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26 April 2022

Reference: 20210311P1

Dear Laura,

AWDM/0608/20 - MONITORING OF WINTER GROUNDWATER LEVELS AT 45A UNDERDOWN ROAD, SOUTHWICK, WEST SUSSEX, BN42 4HN.

H2Ogeo was commissioned to provide information to support the Discharge of Condition 3 of planning permission AWDM/0608/20.

This letter report collates the data from 17 March 2021 to the 7 May 2021 and from 15 December 2021 to the 4 April 2022, delivering a technical summary of groundwater monitoring on site at 45a Underdown Road, BN42 4HN.

An infiltration test was carried out on the 25 March 2021 and results are presented in Annex A.

This report is submitted to support the discharge of the following planning Condition:

Development shall not commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the Local Planning Authority.

The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the recommendations of the SuDS Manual produced by CIRIA. Winter groundwater monitoring to establish highest annual ground water levels and winter infiltration testing to BRE DG365, or similar approved, will be required to support the design of any Infiltration drainage. No building / No part of the extended building shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.

Reason: To ensure adequate drainage and to comply with the National Planning Policy Framework and policy 36 of the Adur Local Plan.

The detailed design of surface water drainage will be provided under separate cover.

Proposed Development

The site is located at 45a Underdown Road, Southwick, West Sussex, BN42 2HN, the site location is presented in Figure 1 and centred on National Grid Reference TQ24022 05891 (northing 524022 Easting 105891) at the existing property named Hydrene.

The approved development is for the subdivision of the existing dwelling (Hydrene) to form two three-bed dwellings including construction of dormer windows to front (south) and rear (north)

roof slopes, construction of a four-bed bungalow with rooms in the roof in the garden to south of the existing dwelling, plus seven parking spaces.

Permission was granted by Adur District Council on the 15 December 2020 pending compliance with conditions.

Rainfall

Rainfall data from meteostat.net was obtained for the Shoreham Airport Shoreham Airport weather station.

The rainfall data is presented in Figure 2.

There was very little daily rainfall over the first monitoring period with two significant events occurring between 24 and 27 March and 30 April and 5 May 2021, the rest of the period was mainly dry.

The second period, December 2021 to April 2022, saw significant rainfall from the end of December 2021 to mid January 2022 and then most of February and late March.

Groundwater Monitoring

A borehole was commissioned by Wood & Associates LLP, drilled and installed by PJ Drilling on the 17 March 2021.

The borehole location is in the existing lawn area centred at National Grid reference TQ24034 05876 (Northing: 524034 Easting: 105876) and presented in Figure 3.

A 1.2m trial pit was excavated to check for services/utilities and the borehole was drilled using a Shell and Auger (Percussion) rig to a final depth of 7.8 metres below ground level (mbgl) into the top of the underlying Chalk Formation.

The borehole log is summarised in in Table 1:

Table 1 Borehole Description

Depth (metres below ground level)	***Description***	***Lithology***	***Thickness (m)***
0 to 1	Turf and topsoil, Orange Silty Clay with angular Gravels <20mm	Topsoil	<1.0m
1 to 2	Brown clay with gravels <20mm	Head Deposits	5m
2 to 3	Orange/Brown Sandy Gravel, Silts with large Flints		
3 to 4	Orange Sand, Fine to Medium		
4 to 5	Rounded pebbles rounded 40-50mm with Sand		
5 to 6	Orange Brown Silty Clay with Flints c.100mm		
6 to 7	Orange, Silty/Sand, Putty Chalk with Flints >100mm	Putty Chalk (Weathered surface of Chalk) <1.0m overlying the Tarrant Chalk Member	35 to 45m (base not proven during drilling)
7 to 7.80	Chalk with Flints		

Groundwater was not struck at the time of drilling and clean potable water was required to progress the borehole.

On completion at the top of the Tarrant Chalk Member 1.4m at the base of the borehole collapsed resulting in a 6m slotted pipe with filter pack being installed from 0.40mbgl to 6.40mbgl. Plain casing was installed from 0 to 0.40mbgl surrounded with bentonite pellets and a secure flush-mounted headworks constructed.

The finished headworks and borehole location are shown in Figure 3. The headworks has been levelled in using LiDAR Data and ground level at the borehole site is 11.30mAOD.

After 1 hour, following completion of drilling, groundwater was observed in the well at approximately 3mbgl.

A data logger was installed on the 19 March 2021 to a depth of 5mbgl and set to record groundwater elevations every 1 hour for the month of April 2021.

A second round of monitoring has taken place between December 2021 and April 2022 and the logger was redeployed for this period.

Manual dip measurements were carried out throughout both monitoring periods are provided in Table 2.

Table 2 Manual Groundwater Monitoring

Date	***Groundwater Depth mbgl***	***Groundwater Elevation mAOD***	***Borehole Toe mbgl***	***Borehole Toe Elevation mAOD***
17 March 2021	3	8.30	Open Hole	Not Measured
19 March 2021	2.11	9.19	6.40	4.90
25 March 2021	2.36	8.94	6.40	4.90
29 March 2021	2.61	8.69	6.40	4.90
30 April 2021	3.90	7.40	6.40	4.90
7 May 2021	4.15	7.15	6.40	4.90
15 December 2021	(DRY)	(DRY)	5.93	5.37
17 February 2022	5.91	5.39	5.93	5.37
4 April 2022	(DRY)	(DRY)	5.93	5.37

It should be noted that approximately 0.47m of the bottom of the borehole has silted up between May 2021 and December 2021.

The data logger was retrieved from the borehole on the 7 May 2021, redeployed on the 15 December 2021, recovered on 4 April 2022 and compensated against barometric data. The automated groundwater elevation profiles along with the manual dips for both monitoring periods are presented in Figure 4 and Figure 5.

Surrounding Groundwater Monitoring Data

The closest public record of continuous groundwater monitoring is located at Whitelot Bottom Groundwater Level Monitoring Station located approximately 2.5km north-north-west of the site.

The observation borehole is approximately 116m deep and was drilled in 1973. The borehole penetrates the Newhaven Chalk Formation, it's ground level is approximately 128mAOD[1]. The Newhaven Chalk underlies the Tarrant Chalk Member.

Figure 6 presents the groundwater elevations from February 2021 to present.

The two peaks represent the Winter highs during this period ranging from 39.86mAOD in February 2021 to 33.60mAOD in February 2022. There is an inflection in the elevation data in March 2022 that is likely to represent the rainfall received prior to this period (Storm Eunice 18 February 2022). Groundwater elevations drop Whitelot Bottom at the start of April 2022.

Whilst the Whitelot Bottom record is useful to observe regional seasonal patterns it is unlikely to be representative of trends beneath the site in the shallow geology. This is due to the 80m unsaturated zone in the Newhaven Chalk Formation and the borehole only monitoring the underlying geology of the Newhaven Chalk Formation. The Tarrant Chalk Member, on site, is part

[1] LiDAR data.

of the Culver Chalk Formation that overlies the Newhaven Chalk Formation and is therefore not present in the Whitelot Bottom borehole.

Data from other nearby borehole logs taken from the British Geological Survey's Geoindex onshore database are presented in Table 3 and Figure 7, comments on groundwater strikes and/or elevations are also shown:

Table 3 BGS Borehole Logs

Reference	*Name*	*Length m*	*Date*	*Ground level mAOD*	*Easting*	*Northing*	*Groundwater comments*
TQ20NW131	SOUTHWICK SEWERAGE SCHEME	10	4 April 1979	12.33	524080	105960	Strike at 5.70mbgl in sand layer, rest water level at 5.20mbgl.
TQ20NW123	SOUTHWICK SEWERAGE SCHEME	10	18 March 1979	15.29	523840	105990	Strike at 9.50mbgl in fine silty sand layer, rest water level at 9.30mbgl.
TQ20NW94	96 SOUTHVIEW ROAD SOUTHWICK	45.72	1950	15.24	524250	105990	Rest water level at 5.33mbgl.
TQ20NW129	SOUTHWICK SEWERAGE SCHEME	10.5	27 March 1979	14.63	524210	105990	Strike level at 7.60mbgl in gravel Layer. Rest water level at 7.40mbgl.
TQ20NW124	SOUTHWICK SEWERAGE SCHEME	10	16 March 1979	11.04	523990	105820	Strike 5.20mbgl in sand with cobbles. Rest water level at 5.60mbgl.
TQ20NW130	SOUTHWICK SEWERAGE SCHEME	10	2 March 1979	9.70	524070	105800	Strike at 4.20mbgl in sand. Rest water level 3.80mbgl.
TQ20NW125	SOUTHWICK SEWERAGE SCHEME	10	13 march 1979	7.70	524120	105670	Strike at 3.70mbgl in sand. Rest water level 3.40mbgl.
TQ20NW126	SOUTHWICK SEWERAGE SCHEME	10	13 March 1979	6.89	524190	105620	Groundwater strike at 3.4mbgl in sand. Rest water level 3.20mbgl.
TQ20NW127	SOUTHWICK SEWERAGE SCHEME	10	13 March 1979	8.88	524210	105770	3.00mbgl strike in sand. Rest water level 3.10mbgl.
TQ20NW128	SOUTHWICK SEWERAGE SCHEME	10	26 March 1979	12.42	524210	105910	Groundwater strike at 6.20mbgl in sand. Rest water level 6.00mbgl.

The surrounding data for the Sewerage Scheme Boreholes in Table 3, indicates groundwater was typically struck in a sand layer overlying the Chalk. The logs indicate a rise in most boreholes between 0.10 and 0.5m.

Groundwater Elevation Discussion

Groundwater strikes were not encountered during drilling.

Groundwater was observed to enter the borehole and fill to 3mbgl in 1 hour after drilling stopped. Levels had risen to 9.19 mAOD two days after installation and then began to recede. Groundwater elevations fell throughout the month of April 2021 and the first round of monitoring was completed at 7.15mAOD on 7 May 2021.

The Head deposits were dry during drilling and the rapid rise in groundwater elevations in the borehole, following installation, suggests the Head has confining properties at this location.

Figure 4 presents the groundwater monitoring data from 19 March 2021 to 7 May 2021 and shows groundwater elevations receding and remaining in the Head Deposits during this period.

Based on the findings of the drilling it is unlikely, without penetrating the sand layer above the Chalk and/or the top of the Tarrant Chalk Member, significant groundwater would be present in the shallow Head Deposits (<3.0mblg) on site.

This has been confirmed during the subsequent groundwater monitoring between December 2021 and April 2022 (Figure 5).

It is unlikely that groundwater has appeared in the borehole during this recent Winter period and, has remained at least 5.80m below ground level on site.

Summary

Groundwater was only encountered having penetrated the Chalk between 6 and 7 metres below ground level. Groundwater recovered to approximately 3mbgl one hour following completion of the drilling indicating confined conditions in the underlying Chalk.

Without penetrating the top of the Chalk at depth it is not anticipated that groundwater would be encountered at significant elevations.

Hourly groundwater elevations were recorded between the 19 March 2021 and 7 May 2021 and show a recession in levels over the monitoring period. The monitoring does show the influence of rainfall in groundwater elevations.

Further monitoring, during the 2021/2022 Winter, has indicated that groundwater is unlikely to have entered the borehole during this period and therefore natural elevations are at least 5.8m below ground level on site.

The JBA Groundwater Map, Appendix H, Strategic Flood Risk Assessment[2], identifies areas prone to groundwater flooding within Adur District. The site is located in an area considered to have 'No Risk' of groundwater flooding.

Based on the monitoring carried over two Winter periods, the surrounding geological and hydrogeological information it is considered unlikely that surface water, discharging via soakaways, at 1mbgl would encounter groundwater, be susceptible to or exacerbate flooding in the area.

Yours sincerely

[redacted]

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[2] SFRA - Appendix H - JBA Groundwater Flood Risk Mapping (adur-worthing.gov.uk)

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 above 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.

Figures

Figure 1 Site Location

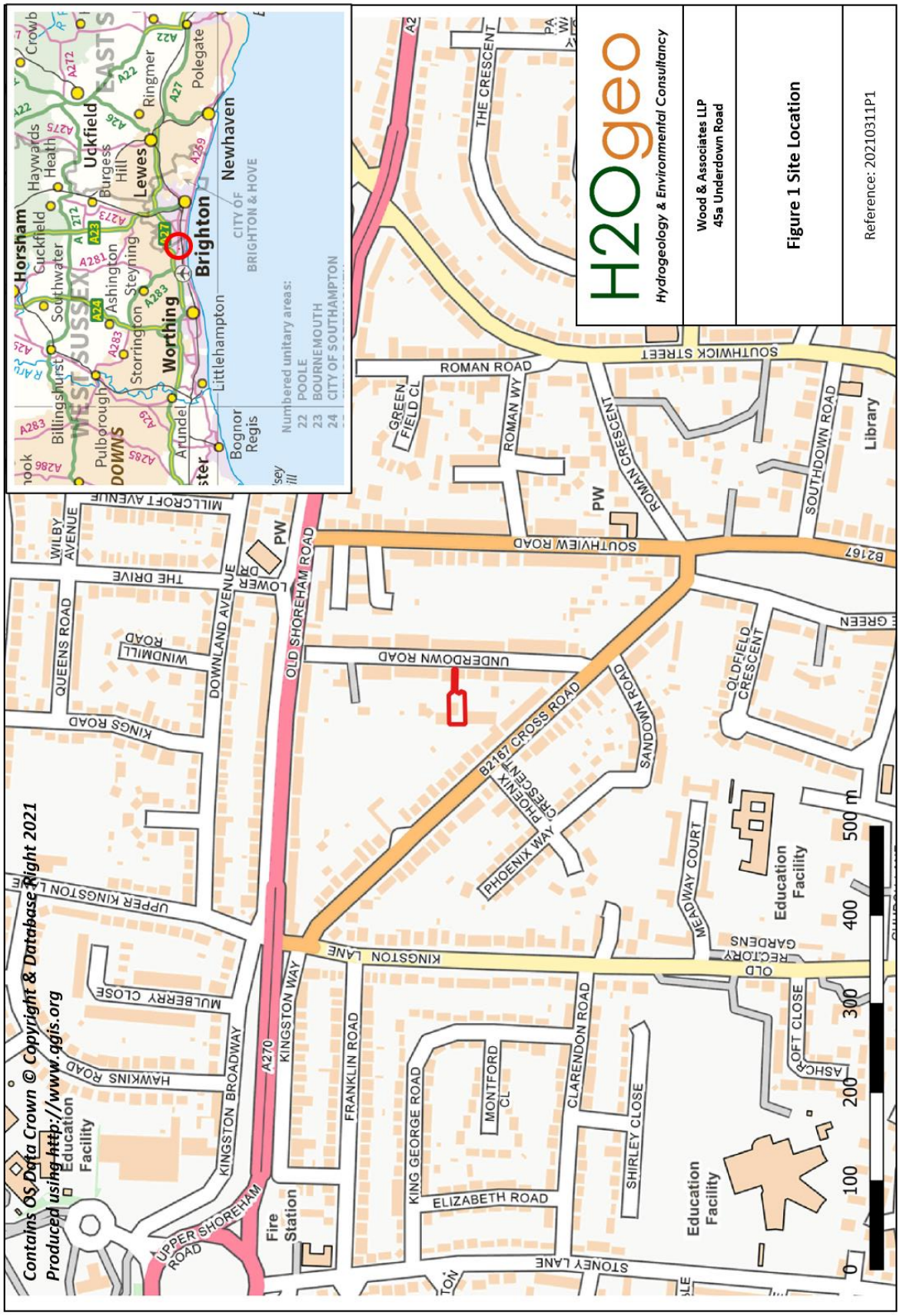


Figure 2 Rainfall

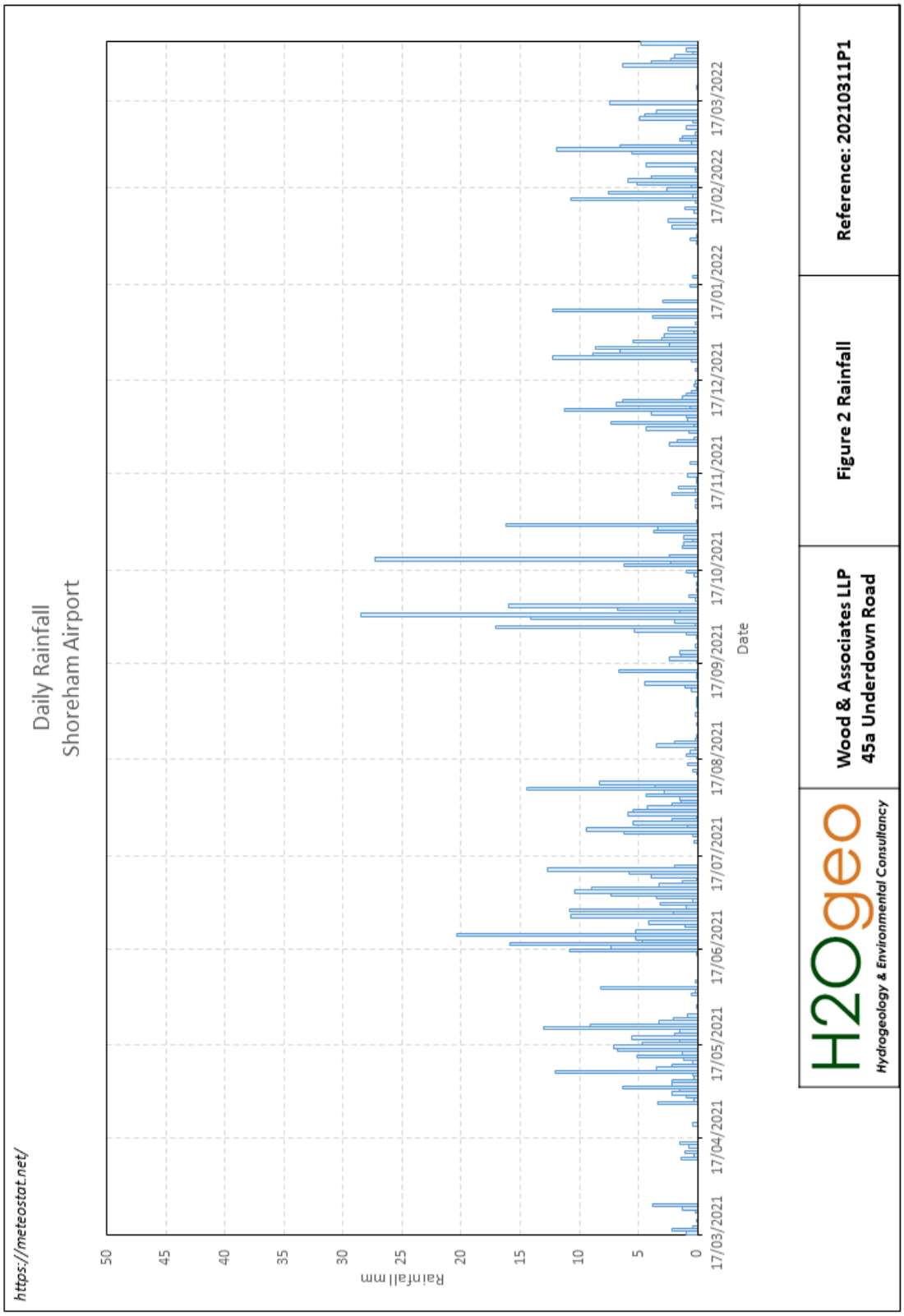


Figure 3 Borehole Location

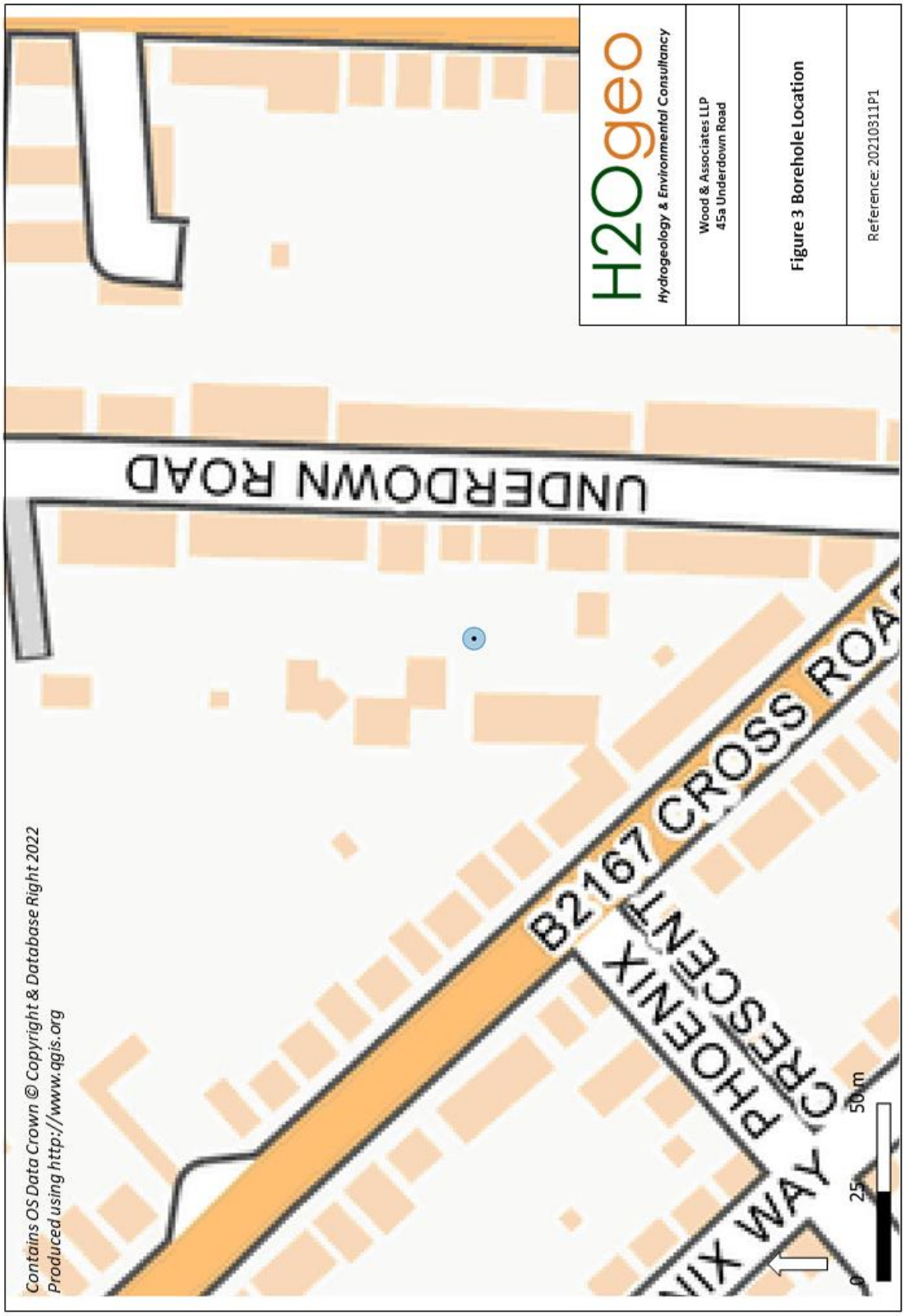


Figure 4 Monitoring Winter 2021

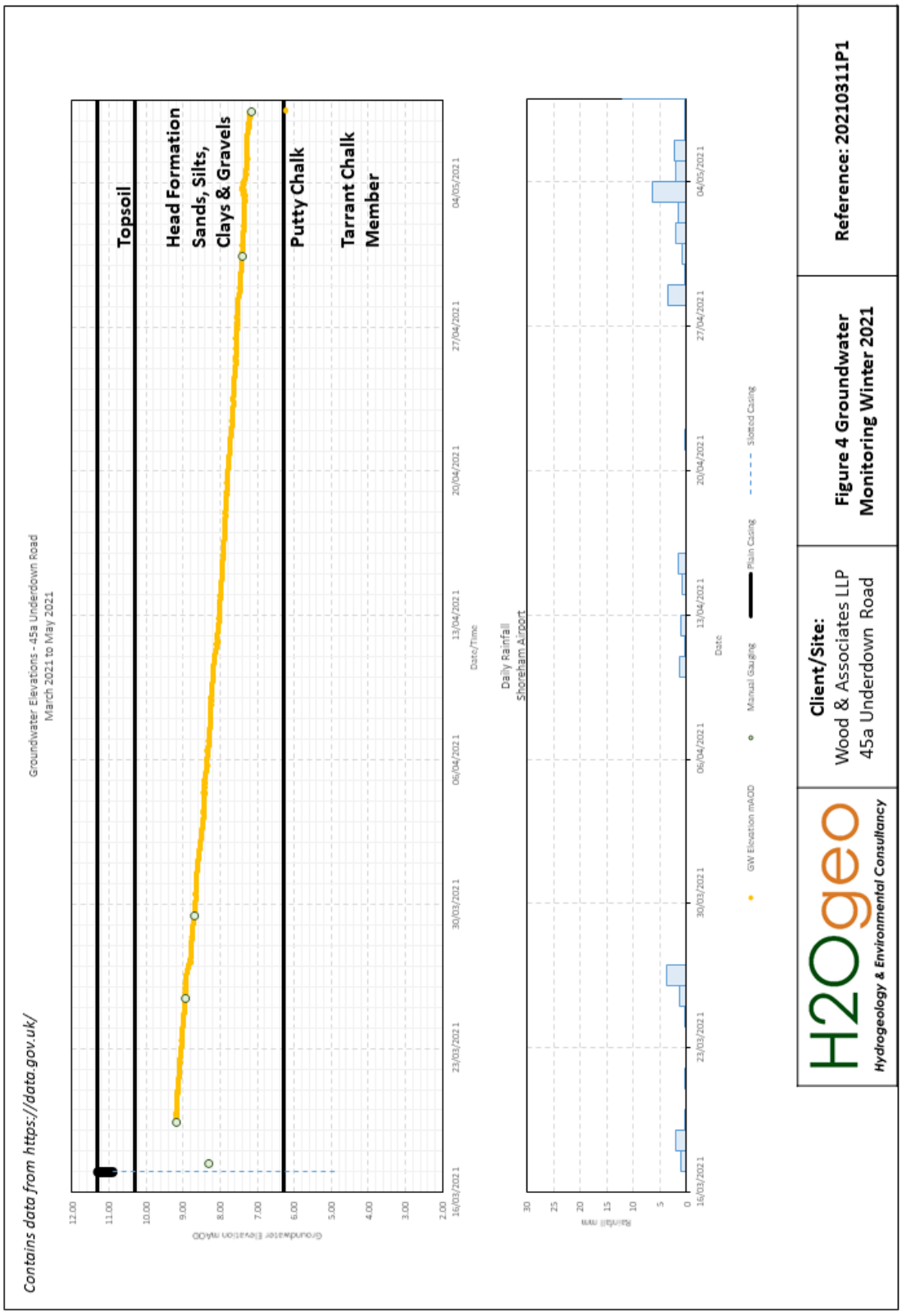


Figure 5 Monitoring Winter 2021/2022

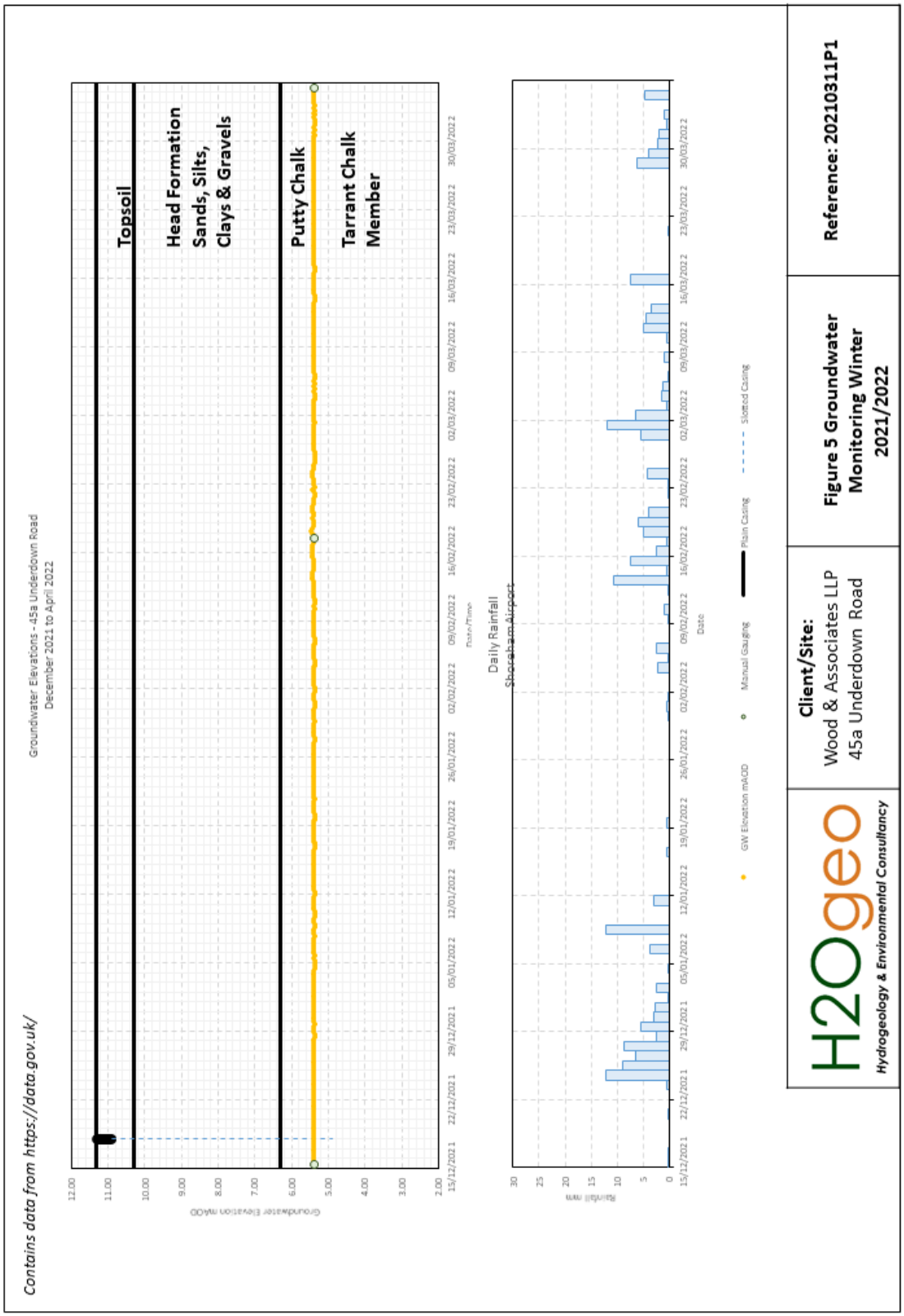


Figure 6 Whitelot Bottom

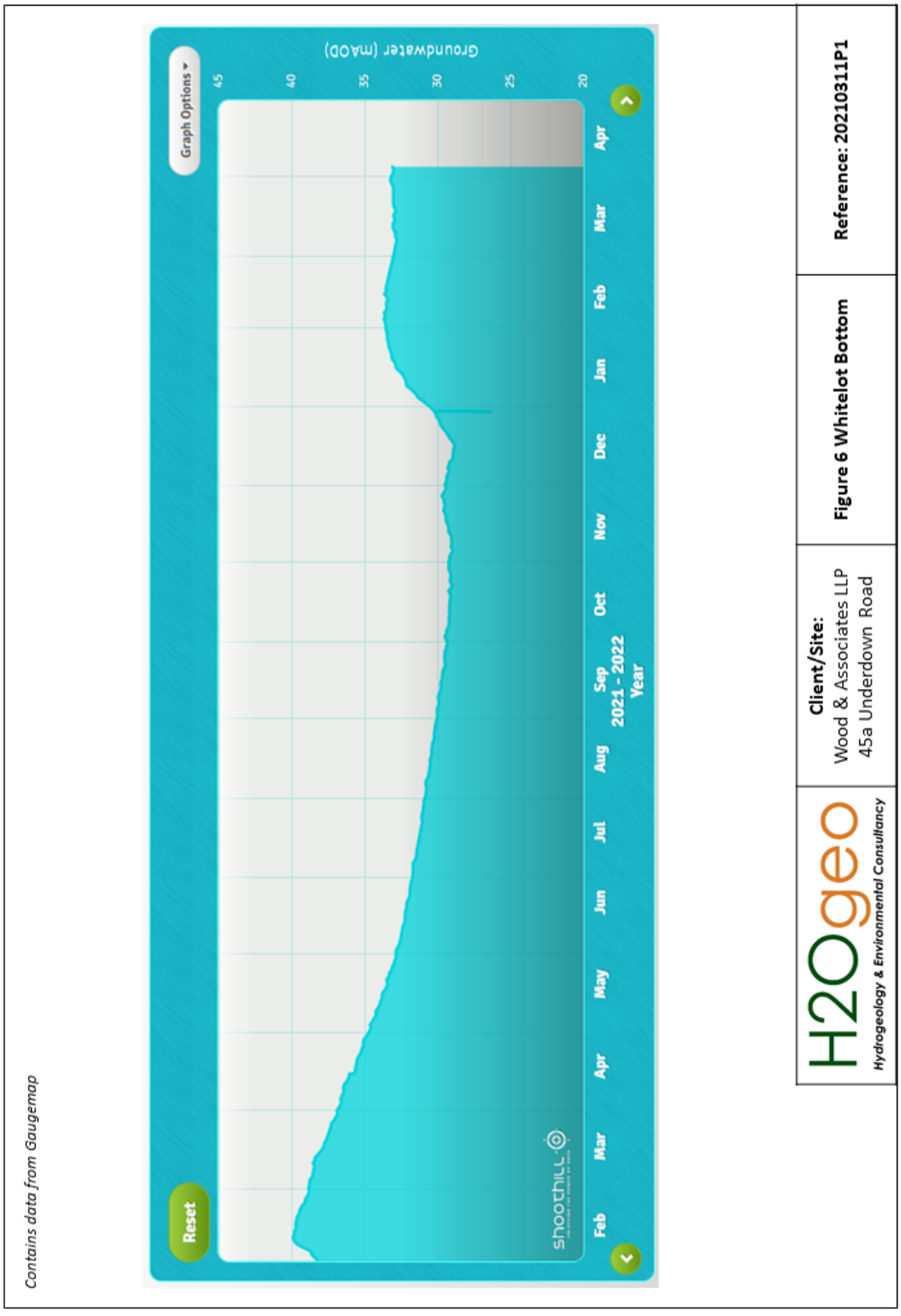
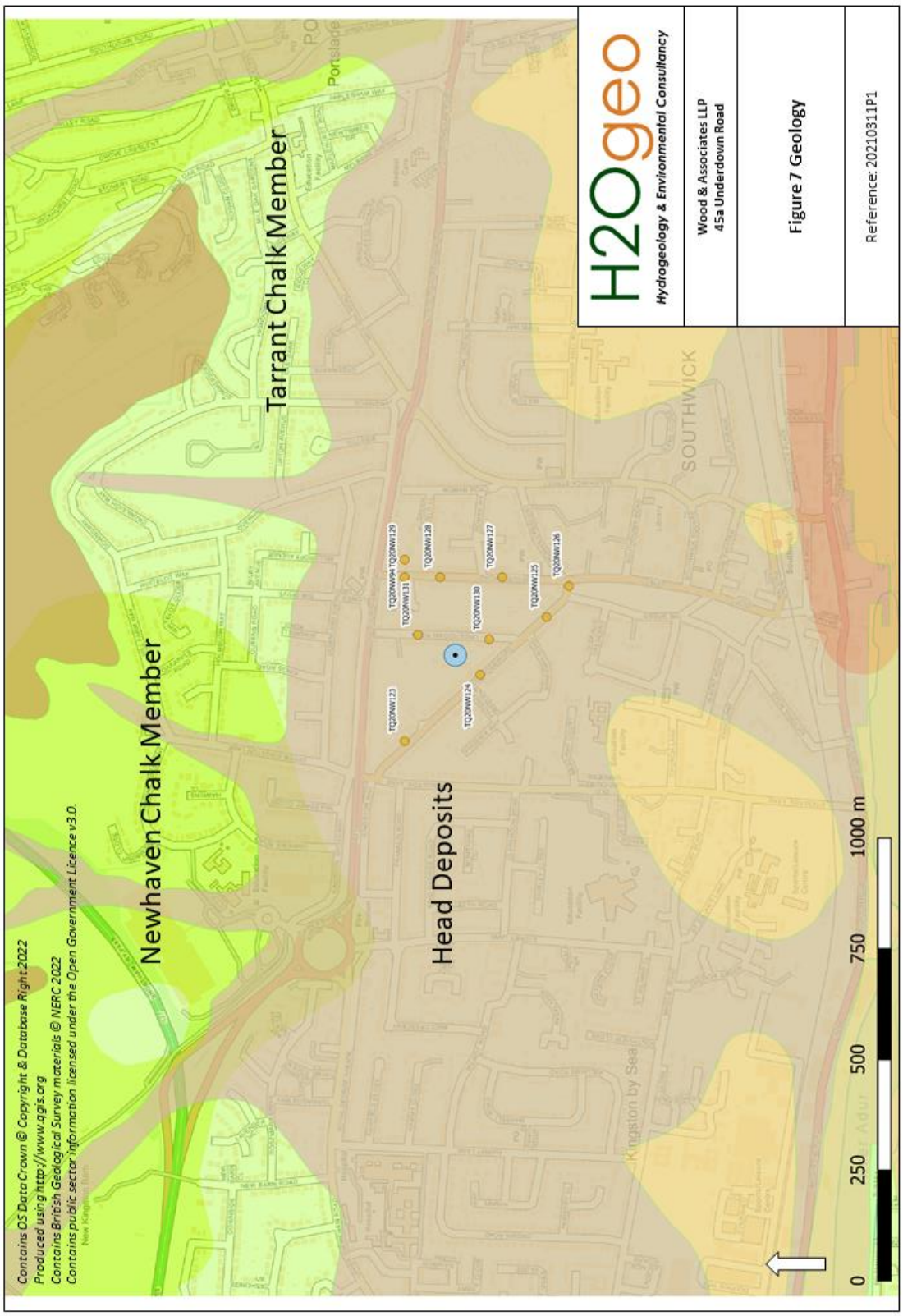


Figure 7 Geology



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Annex A Infiltration Testing

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H2Ogeo	**Project:**	45a Underdown Road, BN42 4HN		**By: H2Ogeo**
	Calculation:	Soakaway Design		
		Infiltration Rate		**Approved: DW**
	Sheet Number:	1	**Date:** 25-Mar-21	

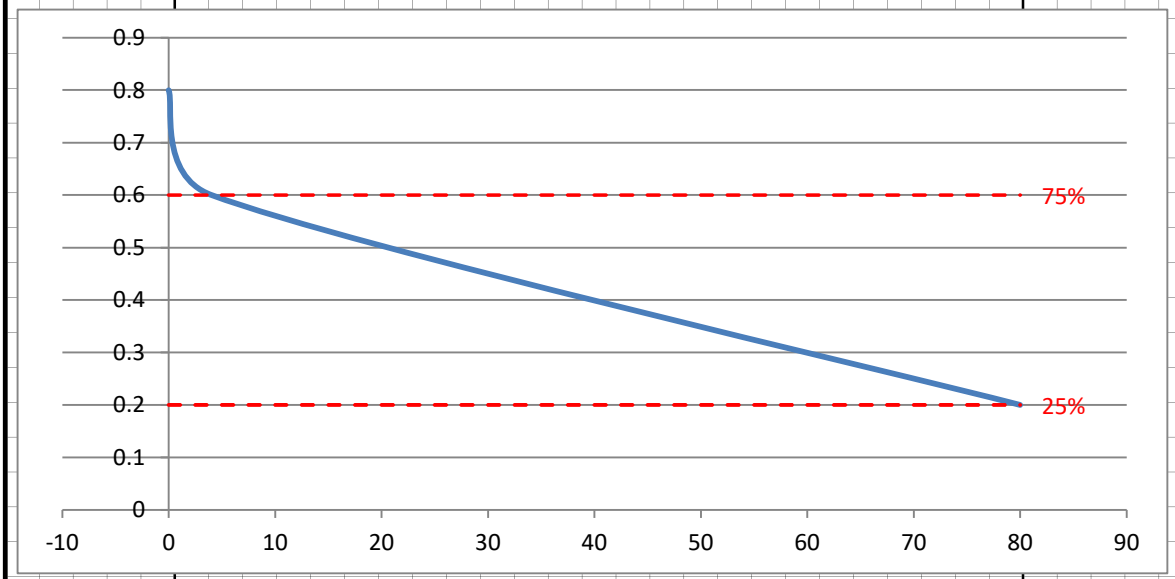
Infiltration Test (BRE 365)

Trial Pit Details

Total Pit Depth	1.2	m
Total Pit Length	1.4	m
Total Pit Width	0.3	m

Test Results

	Time (Mins)	Water Level (From Base)
1	0	0.80
2	4	0.60
3	80	0.20



H2Ogeo	**Project:**	45a Underdown Road, BN42 4HN		**By: H2Ogeo**
	Calculation:	Soakaway Design		
				Approved: DW
	Sheet Number:	2	**Date:** 25-Mar-21	

Results

Time to reach 75% depth:	4.0	mins
Time to reach 25% depth:	80.0	mins
Soil Infiltration Rate:	**2.06978E-05**	m/s
	0.074512123	m/hr