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Consulting Civil Engineers

Horniman Museum

Sunken Garden Repairs

Pre-Construction Information

Ref: 221062/S Wilkinson

Approved By: S Wilkinson

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1.0 INTRODUCTION AND INSTRUCTIONS TO TENDERERS

1.1 The Construction (Design and Management) Regulations 2015 apply to this project and place duties on the Client, Principal Designer, Designers, Principal Contractor and Contractors to plan, manage, monitor and coordinate health and safety in the pre-construction and construction phases of the project. Conisbee Structural Engineers are the Principal Designer under the Construction (Design and Management) Regulations 2015 for pre-construction phase of this project. Details for the client, Conisbee and all other parties to the project, are found together with a description of the project in Section 2.

1.2 This Pre-Construction Information is to assist tendering contractors in identifying issues that have been identified as part of the design process and provides a basis for the Construction Phase Plan including details of any significant or unusual residual health or safety hazards or constraints inherent within the site or adjacent areas. The appointed Principal Contractor should identify these issues in their Construction Phase Plan and state how they will deal with them and what controls will be put in place. This document should be used to assist in addressing all issues identified in tender submissions and the appointed Principal Contractor should use it to address issues in their Construction Phase Plan.

1.3 The Construction (Design and Management) Regulations 2015 require a Construction Phase Plan to be prepared prior to the commencement of the construction phase of the project and maintained until completion of the construction phase. The purpose of the Plan is to provide information and describe procedures that will ensure the health and safety of all those involved in the project.

1.4 A description of the works covered by this plan is provided in Section 2. The plan will draw together all the project-specific information provided by the Client and Designers during the design and early planning stages. It identifies key health and safety issues, in particular those that a contractor might not reasonably be expected to identify. The level of detail found in the plan will be proportionate to the anticipated risks involved in the project. Little emphasis is given to risks that are commonplace or those that a competent contractor would be expected to recognise. Information contained in this plan is intended to alert the contractor to health and safety issues that may have significant resource implications or may affect the way that work is planned and carried out.

1.5 CDM 2015 requires the Client to ensure, the construction phase of any project does not start unless a construction phase plan complying with is in place and is project-specific and suitable for works to start on site. Therefore, prior to the commencement of the construction phase, the Principal Contractor must submit the project-specific construction phase plan to the Client to enable them to ensure compliance with their duties. Where the Client has designated to the Principal Designer the task of reviewing the Construction Phase Plan, a copy of the plan shall also be sent to the Principal Designer.

The Principal Contractor is obliged under Regulation 12 of CDM 2015 to develop the Construction Phase Plan and maintain it until the end of the construction phase.

2.0 PROJECT DESCRIPTION

2.1 Project Description and Programme Details:

2.1.1 Site Address

The Horniman Museum
100 London Road
Forest Hill
London
SE23 3PQ

2.1.2 Description of the Project

External works including:

- Reconstruction of damaged garden walls/piers
- Structural improvement works to existing retaining walls
- Rebedding of existing stone copings
- Repointing of existing garden walls
- Relevelling of existing stone paviours

Also refer to Preliminaries, Schedule of Work, drawings and specifications in the tender document package.

2.1.3 Programme

The start date is to be confirmed but anticipated to be in late September 2023.

Contractor's mobilisation period is 2 weeks.

2.2 Project Team

2.2.1 Client

The Horniman Museum
100 London Road
Forest Hill
London
SE23 3PQ

Contact: Tim Hopkins (Estates Manager)
Tel: 020 8699 1872
Email: thopkins@horniman.ac.uk

2.2.2 Contract Administrator

Conisbee Structural Engineers
1-5 Offord Street
London
N1 1DH

Contact: Simon Wilkinson
Tel: 07968 856 486
Email: simon.wilkinson@conisbee.co.uk

2.2.3 Principal Designer

Conisbee Structural Engineers
1-5 Offord Street
London
N1 1DH

Contact: Simon Wilkinson
Tel: 07968 856 486
Email: simon.wilkinson@conisbee.co.uk

2.2.4 Quantity Surveyor

A J Oakes & Partners
Unit 83
Capital Business Centre
South Croydon
CR2 0BS

Contact: Chris Whalley
Tel: 020 8777 8251
Email: chris.walley@ajoakes.co.uk

2.2.5 Principal Contactor

To be confirmed

2.3 HSE Notification (CDM Regulation 6)

2.3.1 This project is not anticipated to be notifiable under the CDM regulations as the construction period will last longer than 30 working days but will not have more than 20 workers working at the same time or exceed 500 person days. If this is projected to change at any time following appointment of the Principal Contractor, they must notify the project to the HSE.

2.4 Use as a Workplace

2.4.1 The project includes areas that shall be used as a workplace within the meaning of the Workplace (Health, Safety & Welfare) Regulations.

2.5 Existing Health and Safety File & Operation and Maintenance Files

2.5.1 None are available for the areas affected by the works.

2.6 Drawings (Appendix B)

- Plan of site work areas, site compound location and access points

2.7 Survey Information

2.7.1 A site investigation report produced for previous construction work within the Gardens is included at Appendix D. The ground conditions on the site are generally of the London Clay Formation and information contained within the report may be used for guidance only for contractor design of ground anchors. Site confirmation of acceptable pull-out resistance following installation will still be required – together with any other testing or investigations the ground anchor suppliers/installers may consider necessary as part of their design.

2.7.2 No asbestos survey information exists for the work areas and no asbestos containing materials are known or expected to be present.

3.0 CLIENT CONSIDERATIONS AND MANAGEMENT REQUIREMENTS

3.1 Structure and Organisation

3.1.1 The Principal Contractor will be required to appoint a person who has responsibility for planning and managing the works as defined within the Construction (Design & Management) Regulations 2015. This person should also be responsible for liaising on health and safety matters.

3.1.2 This person will be expected to have sufficient authority to act on requests from the Client or their nominated representative and be able to provide suitable information on health and safety issues to the Client.

3.1.3 Co-ordination and liaison on health and safety will be principally through the Contract Administrator for client matters.

3.1.4 Where site works interact/overlap with Client and/or adjoining owner activities the Principal Contractor must establish procedures for managing these health and safety overlaps and communicating, when appropriate, directly with the Client and/or the Contract Administrator. These arrangements must not compromise contractual arrangements.

3.1.5 The Principal Contractor must assess the health and safety implications of any design changes, contract instructions or unforeseen eventualities. The Contract Administrator and the Principal Designer must be advised of any significant health and safety risks or significant changes to programme or methods of working resulting from these changes.

3.1.6 The Principal Contractor must also consider how to maintain health, safety and welfare in the context of the COVID 19 pandemic. All legal requirements and best practice advice and guidance that may apply during the contract period must be followed.

3.2 CDM Health and Safety Objectives for the Project

3.2.1 The overall objective is to control foreseeable risks to the health or safety of any person carrying out or liable to be affected by the works and to complete the project without fatalities, reportable injuries, diseases, or dangerous occurrences affecting employees, sub-contractors and others, including the general public.

3.2.2 The safety of Horniman visitors, staff and inhabitants of adjoining properties must be maintained at all times.

3.2.3 At each project meeting the Principal Contractor will be expected to provide a report on any health and safety matters that have arisen, to include:

- Health and safety incidents

- Time lost due to accidents
- Safety Inspections and Audits (key issues, action)
- HSE visits (observations, enforcement notices, action)
- Implications of developing design issues and changes

3.3 Communication

3.3.1 The Principal Contractor will be required to ensure that all site operatives and visitor have received appropriate inductions and training related to health and safety matters.

3.3.2 The Principal Contractor must ensure that all necessary information related to risk controls and procedures is communicated to contractors and any other relevant parties, including Museum staff when needed. The Principal Contractor's site manager will be primarily responsible.

3.4 Site Security

3.4.1 The Museum and Gardens will remain fully occupied during the works. The Principal Contractor will be responsible for the security of the works and materials on site. Entry to the work site areas by unauthorised persons is to be barred.

3.4.2 The Principal Contractor is to ensure all operatives and contractor's employees wear clear, visible identification and/or clothing with corporate logos at all times when on site.

3.5 Working Hours

- Monday to Friday - 07.15 to 17.00
- No work must be executed outside these hours without prior approval.
- Wherever possible deliveries to and from the site should take place between the hours of 07.15 and 09.00 only.

3.6 Welfare Provisions

3.6.1 The Principal Contractor is to provide suitable welfare facilities in accordance with Schedule 2 of the CDM Regulations 2015. For this project, the contractor must provide welfare unit(s) including WC, cooking and dining facilities and a seating and rest area and maintain the facilities for the duration of the project. The welfare unit is to be located within the site compound (see Appendix B).

3.7 Separation of the Works

3.7.1 The Principal Contractor must ensure that the work areas are safely separated from areas used by the general public and site staff.

3.7.2 Suitable fencing, barriers, tape, signage, and any other appropriate measures must be provided to maintain separation.

3.8 Site Traffic Management

3.8.1 The Museum and Gardens are to remain open to the public during the works and the Principal Contractor must manage site traffic to prevent interactions with members of the public and neighbours.

3.8.2 Materials deliveries and waste collection should be scheduled wherever possible between 07.00 and 09.00. All vehicle movements to be completed and vehicles off site before the Museum opens to the public at 10.00. If vehicles are required to enter the site during public opening hours, the Contractor must notify Tim Hopkins in advance for written agreement.

3.8.3 It is assumed that construction materials and waste will be stored in the agreed site compound. Subject to works being undertaken at any particular time, deliveries and collections should normally be via the Horniman Drive entrance and only enter via the London Rd entrance if Horniman Drive is temporarily inaccessible for any reason.

3.8.4 Movements of small wheeled or tracked plant between the site area and the contractor's compound are acceptable during opening hours, subject to use of trained banksmen in attendance at all times. Every care must be taken to avoid interactions with museum visitors.

3.8.5 All vehicle movements on site are not to exceed 5mph with hazard lights on. Banksmen must be in attendance at all times.

3.9 Non-Working Hours

3.9.1 Note that the client's security staff may need access to the site during non-working hours. Such staff may be unfamiliar with construction sites and may not be wearing personal protective equipment appropriate to construction sites.

3.9.2 At the end of each working day, leave the sites in a tidy condition free from hazards. In particular, any excavations must be suitably protected. If hazards remain which cannot be made safe, provide written notice each day to the client.

3.10 Access for Deliveries, Disabled Visitors & Other Contractors

3.10.1 A vehicular access route for emergency vehicles Café delivery vehicles, other contractors and vehicles used by disabled museum visitors must be maintained at all times either via the Horniman Drive or London Rd entrances and the contractor must not block or obstruct these routes.

3.11 Parking

3.11.1 Parking for contractor vehicles is not available within the Museum and Gardens.

3.12 Waste Management

3.12.1 The Museum's environmental policy requires all removed materials to be recycled either on site or off site and waste notes provided confirming disposal methods and destinations.

3.13 Client Rules and Restrictions

3.13.1 The Museum Rules for Visiting Contractors must be followed (see Appendix A).

3.13.2 In addition, the Principal Contractor's site rules must include the following:

- Workers to wear visible ID cards and or corporate clothing.
- All visitors to site to report to site manager and sign in/out.
- All deliveries to and from vehicles must be fully supervised by a banksman.
- Agreed access routes to the site must be observed at all times.
- All roads and footpaths must be protected and maintained in a condition suitable for vehicular and pedestrian traffic.
- Adequate safety signs and notices will be displayed indicating the construction area and sufficient lookouts must be provided to prevent unauthorised people entering the construction site.
- Work will cease in an area if material suspected as being asbestos or hazardous in nature is discovered in an unexpected location.
- Provide appropriate fire-fighting equipment and establish a safety zone whenever site welding or any other form of hot work takes place.
- Task appropriate PPE is to be worn at all times on site.
- Drugs and alcohol policy to be applied by the Principal Contractor.
- No smoking on site or anywhere within the buildings.
- No parking on site (unless agreed by the client).
- No radios/personal sound equipment

3.14 Permits to Work

3.14.1 All work should be planned in advance and agreed with all relevant parties. The Principal Contractor should then issue permits to work where appropriate.

3.14.2 Activities covered by permits to works may include (but are not limited to)

- Water supply isolation and reconnection

- Electrical isolation and reconnection
- Any external site activities

3.15 Fire Prevention

3.15.1 The risk of fire occurring during these works should be low if appropriate prevention measures are applied by the Principal Contractor.

3.15.2 The Principal Contractor shall review the most recent guidance edition of 'Fire Safety in Construction Work' (HSE Guidance HSG168) and develop an appropriate site-specific fire risk assessment and plan that incorporates the requirements of

- CDM Regulation 29: Prevention of risk from fire etc
- CDM Regulation 30: Emergency procedures
- CDM Regulation 31: Emergency routes and exits
- CDM Regulation 32: Fire detection and fire-fighting

3.15.3 This plan is to be included within the overall Construction Phase Plan and must be provided prior to the commencement of works on site.

3.16 Emergency Procedures

3.16.1 Suitable means of escape in the case of fire or other emergency must be maintained for all site areas.

3.16.2 Existing escape routes and assembly points for other site users must remain clear at all times.

3.17 Restricted Access Areas

3.17.1 Operatives are not permitted to enter areas of the Museum and Gardens occupied by the client (other than public areas).

3.18 Confined Spaces

3.18.1 No areas are currently, or anticipated to be, designated as confined spaces as defined by the regulations.

3.19 Working at Height

3.19.1 Works at height are not anticipated, but should they become necessary, the Principal Contractor is to confirm appropriate control measures within their Construction Phase Plan.

3.20 Reportable Occurrences

3.20.1 Any reportable incident prescribed under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR) is to be reported to the Health and Safety Executive within the required notice period for that event and the Client, Contract Administrator and the Principal Designer are to be notified immediately following occurrence.

3.21 HSE and Local Authority Notices

3.21.1 Notify the Client, Contract Administrator, and the Principal Designer of any notices (improvement or prohibition) or summons received from the Health and Safety Executive or Local Authority.

4.0 ENVIRONMENTAL RESTRICTIONS AND EXISTING ON-SITE RISKS

4.1 Safety Hazards

4.1.1 Site Boundaries and Access

Refer to plan drawing DR-S-5000 in Appendix B. This shows the approximate extents of the site area and expected location of the contractor's storage and welfare facilities.

Any areas where site works are taking place will require a boundary demarcated by fencing or other physical barriers.

The site storage and welfare compound will require permanent secure fencing with lockable gates to prevent unauthorised access.

All locations are within or in close proximity to public areas and access routes are shared with the public and museum staff. Measures to protect both pedestrians and vehicles may be required.

4.1.2 Restrictions on Deliveries, Waste Collection or Storage

Deliveries and collections should generally be undertaken outside of Museum opening hours (see also section 3.8).

Waste must only be stored with the work site areas and must be regularly removed using the closest agreed access point. Movement of materials and waste between the site areas should ideally be avoided wherever possible during working hours but is permissible if control measures are rigorously applied.

4.1.3 Adjacent Land Uses

The areas surrounding the work sites are the Horniman Museum and Gardens. Private premises are not considered likely to be affected by the works.

Liaison and coordination with other contractors working in the Horniman Museum and Gardens may be required.

4.1.4 Existing Storage of Hazardous Materials

None known.

Report any other hazardous materials identified to the Client, Contract Administrator and Principal Designer.

4.1.5 Location of Existing Services

Services present on the Museum and Gardens site include gas, electricity, mains water and telephone/data supplies.

The Museum and Gardens will remain operational and supplies will need to be maintained during the works, unless otherwise specifically agreed with the Client.

Records drawings showing approximate locations of known services will be provided to the Contractor prior to the start of works. The accuracy of these drawings cannot be guaranteed and to avoid damage and/or injury the Principal Contractor will be required to take suitable precautions to identify and protect all existing services that may be affected by the works.

4.1.6 Ground Conditions

The ground conditions with the Museum and Gardens site are predominantly of London Clay however due to the presence of earlier buildings in some areas, made ground may also be locally present.

No contamination is known to be present.

4.1.7 Existing Structures

Historic and modern buildings – not anticipated to be affected by the works as they are relatively distant from the Sunken Garden works area.

4.1.8 Previous Structural Modifications

Not applicable.

4.1.9 Fire Damage, Ground Shrinkage, Movement, Poor Maintenance

Cracking and movement has occurred to existing walls and paved areas. This is considered due to root action and expansion and contraction of shrinkable clay soils as well as inherent design deficiencies.

4.1.10 Existing Plant & Equipment

Not applicable.

4.1.11 Existing Health and Safety Information

No existing Health and Safety File relevant to the works exists.

No other information is available.

4.2 Health Hazards

4.2.1 Asbestos

No Asbestos Containing Materials (ACMs) are known to be present in the areas affected by the works.

If any previously unknown suspected ACMs are encountered, stop work in the area and contact the Client and Contract Administrator immediately for further instructions.

4.2.2 Existing Storage of Hazardous Materials

See 4.1.4 above.

4.2.3 Contaminated Land

Contaminated land has not been reported and is not expected based on known historical land uses.

4.2.4 Existing Structures containing Hazardous Materials

None known.

4.2.5 Health Risks Arising from Client's Activities

None known.

4.2.6 Control of Noise and Vibration

Minimise noise and vibration through good management and best practice.

All plant and equipment is to be fitted with the correct and working exhaust mufflers and noise suppression kits.

4.2.7 Control of Dust

Control dust using dust suppressant tools.

5.0 SIGNIFICANT DESIGN AND CONSTRUCTION HAZARDS

5.1 Design Assumptions and Control Measures

5.1.1 See the Structural Engineer's Construction Hazard Assessments at Appendix C.

5.1.2 Any other issues are considered capable of being dealt with by a competent contractor during the normal course of construction.

5.2 Arrangements for Coordination of Ongoing Design Work

5.2.1 The Principal Contractor should provide details of any contractor-designed temporary works required to maintain stability during the works to the Principal Designer and ensure that sufficient information is included in the Construction Phase Plan and provided to the Contract Administrator for timely review prior to commencement.

5.2.2 Regular site and project team meetings will also be held during the works.

5.3 Significant Risks Identified during Design

5.3.1 Maintenance of stability of retaining walls during the works.

5.3.2 Segregation between the works areas and the remainder of the Museum and Gardens.

5.4 Materials Requiring Particular Precautions

5.4.1 None known.

6.0 HEALTH AND SAFETY FILE

6.1 The Principal Contractor is responsible for preparing the Health and Safety File and is required to collect all relevant information, which could be beneficial to those who will be involved in future construction work to the properties and to pass this information to the Principal Designer (if still appointed). This will include:

1. A brief description of the work carried out.
2. Residual hazards and how they have been dealt with (e.g. surveys or other information concerning asbestos, contaminated land, buried services, etc.).
3. Key structural principles.
4. Hazardous materials used (e.g. hazardous substances, special coatings which should not be burnt off.)
5. Information regarding the removal or dismantling of installed plant and equipment (e.g. lifting arrangements.)
6. Health and Safety information about equipment provided for cleaning or maintaining the structure.
7. The nature, location and marking of significant services, including underground services, gas supply equipment, firefighting services, etc.
8. Information and as built drawings of the structure, and adjacent or incorporated plant and equipment.

6.2 Before the Certificate of Practical Completion is issued, the Principal Contractor must ensure that all such information has been supplied by themselves and their sub-contractors, to the satisfaction of the Principal Designer. The client's requirements for content and format will be discussed at the pre-start meeting.

7.0 CONSTRUCTION PHASE PLAN CONTENT

7.1 The Principal Contractor's Construction Phase Plan should contain the following information as a minimum:

- A brief description of the project including key dates and details of key members of the project team.
- Confirmation of how the project will be managed to include:
  - Health and safety aims for the project.
  - Site rules.
  - Arrangements for cooperation, coordination and liaison between project team members.
  - Arrangements for provision of information and involvement with site workers in respect of health and safety.
  - Site induction arrangements.
  - Details of welfare facilities in compliance with Schedule 2 of the CDM Regulations.
  - Fire prevention and emergency procedures.
- The control of any significant site-specific risks relevant to the project. To include method statements/safe systems of work for:
  - Excavations and avoidance of damage to underground/concealed services.
  - Works undertaken adjacent to occupied areas.
  - Work at height.
  - Structural stability during demolition/excavation works.
  - Construction traffic management on site.
- Provision of Health and Safety File information.

APPENDIX A – MUSEUM RULES FOR VISITING CONTRACTORS

Museum Rules for Visiting Contractors

This sheet sets out the Museum rules for all visiting contractors, and should be issued to all relevant person for information.

We are required under the Health and Safety at Work etc. Act 1974 to ensure that a safe place of work exists for all those who have cause to use the premises. This duty extends to not only staff and visitors but other users, including contractors.

It is the responsibility of every contractor to ensure that his site supervisor receives a copy of these rules and that his employees are informed of those rules which affect them.

These rules are not negotiable and the Museum requires, as part of the work contract, that they are strictly adhered to.

Any willful ignoring of these rules will result in the person being banned from the Museum site and any further breach may result in the company being barred from any further work for the Museum.

Parking

As there is limited space onsite the Museum cannot guarantee to provide contractor parking and staff attending site should be informed of this and advised that they may need to park offsite. If there is equipment to unload, the Museum should be informed in advance and arrangements can be made for short term parking on site. Vehicles should then be removed from the site unless tools and equipment, that is essential to their operation, are kept and accessed in the vehicle.

Vehicle Access

All means of access must be agreed in advance by the Facilities Manager or Deputy Facilities Manager. The normal vehicle access route is via the Horniman Drive gate. Contractors should be reminded of the rules while driving a vehicle on site which must be observed. Mobile telephones must not be used whilst driving. The speed limit is 5mph with hazard lights on.

Identification badges work permits and keys

Every person must wear the prescribed Museum identification badge/work permit in a prominent position at all times when in the Museum. Museum identification badges/work permits may be removed **temporarily** if it is identified that they will interfere with the safe use of tools or equipment. The badge/permit/key/swipe card will be issued at the security desk on arrival and must be returned on departure. The badges/permits/keys/ swipe cards must not be taken 'off site' and must be handed in whenever leaving the Museum. Failure to comply may result in permission to work on site being refused.

Smoking

No smoking except in the designated location is permitted anywhere in the Museum at any time, including courtyard areas.

Hot Works, Working at Height (at any height where there is a risk of a fall), Electrical Work

All works which have any element as above must be agreed in advance with the Facilities Manager or Deputy Facilities Manager and a Permit to Work obtained from the security desk. This may also require the authorized isolation of the fire alarm system prior to the commencement of any hot 'work'. Any work activity which creates flame, sparks, smoke or dust must take into account the smoke and heat fire detection units. Any deactivation of alarms should be authorized by the Facilities Manager or deputy Facilities Manager and logged in the security log book. Work may not commence until this precaution has been confirmed by Security. Those persons carrying out 'hot works' are required to supply their own fire extinguishers which are appropriate to the risk identified in the risk assessment.

Suitable risk assessments should be completed as required by the Management of Health and Safety at Work Regulations 1999 before the work begins.

Any contractor refusing to complete a work permit will not be permitted to work on site.

Equipment brought on site

All equipment used by a Contractor or Supplier must be in good working order, comply with appropriate safety and electrical legislation, should be PAT tested and visually inspected before use.

Equipment left on site shall be kept in a safe and secure manner ideally in a locked cupboard and at the risk of the Contractor or Supplier.

All portable appliances used outside of buildings and on construction sites should, where possible, be battery operated or be suitable for use with 110 volt power supply with additional consideration given to the positioning of the trailing leads to avoid slip and trip hazards.

Personal protection

Contractors should ensure they wear appropriate personal protective clothing as specified in the risk assessment to include, safety footwear, head protection, ear protection, eye protection, suitable gloves and face protection as required by the activity risk assessment.

Competence

All those persons employed to carry out work at the Horniman Museum must be competent. They must have the required skills, knowledge, ability, training and experience to complete their work safely and effectively.

Construction (Design and Management) Regulations 2015, Contractors and the self-employed

The Horniman Museum has strict controls in place to comply with the Construction (Design and Management) Regulations 2015 (CDM 2015). Work classed as construction within CDM 2015 (e.g. building maintenance and repair, redecoration, high pressure water jetting, installation of electrical or IT cabling), which involves more than one contractor, requires one of the contractors to be appointed in writing as the Principal Contractor and Principal Designer where necessary, by the Museum. All such work, whether or not involving one contractor, will require a written Construction Phase Plan in place prior to work commencing.

Under the CDM 2015 Regulations, the Horniman Museum will be the 'client' in respect of any relevant works undertaken. The 'client' is required to inform the Health and Safety Executive (HSE) about certain construction projects. A project becomes notifiable to the HSE if the construction work is expected to last longer than 30 working days and have more than 20 workers working at the same time at any point on the project or if the work will exceed 500 person days. The client for the construction work is required to send the notification to HSE, either on-line (on form F10) or in writing.

It is a requirement under the CDM 2015 Regulations that the Principal Contractor manages the Construction Phase Plan and ensures contractors and self-employed people working on the site are made aware of their duties accordingly. All contractors must ensure that full induction of his/her own staff, sub-contractors and the self-employed is carried out and that these site rules are documented and signed by all inductees to demonstrate full understanding by all persons working on site.

The Principal Contractor is required to check the competence of any domestic named or nominated contractor for the purposes of complying with the Construction (Design and Management) Regulations 2015.

Food and drink

No food or drink of any type may be taken into, or consumed within the Museum galleries, plant rooms or in areas where work is being undertaken.

Radios

No music devices, radio headphones or MP3 players may be used within the Museum or Gardens at any time.

Language

Foul, offensive or immoderate language is not acceptable within the Museum and Gardens at any time. Any willful ignoring of this rule will result in the person being banned from the Museum site and any further breach may result in the company being barred from any further work for the Museum. In hot weather, shirts must be kept on at all time across the site.

Fire alarms and evacuations

Fire alarms are tested every Thursday morning between 07.00 and 09.00. They will sound for a few seconds only and then stop. This activation is repeated several times.

At all other times when the fire alarm sounds, all contractors must make safe any equipment being used and must evacuate the building immediately by the nearest exit and gather in front of the clock tower.

The contractor must nominate a member of staff to be responsible for checking that all of the staff are clear of the building and report such to the nearest Visitor Services Assistant who will relay the information to Incident Controller. Contractors must not re-enter the building without permission from the Incident Controller.

Accidents and work related illness

All accidents and work related illness should be reported to the Security Desk and the relevant forms filled in.

Contractors should notify the museum of any known disability (e.g. hearing impairment, colour blindness), health condition (including allergies) or language difficulty which could affect their safety and/or the safety of others whilst undertaking work at the museum.

Toilets

Contractors may use only the toilets designated by the Museum.

Materials

The delivery and storage of materials and the routes and times of entry into the Museum must be agreed with the Facilities Manager or Deputy Facilities Manager in advance.

Waste

The Contractor is responsible for removing all unused materials and/or waste and recyclable materials by the completion of the works and at the end of each work period.

Work Site

Contractors should restrict their movements to the designated work site and agreed access routes.

Works

No work shall be carried out without the prior knowledge and agreement of the Facilities Manager or Deputy Facilities Manager.

Telephones

The Museum phone system is not to be used by Contractors except when it is crucial to the completion or continuation of works or in cases of emergency. It should also be noted that the use of mobile phones within the Museum building should not cause nuisance or annoyance to staff or visitors.

Late/Lone Working

Whilst every effort is made to ensure that works are carried out during the normal working day it is recognised that on occasion it may be necessary to undertake work out of hours. Any contractor working outside normal hours will be required to make use of the Museum's lone worker protection system and carry a Museum radio to stay in contact with Museum Security staff whilst onsite. Any failure to comply with this request will be refused permission to work onsite.

Any contractor or delivery person failing to take reasonable Health, Safety, and Operational Instruction from security staff or management will be told to leave the premises, their superiors will be informed and they will be banned from accessing or working on the Horniman sites in future.

Declaration

I declare that I have fully read and understand this document. I agree to comply with the Rules and acquaint all persons employed by the Company (including sub-contracted staff) with these Safety Rules.

Signed:

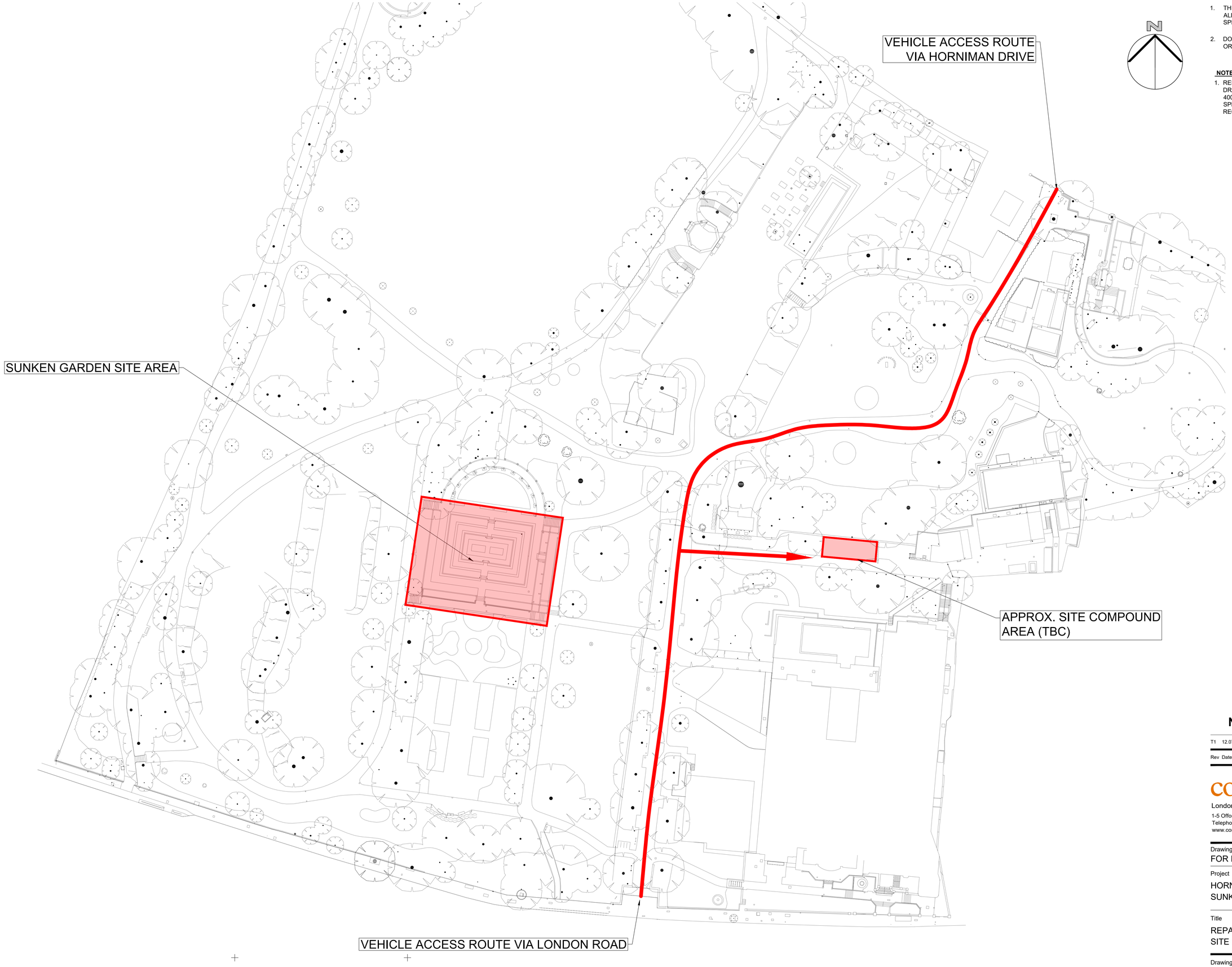
Date:

Name (Block Capitals) Position (Block Capitals)

Company Name (Block Capitals)

Document Reviewed April 2016

APPENDIX B – SITE AREA & LOGISTICS PLAN



GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE FROM THIS DRAWING IN EITHER PAPER OR DIGITAL FORM. USE WRITTEN DIMENSIONS ONLY.

NOTES

1. REFER TO CONISBEE REPAIR PLAN AND DETAIL DRAWINGS DR-S-1000 AND DR-S-4000 THROUGH TO 4002 TOGHETHER WITH THE STRUCTURAL SPECIFICATION FOR FURTHER DETAILS OF WORKS REQUIRED.

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NOT FOR CONSTRUCTION

Rev	Date	Description	Drawn	Check
T1	12.07.23	TENDER ISSUE	SW	SW

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Drawing Status
FOR INFORMATION

Project
HORNIMAN MUSEUM
SUNKEN GARDENS

Title
REPAIR WORKS
SITE LOGISTICS PLAN

Drawing No
220331-XX-XX-DR-S-5000

Date JUL 2023
Scale 1:100@A1
Drawn SW
Engineer SW
Project No **220331**
Revision **T1**

APPENDIX C – CONISBEE CONSTRUCTION HAZARD ASSESSMENT

CONSTRUCTION HAZARD ASSESSMENT
STRUCTURAL DESIGN for

Horniman Museum – Sunken Garden Repairs

It is assumed that the project is to be undertaken by experienced and competent designers and contractors who are aware of the common risks associated with construction processes.

The summary below is intended to help all parties recognise the less common hazards which may be encountered in this particular project through an understanding of the structural principles involved and the assumptions made by the design engineer.

We do not claim to have identified all hazards associated with the project.

Ref: 221062/S Wilkinson
Date: 12 Jul 2023
Status: For Information
Version: 1

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Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
1.0	**NEW SUBSTRUCTURE AND FOUNDATIONS**		
1.1	**Utilities**		
1.1.1	Has a public utilities search been implemented?	NO	
1.1.2	If not why not?		Contractor to use site utilities plan for guidance and carry out their own scanning where needed.
1.1.3	Which utilities may affect the project?		Gas, Water, Electricity, Communications
1.2	Site Investigations	YES	
1.2.1	Has a desk study been undertaken?	NO	
1.2.2	Has a soil investigation been undertaken?	NO	
1.2.3	If not why not?		Previous SI reports confirm predominant ground conditions are London clay.
1.2.4	Does the investigation highlight any:	N/A	
	○ Exceptional strata		
	○ Water problems		
	○ Contamination		
	○ Obstructions		
	○ Other issues?		
1.3	Site Strip	N/A	
1.3.1	What is the anticipated depth of site strip?	N/A	
1.3.2	Are any special precautions needed when excavating and removing material?	N/A	
1.4	**Foundations**	N/A	

Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
1.4.1	Describe the proposed foundations in outline.	N/A	
1.4.2	Do any excavations that require hand finishing exceed 1.2 m depth?	N/A	
1.4.3	Are any excavations envisaged close to adjoining structures?	N/A	
1.4.4	If yes, have their foundations been examined and recorded?	N/A	
1.4.5	Are any special shoring procedures needed?	N/A	
1.4.6	Have any existing underground services or obstructions been identified?	N/A	
1.4.7	Are any excavations close to existing services?	N/A	
2.0	**SUPERSTRUCTURE – NEW BUILD AND EXTENSIONS**	N/A	
2.1	**General**	N/A	
2.1.1	What structural system is proposed?	N/A	
2.1.2	How is stability to be achieved?	N/A	
2.1.3	If a frame is being used will any special sequence of craneage be needed?	N/A	
2.1.4	Will any temporary works be necessary to ensure stability during erection?	N/A	
2.2	**Walling and Cladding**	N/A	
2.2.1	What construction is envisaged for the external envelope of the building?	N/A	
2.2.2	What construction is envisaged for internal partitions?	N/A	
2.2.3	Does walling or cladding provide either	N/A	

Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
	temporary or long-term stability to the building?		
2.2.4	Can all units be safely lifted and placed in position by one person?	N/A	
2.2.5	Are walls stable in the temporary condition before floors/roofs applied?	N/A	
2.3	**Beams and Lintels**	N/A	
2.3.1	What beams and lintels are envisaged in the works?	N/A	
2.3.2	Are special (in terms of size, weight, awkward shape or requiring assembly work on site) beams and lintels necessary?	N/A	
2.3.3	Are there any special handling and erection sequences which need to be followed?	N/A	
	Are beam weights, moments and reactions indicated on the drawing?	N/A	
2.4	**Floors and Stairs**	N/A	
2.4.1	Outline the proposed construction of floors and stairs.	N/A	
2.4.2	Define the imposed load capacity required	N/A	
2.4.3	Has any special allowance for construction loads been allowed?	N/A	
2.4.4	Is the design by others?	N/A	
2.4.5	Is craneage necessary?	N/A	
2.5	**Roof**	N/A	
2.5.1	Describe the proposed roof construction.	N/A	
2.5.2	Define the imposed load capacity required.	N/A	
2.5.3	Is design by others?	N/A	

Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
2.5.4	Is craneage necessary?	N/A	
2.5.5	Is the erection sequence important for stability during construction?	N/A	
3.0	**INFRASTRUCTURE AND EXTERNAL WORKS**		
3.1	Describe the Highway works and any issues related to their construction that are unusual or represent significant hazards.	N/A	
3.2	Describe the drainage works and any issues related to their construction that are unusual or represent significant hazards	N/A	
3.3	Are any excavations close to existing services, or sensitive uses?	N/A	
3.4	Describe any external works, retaining walls, earthworks etc.	N/A	
3.5	Is design by others?	N/A	
3.6	Any special sequence of work or limitation on loading, including temporary loads from construction?	N/A	
4.0	**SUPERSTRUCTURE REFURBISHMENT, REPAIRS AND STRUCTURAL ALTERATIONS**		
4.1	Is there an asbestos register for the building? If yes, are areas to be investigated affected and are precautions required or clearance necessary ahead of any investigations or construction works? If no, lead consultant to organise asbestos	NO	Asbestos containing materials are not expected to be present due to location and construction type.

Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
	survey ahead of any investigations		
4.2	What is the construction and load bearing elements of the existing structures?	YES	Load bearing brickwork free-standing and retaining walls.
4.3	What provides stability at present?	YES	Load bearing brickwork free-standing and retaining walls.
4.4	What is the nature of the proposed works?		Localised reconstruction, repair and restraint of brickwork walls
4.5	What will provide stability in future?	YES	Retrofitted ground anchors, bedjoint reinforcement and reconstructed brickwork
4.6	Have any major structural defects been discovered?	YES	East terrace retaining wall has suffered movement and distortion. Free-standing brickwork piers are collapsed or unstable.
4.7	Are any special precautions or procedures necessary before the works begin in earnest?	YES	Contractor to carefully takedown and make safe any loose or unstable free-standing brickwork elements. Consider requirements for temporary shoring at East terrace during installation of ground anchors.
4.8	Are any unusual risks anticipated in the execution of the works?	NO	
4.9	Are there any special sequences of alteration, repair or erection which need to be followed?	YES	Contractor must assess the work sequence for repairs to upper and lower tiers of East terrace retaining walls to ensure stability.
4.10	Define imposed load capacities to be achieved.	YES	The CDP ground anchor element should allow for 5.0kN/m^2 on the east terrace paved areas.
4.11	Are any walls, floors or their coverings being removed in the works which might lead to	NO	

Project Title: Horniman Museum – Sunken Garden Repairs			Project No: 230331
Consideration		**Yes/No**	**Comment**
	temporary loss of stability in the building?		
5.0	**BUILDING IN USE**		
5.1	Are any elements of the structure expected to fatigue or wear or require ongoing maintenance and repair work during the design life of the building?	NO	
5.2	Are there any elements in the civil engineering works (e.g., pumps, catch pits, silt traps, permeable paving) that require maintenance during the design life of the building?	NO	
5.3	Are regular ongoing inspections required – define frequency.	YES	Due to risk of ongoing unauthorised access to wall tops. Annual visual inspection is recommended and/or reactive inspection as needed.
6.0	**DEMOLITION AT THE END OF DESIGN LIFE**		
6.1	Are any special procedures needed due to method of construction or erection?	NO	

Signature of Project Engineer:		Date:	12.07.23
Signature of Director/checker		Date:	12.07.23

APPENDIX D – SITE INVESTIGATION REPORT

RIDGE

PROPERTY & CONSTRUCTION CONSULTANTS

HORNIMAN MUSEUM AND GARDENS

GROUND CONDITION ASSESSMENT, PROPOSED BUTTERFLY HOUSE

October 2016

Prepared for

Horniman Museum and Gardens

100 London Rd,

London

SE23 3PQ

Prepared by

Ridge and Partners LLP

Partnership House

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Tel: 01962 834400

VERSION CONTROL

Project Name	Horniman Butterfly House - GCA
Project No.	5001510
Report No.	5001510-815-02

Desk Top Study	
Prepared by: Antony Platt – Senior Engineer	Approved by: Rasmus Palmgren – Associate
Factual Report	
Prepared by: Antony Platt – Senior Engineer	Approved by: Rasmus Palmgren – Associate
Generic Quantitative Risk Assessment	
Prepared by: Antony Platt – Senior Engineer	Approved by: Rasmus Palmgren – Associate
Geotechnical Design Report	
Prepared by: David Fall – Geotechnical and Environmental Consulting Ltd	Approved by: Rasmus Palmgren – Associate

VERSION	DATE	DESCRIPTION	CREATED BY	REVIEWED BY
1.0	02/10/16	Ground Condition Assessment	AP	AP

1. INTRODUCTION

1.1. Introduction

Ridge and Partners LLP (Ridge) was commissioned by Horniman Museum and Gardens in September 2016 to undertake a Ground Condition Assessment of a site at the former Lodge on Horniman Drive within the grounds of the Horniman Museum and Gardens.

The brief was to undertake a site investigation and assessment to identify any ground contamination issues that may affect the proposed development. This report provides an assessment of the identified and potential ground conditions of the site, with regard to the proposed works in accordance with the Model Procedures for the Management of Land Contamination (CLR 11), published by the Environment Agency. In addition, the geotechnical sections of this report provide a detailed assessment of the materials present beneath the site and present characteristic parameters that should be used in design of all geotechnical facets of the proposed development.

This report is prepared in line with the agreed brief and is subject to the report conditions shown in Appendix 1.

1.2. Legal Context

Part IIA of the Environmental Protection Act 1990 (inserted by Section 57 of the Environment Act 1995) provides a regime for the control of specific threats to health or the environment from land contamination. In accordance with the Act and the statutory guidance document 'The Contaminated Land (England) Regulations 2000', the definition of contaminated land is intended to embody the concept of risk assessment. Within the meaning of the Act, land is only "contaminated land" where it appears to the Regulatory Authority, by reason of substances within or under the land, that:

- Significant harm is being caused, or there is a significant possibility of such harm being caused; or
- Pollution of controlled waters is being, or is likely to be, caused."

Inherent in this definition is the requirement for contamination risk assessment to be undertaken on a site specific basis, as the potential for harm is determined by the site's end use and its specific environmental setting.

The guidance defines "risk" as the combination of:

- The probability, or frequency, of occurrence of a defined hazard (for example, exposure of a property to a substance with the potential to cause harm); and
- The magnitude (including the seriousness) of the consequences.

While Part IIA of the Environmental Protection Act provides a risk based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment, the regime does not take into account future uses. New developments are therefore controlled by the planning regime, with reference to the National Planning Policy Framework (NPPF), rather than directly by Part IIA of the Environmental Protection Act.

The NPPF is based on the principal that the site should be suitable for its new use, taking account of ground conditions, including from natural hazards or former activities and states that "Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner". The NPPF also links the planning and Part IIA regimes by stating that "after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990". Key components of the Part IIA regime, such as the definition of Contaminated Land and the associated risk based assessment approach, are therefore considered to also be applicable to the planning regime.

1.3. Methodology

This report has been prepared in accordance with published Environment Agency guidance ('Model Procedures for the Management of Land Contamination – Contaminated Land Report (CLR) 11'). CLR 11 provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme (of the former Department of the Environment). CLR 11 has adopted and refined the well recognised methodology and terminology that has been used in contaminated land risk assessment for a number of years.

1.3.1. Pollutant Linkage Concept

In the context of land contamination, there are three essential elements to any risk:

- A **contaminant source** – a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters.
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body.
- A **pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage.

1.3.2. Conceptual Model

An important thread throughout the overall process of risk assessment is the need to formulate and develop a conceptual model for the site, which supports the identification and assessment of pollutant linkages. A conceptual model represents the characteristics of the site in diagrammatic or written form that shows the possible relationships between contaminants, pathways and receptors (pollutant linkages).

1.3.3. Risk Assessment

CLR 11 advocates a phased approach to risk assessment comprising the following in order, as necessary:

Preliminary Risk Assessment – a desk study consisting of a review of documentary, anecdotal and site walk over evidence.

Generic Quantitative Risk Assessment (GQRA) - comparison of contaminant concentrations obtained from site investigation with generic assessment criteria.

Detailed Quantitative Risk Assessment (DQRA) - comparison of contaminant concentrations obtained from site investigation with site-specific assessment criteria.

This document constitutes a Preliminary Risk Assessment, Generic Quantitative Risk Assessment and a Geotechnical Design Report.

1.4. Proposed Use

It is understood that the site is proposed for development as a butterfly house. The Butterfly House will be a publicly accessible single story glasshouse structure to house the Butterfly Garden. A change in the site use from that currently proposed may result in the need for re-assessment of risk criteria and the conclusions and recommendations resulting from the risk assessment could therefore significantly change.

1.5. Report Scope and Limitation

This report is based upon a review of readily available historical and current information and the recent site investigation data detailed herein.

The report presents an interpretation of the borehole and laboratory data provided by the Ridge site investigation undertaken between the 16th September 2016. In addition, this report outlines the basic ground conditions encountered in the exploratory holes and the results of any monitoring of ground installations. This information has been collated, processed and used to provide an interpretation of the ground conditions, with recommendations on potential ground contamination risks for the proposed development.

The recommendations and opinions expressed in this report are based on the strata observed in the exploratory holes, the results of the site and laboratory tests, and information obtained as part of the desk study or provided by others. Ridge takes no responsibility for conditions that have not been revealed by the exploratory holes, or which occur between them.

Whilst every effort has been made to interpret the conditions between investigation locations, such information is only indicative and liability cannot be accepted for its accuracy. Information provided from other sources is taken in good faith and Ridge cannot guarantee its accuracy.

The information contained in this report is intended for the use of Horniman Museum and Gardens and Ridge can take no responsibility for the use of this information by any other party or for uses other than that described in this report.

2. HAZARD IDENTIFICATION

2.1. Site Location and Description

The site chosen for the Butterfly House is irregular in plan shape and sits next to the Animal Walk and on the footprint of the Lodge (to be demolished) on Horniman Drive. The Lodge is currently not in use and used to be occupied by the Gardens Keeper. The area of the site surrounding the Lodge comprises mainly soft landscaping areas & gardens. It is understood from information provided by the client that the Lodge is likely to contain asbestos containing materials and that the demolition contractor is due to remove the asbestos containing materials during the demolition works.

The area to the west slopes down away from the site and is used for keeping animals as part of the Horniman Museum and Gardens Animal Walk. Horniman Drive is located adjacent to the east of the site with further parts of the Horniman Gardens beyond and to the south of the site. An electrical substation is also located adjacent to the southeast corner of the site. Residential properties outside of the Horniman Museum and Gardens Grounds are located adjacent to the north of the site.

2.2. Site History

The Ordnance Survey maps provided and reviewed from 1863 to 2014 (scales 1:2,500, 1:10.000, 1:1,250, 1:10,560) indicate that the site formed part of the landscaped grounds of The Keep (later identified as Surrey Mount) stately home (located to the southwest of the site). Surrey Mount and associated gardens became part of the Horniman Gardens which were donated to the public, along with the Horniman Museum, in 1901. The site appears to have remained a landscaped part of the Gardens until the Lodge was constructed on the site in the 1960s as a dwelling for the Garden Keeper. Since the position of Garden Keeper was made redundant, the Lodge has been vacant and used for various storage.

Residential properties were present adjacent to the north and east of the site from the earliest available maps with the areas to the south and west comprising parts of the landscaped grounds of The Keep (Surrey Mount) and subsequently the Horniman Gardens. The early residential properties to the north of the site appear to have been replaced with the current residential properties during the 1960s and 1970s and the early residential properties to the east appear to have been purchased and redeveloped as part of the Horniman Gardens in the 1960s.

2.3. Documented Ground Conditions

Ground conditions recorded in readily available sources are summarised below.

2.3.1. Geology

Reference to the British Geological Survey (BGS) Map (See Appendix 2) indicates the site to directly overlie bedrock geology of the London Clay Formation with no recorded superficial deposits.

2.3.2. Hydrogeology

The Environment Agency Groundwater Vulnerability Map (See Appendix 2) indicates that the site is underlain by bedrock Unproductive Strata interpreted as the London Clay Formation.

Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The site does not lie within a groundwater source protection zone (SPZ).

2.3.3. Hydrology

There are no surface water features in the immediate vicinity of the site.

2.3.4. Radon

Radon is a naturally occurring radioactive gas which may be harmful to human health. Radon is generally released into the atmosphere in areas underlain by granite and limestone. Harmful concentrations of radon may build up if it becomes trapped in an enclosed space such as a building.

National Radiological Protection Board data presented within the Groundsure Report indicates that the percentage of houses exceeding the Action Levels for Radon in this area is less than 1%. Therefore the British Geological Survey recommends that no radon protective measures are necessary in the construction of new dwellings or extensions.

2.4. Environmental Data Search

A search of an environmental database was undertaken together with information from various other organisations as part of the desk study and is summarised in the following sections. The following summary is generally limited to locations within 250m of the Site boundaries unless it is considered that installations or activities beyond that range could potentially have an impact on the Site or be affected by the redevelopment of the site.

Table 2.1: Data search results

Discharge consents	There are no recorded discharge consents within 250m of the site.
Pollution incidents	There are no recorded pollution incident with impact to controlled waters within 250m of the site.
Water abstractions	There are no recorded water abstractions within 1000m of the site.
Fuel stations	There are no recorded fuel stations within 250m of the site.
Landfill sites	There are no recorded Landfill sites within 250m of the site.

The site is located in an area which may not be affected by mining.

The following ground hazards were identified:

- Compressible ground stability hazards – Negligible hazard
- Collapsible ground stability hazards – Very Low hazard
- Ground dissolution stability hazards – Negligible hazard
- Landslide ground stability hazard – Very Low hazard
- Shrinking or swelling clay ground stability hazard – Moderate hazard
- Running sand ground stability hazards – Negligible hazard

2.5. Department of Environment – Industry Profiles

The Department of Environment Industry Profiles do not cover the known existing or historic land uses for the site.

2.6. Conclusions of Preliminary Risk Assessment

The following potential sources of contamination were identified:

- Potential for asbestos containing material fragments associated with the construction of the former Lodge.
- Potential for PCBs associated with the former adjacent electrical substation

It should be noted that additional sources of contamination may become apparent during any future investigation or development of the site.

The risk of impact to identified receptors from the identified potential PCB source is considered to be **very low** due to the low mobility of PCB contamination in soils and relatively low sensitivity of the end use and therefore is not considered to require further investigation or assessment. The risk of impact to the identified receptors from the identified potential asbestos contamination in soil is considered to be **low/moderate**. A limited intrusive investigation, comprising screening of shallow soil samples for the presence of asbestos, is therefore recommended to further investigate the potential contamination risks to human health from potential asbestos in the soil.

3. FIELDWORK SUMMARY OF SCOPE AND RATIONALE

3.1. Rationale and Summary of Scope

Site investigation works were undertaken by Ridge on the 16th September 2016. The scope and rationale of the ground investigation undertaken are presented below.

- 3no. windowless sample boreholes (WS) to a maximum depth of 4.6mbgl
- Collection of representative samples to undergo chemical and geotechnical laboratory testing as detailed in later sections of this report.
- Installation of 1no. gas / water monitoring standpipe.

Table 3.1: Exploratory hole location rationale

Location	Rationale	Max Depth (mbgl)
WS1-3	3no. windowless sample boreholes positioned across the site to assess the nature and stratigraphy of the subsurface materials and allow collection of representative samples for chemical and geotechnical laboratory testing / analysis.	4.6

The layout of the exploratory positions is presented in Figure 2.

3.2. Sampling

Soil sampling of the near surface materials was undertaken to assess the contamination risks to human health. Soil samples were also taken from various depths in the boreholes for geotechnical testing purposes.

3.3. Monitoring

Ground gas and groundwater monitoring was not considered to be appropriate for this site.

3.4. Site Investigation Standards

Methods employed during the investigation were generally undertaken in accordance with BS10175, BS EN 1997-2 and BS5930.

4. GROUND CONDITIONS ENCOUNTERED

4.1. Soil Conditions

Ground conditions encountered during the recent ground investigation were broadly consistent with those identified in the published literature and in summary comprised a thin layer of Made Ground/Topsoil, overlying the London Clay Formation.

Variations in stratum thicknesses are summarised in Table 4.1 below, engineering logs are presented in Appendix 3.

Table 4.1: Summary of encountered ground conditions

Location	Made Ground		London Clay Formation	
	From (mbgl)	Thickness (m)	From (mbgl)	Thickness (m)
WS1	GL	0.40	0.40	>3.60
WS2	GL	0.50	0.50	>4.10
WS3	GL	0.60	0.60	>3.90

4.1.1. Surfacing

The site is covered by predominantly by the Lodge residential property in the east and no investigation locations were possible within the footprint of the building. The remainder of the site was predominantly covered by overgrown soft landscaping (where WS1 and WS2 were located) and a small patio area to the west of the building and a gravel covered area (where WS3 was located) to the east of the building.

4.1.2. Made Ground

Made Ground was encountered in all locations with a maximum thickness of 0.6m. The material encountered in WS1 and WS2 is considered to be representative of worked topsoil comprising a soft very dark brown slightly gravelly silty clay with occasional fine brick fragments. Made Ground encountered in WS3 generally comprised a similar material with a slightly lighter colour but was very stiff to hard and had potentially been compacted to minimise plant growth through the gravel area.

4.1.3. London Clay Formation

The London Clay Formation was encountered below the Made Ground in all locations and formed the basal stratum in these locations. The London Clay Formation comprised firm brown mottled grey locally silty and sandy clay.

4.2. Obstructions

No obstructions were encountered during the investigation.

4.3. Groundwater Conditions

Groundwater was encountered during the investigation in the form of a slight seepage in WS2 in association with the silty sandy layer within the London Clay Formation between 1.5m and 2.0mbgl. Groundwater was not encountered in WS1 or WS3 during the investigation.

4.4. Visual/Olfactory Evidence of Contamination

No visual or olfactory evidence of contamination was noted within the soil during the investigation.

5. GENERIC RISK ASSESSMENT

5.1. Contamination Assessment Methodology

In order to assess the human health and environmental risks posed by potential contaminants within the underlying soils and groundwater, Ridge undertook an initial screen of the laboratory results using generic assessment criteria. Generic assessment criteria (GAC) are conservative contaminant concentration values used for comparison purposes to assess the risk associated with contaminant concentrations found on site and are derived using non-site-specific information.

On this site, the only potentially viable pollutant linkage identified by the desk top study was the potential for asbestos containing materials to be present in the Made Ground on site as a result of the construction of the Lodge, which is understood to have included asbestos containing material in its construction. Therefore, the only laboratory analysis undertaken on the soil samples recovered for contamination assessment purposes was an asbestos screen. As generic assessment criteria are not available for the screening of asbestos in soil, the criteria adopted was the presence of asbestos, on a conservative basis.

5.2. Soil Assessment

A total of 4no. soil samples collected during the site investigation from depths and locations likely to be subject to human exposure during the proposed development works were submitted to a UKAS accredited laboratory for analysis for asbestos in soil. A full set of all the laboratory test certificates is presented as Appendix 4.

None of the 4no. soil sample analysed were identified to contain asbestos. While occasional fine fragments of brick were identified in Made Ground across the site, no other evidence of building or demolition waste was encountered. It is therefore considered unlikely that asbestos is present in the soil on site but given the discrete nature of asbestos contamination in soil, it is possible that fragments of asbestos containing material or loose fibres are present in the soil not sampled during the investigation.

6. CONCEPTUAL SITE MODEL

6.1. Sources

The conceptual model, based on information obtained as part of the intrusive investigation and screening of the chemical analysis results has not identified the presence of any significant contaminant sources with regard to the proposed redevelopment of the site.

6.2. Pathways and Receptors

As there are no significant sources of contamination identified by the conceptual site model, the assessment of pathways or receptors is not considered to be appropriate as no viable pollutant linkages are considered to be present in association with the proposed development.

7. GEOTECHNICAL ASSESSMENT

7.1. Introduction

This geotechnical assessment and the subsequent foundation design recommendations will use the findings of the ground investigation and the results of the in-situ and geotechnical laboratory testing carried out in the boreholes and on representative samples of the material encountered beneath the site.

7.2. Geotechnical Tests

A programme of geotechnical laboratory testing was carried out on representative samples collected from the strata encountered during the ground investigation.

Details of the specific procedure used in each case are shown below in Table 7.1 and the geotechnical test certificates are presented in Appendix 5.

Table 7.1: Summary of Geotechnical Testing

Test	Standard (BS1377:1990) unless otherwise indicated	No.
Classification Tests		
Atterberg Limits	Part 2, Clauses 4.3, 5.3 & 5.4	5
Shear Strength Tests		
Quick Undrained Triaxial	Part 7, Clause 8.4	5
Chemical Tests		
BRE SD1	Various	3

7.3. Geotechnical and Geological Parameters

This section discusses the key geotechnical characteristics of each encountered stratum as determined from field observations, in-situ and laboratory geotechnical testing. The stratigraphy revealed in WS1 - 5 has been used in the compilation of the following sections as these are adjacent to the former pond location (Figure 2).

7.3.1. Made Ground

Made Ground was encountered in all three WS boreholes and attained a maximum thickness of 0.60m in WS3. The Made Ground comprised soft to very stiff dark brown silty Clay with rootlets and occasional brick and flint fragments.

No in-situ or geotechnical laboratory testing was carried out on this material as all foundations will be constructed beneath this variable superficial deposit.

7.3.2. London Clay Formation

London Clay Formation (LCF) was encountered immediately beneath the Made Ground at all investigative locations and persisted to the full depth of the investigation. The LCF consistently comprised firm brown mottled grey Clay with the exception of a 0.50m thick silty sandy Clay layer in WS2 at 1.50mbgl.

In – Situ Testing

Standard Penetration testing (SPT) was carried out throughout the LCF. The distribution of SPT N-Values is shown in Table 7.2 and graphically presented in Figure 3.

Table 7.2: Distribution of SPT N Values in the London Clay Formation

BH No.	Depth (mbgl)	SPT N Value	Main Constituent	BH No.	Depth (mbgl)	SPT N Value	Main Constituent
WS1	1.00	9	Clay	WS3	1.00	13	Clay
	2.00	11			2.00	12	
	3.00	12			3.00	13	
	4.00	16			4.00	16	
WS2	1.60	10	Silty Sandy Clay				
	3.00	9	Clay				
	4.00	16					

The results of the SPT indicate an increase in SPT N value from 9 at 1.00 mbgl to 15 at 4.00mbgl the (Figure 3).

Classification Testing

Consistency Limits

Five representative samples of the London Clay Formation from the area of proposed development underwent Atterberg limits testing to determine their consistency limits.

Table 7.3: Results of the Atterberg Limits Analyses – London Clay Formation

Location	Depth (mbgl)	Natural Moisture Content, w (%)	Liquid Limit w_L (%)	Plastic Limit w_P (%)	Plasticity Index I_P (%)	Corrected Plasticity Index (%)
WS1	0.60-1.00	25	63	25	38	37
	2.00-3.00	35	75	32	43	43
WS2	0.60-1.00	36	81	34	47	47
WS3	1.00-2.00	34	80	31	49	49
	3.00-4.00	32	82	31	51	51

The results of the Atterberg limits testing reveal plasticity indices in the range from 38 to 51% which is indicative of a high to very high plasticity clay. Only one result required correction to account for its >425µm content giving a corrected range of plasticity indices of 37 to 51% which is consistent with a clay of medium to high volume change potential. However, considering the distribution of results the LCF should be considered as high volume change potential.

The consistency index is the numerical difference between the liquid limit and the natural moisture content expressed as a percentage ratio of the plasticity index, and can be written as:

$$I_C = \frac{w_L - w}{I_P}$$

Calculations based on the results of the Atterberg limits test (Table 7.3) give consistency indices of 0.90 to 1.02 which is indicative of a stiff consistency.

Shear Strength

Undrained Shear Strength

Five representative samples of the London Clay Formation underwent laboratory quick undrained triaxial compression testing. The results of the laboratory testing are presented in Table 7.4; whilst the laboratory test certificates are located in Appendix 5.

Table 7.4: Results of the QU triaxial Compression Testing – London Clay Formation

Location	Depth (mbgl)	Bulk Density (Mg/m^3)	Cell Pressure (kN/m^2)	Undrained Shear Strength c_u (kN/m^2)
WS1	0.60-1.00	2.04	16	48
	2.00-3.00	2.14	50	83
WS2	0.60-1.00	1.92	16	53
WS3	1.00-2.00	1.89	30	50
	3.00-4.00	2.13	70	133

The results of the QU triaxial testing give c_{uk} values of between 48 and 133kN/m² which are consistent with a medium to high strength material.

The laboratory test results have been augmented with c_{uk} values derived from the widely accepted empirical relationship:

$$c_u = f_1 \times SPT N$$

Where f_1 is a correlation factor based on the I_P

Using a correlation factor of 5, all the undrained shear strength data has been plotted and reveals an increase c_{uK} with depth from 550kN/m² at 1.00mbgl to 100kN/m² at 4.00mbgl (Figure 4).

Drained (Effective) Shear Strength

The widely accepted relationship between drained shear strength and plasticity index for remoulded clays has been used to determine the effective shear strength parameters. In terms of effective stress, the shear strength of a fine-grained soil can be considered as frictional, such that c'_k = 0kN/m².

Taking a conservative approach and adopting a characteristic plasticity index of 47% will give a characteristic effective angle of shearing resistance (ϕ'_k) of 21˚.

Other Geotechnical Parameters

Modulus of Deformation (E_K)

Butler (1974) gives an E_{uk}/c_{uk} ratio of 400 for London Clay giving a E_{uk} of 22 rising to 40MN/m² at 4.00mbgl. CIRIA R 143 suggests that the drained modulus (E'_K) should be taken as 0.75E_{uk}. Therefore an E'_k of 17 rising to 30MN/m² is considered appropriate for the London Clay Formation.

Coefficient of Volume Compressibility

The coefficient of volume compressibility (m_v) has been determined from the empirical relationship with the plasticity index (I_P) giving an m_{vk} of 0.15m^2/MN which is indicative of a material of medium compressibility.

7.4. Aggressive Ground Soil Chemistry

Chemical testing was carried out on six samples of the encountered materials in accordance with Box C10, BRE Special Digest 1. The results are summarised in Table 7.5

Table 7.5: Summary of BRE SD1 Results

Test	BRE SD1 Results		
	WS1	WS2	WS3
	0.60m	0.60m	1.00m
pH	7.9	7.9	7.9
Total Sulphate (% SO4)	0.07	0.17	0.70
Total Sulphur (% S)	0.03	0.09	0.24
Water Soluble Sulphate (g/l) SO4)	121	2220	4720
Water Soluble Chloride (mg/kg)	81	86	107
Water Soluble Nitrate (mg/kg)	<40	<40	44
Ammonium (mg/kg)	<0.1	<0.1	<0.1

The amounts of oxidisable sulphides have been determined following the procedure documented in Paragraph C5.1.2 of BRE SD1. The results indicate that pyrite is unlikely to be present in significant amounts. Based on the maximum determined water soluble sulphate content Table C1 of BRE SD1 gives a Design Sulphate Classification of DS-3 and an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2s assuming static groundwater conditions.

7.5. Characteristic Geotechnical Parameters

Based on the laboratory test results, in-situ testing and subsequent analysis a range of characteristic geotechnical parameters, which should be used in the subsequent geotechnical and foundation design calculations are presented in Table 7.6.

Table 7.6: Characteristic Geotechnical Parameters

Stratum	Parameter		Source	Value
Made Ground	Not used in foundation design			
London Clay Formation	Unit Weight γ_k (kN/m^3)		BS8002	19kN/m^3
	Undrained Shear Strength	c_{uk} (kN/m^2)	Laboratory QU Triaxial Testing and data from previous SI.	55kN/m^2 at 1.00 mbgl rising to 100kN/m^2 at 4.00mbgl
		ϕ_{uk} (˚)		0˚
	Drained Shear Strength	c'_k (kN/m^2)	Relationship with I_p	0kN/m^2
		ϕ'_k (˚)		21˚
	Modulus of Deformation	Undrained E_{uk} (MN/m^2)	400 x c_{uk}	22MN/m^2 at 1.00 mbgl rising to 40MN/m^2 at 4.00mbgl
		Drained E'_k (MN/m^2)	CIRIA C143	17MN/m^2 at 1.00 mbgl rising to 30MN/m^2 at 4.00mbgl
	Modulus of Volume compressibility	m_v (m^2/MN)	Relationship with SPT and I_p	0.15m^2/MN

8. FOUNDATION AND GROUND ENGINEERING

8.1. Introduction

The geotechnical assessment below relates to the details of the proposed development. It is understood that the proposed development is a publically accessible butterfly house comprising a single storey glasshouse structure.

Three windowless sample boreholes (WS1-3) were undertaken on the site. The ground conditions encountered comprised Made Ground overlying London Clay Formation forming the basal unit in all exploratory holes. Characteristic geotechnical parameters.7 for the encountered strata are presented in Table 7.7.

Groundwater was recorded as a perched groundwater table within the sandy silty clay horizon encountered in WS2 at 1.50mbgl.

8.2. Shallow Foundations

Given the nature of the proposed development and the ground conditions encountered during the ground investigation a shallow foundation solution is considered most appropriate.

8.2.1. Depth of Foundations

All foundations must be constructed below the Made Ground within the natural strata. The minimum depth of foundation will be controlled by the volume change potential of the underlying strata. Atterberg testing of the underlying materials showed the London Clay Formation to be of high volume change potential. NHBC Guidance offer two different foundation scenarios dependent on the restriction placed on new planting, these are presented in Table 8.1.

Table 8.1: Minimum Depth of Foundations for High Volume Change Soil (after NHBC)

Depth of Foundation	Description	No Tree Planting Zone (m)		
		High Water Demand	Moderate Water Demand	Low Water Demand
1.00m	No tree planting within Zone of Influence	1.25 x mature height	0.75 x mature height	0.50 x mature height
1.50m	Restricted tree planting within zone of influence	1.00 x mature height	0.50 x mature height	0.20 x mature height

Therefore a minimum foundation depth of 1.00m with restrictions placed on planting is recommended across the site. However, whichever of the foundation depth / planting models is adopted it is essential that any planting schedule is appropriate for the foundation depth with respect to both species and distance.

8.2.2. Ultimate Limit State Bearing Resistance

Bearing resistance analysis was carried out in order to check the Ultimate Limit State (ULS) bearing resistance of the London Clay Formation. The ground model and characteristic material properties used in the ULS analysis are presented in Table 8.2.

Table 8.2: Ground Model used in the ULS Bearing Resistance Calculations

Ground Model	Stratum	Thickness		Shear Strength Parameters			
				Total		Effective	
		From (mbgl)	To (mbgl)	c_{uk} (kN/m^2)	ϕ_{uk} (°)	c'_k (kN/m^2)	ϕ'_k (°)
GM1	Made Ground	GL	0.60	Not used			
	Undifferentiated London Clay Formation	0.60	>3.40	55 at 1.00mgl	0	0	21

The UK has implemented Design Approach 1 (DA1) of BS EN1997-1:2004 (Eurocode 7: Geotechnical Design), which requires two design combinations to be satisfied:

Combination 1 (C1): A1 “+” M1 “+” R1
Combination 2 (C2): A2 “+” M2 “+” R1

Where A, M and R refer to groups of partial factors relating to actions, materials and resistance respectively.

Table 8.3: Partial Factors Applied to the Bearing Resistance Analysis

	Combination 1			Combination 2		
	A1	M1	R1	A2	M2	R2
Tangent of the Angle of Shearing Resistance (tan ϕ)		1.00			1.25	
Cohesion Intercept (c')		1.00			1.25	
Undrained Cohesion c_u		1.00			1.40	
Permanent Action	1.35					
Variable Action	1.50					
Resistance						1.00

The summary of the bearing checks are presented in Table 8.4 and the geotechnical calculation sheets are located in Appendix 6.

Table 8.4: Summary of ULS Bearing Resistance Checks

GM	Foundation Type	Foundation Dimensions	Depth (mbgl)	DA1 Combination	Bearing Resistance (kN/m²)	
					Drained	Undrained
1	Strip	0.75m wide	1.00	1	167	464
				2	107	334
	Pad	1.00m x 1.00m	1.00	1	178	439
				2	113	317

These calculations indicate that combination 2 presents the most critical case. The results given represent the ultimate limit state that is the maximum load that can be supported by the soil without failure occurring within the soil mass.

The bearing resistances calculated indicate a ULS of 107kN/m² for a 0.75m wide strip foundation and 113kN/m2 for a 1.0 x 1.0 pad foundation both at a minimum depth of 1.00mbgl.

8.2.3. Serviceability Limit State

Eurocode 7 states that calculations of settlement must always be carried out on footings on soft clays - and should be carried out on footings on firm to stiff clays when the risk is anything other than negligible.

Verification of serviceability limit state (SLS) is demonstrated by satisfying the inequality:

$$s_{Ed} = s_0 \leq s_{Cd}$$

where s_{Ed} is the total settlement; and
s_{Cd} is the limiting value of that settlement

Without site / structure specific data a limiting value of settlement (s_{Ed}) of 25mm is considered appropriate for the type of construction under consideration. Partial factors for serviceability limit state analyses have all been taken as 1.

The settlement analysis has been carried out using the Rockscience software programme Settle 3D. The results are presented in Appendix 8 and précised in Table 8.5.

Table 8.5: Results of Settlement Analyses

Foundation Type	Depth (m)	Applied Foundation Loading (kN/m^2)	Founding Stratum	Immediate Settlement (mm)	Consolidation Settlement (mm)	Total Settlement (mm)
Strip	1.00	105	LCF	6	22	28
		100		6	21	27
		90		5	18	23
Pad	1.00	110	LCF	4	14	18

The results of the settlement analyses show that bearing pressures should not exceed $90kN/m^2$ for strip foundations and $110kN/m^2$ for pad foundations of the dimensions specified if settlements are to be restricted to less than 25mm.

8.3. Other Geotechnical Considerations

8.3.1. Excavation Stability

During the ground investigation groundwater was reported as perched groundwater in WS2 at 1.50mbgl, which is below the proposed depth of the foundation excavations. Therefore it is considered probable that foundation excavations will remain stable in the short term.

It is recommended that foundation excavations are left open for the minimum time prior to the placement of the foundation concrete. The founding material in any foundation excavation that is left exposed to standing water will undergo a degree of softening and the softened material will require excavation prior to the placement of foundation concrete. If it becomes apparent that excavations are to remain open for any length of time it is recommended that the foundation excavation is left short of the finished level to avoid deterioration of the founding stratum.

8.3.2. Floor Slabs

The ground investigation has shown that the volume change potential of the LCF is high. Although not identified as being desiccated it is recommended that suspended floor slabs are used on this site.

8.3.3. Chemical Attack on Buried Concrete

BRE testing of the London Clay Formation has shown it to be potentially pyritic and conforms to a Design Sulphate classification of DS-3 and an ACEC of AC-2s.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. Contamination

The conceptual model, based on information obtained as part of the intrusive investigation and screening of the chemical analysis results has not identified the presence of any significant contaminant sources with regard to the proposed redevelopment of the site. As no viable pollutant linkages are considered to be present in association with the proposed development, contamination of the soil on this site is not considered to present a significant risk.

The local authority should be informed if any sources of contamination are identified during the development that have not been assessed in this report. These sources should then be assessed and dealt with appropriately, with the agreement of the Local Authority.

These conclusions are subject to agreement with the regulatory authority, be it the Local Authority for human health related issues or the Environment Agency for environmental issues.

9.2. Geotechnical

The ground investigation has shown to be underlain by up to 0.60m of Made Ground overlying London Clay Formation.

9.2.1. Shallow Foundations

Atterberg limits tests carried out during the ground investigation have shown the LCF to be of high volume change potential. NHBC Guidance states the minimum depth of foundations to be 1.00m within high volume change material with additional limitations placed on planting.

Therefore Ultimate Limit State (ULS) bearing resistance analyses have been carried out on a 0.75m wide strip foundation and a 1.00m x 1.00m pad both constructed at 1.00mbgl within the LCF. The results indicate ULS bearing resistances of 107kN/m^2 and 113kN/m^2 for strip and pad respectively.

Serviceability Limit State settlement analyses have been carried out and show that in order to restrict foundations to less than 25mm foundation loads should be limited to 90kN/m^2 for strip foundations and 105kN/m^2 for pad foundations

9.2.2. Other Geotechnical Considerations

Groundwater was encountered during the ground investigation at 1.50mbgl in WS2. This is below the proposed depth of the foundations therefore it is anticipated they will remain stable in the short term. However, every effort should be made to reduce the founding stratum's exposure to inclement weather conditions as this will lead to softening of the founding material.

Given the high volume potential of the LCF a suspended floor slab solution is considered appropriate for this site.

9.2.3. Concrete Aggressivity

Chemical tests carried out on the London Clay Formation indicate the materials to be consistent with Design Sulphate Class 3. Based on the static groundwater conditions in the fine-grained materials an ACEC classification of AC-2s should be adopted for concrete placed on the site.

FIGURE 1 – SITE LOCATION PLAN

REF	DATE	REVISION	DRAWN	CHECKED
-	20.09	PRELIMINARY	AP	RP

PROJECT
BUTTERFLY HOUSE
HORNIMAN MUSEUM AND GARDENS

DRAWING
5001510 - SITE LOCATION PLAN

RIDGE
PARTNERSHIP HOUSE
MOORSIDE ROAD
WINCHESTER
HAMPSHIRE, SO23 7RX
TEL: 01962 834400
FAX: 01993 815001
www.ridge.co.uk
Also at Reading, Bristol, London and Leicester

CLIENT
HORNIMAN MUSEUM AND GARDENS

SCALE	DATE	DRAWN BY	CHECKED BY
NTS @ A4	20.09.16	AP	RP

FIGURE 1

REV
-

FIGURE 2 – INVESTIGATION LOCATION PLAN

REF	DATE	REVISION	DRAWN	CHECKED
-	20.09	PRELIMINARY	AP	RP

PROJECT
BUTTERFLY HOUSE
HORNIMAN MUSEUM AND GARDENS

DRAWING
5001510 - SITE LAYOUT PLAN

RIDGE
PARTNERSHIP HOUSE
MOORSIDE ROAD
WINCHESTER
HAMPSHIRE, SO23 7RX
TEL: 01962 834400
FAX: 01993 815001
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SCALE	DATE	DRAWN BY	CHECKED BY
NTS @ A4	20.09.16	AP	RP

FIGURE 2

REV
-

FIGURE 3 – SPT N VS DEPTH

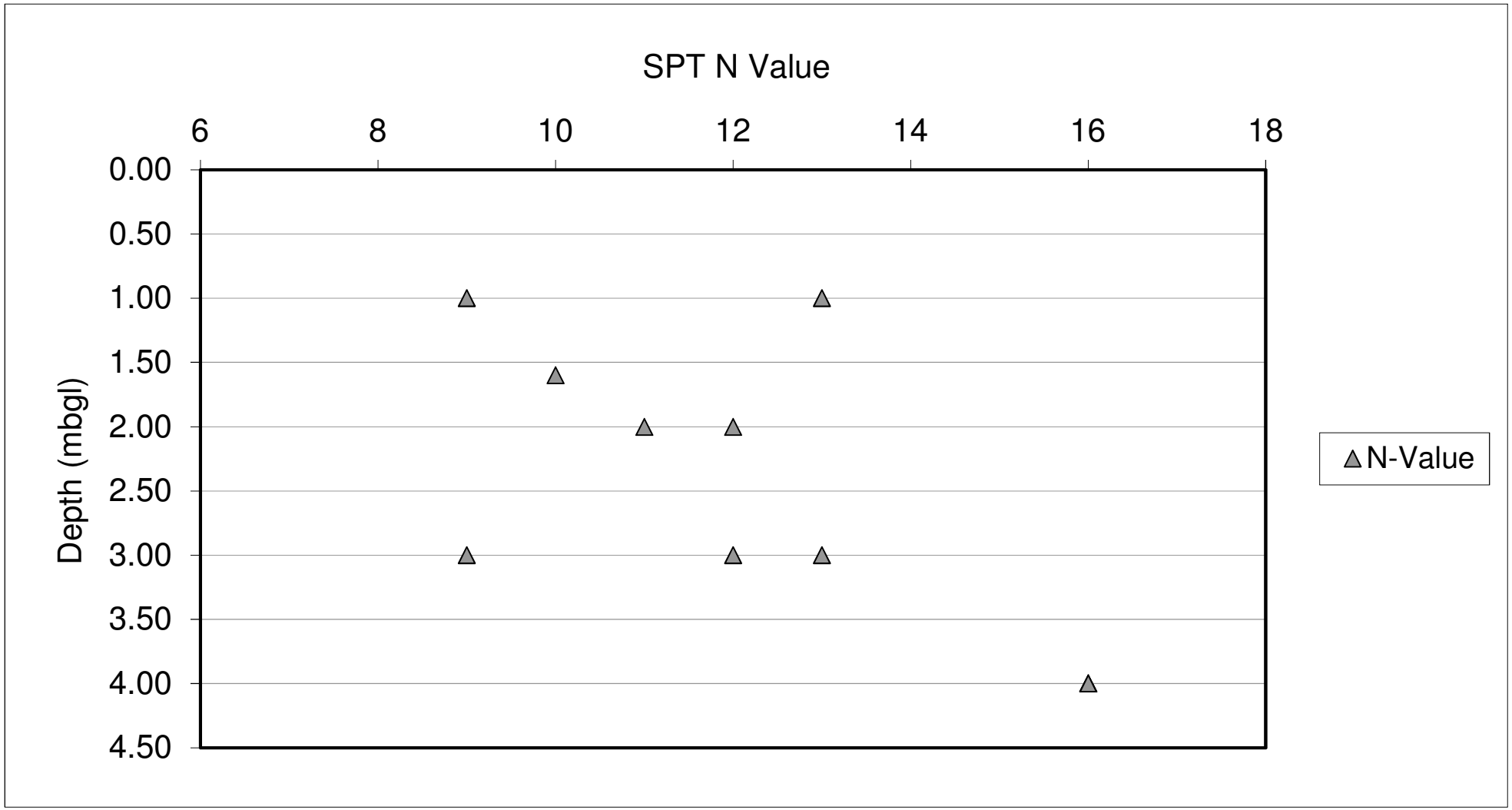
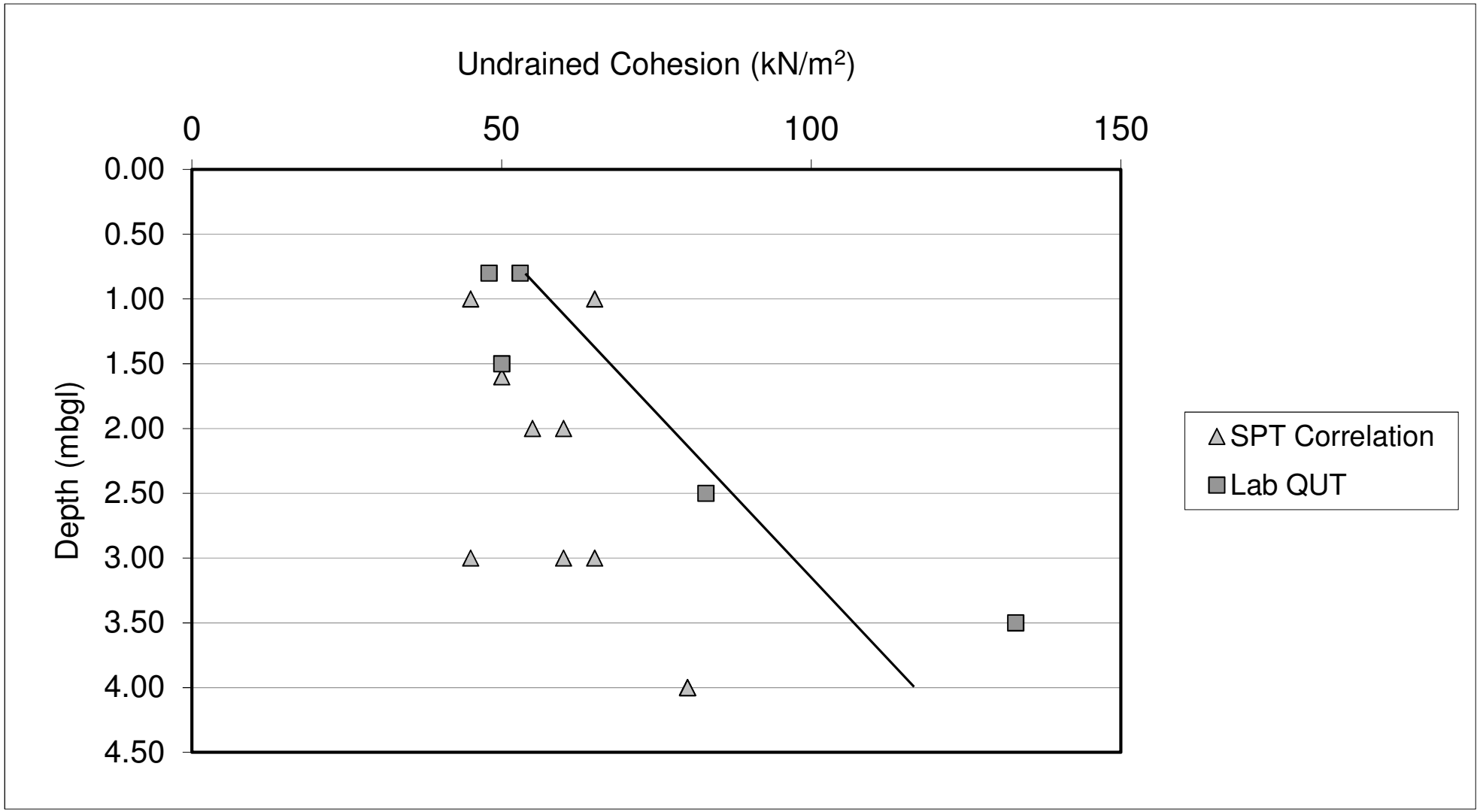

SPT N Value
6
8
10
12
14
16
18
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
Depth (mbgl)
N-Value

FIGURE 4 – UNDRAINED SHEAR STRENGTH VS DEPTH


Undrained Cohesion (kN/m2)
0
50
100
150
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
Depth (mbgl)
SPT Correlation
Lab QUT

APPENDIX 1 – REPORT CONDITIONS

This report is produced solely for the benefit of **Horniman Museum and Gardens** and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the site.

This report is based on a visual site inspection, study of readily accessible referenced historical records, information supplied by those parties noted in the text and preliminary discussions with local and Statutory Authorities. Some of the opinions are based on unconfirmed data and information and are presented in good faith without exhaustive clarification. Where ground contamination is suspected but no physical site test results are available to confirm this, the report must be regarded as initial advice only, and further assessment should be undertaken prior to detailed activities related to the site. Where test results undertaken by others have been made available these can only be regarded as a limited sample. The possibility of the presence of contaminants, not revealed by this research cannot be discounted.

Whilst confident in the findings detailed within this report because there are no exact UK definitions of these matters, being subject to risk analysis, we are unable to give categoric assurances that they will be accepted by Authorities or Funds etc. without question, as such bodies may have unpublished, often more stringent objectives. This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to Ridge and Partners LLP. In time improved practices or amended legislation may necessitate a re-assessment.

The report is necessarily limited to those aspects of land contamination specifically reported on and no liability is accepted for any other aspect especially concerning gradual or sudden pollution incidents that may occur. The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous use and abuse of the site and adjacent sites. The report concentrates on the site as defined in the report and provides an opinion on surrounding sites. If migrating pollution or contamination (past or present) exists this can only practically be better assessed following extensive on and off site intrusive investigations and monitoring.

APPENDIX 2 – GROUNDSURE REPORT

Ridge & Partners LLP

The Cowyards, Blenheim Park,
Woodstock, OX20 1QR

Groundsure Reference:	GS-3305269
Your Reference:	5001510_-_601018
Report Date	19 Sep 2016
Report Delivery Method:	Email - pdf

Groundsure Enviro Insight

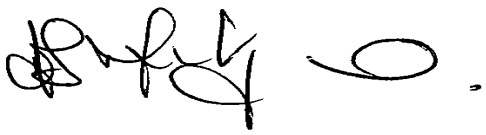
Address: THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Enviro Insight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above Groundsure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
Groundsure Enviroinsight

Groundsure Enviro Insight

Address:	**THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ**
Date:	**19 Sep 2016**
Reference:	**GS-3305269**
Client:	**Ridge & Partners LLP**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	20-Apr-2013
Grid Reference:	534903,173280
Site Size:	0.04ha

Report Reference: GS-3305269
Client Reference: 5001510_-_601018

Contents Page

Overview of Findings

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

Section 1: Historical Industrial Sites	On-site	0-50	51-250	251-500
1.1 Potentially Contaminative Uses identified from 1:10,000 scale mapping	0	0	2	54
1.2 Additional Information – Historical Tank Database	0	0	5	4
1.3 Additional Information – Historical Energy Features Database	0	0	11	54
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	0
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	0	0	5	2
1.6 Potentially Infilled Land	0	0	10	34

Section 2: Environmental Permits, Incidents and Registers	On-site	0-50m	51-250	251-500
2.1 Industrial Sites Holding Environmental Permits and/or Authorisations				
2.1.1 Records of historic IPC Authorisations	0	0	0	0
2.1.2 Records of Part A(1) and IPPC Authorised Activities	0	0	0	0
2.1.3 Records of Red List Discharge Consents	0	0	0	0
2.1.4 Records of List 1 Dangerous Substances Inventory sites	0	0	0	0
2.1.5 Records of List 2 Dangerous Substances Inventory sites	0	0	0	0
2.1.6 Records of Part A(2) and Part B Activities and Enforcements	0	0	3	0
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0
2.1.8 Records of Licensed Discharge Consents	0	0	0	0
2.1.9 Records of Water Industry Referrals	0	0	0	0
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site	0	0	0	0
2.2 Records of COMAH and NIHHS sites	0	0	0	0
2.3 Environment Agency Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	0	0	0
2.3.2 National Incidents Recording System, List 1	0	0	0	0
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990	0	0	0	0

Section 3: Landfill and Other Waste Sites	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency Registered Landfill Sites	0	0	0	0	0	Not searched
3.1.2 Environment Agency Historic Landfill Sites	0	0	0	0	0	0
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	0	0
3.1.4 Records of Landfills in Local Authority and Historical Mapping Records	0	0	0	0	0	0
3.2 Landfill and Other Waste Sites Findings						
3.2.1 Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	Not searched	Not searched
3.2.2 Environment Agency Licensed Waste Sites	0	0	0	0	0	0

Section 4: Current Land Use	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	0	0	6	Not searched
4.2 Records of Petrol and Fuel Sites	0	0	1	0
4.3 National Grid Underground Electricity Cables	0	0	0	0
4.4 National Grid Gas Transmission Pipelines	0	0	0	0

Section 5: Geology	
5.1 Are there any records of Artificial Ground and Made Ground present beneath the study site?	No
5.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site?	None
5.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 6: Hydrogeology and Hydrology	0-500m
6.1 Are there any records of Strata Classification in the Superficial Geology within 500m of the study site?	No
6.2 Are there any records of Strata Classification in the Bedrock Geology within 500m of the study site?	Yes

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
6.3 Groundwater Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	6
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	3
6.6 Source Protection Zones (within 500m of the study site)	0	0	0	0	Not searched	Not searched
6.7 Source Protection Zones within Confined Aquifer	0	0	0	0	Not searched	Not searched
6.8 Groundwater Vulnerability and Soil Leaching Potential (within 500m of the study site)	0	0	0	0	Not searched	Not searched

	On-site	0-50m	51-250	251-500	501-1000	1000-1500

Section 6: Hydrogeology and Hydrology	0-500m					
6.9 Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	No
6.10 Detailed River Network entries within 500m of the site	0	0	0	0	Not searched	Not searched
6.11 Surface water features within 250m of the study site	No	No	No	Not searched	Not searched	Not searched

Section 7: Flooding	
7.1 Are there any Enviroment Agency Zone 2 floodplains within 250m of the study site?	No
7.2 Are there any Environment Agency Zone 3 floodplains within 250m of the study site	No
7.3 What is the Risk of flooding from Rivers and the Sea (RoFRaS) rating for the study site?	Very Low
7.4 Are there any Flood Defences within 250m of the study site?	No
7.5 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
7.6 Are there any areas used for Flood Storage within 250m of the study site?	No
7.7 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Not Prone
7.8 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	Not Applicable

Section 8: Designated Environmentally Sensitive Sites	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	0	0	2	1
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	2	1
8.8 Records of World Heritage Sites	0	0	0	0	0	0
8.9 Records of Environmentally Sensitive Areas	0	0	0	0	0	0
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0

Section 8: Designated Environmentally Sensitive Sites	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.11 Records of National Parks	0	0	0	0	0	0
8.12 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
8.13 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0
8.14 Records of Green Belt land	0	0	0	0	0	0

Section 9: Natural Hazards

9.1 What is the maximum risk of natural ground subsidence?	Moderate
9.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Moderate
9.1.2 What is the maximum Landslides hazard rating identified on the study site?	Very Low
9.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Negligible
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Negligible
9.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
9.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Negligible
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.
9.2.2 Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary.

Section 10: Mining

10.1 Are there any coal mining areas within 75m of the study site?	No
10.2 Are there any Non-Coal Mining areas within 50m of the study site boundary?	No
10.3 Are there any brine affected areas within 75m of the study site?	No

Using this report

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

1. Historical Industrial Sites

Provides information on past land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. Potentially Infilled Land features are also included. This search is conducted using radii of up to 500m.

2. Environmental Permits, Incidents and Registers

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

3. Landfills and Other Waste Sites

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

4. Current Land Uses

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

5. Geology

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

6. Hydrogeology and Hydrology

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

7. Flooding

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

8. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites and Scheduled Ancient Woodland. These searches are conducted using radii of up to 2000m.

9. Natural Hazards

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

10. Mining

Provides information on areas of coal and non-coal mining and brine affected areas.

11. Contacts

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

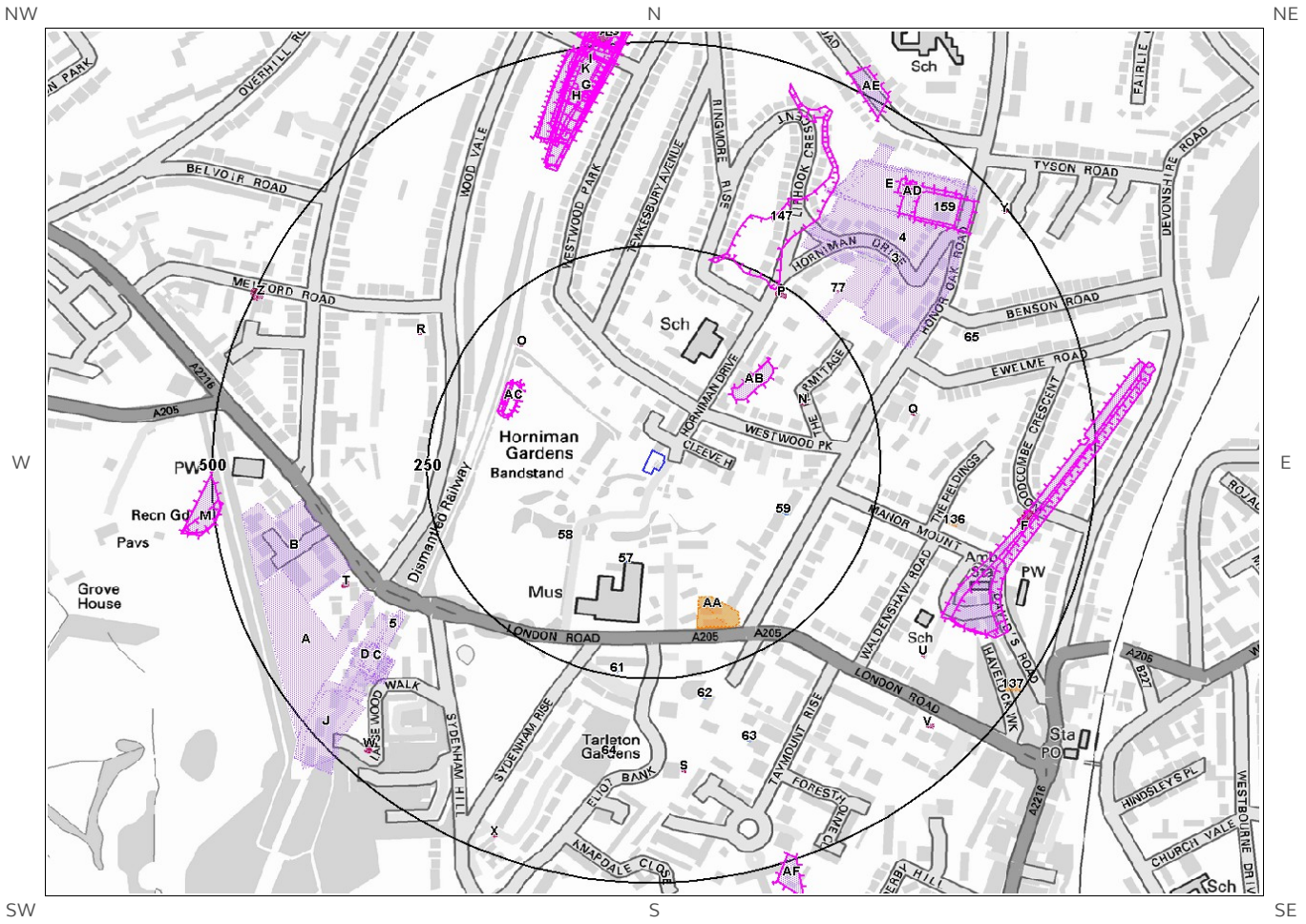
Note: Maps

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

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

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

1. Historical Land Use



Site Outline

250
500
Search Buffers (m)

Historical 1:10,000 and 1:10,560 scale mapping

Industrial Land Use

Potentially Infilled Land

Historical 1:2,500, 1:1,250 and 1:500 scale mapping

Energy Features

Petrol Stations

Tanks

Garages

1. Historical Industrial Sites

1.1 Potentially Contaminative Uses identified from 1:10,000 scale Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information:

Records of sites with a potentially contaminative past land use within 500m of the search boundary: 56

ID	Distance [m]	Direction	Use	Date
1AB	108	NE	Unspecified Heap	1863
2	246	NE	Water Works	1920
3	283	NE	Water Works	1894
4	284	NE	Water Works	1894
5	328	SW	Railway Buildings	1898
6C	332	SW	Railway Station	1898
7D	343	SW	Railway Station	1888
8A	348	SW	Nursery	1920
9A	348	SW	Nursery	1938
10B	358	W	Barracks	1955
11B	358	W	Barracks	1957
12G	359	N	Cuttings	1871
13H	366	N	Cuttings	1870
14C	370	SW	Railway Station	1871
15D	371	SW	Railway Station	1870
16C	371	SW	Railway Station	1894
17F	372	SE	Old Canal	1863
18C	372	SW	Railway Station	1894
19E	373	NE	Water Works	1888
20C	374	SW	Railway Station	1938
21C	374	SW	Railway Station	1920
22E	376	NE	Water Works	1898
23AD	377	NE	Water Works	1898
24C	380	SW	Railway Station	1898
25E	381	NE	Unspecified Works	1968
26C	381	SW	Railway Station	1955
27F	383	SE	Old Canal	1871
28G	385	N	Cuttings	1898
29H	389	N	Cuttings	1894
30H	393	N	Cuttings	1898
31G	393	N	Railway Sidings	1894
32H	394	N	Cuttings	1888
33H	397	N	Cuttings	1920
34H	397	N	Cuttings	1938

35J	421	SW	Railway Sidings	1870
36I	425	N	Cuttings	1957
37I	425	N	Cuttings	1955
38J	433	SW	Railway Sidings	1871
39I	437	N	Cuttings	1968
40K	440	N	Cuttings	1982
41K	440	N	Cuttings	1973
42K	440	N	Cuttings	1992
43AE	483	NE	Cuttings	1870
44L	488	N	Cuttings	1894
45M	489	W	Unspecified Pit	1992
46L	490	N	Cuttings	1920
47L	490	N	Cuttings	1938
48AF	491	S	Unspecified Pit	1968
49M	492	W	Unspecified Pit	1968
50M	492	W	Unspecified Pit	1957
51M	492	W	Unspecified Pit	1982
52M	492	W	Unspecified Pit	1973
53M	492	W	Unspecified Pit	1955
54L	493	N	Cuttings	1888
55AG	494	N	Cuttings	1870
56L	495	N	Cuttings	1898

1.2 Additional Information – Historical Tank Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical tanks within 500m of the search boundary: 9

ID	Distance (m)	Direction	Use	Date
57	109	S	Unspecified Tank	1875
58	120	SW	Unspecified Tank	1875
59	145	SE	Tanks	1863
60AA	175	SE	Unspecified Tank	1863
61	243	S	Unspecified Tank	1875
62	276	S	Unspecified Tank	1863
63	342	S	Unspecified Tank	1863
64	344	S	Unspecified Tank	1875
65	381	E	Unspecified Tank	1863

1.3 Additional Information – Historical Energy Features Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical energy features within 500m of the search boundary: 65

ID	Distance (m)	Direction	Use	Date
66N	170	E	Electricity Substation	1988
67N	170	E	Electricity Substation	1991
68N	171	E	Electricity Substation	1973
69N	171	E	Electricity Substation	1991
70O	197	NW	Electricity Substation	1991
71O	197	NW	Electricity Substation	1972
72O	197	NW	Electricity Substation	1991
73P	235	NE	Electricity Substation	1973
74P	236	NE	Electricity Substation	1988
75P	236	NE	Electricity Substation	1991
76P	236	NE	Electricity Substation	1991
77	284	NE	Electricity Substation	1991
78Q	290	E	Electricity Substation	1988
79Q	290	E	Electricity Substation	1991
80Q	291	E	Electricity Substation	1991
81Q	292	E	Electricity Substation	1973
82R	302	NW	Electricity Substation	1991
83R	303	NW	Electricity Substation	1972
84R	303	NW	Electricity Substation	1991
85S	361	S	Electricity Substation	1969
86S	361	S	Electricity Substation	1991
87S	361	S	Electricity Substation	1968
88S	361	S	Electricity Substation	1978
89S	361	S	Electricity Substation	1991
90T	368	W	Electricity Substation	1991
91T	368	W	Electricity Substation	1991
92T	368	W	Electricity Substation	1972
93U	378	SE	Electricity Substation	1988
94U	378	SE	Electricity Substation	1991
95U	379	SE	Electricity Substation	1991
96U	379	SE	Electricity Substation	1973
97F	415	E	Electricity Substation	1988
98F	415	E	Electricity Substation	1991
99F	415	E	Electricity Substation	1991
100F	417	E	Electricity Substation	1973
101F	417	E	Electricity Substation	1950
102F	417	E	Electricity Substation	1950

103F	417	E	Electricity Substation	1950
104V	438	SE	Electricity Substation	1992
105V	438	SE	Electricity Substation	1991
106V	438	SE	Electricity Substation	1992
107V	438	SE	Electricity Substation	1982
108V	438	SE	Electricity Substation	1991
109V	440	SE	Electricity Substation	1971
110W	462	SW	Electricity Substation	1954
111W	465	SW	Electricity Substation	1978
112W	465	SW	Electricity Substation	1991
113W	465	SW	Electricity Substation	1969
114W	465	SW	Electricity Substation	1991
115W	466	SW	Electricity Substation	1968
116X	474	S	Electricity Substation	1968
117X	474	S	Electricity Substation	1978
118X	474	S	Electricity Substation	1991
119X	475	S	Electricity Substation	1969
120X	475	S	Electricity Substation	1991
121Z	489	W	Electricity Substation	1991
122Y	493	NE	Electricity Substation	1991
123Y	493	NE	Electricity Substation	1972
124Z	493	NW	Electricity Substation	1991
125Z	494	W	Electricity Substation	1979
126Y	494	NE	Electricity Substation	1991
127G	496	N	Electricity Substation	1991
128G	496	N	Electricity Substation	1990
129G	496	N	Electricity Substation	1991
130G	498	N	Electricity Substation	1972

1.4 Additional Information – Historical Petrol and Fuel Site Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical petrol stations and fuel sites within 500m of the search boundary: 0

Database searched and no data found.

1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical garage and motor vehicle repair sites within 500m of the search boundary: 7

ID	Distance (m)	Direction	Use	Date
131AA	159	S	Garage	1991
132AA	160	S	Garage	1991
133AA	160	S	Garage	1972
134AA	171	S	Garage	1962
135AA	171	S	Garage	1951
136	339	E	Garage	1950
137	481	SE	Garage	1950

1.6 Potentially Infilled Land

Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 44

The following Historical Potentially Infilled Features derived from the Historical Mapping information is provided by Groundsure:

ID	Distance(m)	Direction	Use	Date
138AB	108	NE	Unspecified Heap	1863
139AC	166	NW	Pond	1957
140AC	166	NW	Pond	1955
141AC	167	NW	Pond	1938
142AC	167	NW	Pond	1920
143AC	167	NW	Pond	1992
144AC	167	NW	Pond	1982
145AC	167	NW	Pond	1973
146AC	167	NW	Pond	1968
147	241	NE	Covered Reservoir	1894
148G	359	N	Cuttings	1871
149H	366	N	Cuttings	1870
150F	372	SE	Old Canal	1863
151F	383	SE	Old Canal	1871
152G	385	N	Cuttings	1898
153H	389	N	Cuttings	1894
154H	393	N	Cuttings	1898
155H	394	N	Cuttings	1888
156H	397	N	Cuttings	1938
157H	397	N	Cuttings	1920
158AD	403	NE	Covered Reservoir	1898
159	410	NE	Covered Reservoir	1898
160E	422	NE	Reservoir	1955
161I	425	N	Cuttings	1955
162I	425	N	Cuttings	1957
163AD	426	NE	Covered Reservoir	1894
164G	437	N	Cuttings	1968
165K	440	N	Cuttings	1973
166K	440	N	Cuttings	1982

167K	440	N	Cuttings	1992
168AE	483	NE	Cuttings	1870
169L	488	N	Cuttings	1894
170M	489	W	Unspecified Pit	1992
171L	490	N	Cuttings	1938
172L	490	N	Cuttings	1920
173AF	491	S	Unspecified Pit	1968
174M	492	W	Unspecified Pit	1973
175M	492	W	Unspecified Pit	1955
176M	492	W	Unspecified Pit	1968
177M	492	W	Unspecified Pit	1957
178M	492	W	Unspecified Pit	1982
179L	493	N	Cuttings	1888
180AG	494	N	Cuttings	1870
181L	495	N	Cuttings	1898

2. Environmental Permits, Incidents and Registers Map

- Site Outline
- Search Buffers (m) (250, 500)
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

2. Environmental Permits, Incidents and Registers

2.1 Industrial Sites Holding Licences and/or Authorisations

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

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

3

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

ID	Distance (m)	Direction	NGR	Details	
1	194	S	534961 173080	Address: Esso London Rd, SE23 3PE Process: Petrol Vapour Recovery Process Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
2A	228	SE	535045 173087	Address: Esso/tesco Alliance, Forril Service Station, 86 London Road, London, SE23 3PE Process: Unloading of Petrol into Storage at Service Stations Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
3A	228	SE	535045 173087	Address: Tesco/Esso, Forest Hill Express, 86 London Road, London, SE23 Process: Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

2.2 Dangerous or Hazardous Sites

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

Database searched and no data found.

2.3 Environment Agency Recorded Pollution Incidents

2.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:

0

Database searched and no data found.

2.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:

0

Database searched and no data found.

2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

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

Database searched and no data found.

3. Landfill and Other Waste Sites Map

Site Outline

250
500
Search Buffers (m)

E.A. Active Landfill

E.A. Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

E.A. Licensed Waste Site

Local Authority/Historical Mapping Landfill Records

3. Landfill and Other Waste Sites

3.1 Landfill Sites

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

3.1.4 Records of Landfills from Local Authority and Historical Mapping Records within 1500m of the study site:

0

Database searched and no data found.

3.2 Other Waste Sites

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

0

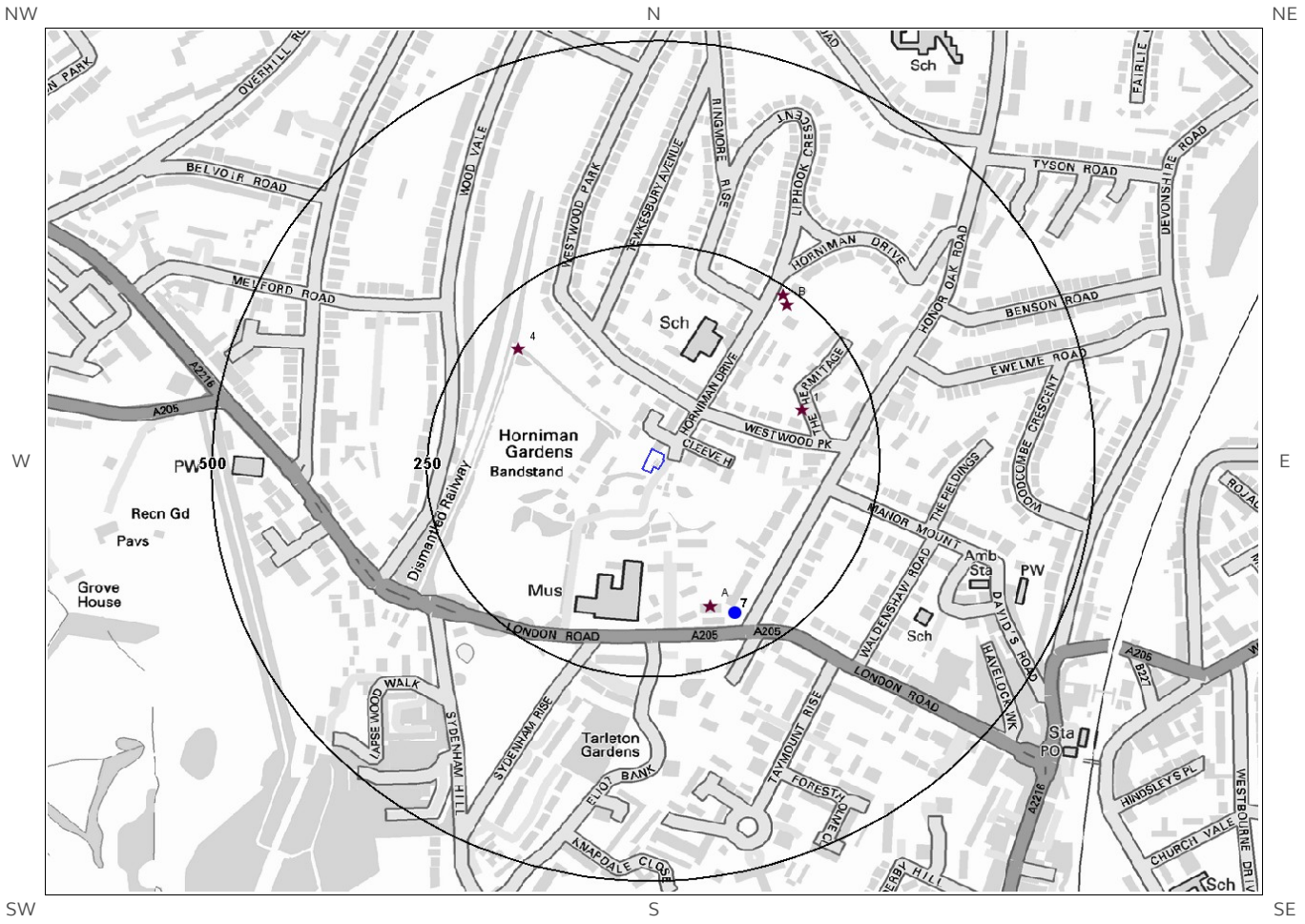
Database searched and no data found.

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

0

Database searched and no data found.

4. Current Land Use Map



Site Outline

Search Buffers (m)

Current Industrial Sites

Petrol & Fuel Sites

Electricity Transmission Cables

Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 6

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

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	170	E	Electricity Sub Station	535074 173342	SE23	Electrical Features	Infrastructure and Facilities
2A	176	SE	Esso	534967 173102	86, London Road, London, SE23 3PE	Petrol and Fuel Stations	Road and Rail
3A	176	SE	Forest Hill Express	534967 173102	86, London Road, London, SE23 3PE	Petrol and Fuel Stations	Road and Rail
4	198	NW	Electricity Sub Station	534744 173417	SE23	Electrical Features	Infrastructure and Facilities
5B	233	NE	Mast	535056 173471	SE23	Telecommunications Features	Infrastructure and Facilities
6B	241	NE	Electricity Sub Station	535052 173483	SE23	Electrical Features	Infrastructure and Facilities

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 1

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

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
7	197	SE	534995 173093	Esso	Forest Hill Express, 86, London Road, London Road, Forest Hill, London, Greater London, SE23 3PE	No	Open

4.3 National Grid High Voltage Underground Electricity Transmission Cables

This dataset identifies the high voltage electricity transmission lines running between generating power plants and electricity substations. The dataset does not include the electricity distribution network (smaller, lower voltage cables distributing power from substations to the local user network). This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high voltage underground electricity transmission cables within 500m of the study site: 0

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

This dataset identifies high-pressure, large diameter pipelines which carry gas between gas terminals, power stations, compressors and storage facilities. The dataset does not include the Local Transmission System (LTS) which supplies gas directly into homes and businesses. This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high pressure gas transmission pipelines within 500m of the study site: 0

Database searched and no data found.

---

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

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

5.2 Superficial Ground and Drift Geology

Database searched and no data found.

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

5.3 Bedrock and Solid Geology

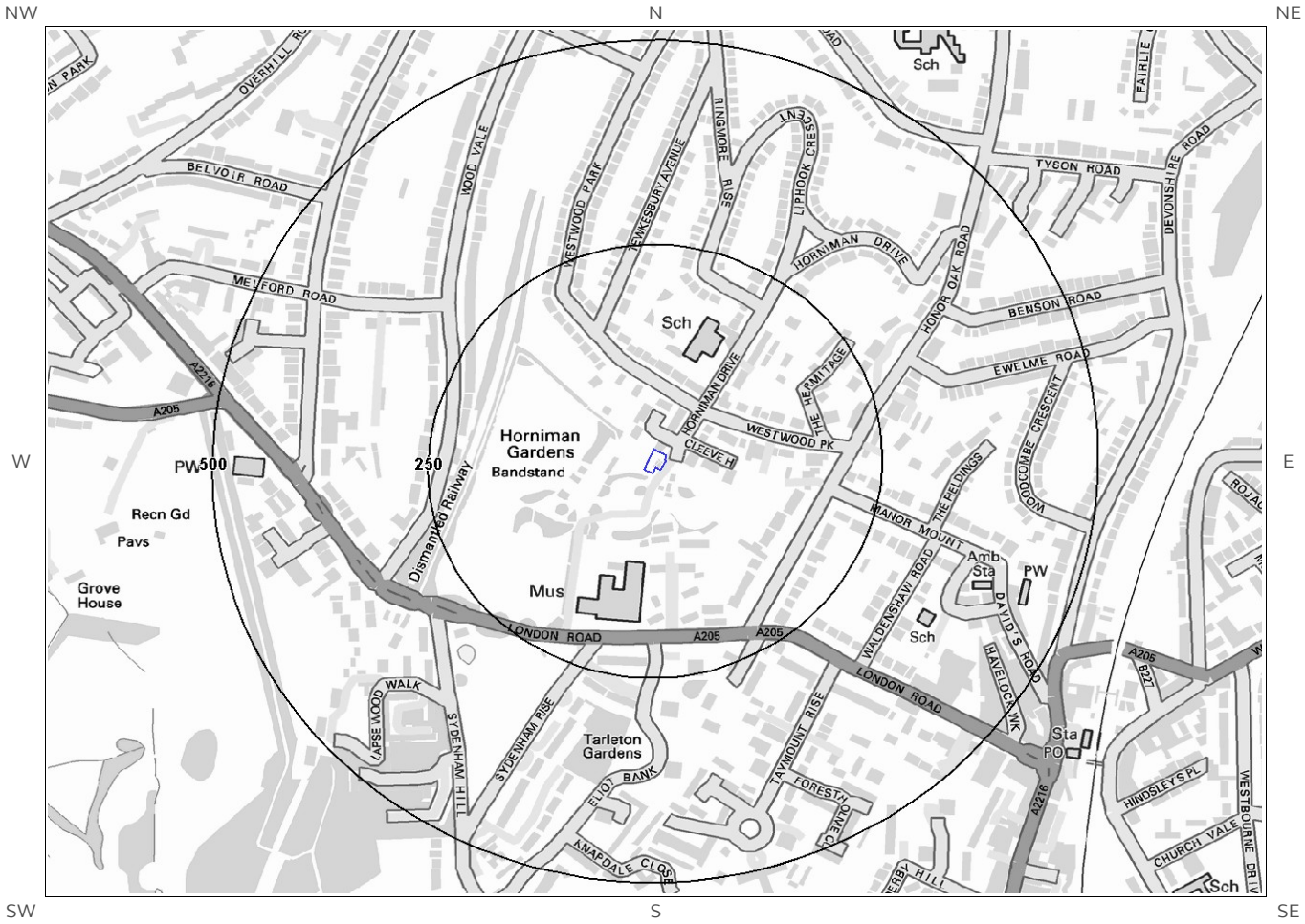
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
LC-CLSI	LONDON CLAY FORMATION	CLAY AND SILT

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

6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

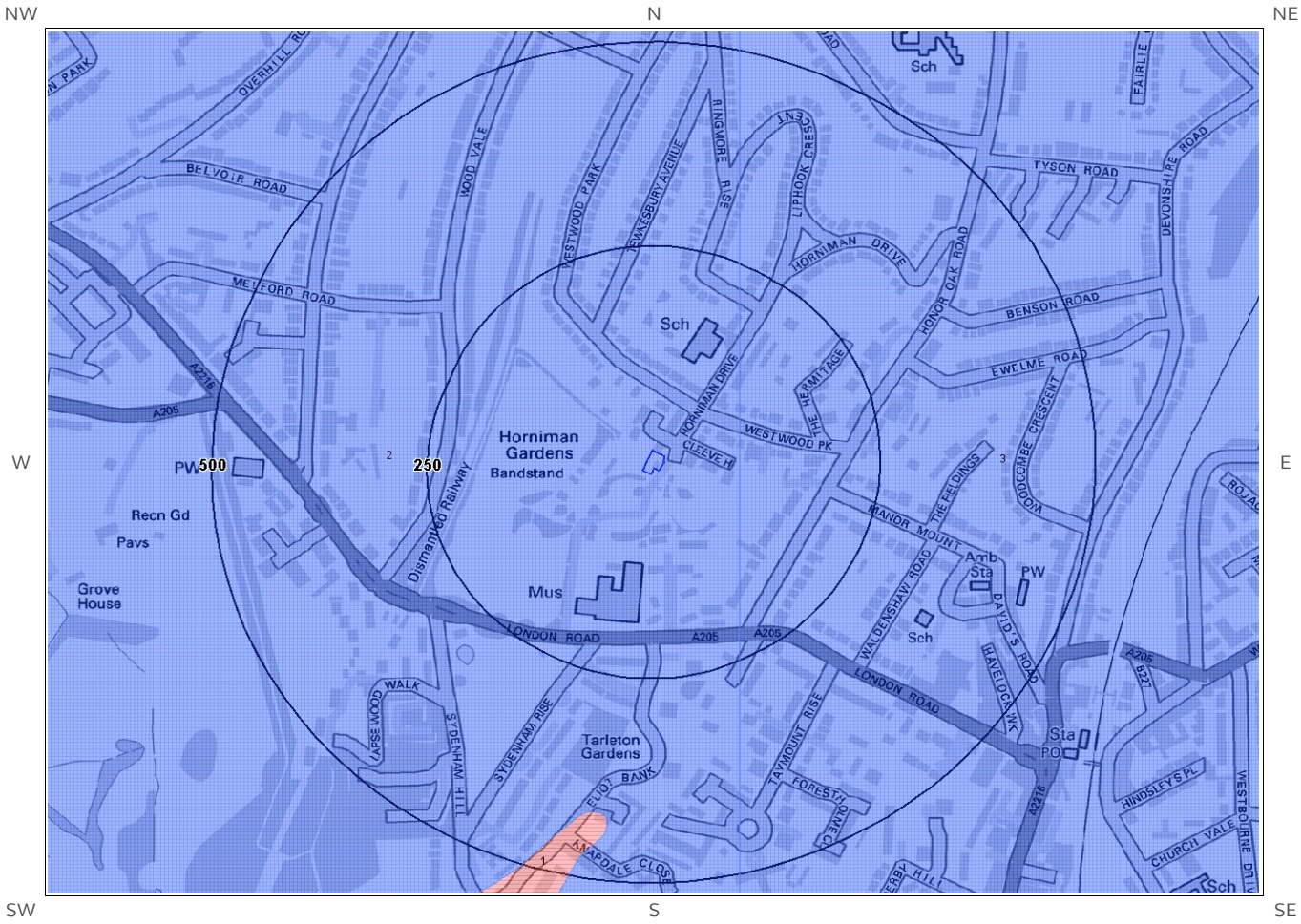
Secondary (B) Aquifer - Lower Permeability Layers

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licenses



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

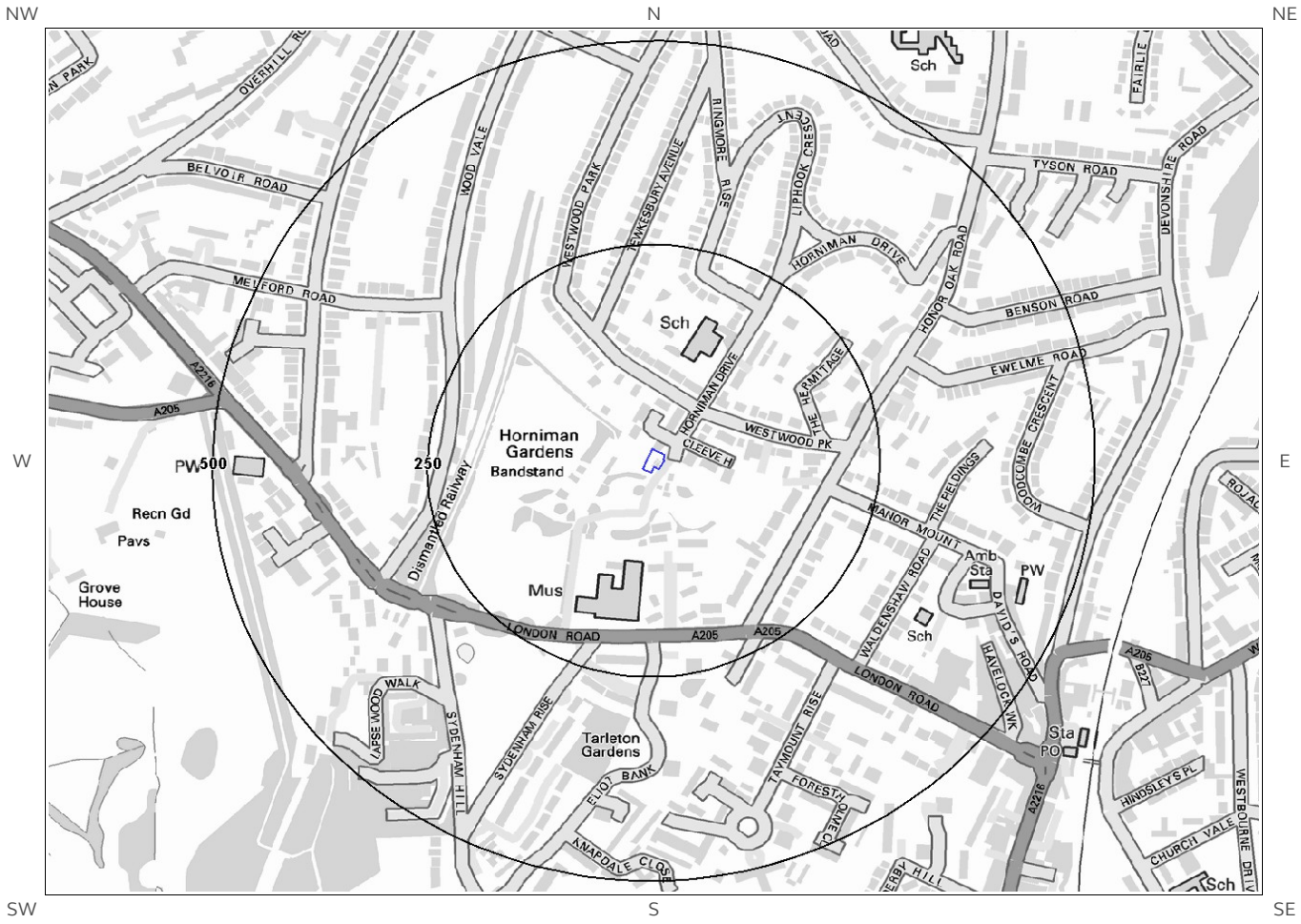
Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

Surface Water Abstraction Licence

6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses



Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

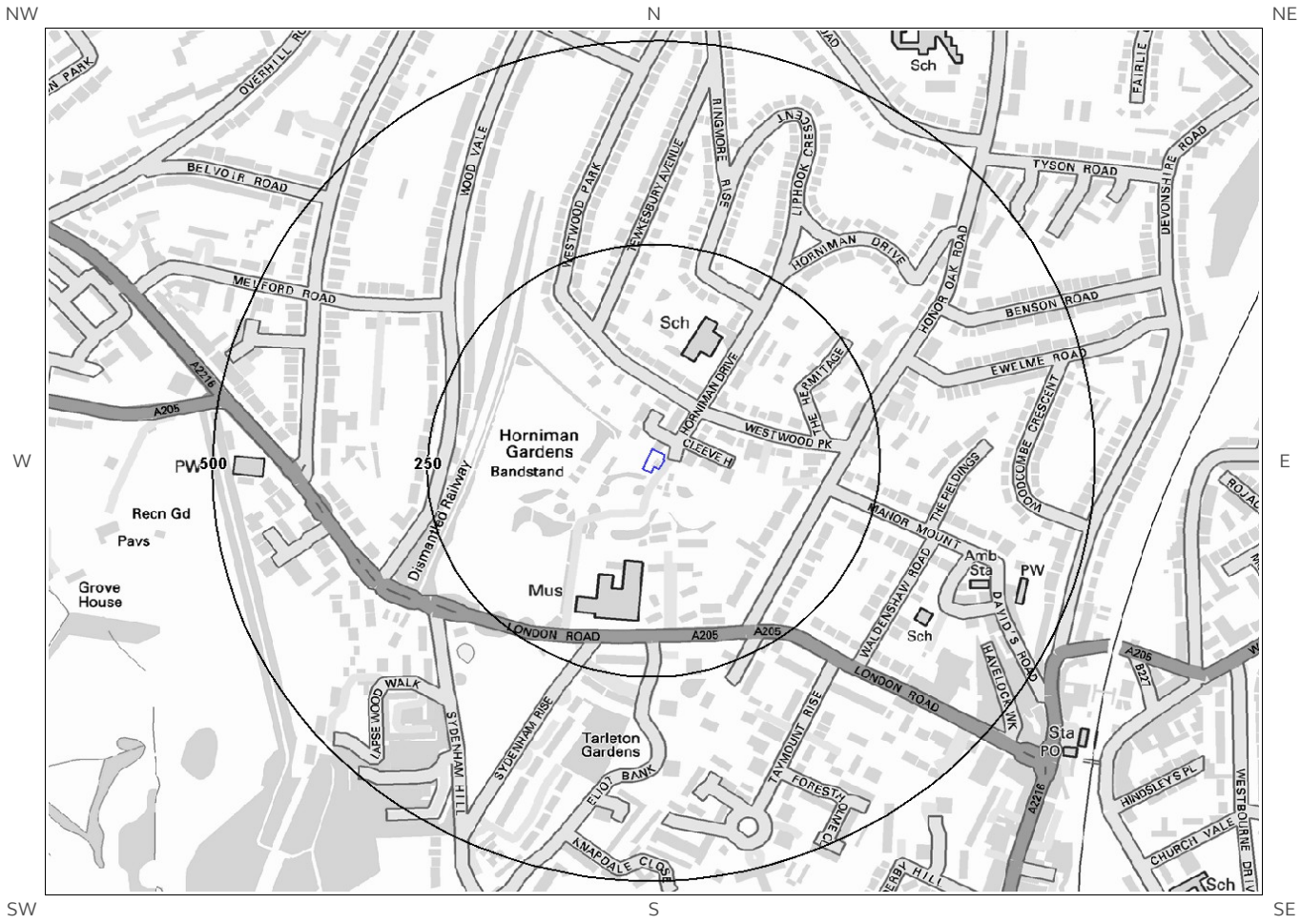
Source Protection Zone 2 - Outer Catchment

Source Protection Zone 3 - Total Catchment

Source Protection Zone 4 - Zone of Special Interest

Potable Water Abstraction Licence

6d. Hydrogeology – Source Protection Zones within confined aquifer



Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2C - Outer Catchment within Confined Aquifer

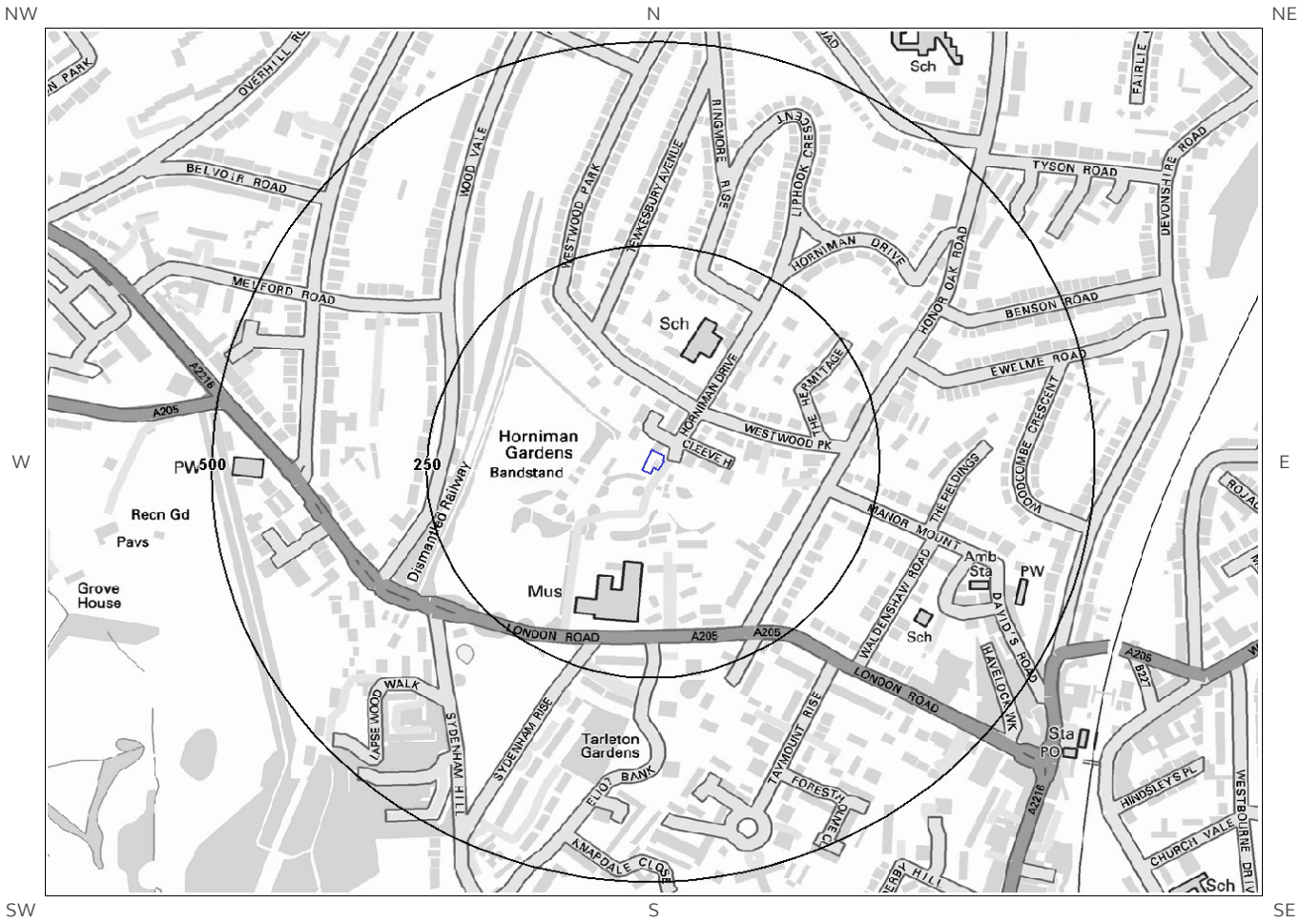
Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

Site Outline

250 — Search Buffers (m)
500

6e. Hydrology – Detailed River Network and River Quality



Site Outline

250 / 500 Search Buffers (m)

Primary River
Secondary River
Tertiary River
Lake/Reservoir
Underground River (inferred)
General Quality Assessment: Biology
General Quality Assessment: Chemistry

Canal
Canal Tunnel
Culvert
Multiple Channel Culvert
Underground River (Potential Sewer)
Underground River (local knowledge)

6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? No

Database searched and no data found.

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

6.2 Aquifer within Bedrock Deposits

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

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

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	Designation	Description
2	0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
3	86	E	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
1	417	S	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site? Yes

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	NGR	Details	
Not shown	1402	W	533550 172850	Status: Historical Licence No: 28/39/42/0058 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 51000 Max Daily Volume (m^3): 415 Original Application No: WRA/S/1054 Original Start Date: 1/1/2000 Expiry Date: 31/12/2009 Issue No: 1 Version Start Date: 1/1/2000 Version End Date:
Not shown	1402	W	533550 172850	Status: Historical Licence No: 28/39/42/0058 Details: Spray Irrigation - Direct Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 51000 Max Daily Volume (m^3): 415 Original Application No: WRA/S/1054 Original Start Date: 1/1/2000 Expiry Date: 31/12/2009 Issue No: 1 Version Start Date: 1/1/2000 Version End Date:
Not shown	1402	W	533550 172850	Status: Historical Licence No: TH/039/0042/003 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 45000 Max Daily Volume (m^3): 830 Original Application No: NPSWR001684 Original Start Date: 1/1/2010 Expiry Date: 31/3/2025 Issue No: 1 Version Start Date: 10/7/2014 Version End Date:
Not shown	1402	W	533550 172850	Status: Historical Licence No: TH/039/0042/003 Details: Spray Irrigation - Direct Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 45000 Max Daily Volume (m^3): 830 Original Application No: NPSWR001684 Original Start Date: 1/1/2010 Expiry Date: 31/3/2025 Issue No: 1 Version Start Date: 10/7/2014 Version End Date:
Not shown	1620	W	533310 172903	Status: Historical Licence No: TH/039/0042/036 Details: Heat Pump Direct Source: Thames Groundwater Point: Borehole A - Dulwich College, Dulwich Common Data Type: Point Name: Dulwich College	Annual Volume (m^3): 17753 Max Daily Volume (m^3): 648 Original Application No: NPS/WR/014797 Original Start Date: 17/11/2014 Expiry Date: 31/3/2025 Issue No: 1 Version Start Date: 17/11/2014 Version End Date:
Not shown	1655	N	535300 174900	Status: Historical Licence No: 28/39/43/0016 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Honor Oak Pumping Station Data Type: Point Name: THAMES WATER UTILITIES LTD	Annual Volume (m^3): 1161527 Max Daily Volume (m^3): 4546.1 Original Application No: RG903 Original Start Date: 13/2/1967 Expiry Date: - Issue No: 100 Version Start Date: 10/7/2014 Version End Date:

6.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site? No

Database searched and no data found.

6.5 Potable Water Abstraction Licences

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

The following Potable Water Abstraction Licences records are represented as points, lines and regions on the SPZ and Potable Water Abstraction Licences Map (6c):

ID	Distance (m)	Direction	NGR	Details	
Not shown	1402	W	533550 172850	Status: Historical Licence No: 28/39/42/0058 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 51000 Max Daily Volume (m^3): 415 Original Application No: WRA/S/1054 Original Start Date: 1/1/2000 Expiry Date: 31/12/2009 Issue No: 1 Version Start Date: Version End Date:
Not shown	1402	W	533550 172850	Status: Active Licence No: TH/039/0042/003 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Dulwich & Sydenham Hill Golf Club, Dulwich, Borehole 'a' Data Type: Point Name: DULWICH & SYDENHAM HILL GOLF CLUB LTD	Annual Volume (m^3): 45000 Max Daily Volume (m^3): 830 Original Application No: NPSWR001684 Original Start Date: 1/1/2010 Expiry Date: 31/3/2025 Issue No: 1 Version Start Date: Version End Date:
Not shown	1655	N	535300 174900	Status: Active Licence No: 28/39/43/0016 Details: Potable Water Supply - Direct Direct Source: Thames Groundwater Point: Honor Oak Pumping Station Data Type: Point Name: THAMES WATER UTILITIES LTD	Annual Volume (m^3): 1161527 Max Daily Volume (m^3): 4546.1 Original Application No: RG903 Original Start Date: 13/2/1967 Expiry Date: - Issue No: 100 Version Start Date: Version End Date:

6.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site? No

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

Are there any Source Protection Zones within the Confined Aquifer within 500m of the study site? No

Historically, Source Protection Zone maps have been focused on regulation of activities which occur at or near the ground surface, such as prevention of point source pollution and bacterial contamination of water supplies. Sources in confined aquifers were often considered to be protected from these surface pressures due to the presence of a low permeability confining layer (e.g. glacial till, clay). The increased interest in subsurface activities such as onshore oil and gas exploration, ground source heating and cooling requires protection zones for confined sources to be marked on SPZ maps where this has not already been done.

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

Is there any Environment Agency information on groundwater vulnerability and soil leaching potential within 500m of the study site? No

Database searched and no data found.

6.9 River Quality

Is there any Environment Agency information on river quality within 1500m of the study site? No

6.9.1 Biological Quality:

Database searched and no data found.

6.9.2 Chemical Quality:

Database searched and no data found.

6.10 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? No

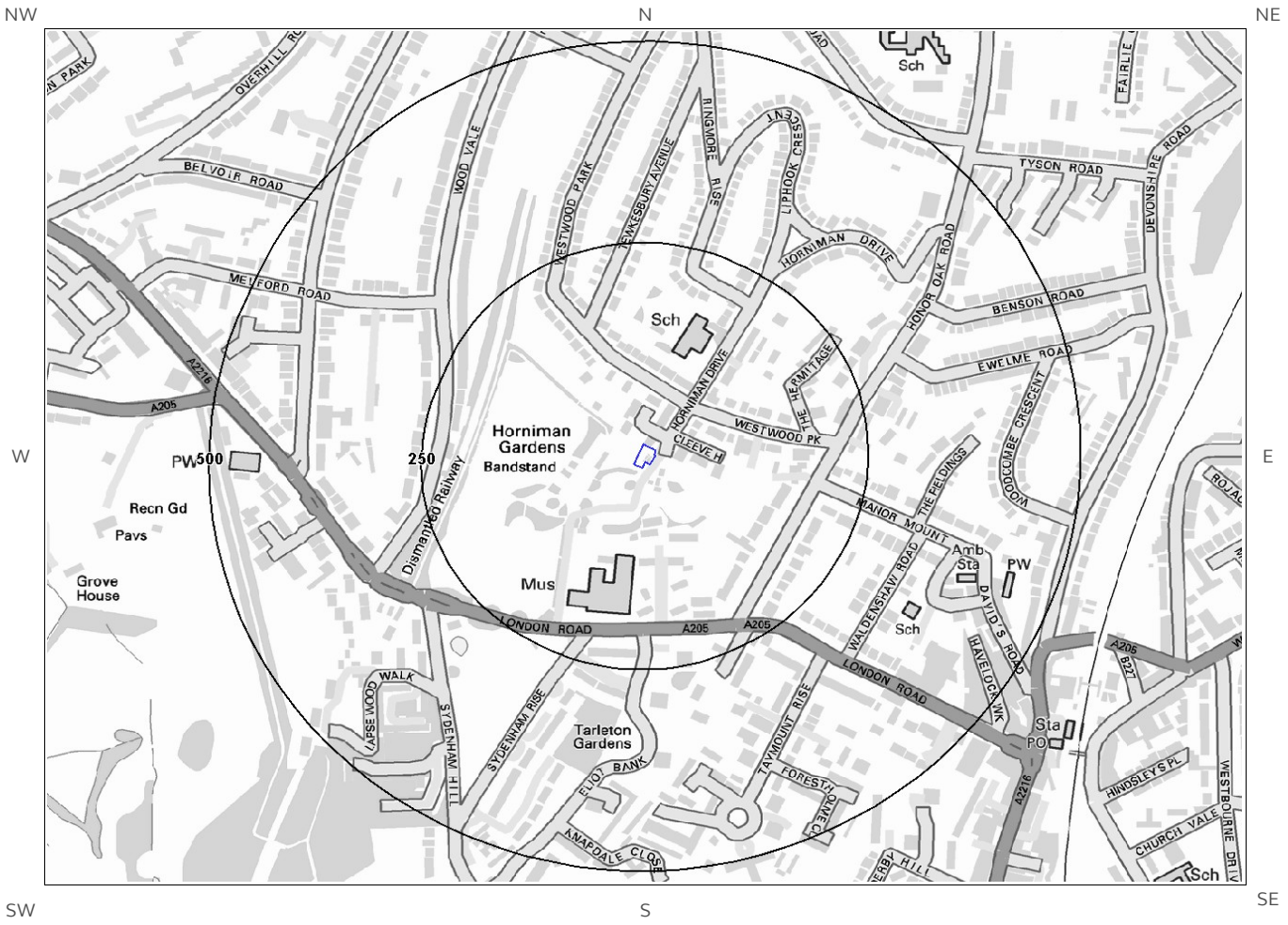
Database searched and no data found.

6.11 Surface Water Features

Are there any surface water features within 250m of the study site?	No

Database searched and no data found.

7a. Environment Agency Flood Map for Planning (from rivers and the sea)



Site Outline

Search Buffers (m)
100
250

Zone 2 Floodplain

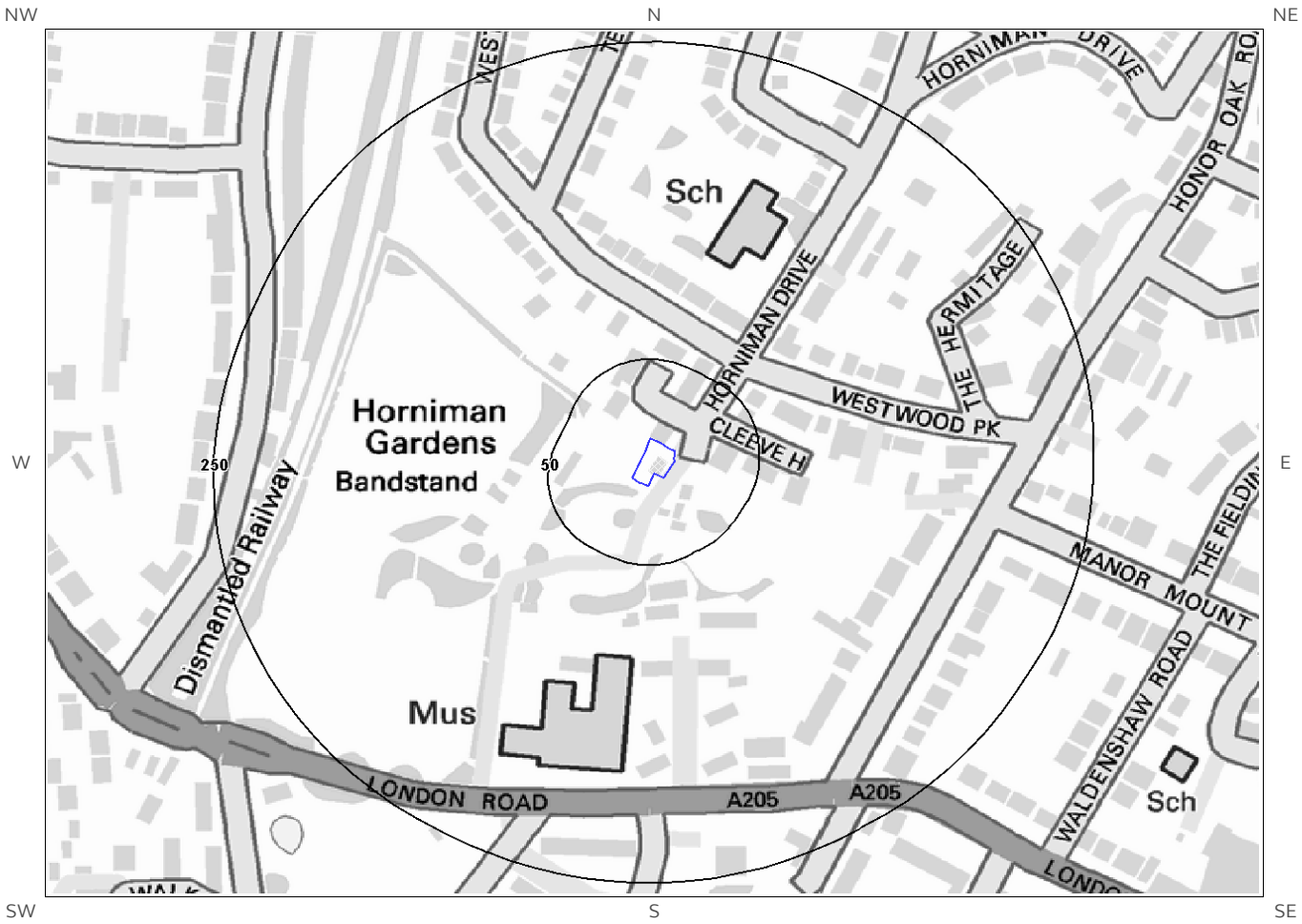
Zone 3 Floodplain

Flood Defences

Area used for Flood Storage

Area Benefiting from Flood Defences

7b. Environment Agency Risk of Flooding from Rivers and the Sea (RoFRaS) Map



Site Outline

100
250
Search Buffers (m)

RoFRaS Rating

Very Low

Low

Medium

High

7 Flooding

7.1 River and Coastal Zone 2 Flooding

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

Environment Agency Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 7a – Flood Map for Planning:

Database searched and no data found.

7.2 River and Coastal Zone 3 Flooding

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

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 7a – Flood Map for Planning.

Database searched and no data found.

7.3 Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating

What is the highest risk of flooding onsite? Very Low

The Environment Agency RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the probability that the flood defences will overtop or breach by considering their location, type, condition and standard of protection.

RoFRaS data for the study site indicates the property is in an area with a Very Low (less than 1 in 1000) chance of flooding in any given year.

7.4 Flood Defences

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

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

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

7.6 Areas benefiting from Flood Storage

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

7.7 Groundwater Flooding Susceptibility Areas

7.7.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site? No

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

7.7.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?

Not Prone

The area is not considered to be prone to groundwater flooding based on rock type.

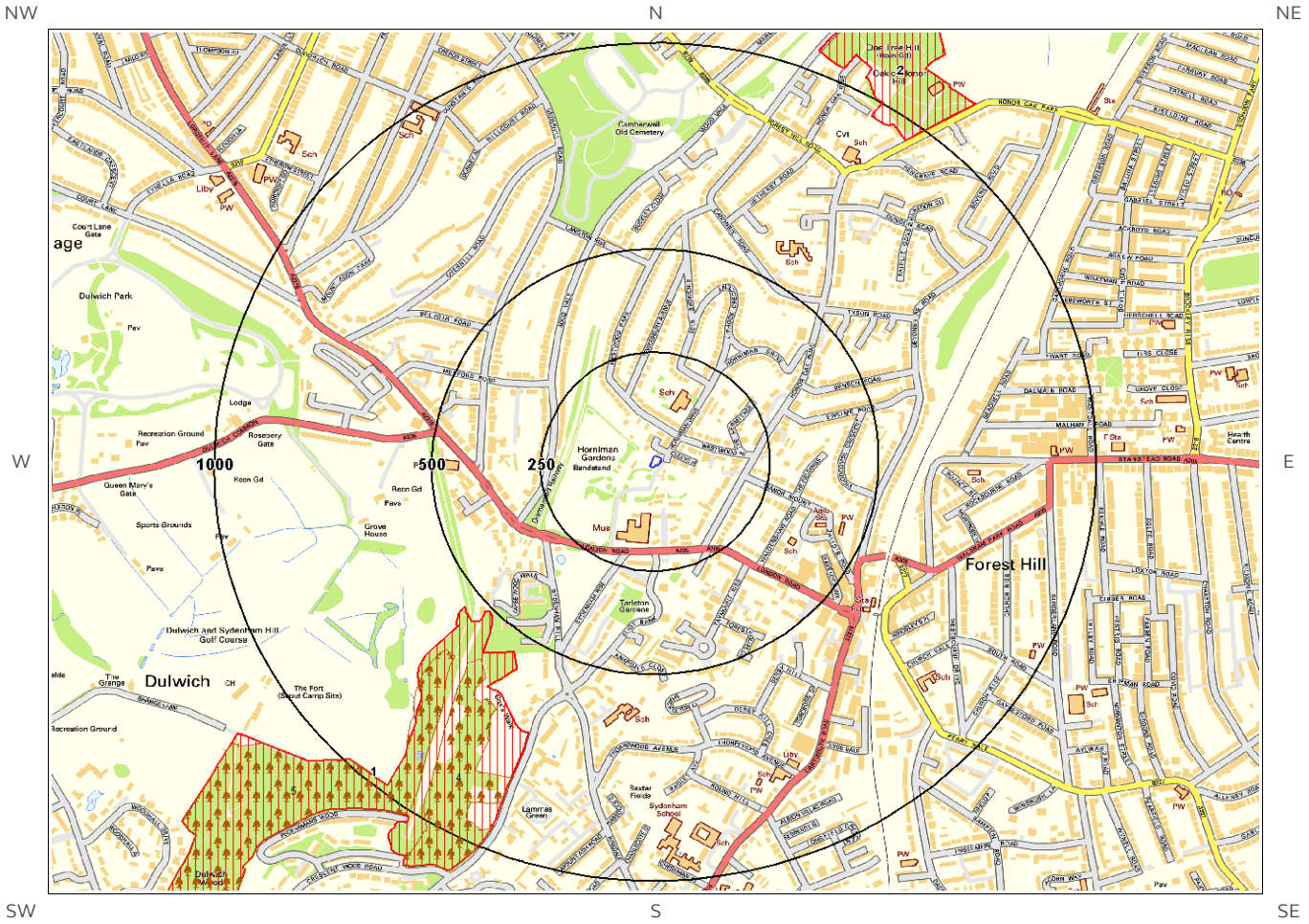
7.8 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? Not Applicable

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

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

8. Designated Environmentally Sensitive Sites Map



Site Outline

100
250
Search Buffers (m)

AONB

National Park

SSSI

Special Protection Areas

Nitrate Vulnerable Zones

Green Belt

Environmentally Sensitive Areas

Special Areas of Conservation

World Heritage Sites

Nitrate Sensitive Areas

Ancient Woodland

National Nature Reserve

Local Nature Reserves

Ramsar Sites

8. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site?	Yes

8.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:

0

Database searched and no data found.

8.2 Records of National Nature Reserves (NNR) within 2000m of the study site:

0

Database searched and no data found.

8.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site:

0

Database searched and no data found.

8.4 Records of Special Protection Areas (SPA) within 2000m of the study site:

0

Database searched and no data found.

8.5 Records of Ramsar sites within 2000m of the study site:

0

Database searched and no data found.

8.6 Records of Ancient Woodland within 2000m of the study site:

3

The following records of Designated Ancient Woodland provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
4	606	SW	UNKNOWN	Ancient and Semi-Natural Woodland
5	641	SW	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1495	SW	UNKNOWN	Ancient and Semi-Natural Woodland

8.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

3

The following Local Nature Reserve (LNR) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	LNR Name	Data Source
1	508	SW	Sydenham Hill Wood and Fern Bank	Natural England
2	955	NE	One Tree Hill	Natural England
Not shown	1224	SE	Dacres Wood	Natural England

8.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

8.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

8.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

8.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

0

Database searched and no data found.

8.14 Records of Green Belt land within 2000m of the study site:

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

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

9.1.1 Shrink Swell

What is the maximum Shrink-Swell*[*] hazard rating identified on the study site? Moderate

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

Hazard
Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a probable increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a probable increase in insurance risk during droughts or where vegetation with high moisture demands is present.

9.1.2 Landslides

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

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

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

9.1.3 Soluble Rocks

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

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

Hazard
Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

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

9.1.4 Compressible Ground

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

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

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

9.1.5 Collapsible Rocks

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

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

Hazard
Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

9.1.6 Running Sand

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

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

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

9.2 Radon

9.2.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

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

9.2.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing
ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

10. Mining

10.1 Coal Mining

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

Database searched and no data found.

10.2 Non-Coal Mining

Are there any Non-Coal Mining areas within 50m of the study site boundary? No

Database searched and no data found.

10.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site? No
Guidance: No Guidance Required.

Contact Details

Groundsure Helpline
Telephone: 08444 159 000
info@groundsure.com

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

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

Public Health England
Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
www.gov.uk/phe
Email:**enquiries@phe.gov.uk**
Main switchboard**: 020 7654 8000**

The Coal Authority
200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Ordnance Survey
Adanac Drive, Southampton
SO16 0AS
Tel: 08456 050505

Local Authority
Authority: London Borough of Lewisham
Phone: 020 8314 6000
Web: http://www.lewisham.gov.uk/
Address: Town Hall, Catford, London, SE6 4RU

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

Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:
https://www.groundsure.com/terms-and-conditions-sept-2016

Groundsure
LOCATION INTELLIGENCE

Ridge & Partners LLP

The Cowyards, Blenheim Park,
Woodstock, OX20 1QR

Groundsure Reference:	GS-3305270
Your Reference:	5001510_-_601018
Report Date	19 Sep 2016
Report Delivery Method:	Email - pdf

Groundsure Geo Insight

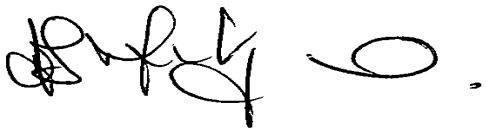
Address: THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Geo Insight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above Groundsure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
Groundsure Geoinsight

Groundsure Geo Insight

Address:	**THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ**
Date:	**19 Sep 2016**
Reference:	**GS-3305270**
Client:	**Ridge & Partners LLP**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	20-Apr-2013
Grid Reference:	534903,173280
Site Size:	0.04ha

Contents Page

Overview of Findings

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

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

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

Section 1:Geology		
1.1 Artificial Ground	1.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	1.1.2 Are there any records relating to permeability of artificial ground within the study site* boundary?	No
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?	No
	1.2.2 Are there any records relating to permeability of superficial geology within the study site boundary?	No
	1.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	1.2.4 Are there any records relating to permeability of landslips within the study site boundary?	No
1.3 Bedrock, Solid Geology & Faults	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records relating to permeability of bedrock within the study site boundary?	Yes
	1.3.3 Are there any records of faults within 500m of the study site boundary?	No
1.4 Radon data	1.4.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level
	1.4.2 Is the property in an area where Radon Protection Measures are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary

Section 2:Ground Workings	On-site	0-50m	51-250	251-500	501-1000
2.1 Historical Surface Ground Working Features from Small Scale Mapping	0	0	10	Not Searched	Not Searched
2.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	0
2.3 Current Ground Workings	0	0	0	0	1

Section 3: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
3.1 Historical Mining	0	0	0	0	0
3.2 Coal Mining	0	0	0	0	0
3.3 Johnson Poole and Bloomer Mining Area	1	0	1	2	4
3.4 Non-Coal Mining	0	0	0	0	0
3.5 Non-Coal Mining Cavities	0	0	0	0	0
3.6 Natural Cavities	0	0	0	0	0
3.7 Brine Extraction	0	0	0	0	0
3.8 Gypsum Extraction	0	0	0	0	0
3.9 Tin Mining	0	0	0	0	0
3.10 Clay Mining	0	0	0	0	0

Section 4: Natural Ground Subsidence	On-site
4.1 Shrink Swell Clay	Moderate
4.2 Landslides	Very Low
4.3 Ground Dissolution of Soluble Rocks	Negligible
4.4 Compressible Deposits	Negligible
4.5 Collapsible Deposits	Very Low
4.6 Running Sand	Negligible

Section 5: Borehole Records	On-site	0-50m	51-250
5 BGS Recorded Boreholes	0	6	9

Section 6: Estimated Background Soil Chemistry	On-site	0-50m	51-250
6 Records of Background Soil Chemistry	1	0	3

Section 7: Railways and Tunnels	On-site	0-50m	51-250	251-500
7.1 Tunnels	0	0	0	Not Searched
7.2 Historical Railway and Tunnel Features	0	0	0	Not Searched
7.3 Historical Railways	0	0	1	Not Searched
7.4 Active Railways	0	0	0	Not Searched

Section 7:Railways and Tunnels	On-site	0-50m	51-250	251-500
7.5 Railway Projects	0	0	0	0

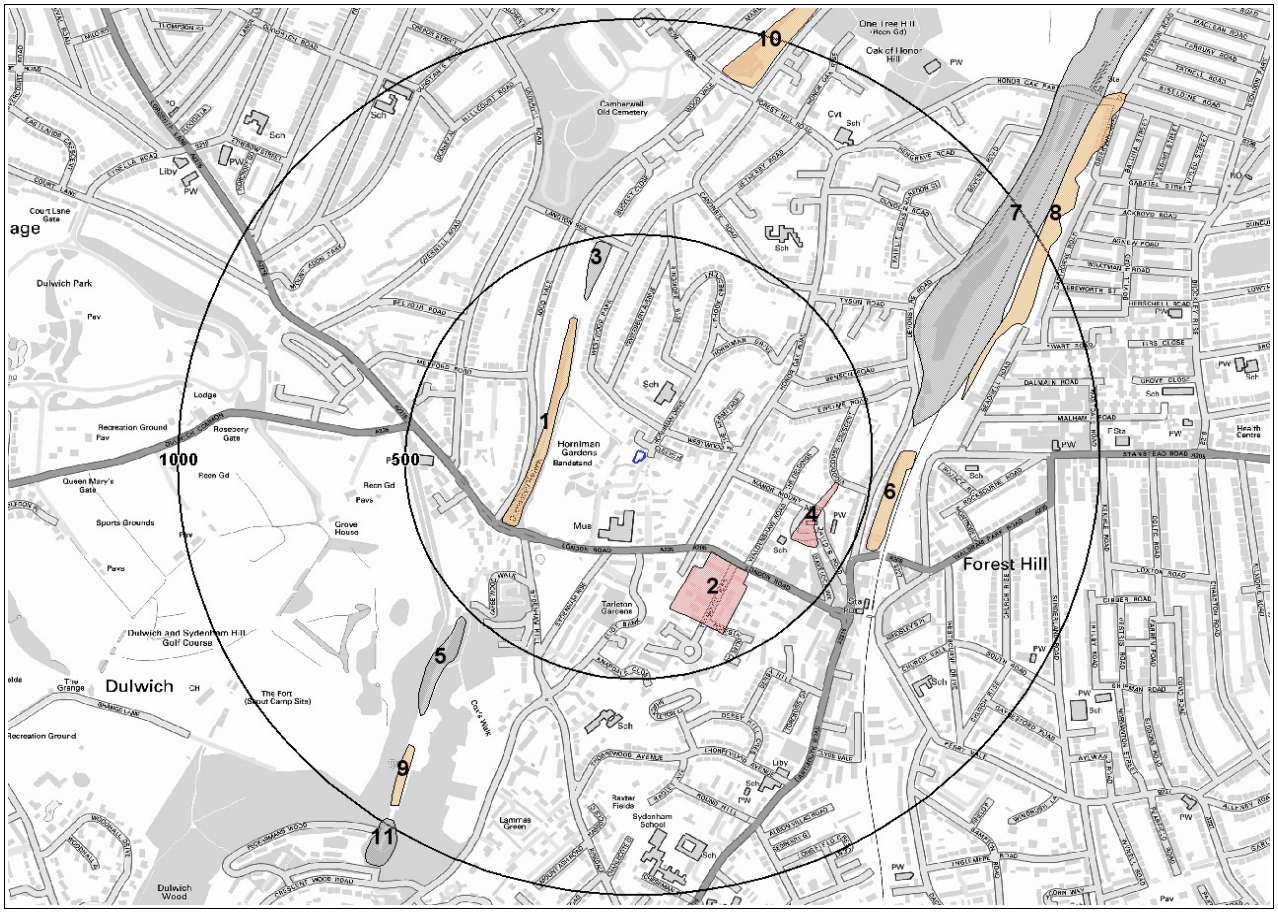
1 Geology

1.1 Artificial Ground Map

NW N NE

W E

SW S SE



Artificial Ground Legend

Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Worked Ground (undivided)

Infilled Ground

Disturbed Ground (undivided)

Landscaped Ground (undivided)

Reclaimed Ground

1 Geology

1.1 Artificial Ground

1.1.1Artificial/ Made Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:270

Are there any records of Artificial/Made Ground within 500m of the study site boundary? Yes

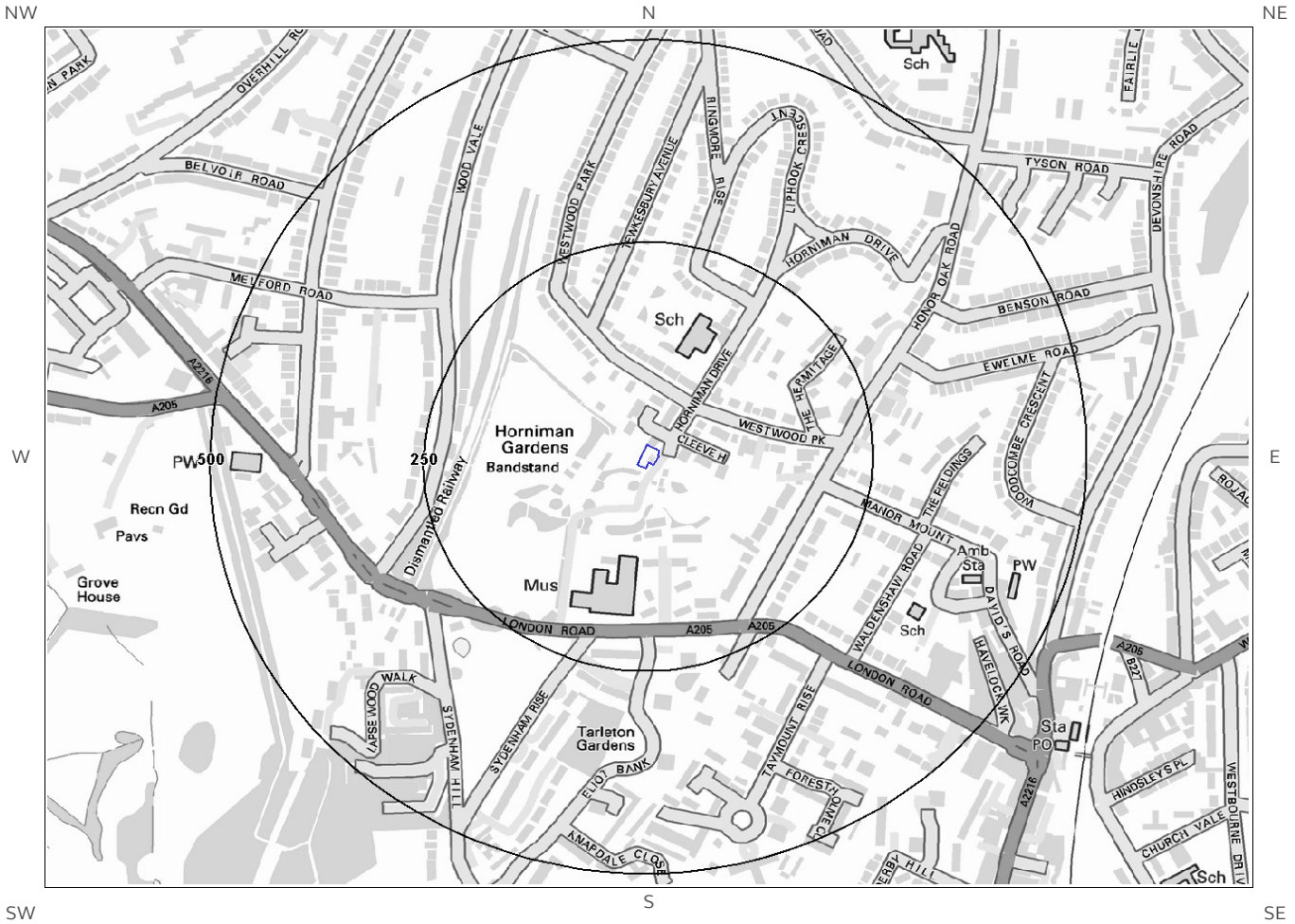
ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	188.0	W	MGR-MGRD	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
2	259.0	SE	WMGR-MGRD	INFILLED GROUND	ARTIFICIAL DEPOSIT
3	366.0	N	WGR-OPEN	WORKED GROUND (UNDIVIDED)	VOID
4	371.0	SE	WMGR-MGRD	INFILLED GROUND	ARTIFICIAL DEPOSIT

1.1.2 Permeability of Artificial Ground

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

Database searched and no data found.

1.2 Superficial Deposits and Landslips Map



Superficial Deposits and Landslips Legend

Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? No

Database searched and no data found.

1.2.2 Permeability of Superficial Ground

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

Database searched and no data found.

1.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.2.4 Landslip Permeability

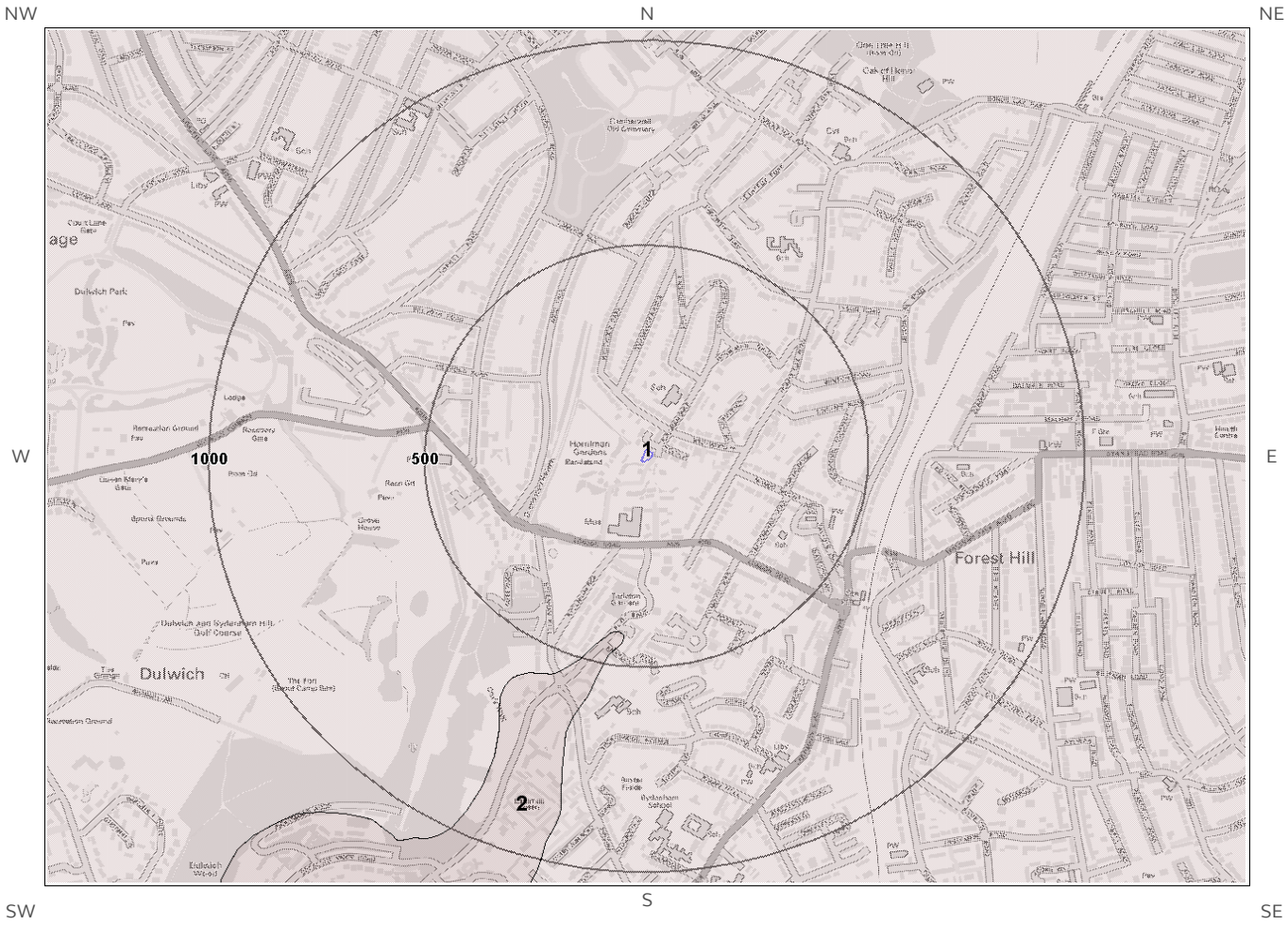
Are there any records relating to permeability of landslips within the study site* boundary? No

Database searched and no data found.

---

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

1.3 Bedrock and Faults Map



Bedrock and Faults Legend

Site Outline

500
1000
Search Buffers (m)

1.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No:270

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/ Solid Geology within 500m of the study site boundary:

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	LC-CLSI	London Clay Formation - Clay And Silt	No Details
2	417.0	S	CLGB-SSCL	Claygate Member - Sand, Silt And Clay	No Details

1.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site* boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	Low	Very Low

1.3.3 Faults

Are there any records of Faults within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

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

1.4 Radon Data

1.4.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level

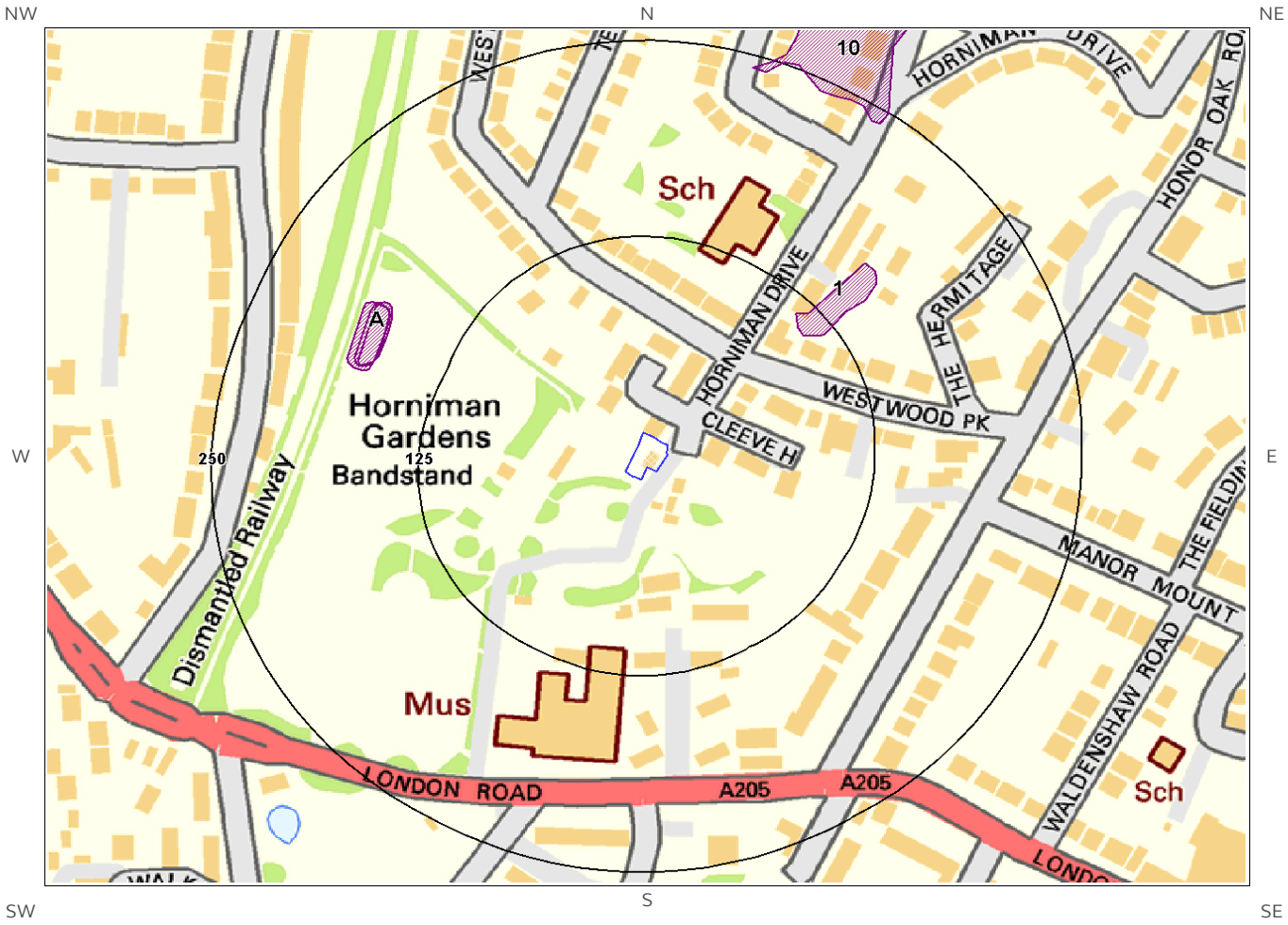
---

1.4.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary

---

2 Ground Workings Map



Ground Workings Legend

Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

2 Ground Workings

2.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping.

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

The following Historical Surface Ground Working Features are provided by Groundsure:

ID	Distance (m)	Direction	NGR	Use	Date
1	108.0	NE	535016 173379	Unspecified Heap	1863
2A	166.0	NW	534737 173357	Pond	1957
3A	166.0	NW	534737 173357	Pond	1955
4A	167.0	NW	534735 173356	Pond	1938
5A	167.0	NW	534735 173356	Pond	1914
6A	167.0	NW	534733 173355	Pond	1968
7A	167.0	NW	534733 173355	Pond	1992
8A	167.0	NW	534733 173355	Pond	1973
9A	167.0	NW	534733 173355	Pond	1982
10	241.0	NE	535103 173617	Covered Reservoir	1894

2.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? No

Database searched and no data found.

2.3 Current Ground Workings

This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

The following Current Ground Workings information is provided by British Geological Survey:

ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
Not shown	874.0	NW	534271 173902	Clay & Shale	East Dulwick Brick and Tile Works	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

3 Mining, Extraction & Natural Cavities Map

Mining, Extraction and Natural Cavities Legend

3 Mining, Extraction & Natural Cavities

3.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

3.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

3.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? Yes

The following information provided by JPB is not represented on mapping: Whilst outside of an area where The Coal Authority have information on coal mining activities, Johnson Poole & Bloomer (JPB) have information such as mining plans and maps held within their archive of mining activities that have occurred within 1km of this property. Further details and a quote for services can be obtained by emailing this report to enquiries.gs@jpb.co.uk.

3.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

3.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

3.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

3.7 Brine Extraction

This data provides information from the Coal Authority issued on behalf of the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

3.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

3.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level.

Are there any Tin Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

3.10 Clay Mining

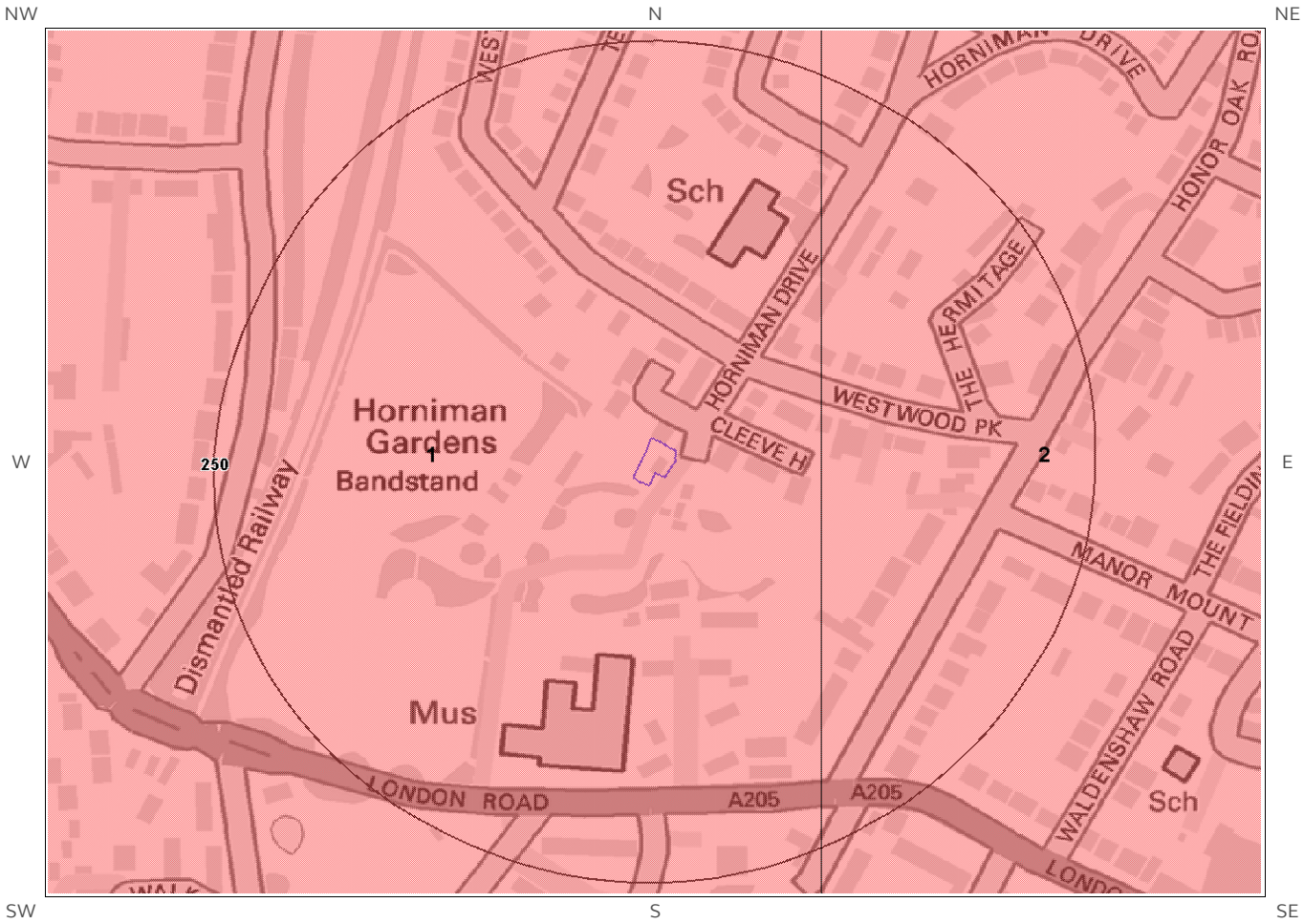
This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

Are there any Clay Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

4 Natural Ground Subsidence

4.1 Shrink-Swell Clay Map



Shrink Swell Clay Legend

Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

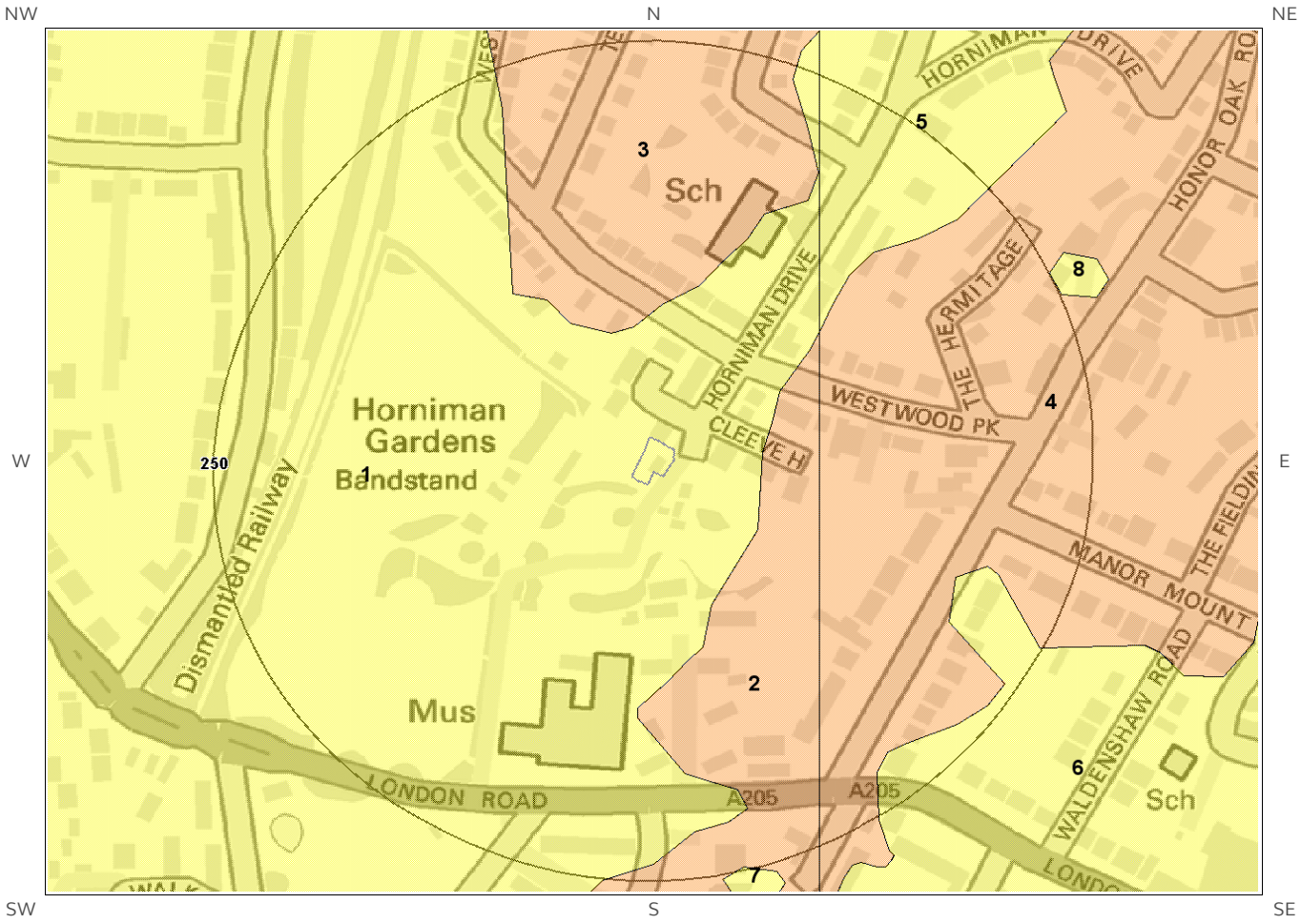
Very Low

Low

Moderate

High

4.2 Landslides Map



Landslides Legend

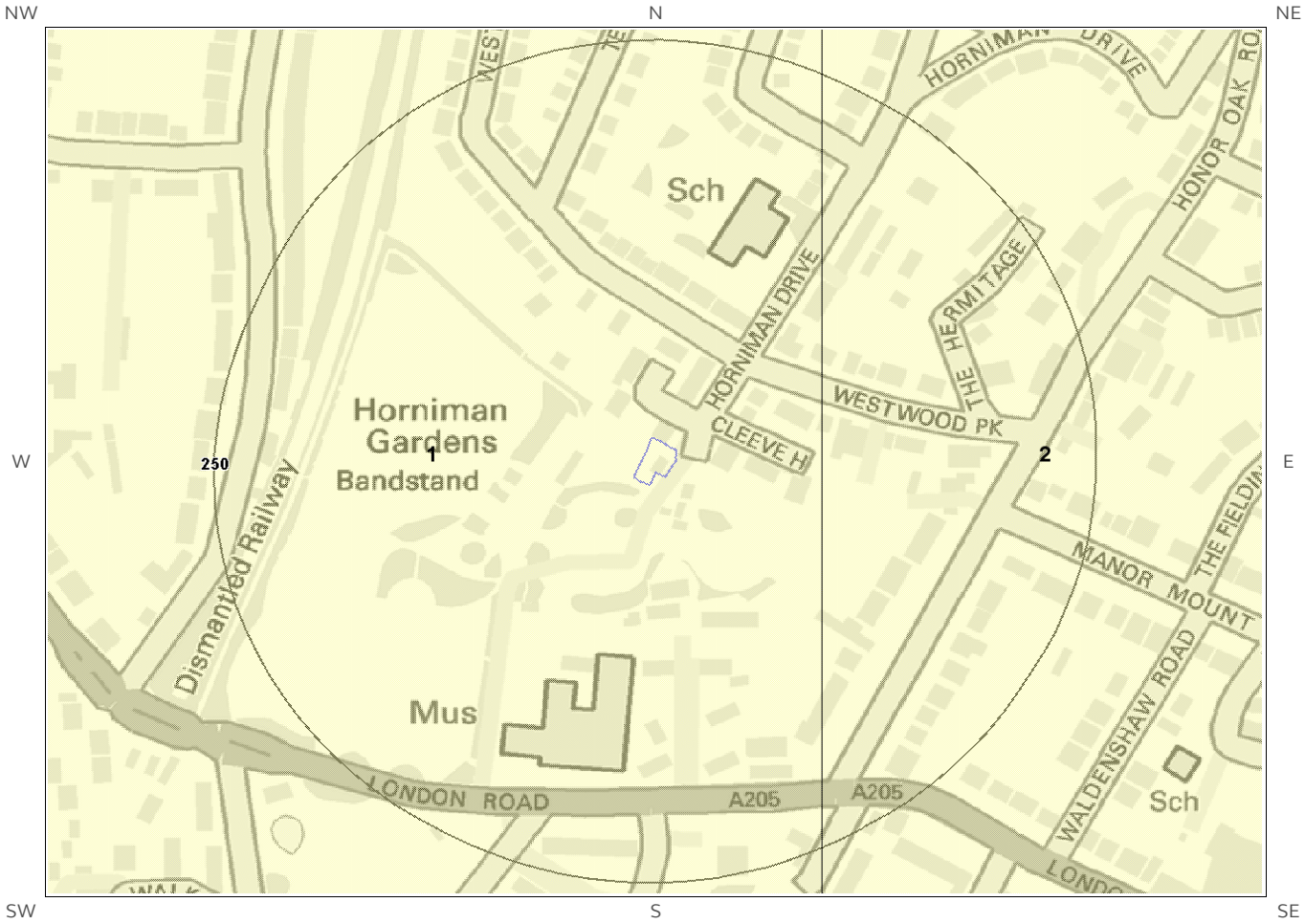
Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

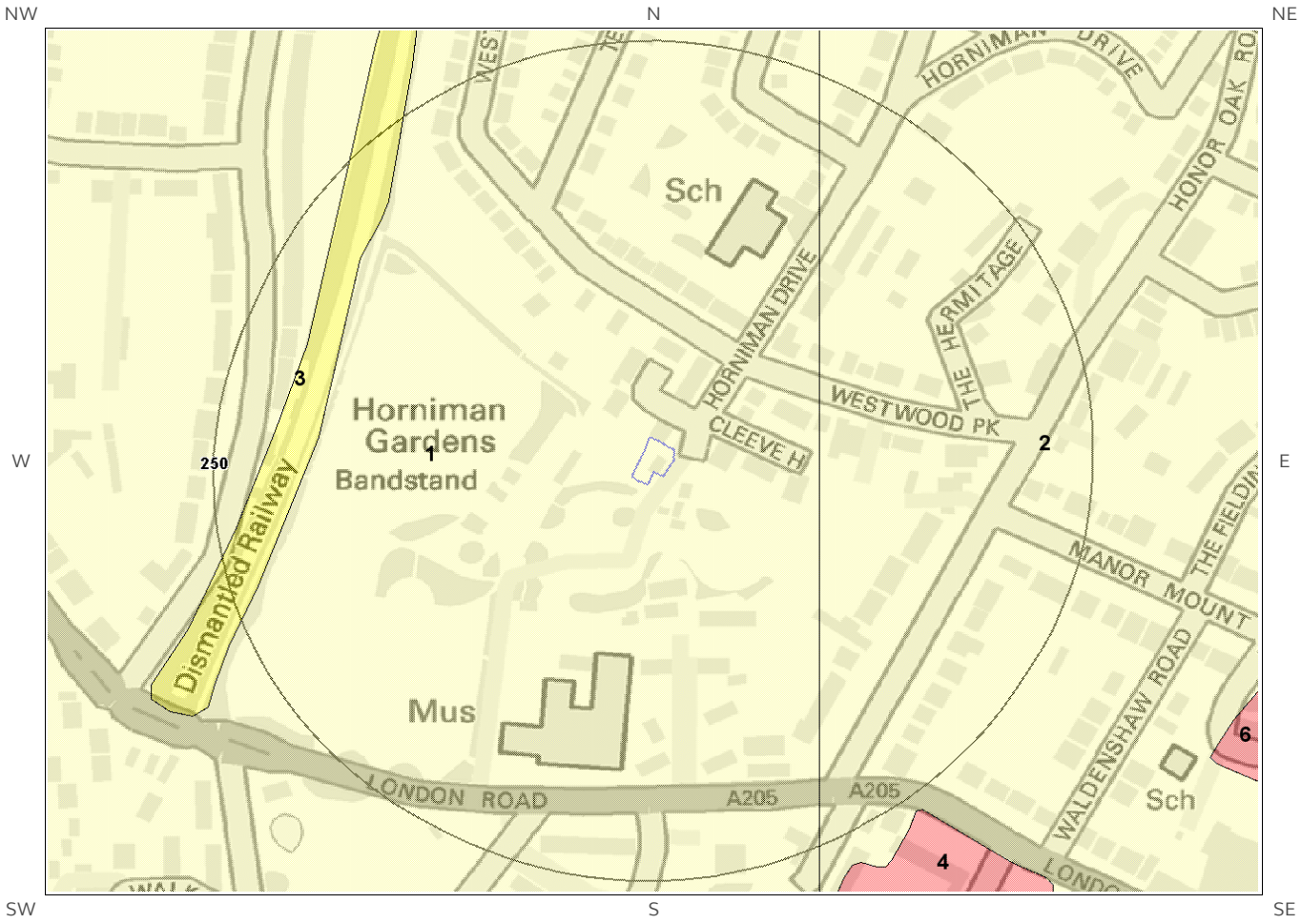
Low
Moderate
High

4.3 Ground Dissolution Soluble Rocks Map



Ground Dissolution Soluble Rocks Legend

4.4 Compressible Deposits Map



Compressible Deposits Legend

Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

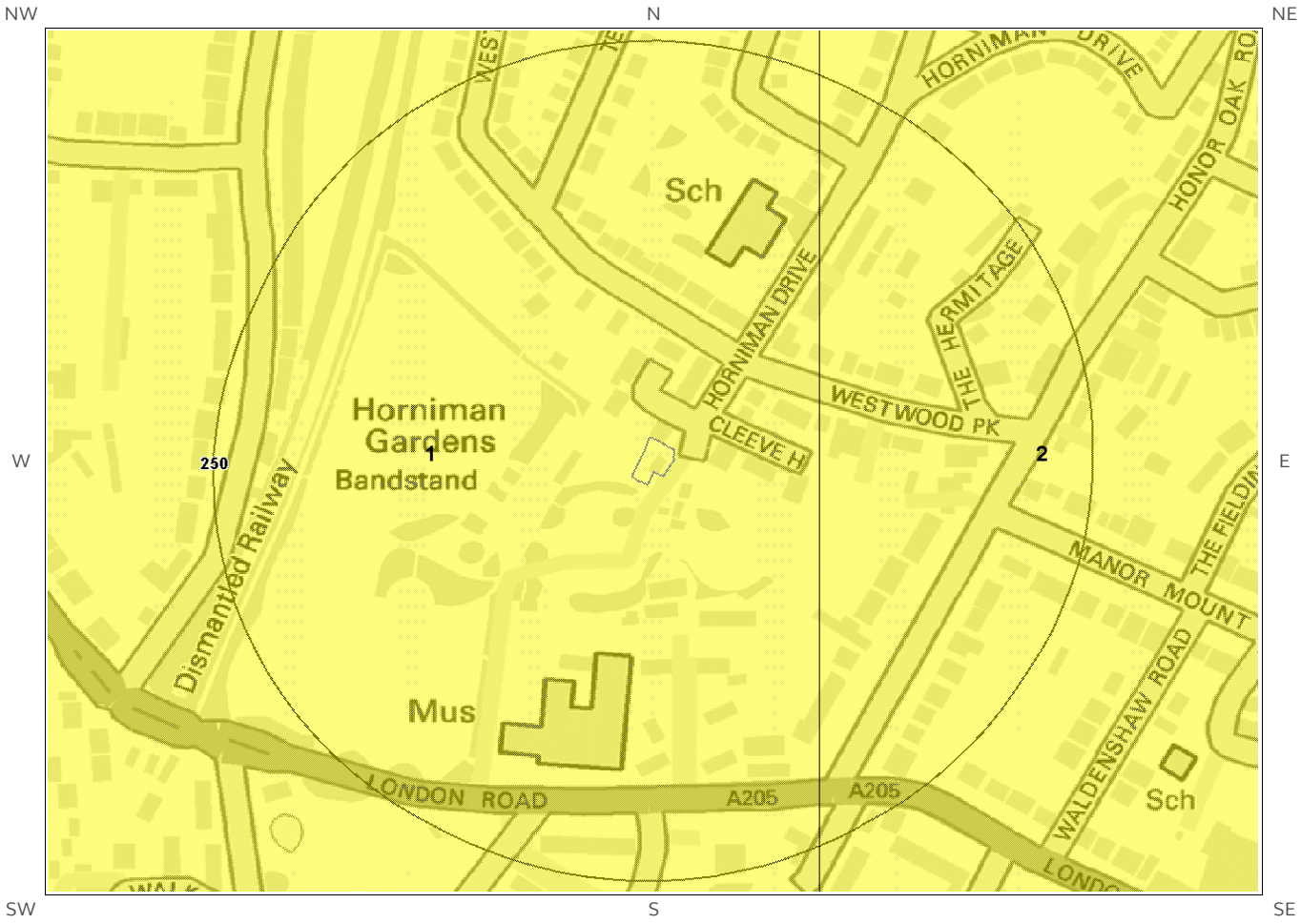
Very Low

Low

Moderate

High

4.5 Collapsible Deposits Map



Collapsible Deposits Legend

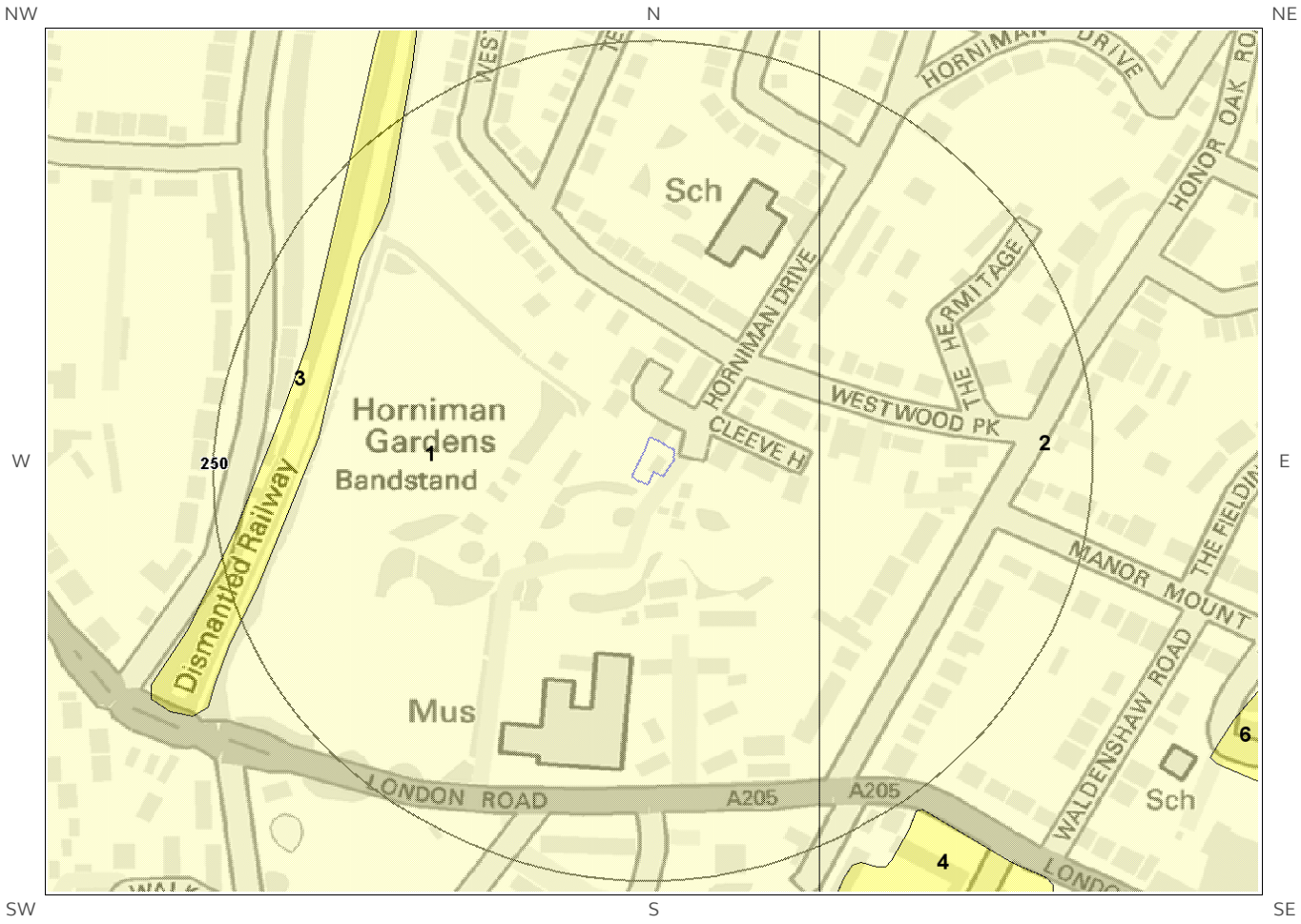
Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

Low
Moderate
High

4.6 Running Sand Map



Running Sand Legend

Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

Low
Moderate
High

4 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

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

What is the maximum hazard rating of natural subsidence within the study site*[*] boundary? Moderate

4.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Moderate	Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a probable increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a probable increase in insurance risk during droughts or where vegetation with high moisture demands is present.

4.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

4.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

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

4.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible ground identified. No special actions required to avoid problems due to compressible ground. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible ground.

4.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

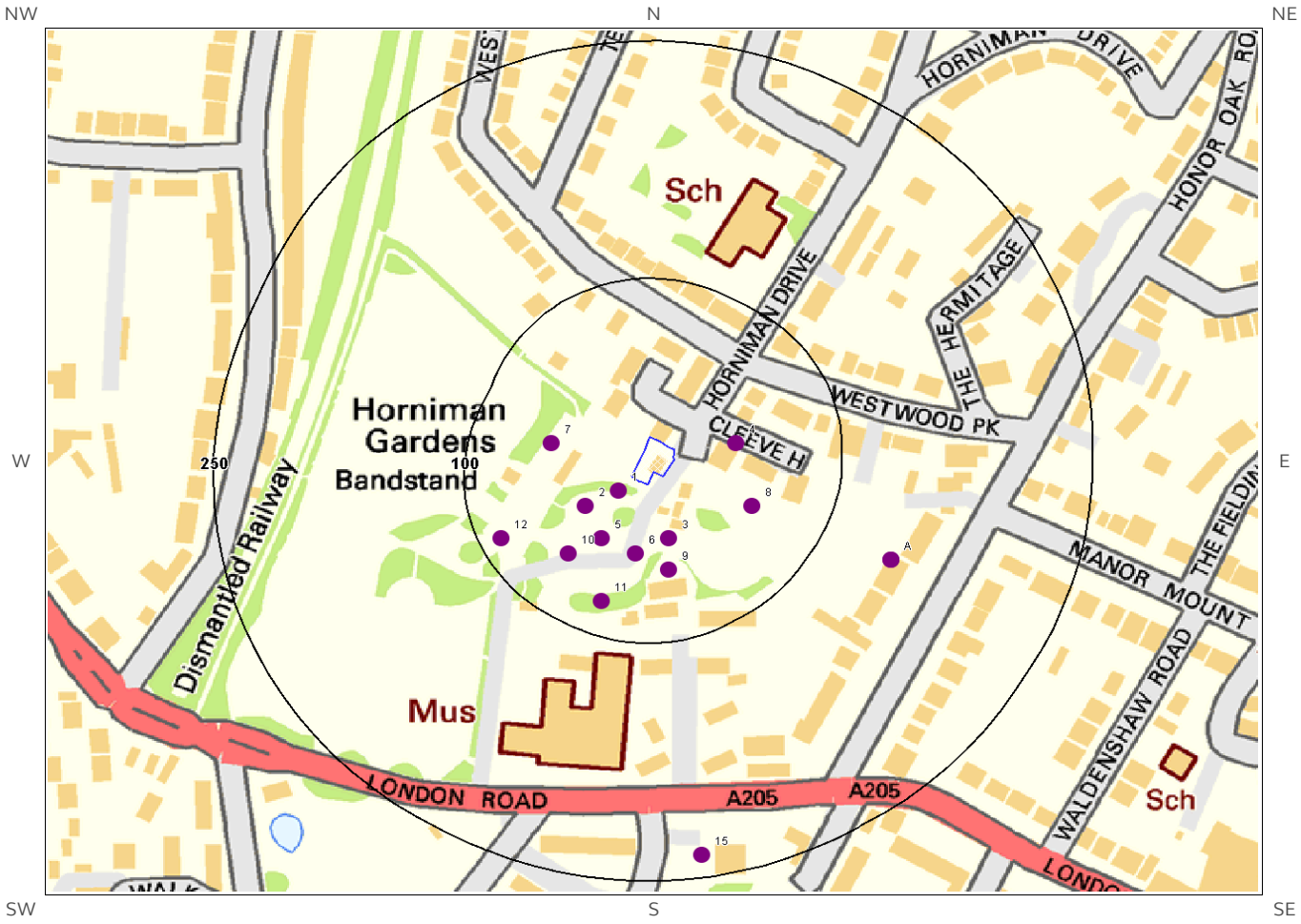
ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

4.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

5 Borehole Records Map



Borehole Records Legend

Site Outline

Borehole Locations

125
250
Search Buffers (m)

5 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: 15

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1	12.0	SW	534880 173260	TQ37SW172	20.0	HORNIMAN MUSEUM BH2
2	34.0	SW	534860 173250	TQ37SW171	22.0	HORNIMAN MUSEUM BH1
3	36.0	S	534910 173230	TQ37SW181	20.0	HORNIMAN MUSEUM BH11
4	36.0	E	534950 173290	TQ37SW353	18.28	FOREST HILL PRIMARY SCHOOL BH1-4
5	43.0	SW	534870 173230	TQ37SW173	20.0	HORNIMAN MUSEUM BH3
6	45.0	S	534890 173220	TQ37SW175	22.0	HORNIMAN MUSEUM BH5
7	52.0	NW	534840 173290	TQ37SW180	20.0	HORNIMAN MUSEUM BH10
8	55.0	SE	534960 173250	TQ37SW176	20.0	HORNIMAN MUSEUM BH6
9	55.0	S	534910 173210	TQ37SW177	20.0	HORNIMAN MUSEUM BH7
10	62.0	SW	534850 173220	TQ37SW174	20.0	HORNIMAN MUSEUM BH4
11	79.0	S	534870 173190	TQ37SW178	20.0	HORNIMAN MUSEUM BH8
12	87.0	SW	534810 173230	TQ37SW179	20.0	HORNIMAN MUSEUM BH9
13A	144.0	SE	535043 173216	TQ37SE765	20.0	72 HONOR OAK ROAD LONDON 2
14A	144.0	SE	535043 173216	TQ37SE764	20.0	72 HONOR OAK ROAD LONDON 1
15	236.0	S	534930 173030	TQ37SW22/D	9.14	ELIOT BANK SITE L.C.C. LEWISHAM D

The borehole records are available using the hyperlinks below: Please note that if the donor of the borehole record has requested the information be held as commercial-in-confidence, the additional data will be held separately by the BGS and a formal request must be made for its release.

#1: scans.bgs.ac.uk/sobi_scans/boreholes/602466
#2: scans.bgs.ac.uk/sobi_scans/boreholes/602465
#3: scans.bgs.ac.uk/sobi_scans/boreholes/602475
#4: scans.bgs.ac.uk/sobi_scans/boreholes/602691
#5: scans.bgs.ac.uk/sobi_scans/boreholes/602467
#6: scans.bgs.ac.uk/sobi_scans/boreholes/602469
#7: scans.bgs.ac.uk/sobi_scans/boreholes/602474
#8: scans.bgs.ac.uk/sobi_scans/boreholes/602470

#9: scans.bgs.ac.uk/sobi_scans/boreholes/602471
#10: scans.bgs.ac.uk/sobi_scans/boreholes/602468
#11: scans.bgs.ac.uk/sobi_scans/boreholes/602472
#12: scans.bgs.ac.uk/sobi_scans/boreholes/602473
#13A: scans.bgs.ac.uk/sobi_scans/boreholes/15639726
#14A: scans.bgs.ac.uk/sobi_scans/boreholes/15639725
#15: scans.bgs.ac.uk/sobi_scans/boreholes/602104

6 Estimated Background Soil Chemistry

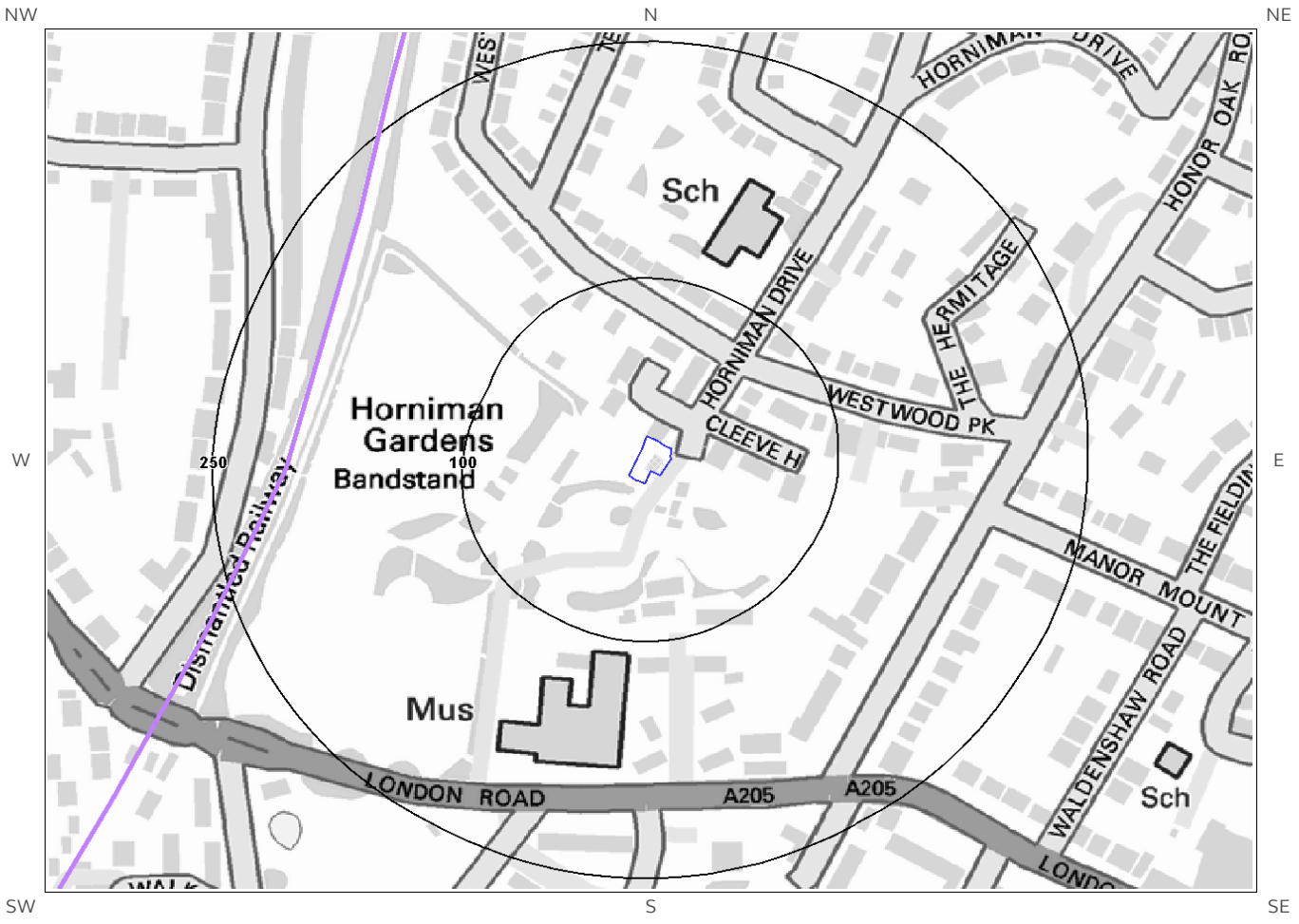
Records of background estimated soil chemistry within 250m of the study site boundary: 4

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	London	No data	No data	No data	No data	No data
86.0	E	London	No data	No data	No data	No data	No data
206.0	N	London	No data	No data	No data	No data	No data
229.0	NE	London	No data	No data	No data	No data	No data

*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

7 Railways and Tunnels Map



Railways and Tunnels Legend

- Site Outline
- Search Buffers (m) 250 500
- Underground or Partially Underground Railway / Subway System
- Railway Tunnel (OS Mapping)
- Abandoned or Dismantled Railway (OpenStreetMap)
- Railway Track (OS Mapping)
- Railway Track (OpenStreetMap)
- High Speed 2
- Crossrail 1
- Railway and/or Tunnel Feature from Historical Mapping

7 Railways and Tunnels

7.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary? No

Have any underground railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary? No

Have any other railway tunnels been identified within 250m of the site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

7.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary? No

Have any historical railway or tunnel features been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

7.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? No

Have any historical railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Status
199	W	Abandoned

Note: multiple sections of the same track may be listed in the detail above

Any records that have been identified are represented on the Railways and Tunnels Map.

7.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? No

Have any active railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Note: multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

7.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project? No

Is the study site within 500m of the route of the Crossrail 1 rail project? No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report.

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Contact Details

Groundsure Helpline

Telephone: 08444 159 000
info@groundsure.com

British Geological Survey Enquiries

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

British Gypsum

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Loughborough
Leicestershire
LE12 6HX

The Coal Authority

200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Public Health England

Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
https://www.gov.uk/government/organisations/public-health-england
Email: **enquiries@phe.gov.uk**
Main switchboard: 020 7654 8000

Johnson Poole & Bloomer Limited

Harris and Pearson Building, Brettel Lane
Brierley Hill, West Midlands
DY5 3LH
Tel: +44 (0) 1384 262 000
Email:**enquiries.gs@jpb.co.uk**
Website: **www.jpb.co.uk**

Ordnance Survey

Adanac Drive, Southampton
SO16 0AS

Tel: 08456 050505
Website: http://www.ordnancesurvey.co.uk/

Getmapping PLC

Virginia Villas, High Street, Hartley Witney,
Hampshire RG27 8NW
Tel: 01252 845444
Website:**http://www1.getmapping.com/**

Contact Details

Peter Brett Associates

Caversham Bridge House
Waterman Place
Reading
Berkshire RG1 8DN
Tel: +44 (0)118 950 0761 E-mail:**reading@pba.co.uk**
Website:**http://www.peterbrett.com/home**

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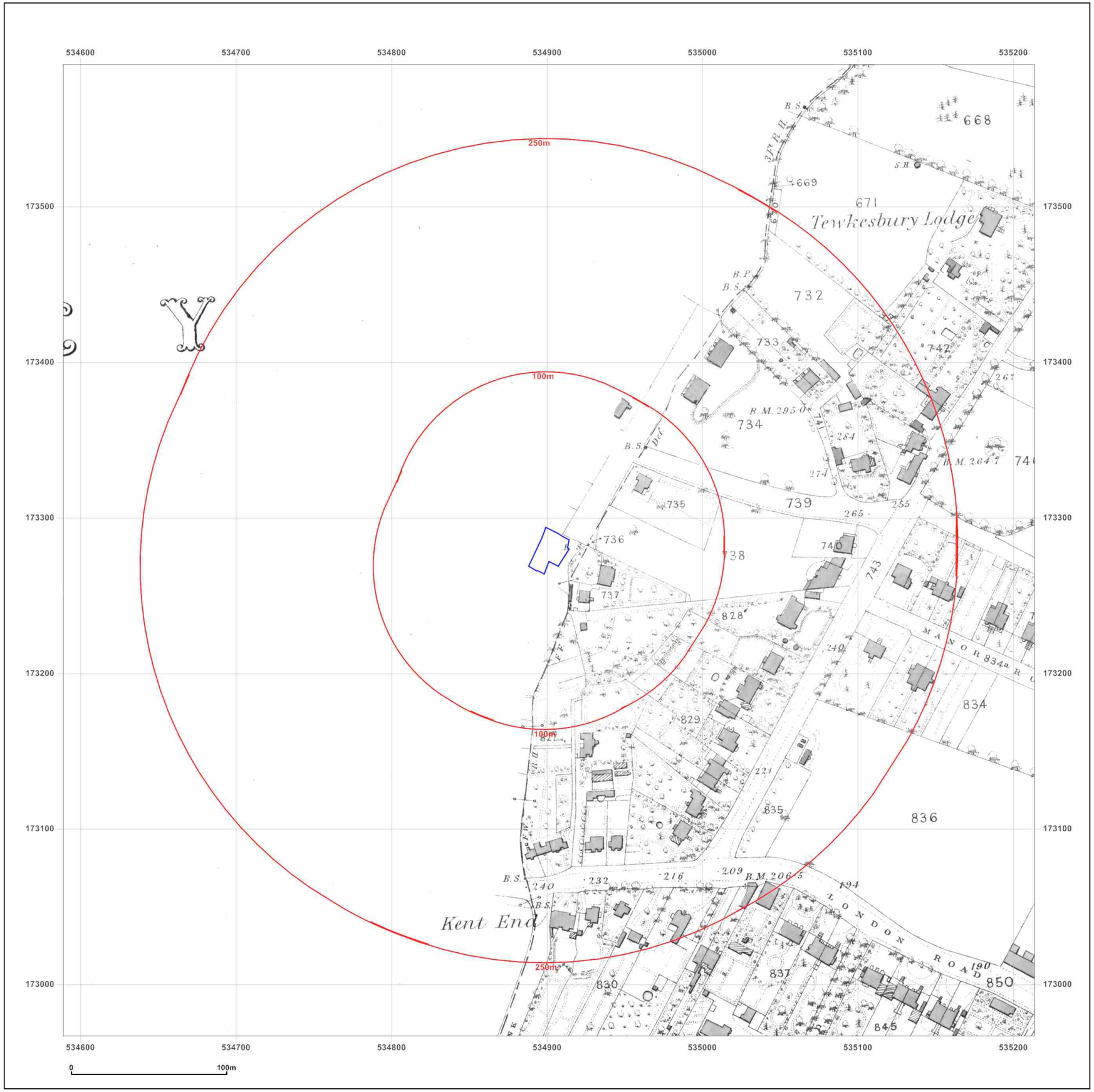

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Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series
Map date: **1863**
Scale: 1:2,500
Printed at: 1:2,500

N
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Surveyed 1863
Revised 1863
Edition N/A
Copyright N/A
Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1875**

Scale: 1:2,500

Printed at: 1:2,500

N
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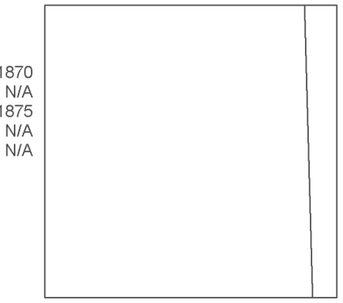
Surveyed 1870
Revised N/A
Edition 1875
Copyright N/A
Levelled N/A



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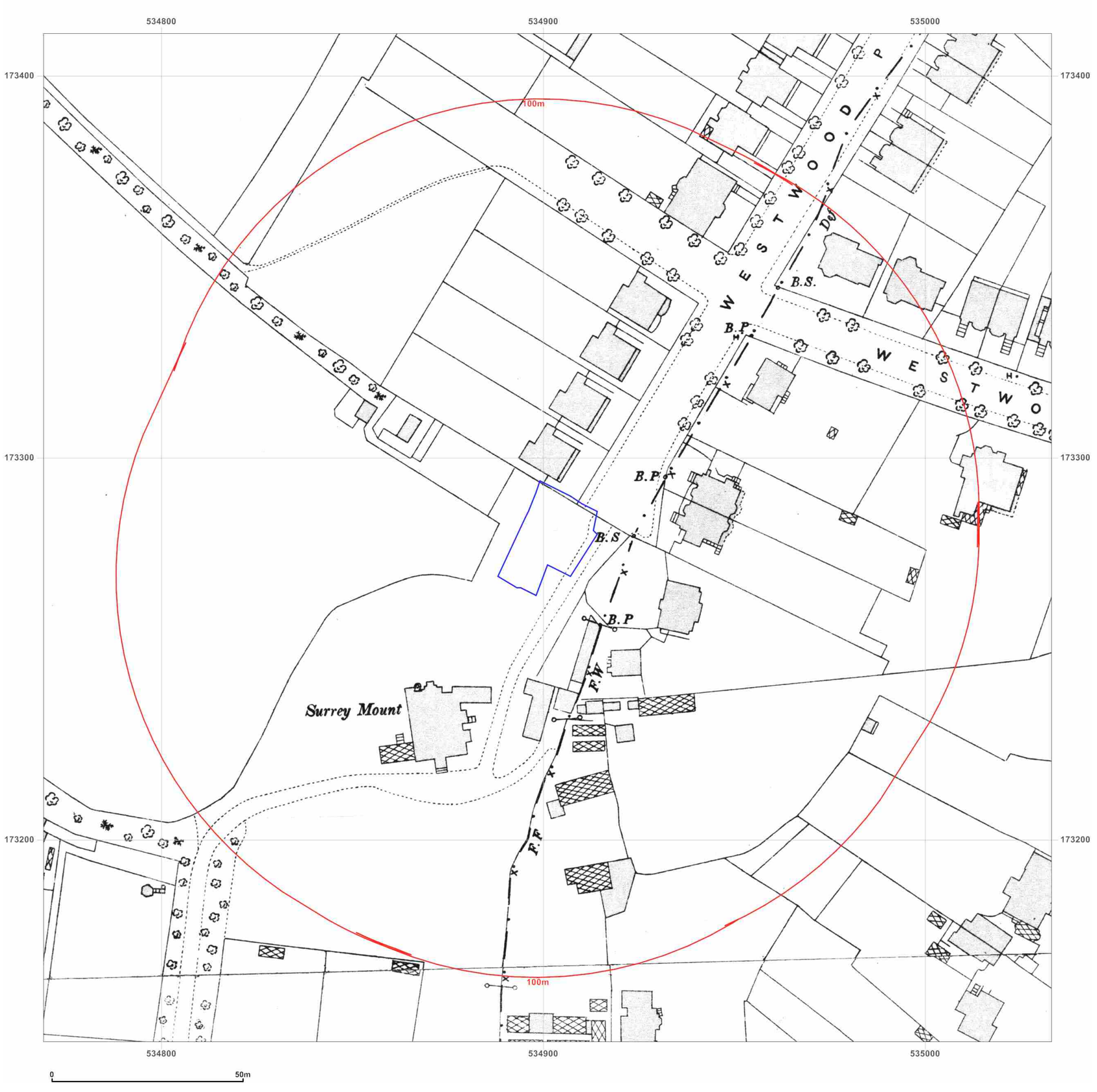

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: 1056 Scale Town Plan
Map date: **1896**
Scale: 1:1,056
Printed at: 1:1,056

N
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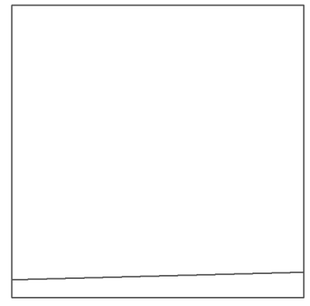
Surveyed 1895
Revised N/A
Edition 1896
Copyright N/A
Levelled N/A



Surveyed 1895
Revised N/A
Edition 1896
Copyright N/A
Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1896-1897**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1894
Revised N/A
Edition 1897
Copyright N/A
Levelled N/A

Surveyed 1896
Revised 1896
Edition N/A
Copyright N/A
Levelled N/A

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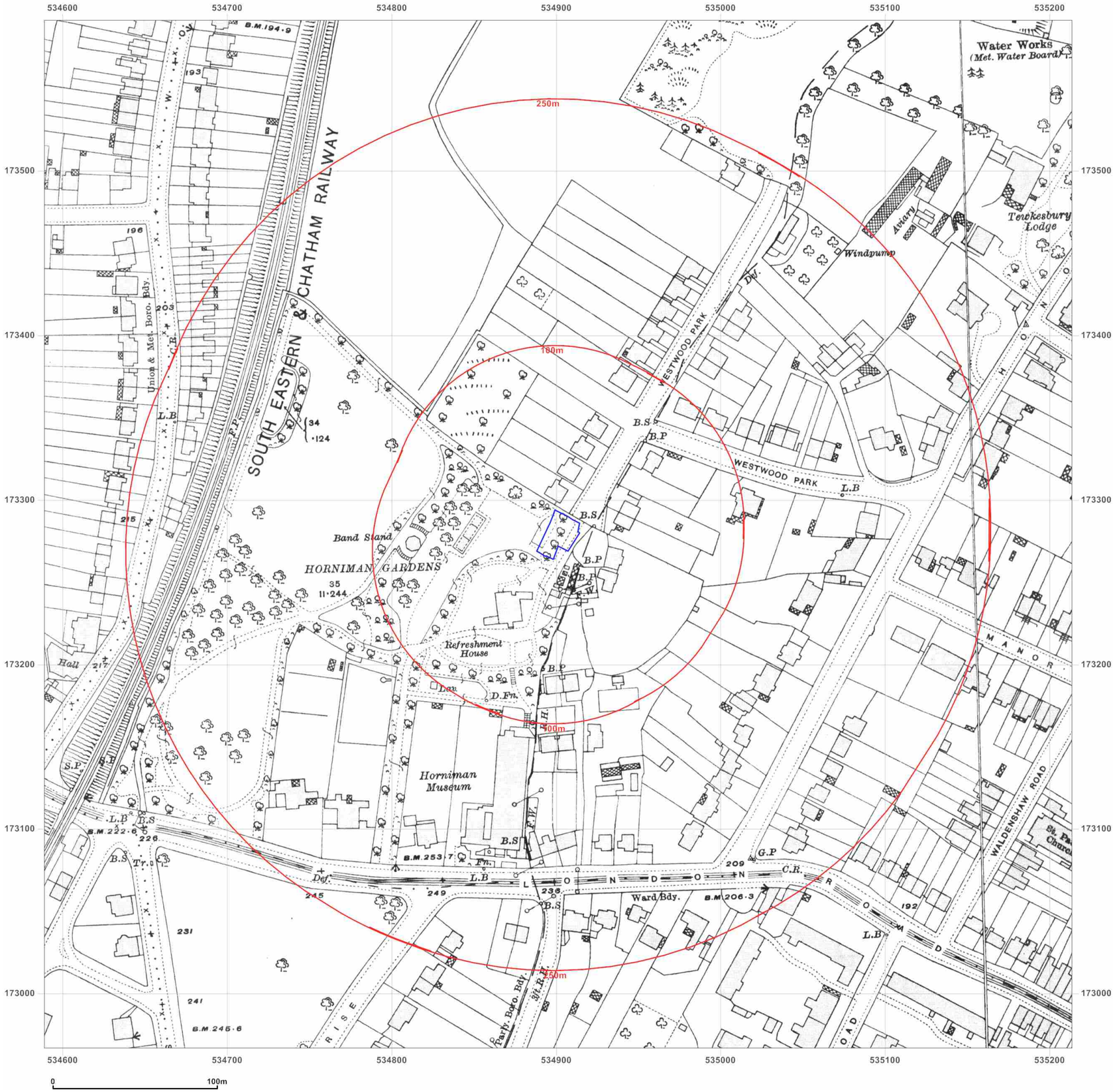

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series
Map date: **1916**
Scale: 1:2,500
Printed at: 1:2,500

N
W E
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Surveyed 1916
Revised 1916
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1916
Revised 1916
Edition N/A
Copyright N/A
Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1950-1951**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1951 Revised 1951 Edition N/A Copyright N/A Levelled 1934	Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled 1934

Surveyed 1951 Revised 1951 Edition N/A Copyright N/A Levelled 1934	Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled 1934

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1950-1951**

Scale: 1:2,500

Printed at: 1:2,500

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Surveyed 1951 Revised 1951 Edition N/A Copyright N/A Levelled N/A	Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled 1934
Surveyed 1951 Revised 1951 Edition N/A Copyright N/A Levelled 1934	Surveyed 1951 Revised 1951 Edition N/A Copyright N/A Levelled 1934

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1962-1964**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1950
Revised 1962
Edition N/A
Copyright 1962
Levelled 1954

Surveyed 1961 Revised 1961 Edition N/A Copyright 1962 Levelled 1954	Surveyed 1950 Revised 1963 Edition N/A Copyright 1964 Levelled 1954

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1972-1973**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1951
Revised 1971
Edition N/A
Copyright 1972
Levelled 1954

Surveyed 1950
Revised 1971
Edition N/A
Copyright 1972
Levelled 1954

Surveyed 1951
Revised 1972
Edition N/A
Copyright 1972
Levelled 1954

Surveyed 1950
Revised 1973
Edition N/A
Copyright 1973
Levelled 1954

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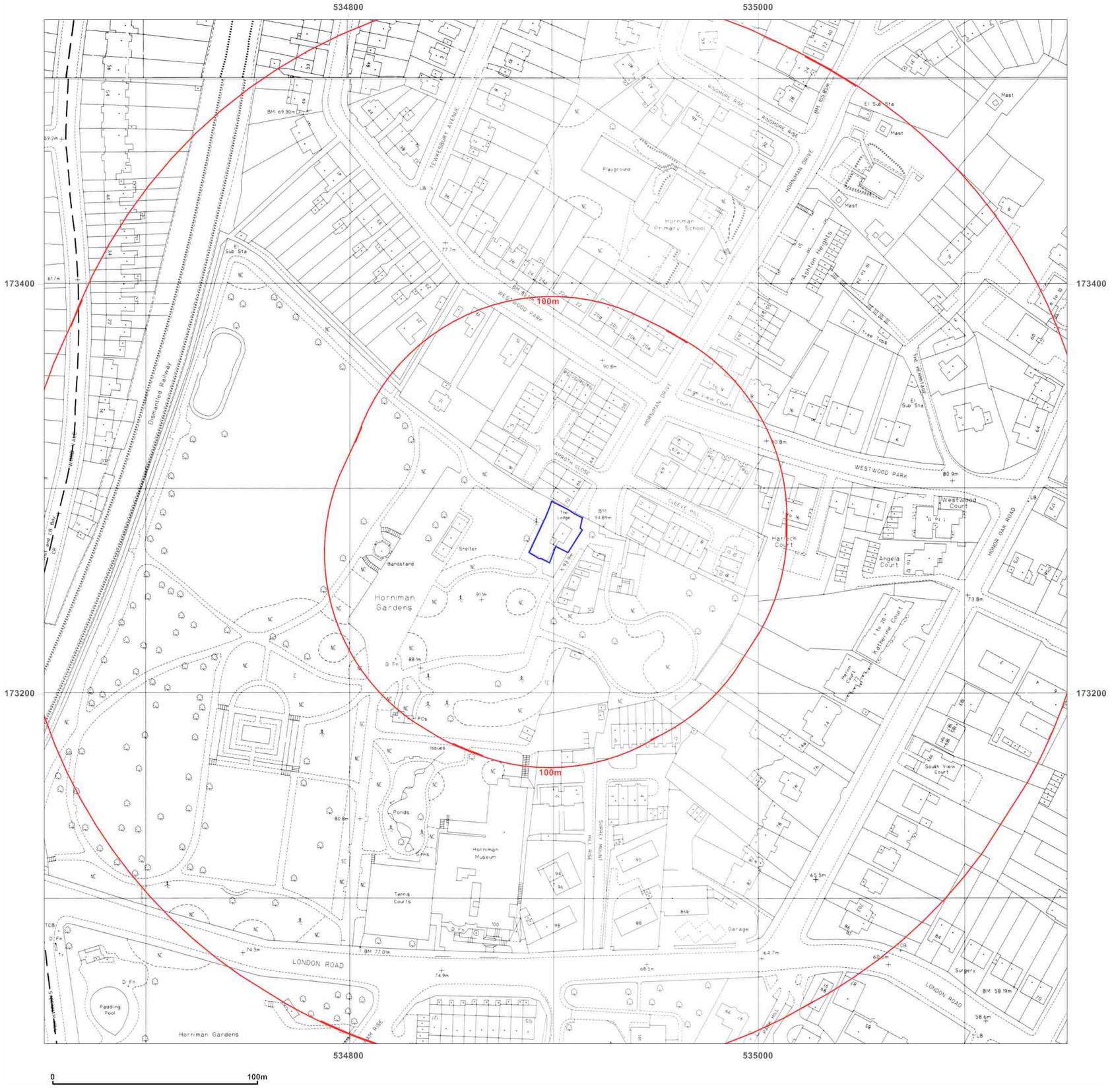

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid
Map date: **1991**
Scale: 1:1,250
Printed at: 1:2,000

N
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Surveyed N/A Revised N/A Edition N/A Copyright 1991 Levelled N/A	Surveyed 1991 Revised 1991 Edition N/A Copyright 1991 Levelled N/A
Surveyed 1991 Revised 1991 Edition N/A Copyright 1991 Levelled N/A	Surveyed 1991 Revised 1991 Edition N/A Copyright 1991 Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1988-1991**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1991
Revised 1991
Edition N/A
Copyright 1991
Levelled N/A

Surveyed 1977
Revised 1988
Edition N/A
Copyright 1988
Levelled 1977

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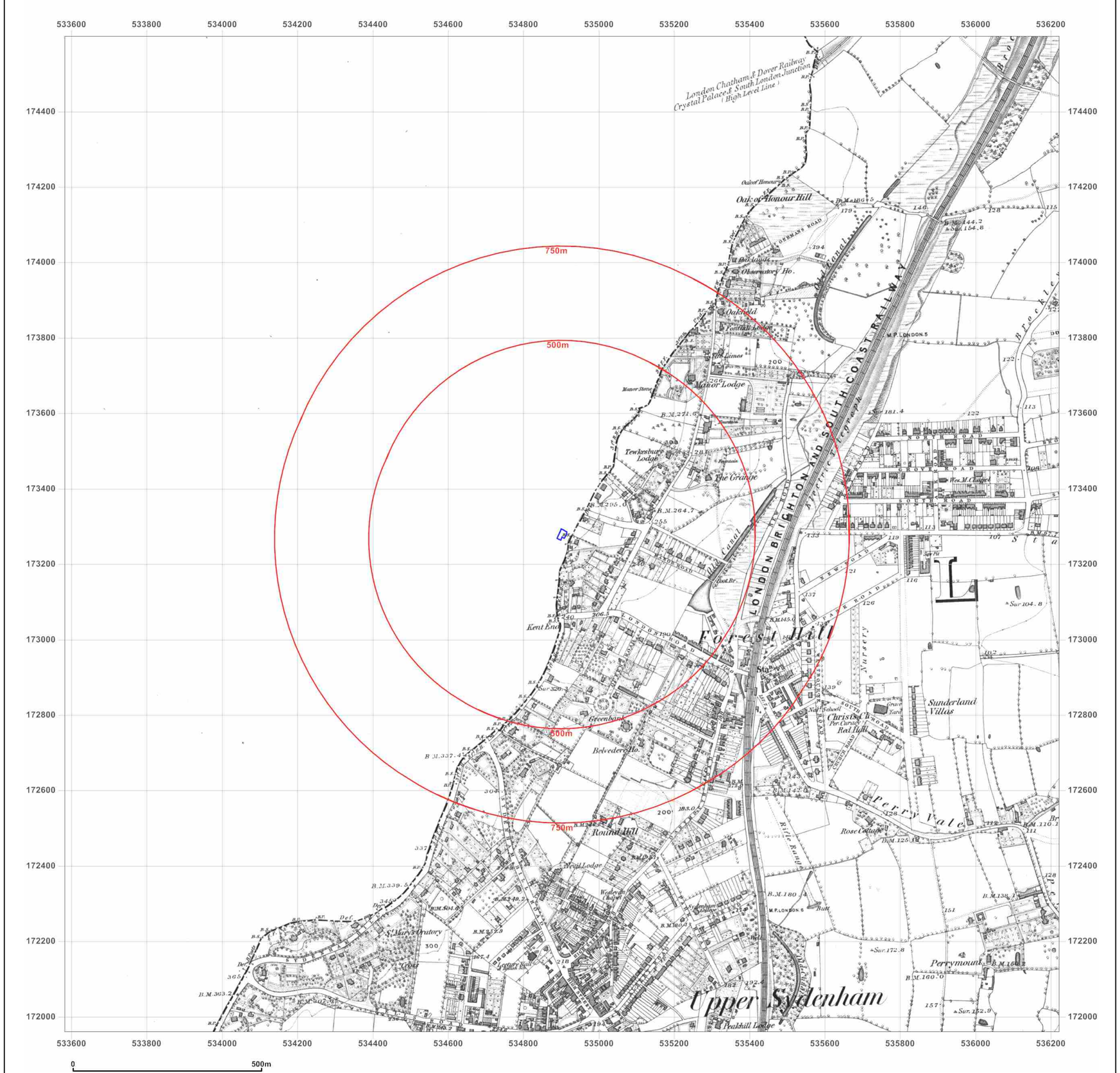

Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1863**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
S

Surveyed 1863
Revised 1863
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 September 2016

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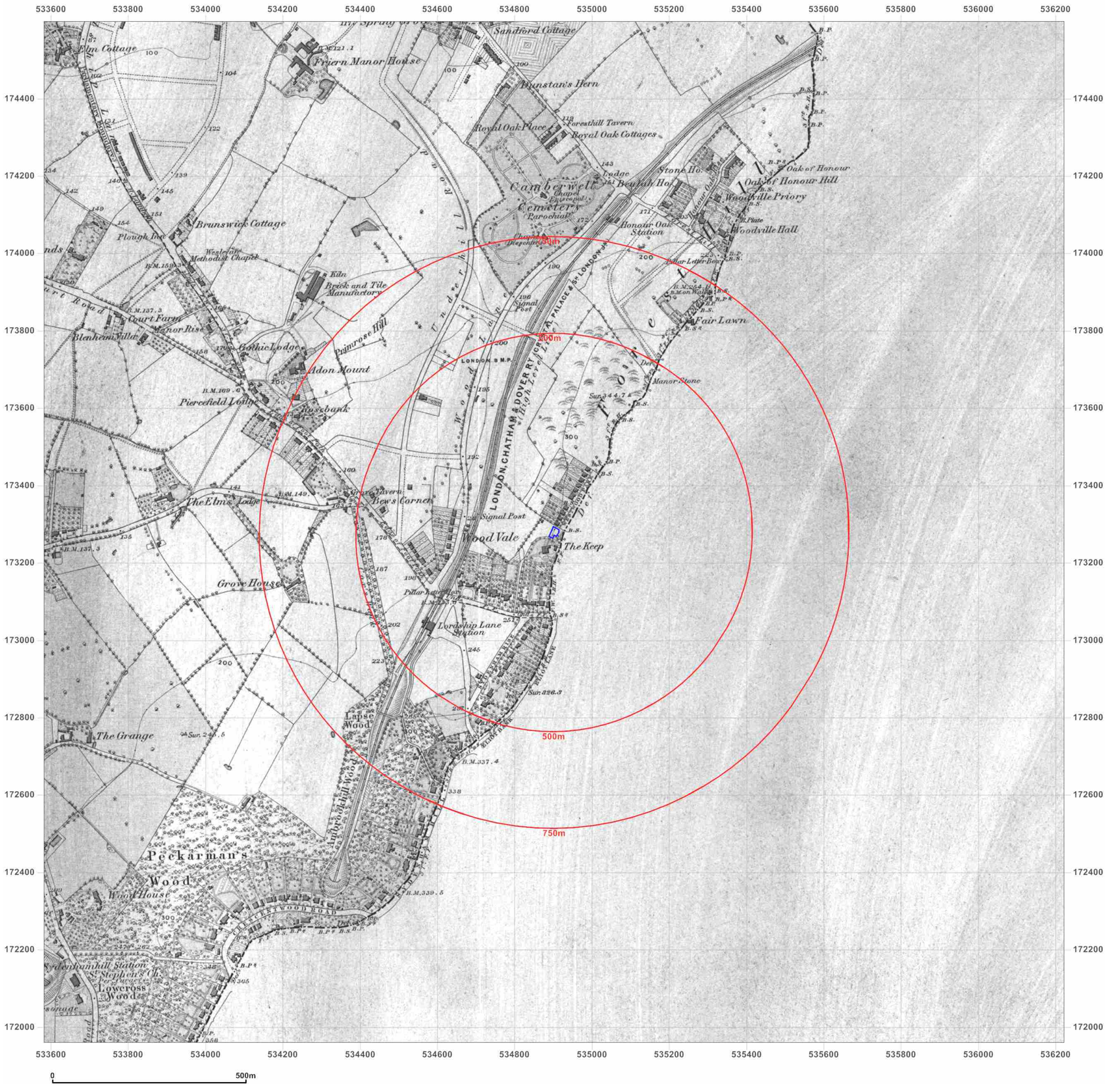

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1870**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
S

Surveyed 1870
Revised 1870
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 September 2016

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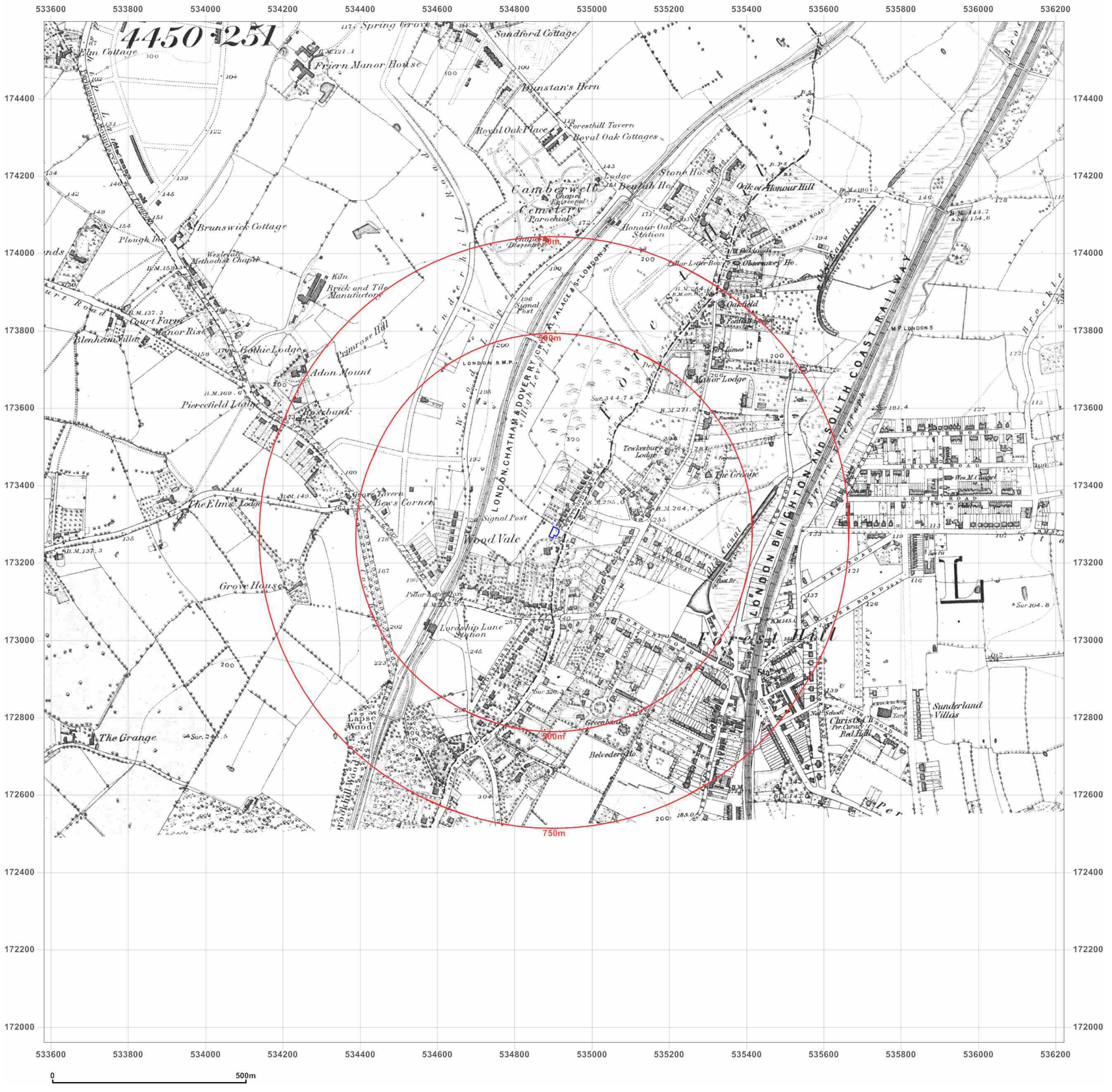

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1871**

Scale: 1:10,560

Printed at: 1:10,560

N
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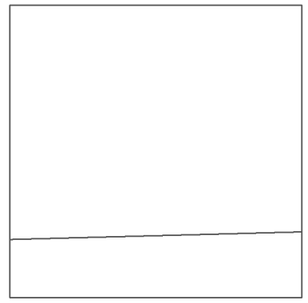
Surveyed 1871
Revised 1871
Edition N/A
Copyright N/A
Levelled N/A



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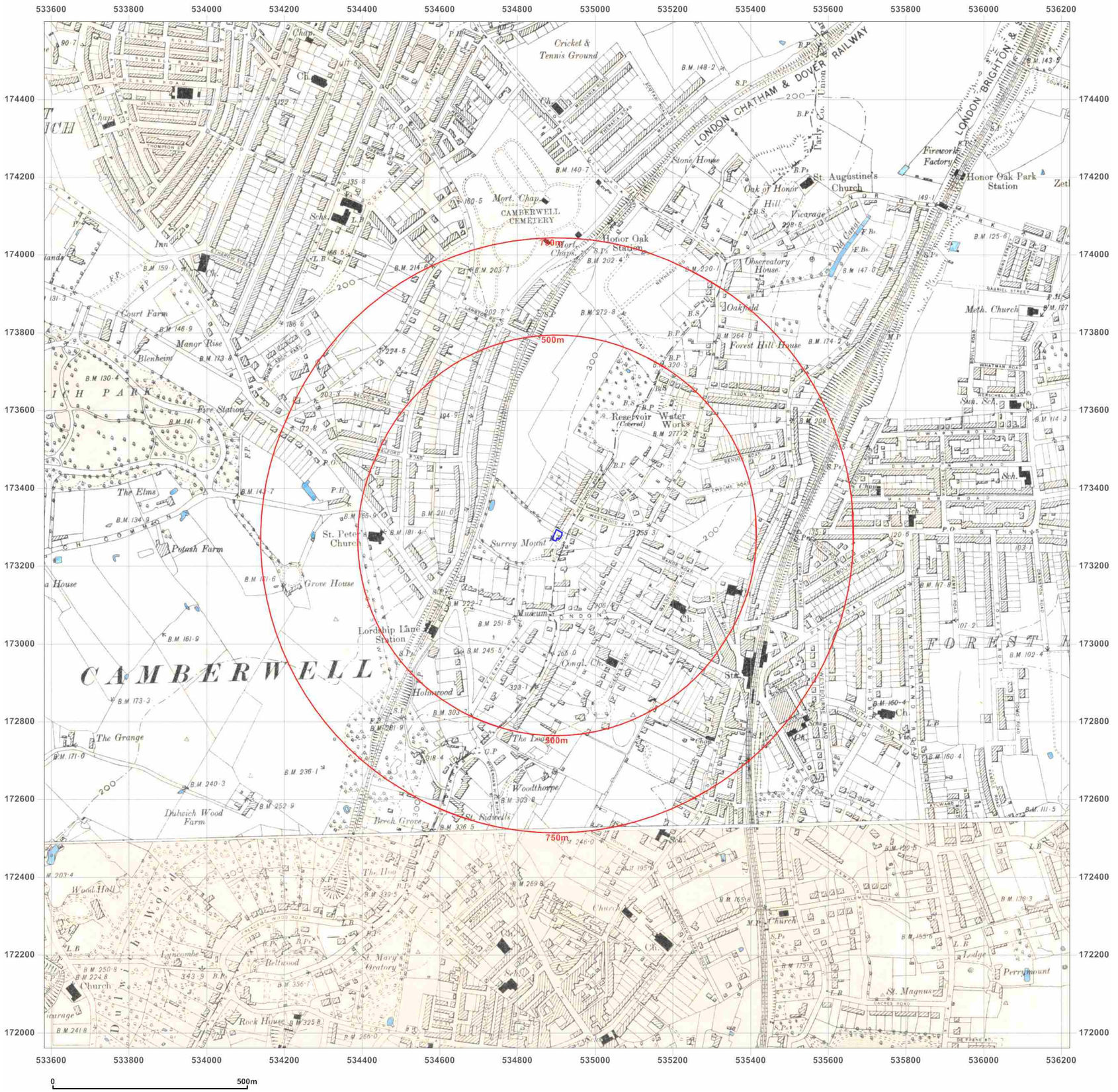

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1894**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1894
~~Revised 1894~~
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1894
Revised 1894
Edition N/A
Copyright N/A
Levelled N/A

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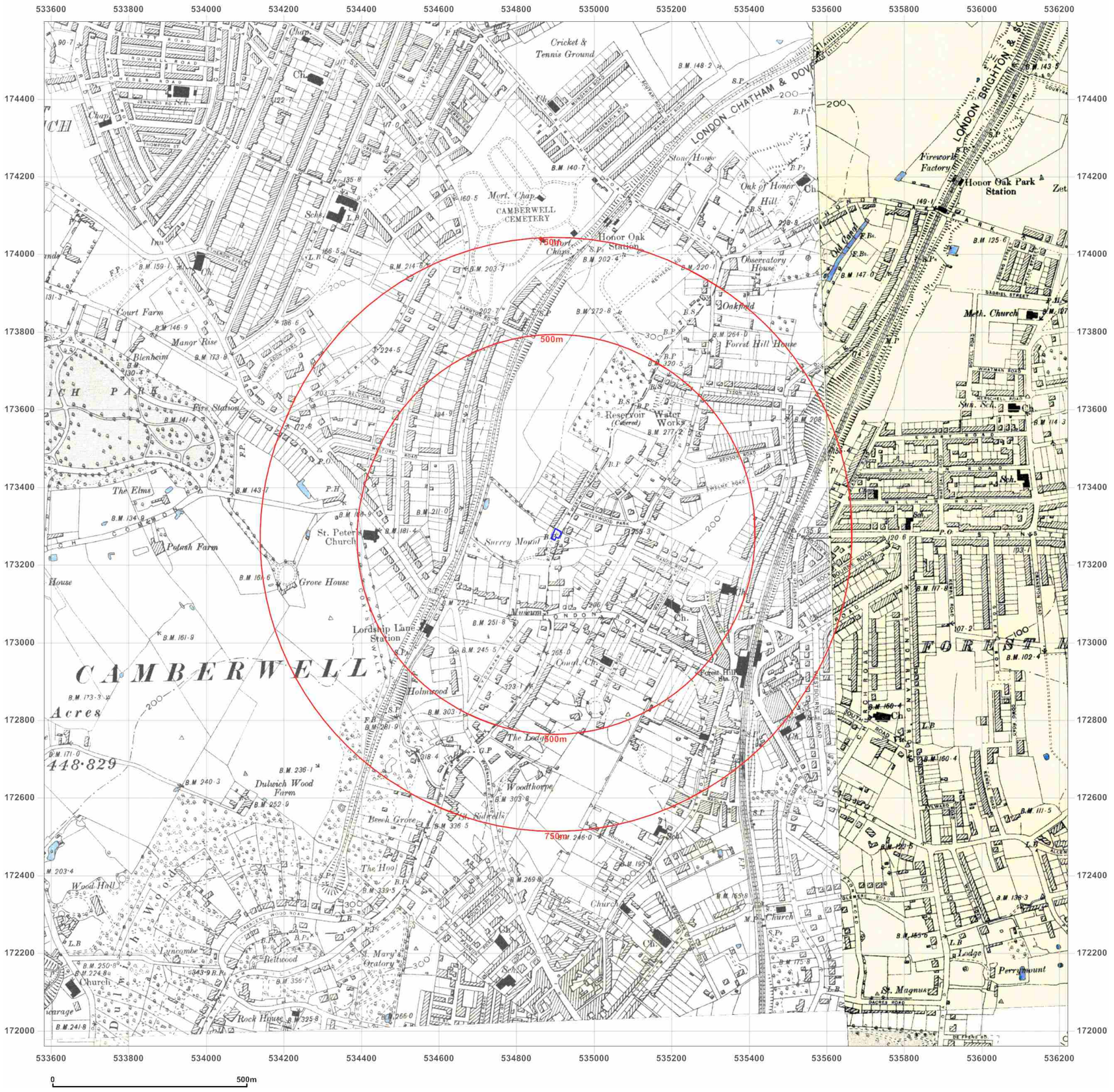

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1895-1898**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
S

Surveyed 1862
Revised 1898
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1861
Revised 1896
Edition 1898
Copyright N/A
Levelled N/A

Surveyed 1868
Revised 1894
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised 1895
Edition N/A
Copyright N/A
Levelled N/A

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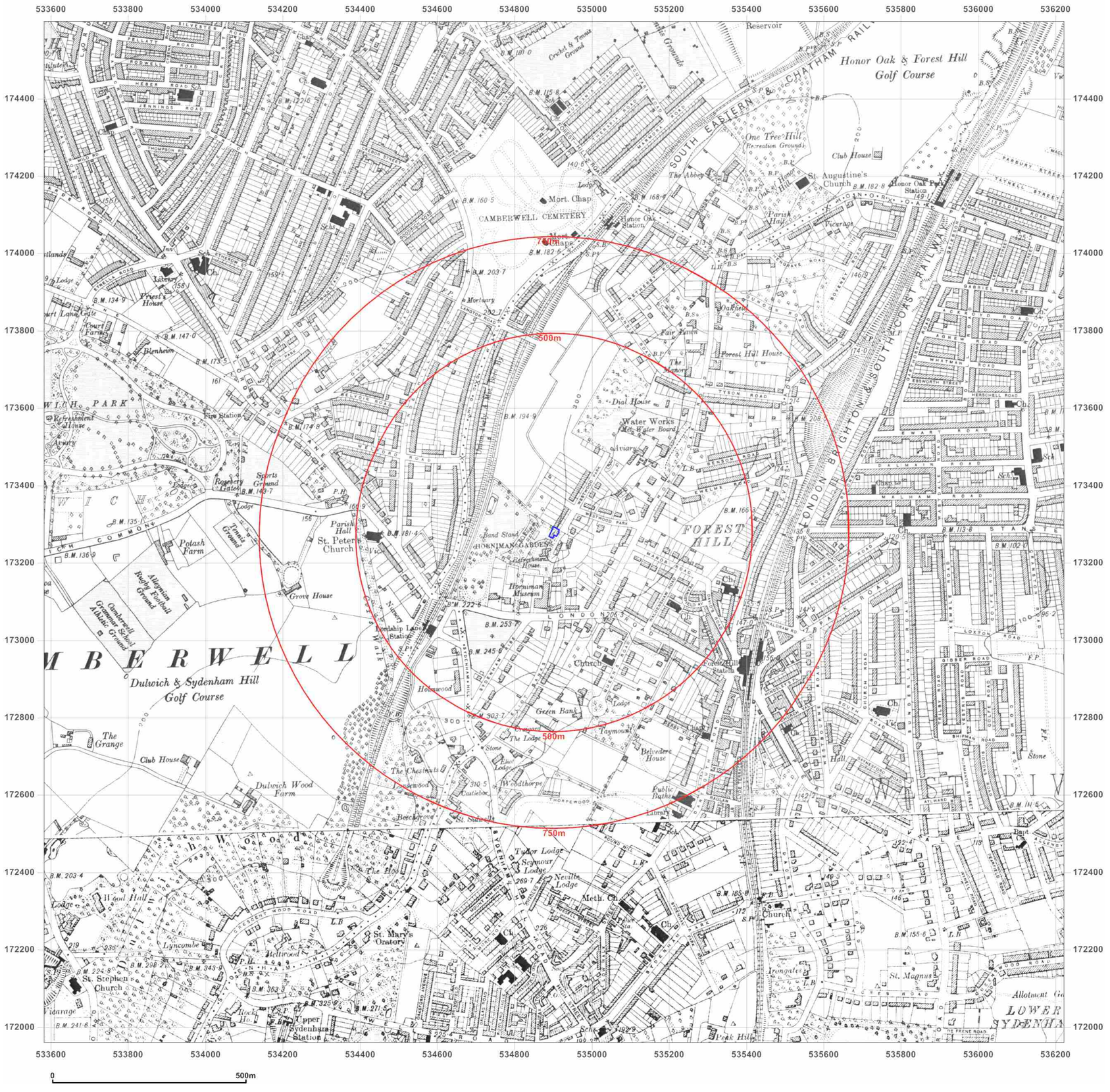

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1919-1920**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1870
Revised 1914
Edition 1920
Copyright N/A
Levelled N/A

Surveyed 1869
Revised 1919
Edition N/A
Copyright N/A
Levelled N/A

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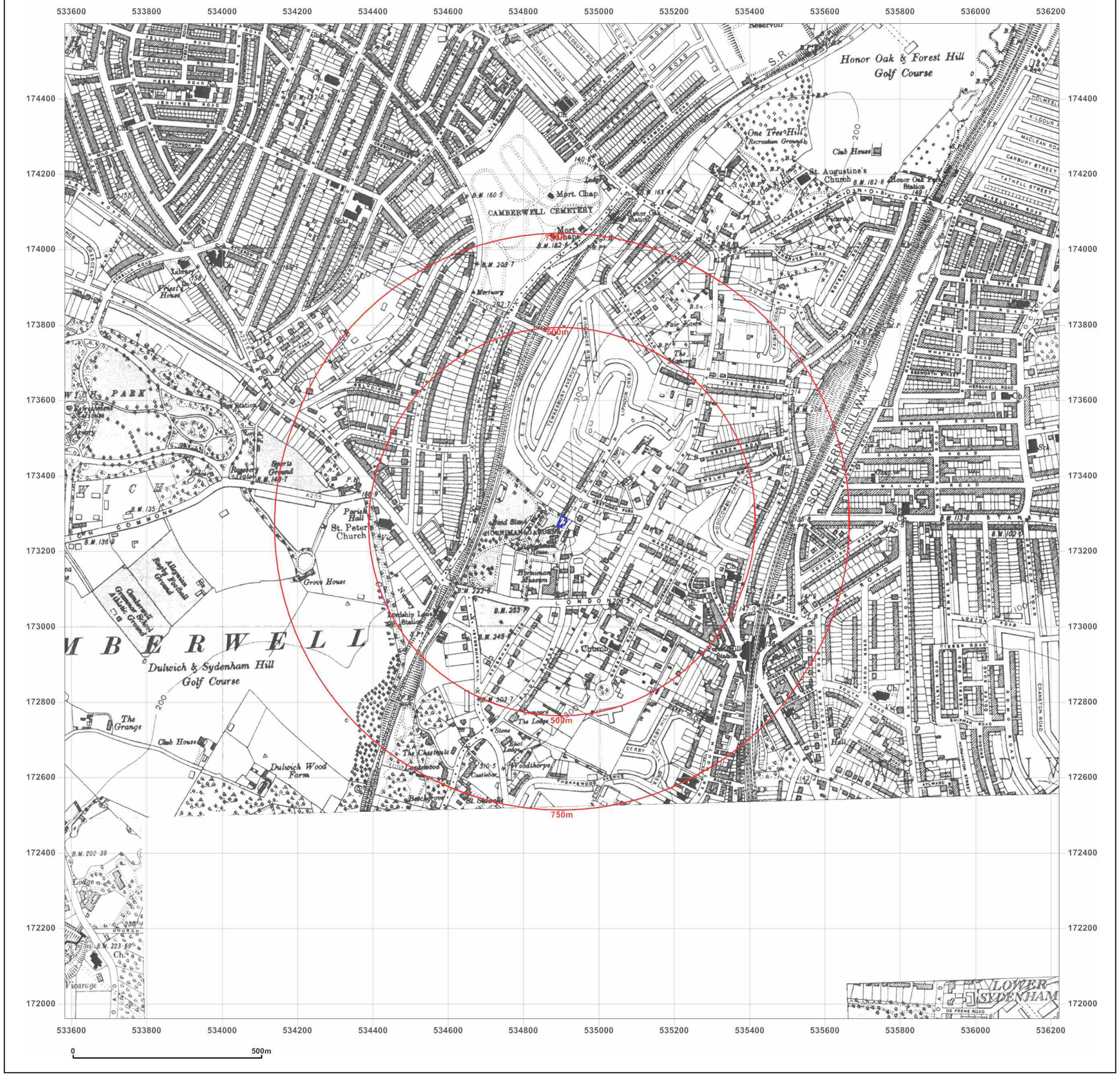

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Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: County Series

Map date: **1933-1938**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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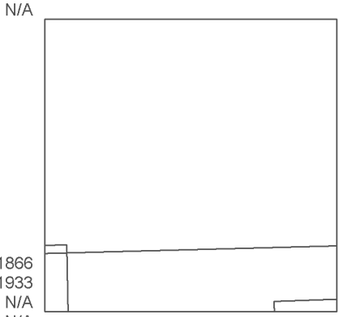
Surveyed 1870
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1866
Revised 1933
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1861
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

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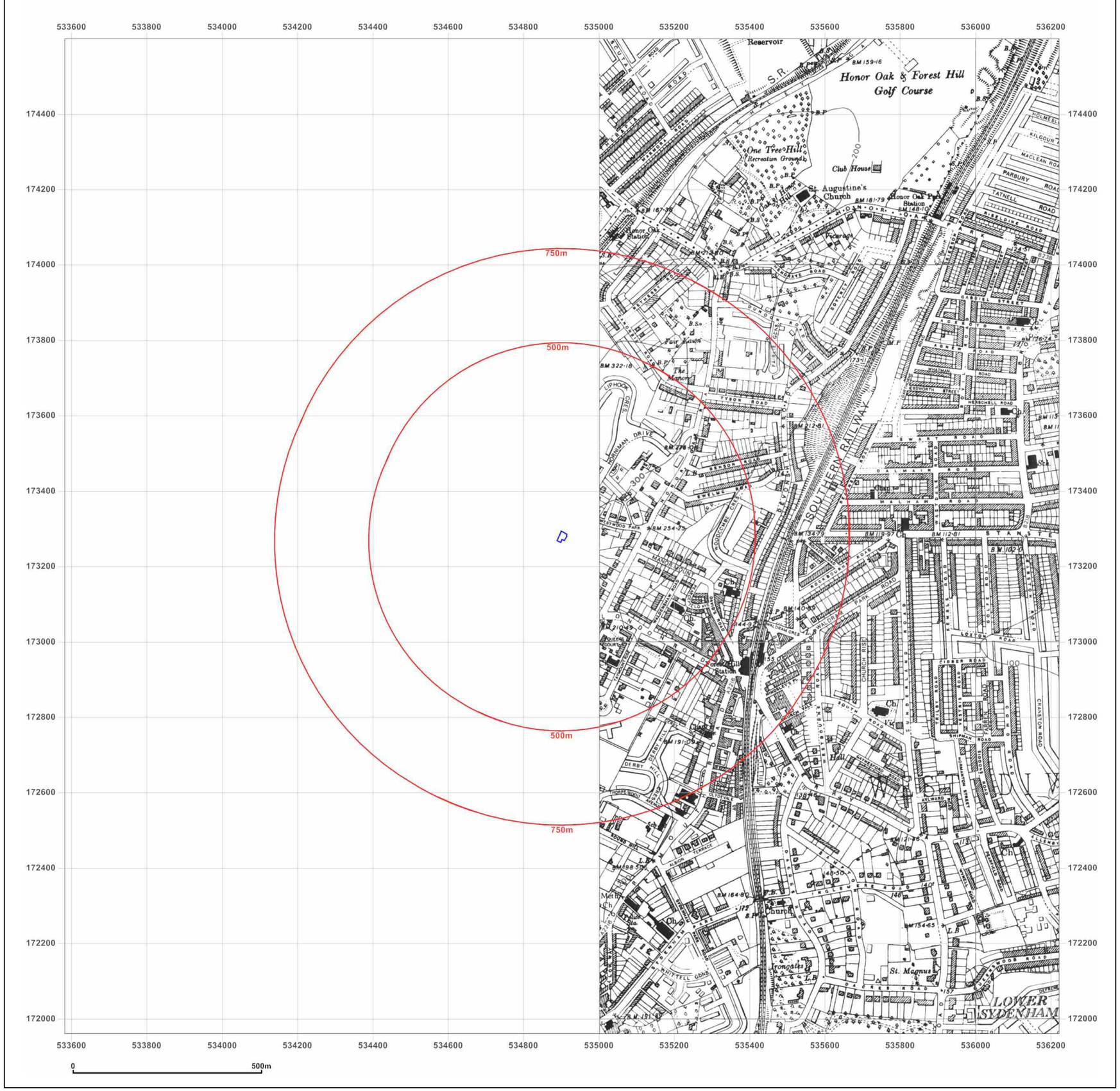

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: Provisional

Map date: **1948**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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Surveyed 1940
Revised 1948
Edition N/A
Copyright N/A
Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: Provisional
Map date: **1955**
Scale: 1:10,560
Printed at: 1:10,560

N
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Surveyed 1955
Revised 1955
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1955
Revised 1955
Edition N/A
Copyright N/A
Levelled N/A

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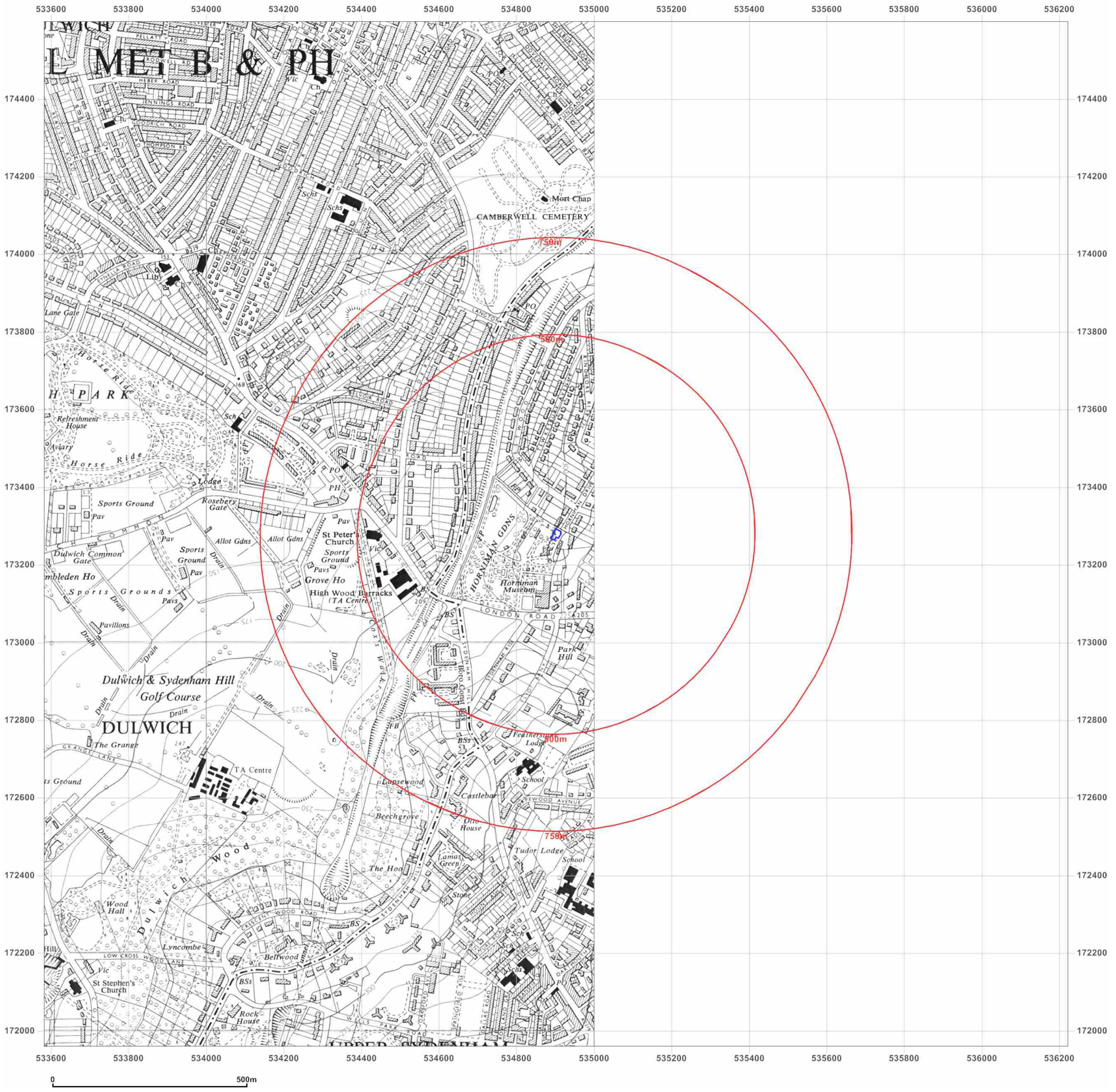

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Site Details:

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: Provisional

Map date: **1957**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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Surveyed 1957
Revised 1957
Edition N/A
Copyright N/A
Levelled N/A

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Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1966
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 September 2016

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Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1973-1974**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1973
Revised 1973
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1974
Revised 1974
Edition N/A
Copyright N/A
Levelled N/A

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Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 September 2016

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Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1982-1985**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1982
Revised 1982
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1984
Revised 1985
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 September 2016

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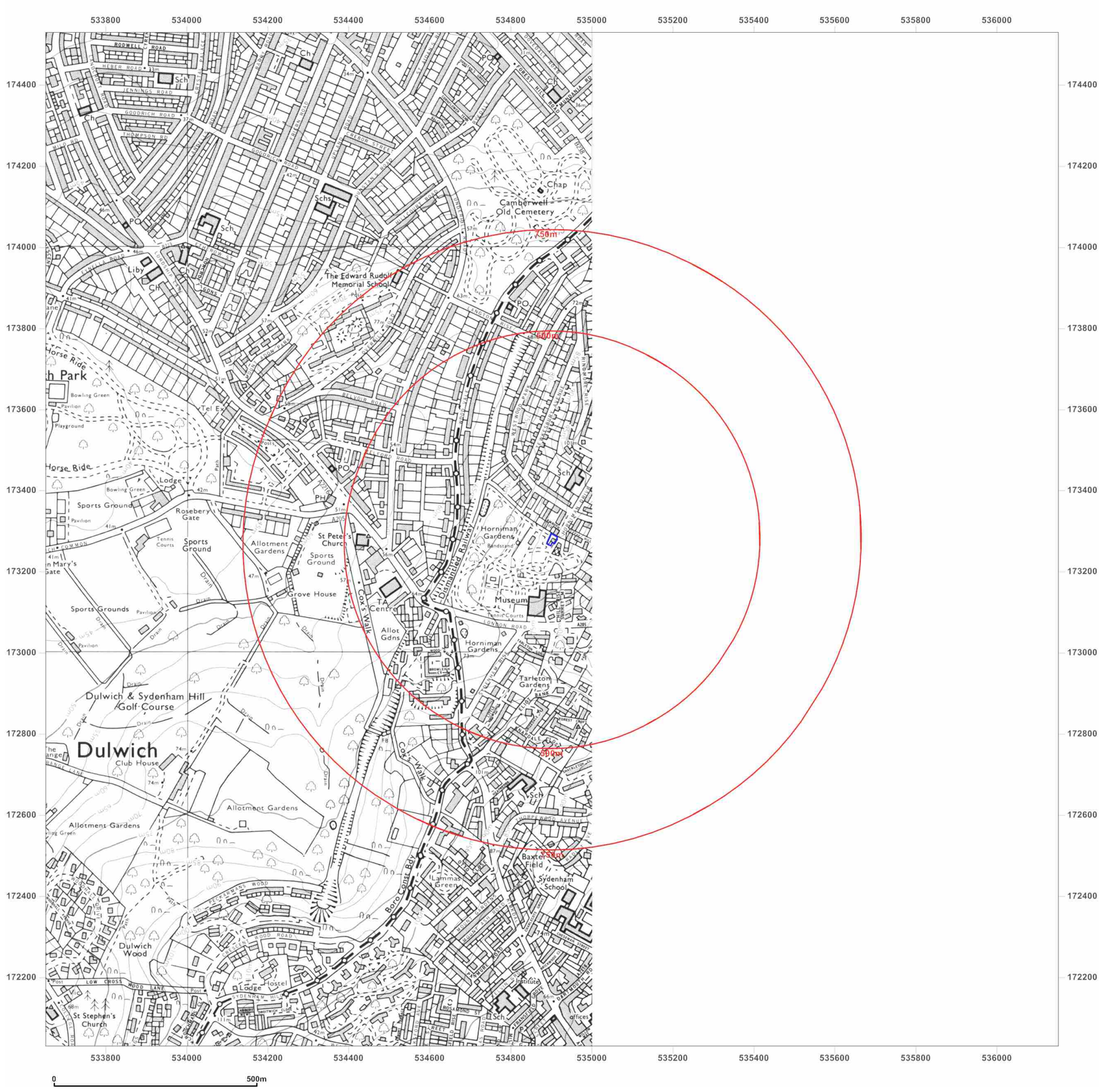

Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **1992**

Scale: 1:10,000

Printed at: 1:10,000

N
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S

Surveyed 1982
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 September 2016

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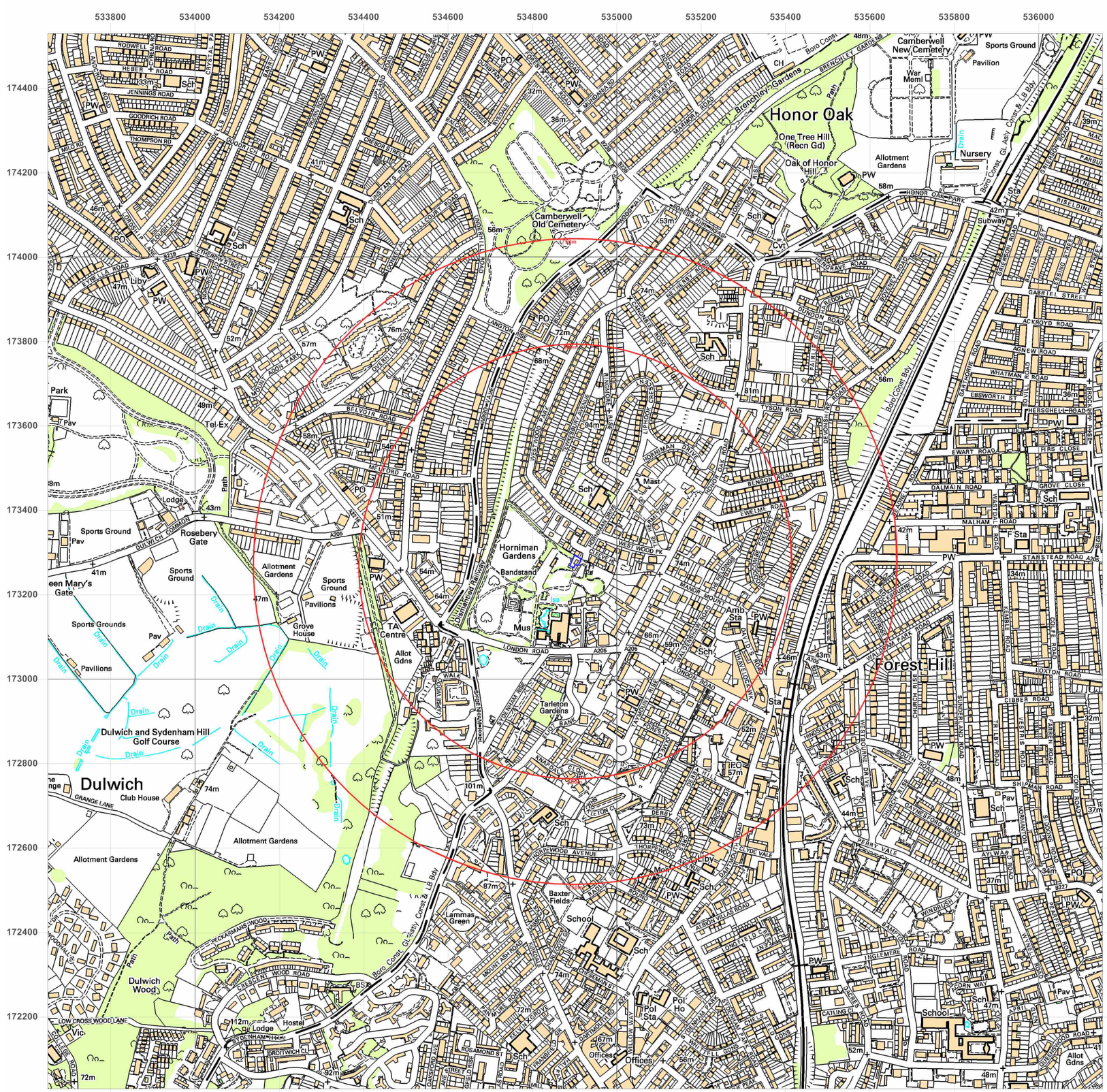

Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

N W E S

2002

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Production date: 19 September 2016

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Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N W E S

2010

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Production date: 19 September 2016

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Groundsure INSIGHTS

Site Details:

THE HORNIMAN MUSEUM & GARDENS, 100, LONDON ROAD, LONDON, SE23 3PQ

Client Ref: 5001510_-_601018
Report Ref: GS-3305271
Grid Ref: 534901, 173279

Map Name: National Grid

Map date: **2014**

Scale: 1:10,000

Printed at: 1:10,000

N
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2014

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Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 September 2016

To view map legend click here *Legend*

APPENDIX 3 – ENGINEERING LOGS

RIDGE Ridge and Partners LLP
Moorside Road, Winchester, SO23 7RX

BOREHOLE LOG

Project				BOREHOLE No
Horniman Museum				WS1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5001510	16-09-16 16-09-16			
Contractor				Sheet
DJ Drilling Ltd				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
						(0.40)	Soft dark brown silty CLAY with frequent rootlets and occasional fine angular brick fragments and flint. MADE GROUND		
						0.40			
0.50	ES1						Firm brown mottled grey CLAY		
0.60-1.00	U3								
1.00	ES2								
1.00		N9							
1.50-2.00	U4								
2.00-3.00	U5								
2.00		N11				(3.60)			
3.00-4.00	U6								
3.00		N12							
						4.00			
4.00		N16							

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:31.25	Client Horniman Museum	Method/ Plant Used Terrier Mk2	Logged By RP

Report ID: AGS4 UK BH || Project: 5001510 - HORNIMAN MUSEUM - SEP 2016.GPJ || Library: GINT STD AGS 4_0.GLB || Date: 27 September 2016

RIDGE Ridge and Partners LLP
Moorside Road, Winchester, SO23 7RX

BOREHOLE LOG

Project				BOREHOLE No
Horniman Museum				WS2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5001510	16-09-16 16-09-16			
Contractor				Sheet
DJ Drilling Ltd				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
						(0.50)	Soft dark brown silty CLAY with frequent rootlers and occasional fine sub angular red brick fragments and flint. MADE GROUND		
0.30	ES1					0.50			
0.60-1.00	U2					(1.00)	Firm brown mottled grey CLAY		
						1.50			
1.60		N10				(0.50)	Firm brown mottled grey silty sandy CLAY		
						2.00			
3.00-4.00	U3						Firm brown mottled grey CLAY		
3.00		N9				(2.60)			
4.00		N16							
						4.60			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:31.25	Client Horniman Museum	Method/ Plant Used Terrier Mk2	Logged By RP

RIDGE Ridge and Partners LLP
Moorside Road, Winchester, SO23 7RX

BOREHOLE LOG

Project				BOREHOLE No
Horniman Museum				WS3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
5001510	16-09-16 16-09-16			
Contractor				Sheet
DJ Drilling Ltd				1 of 1

SAMPLES & TESTS			Water	Reduced Level	Legend	Depth (Thick-ness)	STRATA DESCRIPTION	Geology	Instrument/ Backfill
Depth	Type No	Test Result							
0.30	ES1					(0.60) 0.60	Very stiff dark brown brown silty CLAY with frequent rootlets and occasional fine sub angular brick fragments and flint. MADE GROUND		
1.00-2.00 1.00	U2	N13				(3.90)	Firm brown mottled grey CLAY		
2.00-3.00 2.00	U3	N12							
3.00-4.00 3.00	U4	N13							
4.00		N16				4.50			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Depth	Date	Time	Casing Depth	Casing Dia. mm	Water Depth	From	To	Hours	From	To	

All dimensions in metres Scale 1:31.25	Client Horniman Museum	Method/ Plant Used Terrier Mk2	Logged By RP

APPENDIX 4 – CHEMICAL ANALYSIS RESULTS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

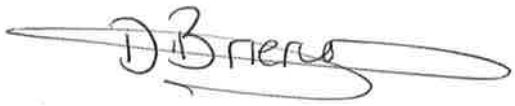
FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 16/05956
Issue Number: 1 **Date:** 26 September, 2016

Client:
Ridge and Partners Ltd
Partnership House
Moorside Road
Winchester
UK
SO23 7RX

Project Manager: Antony Platt
Project Name: Horniman
Project Ref: Not specified
Order No: 601051
Date Samples Received: 21/09/16
Date Instructions Received: 21/09/16
Date Analysis Completed: 26/09/16

Prepared by:



Danielle Brierley
Administrative Assistant

Approved by:

Iain Haslock
Analytical Consultant

UKAS TESTING
1247

Envirolab Job Number: 16/05956

Client Project Name: Horniman

Client Project Ref: Not specified

Lab Sample ID	16/05956/1	16/05956/2	16/05956/3	16/05956/4					Units	Method ref
Client Sample No										
Client Sample ID	WS1	WS1	WS2	WS3						
Depth to Top	0.50	1.00	0.30	0.30						
Depth To Bottom										
Date Sampled	16-Sep-16	16-Sep-16	16-Sep-16	16-Sep-16						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	6	3	3	2AE						
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A						

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

APPENDIX 5 – GEOTECHNIAL TEST CERTIFCATES

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
Telephone: (01424) 718618
Facsimile: (01424) 729911
info@elab-uk.co.uk

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number:	16-08845
Issue:	1
Date of Issue:	07/10/2016
Contact:	James Phaure
Customer Details:	K4 Soils Laboratory Ltd Unit 8 Watford HertfordshireWD18 9RU
Quotation No:	Q16-00568
Order No:	21619
Customer Reference:	21619_1
Date Received:	04/10/2016
Date Approved:	07/10/2016
Details:	Horniman Museum
Approved by:	

John Wilson, Operations Manager

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683

Sample Summary

Report No.: 16-08845

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
75275	WS01 U3 0.60	Not Provided	04/10/2016	Silty clayey loam	a
75276	WS01 U5 2.00	Not Provided	04/10/2016		a
75277	WS02 U2 0.60	Not Provided	04/10/2016	Silty clayey loam	a
75278	WS03 U2 1.00	Not Provided	04/10/2016	Silty clayey loam	a
75279	WS03 U4 3.00	Not Provided	04/10/2016		a

Results Summary

Report No.: 16-08845

			ELAB Reference	75275	75277	75278
			Customer Reference	U3	U2	U2
			Sample ID			
			Sample Type	SOIL	SOIL	SOIL
			Sample Location	WS01	WS02	WS03
			Sample Depth (m)	0.60	0.60	1.00
			Sampling Date	Not Provided	Not Provided	Not Provided
Determinand	**Codes**	**Units**	**LOD**			
Anions						
Water Soluble Chloride	M	mg/kg	40	81	86	107
Water Soluble Nitrate	M	mg/kg	40	< 40	< 40	44
Water Soluble Sulphate	M	g/l	0.02	0.08	1.11	2.36
Water Soluble Sulphate	M	mg/kg	40	121	2220	4720
Inorganics						
Ammonia as NH4	N	mg/kg	0.1	< 0.1	< 0.1	< 0.1
Total Sulphur	N	%	0.01	0.03	0.09	0.24
Acid Soluble Sulphate (SO4)	U	%	0.02	0.07	0.17	0.70
Miscellaneous						
Moisture Content	N	%	0.1	23.4	21.0	20.6
pH	M	pH units	0.1	7.9	7.9	7.9
Stones Content	N	%	0.1	26.2	< 0.1	< 0.1

Tests marked N are not UKAS accredited.

Method Summary

Report No.: 16-08845

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Ammonia in soil	N	As submitted sample	07/10/2016		
pH	M	Air dried sample	06/10/2016	113	Electromeric
Acid Soluble Sulphate	U	Air dried sample	07/10/2016	115	Ion Chromatography
Water soluble anions	M	Air dried sample	06/10/2016	172	Ion Chromatography
Total organic carbon/Total sulphur	N	Air dried sample	07/10/2016	216	IR

Tests marked N are not UKAS accredited

Report Information

Report No.: 16-08845

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis
Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
PCB congener results may include any coeluting PCBs
Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

Summary of Natural Moisture Content, Liquid Limit and Plastic Limit Results

Job No.	Project Name	Programme	
21619	Horniman Museum	Samples received	21/09/2016
		Schedule received	22/09/2016
Project No.	Client	Project started	22/09/2016
-	Ridge and Partners	Testing Started	05/10/2016

Hole No.	Sample				Soil Description	NMC	Passing 425µm	LL	PL	PI	Remarks
	Ref	Top	Base	Type		%	%	%	%	%	
WS01	3	0.60	1.00	U	Medium strength dark brown and light brown slightly gravelly slightly sandy silty CLAY with occasional fm brick and wood fragments and fine rootlets (gravel is fm and sub-angular)	25	98	63	25	38	
WS01	5	2.00	3.00	U	High strength brown slightly mottled bluish grey silty CLAY with occasional orange brown sand partings	35	100	75	32	43	
WS02	2	0.60	1.00	U	Medium strength brown slightly mottled bluish grey silty CLAY	36	100	81	34	47	
WS03	2	1.00	2.00	U	Medium strength brown silty CLAY with scattered traces of selenite	34	100	80	31	49	
WS03	4	3.00	4.00	U	High strength brown silty CLAY	32	100	82	31	51	

Test Methods: BS1377: Part 2: 1990:
Natural Moisture Content : clause 3.2
Atterberg Limits: clause 4.3 and 5.0

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU

Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved

Initials **J.P**

Date: 06/10/2016

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	21619
				Borehole/Pit No.	WS01
Site Name	Horniman Museum			Sample No.	3
Project No.	-	Client	Ridge and Partners	Depth	0.60 m
Soil Description	Medium strength dark brown and light brown slightly gravelly slightly sandy silty CLAY with occasional fm brick and wood fragments and fine rootlets (gravel is fm and sub-angular)			Sample Type	U
				Samples received	21/09/2016
				Schedules received	22/09/2016
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	04/10/2016

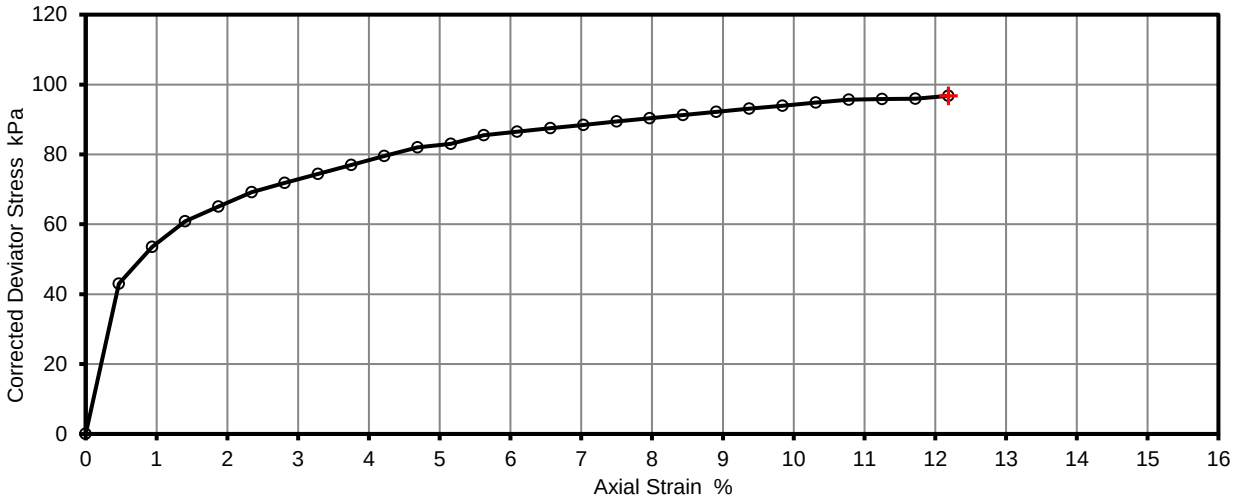
Remarks

Disturbed

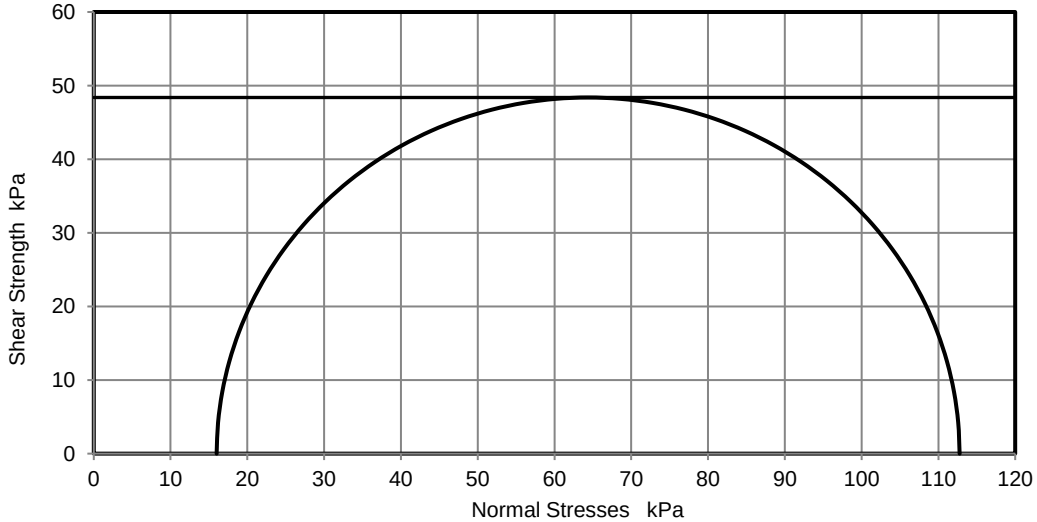
Position within sample

Test Number	1	
Length	160.0	mm
Diameter	80.0	mm
Bulk Density	2.04	Mg/m3
Moisture Content	33	%
Dry Density	1.54	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	16	kPa
Axial Strain	12.2	%
Deviator Stress, (σ1 - σ3)f	97	kPa
Undrained Shear Strength, cu	48	kPa ½(σ1 - σ3)f
Mode of Failure	Compound	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

Checked and Approved
Initials: J.P
Date 06/10/2016

UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	21619
				Borehole/Pit No.	WS01
Site Name	Horniman Museum			Sample No.	5
Project No.	-	Client	Ridge and Partners	Depth	2.00 m
Soil Description	High strength brown slightly mottled bluish grey silty CLAY with occasional orange brown sand partings			Sample Type	U
				Samples received	21/09/2016
				Schedules received	22/09/2016
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	04/10/2016

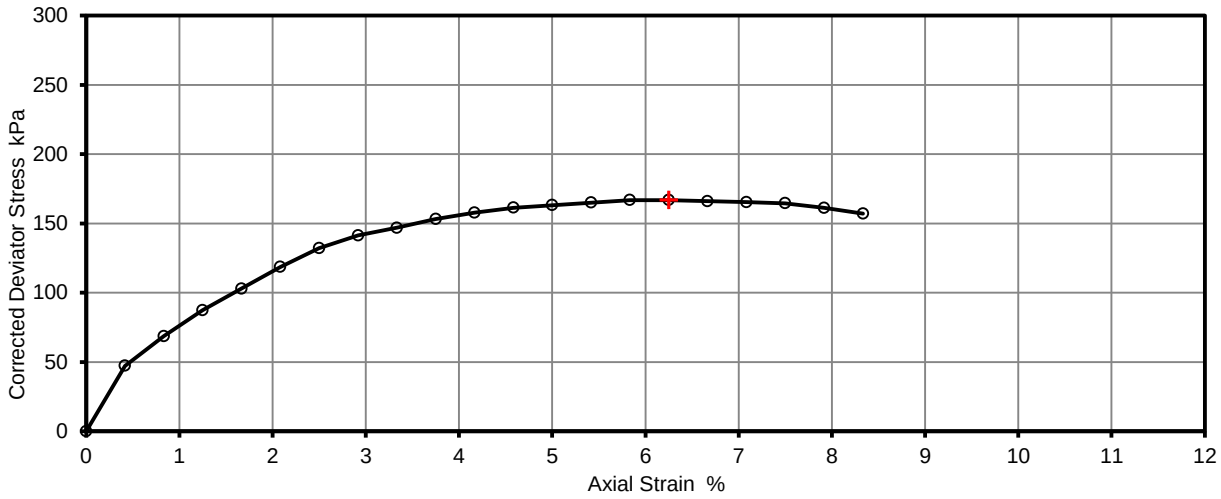
Remarks

Disturbed

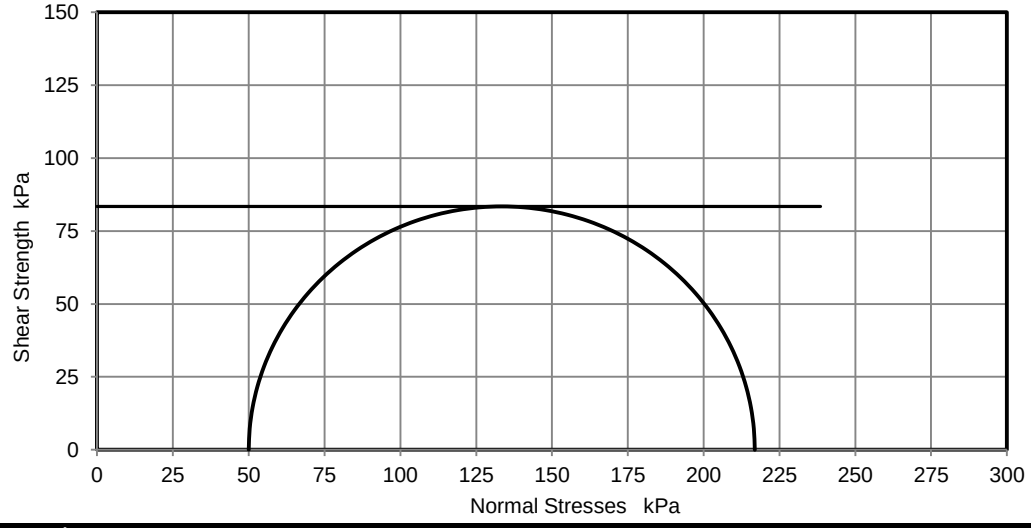
Position within sample

Test Number	1	
Length	120.0	mm
Diameter	60.0	mm
Bulk Density	2.14	Mg/m3
Moisture Content	35	%
Dry Density	1.59	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	50	kPa
Axial Strain	6.3	%
Deviator Stress, (σ1 - σ3)f	167	kPa
Undrained Shear Strength, cu	83	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Checked and Approved
Initials: J.P
Date 06/10/2016

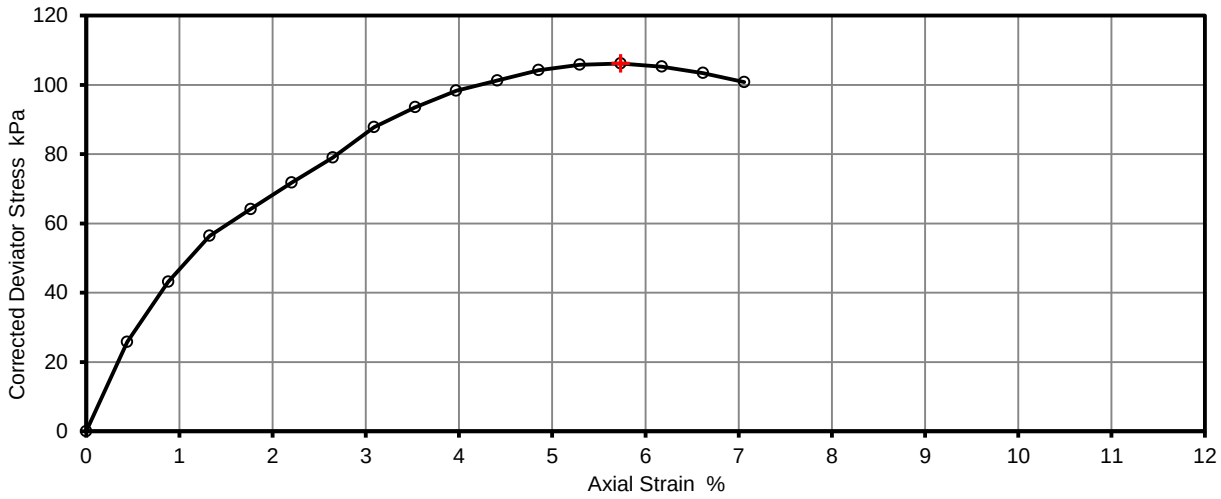
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	21619	
				Borehole/Pit No.	WS02	
Site Name	Horniman Museum			Sample No.	2	
Project No.	-	Client	Ridge and Partners	Depth	0.60	m
Soil Description	Medium strength brown slightly mottled bluish grey silty CLAY			Sample Type	U	
				Samples received	21/09/2016	
				Schedules received	22/09/2016	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	04/10/2016	

Remarks

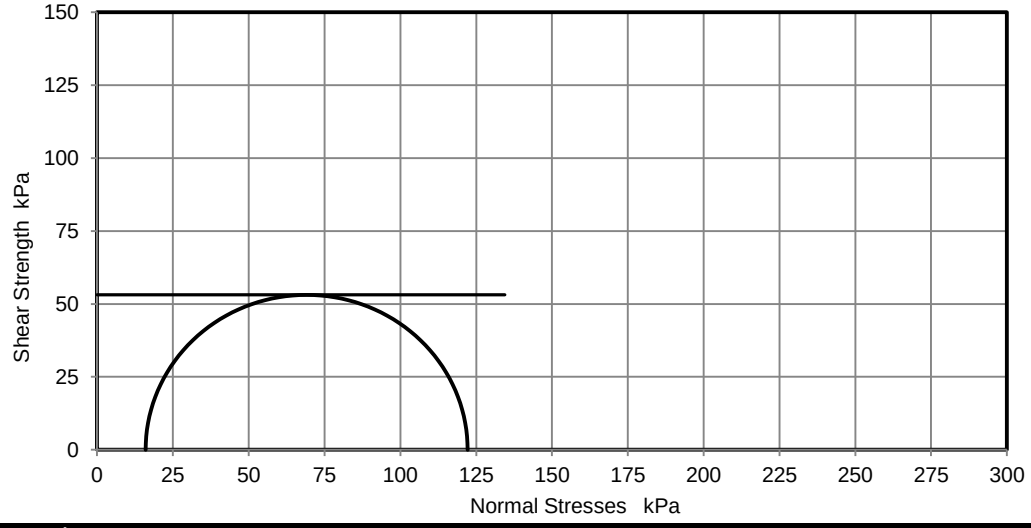
Position within sample

Test Number	1	
Length	170.0	mm
Diameter	85.0	mm
Bulk Density	1.92	Mg/m3
Moisture Content	35	%
Dry Density	1.42	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	16	kPa
Axial Strain	5.7	%
Deviator Stress, (σ1 - σ3)f	106	kPa
Undrained Shear Strength, cu	53	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Test Report by K4 SOILS LABORATORY
Unit 8 Olds Close Olds Approach
Watford Herts WD18 9RU
Tel: 01923 711 288
Email: James@k4soils.com

UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Checked and Approved
Initials: J.P
Date 06/10/2016

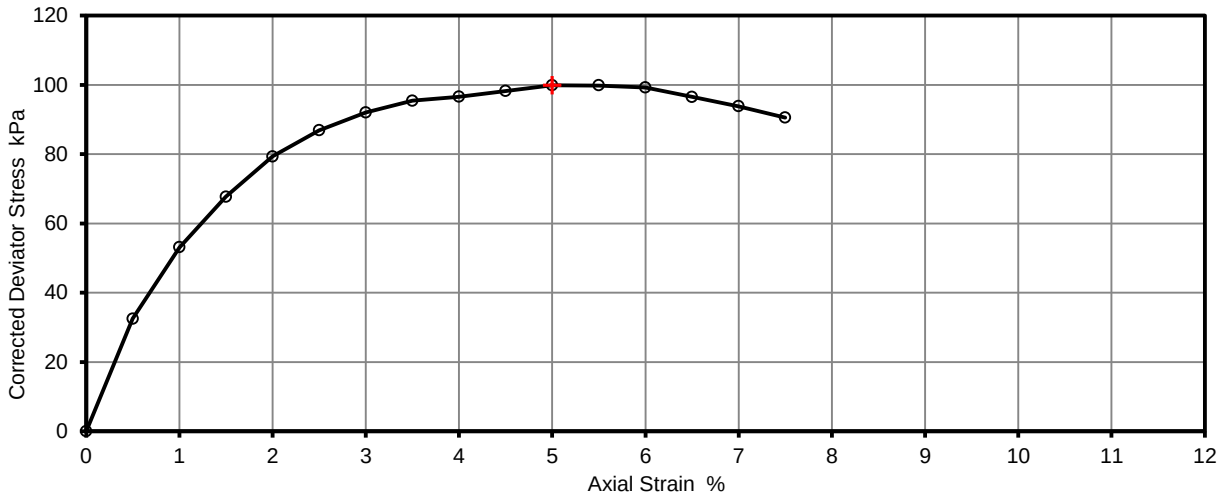
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	21619
				Borehole/Pit No.	WS03
Site Name	Horniman Museum			Sample No.	2
Project No.	-	Client	Ridge and Partners	Depth	1.00 m
Soil Description	Medium strength brown silty CLAY with scattered traces of selenite			Sample Type	U
				Samples received	21/09/2016
				Schedules received	22/09/2016
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	04/10/2016

Remarks

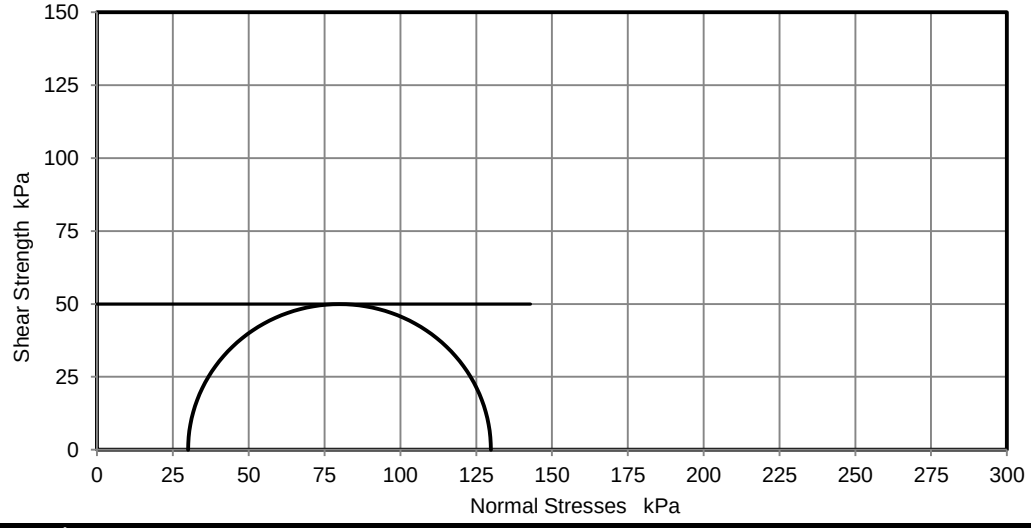
Position within sample

Test Number	1	
Length	150.0	mm
Diameter	75.0	mm
Bulk Density	1.89	Mg/m3
Moisture Content	32	%
Dry Density	1.43	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	30	kPa
Axial Strain	5.0	%
Deviator Stress, (σ1 - σ3)f	100	kPa
Undrained Shear Strength, cu	50	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

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Date 06/10/2016

UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

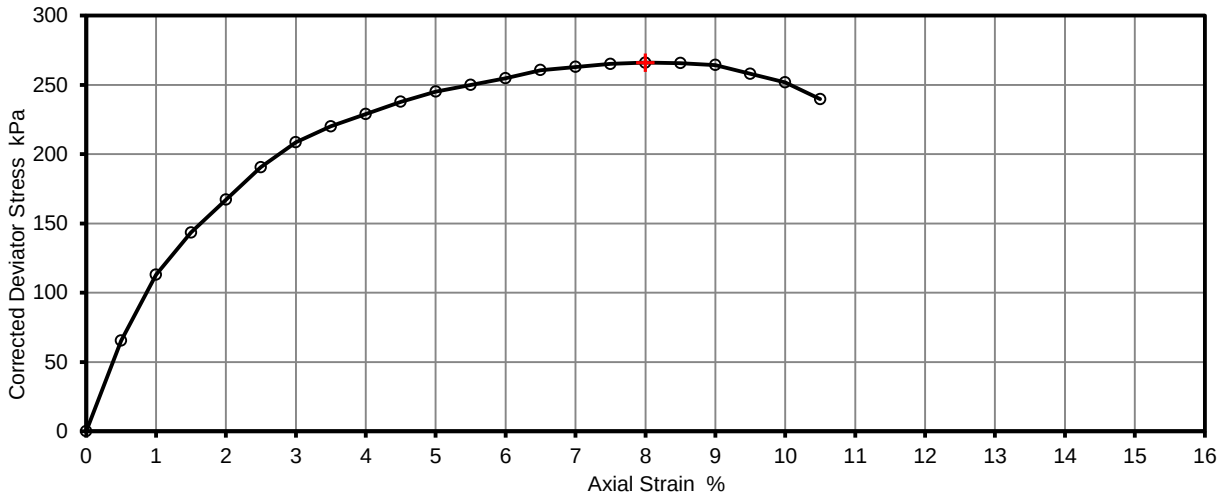
	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen			Job Ref	21619
				Borehole/Pit No.	WS03
Site Name	Horniman Museum			Sample No.	4
Project No.	-	Client	Ridge and Partners	Depth	3.00 m
Soil Description	High strength brown silty CLAY			Sample Type	U
				Samples received	21/09/2016
				Schedules received	22/09/2016
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	04/10/2016

Remarks

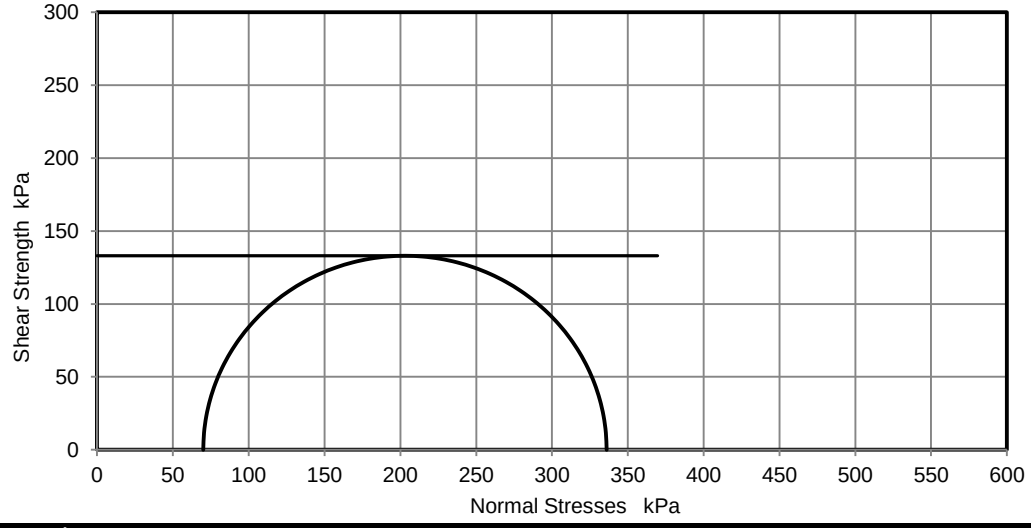
Position within sample

Test Number	1	
Length	100.0	mm
Diameter	50.0	mm
Bulk Density	2.13	Mg/m3
Moisture Content	28	%
Dry Density	1.66	Mg/m3
Rate of Strain	2.0	%/min
Cell Pressure	70	kPa
Axial Strain	8.0	%
Deviator Stress, (σ1 - σ3)f	266	kPa
Undrained Shear Strength, cu	133	kPa ½(σ1 - σ3)f
Mode of Failure	Brittle	

Deviator Stress v Axial Strain



Mohr Circles



Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Test Report by K4 SOILS LABORATORY
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UKAS TESTING 2519

Approved Signatories: K.Phaure (Tech.Mgr) J.Phaure (Lab.Mgr)

Checked and Approved
Initials: J.P
Date 06/10/2016

Unconsolidated Undrained Triaxial Compression tests without measurement of pore pressure
Summary of Results

Tests carried out in accordance with BS1377:Part 7 : 1990 clause 8 or 9 as appropriate to test

Job No.	Project Name	Programme	
21619	Horniman Museum	Samples received	21/09/2016
		Schedule received	22/09/2016
Project No.	Client	Project started	22/09/2016
-	Ridge and Partners	Testing Started	04/10/2016

Hole No.	Sample				Soil Description	Test Type	Density		*w*	Length	Diameter	σ3	At failure				Remarks
	Ref	Top	Base	Type			bulk	dry					Axial strain	σ1 - σ3	cu	Mode	
							Mg/m3		%	mm	mm	kPa	%	kPa	kPa		
WS01	3	0.60	1.00	U	Medium strength dark brown and light brown slightly gravelly slightly sandy silty CLAY with occasional fm brick and wood fragments and fine rootlets (gravel is fm and sub-	UU	2.04	1.54	33	160	80	16	12.2	97	48	C	Disturbed
WS01	5	2.00	3.00	U	High strength brown slightly mottled bluish grey silty CLAY with occasional orange brown sand partings	UU	2.14	1.59	35	120	60	50	6.3	167	83	B	Disturbed
WS02	2	0.60	1.00	U	Medium strength brown slightly mottled bluish grey silty CLAY	UU	1.92	1.42	35	170	85	16	5.7	106	53	B	
WS03	2	1.00	2.00	U	Medium strength brown silty CLAY with scattered traces of selenite	UU	1.89	1.43	32	150	75	30	5	100	50	B	
WS03	4	3.00	4.00	U	High strength brown silty CLAY	UU	2.13	1.66	28	100	50	70	8	266	133	B	

Legend				Mode of failure ;	
	UU - single stage test (single and multiple specimens)	σ3	Cell pressure		B - Brittle
	UUM - Multistage test on a single specimen	σ1 - σ3	Maximum corrected deviator stress		P - Plastic
	suffix R - remoulded or recompacted	cu	Undrained shear strength, ½ (σ1 - σ3)		C - Compound

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APPENDIX 6 – FOUNDATION CALCULATION SHEETS

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk	
	Shallow Foundation				
	Determination of Bearing Resistance	Calcs by	DF	Checked by	RP

Design Approach 1

Ground Model 1
Strip Foundation

Combination 1 A1 + M1 + R1

Material Properties and Resistance

Partial factors set M1: $\gamma_{cu} = 1$ $\gamma_{\phi} = 1$ and $\gamma_c = 1$

$$c_{ud} = \frac{c_{uk}}{\gamma_{cu}} = \quad 55\text{kN/m}^2$$

Design shearing resistance is $\phi_d = \tan^{-1}\left(\frac{\tan\phi_K}{\gamma_\phi}\right) =$ 21°

Design cohesision is $c'_d = \frac{c_k}{\gamma_c} =$ 0kN/m^2

Drained Bearing Capacity Factors

For overburden $N_q = \left[e^{(\pi\times\tan(\phi_d))}\times\left(\tan\left(45+\frac{\phi_d}{2}\right)\right)^2\right] =$ 7.08

For cohesion $N_c = \left[(N_q - 1)\times\cot(\phi_d)\right] =$ 15.84

For self-weight $N_\gamma = \left[2(N_q - 1)\times\tan(\phi_d)\right] =$ 4.67

Depth and Shape Factors

Solgado's depth factor for undrained loading: $d_C = 1 + 0.27\sqrt{\frac{d}{B}} =$ 1.31

Ignore depth factors for drained loading

Solgado's shape factor for undrained loading: $s_c = 1 + 0.17\sqrt{\frac{d}{B}} =$ 1.2

Shape factors are all 1.0 for drained loading and so can be ignored

Undrained Bearing Resitance

Total overburden at foundation base is $\sigma_{vk,b} = \gamma_k \times d =$ 19kN/m^2

Partial factors set R1: $\gamma_{Rv} = 1$

Ultimate resistance is $q_{ult} = (\pi + 2)\times c_{ud}\times d_c \times s_c + \sigma_{vk,b} =$ 464kN/m^2

Design Resistance is $q_{Rd} = \frac{q_{ult}}{\gamma_{Rv}} =$ 464kN/m^2

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk	
	Shallow Foundation				
	Determination of Bearing Resistance	Calcs by	DF	Checked by	

Drained Bearing Resistance Strip Foundation

Groundwater at 1.50mbgl

Effective overburden at foundation base is $\sigma'_{vk,b} = \sigma_{vk,b} - u_{k,b} =$ 19kN/m^2

From overburden $q'_{ult_1} = N_q \times \sigma'_{wk,b} =$ 134kN/m^2

From cohesion $q'_{ult_2} = N_C \times c'_d =$ 0kN/m^2

From self-weight $q'_{ult_3} = \left[N_\gamma \times (\gamma_k - \gamma_w) \times \frac{B}{2} \right] =$ 33kN/m^2

Total resistance is $q'_{ult} = \sum_{i=1}^{3}$ $q'_{ult} =$ 167kN/m^2

Design resistance is $q'_{Rd} = \frac{q'_{ult}}{\gamma_{Rv}} =$ 167kN/m^2

Design Approach 1

Combination 2 A2 + M2 + R1

Material Properties and Resistance

Partial factors set M2: $\gamma_{cu} = 1.4$ $\gamma_\phi = 1.25$ and $\gamma_c = 1.25$

Design undrained strength is $c_{ud} = \frac{c_{uk}}{\gamma_{cu}} =$ 39kN/m^2

Design shearing resistance is $\phi_d = \tan^{-1}\left(\frac{\tan \phi_K}{\gamma_\phi} \right) =$ 17

Design cohesision is $c'_d = \frac{c_k}{\gamma_c} =$ 0kN/m^2

Drained Bearing Capacity Factors

For overburden $N_q = \left[e^{(\pi \times \tan(\phi_d))} \times \left(\tan\left(45 + \frac{\phi_d}{2} \right) \right)^2 \right] =$ 4.78

For cohesion $N_c = \left[(N_q - 1) \times \cot(\phi_d) \right] =$ 12.36

For self-weight $N_\gamma = \left[2(N_q - 1) \times \tan(\phi_d) \right] =$ 2.31

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk
	Shallow Foundation			
	Determination of Bearing Resistance	Calcs by	DF	Checked by

Depth and Shape Factors Strip Foundation

Solgado's depth factor for undrained loading: $d_C = 1 + 0.27\sqrt{\frac{d}{B}} =$ 1.31

Ignore depth factors for drained loading

Solgado's shape factor for undrained loading: $s_c = 1 + 0.17\sqrt{\frac{d}{B}} =$ 1.2

Shape factors are all 1.0 for drained loading and so can be ignored

Undrained Bearing Resitance

Total overburden at foundation base is $\sigma_{vk,b} = \gamma_k \times d =$ 19kN/m^2

Partial factors set R1: $\gamma_{Rv} = 1$

Ultimate resistance is $q_{ult} = (\pi + 2) \times c_{ud} \times d_c \times s_c + \sigma_{vk,b} =$ 334kN/m^2

Design Resistance is $q_{Rd} = \frac{q_{ult}}{\gamma_{Rv}} =$ 334kN/m^2

Drained Bearing Resistance

Effective overburden at foundation base is $\sigma'_{vk,b} = \sigma_{vk,b} - u_{k,b} =$ 19kN/m^2

From overburden $q'_{ult_1} = N_q \times \sigma'_{wk,b} =$ 91kN/m^2

From cohesion $q'_{ult_2} = N_C \times c'_d =$ 0kN/m^2

From self-weight $q'_{ult_3} = \left[N_\gamma \times (\gamma_k - \gamma_w) \times \frac{B}{2} \right]$ 16kN/m^2

Total resistance is $q'_{ult} = \sum_{i=1}^{3}$ $q'_{ult} =$ 107kN/m^2

Design Resistance is $q'_{Rd} = \frac{q'_{ult}}{\gamma_{Rv}} =$ 107kN/m^2

Design Approach	Combination	Design Resistance ULS (kN/m^2)	
		undrained	drained
DA1	Combination 1	464	167
	Combination 2	334	107

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk	
	Shallow Foundation				
	Determination of Bearing Resistance	Calcs by	DF	Checked by	RP

Design Approach 1

Ground Model 1
Pad Foundation

Combination 1 A1 + M1 + R1

Material Properties and Resistance

Partial factors set M1: $\gamma_{cu} = 1$ $\gamma_{\phi} = 1$ and $\gamma_c = 1$

$$c_{ud} = \frac{c_{uk}}{\gamma_{cu}} = \quad 55\text{kN/m}^2$$

Design shearing resistance is $\phi_d = \tan^{-1}\left(\frac{\tan\phi_K}{\gamma_\phi}\right) =$ 21°

Design cohesision is $c'_d = \frac{c_k}{\gamma_c} =$ 0kN/m²

Drained Bearing Capacity Factors

For overburden $N_q = \left[e^{(\pi\times\tan(\phi_d))}\times\left(\tan\left(45+\frac{\phi_d}{2}\right)\right)^2\right] =$ 7.08

For cohesion $N_c = \left[(N_q - 1)\times\cot(\phi_d)\right] =$ 15.84

For self-weight $N_\gamma = \left[2(N_q - 1)\times\tan(\phi_d)\right] =$ 4.67

Depth and Shape Factors

Solgado's depth factor for undrained loading: $d_C = 1 + 0.27\sqrt{\frac{d}{B}} =$ 1.27

Ignore depth factors for drained loading

Solgado's shape factor for undrained loading: $s_c = 1 + 0.17\sqrt{\frac{d}{B}} =$ 1.17

Shape factors are all 1.0 for drained loading and so can be ignored

Undrained Bearing Resitance

Total overburden at foundation base is $\sigma_{vk,b} = \gamma_k \times d =$ 19kN/m²

Partial factors set R1: $\gamma_{Rv} = 1$

Ultimate resistance is $q_{ult} = (\pi + 2)\times c_{ud}\times d_c \times s_c + \sigma_{vk,b} =$ 439kN/m²

Design Resistance is $q_{Rd} = \frac{q_{ult}}{\gamma_{Rv}} =$ 439kN/m²

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk	
	Shallow Foundation				
	Determination of Bearing Resistance	Calcs by	DF	Checked by	

Drained Bearing Resistance Pad Foundation

Groundwater at 1.50mbgl

Effective overburden at foundation base is $\sigma'_{vk,b} = \sigma_{vk,b} - u_{k,b} =$ 19kN/m²

From overburden $q'_{ult_1} = N_q \times \sigma'_{wk,b} =$ 134kN/m²

From cohesion $q'_{ult_2} = N_C \times c'_d =$ 0kN/m²

From self-weight $q'_{ult_3} = \left[N_\gamma \times (\gamma_k - \gamma_w) \times \frac{B}{2} \right] =$ 44kN/m²

Total resistance is $q'_{ult} = \sum_{i=1}^{3}$ $q'_{ult} =$ 178kN/m²

Design resistance is $q'_{Rd} = \frac{q'_{ult}}{\gamma_{Rv}} =$ 178kN/m²

Design Approach 1

Combination 2 A2 + M2 + R1

Material Properties and Resistance

Partial factors set M2: γ_{cu} = 1.4 γ_ϕ = 1.25 and γ_c = 1.25

Design undrained strength is $c_{ud} = \frac{c_{uk}}{\gamma_{cu}} =$ 39kN/m²

Design shearing resistance is $\phi_d = \tan^{-1}\left(\frac{\tan \phi_K}{\gamma_\phi} \right) =$ 17

Design cohesision is $c'_d = \frac{c_k}{\gamma_c} =$ 0kN/m²

Drained Bearing Capacity Factors

For overburden $N_q = \left[e^{(\pi \times \tan(\phi_d))} \times \left(\tan\left(45 + \frac{\phi_d}{2} \right) \right)^2 \right] =$ 4.78

For cohesion $N_c = \left[(N_q - 1) \times \cot(\phi_d) \right] =$ 12.36

For self-weight $N_\gamma = \left[2(N_q - 1) \times \tan(\phi_d) \right] =$ 2.31

Project	Horniman Butterfly House			RIDGE www.ridge.co.uk
	Shallow Foundation			
	Determination of Bearing Resistance	Calcs by	DF	Checked by

Depth and Shape Factors Pad Foundation

Solgado's depth factor for undrained loading: $d_C = 1 + 0.27\sqrt{\frac{d}{B}} =$ 1.27

Ignore depth factors for drained loading

Solgado's shape factor for undrained loading: $s_c = 1 + 0.17\sqrt{\frac{d}{B}} =$ 1.17

Shape factors are all 1.0 for drained loading and so can be ignored

Undrained Bearing Resitance

Total overburden at foundation base is $\sigma_{vk,b} = \gamma_k \times d =$ 19kN/m^2

Partial factors set R1: $\gamma_{Rv} = 1$

Ultimate resistance is $q_{ult} = (\pi + 2) \times c_{ud} \times d_c \times s_c + \sigma_{vk,b} =$ 317kN/m^2

Design Resistance is $q_{Rd} = \frac{q_{ult}}{\gamma_{Rv}} =$ 317kN/m^2

Drained Bearing Resistance

Effective overburden at foundation base is $\sigma'_{vk,b} = \sigma_{vk,b} - u_{k,b} =$ 19kN/m^2

From overburden $q'_{ult_1} = N_q \times \sigma'_{wk,b} =$ 91kN/m^2

From cohesion $q'_{ult_2} = N_C \times c'_d =$ 0kN/m^2

From self-weight $q'_{ult_3} = \left[N_\gamma \times (\gamma_k - \gamma_w) \times \frac{B}{2} \right]$ 22kN/m^2

Total resistance is $q'_{ult} = \sum_{i=1}^{3}$ $q'_{ult} =$ 113kN/m^2

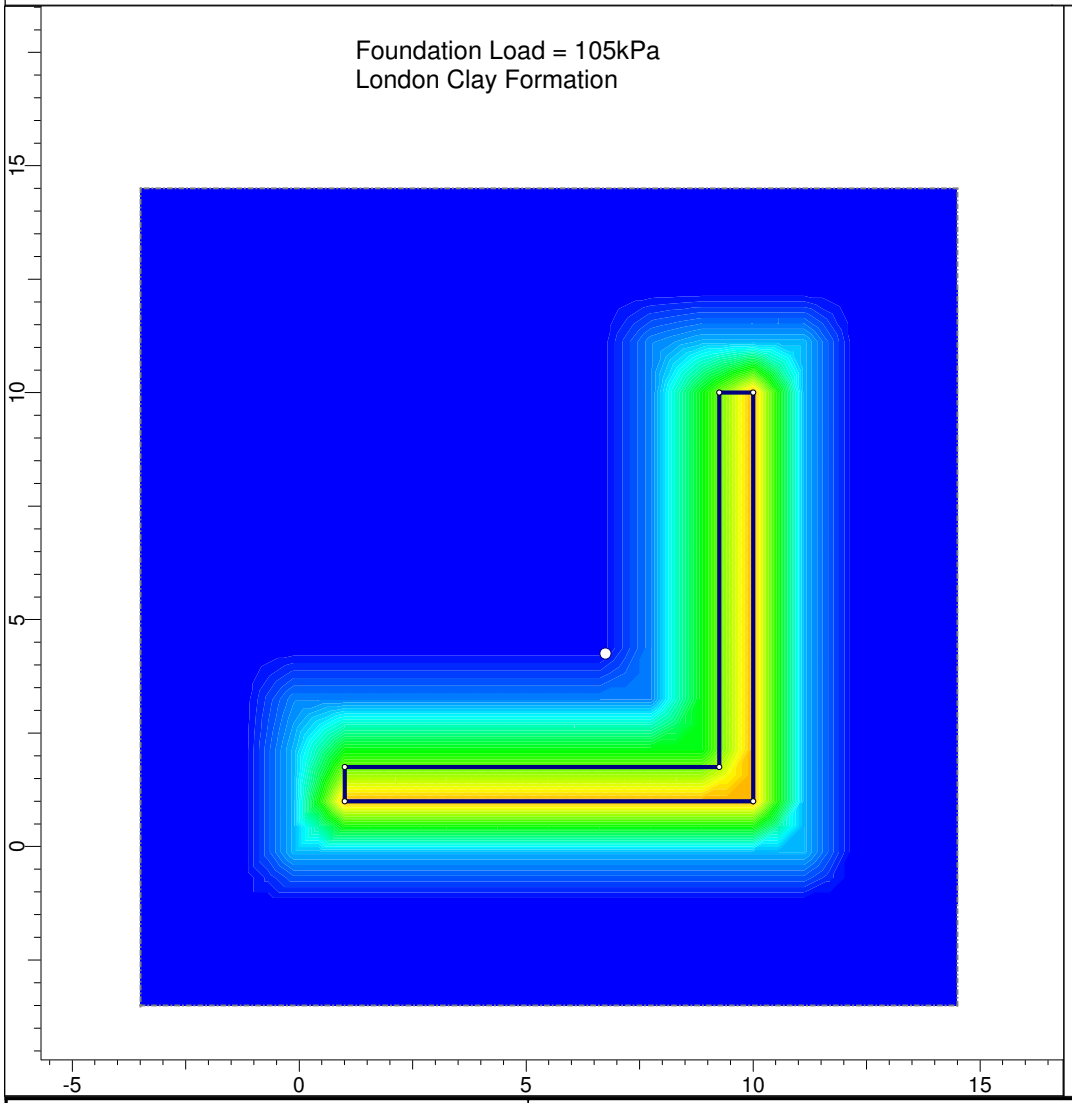
Design Resistance is $q'_{Rd} = \frac{q'_{ult}}{\gamma_{Rv}} =$ 113kN/m^2

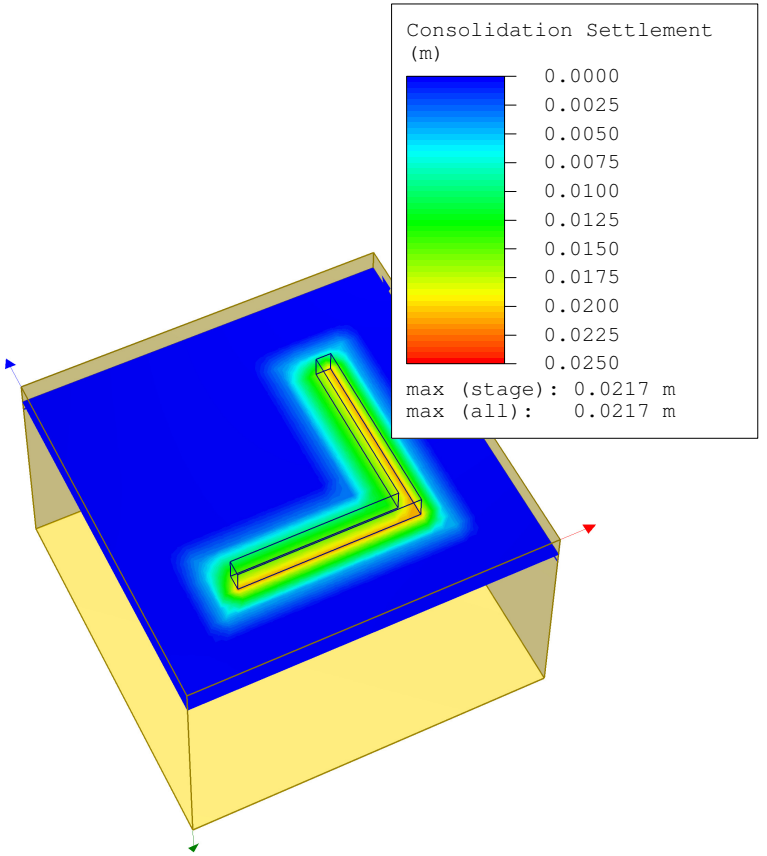
Design Approach	Combination	Design Resistance ULS (kN/m^2)	
		undrained	drained
DA1	Combination 1	439	178
	Combination 2	317	113

Stage 1

Data Type: Consolidation Settlement

Foundation Load = 105kPa
London Clay Formation





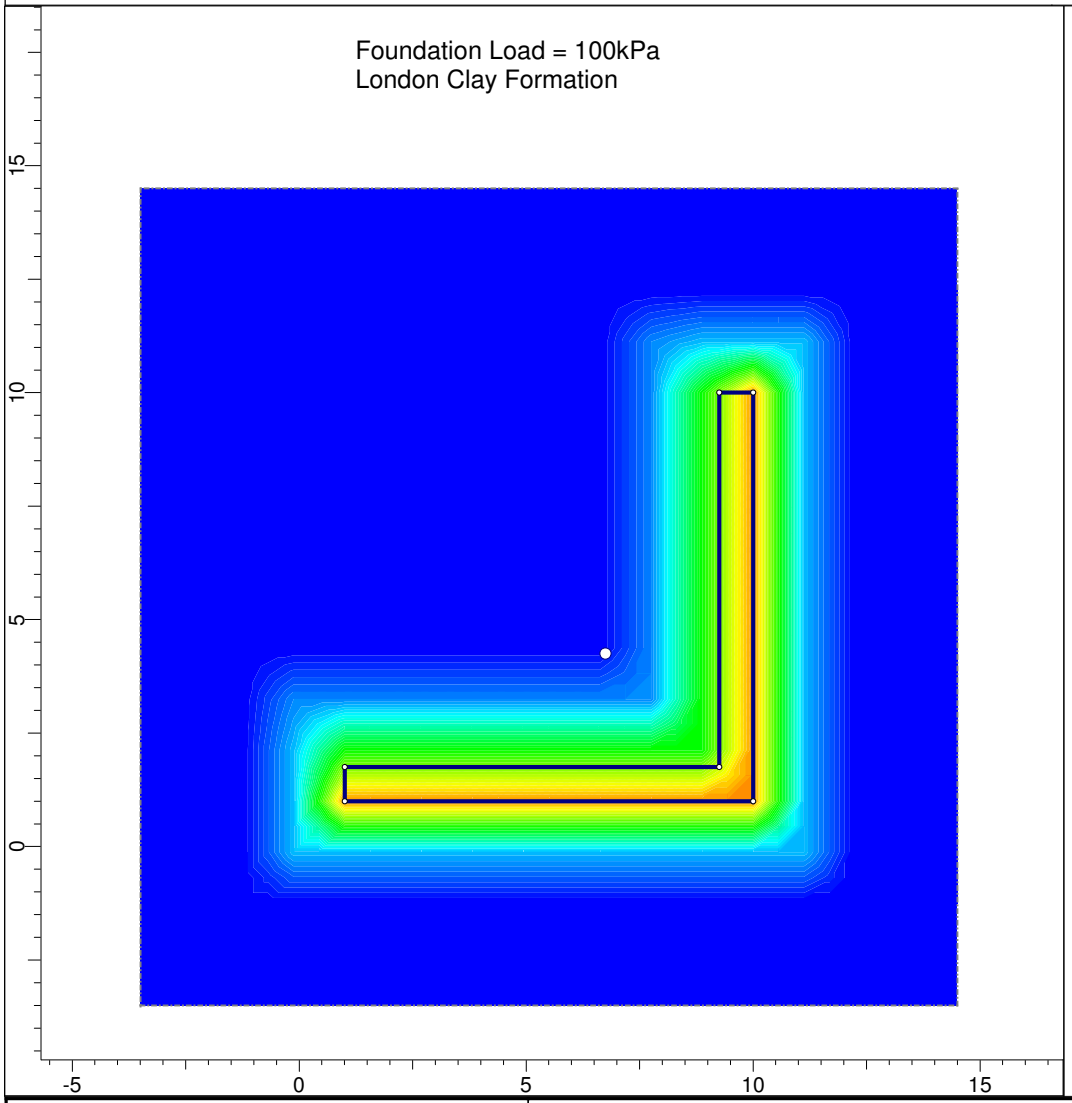
rocscience	*Project*	Horniman Butterfly House	
	Analysis Description	Strip Foundtion	
	Drawn By	Dr David Fall	*Company* Ridge
	Date	10/10/2015	*File Name* Strip Settlement.s3z

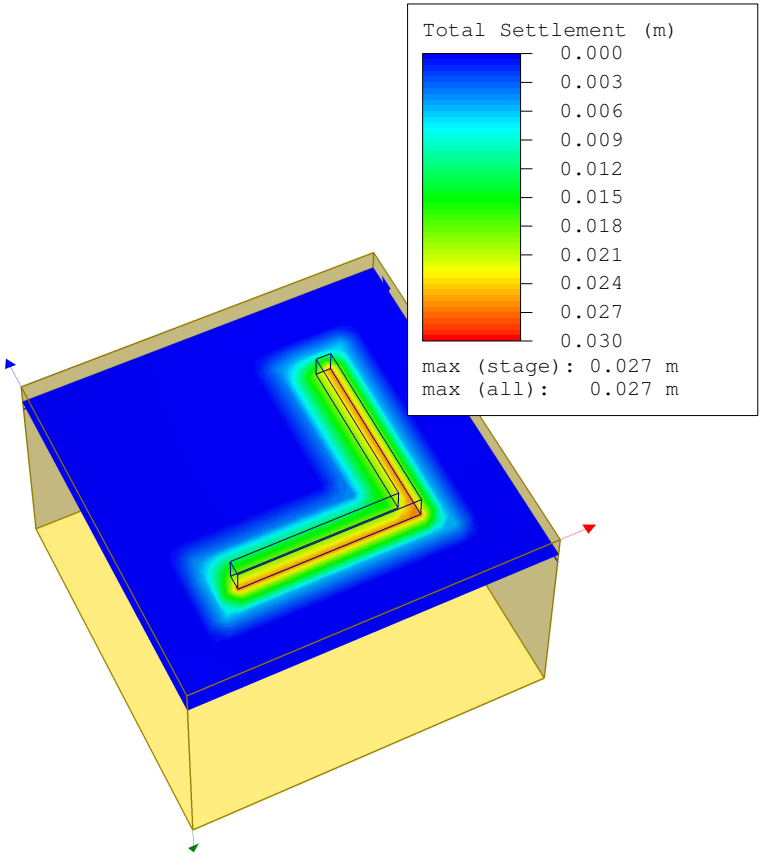
SETTLE3D 2.019

Stage 1

Data Type: Total Settlement

Foundation Load = 100kPa
London Clay Formation





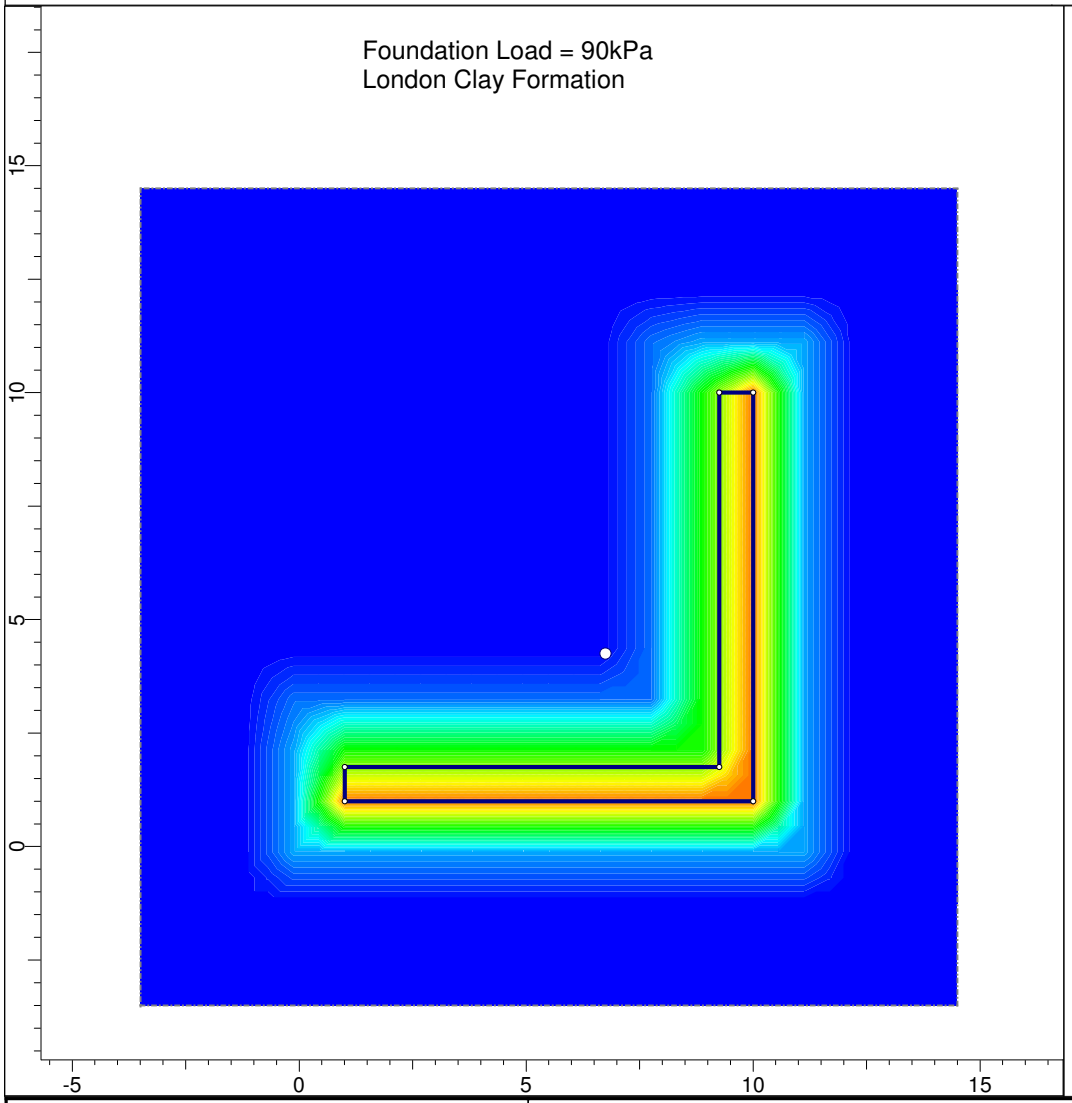
rocscience	*Project*	Horniman Butterfly House	
	Analysis Description	Strip Foundtion	
	Drawn By	Dr David Fall	*Company* Ridge
	Date	10/10/2015	*File Name* Strip Settlement.s3z

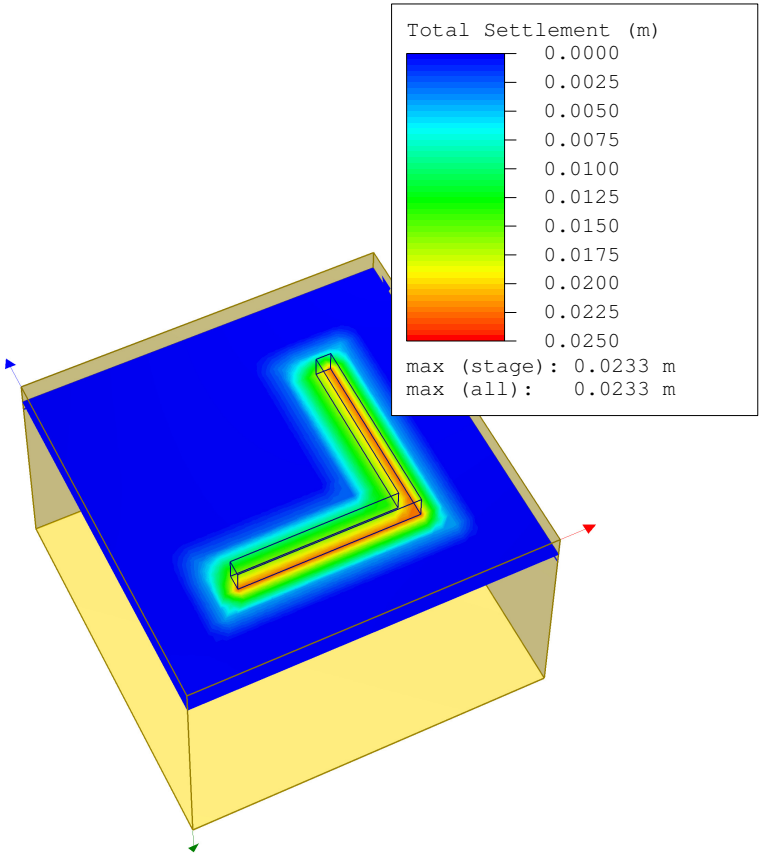
SETTLE3D 2.019

Stage 1

Data Type: Total Settlement

Foundation Load = 90kPa
London Clay Formation





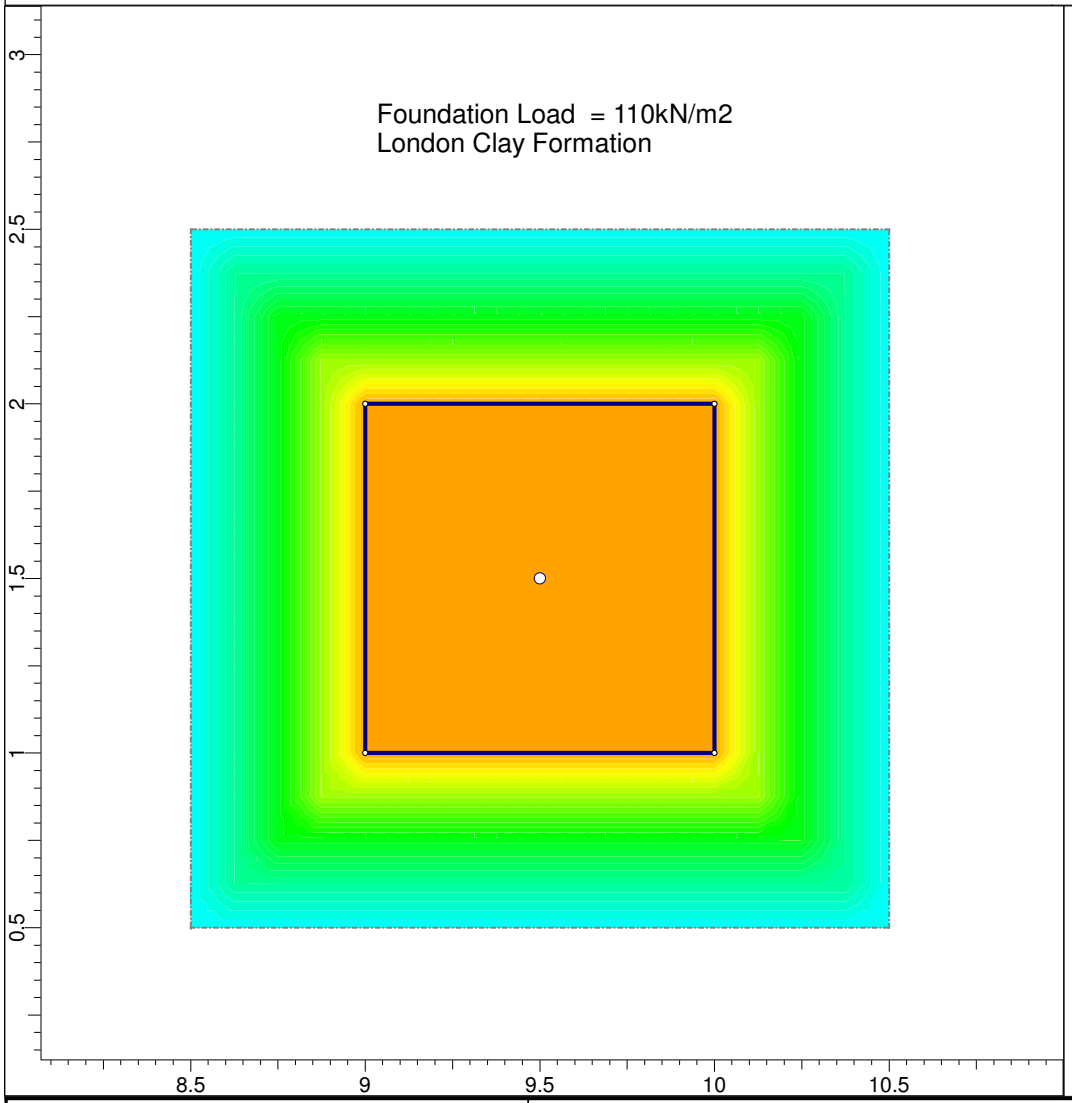
rocscience	*Project*	Horniman Butterfly House	
	Analysis Description	Strip Foundtion	
	Drawn By	Dr David Fall	*Company* Ridge
	Date	10/10/2015	*File Name* Strip Settlement.s3z

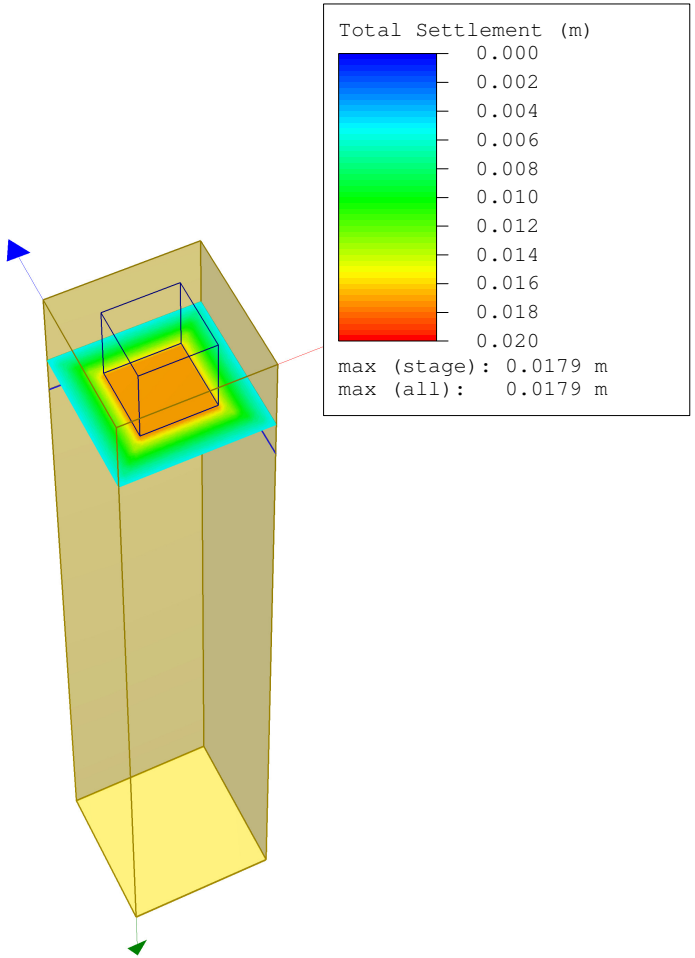
SETTLE3D 2.019

Stage 1

Data Type: Total Settlement

Foundation Load = 110kN/m2
London Clay Formation





Project	Horniman Butterfly House		
Analysis Description	Pad Foundtion		
Drawn By	Dr David Fall	Company	Ridge
Date	10/10/2015	File Name	Strip Settlement.s3z

SETTLE3D 2.019

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