy, which have been reviewed by Applied Geology below.

Clancy, Geo-Environmental Appraisal Report ref. 10/1425/001, dated October 2019:

Clancy undertook a ground investigation at the site in the areas of intended redevelopment (which included the northern grassed area of the Phase 2 site), reported in October 2019 under the instruction of AG Langstone B.V. The investigation comprised:

- Eight Window Sample/Driven Continuous Sampling Boreholes (WS1 to WS8) to a maximum depth of 5.45m bgl;
- Four Hand Dug Pits (HTP1 to HTP4) to a maximum depth of 1.40m bgl;
- Four Cable Percussion Boreholes (BH1 to BH4) to a maximum depth of 24.85m bgl;
- Two machine excavated Trial Pits for soakaways (SA1 and SA2) to depths of 2.05m and 2.10m bgl.

The investigation encountered hardstanding from surface over mixed granular and cohesive Made Ground to a maximum depth of 3.1m bgl, although Made Ground was typically proven to depths of between 0.65m and 1.60m bgl. The Made Ground included anthropogenic inclusions of brick, concrete, pottery and slate, whilst sub-surface obstructions/hardstanding were encountered sporadically across the site, often corresponding with the locations of historic/ demolished structures/features. The Made Ground was underlain by a sequence of interbedded cohesive and granular strata interpreted to predominantly comprise River Terrace Deposits, which were proven to depths of between 5.10m and 6.00m bgl. Solid Geology comprising Undifferentiated Chalk was encountered directly beneath the Superficial Deposits to at least 24.9m bgl. Groundwater was encountered across much of the site and was recorded at depths of between 1.9m and 6.0m bgl, rising to depths of between 1.8m and 3.7m bgl. Groundwater level monitoring was undertaken over 4 monitoring rounds over a 2 week period and recorded levels of between 1.46 and 2.65m bgl.

Chemical testing undertaken during the site investigation did not identify any contaminants which exceeded relevant SSVs for commercial/industrial end use in terms of Human Health. Elevated TPH fractions were encountered in two locations at depths which could pose a risk to Controlled Waters. Further works were recommended in these areas to delineate the contamination and further assess the risk.

Gas protection measures were recommended in-line with CS2 conditions based on the gas monitoring undertaken.

Soakaway testing undertaken in two locations at the site (SA1 and SA2), recorded infiltrations rates of between 10^{-3} and 10^{-5} m/s within the Made Ground and upper horizons of the natural strata.

The report identified that a shallow foundation solution would likely prove problematic due to the variable nature of the shallow natural strata and so a piled foundation solution was recommended.

The report identified that buried concrete should be designed to Sulphate Class DS-1, with an Aggressive Chemical Environment for Concrete (ACEC) class of AC-1.

Clancy, Supplementary Site Investigation Report ref. 10/1425/004 Rev 00, dated September 2020;

Clancy undertook a supplementary ground investigation across the south of the Technology Park (including the area of the Phase 2 site), reported in September 2020 under the instruction of AG Langstone B.V. This investigation comprised;

- Twenty-five Window Sampler/Driven Continuous Sampling Boreholes (WS9 to WS32) to a maximum depth of 4.45m bgl;
- Two Cable Percussion Boreholes (BH5 and BH6) to a maximum depth of 19.95m bgl.

The ground conditions did not differ significantly from the initial investigation and typically comprised hardstanding from surface over predominantly granular Made Ground to a maximum depth of 1.70m bgl, although the Made Ground was typically proven to shallower depths of between 0.15m and 0.80m bgl. The Made Ground included anthropogenic inclusions of brick, clinker and asphalt fragments and unlike the initial investigation only a nominal thickness of concrete was encountered sub-surface in the south-west of the site (WS30). The Made Ground was underlain by River Terrace Deposits, which like previously comprised interbedded clays, silts, sands, and gravels. The Undifferentiated Chalk was encountered directly beneath the Superficial Deposits in the deeper cable percussion boreholes at depths of 5.80, and 6.00 bgl and was proven to the full depth of the investigation (19.95m bgl). Groundwater was encountered during drilling of many holes at depths of between 2.1m and 2.8m bgl, rising to depths of between 2.0m and 2.5m bgl. Secondary groundwater strikes were recorded in the deeper cable percussion boreholes at depths of 5.8m and 6.0m bgl, rising to 3.0m bgl. There is no mention of groundwater level monitoring and no monitoring results were included with the report.

No inorganic contamination was detected in soil samples tested. One SVOC and several VOC compounds were detected above the limit of detection in soils as well as some TPH and PAH in soils and groundwater. No contamination was recorded in soil samples obtained from the Phase 2 site, however, elevated TPH was noted in a groundwater sample from BH5 in the south-west of the Phase 2 site at a depth of 4.5m bgl with a concentration of 282ug/l. This particular result is not discussed in the report assessment. However, based on the findings of the chemical testing to date, a remediation strategy report for the proposed redevelopment was considered necessary.

No geotechnical laboratory testing was undertaken as part of the supplementary works.

Clancy, Remediation Strategy Report ref. 10/1425/005 Rev 00, dated November 2020.

Following the previous phases of investigation, Clancy produced a Remediation Strategy Report for the wider Technology Park site, which set out the necessary ground preparatory and reclamation works required to facilitate the proposed redevelopment. It was advised that this report be submitted to Havant Borough Council for discharge of Planning Condition 9 (2) of Planning Application ref APP/10/00703. It is understood that the Remediation Strategy also covers the Phase 2 subject site.

Proposed works included:

- Excavation of and removal of hydrocarbon hotspots (located offsite and west of Phase 2);
- Validation of excavations by a qualified consultant;
- Watching brief during removal of hotspots and during groundworks across the site in general;
- Provision of 300mm clean soil cover in soft landscaped areas including a min. 150mm topsoil thickness;
- Installation of ground gas protection measures in accordance with CS2;
- Provision of verification report.

Applied Geology, Geotechnical Report ref AG3286-21-AM72 v1, dated August 2021

In addition to the third-party reports listed above, Applied Geology was previously instructed to undertake a supplementary ground investigation for geotechnical purposes across two separate areas of the wider Technology Park: an area in the southwest for a development comprising 4no. industrial units (land adjacent west of Phase 2) and an area in the north for a proposed car park.

A ground investigation comprising the following works was undertaken in June 2021:

- 2 No 150mm diameter Cable Percussion boreholes to depths of 15.40m and 17.62m bgl;
- 2 No Driven Continuous Sampling (DCS) boreholes to depths of 3.60m and 5.45m bgl;
- 7 No Machine Excavated Trial Pits to depths of between 1.40m and 3.00m bgl;
- Soakaway infiltration tests within 4no. trial pits.

Selected boreholes were also installed with groundwater monitoring standpipes and groundwater level monitoring was undertaken on two occasions. No gas monitoring was undertaken.

Ground conditions encountered in the southern area of the Technology Park comprised hardstanding and Made Ground to depths between 0.4m and 1.2m bgl. In the northern area of the site, the investigation was undertaken in an embankment with ground levels were noted to be c.4m higher than the southern area. Made Ground was recorded to depths between 3.60m and 5.45m bgl in that area. The Made Ground was overlying Alluvium to depths between 0.90m and 1.90m bgl and then River Terrace Deposits to 4.30m bgl. The Superficial Deposits were underlain by Solid Strata of Undifferentiated Chalk, proven to the full depth of the investigation

(17.62m bgl). Groundwater strikes were recorded between 1.4m and 2.0m bgl within the River Terrace Deposits with subsequent monitoring recording levels between 1.69m and 4.68m bgl.

It was understood that ground levels would be raised by around 1.2m for the proposed development. Due to this a piled solution for both the foundations and floor slabs was recommended, as it was considered to represent a low-risk solution which would address the various technical considerations with the proposed upfilling. However, ground improvement techniques were also considered to be potentially suitable.

Soakaway tests undertaken predominantly within the granular River Terrace Deposits, recorded infiltration rates in the region of 10^{-3} to 10^{-5} m/s, and the report concluded that the granular River Terrace Deposits may be suitable for the discharge of surface run-off water into conventional soakaways, subject to consideration of groundwater levels.

The Design Sulphate Class for the Alluvium, River Terrace Deposits and underlying Undifferentiated Chalk strata was assessed as DS1 and AC1s, whilst the Design Sulphate Class for the Made Ground was assessed as DS2 and AC1s.

3.4 Planning History

The Havant Borough Council planning portal was searched for planning applications relating to the Langstone Technology Park and the relevant findings are summarised in the table below:

Planning App. Ref.	Date	Description	Decision	AG Comments
APP/19/00703	July 2019	Part-demolition of Building 1000 and associated works; the erection of new flexible use industrial units; and a new parking layout with associated works to layout and access and felling of two trees subject to a Tree Preservation Order (Norway Maples)	Granted	Building 1000 is located NE of Phase 2 site but planning application includes land to the west and northern part of the subject site. AG undertook a GI to support this application – report ref AG3286-21-AM72
APP/21/00405	April 2021	Variation of Conditions 2, 3, 8, 18, 19, 22 and 25 of Planning Permission APP/19/00703 relating to the erection of the flexible use industrial units in the south-western corner of the site (Phase 1)	Granted	Variation of original planning and seems to relate to the construction of Units 1 to 4 (Phase 1) on land adjacent west of the Phase 2 subject site. Construction now complete. Many of the previous reports were submitted as part of this application, including Delta Simons Phase 1, Clancy investigations and the Remediation Strategy
APP/22/00172	March 2022	Outline Planning Application for Phased demolition of existing buildings and the erection of new flexible use employment floorspace (Use Classes E(g)(i) - (iii)/B2/B8) and ancillary uses (Use Classes E(b), E(d) and	Granted	Outline planning for the phased development of the remainder of Langstone Technology Park including the Phase 2 subject site

Planning App. Ref.	Date	Description	Decision	AG Comments
		E(f)); and associated works. All matters reserved except Access		

Additional planning applications were listed but were either for small changes such as lighting and signs; did not relate to the Langstone Technology Park itself, or were for discharge of conditions relating to the Planning Applications above so were not considered relevant to this report.

4.0 CONCEPTUAL SITE MODEL

In developing a Conceptual Site Model for the site, pollutant linkages are determined by identifying likely sources of contamination from previous and current site uses, possible targets such as site users, neighbouring site users and Controlled Waters and linkages between them.

4.1 Sources

The Phase 2 site was previously an unspecified works with an electricity substation on site, with a sewage works off site to the north and other works noted >100m away. Tanks were noted 180m west on mapping dating 1984-1989. Previous intrusive investigations for the Technology Park have not encountered any contamination of note in soils in boreholes on the Phase 2 site, although elevated TPH was recorded in a groundwater sample tested from BH5, in the southwest of the Phase 2 site.

Identified potential sources are as follows:

- Made Ground/Fill across the site associated with former historic development including the former works. Potential contaminants could include heavy metals, fuels, oils, asbestos and solvents;
- Spillages/leaks of fuels/oils on site associated with current site uses including vehicle parking;
- Oils and PCBs associated former electrical substation on site;
- Contamination from off-site sources including neighbouring industrial land use such as sewage works, engine house and various unspecified works. Includes identified hydrocarbons in groundwater in previous GI in the southwest corner;
- Gas generation from the Made Ground/Alluvium (on and off-site) and potential volatile vapours from hydrocarbon/solvent spills;
- Sulphates in Made Ground or underlying natural strata.

4.2 Receptors

Standard receptors to be considered are as follows:

- End users: Site workers, visitors and maintenance personnel (Human Health);
- Underlying Aquifers: Superficial Secondary A Aquifer and Chalk Principal Aquifer (Controlled Waters);
- Surface water features: Lavant Stream 45m east and other surface watercourses/drainage channels within 250m (Controlled Waters);
- Buried foundation/substructure concrete (Building Materials);
- Water supply services (Building Materials).

4.3 Pathways

Generic pathways, potentially linking the above sources and receptors, to be considered are as follows:

- Human dermal contact;
- Human ingestion via soil directly in soft landscaped areas;
- Human inhalation of dust or vapours;
- Direct contact with buried concrete/water supply services;
- Leaching and/or migration through permeable soils (granular Made Ground superficial deposits and/or Chalk bedrock);
- Gas migration.

4.4 Source/Pathway/Receptor Linkage and Assessed Risk

Source-pathway-receptor (SPR) linkages are tabulated below together with the qualitatively assessed risk. The risk to ground workers and construction workers is not included here due to the short-term exposure times that they will be subject to and the assumption that good hygiene practices will be adopted on site, together with the appropriate use of relevant PPE/RPE. Comments regarding contamination issues with respect to ground workers and construction workers are included in the health and safety section of the Standard Procedures included as Appendix F.

Source	Pathway	Receptor	Risk*
Potential contaminants within Made Ground resulting from historical site usage including unspecified works (on site). <i>e.g., heavy metals asbestos</i>	Inhalation, ingestion, direct contact.	End users	Low-Medium
	Migration and leaching	Secondary A Aquifers – Alluvium, Head and River Terrace Deposits	Low-Medium
		Chalk Principal Aquifer at depth	Medium
		Lavant Stream	Low-Medium
	Direct contact	Water supply pipes	Low-Medium
Historical electricity substation (on site) <i>e.g., Oils and PCBs</i>	Inhalation, ingestion, direct contact.	End Users	Low
	Migration and leaching	Secondary A Aquifers – Alluvium, Head and River Terrace Deposits	Low
		Lavant Stream	Low
Localised/small scale spillages or leaks associated with current site use as a car park (on site) <i>e.g., hydrocarbons (TPH & PAH)</i>	Dermal contact, ingestion and inhalation	End users	Low
	Direct contact	Water Supply pipes	Low
Potential contaminants from neighbouring sites uses including sewage works, engine house and unspecified works <i>e.g., heavy metals, fuels, oils, asbestos, solvents and</i>	Inhalation, ingestion, direct contact.	End users	Low
	Migration and leaching	Secondary A Aquifers – Alluvium, Head and River Terrace Deposits	Medium
		Chalk Principal Aquifer at depth	Medium

Source	Pathway	Receptor	Risk*
bacterial/biological contaminants	Direct contact	Water supply pipes	Low
Ground gas from Made Ground. Alluvium or volatile vapours from hydrocarbon spillages (on site): <i>e.g., Methane, carbon dioxide, VOCs</i>	Migration into buildings, service ducts etc.	Proposed Buildings	Low-Medium
	Inhalation	End users	Low-Medium
Elevated sulphates in Made ground or natural soils underlying the site	Direct contact	Buried concrete	Low

*** Definition of Risk Categories**

Negligible - Contaminants that might have unacceptable impact on key receptors, are unlikely to be present, or, no pathway is envisaged.

Low Risk: Contaminants may be present but are unlikely to be at levels to have unacceptable impact on key receptors, or pathways are likely to be minimal.

Medium Risk: Contaminants are probably present and might have an unacceptable impact on key receptors. Pathways may also be present therefore remedial measures may be necessary to reduce the risks.

High Risk – Contaminants probably or certainly present and pathways are probably also present. Therefore, contaminants are likely to have an unacceptable impact on key receptors and remedial measures are likely to be necessary to reduce the risks to acceptable levels.

5.0 APPLIED GEOLOGY GROUND INVESTIGATION WORKS

5.1 Fieldwork

A site-specific intrusive investigation was designed to obtain further information across the site to supplement the previous data from the wider Technology Park investigations, in order to refine the geoenvironmental assessments and the potential foundation solutions available. The following scope of fieldwork was undertaken by Applied Geology between the 23rd October and 6th of November 2023 and is summarised in the following table:

Type	Number	Reference	Max depth (m bgl)	Rationale
Cable Percussion Borehole	3	CP01 – CP03	17.29	General geotechnical coverage in area of proposed buildings
Trial Pit Soakaways	2 plus 3 attempts	SA01, SA01A, SA01B, SA01C, SA02	2.30	To obtain preliminary infiltration rates of near surface superficial strata in areas of proposed SUDs
Driven Continuous Samples	3 plus 1 redrill	DCS01 – DCS03 & DCS03A	5.45	General geotechnical and geoenvironmental coverage
California Bearing Ratio Tests (TRL DCP)	2 plus 2 attempts	CBR01, CBR01A, CBR02 & CBR02A	0.90	To target proposed access road for pavement design

Fieldwork was generally carried out, where relevant, in accordance with BS5930 (2015) “Code of Practice for Site Investigations” and was supervised by an experienced Geoenvironmental Engineer.

The borehole and trial pit records are included in Appendix B, together with an SPT summary and calibration certificate. The soakaway and TRL DCP records are included in Appendix C.

The initial attempt to drill DCS3 was terminated at 0.45m bgl due to shallow refusal on a buried concrete obstruction. A redrill (DCS03A) was attempted in the adjacent soft landscaped area to the north and was completed successfully to a target depth of 5.45m bgl. In addition, Trial Pit Soakaway SA01 was terminated at 1.20m bgl due to a high water level making it unsuitable for a soakaway test. Additional excavation attempts were made further north, with SA01A terminating on a concrete obstruction at 0.60m bgl and SA01B also recording shallow groundwater at 1.30m bgl. A third attempt was made, again further north, and was completed successfully (SA01C)

The locations of the exploratory holes were selected generally in accordance with a proposed borehole location plan provided by the Engineer, which specifically targeted localised areas previously not investigated by Clancy. The exploratory holes were set out on site and cleared for the presence of underground services by specialist contractor Castle Surveys Ltd.

Transport Research Laboratory Dynamic Cone Penetrometer (TRL DCP) tests were undertaken in order to determine the likely in-situ CBR profile of the soils within the area of proposed hardstanding access road. The first two tests were terminated early due to shallow refusals (CBR1 and CBR2) on dense gravels. Two further attempts were made adjacent to the original test locations and were completed successfully (CBR01A and CBR02A). The results are plotted as a number of blows versus depth penetrated bgl with equivalent CBR values for individual layers. The results are included in Appendix C.

A Detailed UXO Risk Assessment was undertaken for the wider Technology Park by 1st Line Defence as part of the initial Phase I Environmental Assessment, undertaken by Delta Simons. The report identified a medium risk of German aerial delivered UXO and anti-craft UXO and a low to medium risk of Allied Ordnance. The report confirmed that it was necessary to employ onsite UXO risk mitigation measures during the intrusive works, consisting of onsite supervision of the investigation works by a Specialist UXO contractor (EOD Contracts Ltd), including downhole magnetometer surveys of the boreholes.

The positions of the exploratory holes were surveyed to National Grid and levelled to Ordnance Datum by Castle Surveys Ltd. The locations of the exploratory holes are presented on the Exploratory Hole Location Plan (AG3544-23-02) included in Appendix A and the co-ordinates and levels are included on the exploratory hole records in Appendix B.

5.2 Instrumentation and Monitoring

On completion of boring, 50mm diameter standpipes were installed in both the cable percussion and DCS boreholes. Full details are included on the relevant borehole logs in Appendix B and a summary is provided below:

Location	Standpipe installation response zone (m bgl)	Stratum
CP01	2.00 to 6.00	Alluvium, River Terrace Deposits and Undifferentiated Chalk
CP02	1.00 to 5.00	River Terrace Deposits and Undifferentiated Chalk
CP03	2.00 to 5.00	River Terrace Deposits

Location	Standpipe installation response zone (m bgl)	Stratum
DCS01	1.00 to 2.00	Made Ground and River Terrace Deposits
DCS02	1.00 to 2.00	Possible Alluvium and River Terrace Deposits
DCS03A	1.00 to 2.00	Possible Alluvium and River Terrace Deposits

Washed silica gravel (6-10mm) was used as the filter medium. Each standpipe was fitted with a push-in bung and single gas tap and was finished with flush metal cover concreted in place.

Ground gas and groundwater monitoring visits were undertaken on 4 occasions from 16th November 2023 to 2nd February 2024 including during two periods of low and/or falling atmospheric pressure. Each monitoring well was monitored for concentrations of carbon dioxide, methane, oxygen, VOCs, flow rates and differential pressures and water level. The monitoring results are included in Appendix D.

5.3 Laboratory Testing

Geotechnical laboratory testing was undertaken by specialist laboratory Geotechnics Ltd (UKAS lab no. 1365) on selected samples and comprised the following:

- 6 No natural moisture content tests;
- 6 No Atterberg limit tests;
- 7 No particle size distribution tests;
- 9 No BRE SD1 natural ground suite tests;
- 4 No BRE SD1 natural ground +pyrite suite tests;
- 5 No Chalk moisture content, porosity and density tests.

Chemical testing was scheduled by Applied Geology based upon the desk study, previous investigations and site observations during the fieldwork. Testing was carried out at UKAS accredited laboratory (i2 Analytical) and 8 No soil samples were analysed for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, lead, mercury, nickel, selenium, vanadium and zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- Phenols;
- pH;
- Soluble sulphate;
- Soil organic matter.

In addition, 5 No samples were submitted for Total Petroleum Hydrocarbon (TPH) testing (with BTEX and MTBE) and 2No. samples were tested for the VOC/SVOC suite. Seven samples were tested for the presence of Asbestos.

Five samples of natural soils were also submitted for WAC testing (inert suite).

Three groundwater samples were also submitted for the following suite of contaminants:

- Selected metals suite [arsenic, boron, beryllium, cadmium, chromium (total, trivalent and hexavalent), copper, lead, mercury, nickel, selenium, vanadium and zinc];
- Speciated (16 US EPA) Polycyclic Aromatic Hydrocarbons (PAH);
- Phenols;
- Total Petroleum Hydrocarbon (TPH) with BTEX and MTBE;
- Volatiles (VOC/SVOCs);
- pH;
- Soluble sulphate;
- Hardness;
- Total organic carbon.

Laboratory test results are included in Appendix E.

6.0 GROUND CONDITIONS

6.1 Strata Encountered

The ground investigation has generally identified hardstanding at surface, underlain by predominantly granular Made Ground soils overlying predominantly granular River Terrace Deposits beneath. Localised Alluvium and Possible Alluvium have also been encountered beneath Made Ground. Solid strata of Undifferentiated Chalk was recorded at depth beneath the Superficial Deposits to the full depth of the investigation (17.29m bgl).

The previous investigations by Clancy did not identify Alluvium directly beneath the Made Ground soils. The very soft to soft organic clays comprising frequent flint gravels, indicative of Alluvium, were assigned as the upper extent of the Superficial River Terrace Deposits.

Full details of the strata encountered are given on the borehole records presented in Appendix B. A generalised ground profile is presented below to summarise the information. An SPT 'N' value versus depth plot is presented in Appendix A.

Stratum	Depth to Top of Strata (m bgl)	Thickness (m)	Comments
Hard Standing	GL	0.10 - 0.20	Asphalt was encountered at surface in all but one exploratory hole (DCS3A)
Made Ground - Subbase	0.10 - 0.20	0.20 - 1.00	Encountered in the majority of exploratory holes underlying hardstanding
Made Ground	0.20 - 1.00	0.30 – 1.30	Encountered in all exploratory holes.
Alluvium & Possible Alluvium	1.0 - 2.2	0.2 - 1.30	Alluvium encountered in CP01 in the northwest of the site. Possible Alluvium encountered in DCS02 and DCS03A
River Terrace Deposits	0.80 – 3.50	0.60-2.30	Encountered in all exploratory holes where Made Ground/Alluvium was fully

Stratum	Depth to Top of Strata (m bgl)	Thickness (m)	Comments
			penetrated. Base not proven in soakaway Trial Pits
Undifferentiated Chalk	3.40 – 5.10	12.99+	Encountered in the deeper boreholes only. Proven to the full depth of the investigation (17.29m bgl)

6.2 Hard Standing and Made Ground

Asphalt hardstanding covered the majority of the car parking area across the site, and was proven to depths of between 0.10m and 0.20m bgl. The only exception was DCS3A which was located in the soft landscaped area in the northeast of the site, hence asphalt was absent. At this location Made Ground/Topsoil was encountered at surface to 0.20m depth described as soft brown slightly gravelly very sandy clay with frequent rootlets.

Underlying the asphalt, a layer of Subbase material was encountered ('Made Ground-Subbase' on the logs) generally comprising grey slightly clayey slightly sandy gravel of coarse angular limestone. The subbase varied in thickness across the site, and generally between 0.07m and 0.30m thick but was recorded up to 0.85m thick in CP01 and 0.45m thick on CP02.

Other Made Ground was encountered in all exploratory holes beneath the hardstanding and subbase materials, between 0.5m (DCS02) and 1.3m thick (CP03) and was recorded to depths between 0.8m (SA01) and 2.2m bgl (CP01) where proven. The Made Ground strata was variable and had both cohesive and granular horizons, although was dominantly granular. The main Made Ground strata encountered are described as follows:

- Soft to firm brown slightly to sandy gravelly clay. Gravel is fine to coarse subangular to rounded flints, locally with brick and concrete fragments and rare ash;
- Medium dense brown very clayey sandy gravel of fine to coarse subangular to rounded flints, locally with subangular brick fragments.

The previous Clancy investigations at the Phase 2 site encountered Made Ground proven to depths of between 0.40m (WS11) and 2.60m bgl (BH1A) which accords with the findings of the current investigation.

Five in-situ SPTs were carried out in the Made Ground and recorded uncorrected 'N' values of N=14 and N=26.

6.3 Alluvium and Possible Alluvium

Strata considered to represent Alluvium were encountered in CP01 only between 2.2m and 3.5m bgl (1.3m thick). The Alluvium was described as firm light grey slightly gravelly sandy silt/clay with gravel of medium to coarse subangular to rounded flint.

The results of two Atterberg Limit tests undertaken on the cohesive horizons of Alluvium have indicated plasticity indices of 11% and 17% (corrected to 4.1% and

18.2%), indicating these soils to be of low shrinkability as defined by NHBC Standards. Uncorrected liquid limits of 26% and 36%, plastic limits of 15% and 19%, and moisture contents of 15.6% and 24.3% were also recorded. The results indicate the clays to be of low to medium plasticity.

Only one SPT was carried out in these soils, recording an 'N' value of N=18 at 3.00-3.45m bgl.

It should be noted that the previous investigation by Applied Geology on the land adjacent to the west encountered site wide Alluvium to depths between 0.90m and 1.90m bgl. The previous Clancy investigations did not identify Alluvium at the site.

Soils considered to be Possible Alluvium were encountered in two boreholes only, namely DCS02 in the west of the Phase 2 site and DCS03A in the northeast of the Phase 2 site. The Possible Alluvium was encountered beneath the Made Ground at 1.20m to 1.45m bgl in DCS02 and between 1.10m and 1.30m bgl in DCS03A. The soils were described as soft or firm dark brown/ dark brownish grey slightly sandy slightly gravelly silt/ sandy clay with fine to medium gravel of subrounded chalk and flint. These potentially represent a buried topsoil but, given the absence of significant decayed roots etc, has been termed Possible Alluvium for the purpose of this report.

6.4 River Terrace Deposits

Strata considered to represent River Terrace Deposits were encountered in all exploratory holes across the Phase 2 site, underlying the Made Ground or Alluvium and Possible Alluvium where these strata were fully penetrated. This stratum was encountered from depths of between 0.80m (SA01) and 3.50m bgl (CP01) and the base was encountered at depths of between 3.40m and 5.1m bgl (0.6m to 3.3m thick) where proven.

The strata were generally recorded as medium dense light brown and brown slightly sandy clayey gravel of fine to coarse subangular to rounded flint and occasional chalk. Occasional cobbles of subrounded flint were noted.

The previous Clancy investigations noted the River Terrace Deposits to comprise a variable sequence of interbedded clayey sandy gravel and gravelly sandy clays. The gravel was generally described as fine to coarse subrounded flint, whilst frequent wood fragments and rare amorphous peat were also recorded in the cohesive horizons. The base of the River Terrace Deposits was not encountered in six out of eight of the Clancy boreholes undertaken across the Phase 2 site due to shallow refusals/hard drilling.

Particle Size Distribution (PSD) tests were undertaken on samples of the River Terrace Deposits. The results of this testing and the resultant classifications are given in the table below.

Location	Depth (m bgl)	Fines % (Clay + Silt <0.063mm)	Sand %	Gravel %	Cobbles %	Classification
CP01	3.60	20	17	63	0	Sandy silty GRAVEL
CP02	2.50	4	13	83	0	Slightly clayey sandy GRAVEL
CP03	4.00	5	15	80	0	Slightly clayey sandy GRAVEL
DCS01	1.40	11	7	82	0	Sandy clayey GRAVEL
DCS02	2.20	13	15	72	0	Sandy clayey GRAVEL
DCS03A	1.30	26	33	41	0	Very clayey very sandy GRAVEL
DCS03A	2.20	11	15	74	0	Sandy clayey GRAVEL

The test results are generally in line with the field descriptions.

As part of the initial Clancy investigation, one particle size distribution test was undertaken on a bulk sample of granular River Terrace strata and the results typically accord with the proportions discussed above.

Clancy also undertook one CBR test on a bulk sample of granular River Terrace strata at 0.70m bgl, which recorded a minimum CBR value of 2.7%.

Twelve in-situ SPTs were carried out in the granular River Terrace Deposits and recorded uncorrected 'N' values of between N=14 and N=31 but with one result of >50 was recorded (extrapolated to N=61). The SPT vs depth plot shows a slight increase in strength with depth. SPT 'N' values of between N=1 and N=>50, were recorded during the previous Clancy investigations, indicating the River Terrace Deposits to be more variable.

6.5 Undifferentiated Chalk

Strata considered to represent Undifferentiated Chalk were encountered directly beneath the Superficial River Terrace Deposits (where base was proven). The Undifferentiated Chalk was encountered at depths of 3.40m to 5.10m bgl and was proven to the full depth of the investigation (17.29m bgl).

The cable percussion drilling and driven sampling methods severely disturb any structure present in chalk strata, leading to the recovery of highly disturbed samples. As such, full engineering descriptions and the assignment of chalk grades was generally not possible.

Findings of the previous investigations undertaken by Clancy typically accord with those of the current Applied Geology investigation, although previously the chalk strata were encountered at greater depths of between 5.4m and 5.8m bgl in the area of the Phase 2 site.

Thirty-five in-situ SPT tests were carried out within the Undifferentiated Chalk strata, recording general 'N' values of between N=14 and N=50. Consistent 'refusals' with extrapolated N values of between N=52 and N=61, were generally recorded from depths of 15m onwards which is in-line with AG's previous investigation to the north. The SPT N value vs depth plot shows a consistent increase with depth from c.15 at 5m bgl to c.60 at 17m bgl.

Lower SPT 'N' values of between N=6 and N=21, were typically recorded at depths of between 6m and c.15m bgl, during the previous Clancy investigations, increasing to SPT 'N' values of between N=15 and N=26 at depths of between 15m and 18m bgl.

Five saturation Moisture Content (SMC) tests were undertaken on bulk samples of Chalk and recorded dry density values of between 1.59Mg/m³ and 1.66Mg/m³ (mean 1.63Mg/m³), indicating low to medium density chalk. The tests also recorded saturated moisture contents of between 23% and 26% (mean 24%). The results recorded are in line with the previous AG investigation adjacent. In addition, nine SMC tests were undertaken as part of the initial Clancy investigation, recording dry density values of between 1.56Mg/m³ and 1.72Mg/m³ (mean 1.64Mg/m³), similarly indicating low to medium density chalk strata. These tests also recorded moisture contents of between 20% and 27% (mean 23%) and SMCs of between 21% and 27% (mean 24%), which typically accord with the findings of the Applied Geology investigations.

Clancy also undertook one undrained triaxial test on a sample of silt chalk at a depth of 6m bgl, which recorded an undrained shear strength of 38kPa.

6.6 Groundwater and Soakaway Tests

Groundwater strikes were encountered during drilling within River Terrace Deposits as detailed in the table below.

Location	Stratum	Depth (m bgl)	Groundwater level after 20min (m bgl)
CP01	River Terrace Deposits	4.00	1.80
CP02	River Terrace Deposits	1.60	1.40
CP03	River Terrace Deposits	2.20	2.20
DCS01	River Terrace Deposits	2.10	2.10
DCS02	River Terrace Deposits	2.30	2.10
DCS03A	River Terrace Deposits	2.20	2.10
SA01	River Terrace Deposits	1.20	-
SA01B	River Terrace Deposits	1.30	-
SA01C	River Terrace Deposits	1.60	-
SA02	River Terrace Deposits	2.30	-

The previous investigations by Clancy, recorded groundwater at depths of between 2.0m and 5.80m bgl in the Phase 2 site, in both the River Terrace Deposits and underlying Undifferentiated Chalk strata.

Groundwater levels may fluctuate for a number of reasons, including in the short term the prevailing weather conditions immediately before and during investigation and monitoring works and longer-term seasonal variations should be expected.

During the subsequent monitoring programme standing groundwater levels within the standpipes were recorded and are summarised below:

Location	Response Zone (m bgl)	Stratum	Depth to groundwater (m bgl)
CP01	2.00 to 6.00	Alluvium, River Terrace Deposits and Undifferentiated Chalk	1.63 – 2.04 (2.60 – 3.01m AOD)
CP02	1.00 to 5.00	River Terrace Deposits and Undifferentiated Chalk	1.25 – 2.01 (2.32 – 3.08m AOD)
CP03	2.00 to 5.00	River Terrace Deposits	1.60 – 1.94 (2.72 – 3.06m AOD)
DCS01	1.00 to 2.00	Made Ground and River Terrace Deposits	1.67 – 1.85 (2.92 – 3.10m AOD)
DCS02	1.00 to 2.00	Possible Alluvium and River Terrace Deposits	1.54 – 1.93 (2.52 – 2.91m AOD)
DCS03A	1.00 to 2.00	Possible Alluvium and River Terrace Deposits	1.97 – 2.00 (2.99 – 3.01m AOD)

During the return monitoring programme, groundwater was recorded at depths of between 1.25m and 2.04m bgl (2.32m AOD to 3.10m AOD) with a slight drop between November 2023 and February 2024.

Based on the data collected, it is considered that the River Terrace Deposits and Chalk are likely to be in hydraulic continuity. The groundwater flow direction was unable to be determined as the levels are generally consistent across the site, however, it is likely to be towards the east towards the Lavant Stream.

Preliminary soakaway tests were carried out in two trial pit locations (SA01C and SA02). The soakaway tests were carried out in general accordance with BRE Digest DG365 methodology, with three fills undertaken. The results of the tests are summarised below and included in full in Appendix C.

Test ID	Stratum	Infiltration Rate (m/s)		
		Fill 1	Fill 2	Fill 3
SA01C	River Terrace Deposits 1.00-1.60m bgl	4.7 x10 ⁻⁴	4.8 x10 ⁻⁴	4.4 x10⁻⁴
SA02	River Terrace Deposits 1.05-2.30m bgl	4.1 x10 ⁻⁶	2.2 x10⁻⁶	9.3 x10 ⁻⁶

*Bold text indicate the lowest result recorded for each location

The soakaway testing has indicated a variable infiltration rate for the River Terrace Deposits depending on location. The results of each fill were generally consistent for SA01C but not for SA02. The River Terrace Deposit soils in both locations were dominantly granular but contained a variable portion of fines (Note: 4 to 26% fines content in this stratum based on laboratory tests) which would affect permeability. Standing groundwater was noted at the base of each pit prior to the test commencing which will have inhibited downward infiltration.

6.7 Ground Gas

Gas screening values have been calculated for each installation using highest concentrations and highest flow rates in accordance with CIRIA C665. The GSVs are as follows:

Stratum	BH	Response Zone (m bgl)	Ground water level (m bgl)	Max. Methane (%)	Max. Carbon Dioxide (%)	Max. Steady Flow (l/hr)	GSV Methane (l/hr)	GSV Carbon Dioxide (l/hr)
ALL, RTD & CHK	CP01	2.0 to 6.0	1.63-2.04	0.3	4.3	1.2	0.0036	0.0516
RTD & CHK	CP02	1.0 to 5.0	1.25-2.01	0.3	1.8	<0.1	0.0003	0.0018
	CP03	2.0 to 5.0	1.60-1.94	0.3	2.7	<0.1	0.0003	0.0027
MG & RTD	DCS01	1.0 to 2.0	1.67-1.85	0.2	3.1	<0.1	0.0002	0.0031
PBT & RTD	DCS02	1.0 to 2.0	1.54-1.93	0.3	2.2	0.1	0.0003	0.0022
	DCS03 A	1.0 to 2.0	1.97-2.00	0.2	2.5	1.1	0.0022	0.0275

Key:

MG: Made Ground, PBT: Possible Alluvium, ALL: Alluvium, RTD: River Terrace Deposits, CHK: Chalk
Blue highlighted cells indicate fully flooded response zone.

Green highlighted cells indicate CS-1 conditions.

Gas monitoring recorded methane concentrations up to a maximum of 0.3% in the majority of installations. Carbon dioxide concentrations ranged from 0.1% v/v up to 3.1% v/v with the highest readings recorded in DCS01 located in the southeast of the site.

Oxygen concentrations between 8.5% (depleted) and 21.4% (atmospheric) by volume, with depleted levels mainly recorded in CP01 and did not correlate with boreholes with higher carbon dioxide values. VOC and carbon monoxide concentrations were recorded between <0.1ppm and 3.6ppm and are considered negligible. Flow readings taken over a three-minute average period recorded flow rates of between <0.1 l/hr and 1.2 l/hr with -3.1 l/hr recorded on one occasion in CP01.

6.8 Contamination

Ash was observed locally in the Made Ground in CP02 and the majority of exploratory hole locations recorded brick and concrete fragments. However, there was no visual or olfactory evidence of any gross contamination observed. No evidence of hydrocarbons was noted in the exploratory hole closest to the former substation.

7.0 GEOENVIRONMENTAL ASSESSMENT

7.1 Human Health Risk Assessment

The results of the chemical testing on soils have been assessed as described in Appendix F, with specific details as follows:

- Proposed end-use – Commercial/industrial units;
- Screening criteria – Commercial/industrial, assuming 1% SOM;
- Assuming a single dataset based on the size of the site, the site's history, current land-use and/or the proposed redevelopment.

In respect of benzo(a)pyrene and other genotoxic PAHs, various PAH ratios have been plotted and compared against data from the Culp et al study and found to be within the same range, therefore use of the surrogate marker approach is justified.

The spreadsheets summarising the laboratory results and relevant screening values for each dataset are presented in Appendix E. All determinants have been found to be below the screening values. No elevated metals, phenols or BTEX have been detected in any of the samples tested.

There were no exceedances of TPH compounds recorded in the five samples tested, however, one sample recorded a concentration of Total TPH >1,000mg/kg - CP03 at 0.2m with a concentration of 5,000mg/kg. The TPH concentration is mainly made up of heavier-end Aliphatic and Aromatic fractions in the C21-C44 range. The TPH chromatogram from the laboratory indicates that the trace is complex and does not match any standard petroleum product profiles. No visual or olfactory evidence of contamination was noted in this borehole during fieldwork, however, as the sample was taken directly beneath the asphalt surfacing, it is likely that the sample may have contained fragments of asphalt which may have been a source for the TPH.

Four Semi-Volatile Organic Compounds (SVOCs) have been recorded above the limit of detection in one sample of Made Ground-Subbase taken from CP03 at 0.2m depth – the same sample as the highest TPH concentration. In addition, two of the SVOCs have also been detected in a second sample of Made Ground-Subbase taken from DCS02 at 0.2m bgl. Again it is considered likely that fragments of asphalt may have been in the samples of Made Ground sub-base which may be a source of the SVOCs. It should be noted that there are no published screening values for these SVOCs so the detection limit has been used as the screening value as a very conservative approach.

The existing asphalt will be removed during the development and it is understood that site levels will be raised by approximately 1.2m which will act as a cover layer to mitigate the risk to end users. Based on the proposed end use, the hydrocarbon impacted soils are considered to pose a low risk to end users, but may pose a risk to Controlled Waters based on the encountered ground conditions, discussed further in Section 7.2 below.

The Asbestos screening tests did not detect the presence of any Asbestos fibres.

Based on the lab testing undertaken and proposed development, there is considered to be a low risk to Human health receptors from identified contamination in soils.

7.2 Controlled Waters Risk Assessment

The soil testing has not recorded concentrations of any determinants above those values considered typical for Made Ground background concentrations, with the exception of localised elevated concentrations of TPH in shallow Made Ground in CP03. It should also be noted that the previous investigations by Clancy found elevated TPH in a groundwater sample from BH5 in the southwest of the site (282ug/l Total TPH).

In the context of Controlled Waters, the receptors to be considered are as follows:

- The Lavant Stream located 45m east;
- The Superficial Deposits underlying the site are classified as a Secondary A Aquifer, however, the underlying Undifferentiated Chalk is classified as a Principal Aquifer, although there are no potable water abstractions in proximity to the site.

The proposed development is noted to cover a large proportion of the site with hardstanding with only limited soft landscaping within the car park areas. This will therefore limit any leaching potential and migration of contaminants from the Made Ground into the underlying groundwater. It is also noted that historically the surrounding area has been utilised for numerous industrial uses which could potentially impact groundwater.

The results of the chemical testing on leachate and groundwater samples have been assessed as described in Appendix F, with the UK Drinking Water Standards (UK DWS) used as the screening criteria (or where unavailable, Water Framework Directive Environmental Standards (WFD ES) or detection limit) based on the presence of a Principal Aquifer underlying the site (Undifferentiated Chalk).

Groundwater Testing

The groundwater results and relevant screening values have been directly compared, with a summary comparison spreadsheets included in Appendix E of this report.

The summary spreadsheets do not identify any determinants exceeding the corresponding screening values, with the majority of the concentrations (including PAHs, TPH, BTEX, MTBE, VOC and SVOC) all having been recorded below the limit of laboratory detection.

Although localised TPH up to 5,000mg/kg has been found in shallow Made Ground – Subbase, there is no indication that this has had an impact on underlying groundwater. Therefore, based on the context of the site and the proposed redevelopment, there is considered to be a negligible to low risk to Controlled Waters.

7.3 Disposal of Soil Arisings

General comments regarding the procedures for the assessment of waste soil for off-site disposal purposes is included in Appendix F.

Made Ground soils at the site are unlikely to be acceptable at inert landfills and are likely to be generally categorised as non-hazardous. If Made Ground soils are to be disposed of at landfill, further testing will likely be required for the actual waste stream during construction.

If natural soils are to be disposed of from site, inert WAC testing will likely be required to classify the soils for disposal.

8.0 GEOTECHNICAL ASSESSMENT

8.1 General

Proposals for the site comprise the construction of three new commercial/industrial units (5, 6 & 7) at the Phase 2 site, together with associated yard/loading areas and car parking. Site levels beneath the proposed buildings will be raised in the order of 0.6-1.2m above existing ground level and two small retaining walls will be incorporated into the final design. It is understood that foundations for the proposed new portal frame structures will require to be founded in soils with up to 150kN/m² bearing pressures and the ground bearing floor slab should be assumed to have a uniformly distributed loading of 50kN/m².

In the area of Phase 2, the ground investigation has identified a covering of asphalt hardstanding from surface over predominantly granular Made Ground, proven to depths of between 0.8m and 2.2m bgl. Upon proving the base of the Made Ground, Superficial Deposits of granular River Terrace Deposits, were proven to a base depth of between 3.60m and 5.80m bgl, with Undifferentiated Chalk recorded directly beneath. Localised Alluvium and Possible Alluvium were also encountered.

In the area of Phase 2, groundwater strikes were recorded in the Superficial River Terrace Deposits at depths of between 1.20m and 2.30m bgl during formation. During the subsequent monitoring of standpipes, groundwater was recorded at depths of between 1.25m and 2.04m bgl (2.32m AOD to 3.10m AOD).

8.2 Foundation and Floor Slab Design

Based on the strata encountered, traditional pad foundations would potentially be suitable founded on firm clays or medium dense granular natural soils at between 1m and c.2.5m bgl across the site. However, as site levels are to be raised by 0.6-1.2m and groundwater was frequently encountered in close proximity and locally above likely foundation depths, it is considered that some form of ground improvement or a piled foundation solution will be required.

Excavation and re-engineering of the Made Ground prior to placement of further engineered fill to raise site levels could be considered. The re-engineering of existing soils and placement of new engineered fill would need to be undertaken to an agreed Earthworks Specification that was designed to provide an allowable bearing capacity for shallow foundation of 150kN/m² and the required floor slab design loading whilst meeting the required settlement criteria. Some soils are likely to be unsuitable for re-engineering. This would require careful and detailed assessment and would require further ground investigation works in order to obtain bulk samples for earthworks testing. Advantages of this method would include 'guaranteed' removal of any soft spots and/or hard spots/obstructions in the Made Ground under the buildings, no requirement for any required working platform and continuity with the likely required earthworks for external areas. Disadvantages would include having to deal with shallow groundwater in places and it is likely to be more costly than some ground improvement techniques.

Ground improvement by vibro-replacement or rigid inclusions could be considered and would allow the use of shallow pad foundations and ground bearing slabs and avoid the need for dealing with groundwater. Discussions should be held with specialist contractors to confirm that the required allowable bearing capacity of 150kN/m² is achievable in the ground conditions encountered. A working platform would be required for such ground improvement techniques; however, this could be incorporated into the required upfill to get to the required site levels, assuming the ground improvement would be undertaken post upfilling. For treatment of the full thickness by vibro-replacement, any upfill would need to be wholly granular and suitable for treatment by the vibro-replacement process. Typically, this requires a granular upfill to contain less than 5-10% clay and silt fines, with no particles greater than 100mm, though the specific requirements of ground improvement contractors would need to be established. Where such treatment was proposed, it is likely that treatment would extend through placed upfill, Alluvium/loose/soft River Terrace Deposits, terminating within competent granular River Terrace Deposits or Chalk. If vibro-replacement was proposed prior to upfilling, proposed upfill could comprise suitably engineered granular material, or potentially other suitably engineered fill (including possible modified or stabilised clay fills). The specification for the upfilling would need to be agreed in advance with the ground improvement contractor to avoid pre-boring requirements and to ensure the required bearing capacity and settlement tolerances are not compromised.

Taking into account the depth of the Made Ground, the localised presence of underlying low strength superficial deposits and the proposal to raise site levels by up to 1.2m, a piled solution for the foundations and floor slabs represents a low-risk solution which would address the various technical considerations. The piles would need to extend through any imported upfill, existing Made Ground, Superficial Deposits and gain support in skin friction and end bearing within the Undifferentiated Chalk, together with some contribution from the Superficial Deposits. The use of bored, CFA or driven piles is likely to prove suitable for the site, however it is recommended that the advice of a specialist piling contractor is sought with regard to detailed design, including suitable pile diameters, capacities and confirmation of suitable pile types. The nature and thickness of the upfill material will need to be taken in to account with regards to pile mat design.

Prior to placement of upfill, it is recommended that any hardstanding and known obstructions are removed as they would represent potential obstructions to ground improvement or piling.

Placement of upfill above the existing ground surface will result in induced settlements within the underlying Made Ground and natural strata as a result of the additional loading. The majority of settlements within the granular Made Ground and granular River Terrace Deposits would occur quickly, though induced settlements within the cohesive Alluvium/possible Alluvium would be ongoing for a longer period. Detailed assessment would be required to determine the likely magnitude of potential total/differential settlements. Settlement assessments will need to be undertaken once final site levels, sources of fill and loading are known.

As documented in Section 3.3 above, the STATs site investigation report (dated 2003) considered the site to be of a moderate low subsidence risk from potential chalk dissolution features/cavities. The report stated that the Edmund's database of known natural and man-made chalk features did not identify any such features within the boundaries of the wider Technology Park. Further assessment into the Chalk

dissolution hazard risk was outside the scope of the current investigation, although no evidence of potential solution features/cavities was noted in any of the cable percussion boreholes.

8.3 Retaining Walls

Due to the site levels being raised across the site, the development proposal includes two retaining walls including a section c.39m long and 0.7m high at the southern boundary and another 5m long and 0.45m high at the northwest boundary. It is anticipated that these will be retaining the Engineered Fill.

Given the low retained heights, it is envisaged that the retaining walls will be simple gravity walls such as gabions, crib lock or reinforced earth. It is understood that the retaining walls will be designed by specialist contractors. As well as the findings of this investigation, the design should also take into account the nature of the retained soils (engineered fill), which, at this stage, are not known. The wall designs should also take account of the likely settlements induced by placement of the upfill materials.

Both sections of proposed retaining wall are underlain by around 2m of Made Ground, which may not provide a suitable founding stratum for the walls. Some localised overdig and re-engineering or ground improvement is therefore anticipated in the location of the retaining walls.

8.4 Floor Slab Gas Protection

Based on the gas monitoring undertaken to date and the calculated GSVs the site is likely to be characterised as Characteristic Situation 1 (CIRIA C665). The site is also not in a Radon affected area. Therefore, gas protection measures are not considered necessary for the proposed development.

8.5 Excavations

No instability was recorded in shallow excavations undertaken for soakaway testing. However, trial pits undertaken as part of the previous AG investigation on the adjacent site were noted to be unstable with continual sidewall collapse recorded. Instability was generally encountered within the granular River Terrace Deposits, occasionally coinciding with the depths of water ingress.

In general, excavations will likely be prone to some instability particularly where advanced into the granular River Terrace Deposits and in particular once groundwater is encountered. As such, excavations into these soils may need to be graded back to a stable angle or trench support be provided. Trench support or the angle of batter should be designed by an appropriately qualified engineer or competent person to suit the required depth and the ground and groundwater conditions. Furthermore, due to the potential of groundwater ingress (at depths greater than 1.5m), it is recommended provision for groundwater control is made, particularly if any deeper excavations are proposed.

8.6 Pavement Design

In-situ testing by TRL DCP at the Phase 2 site has indicated approximate CBR values of between 2% and >100% principally within Made Ground. Collectively, the lower

CBR values indicated should be considered as indicative short-term CBR values, with higher values probably influenced by the presence of gravel and cobble sized fragments.

Based on the proposed development site levels will be raised by up to c.1.2m.-The CBR at formation level will therefore largely be dictated by the quality of engineered fill placed to raise site levels. The placement of fill may lead to additional settlement of underlying Made Ground/Alluvium so some assessment of this is required and soft spot removal may be needed prior to placement of the fill.

Based on a review of the classification testing, soil type and construction conditions, indicative long-term equilibrium CBR design values of 2-3% for the Alluvium and 5% for the River Terrace Deposits are recommended, should these soils be within influencing distance of pavement loadings.

Based on the visual description of the Made Ground during the intrusive investigation, this material is considered likely to be frost susceptible. Additionally, based on the laboratory analysis, the Alluvium and River Terrace Deposits strata are likely considered to be frost susceptible, however, based on the proposed development, it is unlikely that these material will be present within 450mm of pavement surfaces.

8.7 Soakaways

The soakaway tests undertaken as part of this current investigation, predominantly within the granular River Terrace Deposits, recorded infiltration rates of c. 4×10^{-4} m/s (SA01C) to 2×10^{-6} m/s (SA02) and varied by location. The variability is likely due to different percentage of fines present in the strata locally affecting the infiltration. Values of around 1×10^{-4} indicate a relatively good permeability and typically comply with the lower end limits for a poorly graded gravel. As such, it is considered likely that the shallow granular River Terrace Deposits across the site may be locally suitable for the discharge of surface run-off water into conventional soakaways, subject to consideration of groundwater levels, which are quite shallow in places. Strata with higher fines content and infiltration rates of around 10^{-6} m/s will be less suitable for soakaway drainage.

The soakaway tests undertaken as part of previous investigations, predominantly within the granular River Terrace Deposits, recorded infiltration rates in the region of 10^{-3} to 10^{-5} m/s.

It should be noted that due to the relatively high groundwater level encountered at the site, this could limit the capacity for soakaway drainage and hence, this should be considered in the soakaway design. If infiltration drainage is considered further, additional testing may be required to further assess the suitability at specific locations.

8.8 Buried Concrete

As defined by BRE Special Digest 1, Concrete Aggressive Ground, 2005 the Design Sulphate Class and the Aggressive Chemical Environment for Concrete (ACEC) has been assessed for the Made Ground, Superficial Deposits and underlying Undifferentiated Chalk strata. Characteristic values for each stratum have been determined and are detailed in the table below:

Strata	No of samples tested ^{*3}	Soluble Sulphate (g/l) ^{*1}	Total Potential Sulphate (%)	Potentially Pyritic	pH	Design Sulphate Class	ACEC ^{*2}
Made Ground	8	0.60	-	-	7.4	DS-1	AC-1
Alluvium & Possible Alluvium	6	0.07	0.27	No	7.7	DS-2	AC-2
River Terrace Deposits	5	0.02	-	-	8.2	DS-1	AC-1
Undifferentiated Chalk	3	0.01	-	-	8.6	DS-1	AC-1
Groundwater	3	0.03	-	-	7.3	DS-1	AC-1

*1: Characteristic values are rounded to the nearest 0.01g/l.

*2: Assumes mobile groundwater

*3: In a data set less than 5 samples, the highest sulphate value and lowest pH is taken as the characteristic value. In a data set of between 5 and 9 the mean of the highest two sulphate test results has been taken as the characteristic value. In a data set in excess of 10, the mean of the highest 20% has been taken as the characteristic value.

The Design Sulphate Class for each strata and groundwater is DS-1 and AC-1, except for the Alluvium/Possible Alluvium, which is DS-2 and AC-2 due to a total Potential Sulphate of 0.27% recorded. These results typically accord with the findings of the previous investigations, although Alluvium was assessed as DS-1.

Further reference should be made to BRE Special Digest 1 for requirements in respect of types of cement and aggregate to be used and variations in type of concrete construction.

It is considered unlikely that barrier pipes will be required for the proposed development.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Geoenvironmental

The risk assessments in Section 7.0 have indicated a low risk to Human health and Controlled Waters receptors based on the proposed development. Therefore, no further action is considered warranted. However, should any suspected contamination be encountered during redevelopment appropriate advice should be sought.

9.2 Geotechnical

Ground improvement or piling is anticipated to be required for the proposed units and floor slabs. Discussions should be held with specialist ground improvement contractors to confirm that the required allowable bearing capacity of 150kN/m² is achievable in the ground conditions encountered.

The proposed upfill will influence the design of the ground improvement and piling and will also influence the design of the external areas, in terms of induced

settlements (which need to be assessed), likely CBR values, working platform design, sulphate classification etc.

Simple gravity retaining walls such as gabions, crib lock or reinforced earth should be suitable based on the proposals and should be designed by specialist contractors. Some localised over-dig and re-engineering/ground improvement is anticipated in the location of the retaining walls due to the depth of Made Ground.

Gas protection measures are not considered necessary for the proposed development.

Infiltration drainage is likely to be only feasible in some areas of the site targeted to the dominantly granular River Terrace Deposits, however, the shallow depth to groundwater needs to be taken into account.

Special measures relating to buried concrete are generally not required, however, sulphate resisting concrete appropriate to DS-2, AC-2 will be required for the any buried concrete in contact with the Alluvium/possible Alluvium.

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GENERAL NOTES

- A) The assessment made in this report is based on the site terrain and ground conditions revealed by the various field investigations undertaken and also any other relevant data for the site including previous site investigation reports (if available) and desk study data. There may be special conditions appertaining to the site, however, which have not been revealed by the investigation and which have not, therefore, been taken into account in the report. The assessment may be subject to amendment in the light of additional information becoming available. It must be recognised that many of the Environmental Searches obtained during the course of the desk study are often lengthy. Applied Geology have, where appropriate and in the interests of simplicity, only reproduced the summary of the searches within the report. A full copy of all the search data is held at the Applied Geology office and is available for inspection if required.
- B) The services provided are defined within our proposal and are carried out in line with the terms of appointment between Applied Geology and the Client.
- C) Where any data supplied by the Client or other external source, including that from previous site investigations, has been used it has been assumed that the information is correct. No responsibility can be accepted by Applied Geology for inaccuracies within this data.
- D) Whilst the report may express an opinion on possible configurations of strata between or beyond the exploratory locations, or on the possible presence of features based on either visual, verbal or published evidence this is for guidance only and no liability can be accepted for the accuracy.
- E) Comments on groundwater (and landfill gas) conditions are based on observations made during the course of the present and past investigations or with reference to published data unless otherwise stated. It should be noted, however, that groundwater (and landfill gas) levels vary due to seasonal (or atmospheric conditions) or other effects.
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- I) Ground conditions should be monitored during the construction of the works and the recommendations of the report re-evaluated in the light of this data by the supervising geotechnical or geo-environmental engineers.
- J) Unless specifically stated, the investigation has not taken into account the possible effects of mineral extraction.
- K) The works performed are not a comprehensive site characterisation and should not be construed as being such.
- L) The findings of the geo-environmental risk assessment are based on information obtained from a variety of sources which Applied Geology believe to be correct. Applied Geology cannot and does not guarantee the authenticity or reliability of the information it has relied upon.
- M) The report represents the findings and opinions of experienced geo-environmental consultants. Applied Geology does not provide legal advice and the advice of lawyers may be required.
- N) Conditions at the site are subject to change from the time of the site inspection.
- O) It is possible that researches carried out by Applied Geology, whilst fully appropriate for a phase 1 desk study, failed to indicate the existence of important information sources. Assuming such indicators actually exist, their information could not have been considered in the formulation of Applied Geology findings and opinions.
- P) The economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, depends on very many factors in addition to geotechnical considerations and hence its evaluation is outside the scope of this report.
- Q) Applied Geology operates as a Consultancy and does not operate its own laboratory for soil testing, this work being sub contracted to known and respected, generally UKAS accredited, laboratories. Applied Geology can therefore not be held responsible for the testing carried out.

LIST OF REFERENCES COMMONLY USED BY APPLIED GEOLOGY IN REPORTS

SECTION/TITLE	AUTHOR/PUBLICATION
LABORATORY TESTING	
BS 1377 Methods of Test for Soils for Civil Engineering Purposes.	BSI
BS 17892 Geotechnical Investigation and testing. Laboratory testing of soil.	BSI
SITE WORK	
Guidelines for Combined Geoenvironmental and Geotechnical Investigations. Issue 2. March 2006.	AGS
BS 5930:2015. Code of Practice for Ground Investigations	BSI
BS 10175:2011 + A2:2017 Code of Practice for the Investigation of Potentially Contaminated Sites	BSI
GEOTECHNICAL DESIGN	
BS EN 1997-1 + A1:2013 Eurocode 7 – Geotechnical Design, Part 1. 2004.	BSI
BS EN 1997-2 Eurocode 7 – Geotechnical Design, Part 2. 2007.	BSI
BS EN 16907:2018 Earthworks, Part 1 & 2.	BSI
BS 6031:2009 Code of Practice for Earthworks.	BSI
BS 8004:2015 Code of Practice for Foundations.	BSI
Paper by M. A. Stroud 'The Standard Penetration Test – its Application and Interpretation' within Thomas Telford/ICE book 'Penetration Testing in the UK'. 1989.	Stroud
BRE Special Digest 1: 2005 Third Edition. Concrete in Aggressive Ground	BRE
NHBC Standards, Chapter 4.2: Building Near Trees. 2022.	National House Building Council
C574 Engineering in Chalk. 2002.	CIRIA
C570 Engineering in Mercia Mudstone. 2001.	CIRIA
C504 Engineering in Glacial Till. 1999.	CIRIA
Foundation Design and Construction, 7th Edition.	MJ Tomlinson
GROUND GAS	
Radon Indicative Atlas (online)	BGS
BS 8485:2015 + A1:2019 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.	BSI
Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present. 4 th Ed, 2007	NHBC & RSK Group
Assessing Risks Posed by Hazardous Ground Gases to Buildings. C665. 2007.	CIRIA
Research Bulletin 17. 2012.	CLAIRE
BS 8576:2013 Guidance on Investigations for Ground Gas. Permanent Gases and Volatile Organic Compounds (VOCs)	BSI
C748 Guidance on the Use of Plastic Membranes as VOC Vapour Barriers. 2014.	CIRIA
Remediating and Mitigating Risks from Volatile Organic Compound (VOC) Vapours from Land Affected by Contamination. C716. 2012.	CIRIA
BR211:2023 Radon: Guidance on Protective Measure for New Buildings (including supplementary advice for extensions, conversions and refurbishment projects).	BRE
BR212:1991 Construction of New Buildings on Gas-Contaminated Land.	BRE
BR414:2001 Protective Measures for Housing on Gas-Contaminated Land.	BRE
RB13 The Utility of Continuous Monitoring in Detection and Prediction of 'Worst-Case' Ground-Gas Concentration. 2011	CL:AIRE
TB17 Ground Gas Monitoring and 'Worst-Case' Conditions. 2019.	CL:AIRE
GROUNDWATER	
BRE DG 365: Soakaway Design. 2016.	BRE
BS EN ISO 22282-2:2012 Geotechnical Investigation and Testing – Geohydraulic Testing, Part 2. 2012.	BSI
CONTAMINATION ASPECTS (Soil & Groundwater)	
Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance. 2012.	DEFRA
Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - SP1010. 2014.	DEFRA
HPA Contaminated Land Information Sheet – Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons. Version 3. 2010.	HPA
Cover Systems for Land Regeneration. Thickness of Cover Systems for Contaminated Land. 2004. BR465 (archived) .	AGS/BRE
C552 Contaminated Land Risk Assessment – A Guide to Good Practice. 2001.	CIRIA
Development of Generic Assessment Criteria for Assessing Vapour Risk to Human Health from Volatile Contaminants in Groundwater. Version 1.0. February 2017.	SoBRA
BS 3882:2015 Specification for Topsoil	BSI
The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015. S4UL3159.	Chartered Institute of Environmental Health. Land Quality Management.
Generic Assessment Criteria for Human Health Risk Assessment. 2009.	Chartered Institute of Environmental Health. Land Quality Management.
Land Contamination Risk Management (LCRM). 2020.	Environment Agency
The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils. February 2005.	Environment Agency
The Environment Agency's Approach to Groundwater Protection, V1.2. 2018.	Environment Agency

Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination. 2006.	Environment Agency
Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66. 2008.	NHBC
Sampling Strategies for Contaminated Land. Contaminated Land Research Report no.4. 1994.	DoE
NHBC Standards, Chapter 4.1: Land Quality – Managing Ground Conditions (online) 2023.	National House Building Council
CLEA Software (Version 1.071). 2015.	Environment Agency
The Water Supply (Water Quality) Regulations. 2018.	DWI
Code of Practice for the Investigation & Mitigation of Possible Petroleum-Based Land Contamination. 1993.	The Institute of Petroleum
www.gov.uk/contaminated land	Environment Agency
Guidance for the Selection of Water Supply Pipes to be Used in Brownfield Sites. (10/WM/03/21). 2011.	UK Water Industries Research
DISPOSAL OF SOIL	
Guidance on the Classification and Assessment of Waste. Technical Guidance WM3. 1 st Ed. Version 1.2.GB. 2021.	SEPA, NIEA, Natural Resources Wales & Environment Agency
Disposal of Waste to Landfill. 2021.	Environment Agency
PAVEMENT DESIGN	
Interim Advice Note 73/06 Rev 1, 2009. Design Guidance for Road Pavement Foundations (Draft HD25) (withdrawn).	Highways Agency
CD 622 Managing Geotechnical Risk, Rev 1, 2020.	Highways England, Transport Scotland, Welsh Government & Department for Infrastructure
CD 225 Design for New Pavement Foundations, Rev 1, 2020.	Highways England, Transport Scotland, Welsh Government & Department for Infrastructure
CD 226 Design for New Pavement Construction, Rev 1, 2021.	Highways England, Transport Scotland, Welsh Government & Department for Infrastructure
PLANNING	
National Planning Policy Framework and Practice Guidance. 2021.	Department for Communities and Local Government
HEALTH & SAFETY ASPECTS	
www.ags.org.uk	AGS
Construction (Design & Management) Regulations 2015 (CDM)	Health & Safety Executive
Control of Substances Hazardous to Health Regulations 2002	Health & Safety Executive
Workplace Exposure Limits. EH40/2005	Health & Safety Executive
Trenching Practice. Guidance on Groundwater Control (Report 97). 2 nd Ed. 2001.	CIRIA
Control of Groundwater for Temporary Works (Report 113). 1986.	CIRIA
C733 Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks. 2014.	CIRIA
C765 Asbestos in Soil and Made Ground Good Practice Site Guide. 2017.	CIRIA
C681 Unexploded Ordnance (USO) – A Guide for the Construction Industry. 2009.	CIRIA
HSG47 Avoiding Danger from Underground Services. 3 rd Ed. 2014.	Health & Safety Executive

APPENDIX A



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APPLIED GEOLOGY

The Old Barn, Church Farm
Fulbrook Lane
Sherbourne
Warwick
CV35 8AR

Tel: 02476 511822
email: admin@appliedgeology.co.uk

Client:

HAVANT S.a.r.l

Project:

LANGSTONE TECHNOLOGY PARK,
HAVANT – PHASE 2

Drawn By:

KM

Checked By:

CE

Paper Size:

A4

Scale:

NTS

Date:

09.01.2024

NGR:

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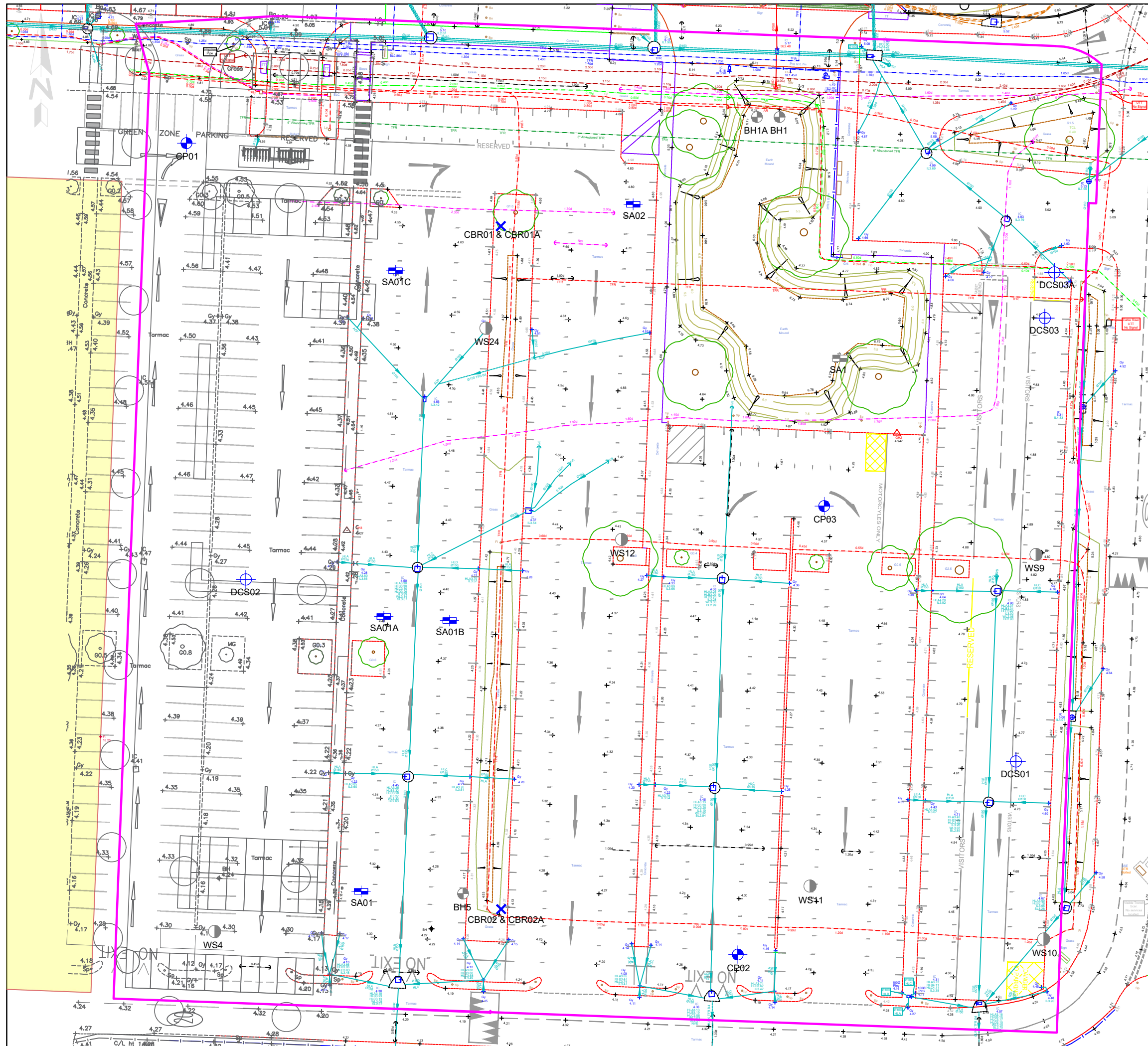
SITE LOCATION PLAN

Drawing No:

AG3544-23-01

Revision:

0



- Key:**
- CP01 Cable Percussion Borehole
 - DCS01 Driven Continuous Sampling Borehole
 - TP01 Soakaway Test
 - CBR01 CBR Test
 - Site boundary

Clancy Investigations 2019 & 2020

- BH1 Cable Percussion Borehole
- WS4 Driven Continuous Sampling Borehole
- SA1 Soakaway Test

Drawing based on Greenhatch Group drawing No. 38869D_T Rev 1 dated 13.09.2023 and Baynham Meikle drawing No. 114 Rev P1 dated 09.06.2023.

APPLIED GEOLOGY

The Old Barn
Church Farm
Fulbrook Lane
Sherbourne
Warwick
CV34 8AR

Tel: 02476 511822
email: admin@appliedgeology.co.uk

Client:
HAVANT S.A.R.L

Project:
LANGSTONE TECHNOLOGY PARK,
HAVANT - PHASE 2

Title:
EXPLORATORY HOLE LOCATION PLAN

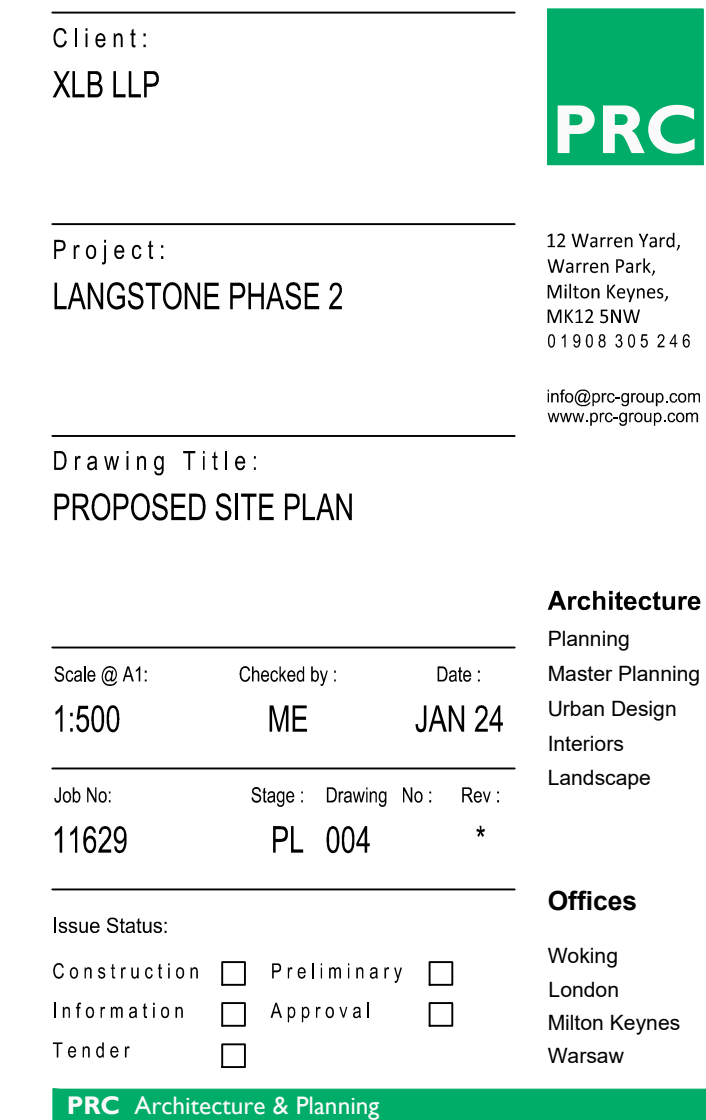
Drawn by: KM	Checked by: EY	Paper Size: A3
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Scale: 1:500	Date: 21/11/2023
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Drawing No: AG3544-23-02	Revision: 0
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Revisions: Drawn/Chkd: Date:



- KEY:**

 - FFL: 0.000 PROPOSED FINISHED FLOOR LEVEL
 - + 0.000 PROPOSED LEVELS
 - ***** PROPOSED RETAINING WALL
 - ↖ 1/10 PROPOSED GRADIENT
 - Proposed Gradient Change

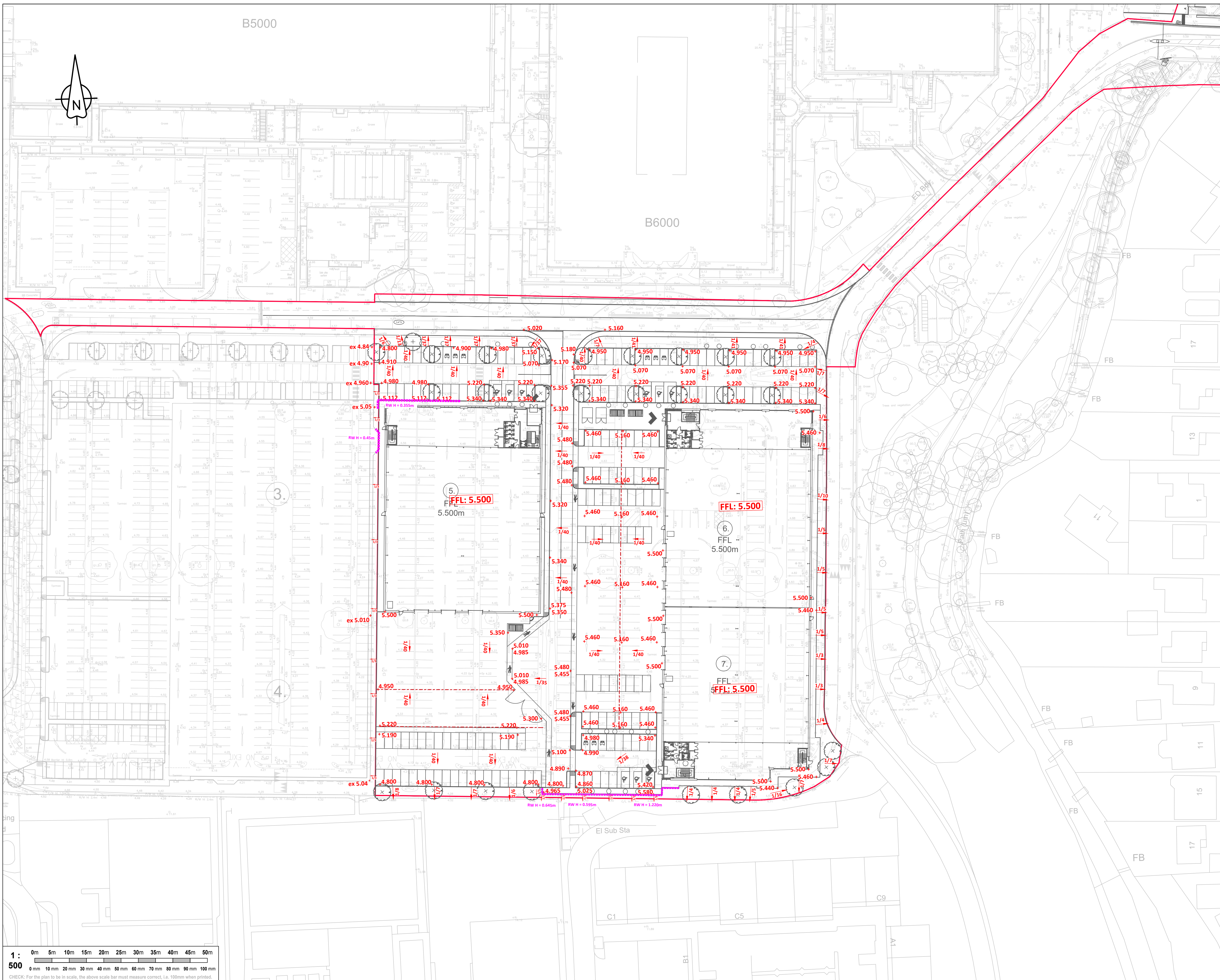
Revision Schedule

For Planning

Drawing Title

Proposed Levels Plan

BM Ref 13508	Scale @ A1 1 : 500	Drawn by R.B.	Checked by A.B.	Project Eng G.L.
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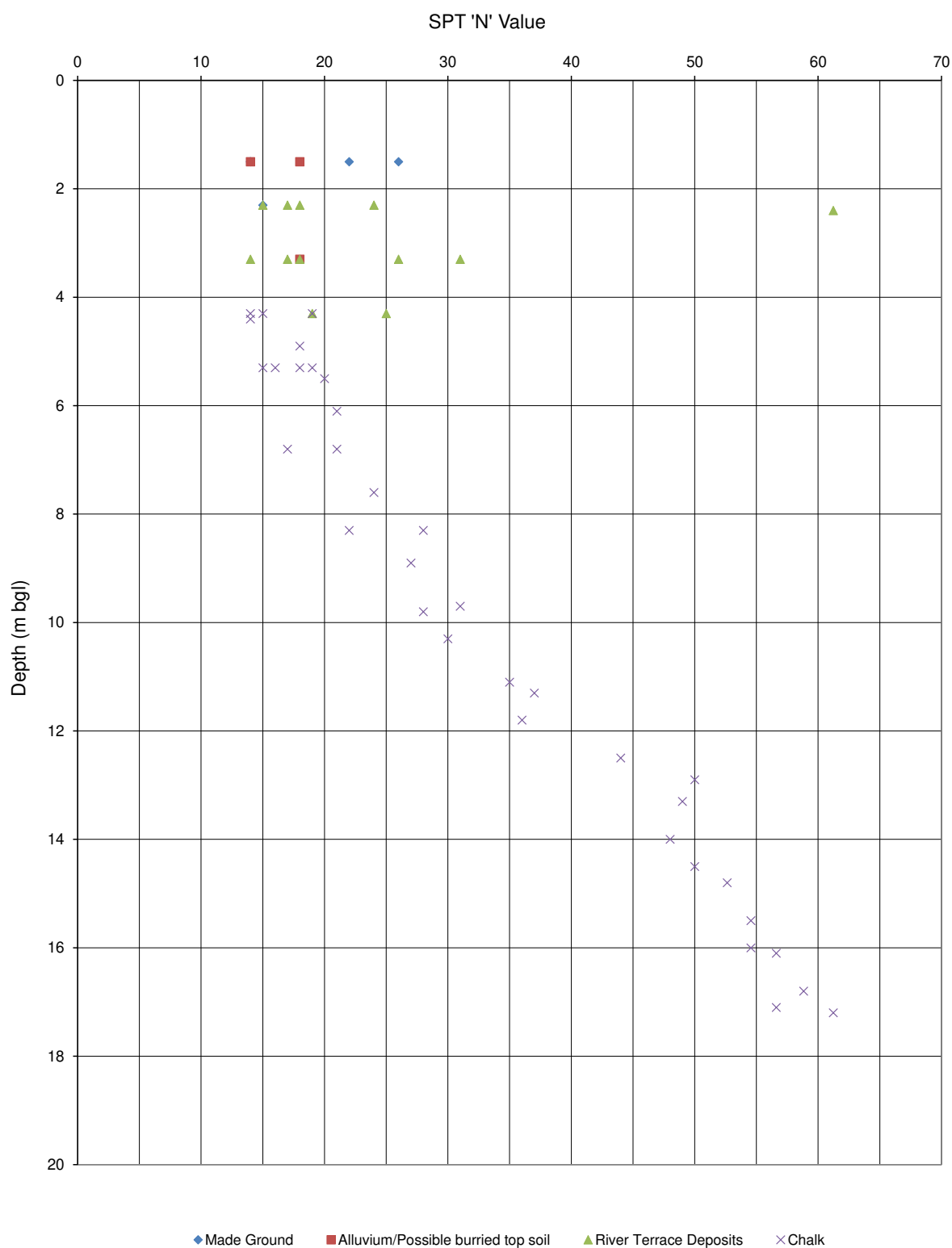




Notes:

Copyright Greenhalch Group. 06/07/13

Uncorrected SPT 'N' Value versus depth



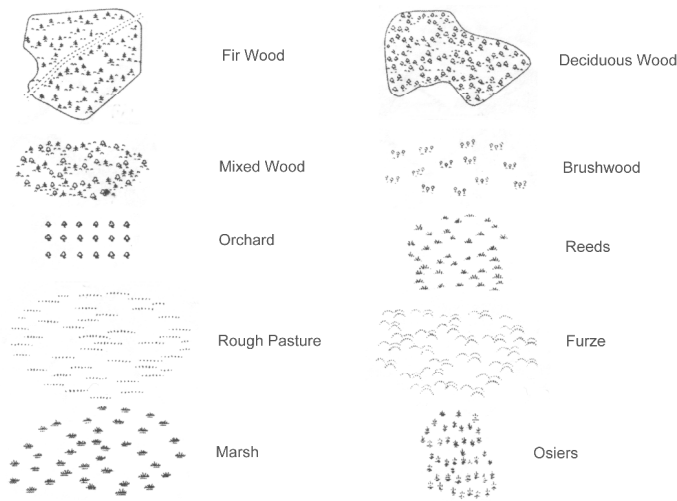
Notes: 1. Uncorrected N values plotted, values >100 omitted for clarity etc

Client:	Havant S.a.r.l	APPLIED GEOLOGY
Project:	Langstone Technology Park, Havant - Phase 2	
Project No.	AG3544-23	

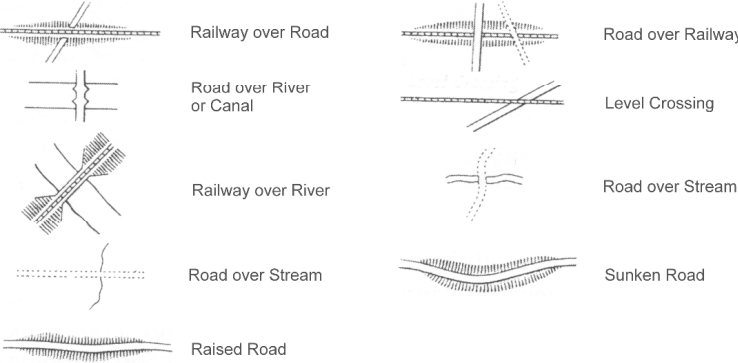
APPENDIX B

County Series 1:10,560 scale

VEGETATION



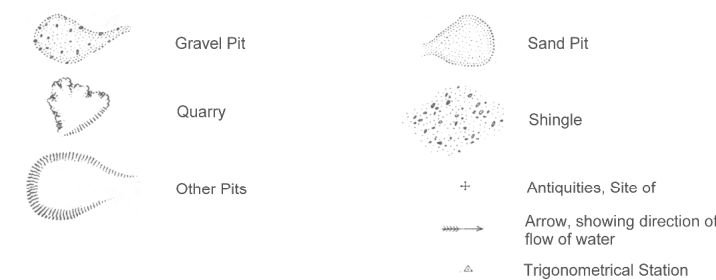
ROADS



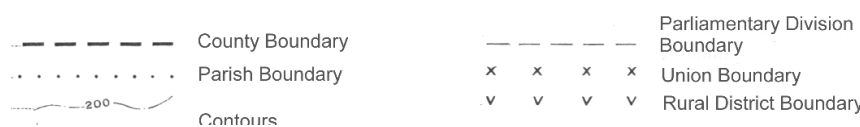
RAILWAYS



GENERAL FEATURES



BOUNDARIES



National Grid 1:10,000 scale

HEIGHTS (METRES)

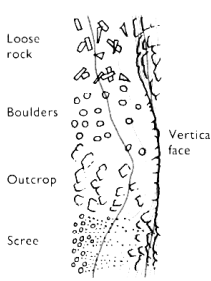
Values are given in metres above mean sea level at Newlyn.

Surface heights determined by ground survey + 163m
air survey + 16m

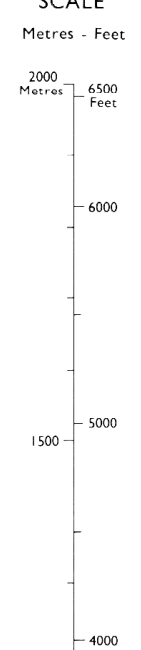
Bench marks and their values are shown on large scale maps, and bench mark lists containing fuller and possibly later levelling information are obtainable from the Director General, Ordnance Survey.

Contours are at 5 metres vertical interval.

ROCK FEATURES



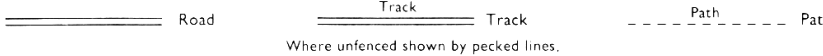
CONVERSION SCALE



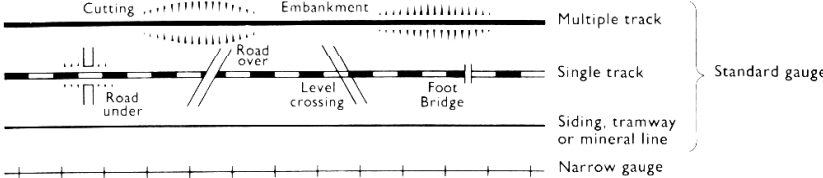
ABBREVIATIONS

BP,BS	Boundary Post or Stone	PO	Post Office
Ch	Church	PC	Public Convenience
CH	Club House	PH	Public House
F Sta	Fire Station	S	Stone
FB	Foot Bridge	Spr	Spring
Fn	Fountain	TCB	Telephone Call Box
GP	Guide Post	TCP	Telephone Call Post
MP,MS	Mile Post or Stone	TH	Town Hall
P	Pole or Post	W	Well
Pol Sta	Police Station	Y	Youth hostel

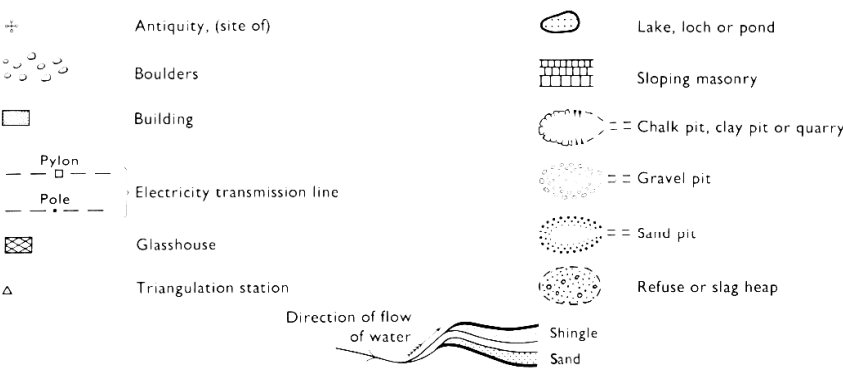
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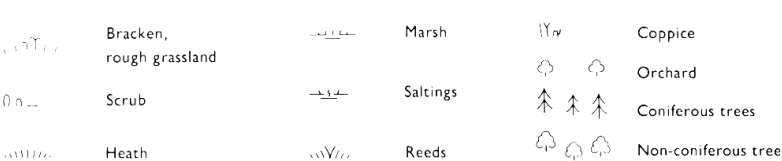
RAILWAYS



GENERAL FEATURES



VEGETATION



In some areas bracken () and rough grassland () are shown separately.



Historical Map Pack Legend

County Series & National Grid 1:10,560 scale

Information present on these legends is sourced from the same Ordnance Survey mapping as the maps used in this product.

If you have a query regarding any of the maps provided please contact GroundSure's technical helpline. We will endeavour to answer any queries you may have.

Technical Helpline

Tel 08444159000

groundsureinsight@groundsure.com
www.groundsure.com

Site Details:

PROPOSED UNITS 5 + 6,
LANGSTONE TECHNOLOGY
PARK, HAVANT, PO9 1SA

Client Ref: AG3544-23
Report Ref: GS-QB8-8XR-VBQ-SG7
Grid Ref: 471341, 105559

Map Name: County Series

Map date: 1866

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1866
Revised 1866
Edition N/A
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Production date: 23 October 2023

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf

