

HYDROGEOLOGICAL APPRAISAL OF LAND AT STANSTED PARK, ROWLANDS CASTLE, HAMPSHIRE, PO9 6DX FOR A NUTRIENT NEUTRALITY FEASIBILITY ASSESSMENT

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Executive Summary

H2Ogeo was contacted by Land and Partners Ltd (The Client) and asked to provide a Hydrogeological Appraisal for three parcels of land proposed for nutrient neutrality offsetting in Hampshire near Rowlands Castle.

The work has been carried out in the context of understanding the suitability of the proposed land, in terms of its hydrogeology and hydrology, for use as nutrient mitigation land.

Nutrient burdens can be neutralised through permanent land use change by converting agricultural land with higher nitrogen loading to alternative uses with lower nitrogen loading. This report provides a hydrogeological assessment to understand the potential to use land as mitigation against nutrient loading in the receiving waters of Langstone Harbour.

The three areas of mitigation land are situated primarily on the Chalk Formation with some areas on the Lambeth Group. They are all in the Source Protection Zone One (SPZ1) for the Havant & Bedhampton Springs. The SPZ1 defines a 50 day travel time in the Chalk Aquifer and the shape of the SPZ suggests groundwater flows, on a regional scale, north to south, beneath the Chichester Syncline discharging at the Havant and Bedhampton Springs.

By changing the use of the mitigation land from agriculture to woodland, concentrations of Nitrates entering surface water runoff and groundwater would be reduced. It is anticipated this could be observed within one year.

It is concluded that the proposed areas, as Nitrate Mitigation Sites for the Langstone and Chichester Harbour, are suitable and have the potential to provide Nutrient mitigation that could be observed in the environment within one year.

1 Introduction

H2Ogeo was contacted by Land and Partners Ltd (The Client) and asked to provide a proposal for a Hydrogeological Appraisal of land proposed for nutrient neutrality offsetting in Hampshire near Rowlands Castle.

The proposal was approved on the 11 February 2022 with supplementary work approved in September 2022. The scope of work has been carried out in the context of understanding how suitable the three parcels of proposed land are, in terms of its hydrogeology and hydrology, for use as nutrient mitigation land.

A Statement of Limitations is presented at the end of this report.

1.1 Background & Scope of Work

Land & Partners are promoting a housing site for 210 homes on the edge of Emsworth, to the south of Stansted Park.

Assessments have been undertaken to support an outline planning application for the proposed development and the new urban area would comprise 8.1 hectares with the provision of 6.5 hectares of Public Open Space.

Calculations of the change in nutrient outputs from existing land to future use associated with the proposed development have been carried out by Tetra Tech (WYG, Ref: A115474).

Nutrient burdens can be neutralised through permanent land use change by converting agricultural land with higher nitrogen loading to alternative uses with lower nitrogen loading. This report provides a hydrogeological assessment to understand the potential to use three parcels of land as mitigation against nutrient loading in the receiving waters of Langstone Harbour.

The report provides a Hydrogeological Conceptual Site Model (HCSM) for the three parcels of land indicating the groundwater table (depth to groundwater), its interaction with nearby surface water courses and calculated travel times from surface, via groundwater, to the Chichester Harbour.

To develop the HCSMs publicly available data sourced from a range of providers including the Environment Agency and .gov has been used.

2 Mitigation Site Setting

2.1 Location

The three proposed areas of mitigation land are located east of Rowlands Castle, close to the West Sussex and Hampshire border, in West Sussex off The Avenue in Stoughton north of Horse Pasture Farmhouse.

The site is located in the South Downs national Park and presented in Figure 1. The site, Horse Pasture Farmhouse, is centred on National Grid Reference SU74250 10250 (Easting: 474250, Northing: 110250).

The land is currently in intensive agricultural use and has been selected to complement the existing adjacent woodland, additionally there is new planting proposed that will link the strategic forests to the north and south providing a 'flight corridor' for bats.

The mitigation land covers three main areas, named for the purpose of this report as Northern, Central and Eastern Area and the table below shows the central NGR for each plot and area based on the GIS boundaries presented in Figure 1.

Table 1 Site coordinates

Area Name	National Grid Reference	Easting	Northing	Area (Hectares)
Northern Area	SU74045 10505	474045	110505	5
Central Area	SU74426 10298	474426	110298	3
Eastern Area	SU74594 09895	474594	109895	8
Total Area				16

2.2 Topography

2.2.1 Regional Topography

Regional topography is presented in Figure 2, it shows the surrounding area dominated by Chalk Downland of the South Downs National Park. The Chalk exhibits dry valley features with an overall landfall from the north to south down to the Coastal Plain approximately 4km south of the site.

The peak elevation, at the head of a valley, is an area at 190mAOD approximately 6km north-north-west of the site falling to between 40 and 50mAOD on site.

2.2.2 Field Topography

The topographic features of the proposed mitigation land, northern, central and eastern area, are detailed below and, Figure 3 presents the topography on site based on the 2020 2m LiDAR Digital Terrain Model:

Table 2 Summary of Field Topography

Field Name	Predominant Fall	High Point (mAOD)	Low Point (mAOD)	Surface Gradient (m/m)
Northern Area	North to South	48	44	0.05
Central Area	North to South	46	38	0.03
Eastern Area	North West to South East	34	29	0.02

3 Soil Types & Geology

3.1 Soil Types

The site is covered by freely draining slightly acidic loamy soils, with some slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils in the Central and Southern Areas¹.

Underlying the Soils are Superficial Deposits, where present and Bedrock, these are described below:

3.2 Geology

The table below summarises the geology anticipated on site based on the BGS 1:50,000 geological mapping, Figure 4 presents the Superficial and Bedrock geology described below:

Table 3 Superficial and Bedrock Geology

Area Name	Superficial Geology	Bedrock Geology	Comments
Northern Area	None	Tarrant Chalk Member	No Superficial deposits mapped on site.
Central Area	None	Tarrant Chalk Member Lambeth Group	The Lambeth group is overlying the southern portion of the central area and consists of Sands, Silts and Clays with the extremities consisting of mainly Sands.
Eastern Area	None	Tarrant Chalk Member and Lambeth Group	The Lambeth group is overlying the southern portion of the Eastern Area and consists of Sands, Silts and Clays with the extremities consisting of mainly Sands. The Lambeth Group on in the east is recorded as Sandy.

3.3 Superficial Geology

There are no Superficial Deposits mapped on site. There are Head Deposits that follow the valley bottoms east, west and south of the mitigation land and some Clay with Flints mapped 900m to the north east.

3.3.1 Head Deposits

Head is poorly sorted and poorly stratified, angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope and deposited by solifluction and gelifluction processes.

Solifluction is the slow viscous downslope flow of waterlogged soil and other unsorted and unsaturated superficial deposits. The term gelifluction is restricted to the slow flow of fluidized superficial deposits during the thawing of seasonally frozen ground. The flow is initiated by meltwater from thawing ice lenses. Polymict deposit: comprises gravel, sand and clay depending on upslope source and distance from source. Locally the Head Deposits have lenses of silt, clay or peat and organic material².

3.3.2 Clay with Flints

The Clay with Flints is a residual deposit formed from the dissolution, decalcification and cryoturbation of bedrock strata of the Chalk Group and Palaeogene formations and, in the extreme west of the outcrop, the Upper Greensand Formation.

It is unbedded and heterogenous. The dominant lithology is orange-brown and red-brown sandy clay with abundant nodules and rounded pebbles of flint. Angular flints are derived from the Chalk, and rounded flints, sand and clay from Palaeogene formations. There is commonly a discontinuous basal layer up to 10 cm thick, with dark brown to black matrix, stiff, waxy and fissured, with relatively

¹ <http://www.landis.org.uk/soilscapes/index.cfm>

² <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=HEAD>

fresh flint nodules stained black or dark green with manganese or glauconite. The deposit locally includes bodies of yellow fine- to medium- grained sand, reddish brown clayey silt, and sandy clay with beds of well-rounded flint pebbles, derived from Palaeogene formations³.

3.4 Bedrock Geology

The Lambeth group consists of vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate. The Lambeth Group was deposited in fluvial, estuarine, lagoonal or proximal marine environments. Late Paleocene to Early Eocene (late Thanetian to early Ypresian)⁴.

The Eastern Area, in the south and east, is underlain by a Sandy portion of the Lambeth Group.

The Tarrant Chalk Member is described as Soft white chalk with relatively widely spaced but large flint seams. It is part of the White Chalk Formation and the lower Member of the Culver Chalk Formation.

The following table shows the borehole logs in the vicinity of Horsepasture Farm and their locations are presented in Figure 4.

Table 4 BGS Borehole Logs

Reference	Name	Length m	Easting	Northing
SU71SW72	Horsepasture Farm Racton	>30.50	474250	110250
SU70NW270	Woodberry Cottage Rowlands Castle	24.38	474050	109990

3.5 Structural Geology

There is a small fault that runs south east to north west 600m south of the site and the Chichester Syncline 4km south.

³ <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=CWF>

⁴ <https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=LMBE>

4 Hydrogeology

The Tarrant Chalk Member is classified as a Principal Aquifer, defined by the Environment Agency as:

Principal Aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer⁵.

The overlying Lambeth Group, in the south of the Central and Eastern Areas, are classified as a Secondary A Aquifer, defined as:

Secondary A aquifers comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers.

All three proposed mitigation sites are in the Source Protection Zone One (SPZ1) for the Havant & Bedhampton Springs. The Springs are one of the principal public water supplies for Portsmouth Water and the SPZ1 defines a 50 day travel time in the Chalk Aquifer. The shape of the SPZ suggests groundwater flows, on a regional scale, north to south, beneath the Chichester Syncline and discharges at the Havant and Bedhampton Springs.

Chalk Formations exhibit a dual porosity, meaning both fracture and matrix flow are active in the subsurface. The hydrogeology of the area is presented in an excerpt from the Hydrogeology Map of the South Downs and Adjacent Parts of the Weald, NERC, 1978 in Figure 5.

The map indicates Chalk groundwater elevations to be between 10 and 20mAOD at the site and flowing north to south as anticipated. It is important to note that the Chalk groundwater contours on this map were drawn based on data from 1978. As a result, it is possible that groundwater elevations are different from those reported on the map.

The nearby borehole logs provide some information on groundwater elevations with Horsepasture Farm recording a level of 23 metres below ground level (mbgl), 15.52mAOD in 1957 and Woodberry Cottage providing a reading of 20.73bgl (13.94mAOD) in 1968.

The closest groundwater elevation data comes from the Carpenters Finchdean Groundwater Observation Borehole, 2.3km north of the site. The groundwater monitoring record indicates groundwater fluctuating from around 41.5mAOD to 27.60mAOD.

The borehole location is shown in Figure 4.

⁵ <http://apps.environment-agency.gov.uk/wiyby/117020.aspx>

5 Hydrology

The site straddles two surface water management catchments in the South East River Basin District, East Hampshire Management Catchment and the Arun and Western Streams Management Catchment.

5.1 East Hampshire Management Catchment

The East Hampshire catchment covers an area of 571km², with rolling chalk downland to the north and a flat, heavily urbanised coastal plain in the south.

The main rivers in the catchment are the Hamble, Meon, Wallington, Hermitage and Lavant. Their sources are in the upland chalk, from where they flow into Southampton Water or the harbours of Portsmouth and Langstone⁶.

5.1.1 River Lavant (Hants)

The Northern Area and half the Central Area fall within the Lavant (Hants) Water Body presented in Figure 6. The Lavant is 6.535km long and has a catchment area of 57.378km², it discharges at Langstone Harbour.

5.2 Arun and Western Streams Management Catchment

The Arun and Western Streams catchment covers 1,490 square kilometres and mainly lies within the South Downs National Park. It is dominated by the chalk ridge of the South Downs and the sand and clay of the Weald.

The catchment includes the Rivers of the Western Rother, the Arun and several small coastal streams which include the chalk fed Ems and Lavant which feed into Pagham and Chichester Harbours. It is a predominantly rural catchment with its key towns being Worthing, Bognor Regis, Chichester, Arundel, Midhurst and Horsham⁷.

5.2.1 River Ems

Half of the Central Area and all of the Eastern Area falls within the River Ems catchment, 60.125km² and 8.79km in length. The River Ems discharges into Chichester Harbour and is presented in Figure 6.

⁶ <https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3034>

⁷ <https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3004>

6 Hydrogeological Conceptual Site Models

The HCSM identifies the key hydrological and hydrogeological processes and assumptions that have been made when assessing the mitigation sites.

6.1 Surface Water Flows

Information on surface water flow routes was provided by the Client.

The Figure presented in Annex A indicates surface water in the west of the Northern Area flowing west, under a culvert and into the valley feature of the Lavant. Surface water from the east of the Central Area flows to the east into the boundary ditch and then south where it crosses Woodberry Lane and discharges into the headwaters of the Lavant.

The Eastern Area drains, with topography, to the south east from the north west, towards Racton Common and Brickkiln Ponds and into the River Ems.

6.2 Site Hydrogeological Conceptual Site Models

the Hydrogeological Conceptual Site Model for the mitigation land is presented in Figure 7.

Precipitation falls on the landscape and enters the Chalk aquifer, recharging the aquifer and causing overland flow along the flow paths identified in Annex A. Baseflow in the aquifer will be derived from up hydraulic gradient in the Chalk Formation to the north.

Rapid connections to surface water features i.e. the Lavant transmits surface water down-catchment.

Highly permeable and fractured Chalk (dual porosity) conveys groundwater down, under the Chichester Syncline to the Havant & Bedhampton Springs. Travel times for groundwater beneath the site to the H&B Springs are estimated to be 50 days and, most likely, faster. Some Chalk groundwater issues at the springs as surface water and the excess recharges the River Lavant, Brockhampton and Hermitage Streams as groundwater and surface water prior to discharging into Broad Lake and eventually the Langstone Channel.

6.3 Travel Times

The SPZ1 has been used to understand the potential travel times of groundwater beneath the site reaching south of the Chichester Syncline and recharging surface water, this equates to less than 50 days.

A conservative approach has been taken to allow for surface water runoff and groundwater recharge on the site leading to ground and surface water flow down the catchment in the Lavant and underlying Chalk Formation. Based on the HCSM it is anticipated that an observed change in Nutrient contributions could be seen within a year.

7 Summary

The Hydrogeological Conceptual Site Model, presented in this report and the estimated travel times, based on the SPZs, indicate that a reduction in nutrient contributions to the River Lavant and River Ems could be realised within one year.

By changing the use of the mitigation land from agriculture to woodland, concentrations of Nitrates entering surface water runoff and groundwater would be reduced.

It should be noted that change of land use would not mitigate the existing load/concentrations already present in groundwater entering Langstone/Chichester Harbour from other sources/parcels of agricultural land that pass under the Fields assessed.

The groundwater catchment extends at least nine kilometres north of the mitigation sites with the majority of groundwater flowing north to south.

The two areas, Northern Area and Central Area, proposed as Nitrate Mitigation Sites for Langstone Harbour are both suitable with the Eastern Area providing mitigation to Chichester Harbour. As set out by [Ricardo Energy and Environment \(2020\)](#) there is a known transfer of water between the two harbours, with them considered to act as a single hydrographic unit. This is confirmed within the Natural England guidance whereby Chichester and Langstone Harbours are included within the same Chichester Harbour Fluvial Catchment. Therefore, all three areas have the potential to provide Nitrate mitigation that could be observed in the environment within one year.

8 Statement of Limitations

This report was prepared in accordance with the scope of work outlined within this report and is subject to the applicable cost, time and other constraints.

H2Ogeo performed the services on behalf of the Client in a manner consistent with the normal level of care and expertise exercised by members of the environmental profession. No warranties, expressed or implied, are made.

Except as otherwise stated, H2Ogeo's assessment is limited strictly to the scope of work outlined in Section 1.1 and does not evaluate structural or geotechnical conditions of any part of the Site (including any buildings, equipment or infrastructure) or outside the Site boundary.

All conclusions and recommendations made in the report are the professional opinions of H2Ogeo personnel involved with the project and, while normal checking of the accuracy of data has been conducted, H2Ogeo assumes no responsibility or liability for errors in data obtained from external sources, regulatory agencies or any other external sources, nor from occurrences outside the scope of this project.

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Any use of this report by a third party is deemed to constitute acceptance of this limitation.

This report does not constitute legal advice.

9 Figures

Figure 1 Site Location

Figure 2 Regional Topography

Figure 3 Field Topography

Figure 4 Geology

Figure 5 Hydrogeological Map

Figure 6 Lavant (Hants) & River Ems Catchment

Figure 7 Hydrogeological Conceptual Site Model

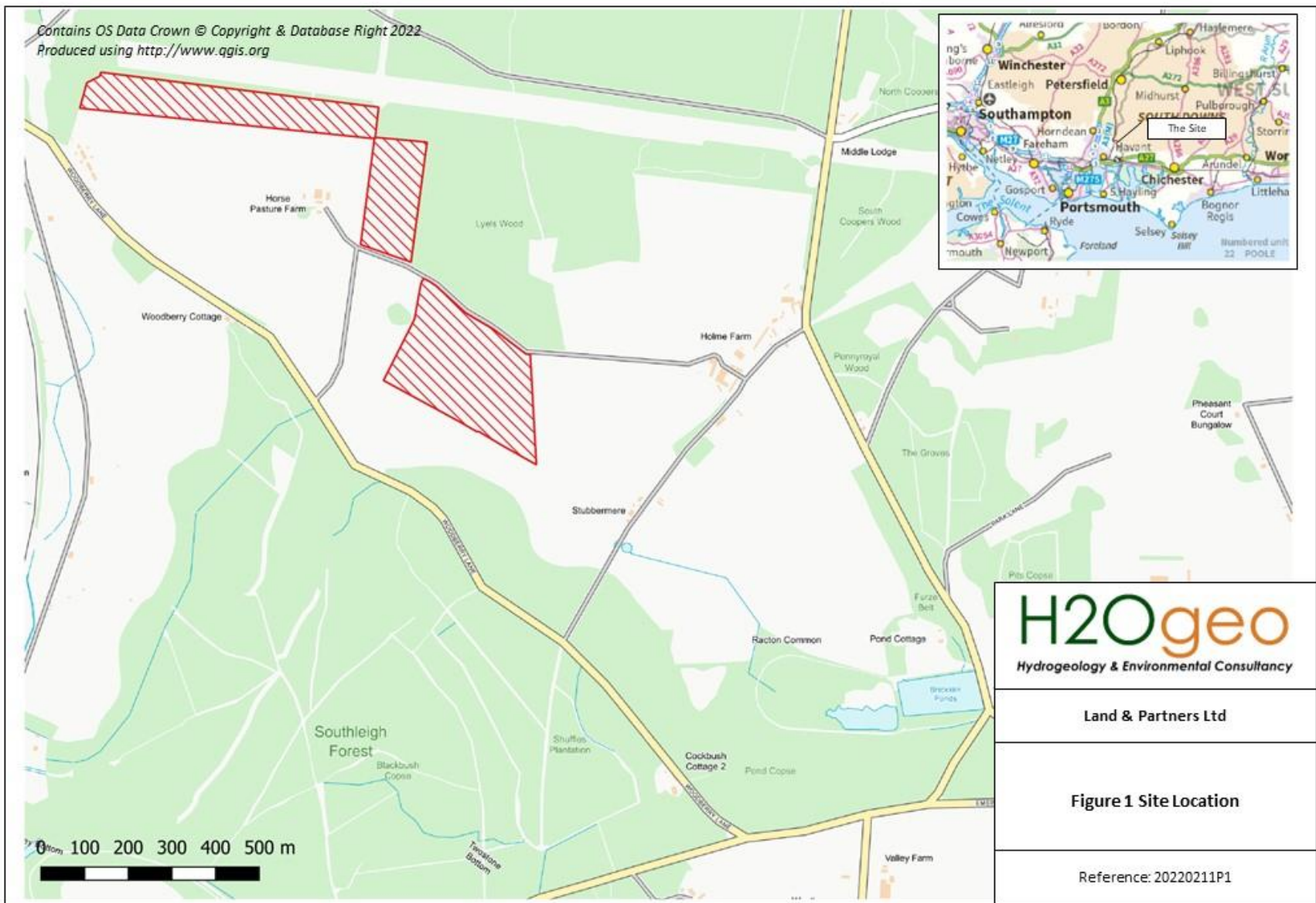


Figure 1 Site Location

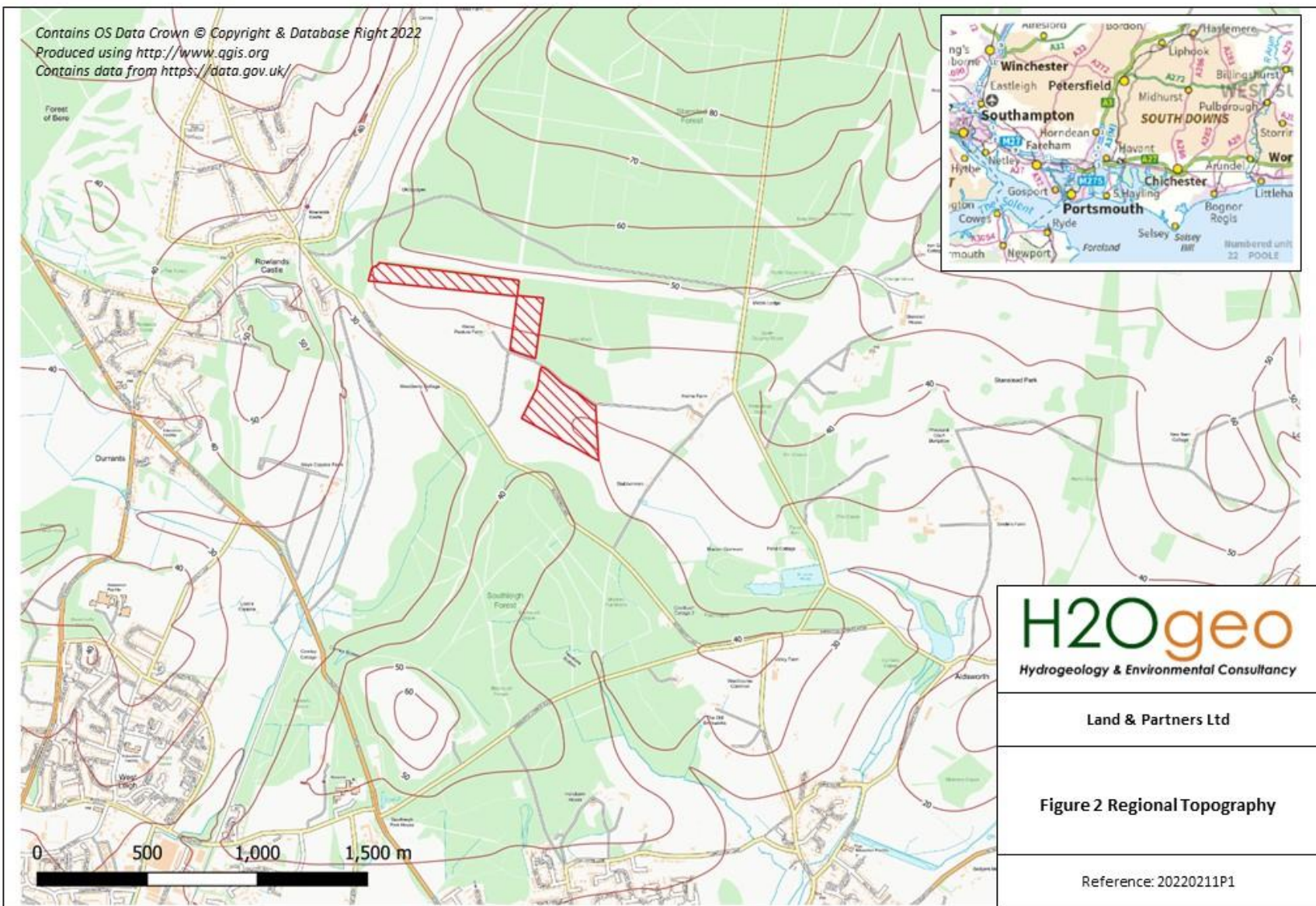
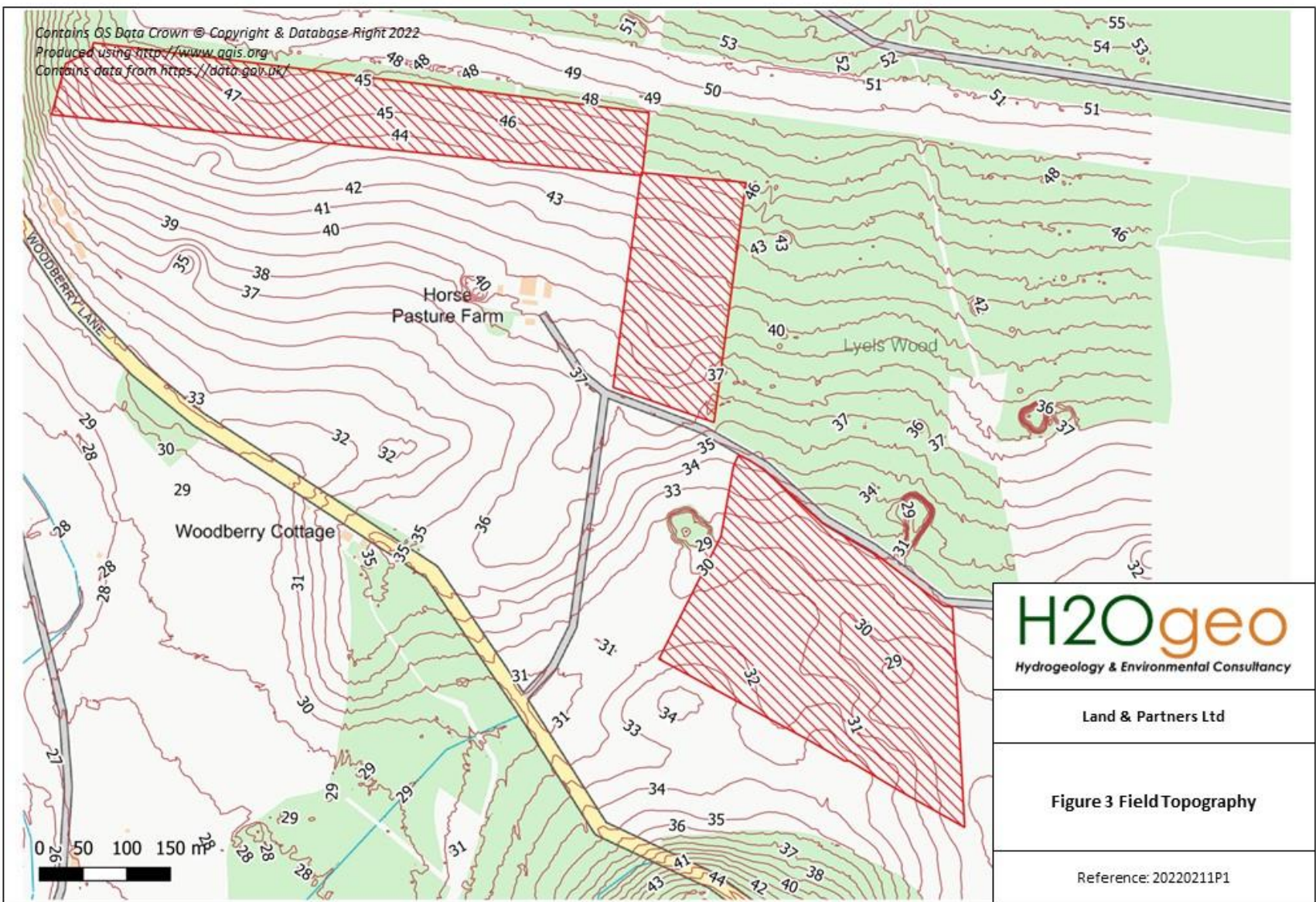


Figure 3 Field Topography



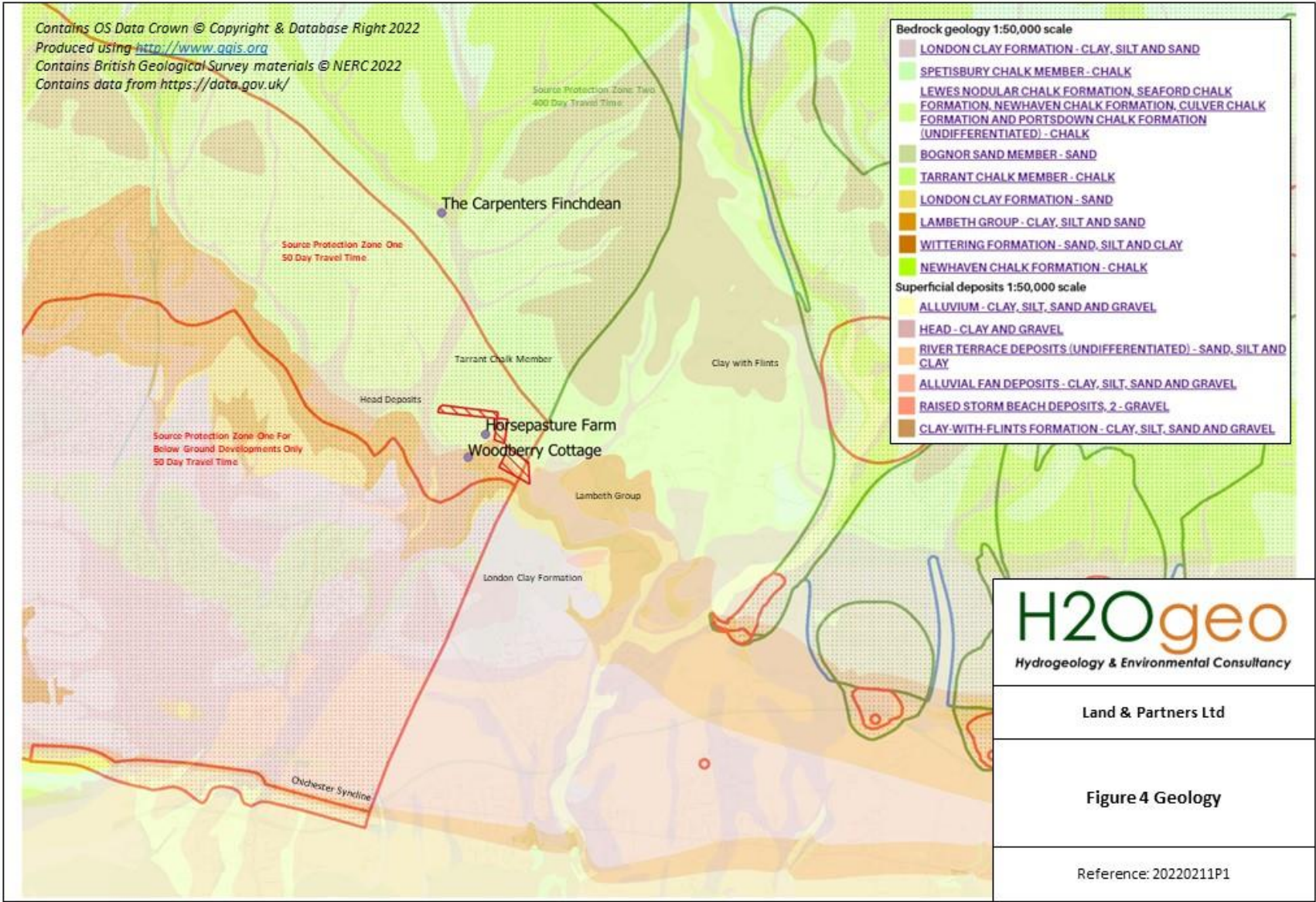


Figure 4 Geology

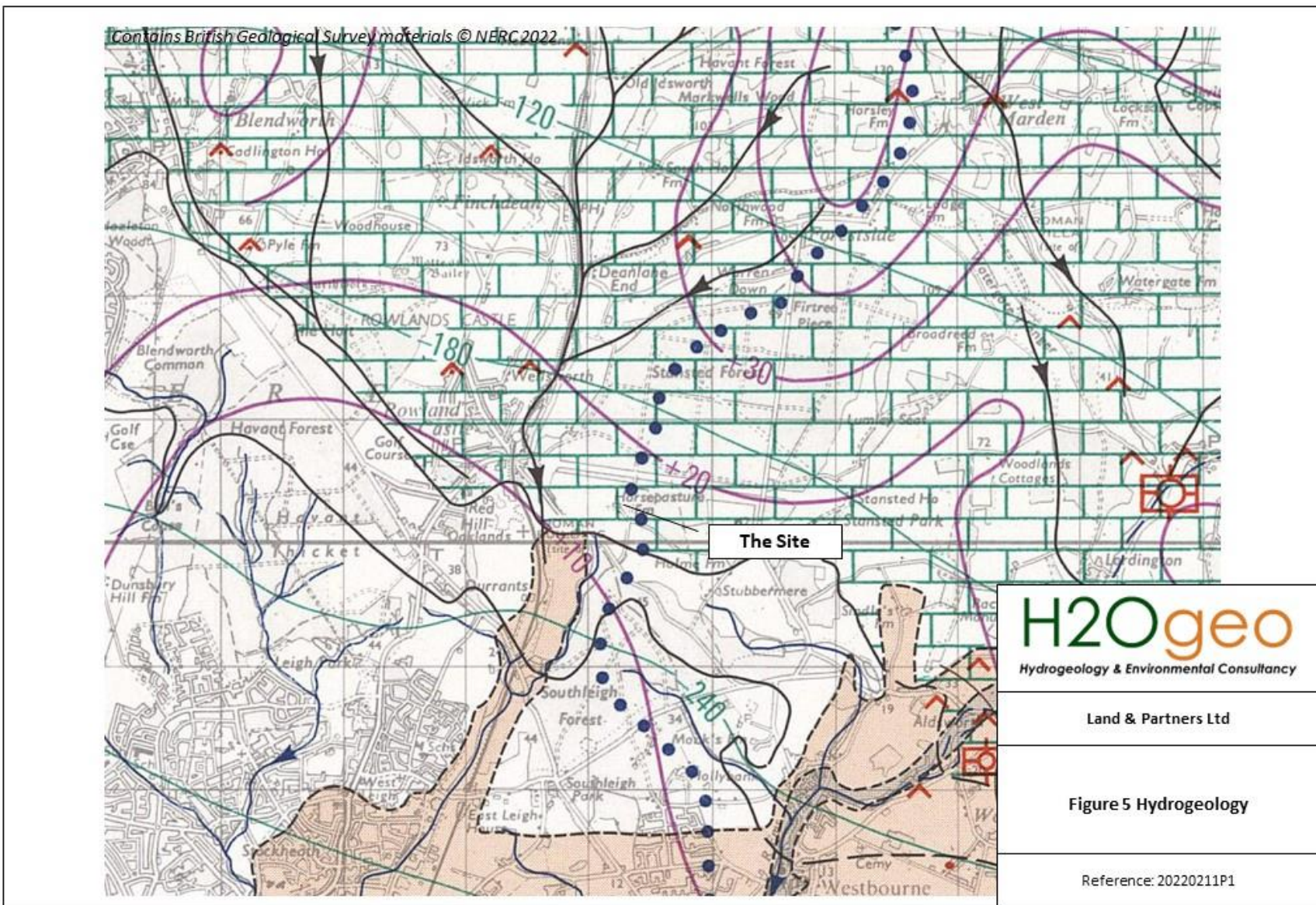


Figure 5 Hydrogeological Map

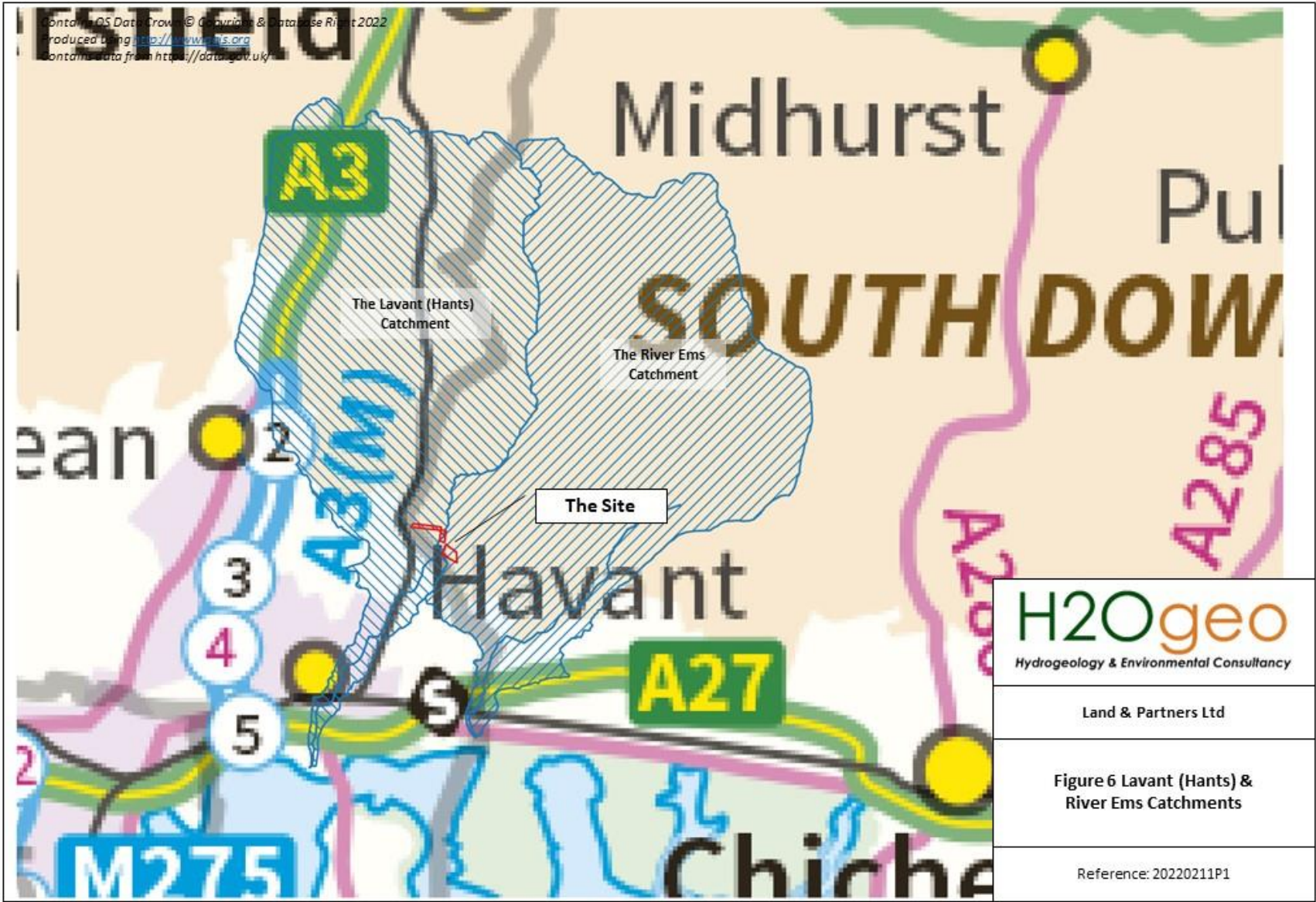


Figure 6 Lavant (Hants) & River Ems Catchments

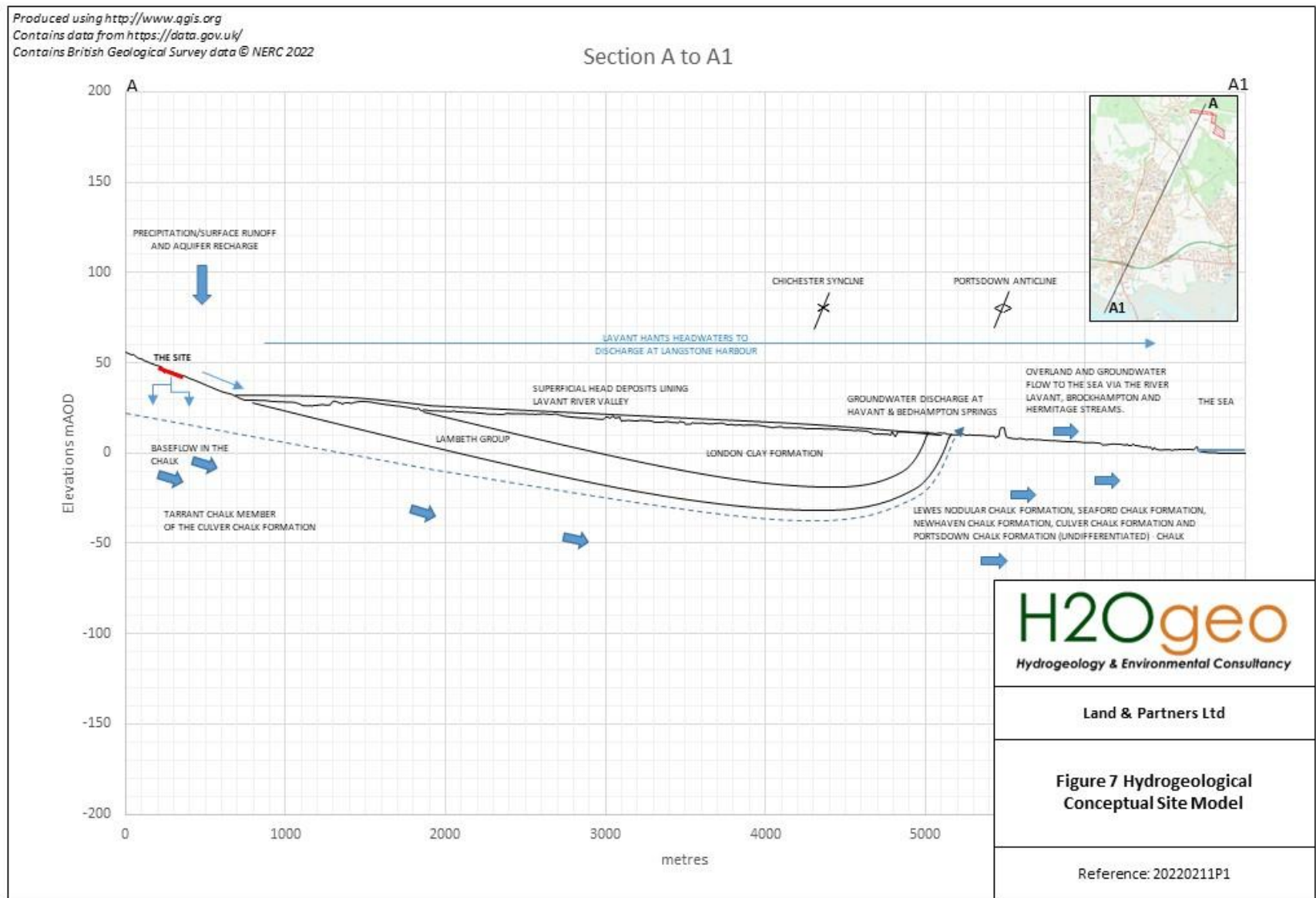


Figure 7 Hydrogeological Conceptual Site Model

10 Annexes

Annex A Client Drawings

