



Geo-Environmental

REMEDIATION STRATEGY & VERIFICATION REPORT

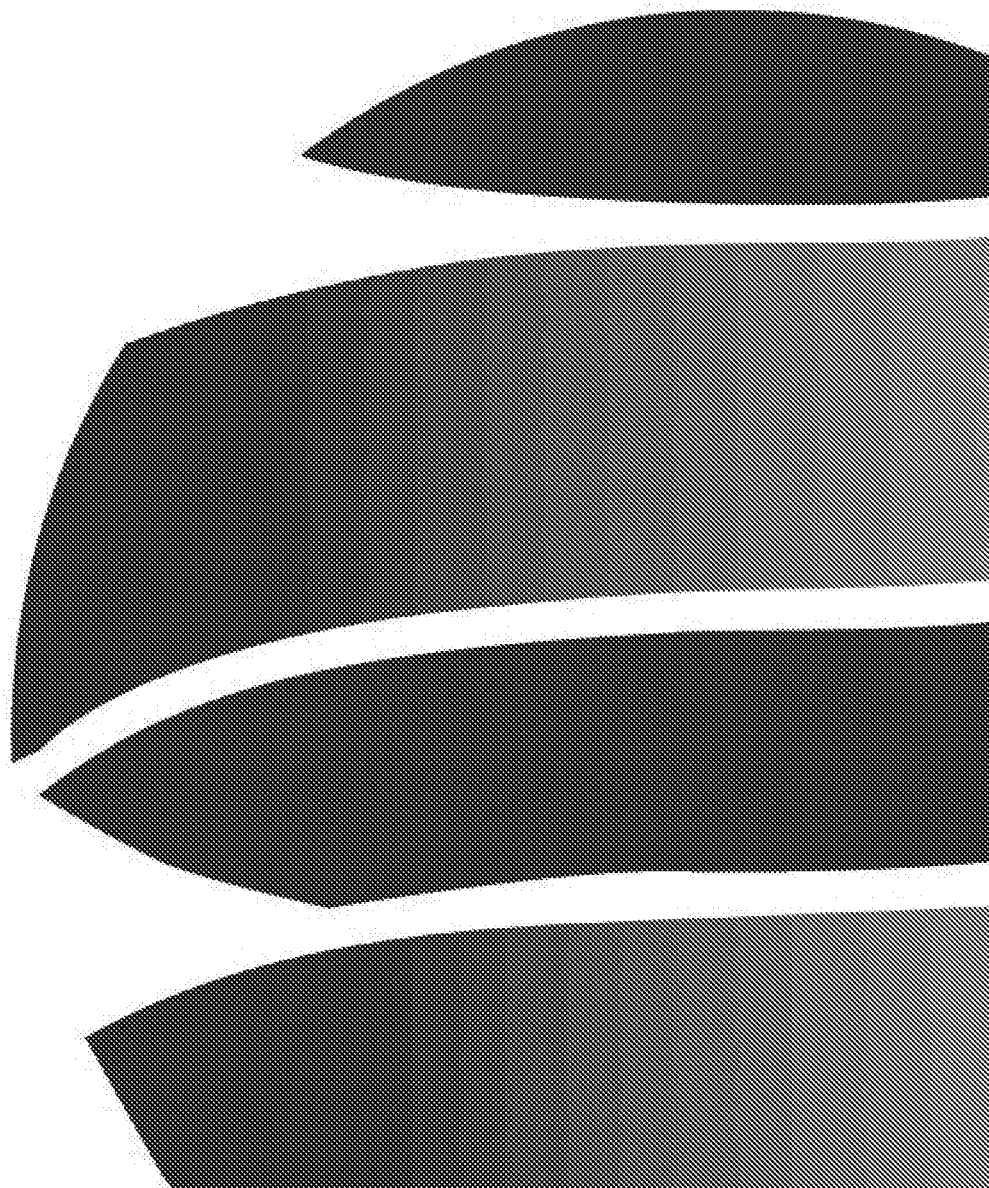
for the land to the south of

BURNDILL ROAD, YAPTON

WEST SUSSEX, BN18 0HP

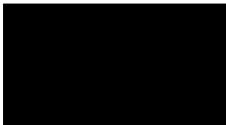
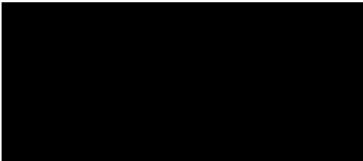
on behalf of

BOVIS HOMES





Remediation Strategy & Verification Report

Report:	REMEDICATION STRATEGY AND VERIFICATION REPORT
Site:	LAND TO THE SOUTH OF BURNDELL ROAD, YAPTON, WEST SUSSEX, BN18 0HP
Client:	BOVIS HOMES
Date:	20/09/2019
Reference:	GE18533-RSVR-SEP19
Version:	1.0
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**AMENDMENT RECORD**

Revision ref.	Date	Reasons for amendment	Author's initials	Reviewed by	Approved by
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1.0 INTRODUCTION

1.1 General

Following a Phase I and Phase II assessment of the site undertaken by third parties and an intrusive investigation and contamination assessment of the portion of the site fronting onto Burndell Road undertaken by Geo-Environmental Services Limited ('Geo-Environmental'), detailed within reports listed below, Geo-Environmental was appointed by Bovis Homes, to formulate a Remediation Strategy in relation to the proposed development on land to the south of Burndell Road, Yapton, West Sussex, BN18 0HP herein referred to as 'the site' (see Figure 1). This Remediation Strategy is specific to the area of the development site located immediately to the south of Burndell Road, forming the access spur road to the proposed development area and no remediation was required within the residential development area.

The site as a whole, has been the subject to Phase I Geo-Environmental Desk Study for Land South of Burndell Road, Yapton, undertaken by BRD Environmental Limited on behalf of Gleeson Developments, ref: BRD2484-OR1-A, dated November 2015; a Phase II Geo-Environmental Site Investigation for Burndell Road, Yapton, undertaken by BRD Environmental Limited on behalf of Gleeson Developments, ref: BRD2484-OR2-A, dated December 2015. The portion of the site fronting Burndell Road has been subject to an additional Letter Report summarising encountered ground conditions and a contamination assessment undertaken by Geo-Environmental on behalf of Bovis Homes, ref: GE17640/GR02/180921, dated September 2018.

The remedial strategy has been developed to reflect the findings from all phases of the assessments undertaken on this site. Based on the findings of the investigations it was considered that remediation works would be required with respect to the asbestos detected within the Made Ground located in the portion of the site fronting Burndell Lane, proposed for the bell-mouth and access spur road immediately adjacent to Burndell Road.

1.2 Objectives

The Remediation Strategy sets out the remedial works to be undertaken on this specific portion of the overall site to enable construction of the site access road at the junction with Burndell Road. No remedial action was warranted for the residential development portion of the site.

1.3 Planning Permission

It is understood that a planning application has been approved for the site by planning appeal through Arun District Council under Planning Reference Y/19/16/OUT. It is understood that the following conditions through the Local Planning Authority and NHBC have been attached to the application which relate to the remediation and validation of land contamination on the site.

NHBC Condition - LQ1

Remediation Report/Strategy required. The report is to include a Verification Report in accordance with NHBC Standards Chapter 4.1 For 'Tarmac Slab' area only.



2.0 BACKGROUND

This Remediation Strategy and Verification Report (RSVR) has been developed from the findings of the various phases of assessment.

A brief overview of the findings of the letter report ref GE17640/GR02/180921 is presented below. For further information, the individual report should be referred to directly.

2.1 Overview

An intrusive investigation was undertaken comprising the excavation of 5 No. shallow hand pit locations, up to 1m bgl, located within the portion of the site fronting onto Burndell Road. The exposed strata were logged and representative samples recovered for laboratory analysis for a suite of commonly occurring brownfield contaminants.

The ground conditions encountered in the trial pits comprised tarmac overlying Made Ground, with natural soils encountered within three of the five pits. Trial pits HP203 and HP204 did not prove the depth to the natural strata due to the presence of suspected asbestos within HP203 (halted to prevent breaking and release of asbestos). The Made Ground was generally found to comprise brick, concrete and flint gravel to cobble size in a greyish brown sandy silty matrix.

The geochemical test results were compared individually against published Tier 1 Generic Assessment Criteria (GAC) assuming a general residential end use (given that the proposed site layout plans were unknown at the time). Exceedances of several determinands were identified within the soil samples collected when compared against the screening criteria, as summarised in Table 1 below.

Determinand	Exceedance samples against end use scenario	
	Residential with pant uptake	Residential open space
Barium	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m	None
Lead	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m
Benzo(a)anthracene	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m	HP202 at 0.1m
Chrysene	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m	None
Benzo(b)fluoranthene	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m
Benzo(a)pyrene	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m
Indeno(1,2,3-cd)pyrene	HP203 at 0.3m	None
Dibenzo(a,h)anthracene	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m	HP201 at 0.2m; HP202 at 0.1m; HP203 at 0.3m; HP205 at 0.15m

Table 1 Summary of exceedances against Tier 1 GAC

In addition, all of the samples analysed were also screened for the presence of asbestos and where identified, asbestos quantification was undertaken. This process identified asbestos to be present as follows:

- HP202 – the soil sample at 0.1m bgl was found to contain chrysotile lagging with a free fibre content of <0.001% and a total asbestos content of 0.048%.



- HP203 – no asbestos was identified in the soil sample from HP203 at 0.3m but the cement sheet fragment recovered as a separate sample from HP203 at 0.3m (immediately beneath the soil sample) was confirmed to contain chrysotile (white) and crocidolite (blue) asbestos, with a free fibre content of <0.001% and a total asbestos content of 25.0%.

It was therefore considered that the Made Ground was impacted by multiple contaminants and was not suitable for retention within gardens or open space, unless measures such as a soil cover system were incorporated to prevent end user contact with, or exposure to these Made Ground soils.

It was also considered that it would be highly likely that these soils would be exposed and excavated as part of site clearance, enabling and ground works, as well as possible future exposure to maintenance personnel and thus it would be considered prudent to remove the contaminated Made Ground from any areas where the Made Ground is likely to be exposed, disturbed or where it could be located in an area of soft landscaping following development.

Given the presence of asbestos cement sheeting identified in one location (25% chrysotile and crocidolite) it was recommended that the removal of these materials be undertaken by a specialist contractor and that materials would be classified as hazardous waste.

2.2 Proposed Site Use

The proposed development is understood to comprise the development of 108 residential units, vehicle access from Burndell Road, associated car parking, open space and landscaping. The portion of the site fronting Burndell Road, i.e. where the contaminated Made Ground was encountered, covers the proposed access road, no residential properties or gardens are proposed within this area.

2.3 Conceptual Site model

Assessment of the investigation findings identified particular hazards, or potential hazards which were considered to require intervention (remediation) to mitigate the risk of harm. Remediation works were proposed to break the identified plausible pollutant linkages associated with respect to soil contamination identified within Made Ground soils within the vicinity of HP201 to HP205 (proposed access road), thereby mitigating the associated risk of harm to human health.



3.0 SOILS

The ground conditions on the portion of the site fronting Burndell Road have been established through intrusive investigation works. Encountered soils comprised a thickness of Made Ground overlying the natural soils. Made Ground was encountered within all the hand pit locations to a maximum depth of 0.7m bgl.

A review of chemical analysis of the soil samples was undertaken within Letter Report GE17640/GR02/180921, and the results compared individually against the relevant GAC or C4SL for a proposed residential end use (with plant uptake). The proposed layout was unknown for this portion of the site at the time of this assessment, therefore the results were assessed against GAC for residential gardens with plant uptake (most sensitive use) and open space in a residential setting (communal and amenity soft landscaping). Several exceedances were identified above these screening criteria.

In addition, all samples were submitted for asbestos screening, and where identified asbestos quantification was undertaken. This process identified asbestos to be present as follows:

- HP202 – the soil sample at 0.1m bgl was found to contain chrysotile lagging with a free fibre content of <0.001% and a total asbestos content of 0.048%.
- HP203 – no asbestos was identified in the soil sample from HP203 at 0.3m but the cement sheet fragment recovered as a separate sample from HP203 at 0.3m (immediately beneath the soil sample) was confirmed to contain chrysotile (white) and crocidolite (blue) asbestos, with a free fibre content of <0.001% and a total asbestos content of 25.0%.

Subsequently, it was confirmed that the development proposals for this area of the site were to comprise the junction with Burndell Road and access road onto the development site and therefore, the impacted Made Ground soils would be located beneath a permanent hard cover. This said, it would be highly likely that these soils would be exposed and excavated as part of site clearance, enabling and ground works, as well as possible future exposure to maintenance personnel. It was therefore considered that remedial action would be warranted to protect ground workers and future maintenance personnel on this site in relation to the presence of asbestos identified within HP202 and HP203. The nearest residential property (including any garden) was located c. 85m to the south of the remediation area.

The initial remedial strategy comprised a phased process based on an end use comprising an access road (not housing and gardens):

- 1) Surface strip of up 0.6m bgl of impacted Made Ground soils in the vicinity of HP202 and HP203 to remove the asbestos impacted soils. Excavation and disposal (with/without prior treatment/separation subject to space and time constraints) of the impacted soils identified within the vicinity of HP202 and HP203. The impacted soils would not be suitable for re-use within private garden areas or areas of soft landscaping and would need to be segregated from other materials on site to avoid cross contamination. If excavated soils are to be stored on site prior to their removal they will need to be placed on sheeting, or otherwise stored in such a way as to prevent the spread of any asbestos or asbestos containing material.
- 2) Placement of a visible marker deter-to-dig membrane.
- 3) Backfill of the excavated area with suitable clean imported material.

During the remediation works it became evident that impacted Made Ground was present in some areas of the excavation to depths greater than 0.6m bgl and that asbestos was present sporadically within the Made Ground, such that localised excavation, or segregation of excavated materials was not feasible. The Made Ground appeared to have been deposited to infill a shallow (variably c. 0.3-1.0m deep) sump, pond or similar localised feature. Following discussion with the Client, the strategy was revised such that Made Ground material was



excavated *en masse* to the natural underlying strata, thereby removing all Made Ground and associated contamination hazards within the vicinity of HP201-HP205. Mass excavation down to and exposing the underlying natural strata was observed during a site visit on 15th April 2019. It was possible to distinguish visibly between the Made Ground and underlying natural strata both by colour and soil composition.

The area subject to the mass excavation is presented in Figure 3 and site photographs of the excavation are presented in Appendix A.

Any soils imported onto the site should be verified free from contamination with chemical testing undertaken to confirm their suitability for use within areas of soft landscaping.

Retention and re-use of the excavated Made Ground soils was not proposed, i.e. the excavated soils were to be removed from site under appropriate duty of care to a suitably registered facility.

Following completion of backfilling, the road was to be constructed over the mass excavation area.

3.1 Site Workers

It is the responsibility of the Principal Contractor and their appointed sub-contractors to implement and manage safe systems of work, prepare their own risk assessments in accordance with Health and Safety legislation in order to protect persons in their employ, as well as mitigate the risk of harm to others due to works in their control. Special consideration should be given to the provisions of the Construction (Design & Management) Regulations 2015, Health and Safety at Work Act and the Control of Substances Hazardous to Human Health regulations to protect the safety of persons in their employment. Additional guidance can be sought from the CIRIA publications entitled "A Guide for Safe Working on Contaminated Sites" and "Environmental Good Practice on site guide (fourth edition)".

In addition to the safe systems of works to be implemented alongside appropriate risk assessments and method statements, all site personnel shall benefit from on-site hygiene facilities including wash area, toilets and drying room. Separate canteen area and welfare facilities should be provided. All eating and drinking should be restricted to the canteen/clean area and only once site personnel have removed outer PPE and washed exposed skin.

In the event of dry spells, or where the exposed surface becomes dry, regular damping down (not flooding) of the surface of the site will be required to prevent the release of soil dust which could impact on site operatives or migrate off-site, thereby mitigating both off-site exposure and nuisance for neighbours.

3.2 Built Environment

Given that the Made Ground was excavated *en masse* down to the underlying natural strata and backfilled with imported fill (chalk) it is considered that specific protection measures are not required for potable water supply. As a matter of good practice and to maximise the protection to maintenance workers, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

3.3 Inspection/Validation

Verification of remediation measures shall be required through inspection of the works to include:

- The removal of Made Ground down to natural strata, from across the portion of the site fronting Burndell Road (HP201-HP205).



4.0 WASTE

Waste may be defined as any substance or object in Annex 1 of the Waste Framework Directive which the holder discards, intends to discard, or is required to discard. The holder of waste is anyone in possession of waste or generates it and therefore both the contractor and ultimately the developer are responsible for safe disposal of waste.

The geochemical results were assessed for waste classification purposes using CATWASTE which categorised the samples of Made Ground from HP201, HP202, HP203 and HP205 to be Hazardous Waste due to the reported concentrations of chromium, copper and zinc, and pH in the sample from HP205.

In addition, given the percentage of asbestos present in the cement sheet fragment recovered from HP203, any such material would be classified as Hazardous Waste. As such, it is recommended that once materials for disposal have been identified, further WAC testing should be undertaken to further classify the materials for the purpose of disposal.



5.0 DISCOVERY STRATEGY

5.1 General

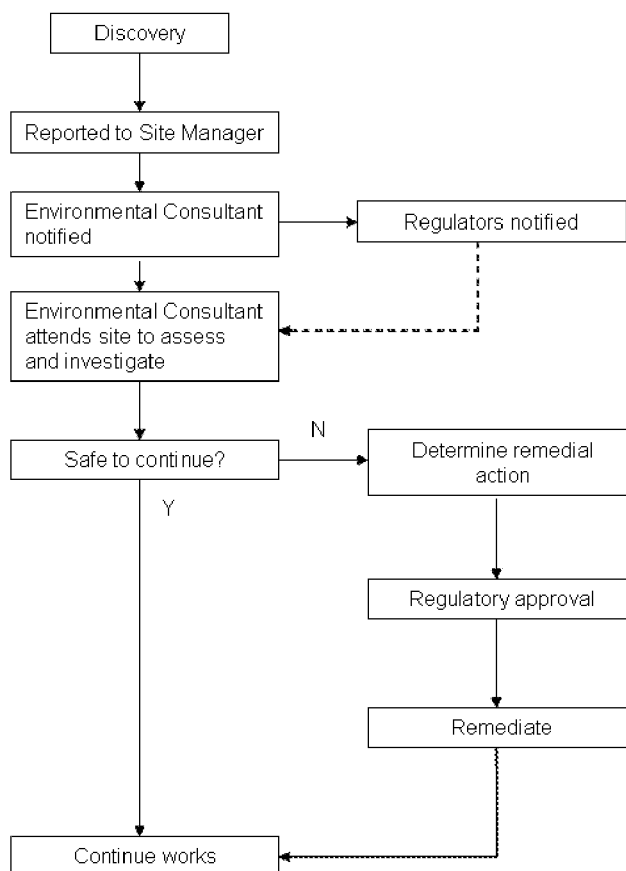
Whilst the site has been the subject of several phases of investigation and assessment, it remains possible that previously unexpected soil conditions may be encountered during the process of site preparation and construction.

Examples may include oily pockets within the soil, pockets of cement boarding or fibrous materials within the soil, black ashy materials, soils exhibiting strong odours, brightly coloured materials, and former structures or brickwork.

Should previously undiscovered contamination be encountered during the demolition/construction of the new buildings the following course of action should be adhered to:

- Works in the area of the suspected contamination should cease immediately. The ground workers should report any suspected contamination immediately to the Client's site supervisor. The supervisor should contact the Environmental Consultant, who should visit the site to assess the extent of the 'contamination'.
- The Environmental Consultant shall make records of their inspection, and pass details of these to the Local Authority.
- Where the conditions revealed differ from those previously anticipated, the Environmental Consultant shall take samples as deemed appropriate to be dispatched for appropriate chemical testing.
- Depending on the results of the testing either: 1) no further work will be required; 2) a further detailed risk assessment will be required; and/or 3) localised specific remedial measures will be necessary. Appraisal criteria will vary depending on the nature of the assessment.
- The results of any such testing will be sent to the Regulatory Authority for consultation. If further remediation is required, the Regulatory Authority will be informed of the date and time of the proposed works.
- Any further remediation will be undertaken in accordance with a method statement submitted to the Local Authority for approval. The works shall be supervised by the Environmental Consultant who shall provide a Verification Report for the Local Authorities purposes.

The process is summarised overleaf:



A copy of this strategy should be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.

5.2 Update

As noted in Section 3, during the course of the on-site remediation works, asbestos impacted Made Ground was encountered to a greater extent and as such, the Discovery Strategy was enacted and the exposed conditions were reviewed, assessed and the remedial strategy revised to remove the Made Ground *en masse*, expose the underlying natural strata and backfill with imported fill (chalk).



6.0 VERIFICATION

Verification is required to be undertaken throughout the course of the remediation works. A summary of verification proposals is presented in Table 1 below.

As noted in Section 3, the site was visited during the remediation exercise, i.e. towards the end of the mass excavation and removal of the Made Ground down to the natural strata was evident, visual distinction between the Made Ground and underlying natural soils both in colour and composition. The portion of mass excavation at the boundary with Burndell Road had been partially backfilled with imported Chalk to enable vehicles to enter and exit the site. The area of mass excavation was located at the junction with Burndell Road and the access spur into the site, as shown in Figure 3.

Photographs taken during the site visit showing the mass excavation are presented in Appendix A.

Following completion of the mass excavation of Made Ground soils and backfilling with suitable fill materials, the access road was to be constructed. The nearest portion of the residential development to the remediation area was estimated to be c. 85m, with that distance covered by the remainder of the access road from Burndell Road into the main development site.

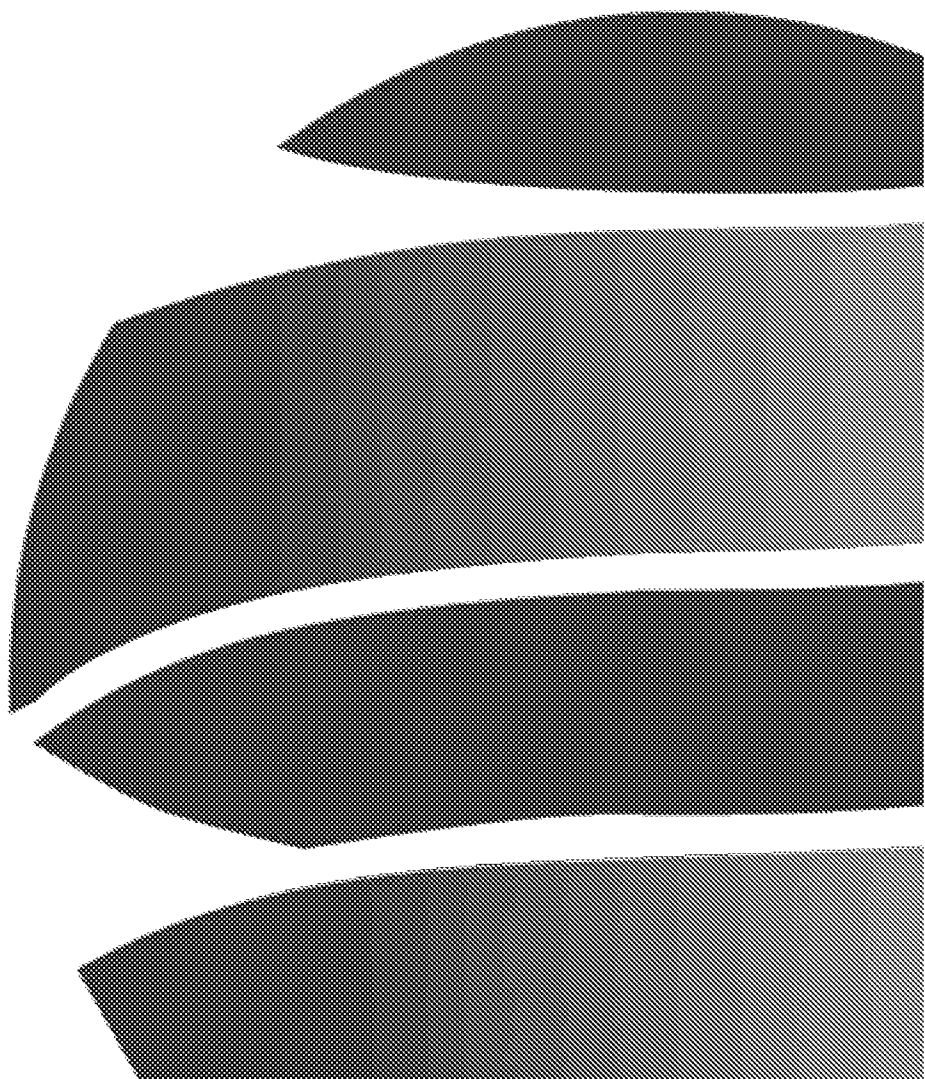


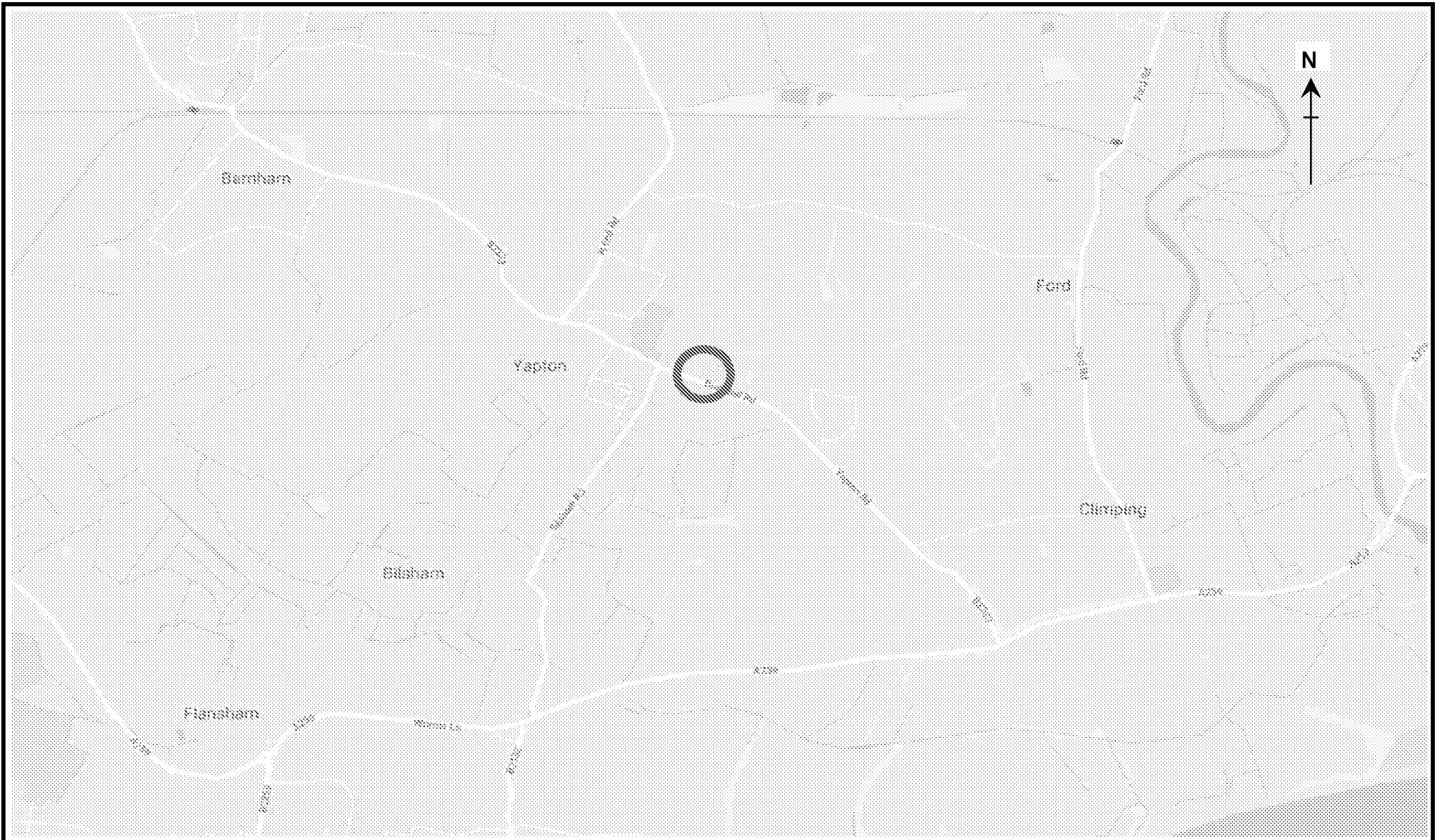
Reference	Principal requirements	Design or construction related	Site visit required by Qualified Geo-Environmental Engineer	Commentary
1.0 Excavation of Made Ground	Mass excavation exercise to excavate all Made Ground within the portion of the site fronting Burndell Road to natural strata.	Construction	Yes (undertaken on 15/04/2019)	Visit to site on 15/04/2019 to confirm works being undertaken and visual inspection to confirm the natural soils have been reached following removal of the Made Ground.
2.0 Waste Management	Waste soils arisings from the mass excavation will be disposed of appropriately. Analytical results should be presented to the landfill site prior to removal for confirmation of the classification.	Design and Construction	No	Chemical test results (WAC), or evidence of waste classification to be provided by the Remediation Contractor.
	Waste tickets for the removal of arisings should be compiled for submission as part of the verification report. The waste tickets will be required to demonstrate that the approximate amount of material being removed is equal to the summed volume on the waste tickets.			Waste tickets to be provided by the Remediation Contractor.

Table 1 Details of verification measures proposed



Figures

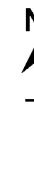




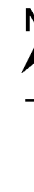
Project: Burndell Road, Yapton		Title: Site Location Plan	
Client: Bovis Homes		Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	
Ref No: GE18533	Revision: 0		
Drawn: FG	Date: 20/09/2019		
Figure: 1	Scale: Not To Scale		



Geo-Environmental



Project: Burndell Road, Yapton		Title: Exploratory Hoel Location Plan	
Client: Bovis Homes		Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	
Ref No: GE18533	Revision: 0		
Drawn: FG	Date: 20/09/2019		
Figure: 2	Scale: Not To Scale		
		 Geo-Environmental	



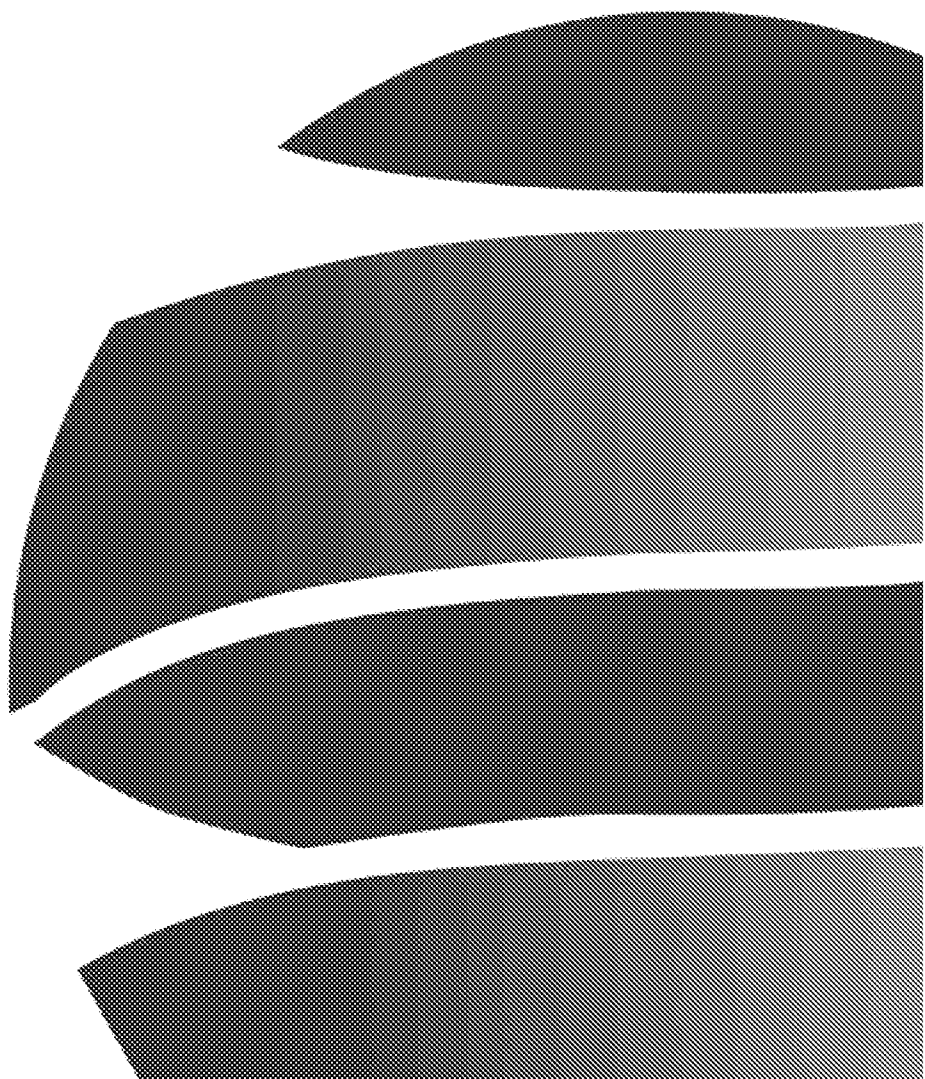
Area of Made Ground
Excavation

Project: Burndell Road, Yapton		Title Area of Made Ground Mass Excavation	
Client: Bovis Homes		Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	
Ref No: GE18533	Revision: 0		
Drawn: FG	Date: 20/09/2019		
Figure: 3	Scale: Not To Scale		
		 Geo-Environmental	



APPENDIX A

Site Photographs



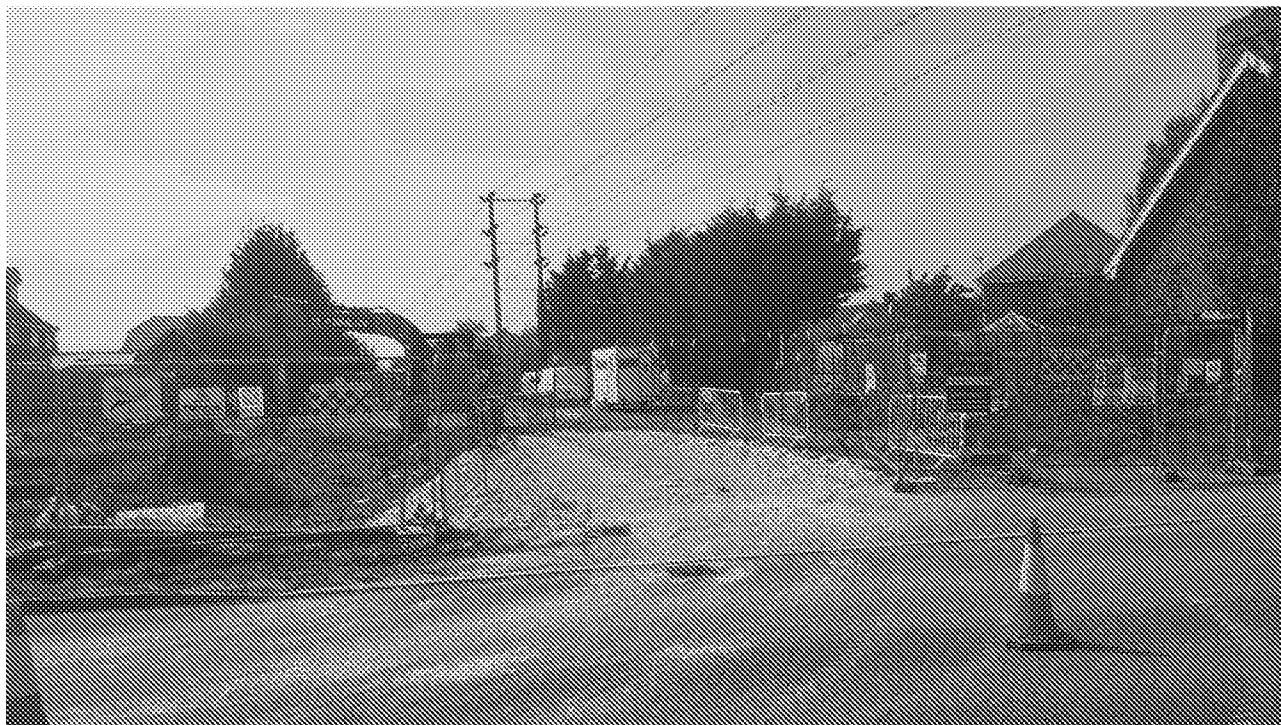


Plate 1 View of Made Ground excavation with chalk backfill along access route



Plate 2 View of the Made Ground excavation



Plate 3 View across the site following the Made Ground excavation