The Sizewell C Project

9.34 Fen Meadow Plan Report - Baseline Report

Part 2 of 2

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Fen Meadow Plan Report 1 – Baseline Report

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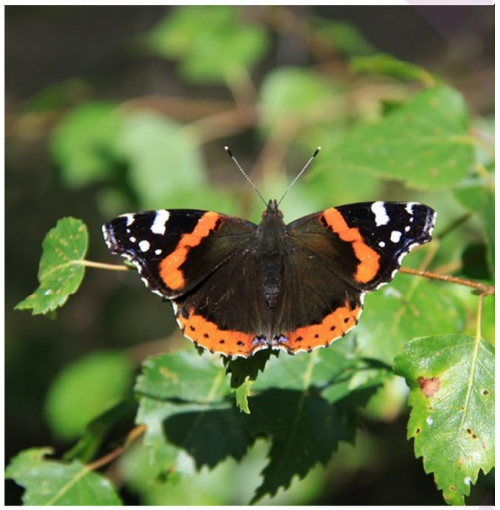
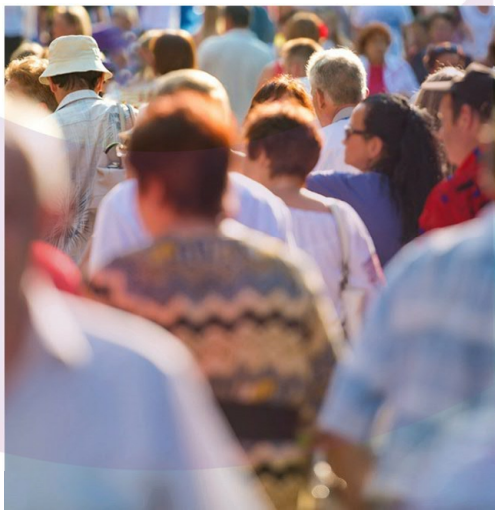
EDF Energy

Sizewell C

Fen Meadow Compensation Site: Halesworth Site 28 Baseline Hydrogeological Report





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1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, were reported in Wood (2018)[1]. Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the site margins;
- A reconnaissance hand augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);

[1] Wood (2018). *Sizewell C. Fen Meadow Compensation Study – Approach and Initial Site Screen Report 2018*. EDF Energy

- Site 28: primary locus 1.2ha, further area 1.3ha;
- Site 54 north: primary locus 3.2ha, further area 6.2ha; and
- Site 54 south: primary locus 1.7ha, further area: 4.3ha.

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the Sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available hydrogeological data;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This Report

This report presents the hydrogeological baseline for Site 28 Halesworth (hereafter the 'Halesworth site' or 'the Site') (Figure 1.1).

The structure of this report is as follows:

- Section 2 presents the methods and sources of data gathering and a summary of survey work undertaken;
- Section 3 presents the baseline environmental characteristics of the Sites;
- Section 4 presents an initial conceptual site model.

2. Data Gathering Methodology

2.1 Study Area

The geographical extent of the study area for this report focuses on the area within the Site boundary (Figure 1.1), together with relevant information obtained from a nominal 2km search area around the extension.

2.2 Desk Study Sources

A summary of the organisations that have supplied data, together with the nature of that data is summarised in Table 2.1 below.

Table 2.1 Sources of desk study information

Source	Data
Wood (and Subconsultants)	Details of soil core survey. Details of piezometry and exploration boreholes (Structural Soils Ltd). Details of gaugeboard installations (WSP UK Ltd). Topography of Proposed Development (WSP UK Ltd).
Ordnance Survey **OS, 1: 25,000, Explorer Sheet 231 Southwold & Bungay (Halesworth & Kessingland)**	Topography, relief, springs, wells, watercourses, surface waterbodies
Environment Agency (by enquiry)	Rainfall data for closest raingauge - Benhall rain gauge. Flow data for Blyth at Holton. Observation Borehole data for Chalk borehole TM47/070. Locations of licensed and deregulated surface water and groundwater abstractions and consented discharges.
Environment Agency (Online) **Catchment Data Explorer** http://environment.data.gov.uk/catchment-planning/ **Main Rivers Map** https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386 **East Suffolk WFD Management Area Abstraction Licencing Strategy** https://www.gov.uk/government/publications/cams-east-suffolk-abstraction-licensing-strategy	WFD waterbody status and objectives. River designations. Abstraction licensing strategies.
Centre for Ecology and Hydrology - National River Flow Archive On-line https://nrfa.ceh.ac.uk/data/station/meanflow/35013	River Blyth at Holton gauging station – flows, statistics, catchment daily rainfall, and catchment descriptors
Cranfield University Land Information System http://www.landis.org.uk/soilscapes/	Soil types

Source	Data
British Geological Survey (BGS) **British Geological Survey, 1996. Lowestoft. England and Wales Sheet 176. Solid and Drift Geology. 1:50 000. (Keyworth, Nottingham: British Geological Survey)** **British Geological Survey, 2000. Geology of the country around Lowestoft and Saxmundham: memoir for 1:50000 geological sheets 176 & 191 (England & Wales) (Author: Morlock et. al.)** **BGS Digital Mapping** **BGS Online** https://www.bgs.ac.uk/geoindex/	Geological mapping (1:50 000 scale). Geological sheet description. Stratigraphic and lithological information. Borehole locations.
BGS Major Aquifer Properties Manuals (Allen *et al.*, 1997) **BGS Minor Aquifer Properties Manuals (Jones *et al.*, 2000)**	Hydrogeological characteristics
MAGIC On-line http://magic.defra.gov.uk/MagicMap.aspx	Conservation sites, groundwater vulnerability map, aquifer designation map, Nitrate Vulnerable Zones, Source Protection Zones
Natural England https://designatedsites.naturalengland.org.uk/	Locations and citations of protected sites
Open Government Data On-line https://data.gov.uk/	Authorised and historic landfills
East Suffolk District Council	Information regarding private water supplies

2.3 Survey Work

2.3.1 Initial Survey

An initial hand augering survey was undertaken in April 2019 to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater. Findings were reported in Wood (2019).

Following the findings of the Wood (2019) report a programme of hydrogeological monitoring was designed to enable collection of site specific baseline data, aid site conceptualisation and inform options for fen meadow compensation.

2.3.2 Installations and Monitoring

Following an initial site walkover to establish suitable monitoring locations in July 2020, a programme of installation works commenced on 5th October 2020 for a period of 3 weeks. Details are provided below and are presented in Figure 2.1.

Surface Water Monitoring

Four gaugeboards were installed between 12th and 16th October 2020 to allow monitoring of surface water levels in site watercourses / drains. Three of the gaugeboards included stilling wells and water level data loggers. Installation reports are provided in Appendix A and a summary is given in Table 2.2 below.

Table 2.2 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Top of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
HAL-GB01	TM 39161 76703	Tbc	1	OTT Orpheus Mini	15
HAL-GB02	TM 39185 76674	Tbc	1	OTT Orpheus Mini	15
HAL-GB03	TM 39132 76581	Tbc	2	OTT Orpheus Mini	15
HAL-GB04	TM 39080 76655	Tbc	1	n/a	n/a

*mAOD = metres above ordnance datum

A programme of monthly monitoring visits commenced in November 2020 to download and record surface water data at the gaugeboard locations and obtain in-situ water quality readings. Monthly spot flow gauging at selected watercourses and drains also commenced in November 2020.

Groundwater Monitoring

Seven groundwater monitoring points were installed between 5th and 23rd October 2020. Four shallow dipwells were installed to measure groundwater levels in the superficial near surface deposits. Three piezometers were installed to measure groundwater levels in the Crag, one of which was originally planned to penetrate the underlying chalk but complications during drilling (collapse) resulted in completion of this installation near the base of the Crag deposits. Two of the Crag piezometers are nested (within the same borehole) with a dipwell. Drilling logs are presented in Appendix B and an installation summary is provided in Table 2.3 below.

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Water quality samples will also be collected quarterly and sent for laboratory analysis. In addition to the quarterly monitoring a programme of monthly monitoring will be undertaken to manually record groundwater levels and in-situ water quality readings.

The groundwater level data will give insight into the groundwater gradient across the Site and will help to identify vertical head gradients (if present) between aquifers.

Table 2.3 Summary of groundwater monitoring installations

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
HAL_2801_d	bh2801	TM 38990 76600	7.254	6.689	10	50	Nested with HAL_2801_s
HAL_2801_s	bh2801	TM 38990 76600	7.254	6.869	40	50	Nested with HAL_2801_d

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
HAL_2802_d	bh280	TM 39098 76604	6.886	6.653	10	50	Nested with HAL_2802_s
HAL_2802_s	bh2802	TM 39098 76604	6.886	6.653	10	50	Nested with HAL_2802_d
HAL_2803_d	bh2803	TM 38985 76600	7.142	6.881	40	50	
HAL_2803_s	ws2803	TM 39051 76659	7.312	7.05	3	50	
HAL_2804_s	ws2804	TM 39143 76703	7.114	6.869	2	50	

s = shallow; d = deep
*m bgl = metres below ground level

Topographic Survey

A topographic survey of the Site was conducted in November 2020. The purpose of the survey is to allow profiling of the land surface and channels so that water levels and ground levels can be related to a common datum to further inform potential water management options.

The survey involved two long sections across the Site, eight short ditch sections across watercourses / ditches, and a topographic grid of the primary locus area for fen meadow. The results of the survey are presented in Appendix C.

3. Baseline Environmental Characteristics

3.1 Site Description

The Halesworth site (Figure 1.1) is a section of floodplain by the Walpole River (minor tributary of the River Blyth) on the south side of Halesworth, immediately east of the Bramfield Bridge where the A144 crosses the river valley. The Walpole River drains the thinning margin of the East Anglian clay plateau to the west, where sands and gravels and crag sands have been exposed on the valley sides. Upstream of the river, land use is agricultural; the Site itself lies between the river and a modern industrial estate and is immediately upstream of Halesworth Sewage Treatment Works.

The site boundaries are defined by the river on the southern side and by the recently constructed Blyth Road on the upland margin. As seen elsewhere on this river section, the floodplain is dissected by drainage ditches leading from the base of the upland onto the channel corridor. All ditches run from a catch dyke running from beside the A144 along the upland toeslope to the eastern corner of the Site. Here, although the dyke extends further along the floodplain margin, it is connected to a substantial ditch that crosses the floodplain to join the only cut-off meander within the Site. The modern course of the Walpole is otherwise long-established, though a low bund extends across the Site's frontage.

The redline boundary for the Site area is shown on Figure 1.1. Figure 1.1 also shows the primary locus area for fen meadow (1.2 ha) and potential additional area for fen meadow (1.3 ha).

3.2 Landscape and Topography

The Site is positioned immediately adjacent to, and on the northern side of, the Walpole River which flows past the Site from southwest to northeast. Ordnance survey maps show that ground level falls from highs of approximately 40 mAOD west of Halesworth to 10 mAOD just north of the Site and to around 5 mAOD in the valley floor.

The recent topographic survey of the Site (Appendix C) focused on the primary locus area for fen meadow along with long sections and ditch profiles. A topographic profile for the whole site has been extrapolated from the available data and is presented in Figure 3.1.

The recent topographic survey shows that the north-western boundary of the Site ranges from *c.*7.5 mAOD in the west to *c.*8.25 mAOD in the east. The land surface gently slopes to the southeast and levels out at around 6.9 m before gently falling to a bank level of 6.6 mAOD at the catch dyke. The catch dyke water level was recorded to be between 6.33 and 6.42 mAOD during the survey. On the south-eastern side of the catch dyke the land surface is relatively flat but undulates between 6.6 mAOD and 7 mAOD, with a raised bank level along the Walpole River in the southern part of the Site. The Walpole River had a water level of 5.56 mAOD at the time of the survey. The bank of the Walpole River is relatively steep, more so at the southwestern end of the Site.

The catch dyke bed level is approximately 5.4 mAOD at its deepest, giving a water depth of approximately 0.7-0.8 m. The ditches connected to the catch dyke are generally 0.5 to 1.0 m deep and follow topography.

Utility plans indicate that surface drainage from Blyth Road is conveyed below the land surface and beneath the catch dyke through a culvert. This main drainage channel flows into the Walpole River through a second culvert which has an invert level of 5.59 mAOD on the Site side and 5.55 mAOD on the Walpole River side.

3.3 Climate

Daily rainfall data have been supplied by the EA for the nearest raingauge located at Benhall TBR *c.* 16 km north of the Site for the period 1991 to 2019 (see inset on Figure 3.2 for location). There are quite a few years with missing or suspect data but from the years with a full dataset the long-term average (LTA) rainfall is calculated to be 574 mm/a.

A long term time series (1961-2017) of catchment daily rainfall (CDR) data has also been downloaded from the Centre for Ecology and Hydrology (CEH) National River flow Archive (NRFA) website. The catchment averaged daily rainfall data have been derived from a 1km gridded rainfall dataset generated from all daily and monthly observed rainfall data available from the Met Office. Catchment daily rainfall data are shown graphically in Appendix E on a monthly and annual scale. The annual average rainfall value over the catchment for the River Blyth at Hotlon (which includes the Halesworth site) for the period 1961 to 2017 is 602 mm, which is slightly higher than the average calculated from the Benhall TBR data.

3.4 Hydrology

OS Mapping, data received from the Environment Agency, data from the CEH Website, the FEH Web Service, and information from site visits were used to characterise the baseline hydrology. The key locations and watercourses within the search are shown on Figure 3.2.

3.4.1 Main Rivers: Walpole River (minor tributary to the River Blyth)

The Walpole River demarks the south eastern extent of the Halesworth site (Figure 3.2). The Walpole River flows north-easterly and joins the River Blyth approximately 500m northeast of the Site. Both the Walpole and the River Blyth are defined as a main river:

"Main rivers are usually larger rivers and streams. Other rivers are called 'ordinary watercourses'. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk. Environment Agency powers to carry out flood defence work apply to main rivers only. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses. The Environment Agency decides which watercourses are main rivers. It consults with other risk management authorities and the public before making these decisions. The main river map is then updated to reflect these changes". Taken from the Environment Agency website (July 2020).

The closest permanent flow gauging station is located on the River Blyth approx. 2km downstream (east) of the Site at Holton (Ref No. 35013). Table 3.1 displays the catchment and flow parameters for the Blyth at Holton and a daily hydrograph is presented in Appendix E.

Table 3.1 River Flows and Catchment Information

	35013 – Blyth at Holton (downstream of site)
NGR	TM 40620 76880
Catchment area (km²)	92.9
BFI (Base Flow Index)	0.32
Q10 flow (m³/s)	0.937
Q95 flow (m³/s)	0.066
Mean flow (m³/s)	0.457

	35013 – Blyth at Holton (downstream of site)
Flow records for	1970 - 2019
Mean Annual Rainfall from CDR (mm)	602
Mean annual catchment runoff (mean flow/catchment area) (mm/year)	155
Mean annual catchment runoff as % Rainfall	26

Source: National River Flow Archive, https://nrfa.ceh.ac.uk/data/station/info/35013, 27th July 2020.

3.4.2 Ordinary Watercourses

There are no ordinary watercourses at the Site, but a series of land drainage ditches dissect the floodplain.

Ditch Network

A main catch dyke (W1, Figure 3.3) runs from southwest to north east adjacent to Blyth Road and continues north-eastwards past the Halesworth sewage treatment works and underneath the north-south orientated railway line. Groundwater is captured by the catch dyke near to the north-western boundary of the Site. Utility plans also indicate that surface drainage from Blyth Road is conveyed below the land surface and appears to pass below the catch dyke through a culvert.

A series of drains run across the floodplain from the catch dyke towards the River Blyth. Only one of the drains discharges to the Walpole River (W6) via a culvert in the river bank. There is a drainage ditch along the northeastern boundary of the Site which does not appear to be connected to the catch dyke. It does extend towards the Walpole River and joins with the only cut-off meander within the Site.

There are no existing water level control structures in the drains on site, although there is a culvert discharge to the River Blyth at W6. There is potential to install water level control structures along the catch dyke to encourage water to back-up, thus raising water levels within the catch dyke and the perpendicular drainage ditches. To prevent loss of water to the Walpole River via the culvert, a water level control structure may also be required within the ditch at W6. Raising water levels in these ditches will create the opportunity to distribute water onto the land.

A summary of observation made in relation to the ditch network during a site visit by Wood in April 2019 are given in Table 3.2 and are shown on Figure 3.3.

Table 3.2 Ditch network observation summary

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes	Water level (November 2020 Topographic Survey) (mAOD)
W1	Catch dyke (SW)	2.5	0.5-1	0.4	No apparent flow	Runs SW-NE across the whole site. 1m freeboard on northern side, 0.5m on southern side. Catches groundwater from the north. Utility plans indicate this ditch may receive run-off water from the industrial estate to the north.	6.39 – 6.42

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes	Water level (November 2020 Topographic Survey) (mAOD)
W2-W3	NE boundary drain	2.5 -3	0.5-1	0.4-0.5	No apparent flow	No flow visible during the visit. Ditch appears to be permanently wet with an approx. 20cm variation in level. Not connected to catch dyke.	5.98
W4	Cut-off meander	1.5-2	0.5	Boggy	No apparent flow	This feature appears to be an old meander that has been cut off from the Walpole River. The old channel is boggy with some standing water. It's possible that water may back-up here from the River.	
W5 & W10	Walpole River (East)	3-4	2-2.5	0.6	Flow from SW to NE	The Walpole River runs from SW to NE and forms the southern boundary of the Site. One drain appears to discharge to the Walpole River (W6).	5.56 (W5) 5.62 (W10)
W6	Connecting drain and culvert	2.5	1	0.2	No apparent flow	This drain connects the Catch Dyke to the Walpole River. The is a concrete retaining wall at the northern end, presumably with a culvert although this could not be seen during the visit. At the southern end the is another concrete retaining wall with a culvert (~0.7m diameter) that leads to the River Blyth. The was no flow and no discharge at the time of the visit.	5.69
W7-W9	Drainage ditches	2-2.5	0.6	0.1-0.3	No apparent flow	These drainage ditches extend SE from the catch dyke. There was no flow in these ditches at the time of the visit although shallow water was present in each of the ditches. It is not clear if these are draining to, or from, the catch dyke.	6.4 (W7) 6.41 (W8) 6.53 (W9)
W11	SW boundary ditch	1	0.3	Dry		This is a shallow ditch along the boundary of the Site. This is a surface drain and does not appear to intercept groundwater.	6.67

Note: Dimensions are approximate. The ID field references label on Figure 3.3.

3.4.3 Surface Waterbodies

The River Blyth is present along the south-eastern boundary of the Site, with a network of drains which are present on-site and within the wider area which feed into the river. Information gathered from site visits and from OS maps indicate that there are no surface waterbodies within the area of the Site other than the

ditches described above. Five water bodies are located off-site within 500m of the Site boundary (Table 3.3 and Figure 3.2).

Table 3.3 Water bodies within 500m of the Site.

Water bodies	NGR	Distance and direction from Site	Geological Setting
W1	TM3929 7669	100m east	Pond located on Alluvium overlying Crag.
W2	TM3872 7683	365m north-west	Pond located at the boundary between the Lowestoft Till (Diamicton) and Lowestoft Sands and Gravels.
W3	TM3926 7613	385m south-east	Pond located on the Lowestoft Till (Diamicton)
W4	TM3916 7600	448m south-east	Pond located on the Lowestoft Till (Diamicton)
W5	TM3915 7598	458m south-east	Pond located on the Lowestoft Till (Diamicton)

3.4.4 Flood Risk

Fluvial flood risk

The Environment Agency Flood Map for Planning Service (2020), https://flood-map-for-planning.service.gov.uk (accessed 08/12/20) shows that the Halesworth site is located within Flood Zone 3 (high probability of flooding). The site falls with the medium risk category with a 1% to 3.3% chance of flooding from rivers each year (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 08/12/20).

Surface water flood risk

The Environment Agency surface water flood risk map (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 08/12/20) indicates that flood risk from surface water flooding ranges from very low risk to high risk across the Site. Low risk areas a generally associated with topographic high points across the Site such as the northern corner close to Halesworth sewage treatment works.

Areas of medium to high risk are generally associated with topographic low points such as ditches and the cut-off meander in the southeast corner of the Site. An area of high surface water flood risk is located on the eastern edge of the Site suggesting potential flooding of the eastern boundary ditch.

3.4.5 Surface Water Abstractions

There are no active licensed surface water abstractions within 2km of the Halesworth site.

3.4.6 Surface Water Discharges

The Environment Agency has indicated that there is one active licensed discharge consent within 2 km of the Halesworth site. A table of the location and type can be seen in Table 3.4, and the location is shown on Figure 3.2. The Halesworth sewage treatment works is located immediately to the north east, downstream, of the Site and discharges to the Walpole River approximately 50m east of the Site where the river passes beneath the railway.

Table 3.4 Details of surface water discharges

Site Name	Discharge Consent No.	Operator	Discharge Grid Ref	Type	Receiving Water	Distance from Site (km)	Licenced Discharge Volume (Ml/d)
Halesworth Sewage Treatment Works, Suffolk	ASENF1286C	Anglian Water Services Ltd	TM 3925 7662	Sewage Effluent	Walpole River (minor tributary to River Blyth)	0.05	3.553

3.5 Soils

The Cranfield University Soilscapes website indicates that soils at and in the immediate vicinity of Site 28 consists of naturally wet, peaty, fen peat soils. The main risk to water protection is associated with the drainage of cultivated soils. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients applied to the land. Drainage of peat containing sulphides will release extremely acid drainage water. The predominant land use is arable and horticulture.

3.5.1 Soil Survey

A shallow soil core survey was undertaken at the Halesworth site on 10 April 2019. The site was sampled by three transects, as shown in Figure 3.4 which also indicates the location of three zones suggested by the coring results. A summary of the soil survey is provided as a log of soil cores in Table 3.5; full site notes are given in Appendix D.

Zone A represents the small area of upland in the northeast corner of the Site, and the fringes of the floodplain where the upland sediments are near the ground surface. Manganiferous streaks (in cores 1 and 4) provide evidence for the depth in each core where the water table has typically fluctuated; the streaks are also associated with evidence for periodic wetting and drying where ferrous iron has been mobilised within a high water table and precipitated out as ferric (rust-coloured) iron in soil voids when the water table falls. The occurrence of streaks, in particular, is evidence for relatively high groundwater levels along the valley margin. Core 5, on the margin of this zone, confirms the relative dispositions of the floodplain sediments. In the past, groundwater seepage through the sands and freshwater river incursions have led to the development of reed-carr peats except along the valley edge. These have subsequently been buried by a layer of brackish clay. The subsequent deposition of a silt loam alluvium has also extended to the valley margin.

Zone B reveals a substantial development of peat on the valley floor buried beneath the silty clay; here, subsequent alluvial deposition seems to have been sporadic and was not recorded from two of the cores sampling this area. Cores 6 and 10 appear to lack modern alluvial deposits but have a relatively thick 'peaty top' at the ground surface, which was recorded directly over silty clay. Core 2 proved the full sequence of mineral sediments and, in this, is transitional to Zone C.

Zone C covers much of the floodplain and demonstrates that the silt-clay-peat sequence is widespread. Cores 7 and 9 lack the peaty top found in Zone B but are otherwise similar; Core 8 demonstrates that the peat thins in the southwest and overlies sand, while Core 3 records a local deposit of dark-grey (probably sulphidic) silty clay beneath the spread of silt clay recorded across the floodplain.

Table 3.5 Blyth Road, Halesworth – Log of soil cores

	Zone A			Zone B			Zone C			
Core / Soil type	**1**	**4**	**5**	**2**	**6**	**10**	**3**	**7**	**8**	**9**
					cm bgl					
Peaty top		0		0	0	0	0			
Silt loam			0	6			1	0	0	0
Silty clay			18	30	8	9	31	29	39	29
Peat				40	41	48		41	65	42
Coarse angular sand									116	
Humic sand	0	6								
Light yellow sand	56	36	35							
Light grey-green sand		71	57							
End of core	82	82	97	125	125	125	125	125	121	125
Mottling	38	20	7	6	8	9	2	5		3
Manganiferous streaks	66	71								
Yellow iron mottles	66									
Sulphidic							31			
Water table - initial	-	62	57	62	66	72	82	90	-	89
Water table - final	-	62	57	45	66	72	68	90	-	89

The disposition of these floodplain sediments and the water table broadly correspond with the distribution of groundwater-influenced species on the floodplain. The silty clay layer is likely to impede movement of groundwater, rainwater and also floodwater.

It should be noted that the modern water table - recorded from most floodplain cores - lies at some depth below the upper peat surface across the floodplain. This is undoubtedly at a lower level than would have been required for peat formation, and also suggests that the groundwater is under insufficient hydrostatic pressure over most of the floodplain to influence near-surface conditions (at the time of measurement).

Local exceptions are indicated in Core 2 (Zone B) and Core 3 (Zone C). Core 2 sampled Soft Rush pasture near the margin of the Hard Rush area; the water table depth rose during coring to near the top of the peat layer but did not enter the silty clay deposit. The rise recorded in Core 3 is likely to be the local influence of the abandoned meander channel.

The peat is uniformly hemic above the water table and has been protected from decomposition to a large extent by the overlying bed of silt clay. Below the water table, woody peat is prevalent in the upper part and increasingly sapric with depth. No crystalline precipitation was observed, which suggests that groundwater flows from upslope have been sufficient to maintain a stable freshwater environment.

The silty clay and overlying silt loam both show the effects of periodic waterlogging. This is most pronounced in Zone B, where strong mottling reaches almost to the ground surface in cores 2 and 6, and in the lower-lying parts of Zone A, sampled by Core 5. As the water table was recorded at depth in these cores, these effects are certainly the result of surface water detention and are concentrated in those areas where rush growth is frequent. Over the rest of the floodplain, mottling is less concentrated and is encountered lower in the soil profiles; this may be viewed as impeded drainage rather than water detention.

On the valley margin, the cores in the sands of Zone A show evidence of active water table movement above the height of the recorded water table. This is interpreted as the influence of near-surface groundwater in the vicinity of the catch drain. As at other sampled parts of the Site, the current water table may be influenced by the low rainfall total through the winter and into this spring.

3.6 Geology

3.6.1 Superficial Deposits

BGS geological mapping (Figure 3.6) indicates that the Walpole valley is underlain by Quaternary sands and gravel of the Lowestoft Formation which are exposed at the north-western edge of the Site and towards Halesworth. Lowestoft Till is present at higher ground to the west of Halesworth. A combination of Alluvium (clay, silt, sand and gravel) and Head deposits (including Peat) overlie the Lowestoft sands and gravels within the boundary of the Site. This sequence is effectively mirrored on the southern side of the Walpole River, although Crag sands have also been exposed in narrow bands to the southeast of the Site.

3.6.2 Solid Geology

The solid geology (Figure 3.5) below the Site is the Quaternary Crag Group. BGS describe the Crag as mainly fine grained, locally shelly, micaceous sands with local rounded flint gravels, up to 70 m thick. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'.
The Crag lies unconformably on the London Clay Formation (Palaeogene) of the Thames Group. The Site is located close to the western limit of the London clay and is likely to be relatively thin at the Site, increasing in thickness to the east. The London Clay lies unconformably over the Chalk Group.

A generalised geological succession for the local area is presented in Table 3.6.

Table 3.6 Simplified Stratigraphy of the Halesworth site

Age	Group	Formation	Description
Quaternary		Alluvium	Silt, sand, clay, gravel
		Head	Peat, silt, sand, clay, gravel
		Lowestoft Formation	Diamicton. Chalky till, sandy silty clay. Located northwest of the Site.
			Sands and Gravels. Sands and gravels, silts and clays
	Crag Group	Norwich Crag Formation	Fine- to medium grained, micaceous sub-angular quartz sands, interbedded with clays. The sands are characteristically dark green from glauconite but weather bright orange with haematite 'iron pans'
Palaeogene	Thames Group	London Clay	Bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay.

Age	Group	Formation	Description
Upper Cretaceous	Chalk Group	Chalk	Chalk, with or without flint and discrete limestone, marl (calcareous mudstone), sponge, calcarenite, phosphatic, hardground and fossil-rich beds.

3.6.3 BGS borehole logs

The closest geological log available to view online via the BGS website (TM37NE51) is based on a trail pit dug to some 3m depth alongside Blyth Road at the northern boundary of the Site. The log shows topsoil to 0.25m, soft brown clayey peat to 1.0m, sands and gravels to 2.8m, and soft firm grey silty clay to 3.0m. Water seepages were noted at 1.0m, 2.2m and also at 3.1m rising to 2.6m after 10 minutes.

A borehole drilled to 10m depth a little further north (TM37NE55) recorded sands and gravels to 2.1m, clayey sand and gravel to 3.8m, sand with some gravel to 10m. No water strikes were recorded although this was likely due to the fact the borehole was cased and water added during drilling.

A deeper borehole located some 1.4km to the west of the Site (TM37NE86) recorded Crag deposits from around 9m depth to 39m depth, overlying Chalk. Another borehole at a similar distance to the west (TM37NE97) recorded Chalk at around 29m depth.

The feather edge of the London Clay is believed to be west of Site 28, indicating the presence of London Clay between the Crag and the Chalk. The piezometric surface of the Chalk, where confined by the London Clay may, therefore, be close to ground-surface (possibly even slightly artesian at times).

3.6.4 Drilling programme

Geological information was recorded during the borehole drilling and installation programme between 5th and 23rd October 2020. Drilling logs are presented in Appendix B and a summary of the geology encountered is provided in Table 3.7 below. The monitoring network is shown in Figure 2.1.

The deeper borehole (HAL_2803_d) confirmed the presence of London Clay at a depth of 30.5 m bgl. The borehole was terminated at 40 metres and Chalk was not encountered. To the northwest of the catch dyke the Crag is encountered at a depth of 7 to 8.6 metres, whereas to the southeast of the catch dyke closer to the Walpole River the Crag is encountered closer to ground surface at 3.9 metres. Alluvial sands and gravels were shown to overlie the Crag as expected and were interspersed with Peat between the catch dyke and the Walpole River.

Table 3.7 Summary of Halesworth site geology

Name	Drillers ID	NGR	Ground Level (mAOD)	Drilled Depth (m bgl)	Depth to base of (m bgl)						Notes
					Topsoil	Alluvial Sands & Gravels	Peat	Alluvial Sand & Gravels	Crag	London Clay	
HAL_2801_d	bh2801	TM 38990 76600	6.689	10	0.16	7	-	-	>10	-	Water seepage at 0.2m, 0.72m. Standing water at 0.07m.
HAL_2803_d	bh2803	TM 38985 76600	6.881	40	0.4	8.6	-	-	30.5	>40	Nested with HAL_2801_s
HAL_2801_s	ws2801	TM 38990 76600	6.869	40	0.4	8.6	-	-	30.5	>40	Nested with HAL_2803_d
HAL_2802_d	bh2802	TM 39098 76604	6.653	10	0.15	0.68	1.8	3.9	>10	-	Nested with HAL_2802_s
HAL_2802_s	bh2802	TM 39098 76604	6.653	10	0.15	0.68	1.8	3.9	>10	-	Nested with HAL_2802_d
HAL_2803_s	ws2803	TM 39051 76659	7.05	3	0.32	>3	-	-	-	-	Water seepage at 0.3m and 0.92m
HAL_2804_s	ws2804	TM 39143 76703	6.869	2	0.43	>2	-	-	-	-	Standing water level 0.2m

3.7 Hydrogeology

3.7.1 Aquifer designation

The Crag Formation is designated as a Secondary A aquifer. The Environment Agency describe Secondary A aquifer units as 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.

The Underlying Chalk Group is classified as a Principal aquifer which is characterised as consisting of 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.

Groundwater resources are also assigned a vulnerability class based on soil type and the underlying geology. The groundwater resources in the area of the Proposed Development are mapped on the Magic web site[2] as Medium-High groundwater vulnerability.

3.7.2 Aquifer properties

Information on the hydraulic properties of the Chalk and Crag near the Site has been obtained from BGS Major and Minor Property Manuals (BGS, 1997 and 2000) and from scanned borehole logs from BGS GeoIndex Onshore records online.

There are three Crag boreholes with associated aquifer property records identified within 2 km of the Halesworth site. Borehole TM37NE25 950m south of the Site records an average transmissivity value of 262 m^2/d; 1.6km to the east, borehole TM47NW58 is recorded to have a transmissivity of 317 m^2/d; and 1.1km to the north west a Transmissivity of 427 m^2/d is recorded at TM37NE70.

Chalk transmissivity values are available from borehole scans in and around water supply boreholes in Halesworth and values ranges from approximately 47 m^2/d to 320 m^2/d in this area.

3.7.3 Springs

There are no springs identified within the vicinity of the Site on OS maps.

3.7.4 Groundwater levels and flow

The closest EA observation borehole (TM47/070) is located approximately 1.6km northeast of the Site near Holton. The borehole monitored groundwater levels in the Chalk between 1988 and 2002 and is no longer monitored. During that period Chalk groundwater levels fluctuated between 5.5 mAOD and 7.6 mAOD and showed typical seasonal fluctuations (Appendix E).

The Hydrogeological Map of Southern East Anglia (Institute of Geological Sciences, 1981) maps both the Chalk and the Crag piezometric surface during August/September 1976. At the Halesworth site the Crag levels are mapped slightly higher than the corresponding levels in the underlying Chalk, at approximately 7-8 mAOD and 6-7 mAOD respectively. Regional groundwater flow is towards the coast from west to east (Institute of Geological Sciences, 1981).

The soils core surveys carried out in April 2019 indicated that the water table was generally between 0.45m and 0.9 m bgl. The October 2020 drilling programme recorded slightly higher rest ground water levels (0.07

[2] http://magic.defra.gov.uk/MagicMap.aspx

to 0.2m) suggesting that groundwater hydrostatic pressure is higher at depth and its influence on near surface conditions may be reduced by the presence of clayey layers within the Alluvium.

The deeper piezometer (HAL_2803_d) was drilled into the London Clay to a depth of 40 m and the piezometer is measuring groundwater levels at the base of the Crag Formation between 29 and 33 mAOD. Early indications show that this piezometer is slightly artesian which indicates the presence of semi-confining clay layers as identified on the drilling log in Appendix B.

Groundwater levels will be monitored at all installations listed in Table 2.3 for period of 12 months from November 2020 using electronic dataloggers set at 15 minute recording intervals.

3.7.5 EA Regional Groundwater Modelling

The Environment Agency's North East Anglian Chalk (NEAC) Model has been developed through the Anglian Region Groundwater Strategy Framework. Data from the EA model have been made available to EDF Energy under a licence agreement for use in this study. The use of the regional groundwater model is the best available to cover the transient groundwater conditions that may affect the Site thus enabling better definition of long-term water level variation, drought conditions and the influence of fully licensed abstraction on water levels and flows.

The NEAC model comprises two main components:

- A recharge and runoff model that provides input data to the uppermost boundary of the groundwater flow model. This model uses the routing of rainfall, runoff and recharge (4R) code (Entec, 2006) to process the soil moisture balance, actual evapotranspiration (AE), interflow, runoff and recharge data on a daily time interval; and
- An eleven-layer groundwater model that simulates flow in the saturated zone, including the Sandringham Sands, Carstone, Chalk and Crag aquifers, as well as in the post-Chalk Eocene and Quaternary deposits. In the vicinity of Halesworth, the layers representing pre-Chalk geology are inactive in the model.

The modelled representation of the observed geology is shown in Table 3.8. The model layers which are most relevant to this study are Layers 1-6.

Table 3.8 Geological Composition of Model Layers in NEAC

Layer Number	Description
1	Unconsolidated permeable recent and glacial deposits, e.g. Alluvium, Peat, River Terrace Deposits, upper Glacial Sands and Gravel.
2	Unconsolidated clays e.g. Glacial Till.
3	Unconsolidated sands and gravels which pre-date the Till e.g. lower Glacial Sands and Gravels, pre-glacial fluvial deposits (e.g. Bytham/Kesgrave Sands and Gravel), Crag.
4	London Clay.
5	Upper 20 m of saturated Chalk. The Lower London Tertiaries are also included in this layer where they exist in the model area.
6	Nominally, 80 m of saturated, 'lower' Chalk. The whole Chalk thickness (Layer 5 plus Layer 6) is nominally 100 m.

The Environment Agencies NEAC model extends over a total area of almost 15,500 km2; a common 200 m by 200 m fixed-mesh grid is used for both the 4R and MODFLOW components of the model, orientated parallel

to the Ordnance Survey National Grid. The 4R and MODFLOW models were developed and calibrated on the basis of the field-based conceptual understanding and by comparison with observations of river flow and groundwater levels. The model simulation period is effectively between 1970 and 2018, nominally comprising monthly stress periods (each split into three time steps). For the purposes of providing input to the groundwater model the daily output from 4R is aggregated according to the number of days within each monthly stress period. The calibration status of the model in the vicinity of the Halesworth (Blyth (Suffolk) catchment) is considered 'High'.

Modelled Groundwater Levels

Modelled groundwater levels for observation boreholes used in regional model calibration have been obtained to assess the overall performance of the groundwater model in the vicinity of the Halesworth Site. Comparing the closest modelled and measured data for the observation borehole (OBH) at TM47/070 [Chalk observation well] c. 1.5 km to the north-east of the site, shows that for the most part the historical modelling of the timing of seasonal and longer-term fluctuations of the Chalk groundwater levels between 1988 and 2000 are very well represented by the model. Towards the end of the observed levels in 2001 and 2002 the levels are less closely aligned. The modelled surface water flows of the River Blyth at Holton show a reasonably good representation of the model, although some of the more recent observed peaks are underrepresented in the model.

Modelled historic groundwater levels in the Crag show that the general flow of groundwater from south-west to north-east in all the modelled scenarios; 'dry' (August 1991), 'average' (May 1994) and 'wet' (March 2001) months with the Crag groundwater levels modelled at around 7 mAOD in the example average and dry scenarios and 6 mAOD in the dry period. The groundwater contours show a very slight deflection towards the Walpole River in all scenarios.

The historic water table modelled at the site shows that the water table flow is generally from south-west to north-east in all example periods; wet, dry and average, with deflection towards the Walpole River. The modelled water tables is around 6 mAOD. The model shows that for the most part, the depth the water table in the model cells around between 0.75 m and 1.76 m below ground level in the example 'average' month. The modelled data indicated an average annual water level fluctuation of between 7 cm and 28 cm a year.

Modelled historic groundwater levels in the Chalk show that the general flow of groundwater from south-west to north-east all example periods with the Chalk groundwater levels modelled at around 6 mAOD in the average and wet periods reducing to 4 mAOD in the example dry period.

Comparing the historic modelled time series to theoretical Full Licensed (FL) abstraction conditions (where all abstractions are operating at maximum abstraction quantities throughout the modelled time series) indicates that FL abstraction would make very little difference to the water levels in the Crag at the site, with a very small increase in water levels (up to +4cm increase) during the example 'dry' period. In the Chalk, groundwater levels under the Site in the FL conditions would increase up to 50cm during the 'dry' period.

3.7.6 Groundwater abstractions and protection zones

Licensed groundwater abstractions

The Environment Agency lists five groundwater abstraction licences from ten points within 2km of the Halesworth site, as summarised in Table 3.9. No returns data has been provided by the Environment Agency. The locations of licensed groundwater abstractions within 2km of the Halesworth site are shown on Figure 3.7.

There are two public water supply (PWS) licences within 2km of the Site, both of which are operated by Northumbrian Water; Walpole PWS (7/35/02/*G/0082) which has three supply boreholes approximately 1.2 km south west of the Site, and Halesworth-Hotlon PWS (7/35/02/*G/0083) which has 3 supply boreholes

spread between Halesworth and Holton approximately 1 km to the north-northwest and northeast of the Site.

Most of these abstractions are sourced from the Chalk aquifer and their potential impact on near surface groundwater levels below the Site, which is more likely influenced by groundwater levels in the Crag and near surface deposits, is likely to be small.

Table 3.9 Licensed groundwater abstractions within 2km of the Halesworth site.

Licence No.	Operator (Name)	Purpose	Description of Source	Aquifer	Max annual Abstraction Quantity (TCMA)	Max Daily Abstraction Quantity (Ml/d)	Distance from site (km)
7/35/02/*G/0082	Northumbria Water Ltd (Walpole)	Public water supply	3 no. Boreholes	Chalk	1040	3.86	1.2 SW
7/35/02/*G/0083	Northumbria Water Ltd (Halesworth & Holton)	Public water supply	3 no. Boreholes	Chalk	1726	4.73	1.1 NNW; 0.7 NNE; 1.0 NE
7/35/02/*G/0139	John Hill Farms (Old Chapel Farm)	Spray Irrigation	Borehole	Chalk	27.5	0.82	1.4 E
7/35/02/*G/0145	Halesworth Golf Club	Spray Irrigation & Private Supply	2 no. Boreholes	Crag	12	0.18	0.7 SSE
AN/035/0002/006	Brookhill Farm, Bramfield	Private Water Supply (Heat Pump)	Borehole	Chalk	30	0.10	1.9 S

Deregulated groundwater abstractions

The Environment Agency has provided details of seven deregulated groundwater abstractions within 2km of the Halesworth site. These abstractions are generally related to agricultural purposes of less than 20 m^3/d. The current status of these abstractions is not known.

Private water supplies

Records of private water supplies (unlicensed) are held by East Suffolk Council. East Suffolk Council have provided maps showing the locations of eighteen private water supplies within 2km of the Site. The supplies shown all abstract a volume of less than 10m^3 per day. The majority abstract less than 1m^3 per day. All are either a borehole or well supply. The closest unlicensed private water supplies are associated with a group of properties between 0.2 and 0.5 km south of the Site, where there is a cluster of six supplies.

Source protection zones

Groundwater source protections zones (SPZ) identified in relation to the Halesworth site are shown on Figure 3.8. The Halesworth site falls within Zone 3 of a groundwater SPZ. Zone 3 is defined as the total area needed to support the abstraction or discharge from the protected groundwater source. Zone 2 and Zone 1 SPZ's associated with Licence 7/35/02/*G/0083 are located approximately 50m and 260 m north east of the Halesworth site respectively. Approximately 0.8 km to the south west of the Site there is an SPZ Zone 2

associated with licence 7/35/02/*G/0082, with the corresponding Zone 1 boundary located 1 km to the south west.

3.7.7 Nitrate vulnerable zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. The Halesworth site is located within an NVZ.

3.7.8 Groundwater quality

Groundwater quality will be monitored at all installations listed in Table 2.3 for period of 12 months with a mix of monthly in-situ water quality readings and quarterly water quality sampling and laboratory analysis for major determinands.

3.8 Water Framework Directive water body status

River Basin Management Plans (RBMPs) are drawn up for the eleven river basin districts in England and Wales as a requirement of the WFD. The plans have been developed by the Environment Agency through consultations with organisations and individuals. The plans are designed to protect and improve the quality of the water environment, providing information on what needs to be done to tackle water issues, i.e., measures to improve water quality in rivers, lakes, estuaries, coasts and in groundwater. The Halesworth site is located within the area covered by the Anglian RBMP (Environment Agency, 2015). River Basin Districts are divided into Management Catchments, which are further divided into Operational Catchments, within which there are sub-catchment water bodies.

With respect to surface water, The Halesworth site is in the Blyth (Hevingham Hall – d/s Halesworth) surface water body (GB105035046030) which has been designated as heavily modified. In the 2019 WFD classification (Cycle 2) the water body had an overall classification of 'Moderate' based on a 'Good' ecological status and failing chemical status.

The ecological elements were classified as 'High' (near natural conditions) for invertebrates and specific pollutants, 'Supports Good' for the hydrological regime elements class, and 'Good' for the physico-chemical quality elements.

The chemical status fails due to persistent chemicals, such as brominated flame retardants and mercury which is a common theme across much of England in the 2019 classifications.

In terms of groundwater, The Halesworth site is located within the Waveney and East Suffolk Chalk & Crag groundwater body (GB40501G400600). In the 2019 WFD classification (Cycle 2) the Waveney and East Suffolk Chalk & Crag groundwater body was classified as at 'Poor' quantitative status due to the quantitative dependent surface water body status of 'Poor'. The groundwater chemical status was also classified as 'Poor'.

3.9 Water resources

The Halesworth site lies within the Environment Agency's East Anglia (Map area 10) Abstraction Licencing Strategies (ALS) (CAMS process) area. The East Suffolk ALS covers a catchment area of approximately 1,364 km^2 and includes the Halesworth site. Water availability is calculated at Assessment Points (APs) and AP3 is relevant to the Halesworth Site because it covers the River Blyth at Blythford Bridge (NGR TM 42237 76479).

At AP3, to the east of the Halesworth site, water is available for licensing at Q30, Q50 and Q70 flows, but is restricted at Q95 flows. Water becomes available for licensing at Q79 and there is a Hands-Off Flow (HOF) restriction of 10.4 Ml/d. Applications for new consumptive summer abstractions will not be accepted by the Environment Agency except during higher flows.

Groundwater management units (GWMUs) are assigned to the groundwater bodies (Principal aquifers) for the purposes of local groundwater availability assessment in ALSs. The Halesworth site is located within the East Suffolk Chalk and Crag GWMU, where resource availability is designated as 'restricted water available' in the Blyth catchment. Opportunities for new consumptive groundwater licenses are very limited due to the impact of abstraction on low flows in overlying surface water bodies and the level of resource available in the aquifers.

3.10 Designated conservation sites

3.10.1 Designated Sites

Holton Pit SSSI, 1.4km to the north east of Site 28, is of geological interest because the exposures north of Blyford Lane show around 5m of Westleton Beds overlain by Kesgrave Gravels and till.

The site falls within the Impact Risk Zone for Dew's Pond SSSI, located 4.5km south. Creation of fen meadow does not however fall within the criteria that would require consultation with Natural England in respect of risk to this SSSI.

There are no non-statutory designated sites on-site. However, there are three non-statutory CWSs within 1km of the Site, with the nearest being New Reach River and Marsh CWS located 0.43km north of the Site. The interest features of the CWSs are summarised in Table 3.10 and locations are shown in Figure 3.9.

Table 3.10 Non-Statutory Designated Sites within 1km of Halesworth site 28

Designation	Distance from Site Boundary	Description
New Reach River and Marsh CWS	0.43km north	Comprises a small stretch of tributary of the River Blyth, providing a direct link between Halesworth and the sea at Southwold. The site forms part of a larger area known as Millennium Green, which comprises 20ha of habitat including meadows south of New Reach. The tributary, banks and wet meadow support a diverse range of wildlife such as terrestrial and aquatic invertebrates, water vole, otter, water shrew, and a number of species of bat. The site also provides opportunities for black cap and reed warbler.
Birds Folly CWS	0.57km north	Comprises a mosaic of habitat types such as secondary mature woodland, dense scrub, acid heath and acid grassland. Dense scrub provides an important refuge for nesting birds. The site is valuable for reptiles, with records of grass snake, slow worm and common lizard. The site also forms part of Millennium Green and has excellent connectivity with the wider countryside.
Halesworth Cemetery CWS	0.92km north	There are two sections of Halesworth cemetery. The Quay Street section to the north is a good example of species rich grassland; and the Loam Pit Lane section to the south-east, which contains more scattered trees comprising dogwood, elder and hawthorn. The ground flora is less rich in this section. The site overall provides opportunities for a range of invertebrates and is important for reptiles with grass snake, slow worm and common lizard recorded.

3.11 Landfills

One authorised landfill lies within the search area (Figure 3.10), approximately 1.8km to the west of the Proposed Development at Storridge Lane (NGR ST 3183 0404).

There are also four historic landfills within 3km of the Proposed Development (Figure 4.10), with the closest 400m to the northeast of the Proposed Development at Batemans Pit (NGR ST 3420 0420).

4. Conceptual Site Model

This section presents a summary of the conceptual understanding for the Halesworth site and focuses on the main elements which will influence the feasibility of creating fen meadow habitat at this site. The conceptual model is illustrated by a schematic cross section (Figure 4.1) across the Walpole River valley through the centre of the Site, showing the relationship between ground level, groundwater levels, surface water levels and logged geological strata.

The conceptual site model has been developed using all information presented in this desk study including results of the topographic survey and drilling logs for the groundwater monitoring installation points.

The conceptual model for Halesworth site is outlined as follows:

- The Halesworth site covers an area of 4.3 ha. The primary locus area for fen meadow has an area of 1.2 ha and the potential additional area for fen meadow is 1.3 ha. Annual average rainfall is for the area is *c.*602mm.
- The surface elevation slopes gently from northwest to southeast towards the Walpole River, which is a main river that flows north-easterly. Ground elevations are highest in the northwest at 7.5-8.25 mAOD, flattening out to between 6.6-7 mAOD across much of the Site. The Walpole River cuts a channel past the south-eastern boundary of the Site and has relatively steep banks, particularly to the south (Figure 3.11).
- The Halesworth site is located in Flood Zone 3 (high probability of flooding) and falls with the medium risk category with a 1% to 3.3% chance of flooding from the Walpole River each year.
- The Halesworth site is criss-crossed by a network of land drainage ditches many of which feed into a main catch dyke which runs from southwest to northeast and drains north-eastwards past the Halesworth Sewage Treatment Works. Surface drainage from Blyth Road industrial estate is culverted beneath the catch dyke but discharges to an open ditch and is conveyed along the lower part of the site before discharge to the Walpole River via a second culvert.
- Data obtained from the topographic surveys initially indicate that water levels in the catch dyke and attached drainage ditches are between 6.4-6.5 mAOD (November 2020). The Blyth Road drainage channel (W6) recorded a water level of 5.69 mAOD during the survey visit and Walpole River levels were 5.6 mAOD.
- The bedrock geology at the site is Crag sands (c.21-26m thick) overlying London Clay. Although the Site is near the feather edge of the London Clay it is recorded to have a >10m thickness at the deeper on site borehole. The London Clay overlies the Chalk. Superficial deposits of Lowestoft Sands and Gravels overlie the Crag sands which are in turn overlaid by a combination of Alluvium (clay, silt, sand and gravel) and Head deposits.
- Development of Peat has occurred on the southern side of the catch dyke and is encountered between 0.4 and 0.7 m bgl with a thickness of 1.1m at borehole HAL_2803_d. Soils cores show that a silty clay layer is often present above the Peat and is likely to impede movement of groundwater, rainwater and also flood water.
- The soil core survey (April 2019) indicated that groundwater levels were within the Peat (often below its upper surface) between 0.45 and 0.9 m bgl. The October 2020 drilling programme, which occurred during a relatively wet few weeks, showed a slightly higher rest groundwater level between 0.07 and 0.2 m, which indicates that the upper part of the peat may experience seasonal wetting and drying as the water table changes. Groundwater flow is generally toward the Walpole river in the southeast.

- Groundwater in the deeper Crag sands is under positive hydrostatic pressure, resulting in slightly artesian conditions at piezometer HAL_2803_d. This indicates the presence of semi-confining clay layers within the Crag.
- The soil core surveys, drilling logs and topographic survey indicate that groundwater levels are in continuity with surface water levels in the on-site ditches. The catch dyke intercepts groundwater flow from the northwest. Beyond the catch dyke to the southeast the water table flattens out and is higher than the Walpole River water level, indicating the potential for groundwater discharge to the river.
- There are two significant groundwater abstractions licences for public water supply from six boreholes within 1.2km of the Halesworth site. These abstractions are sourced from the Chalk aquifer and their potential impact on near surface groundwater levels below the Site is likely to be small due to the presence of London Clay and semi-confining clay layers within the Crag. Nevertheless, the Site falls within Zone 3 of the groundwater protection zones for those sources.
- The Halesworth Sewage Treatment Works discharge to the Walpole River approximately 50m downstream of the Site. The licensed discharge volume is 3.553 Ml/d. Flow is not gauged in the Walpole River. The closest permanent flow gauging station is located on the River Blyth approx. 2km downstream (east) of the Site at Holton (Ref No. 35013) which has an average flow of 0.46 m^3/s (39.7 Ml/d).

Water levels will be continuously monitored at all on-site groundwater and surface water installations for period of 12 months from November 2020 to further develop and refine this conceptual understanding. Hydrochemical sampling (monthly in-situ readings and quarterly laboratory analysis) will also take place at selected installations to aid conceptualisation of water supply mechanisms to the site and to quantify the extent/variability of distinctive/essential chemistry (salinity/nutrient status/alkalinity) associated with ecological features.

5. References

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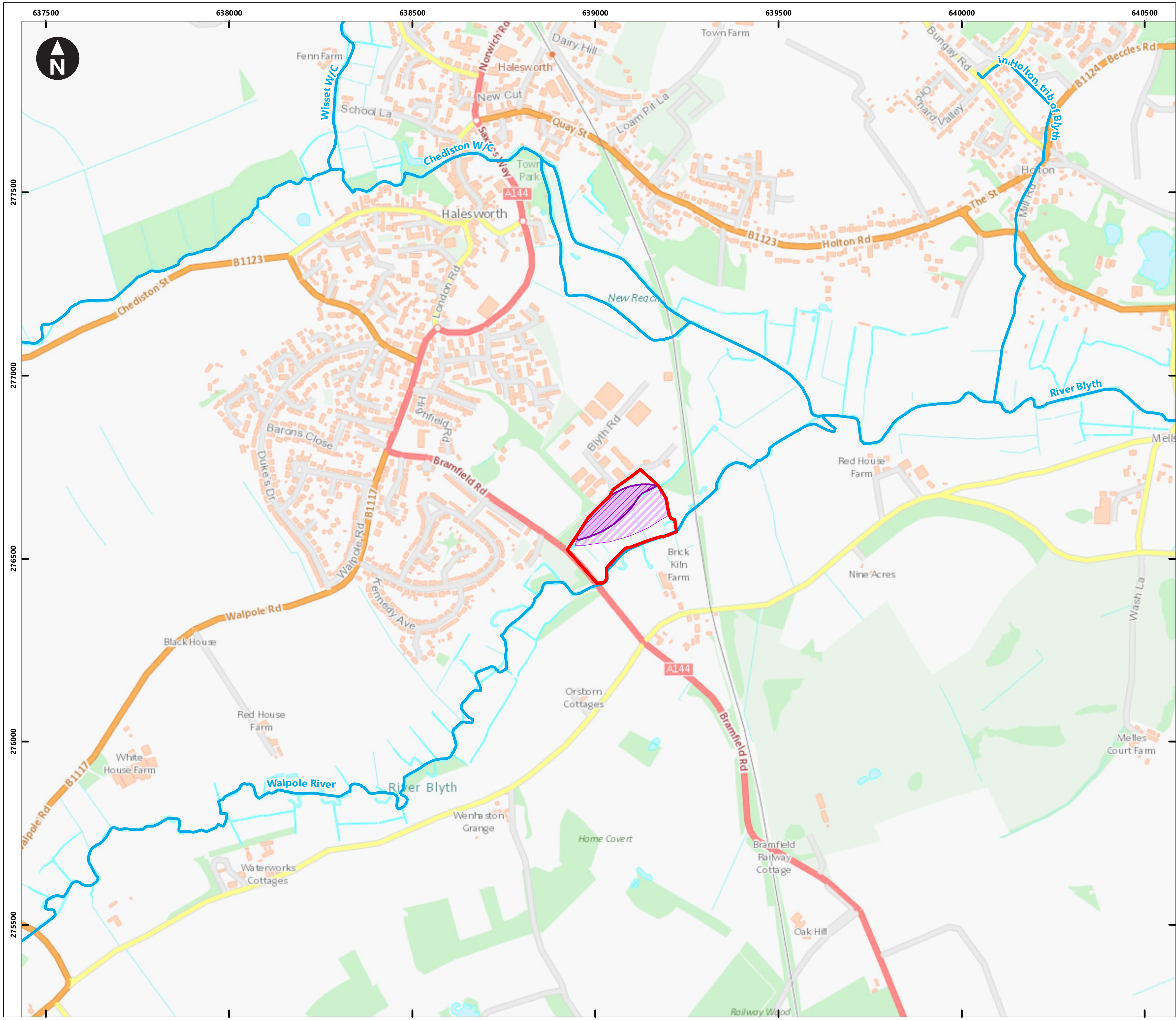
Figures



Key

- Site 28 boundary
- River
- Primary locus for fen meadow
- Potential area for fen meadow

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

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Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 1.1
Site location plan

January 2021

wood.

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639000

276500

HAL_2804_s
HAL-GB01
GB01
DS4
HAL-GB02
GB02
DS3
HAL_2803_s
HAL-GB04
GB04
DS5
HAL_LS1
HAL_2803_d
HAL_2801_s
HAL_2801_d
DS2
HAL_2802_s
HAL_2802_d
HAL_LS2
HAL-GB03
DS6
GB03
DS7
DS1
DS8
Walpole River
Brick Kiln Farm

Key

- Site 28 boundary
- River
- Gaugeboard
- Dipwell
- Piezometer
- Long section
- Cross section
- Ditch section

0 20 40 60 m

Scale at A3: 1:1,250

Fen Meadow Compensation Sites:
Benhall Site 28
Baseline Hydrogeological Report

Figure 2.1
Monitoring installations and topographic section lines

January 2021

wood.

638800 638900 639000 639100 639200 639300

276800 276700 276600 276500 276400 276300

N

Key

Site 28 boundary

Topographic contour (m)

Note: Topographic data on-site extrapolated from WSP November 2020 survey

River Blyth

Blyth Rd

Cherry Close

Brick Kiln Farm

Bramfield

0 20 40 60 80 100 120 m

Scale at A3: 1:2,000

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.1
Site topography

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wood.

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639000 640000 641000

277000 276000

Wisset W/C
School La
New Cut
Quay St
Loam Pit La
Chediston W/C
Saxmundham Rd
Town Park
A144
Halesworth
B1123
Holton Rd
The St
in Holton, trib of Blyth
Southwold Rd
London Rd
New Reach
River Blyth
Holton GS
35013
Mells
W2
Ohfield Rd
Barons Close
Duke's Dr
Bramfield Rd
B1117
Walpole Rd
Kennedy Ave
Blyth Rd
HAL-GB01
HAL-GB04
W1
HAL-GB02
HAL-GB03
ASENF1286C
Brick Kiln Farm
Red House Farm
Nine Acres
Wash La
W3
W4
W5
Orsborn Cottages
Walpole River
River Blyth
Wenhaston Grange
Home Covert
Bramfield Railway Cottage
Oak Hill
Railway Wood
Manwood
Waterloo Farm

Halesworth
A12
Saxmundham
Leiston
Benhall RG BENHAR

Key
- Site 28 boundary
- River
- Discharge
- Flow gauge
- Gaugeboard
- Waterbody
- Rain gauge

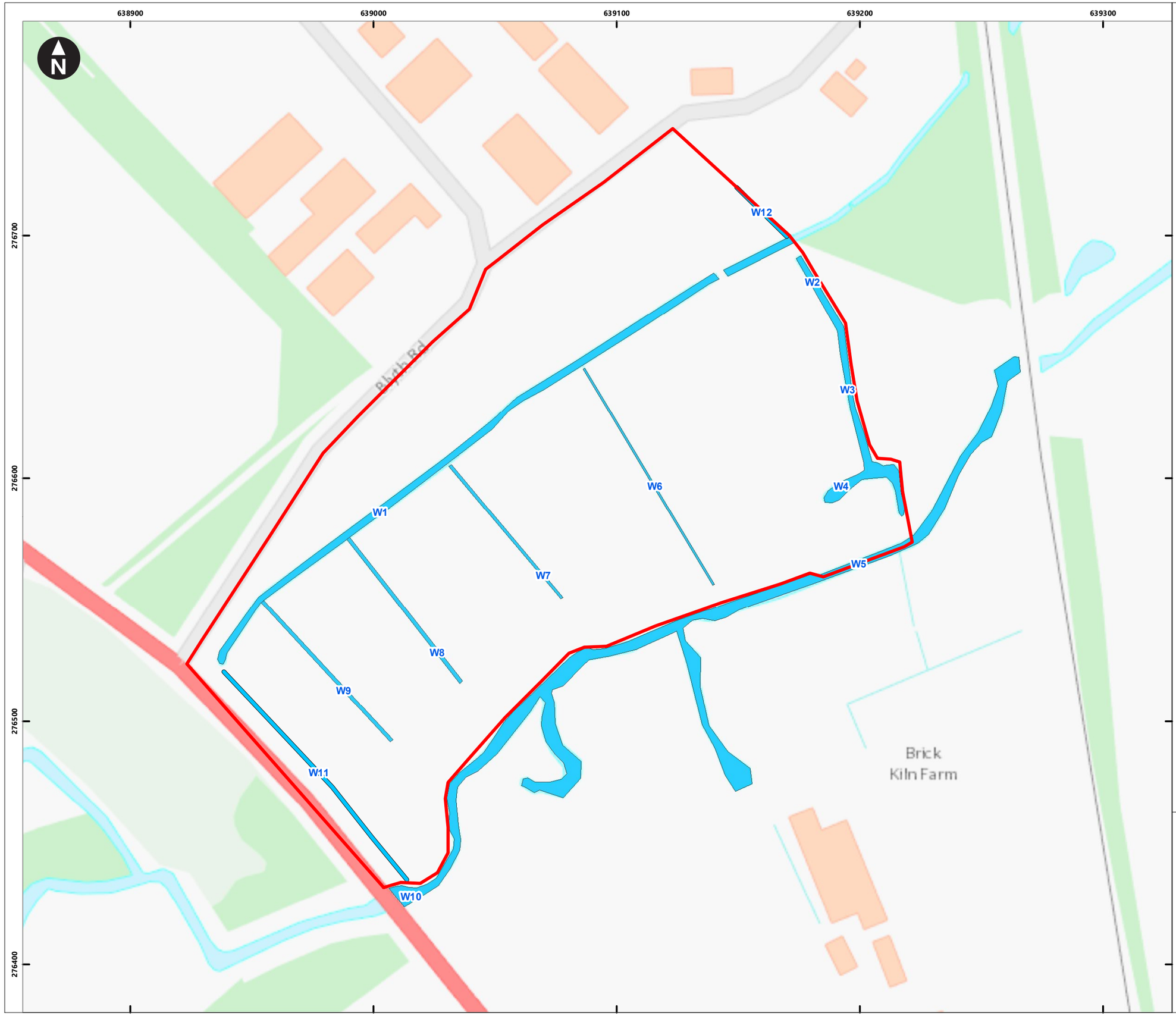
0 100 200 300 400 500 600 m
Scale at A3: 1:10,000

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.2
Hydrology - rain and flow gauges, rivers, ponds

January 2021

wood.



Key

- Site 28 boundary
- Water
- W1 Ditch number

0 20 40 60 80 m

Scale at A3: 1:1,500

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.3
Ditch network

January 2021

wood.

638900
639000
639100
639200
276700
276600
276500
276400

N

Zone A
Zone B
Zone C

1
2
3
4
5
6
7
8
9
10

Brick Kiln Farm

Key

Site 28 boundary
Zone boundary
Soil core sample location

0 20 40 60 80 m
Scale at A3: 1:1,500

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.4
Soil core survey

January 2021

wood.

638000 639000 640000

277000 276000

N

Chediston W/C
Wisset W/C
Halesworth
Chediston St
Beech Cl
B1123
Roman Way
Holmes Dr
London Rd
Pound Cl
Lansbery Rd
Babington Dr
Highfield Rd
Barons Cl
Queens Dr
Orchard Cl
Oak Way
Smedy Ave
Bedingfield Cl
Durban Cl
Cherry Cl
Blyth Rd
Hill Farm Rd
B1123 Holton Rd
The St
New Beach
River Blyth
in Holton, trib of Blyth
Red House Farm
Brick Kiln Farm
Nine Acres
A144
Black House
Red House Farm
Orsbom Cottages
Bramfield Rd
Walpole River
River Blyth
Wenhaston Grange
Home Covert
Bramfield Railway Cottage
Waterworks Cottages

Key

- Site 28 boundary
- River
- Discharge
- Dipwell
- Gaugeboard
- Piezometer

Superficial geology

- CRAG GROUP - CLAY
- CRAG GROUP - SAND
- CRAG GROUP - GRAVEL

0 100 200 300 400 m

Scale at A3: 1:7,500

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.5
Bedrock geology

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638000 639000 640000

277000 276000

Wisset W/C
Chediston W/C
Halesworth
Chediston St
Beech Cl
B1123
Roman Way
London Rd
Pound Cl
New Beach
B1123
Holton Rd
The St
River Blyth
in Holton, trib of Blyth
Blyth Rd
Babington Dr
Barons Cl
Queens Dr
Dukes Cl
Oak Way
Kennedy Ave
Bedingfield Cres
Red House Farm
Brick Kiln Farm
Nine Acres
Black House
A144
Orsham Cottages
Bramfield Rd
Walpole River
Wenhaston Grange
Home Covert
Bramfield Railway Cottage
Waterworks Cottages

Key

- Site 28 boundary
- River
- Discharge
- Dipwell
- Gaugeboard
- Piezometer

Superficial geology

- ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
- LOWESTOFT FORMATION - DIAMICTON
- LOWESTOFT FORMATION - SAND AND GRAVEL
- HEAD - CLAY, SILT, SAND AND GRAVEL
- PEAT - PEAT

Bedrock geology

- CRAG GROUP - CLAY
- CRAG GROUP - SAND
- CRAG GROUP - GRAVEL

0 100 200 300 400 m

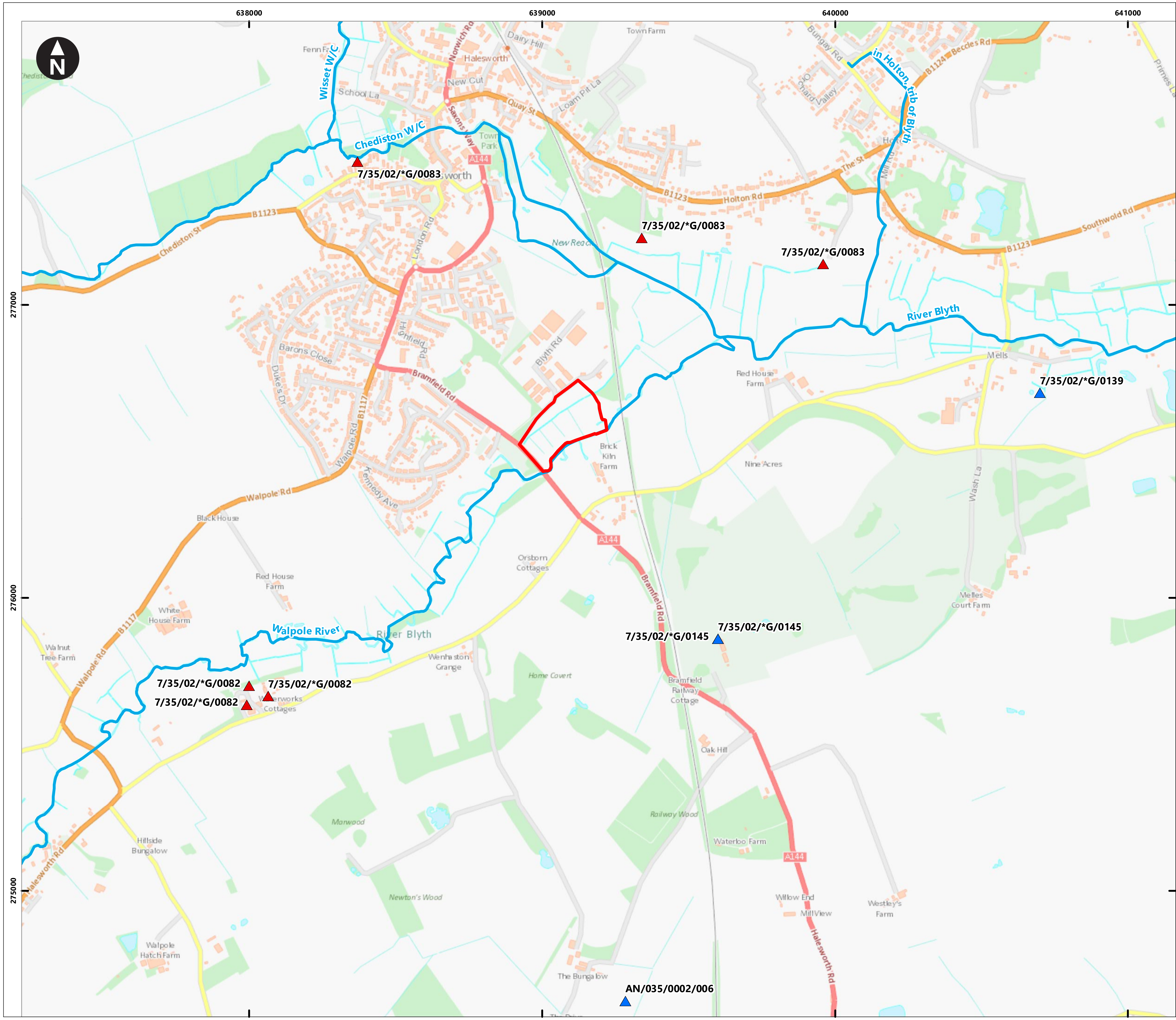
Scale at A3: 1:7,500

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.6
Superficial geology

January 2021

wood.



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7/35/02/*G/0083
7/35/02/*G/0083
7/35/02/*G/0139
7/35/02/*G/0145
7/35/02/*G/0145
7/35/02/*G/0082
7/35/02/*G/0082
7/35/02/*G/0082
AN/035/0002/006
Chediston W/C
Wisset W/C
River Blyth
Walpole River
638000
639000
640000
641000
277000
276000
275000
Key
Site 28 boundary
River
Groundwater abstraction (PWS)
Groundwater abstraction (Non-PWS)
0 100 200 300 400 500 600 700 m
Scale at A3: 1:12,500
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Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.7
Groundwater abstractions

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637000 638000 639000 640000 641000

278000 277000 276000 275000

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7/35/02/*G/0083
7/35/02/*G/0083
7/35/02/*G/0139
7/35/02/*G/0145
7/35/02/*G/0145
7/35/02/*G/0082
7/35/02/*G/0082
7/35/02/*G/0082
AN/035/0002/006

Key

- Site 28 boundary
- SPZ 1
- SPZ 2
- SPZ 3
- Groundwater abstraction (PWS)
- Groundwater abstraction (Non-PWS)

0 200 400 600 800 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.8
Groundwater source protection zones

January 2021

wood.

638000 639000 640000

278000 277000 276000

N

Halesworth Cemetry

New Reach River and Marsh

Birds Folly

Holton Pit

Fenn Farm
Norwich Rd
Dairy Hill
Town Farm
Halesworth
New Cut
School La
Quay St
Loam Pit La
Bungay Rd
Orchard Valley
B1124 Beccles Rd
Savons Way
Town Park
A144
Holton
The St
Mill Rd
Halesworth
B1123
Holton Rd
Chediston St
London Rd
New Reach
Ohfield Rd
Barons Close
Duke's Dr
Bramfield Rd
Blyth Rd
Mells
Red House Farm
B1117
Walpole Rd
Kennedy Ave
Brick Kiln Farm
Nine Acres
Wash La
Black House
Red House Farm
Orsborn Cottages
White House Farm
River Blyth
Wenhaston Grange
Home Covert
Bramfield Railway Cottage
Melles Court Farm
Waterworks Cottages
Oak Hill

Key

- Site 28 boundary
- County Wildlife Sites (CWS)
- Site of Special Scientific Interest (SSSI)

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.9
Designated conservation sites

January 2021

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637000 638000 639000 640000 641000

278000 277000 276000 275000

Key

Site 28 boundary

Historic landfill site

Holton Pit

Holton Pit

0 200 400 600 800 m

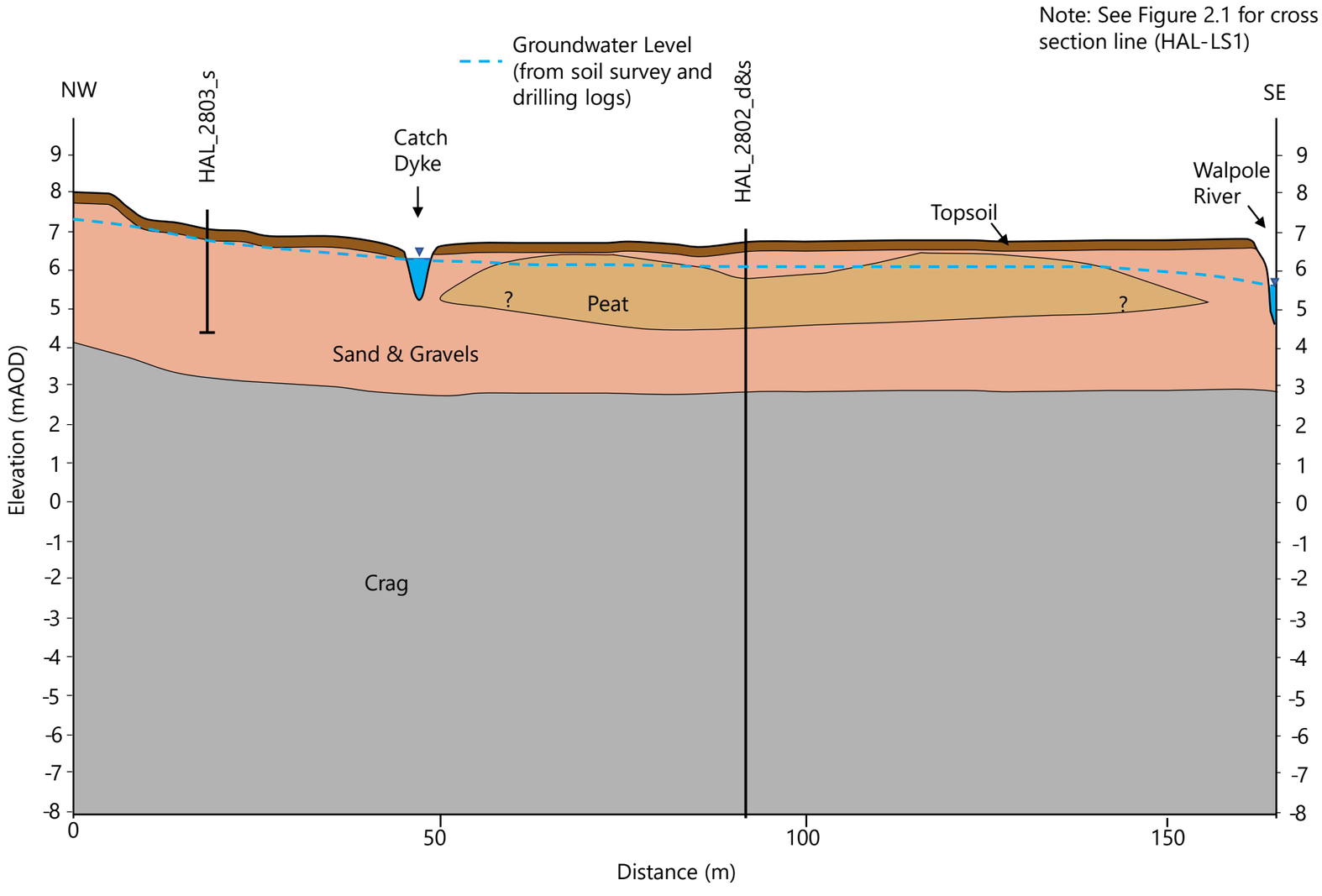
Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 3.10
Landfills

January 2021

wood.



Key

- Topsoil
- Peat
- Sand and gravels
- Crag
- Groundwater level

Fen Meadow Compensation Sites:
Halesworth Site 28
Baseline Hydrogeological Report

Figure 4.1
Schematic cross section

January 2021

wood.

Appendix A
Gaugeboard Installation Report

SIZEWELL C – MONITORING INSTALLATION REPORT

TO	[redacted]	**FROM**	[redacted]
DATE	**24 November 2020**	**CONFIDENTIALITY**	**Confidential**
AUTHOR	[redacted]	**REVIEWED**	[redacted]
PROJECT	**70075143 - Sizewell C Hydrometric Monitoring**		
SUBJECT	**SIZEWELL C - FEN MEADOW MONITORING INSTALLATION REPORT**		

INTRODUCTION

This report documents the surface water level monitoring installations installed across two potential fen meadow compensation sites in Suffolk (Site 28 [Halesworth] and Sites 10/11 [Snape]) by WSP and OTT Hydrometry. This programme of works took place over the period 12th – 16th October 2020 and was undertaken as part of the Sizewell C Fen Meadow Strategy, on behalf Wood.

Access routes, monitoring equipment locations, data logger specifications and datum information is presented in this document.

INSTALLATION SUMMARY

Site 28 - Halesworth

A total of four gaugeboards (of which 3 include stilling wells and water level data loggers) were installed at Site 28 – Halesworth.

Site 28 - Halesworth				
Ref.	**HAL-GB01**	**HAL-GB02**	**HAL-GB03**	**HAL-GB04**
GPS Grid Ref.*	TM 39161 76703	TM 39185 76674	TM 39132 76581	TM 39080 76655
Gaugeboard Length (m)	1	1	2	1
Data Logger	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	n/a
Logger S/N	OM-453494	OM-453491	OM-453497	n/a
Sensor S/N	R806AF01010	R806BA01010	R6059601010	n/a
Range (m)	4	4	4	n/a
Cable Length (m)	3	3	4	n/a

Sites 10/11 Snape

A total of five gaugeboards (of which all 5 include stilling wells and water level data loggers) were installed at Sites 10/11 – Snape.

Sites 10/11 - Snape					
Ref.	**SNP-GB01**	**SNP-GB02**	**SNP-GB03**	**SNP-GB04**	**SNP-GB05**
GPS Grid Ref.*	TM 38130 60235	TM 38249 60509	TM 38207 60658	TM 38350 60725	TM 38300 60618
Gaugeboard Length (m)	1	1	1	2	2
Data Logger	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini
Logger S/N	OM-453493	OM-453492	OM-453498	OM-453495	OM-453496
Sensor S/N	R806B601010	R8076501010	R8076A01010	R8068D01010	R806BD01010
Range (m)	4	4	4	4	4
Cable Length (m)	3	3	2.5	3	4

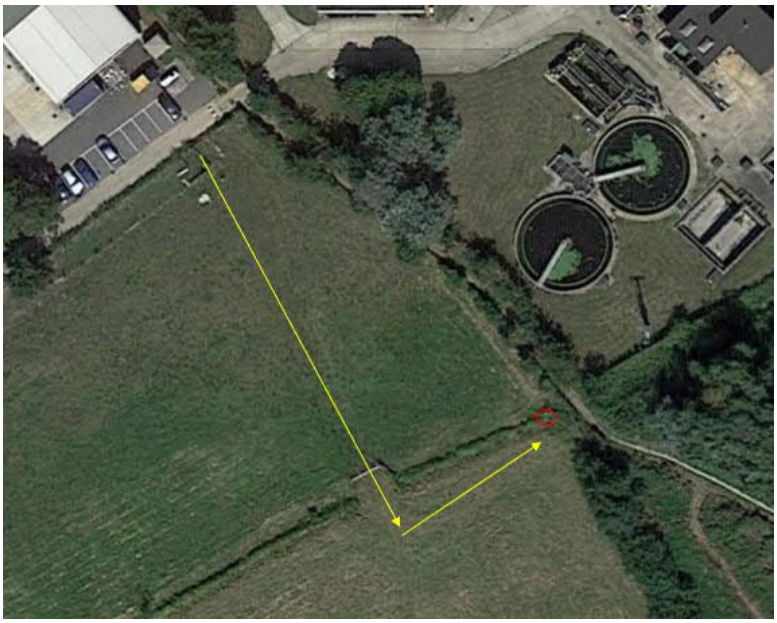
A full topographic survey of Site 28 – Halesworth, and Sites 10/11 Snape is planned shortly and this will include topo surveys of all of the above gaugeboard locations including gaugeboard datum elevations to enable water level data analysis relative to Ordnance Datum (mAOD).

*Please note that the GPS co-ordinates provided in the above tables are from hand held field GPS units with accuracy of +/- 15 metres recorded during the installation phase.

SITE 28 HALESWORTH – HAL-GB01

Installation Name: HAL-GB01		
Equipment Installed: OTT Orpheus Mini - OM-453494	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39161 76703
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:



Installation Notes: Deep water, significant vegetation.

SITE 28 HALESWORTH – HAL-GB02

Installation Name: HAL-GB02		
Equipment Installed: OTT Orpheus Mini - OM-453491	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39185 76674
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Deep sediment.

SITE 28 HALESWORTH – HAL-GB03

Installation Name: HAL-GB03		
Equipment Installed: OTT Orpheus Mini - OM-453497	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 39132 76581
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Cable coiled within stilling well.

SITE 28 HALESWORTH – HAL-GB04

Installation Name: HAL-GB04		
Equipment Installed: N/A	**Logging Interval:** N/A	**OS Grid Reference:** TM 39080 76655
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Not logged.

SITES 10/11 SNAPE – SNP-GB01

Installation Name: SNP-GB01		
Equipment Installed: OTT Orpheus Mini - OM-453493	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38130 60235
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:

Installation Notes: Watch barbed wire at ankle level.

SITES 10/11 SNAPE – SNP-GB02

Installation Name: SNP-GB02		
Equipment Installed: OTT Orpheus Mini - OM-453492	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38249 60509
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

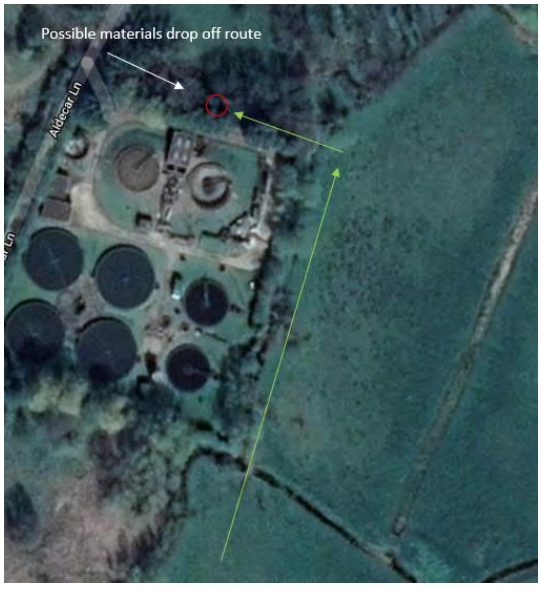
Location Map:

Installation Notes: Deep ditch.

SITES 10/11 SNAPE – SNP-GB03

Installation Name: SNP-GB03		
Equipment Installed: OTT Orpheus Mini - OM-453498	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38207 60658
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 1m

Location Map:



Installation Notes: Watch barbed wire fence.

SITES 10/11 SNAPE – SNP-GB04

Installation Name: SNP-GB04		
Equipment Installed: OTT Orpheus Mini - OM-453495	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38350 60725
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Moved due to Water Voles at original location. Very deep water.

SITES 10/11 SNAPE – SNP-GB05

Installation Name: SNP-GB05		
Equipment Installed: OTT Orpheus Mini - OM-453496	**Logging Interval:** 15 minutes	**OS Grid Reference:** TM 38300 60618
Datum Level: Awaiting Survey	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: Springy reed layer in water column. Cable coiled within stilling well.

Appendix B
Drilling Logs – Groundwater Monitoring Installations

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. Fracture spacings (If) quoted in the Description of Strata for specific strata or specific fracture sets are also quoted in mm, e.g. (25/80/230) referring to (Min/Avg/Max).
4. The data on any sheet within the report showing the AGS icon is available in the AGS format.

Structural Soils Ltd, Head Office - Bristol: The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB. Tel: 0117-947-1000, Fax: 0117-947-1004, Web: www.soils.co.uk, Email:admin@soils.co.uk.

STRUCTURAL SOILS

Contract Reference: **735270**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level following first strike, standing water level following second strike etc.


Seepage.


Standing water level recorded at documented date.

MATERIAL GRAPHIC LEGENDS


Clayey gravelly SAND


Clayey gravelly SAND with COBBLES


Clayey SAND


GRAVEL


Silty gravelly CLAY


Gravelly SAND


Gravelly SAND with COBBLES


PEAT


SAND


SAND with COBBLES


Sandy CLAY


Sandy silty CLAY


Silty sandy CLAY


Sandy GRAVEL


Sandy gravelly silty CLAY


Silty sandy gravelly CLAY


Sandy gravelly SILT


Sandy clayey SILT


Sandy SILT


Topsoil

INSTRUMENTATION SYMBOLS


Backfill


Bentonite seal


Concrete


Gravel filter


Sand filter


Upstanding cover


Plain pipe


Slotted pipe

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**15.10.20** End: **16.10.20**	**6.90**	**E:638990.1 N:276600.1**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over brown silty sandy slightly gravelly CLAY with frequent roots and rootlets. Gravel is angular to subangular fine to medium of flint. Sand is fine to medium. (TOPSOIL)	6.74	0.16	
						Firm silty sandy slightly gravelly CLAY with occasional roots and frequent rootlets. Gravel is angular to subangular fine to medium of flint. Sand is fine to predominantly coarse. (SUPERFICIAL DEPOSITS)	6.48	0.42	
						Light greyish brown slightly silty slightly gravelly fine to predominantly medium SAND with pocket of clayey sand. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	6.27	0.63	
						Light greyish brown slightly silty slightly gravelly fine to predominantly medium SAND with pocket of clayey sand. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	6.05	0.85	
						Pale bluish grey silty gravelly fine coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	5.70	1.20	
						Brown gravelly fine to coarse SAND with occasional subangular to subrounded cobbles up to 70mm of flint. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)		(0.80)	
						Yellowish brown SAND and GRAVEL with occasional subangular to subrounded cobbles up to 70mm of flint. Gravel is angular to rounded fine to coarse of flint. Sand is fine to coarse. (ALLUVIAL GRAVEL)	4.90	2.00	
						Orangish yellow fine to coarse SAND. (ALLUVIAL SAND)		(2.10)	
						Orangish yellow slightly gravelly fine to coarse SAND. Gravel is angular to rounded fine to medium of flint. (ALLUVIAL SAND)	2.80	4.10	
						Orangish yellow fine to coarse SAND with occasional pockets of soft grey silty very sandy clay. (ALLUVIAL SAND)		(0.90)	
						Greyish green fine to medium SAND. (CRAG GROUP)	1.90	5.00	
								(1.80)	
							0.10	6.80	
							-0.10	7.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
15/10/20		0.20	-		0.20
15/10/20		0.72	-		0.72
16/10/20		10.00	10.00	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit terminated at 1.00m due to rapid water ingress.
3. Water seepage at 0.20m.
4. Water strike at 0.72m.
5. Standing water at 0.07m over 24h.

All dimensions in metres | Scale:

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**15.10.20** End: **16.10.20**	**6.90**	**E:638990.1 N:276600.1**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Greyish green fine to medium SAND. (CRAG GROUP) *(stratum copied from 7.00m from previous sheet)*	-3.10	(3.00) 10.00	
						Cable percussion borehole terminated at 10.00 m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

6. 16th Oct: Re-drill borehole from 7.20m to 10m depth due to blowing sands.
7. 50mm standpipe installed to 9.10m depth.

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2802**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**16.10.20** End: **19.10.20**	**6.65**	**E:639098.9 N:276604.8**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass over soft brown silty slightly sandy CLAY with frequent roots and rootlets and rare rounded fine to medium gravel of flint. Sand is fine to medium. (TOPSOIL)	6.50	0.15	
							6.25	0.40	
						Soft greyish brown mottled orangish brown silty slightly sandy slightly gravelly CLAY with frequent rootlets. Sand is fine to medium gravel is angular to subrounded fine to medium of flint. (SUPERFICIAL DEPOSITS)	5.97	0.68	
						Very soft dark blackish brown slightly sandy SILT with a high organic matter content and frequent wood fragments up to 30 mm in diameter. Sand is fine to medium. (ALLUVIUM)		(1.12)	
							4.85	1.80	
						Plastic blackish brown PSEUDO FIBROUS to FIBROUS PEAT with wood fragments up to 35 mm in diameter and an organic odour. (PEAT)		(0.80)	
						Grey fine to coarse SAND and multicoloured angular to subrounded fine to coarse GRAVEL of flint. (ALLUVIAL SAND) . . . 1.80m-1.90m: band of grey coarse sand	4.05	2.60	
						Yellowish brown to greenish brown slightly silty gravelly medium to coarse SAND. Gravel is angular to rounded fine to coarse (ALLUVIAL SAND)		(1.30)	
							2.75	3.90	
						Greenish grey speckled black slightly silty fine to coarse SAND (CRAG GROUP)	2.45	4.20	
						Greenish grey speckled black fine to medium SAND with occasional coarse sand to fine gravel sized comminuted shell fragments and rare rounded fine gravel of quartz. (CRAG GROUP)		(1.90)	
							0.55	6.10	
						Orangish brown mottled greyish brown silty fine to medium SAND. (CRAG GROUP) . . . 6.10m-6.25m: lenses of very sandy silt becoming occasional with depth		(2.30)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
19/10/20		10.00	-	200	

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Water strike at 1.80m depth.
4. Dual 50mm standpipe installed to 3.00m and 9.30m depth:

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ATidswell**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2802**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**16.10.20** End: **19.10.20**	**6.65**	**E:639098.9 N:276604.8**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . 7.90m-10.00m: rare rounded fine gravel of quartz	-1.75	8.40	
						Greenish grey speckled black fine to coarse SAND with coarse sand to fine gravel sized comminuted shell fragments. (CRAG GROUP)	-3.35	(1.60) 10.00	
						Cable percussion borehole terminated at 10.00 m depth.			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**DHubbard**	**ATidswell**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start: **06.10.20** End: **15.10.20**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270		**6.88**	**E:638985.1 N:276600.5**	**1** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Brown sandy slightly gravelly organic silty CLAY with frequent roots and rootlets. Gravel is angular to rounded fine to coarse of flint. Sand is fine to medium. (TOPSOIL)	6.48 6.38	0.40 0.50	
						Soft dark brown mottled orange organic silty CLAY with frequent rootlets. (SUPERFICIAL DEPOSITS)	6.28 6.18	0.60 0.70 (0.50)	
						Pale yellowish grey slightly gravelly fine to coarse SAND with frequent pockets of black clayey peaty sand. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	5.68	1.20 (0.80)	
						Multicolored white grey light brown slightly silty gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	4.88 4.68	2.00 2.20	
						Pale bluish grey slightly silty gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)			
						Bluish grey mottled blue silty gravelly slightly organic fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)		(1.80)	
						Brown SAND and GRAVEL. Gravel is angular to subangular fine to coarse of flint (predominantly small fragments). Sand is fine to coarse. (ALLUVIAL GRAVEL)	2.88	4.00	
						Brown SAND and GRAVEL. Gravel is angular to subangular fine to coarse of flint. Sand is fine to coarse. (ALLUVIAL GRAVEL)	2.38	(0.50) 4.50	
						Orangish yellow fine to medium SAND. (ALLUVIAL SAND)			
						Orangish yellow slightly gravelly fine to medium SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)		(1.50)	
							0.88	6.00	
						Greyish brown fine to coarse SAND. (ALLUVIAL SAND)		(2.20)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
07/10/20	08:00	0.00	-		-
07/10/20	18:15	11.00	11.00	200	-
08/10/20	08:00	11.00	11.00	200	1.06
08/10/20	17:45	27.00	25.00	200	-
09/10/20	08:00	27.00	27.00	200	2.10
09/10/20	14:30	29.00	29.00	200	-
12/10/20	11:00	16.80	29.00	200	4.40
12/10/20	18:00	30.50	30.10	200	0.00

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Drilled to 29.0m in 200mm. Base of hole sealed with bentonite pellets to try and stop blowing sands over the weekend (10th/11th Oct)
4. 12th Oct: Blowing sands up inside borehole and

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**06.10.20** End: **15.10.20**	**6.88**	**E:638985.1 N:276600.5**	**2** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
							-1.32	8.20	
						Brown fine to coarse SAND. (ALLUVIAL SAND)	-1.72	8.60	
						Greenish/greyish brown slightly gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of sandstone, siltstone. (CRAG GROUP)		(1.40)	
				4			-3.12	10.00	
						Greenish/brownish grey slightly silty slightly gravelly fine to coarse SAND with abundant shell fragments content. Gravel is subangular to rounded fine to medium of sandstone. (CRAG GROUP)		(1.20)	
							-4.32	11.20	
						Firm to Stiff bluish grey silty sandy CLAY. Sand is fine to medium. (CRAG GROUP)		(1.80)	
							-6.12	13.00	
				3		Stiff bluish grey silty sandy very gravelly CLAY. Gravel is subangular to rounded fine to coarse of sandstone, siltstone. Sand is fine to medium. (CRAG GROUP)		(1.00)	
							-7.12	14.00	
				3		Stiff brownish grey silty very sandy CLAY. Sand is fine to medium. (CRAG GROUP)		(0.60)	
							-7.72	14.60	
						Stiff grey silty sandy slightly gravelly CLAY with occasional cobble content. Gravel is angular to subangular fine to coarse of limestone. Sand is fine to medium. Cobbles are subangular up to 7cm of limestone. (CRAG GROUP)			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
13/10/20	08:00	30.50	30.10	200	0.00
13/10/20	17:00	35.50	29.00	200	3.00
14/10/20	08:00	28.80	29.00	200	0.90
14/10/20	17:00	40.00	35.00	150	0.00

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

casing to 18.6m depth at start of shift BH re-drilled over course of shift.

5. 13th Oct: Re-drilled from 27m to 30.50m due to blowing sands. Complete shift at 35.50m depth.
6. 14th Oct: Re-drilled from 28.5m to 35.50m due to blowing sands. Reduce to 150mm diamter casing and tooling, complete shift at 40m depth.

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start: **06.10.20**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	End: **15.10.20**	**6.88**	**E:638985.1 N:276600.5**	**3** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Stiff grey silty sandy slightly gravelly CLAY with occasional cobble content. Gravel is angular to subangular fine to coarse of limestone. Sand is fine to medium. Cobbles are subangular up to 7cm of limestone. (CRAG GROUP) *(stratum copied from 14.60m from previous sheet)*	-10.62	(2.90)	
						Stiff brownish grey silty sandy CLAY. Sand is fine to coarse. (CRAG GROUP)	-13.12	(2.50)	
						Very stiff greyish brown silty sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of sandstone, siltstone. Sand is fine to medium. (CRAG GROUP)	-15.62	(2.50)	
				5		Stiff greyish brown silty slightly sandy CLAY. Sand is fine. (CRAG GROUP)		(2.00)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

Deep (35.5m monitoring well) installation undertaken, 12m of 200mm casing left in hole overnight.

7. 15th Oct: Complete shallow installation and de-mobilse from position.
8. Dual 50mm standpipe installed to 3.00m and 34.00m depth:: shallow pipe is referenced as

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**06.10.20** End: **15.10.20**	**6.88**	**E:638985.1 N:276600.5**	**4** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Stiff greyish brown silty slightly sandy CLAY. Sand is fine. (CRAG GROUP) *(stratum copied from 22.50m from previous sheet)*	-17.62	24.50	
						Stiff dark greyish brown mottled black very sandy CLAY. Sand is fine to medium. (CRAG GROUP)	-18.12	(0.50) 25.00	
						Stiff bluish grey mottled brown and yellow silty slightly gravelly CLAY. Gravel is rounded fine to medium of flint. (CRAG GROUP)	-19.12	(1.00) 26.00	
						Very stiff bluish grey mottled red (possible iron oxide) silty CLAY. (CRAG GROUP)	-20.12	(1.00) 27.00	
				4		Brown clayey fine to medium SAND. (CRAG GROUP)	-21.12	(1.00) 28.00	
						Stiff greyish brown silty sandy slightly gravelly CLAY embedded with brown clayey SAND. Gravel is subangular to subrounded fine to medium of sandstone. Sand is fine to medium. (CRAG GROUP)	-23.62	(2.50) 30.50	
						Interbedded Stiff brownish grey occasionally mottled red silty sandy slightly gravelly CLAY with brown clayey SAND. Occasional lenses of shell fragments. Gravel is subangular to rounded fine to coarse of sandstone, siltstone and rare flint. Sand is fine to medium. (LONDON CLAY FORMATION)		(2.50)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

WS2801.

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start: **06.10.20**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	End: **15.10.20**	**6.88**	**E:638985.1 N:276600.5**	**5** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Interbedded Stiff brownish grey occasionally mottled red silty sandy slightly gravelly CLAY with brown clayey SAND. Occasional lenses of shell fragments. Gravel is subangular to rounded fine to coarse of sandstone, siltstone and rare flint. Sand is fine to medium. (LONDON CLAY FORMATION) *(stratum copied from 30.50m from previous sheet)*	-26.12	33.00	
						Very stiff brownish grey silty slightly sandy CLAY with occasional lenses of shell fragments. Sand is fine. (LONDON CLAY FORMATION)	-29.12	(3.00) 36.00	
						Stiff grey silty sandy CLAY with green fine glauconite sand. Low content of shell fragments. Sand is fine. (LONDON CLAY FORMATION)	-33.12	(4.00) 40.00	

Cable percussion borehole terminated at 40.00m depth.

Boring Progress and Water Observations						Chiselling / Slow Progress			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**BH2803 / WS2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**06.10.20** End: **15.10.20**	**6.88**	**E:638985.1 N:276600.5**	**6** of **6**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						

Boring Progress and Water Observations						Chiselling / Slow Progress			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:44**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 2000**	**Adam Langford**	**TClemente**	

STRUCTURAL SOILS

FINAL

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS2801**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**06.10.20** End: **06.10.20**	**7.05**	**E:638988.9 N:276605.4**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
					1		Grass over sandy slightly gravelly silty CLAY with frequent rootlets. Gravel is angular to rounded fine to coarse of flint. Sand is fine medium. (TOPSOIL)	6.65	(0.40) 0.40	
							Greyish brown mottled black slightly silty slightly gravelly fine to medium SAND. Gravel is angular to rounded fine to medium of flint. (ALLUVIAL SAND)	6.55 6.35	0.50 0.70	
					1		Yellow mottled black slightly gravelly fine to medium SAND with occasional pockets of clayey sand. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	6.05	(0.30) 1.00	
							Multicolored white yellow light brown slightly silty gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)			
							Window sample hole terminated at 1.00m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.00m depth.
3. Water strike at 1.00m rising to 0.50m after 20min. Water ingress from the bottom of bore hole. Hole collapsed to 0.70m.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Jordan Evans**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS2802**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**07.10.20** End: **07.10.20**	**6.72**	**E:639096.6 N:276607.4**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
1.20 - 2.00 (85mm dia) 100% rec							Grass over friable dark brown silty slightly sandy CLAY with frequent roots and rootlets. Sand is medium to coarse. (TOPSOIL)	6.57	0.15	
							Soft greyish brown mottled orangish brown slightly sandy silty CLAY with frequent rootlets and organic matter and rare angular coarse gravel of flint. (ALLUVIUM)	6.32	0.40	
							Very soft dark brown silty sandy slightly gravelly CLAY with frequent rootlets, high organic content and frequent woody fragments. Sand is coarse. Gravel is angular fine to coarse of flint. (ALLUVIUM)	5.92	(0.40) 0.80	
					1		Plastic dark blackish brown fibrous PEAT. Medium organic odour. (PEAT)	5.29	(0.63) 1.43	
							Spongy dark brown fibrous PEAT with medium organic odour. (PEAT)	5.14	1.58	
							Dark brownish grey to grey silty slightly gravelly coarse SAND. Gravel is angular to subrounded fine to coarse of flint. (ALLUVIAL SAND)	4.72	(0.42) 2.00	
2.00 - 3.00 (85mm dia) 73% rec							Light grey coarse SAND (ALLUVIAL SAND)	4.19	(0.53) 2.53	
							. . . 2.50m-2.53m: becoming slightly	4.07	2.65	
							Light grey slightly silty sandy angular to subrounded fine to coarse predominantly medium and coarse GRAVEL of flint. (ALLUVIAL GRAVEL)	3.72	(0.35) 3.00	
							Yellowish brown slightly silty gravelly coarse SAND. Gravel is angular to subrounded fine to coarse of flint. (ALLUVIAL SAND)			
							Terminated at 3.00 metres depth			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Water seepage at 0.35 m depth.
4. Due to ground conditions install will be done via cable rig.

Installation details to follow

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Jordan Evans**	**TClemente**	[redacted]

STRUCTURAL SOILS

FINAL

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS2803**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**07.10.20** End: **07.10.20**	**7.05**	**E:639051.6 N:276659.3**	**1** of **2**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
1.20 - 2.00 (85mm dia) 50% rec							Grass over soft brown silty sandy CLAY with frequent roots and rootlets and rare angular medium to coarse gravel. Sand is fine to coarse predominantly coarse. Gravel is angular fine to medium of flint. (TOPSOIL)	6.73 6.65	(0.32) 0.32 0.40	
							Firm orangish brown and orangish grey mottled dark brown slightly sandy silty CLAY with frequent organic matter and lenses of dark brown coarse silty sand up to 20 mm. (SUPERFICIAL DEPOSITS)	6.45 6.13	0.60 (0.32) 0.92	
					1		Yellowish brown silty fine to coarse predominantly coarse SAND with occasional rootlets and occasional angular to subrounded fine to coarse gravel of flint. (ALLUVIAL SAND)			
							Yellowish brown and light grey slightly silty slightly gravelly medium to coarse SAND with rare rootlets. Gravel is subangular to subrounded fine to coarse of flint. (ALLUVIAL SAND)		(1.08)	
					1		Grey to light brown gravelly silty medium to coarse predominantly coarse SAND with occasional organic material and wood fragments. Gravel is subangular to rounded of flint. (ALLUVIAL SAND)	5.05	2.00	
2.00 - 3.00 (85mm dia) 50% rec							Orangish brown silty slightly gravelly medium to coarse SAND. Gravel is angular to subangular fine to coarse of flint. (ALLUVIAL SAND)	4.45	(0.60) 2.60	
							Orangish brown silty slightly sandy angular to subrounded fine to coarse GRAVEL of flint and quartzite. Sand is fine to medium. (ALLUVIAL GRAVEL)	4.05	(0.40) 3.00	
							Window sample hole terminated at 3.00m depth.			

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. 50 mm diameter standpipe piezometer (complete with Upstanding protective cover) installed to 2.20 m depth on completion. Response zone 1.20 -2.20 m to m depth.
4. Water seepage at 0.30 m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Jordan Evans**	**BKitchiner**	[redacted]

FINAL

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS2803**

Contract Ref:	Start: **07.10.20** End: **07.10.20**	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270		**7.05**	**E:639051.6 N:276659.3**	**2** of **2**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

5. Water seepage at 0.92 m depth.
6. 50mm standpipe installed to 2.20m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window sampling	**Dando Terrier**	**Jordan Evans**	**BKitchiner**	

FINAL

STRUCTURAL SOILS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Sizewell C Fenland Creation Area	**Wood Group UK Limited**	**WS2804**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735270	**06.10.20** End: **06.10.20**	**6.87**	**E:639143.2 N:276703.5**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results						
							Grass over brown sandy slightly gravelly silty CLAY with frequent roots and rootlets. Gravel is angular to rounded fine to coarse of flint. Sand is fine to medium. (TOPSOIL)		(0.43)	
					1		. . . at 0.34: water strike medium inflow.	6.44	0.43	
							Yellow mottled brown slightly clayey slightly gravelly fine to medium SAND. Gravel is angular to rounded fine to coarse of flint. (SUPERFICIAL DEPOSITS)	6.37	0.50	
							Multicolored white yellow light brown silty gravelly fine to coarse SAND. Gravel is angular to rounded fine to coarse of flint. (ALLUVIAL SAND)	6.27	0.60	
							Bluish grey silty gravelly fine to coarse SAND with occasional pockets of orangish brown coarse sand. Gravel is angular to rounded fine to coarse flint. (ALLUVIAL SAND)	5.95	(0.32) 0.92	
1.20 - 2.00 (85mm dia) 40% rec							Yellow SAND and GRAVEL. Gravel is angular to rounded fine to coarse of flint. Sand is fine to coarse. (ALLUVIAL GRAVEL)		(1.08)	
							. . . at 0.92m: water seepage medium inflow.	4.87	2.00	
							Window sample hole terminated at 2.00m depth.			

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Position checked with Ground Penetrating Radar, CAT and Genny prior to excavation.
2. Inspection pit hand dug to 1.20m depth.
3. Hole terminated at 2.00m do to blowing sand at 1.70m. Water level at the end is at 0.20m.
4. 50mm standpipe installed to 1.70m depth.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Dando Terrier**	**Jordan Evans**	**TClemente**	[redacted]

Appendix C
Topographic Survey Results

Sizewell C Hydro Survey (Area 10&11 and Area 28)

TOPOGRAPHICAL SURVEY REPORT

December 2020

Wood Environment & Infrastructure Solutions UK Limited

TOPOGRAPHICAL SURVEY REPORT

Sizewell C Hydro Survey (Area 10&11 and Area 28) Topographical Transect Survey

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. Ref – 40773-WOOD
OUR REF. NO. 70078783

DATE: December 2020

WSP
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Edinburgh Park
Edinburgh, Midlothian
EH12 9DH
Phone: +44 131 344 2300
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WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Final	Appendices added		
Date	08.12.20	14/12/20		
Prepared by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Checked by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Authorised by	[redacted]	[redacted]		
Signature	[redacted]	[redacted]		
Project number	**70078783**	**70078783**		
Report number				
File reference				

REPORT CONTENTS

1 OVERVIEW

1.1 INTRODUCTION

In November 2020 WSP carried out a topographical survey over two sites (Area 10&11 and Area 28). These surveys included transects and a topographic survey on a 20mx20m grid over areas identified for primary locus area for fen meadow. Alongside this a survey of gauge boards and spot flow gauging locations was undertaken.
The survey was carried out in accordance with instructions and specifications as set out in the survey brief by Wood.

1.2 SURVEY SCOPE

Area 10&11

- 20x20m topographic grid and bank profiling of primary locus area for fen meadow.
- Survey of 8 Transects and 5 ditch profiles across the site.
- Survey of 5 spot flow gaugings and 5 gaugebaords locations along with 1 concrete dipwell. A cross section will be taken at each location along with position of flow meter and top of gaugeboard. Bed levels will also be taken 50m upstream and downstream at 10m intervals.

Area 28

- 20x20m topographic grid and bank profiling of primary locus area for fen meadow.
- Survey of 2 Transects and 8 ditch profiles across the site.
- Survey of 3 spot flow gaugings and 4 gaugeboard locations. A cross section will be taken at each location along with position of flow meter and top of gaugeboard. Bed levels will also be taken 50m upstream and downstream at 10m intervals.

1.3 PERSONNEL

- Principal Surveyor
- Project Surveyor
- Land Surveyor
- Graduate Surveyor

1.4 EQUIPMENT

- 2 x Leica Captivate GS08 GNSS Antenna with Leica CS20 Field Controller
- 1 x Leica TS16 Total station & CS20 Field Controller
- N4ce Survey Software

1.5 RISK ASSESSMENT

A client approved Risk Assessment was carried out prior to attending the site. The risk assessment can be found in appendix A. On attending the site, a daily dynamic risk assessment was carried out and any new risks found added and assessed on site. It was noted that in some areas silt levels were very deep, so extra care was taken around these areas. It was also noted before accessing site that there may be cattle in Area 28 so precautions were in place. Upon arrival it appeared the livestock had been moved.

1.6 TOPOGRAPHICAL SURVEY SUMMARY

Most topographical data was surveyed using Leica RTK rover units set at ±0.020m tolerance. Where Trees were present and RTK methods were not possible, temporary stations were installed and a total station used to continue surveying transects. Stations were installed using GPS for a minimum of 600 obs.

Water flow direction was labelled as best as possible. Stagnant water and with heavy reed cover meant it was often difficult to determine water flow direction. This has been noted on the CAD drawings.

Area 10&11

Transects

BHALL_LS1 - No land access east end of transect.
BHALL_LS2 - No land access east end of transect
BHALL_LS3 - No land access east end of transect
BHALL_LS4 - Transect was surveyed in its entirety
BHALL_LS5 - Transect was surveyed in its entirety
BHALL_LS6 - Transect was surveyed in its entirety
BHALL_LS7 - Transect was surveyed in its entirety
BHALL_LS8 - No land access north end of transect

Ditch sections

BHALL_DS1 - Section was surveyed in its entirety
BHALL_DS2 - Section was surveyed in its entirety
BHALL_DS3 - Section was taken approximately 5 metres north as it was unsafe to access where section was plotted
BHALL_DS4 - Section was surveyed in its entirety
BHALL_DS5 - Section was surveyed in its entirety

Topographic Survey

All of Area 11 was surveyed on a 20x20m grid. All of Area 10 was surveyed on 20x20m grid with the exception of an area to the south-west of the site that is marked in the CAD. This area was unsafe to access due deep silt.

Gaugeboards and Flow Meters

All gaugeboards and flow meters were surveyed including the concrete dipwell and a cross section taken at each location. Alongside this, bed levels were taken 50m upstream and downstream of the gauging station.

AREA 28

Transects

HAL_LS1 - Transect was surveyed in its entirety
HAL_LS2 - Transect was surveyed in its entirety

Ditch sections

BHALL_DS1 - Section was surveyed in its entirety
BHALL_DS2 - Section was surveyed in its entirety
BHALL_DS3 - Section was surveyed in its entirety
BHALL_DS4 - Section was surveyed in its entirety
BHALL_DS5 - Section was surveyed in its entirety
BHALL_DS6 - Section was surveyed in its entirety
BHALL_DS7 - No land access west end of transect
BHALL_DS8 - No land access west end of transect

Topographic Survey

All of Area 28 was surveyed on a 20x20m grid.

Gaugeboards and Flow Meters

All gaugeboards and flow meters were surveyed, and a cross section taken at each location. Alongside this, bed levels were taken 50m upstream and downstream of the gauging station.

1.7 DELIVERABLES

The deliverables for this report include:

- Both 2D and 3D AutoCad drawings
- Raw (x,y,z) triplets of all survey points

1.8 APPENDICES

A) Risk Assessment & Method Statement (RAMS)

T480: Site Visit Risk Assessment & Method Statement (RAMS)

A hard copy of this form should be available on site throughout the duration of our works

Project Number	70078783	**Project Name**	Sizewell C Hydro Suryey
Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

1. Site Location, Access Arrangements
Site address and pertinent access details. Attach plans and maps to rear of document if needed (include hospital route map if pertinent)

The works are required on two sites, located some 16 miles apart. The locations are shown in Figures 1.1 and 1.2 and described as follows: Site 10/11 Sites 10/11 is located between Farnham to the west and Sternfield to the north east. The closest postcode to the site is IP17 1HN and the site is centred on NGR TM 38160 60336. The site comprises undeveloped agricultural land. The sites are accessed via private track off Aldecar Lane which leads to Manor House Farm and the nearby sewage treatment works.

Site 28

Located to the south of Halesworth and accessed at its southern end by a gate from the A144. The closest postcode to the site is IP19 8DY and the site is centred on NGR TM 39063 76589. The site comprises agricultural grazing land adjacent to the River Blythe. The river forms the sites eastern boundary. Several drainage ditches traverse the site. Historical mapping shows that, other than the formation of the drainage ditches, the site has been undeveloped since mapping of 1884.

A location plan of site is shown below.

Nearest A&E: Ipswich Hospital, Heath Road , Ipswich, Suffolk, IP4 5PD

Tel: +441473712233, 999

All employees must complete the WorkTogether mandatory self-assessment app every day to get clearance before leaving for the office, client office or site.

https://worktogetheruk.wspis.com/

2. Site Maps
Insert screen grab of appropriate site location map - highlight any constraints that are appropriate. Attach plans and maps to rear of document if needed.

Figure 1.1 - Sites 10 and 11

Figure 1.2 Site 28

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

3. Anticipated Works and Programme *Outline of the anticipated works (layman's explanation) & overview of programme as appropriate*	Wood Environment & Infrastructure Solutions are completing an environmental assessment for a fen meadow strategy for the proposed Sizewell C power station. WSP have been appointed to complete Task 2 of this assessment, a topographic Transect Survey. Across the two sites they are required to be grided, complete 11 long sections, 13 short ditch sections and bank profiling. It is proposed two survey teams of 2 surveyors will be assigned to this project as per our Safety, Health and Wellbeing best practices - WSP do not encourage lone working. Land access will be confirmed and arranged prior to accessing site. The survey will be carried out using a combination of Leica GNSS and, where required, Leica Total Station for grid and sections data capture. Surveys will be carried out during daylight hours with all surveyors working together (physical distancing) when operating on or near water. All team members entering or working near water are required to be First Aid Trained and are Cold Water Trained. A dynamic risk assessment will be made on the day looking at the depth and speed of the waterbody and if deemed unsafe, no work will take place and then reported. Safe access routes for all staff working on banks will also be identified by the safety team. Only then will a toolbox talk and safety brief be conducted to inform and discuss the planned activities, full RAMS will be signed by the whole team and the site agreed safe to work on. Appropriate PPE relevant to site requirements will be worn, including dry suits (and thermals where required), canoeing helmets and appropriate buoyancy aids/life jackets. **Timeframe and hours of work may be subject to change once a dynamic risk assessment has been carried out on day 1 to take into account of risks involved with Covid 19**

4. Contacts	**Name**	**Contact Number**	**Comments including Specific Buddy Arrangements**
Project Director	[redacted]		WSP Principal Engineer
Project Manager			**WSP, CSCS, DOMS, Streetworks, Cold Water Training, First Aid**
Senior Surveyor	[redacted]		WSP, CSCS, DOMS, Streetworks, Confined Space, Cold Water Training, First Aid
Surveyor	[redacted]		**WSP, CSCS, Streetworks, Confined Space, Cold Water Training, First Aid**
Surveyor	[redacted]		**WSP, CSCS, DOMS, Streetworks, Cold Water Training, First Aid**
Assistant Surveyor	[redacted]		WSP, CSCS, DOMS, Confined Space, Streetworks, Cold Water Training, First Aid
Assistant Surveyor	[redacted]		**WSP, CSCS, DOMS, Confined Space, Streetworks, First Aid**
Client	[redacted]		WSP Hydrogeologist - Ground and Water

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

24/7 Incident Report Line - 0870 240 8822

Travel arrangements	The Topo survey team will be staying locally. Every effort will be made to reduce the need to stop during there travel including, filling up each vehicle with fuel in there home town and preparing lunch at home. Each surveyor will travel to site in separate vehicles complying with the Covid-19 guidelines. Vehicles will be chapter 8 compliant to access Traffic Management and to displayed a sign in the rear window stating - Covid-19 essential works.
COVID-19 Response	**COVID-19 Response and Actions to be Taken: All Government advice regarding physical distancing will be adhered to** •Keep at a distance of 2m or more from each other and members of the public. This applies particularly when using welfare facilities or getting food. •Staff to travel in separate vehicles to site. Where possible, mobilise from home. Upon arrival check the number of people on foot in the area. If numbers are high and close contact with members of the public is unavoidable remain in vehicle until the area becomes quieter. If the area remains busy / crowded contact project manager and consider rescheduling the survey. •Fill up with fuel in the local area before departure, to avoid having to stop an route, thus minimising spread to another area. Use disposable gloves whilst refuelling and try to pay at the pump. •Welfare facilities should be identified and confirmed that they are open. •You should take your lunch with you, to avoid going to shops. •Staff to wear appropriate gloves and dispose of/disinfect properly after use. If you wear your normal site gloves, wash them in antibacterial solution after site work. Disposable gloves should be removed by unpeeling one of them from the cuff with one hand, then unpeeling the other over the hand AND the first glove, and bagging both, then hand sanitising. •Avoid touching your face, with or without gloves. •Wash hands regularly throughout the day, especially before eating or drinking, using soap and water or 60% alcohol hand gel. Decide on the method before leaving for site, and make sure you have an adequate supply. •The survey team has access to wipes and hand sanitizer and will make use of both regularly throughout the day, both for personal use and to disinfect the equipment. Use anti-bacterial wipes to disinfect the equipment, if it is being shared. Try to minimise this by having your own set of equipment, if at all possible. •WSP survey staff will keep up to date with the latest government advice. Should relevant restrictions on movement come into place the survey team will demobilise from site. •Local residents may object to your presence- if so retreat from the situation. A heightened level of care will be taken during any interaction with the public. •Should WSP survey staff display coronavirus symptoms then they should return home immediately, and a decision made by the project manager, director and Safety Advisor will decide what further action to be taken. The WSP reporting policy will also be followed. •If carrying out a work activity would prevent physical distancing from being maintained approved face masks or face coverings shall be worn. •Upon arrival on site if you do not feel safe, you should leave site and return home.
Guidance	GNHS012-03: Risk Management - Site Activity Guidance

T480: Site Visit Risk Assessment & Method Statement (RAMS)

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Site Specific Risk Assessment

Significant Hazards	**Risk** *(Who might be harmed and how)*	**Site Specific Risk Assessments & Controls** *(What is being done to control the risk on this job?)*	**Risk Rating** See Matrix	**Risk Grading** *(automated)*
Covid-19	**COVID-19 is a new illness that can affect your lungs and airways. It's caused by a virus called coronavirus COVID-19 can result in death** **Staff, public** **Symptoms:** **• A new or continuous cough** **• High temperature** **• Shortness of breath** **• loss or change to your sense of smell or taste**	**All government advice regarding physical distancing will be adhered to.** **•Keep at a distance of 2m or more from each other and members of the public. This applies particularly when using welfare facilities or getting food.** **•Staff to travel in separate vehicles to site. Where possible, mobilise from home. Upon arrival check the number of people on foot in the area. If numbers are high and close contact with members of the public is unavoidable remain in vehicle until the area becomes quieter. If the area remains busy / crowded contact project manager and consider rescheduling the survey.** **•Fill up with fuel in the local area before departure, to avoid having to stop an route, thus minimising spread to another area. Use disposable gloves whilst refuelling and try to pay at the pump.** **•Welfare facilities should be identified and confirmed that they are open.** **•You should take your lunch with you, to avoid going to shops.** **•Staff to wear appropriate gloves and dispose of / disinfect properly after use. If you wear your normal site gloves, wash them in antibacterial solution after site work. Disposable gloves should be removed by unpeeling one of them from the cuff with one hand, then unpeeling the other over the hand AND the first glove, and bagging both, then hand sanitising. Further details and COVID-19 responses highlighted above.**	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Driving to Site	Employee and public Driving to and from site, risk of collision, Vehicle damage, RTA, disablement, death.	• Staff to read, understand and adhere to MCHS121 - Driving at Work. • Staff to have completed the permit to drive application on Driving Monitoring and e-learning courses. • Staff to drive in accordance with current safety standards and the law. • Plan Journey – allow enough time and ensure adequate fuel. • Check weather forecast before journey begins (the survey will be cancelled following prolonged rainfall and during inclement weather). • Charge all mobile phones for use in emergency. • Do not use mobile phone whilst driving (including Bluetooth or hands free equipment). • Carry out pre-journey checks (water levels / tyre pressure). • Take a break at least every 2 hours or as required. • Share the driving between staff. • DO NOT DRIVE WHEN TIRED. When travelling home after multiple evenings and mornings of surveying, stop for coffee/nap breaks, share driving.	Seldom Fatal Injury/Disease	**Moderate Risk - Proceed**

T480: Site Visit Risk Assessment & Method Statement (RAMS)

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Manual handling; carrying equipment	Employee At risk of injury (muscle strain, sprain or tear, cuts, grazes or lacerations, back injury)	• Staff to read, understand and adhere to MCHS313 - Manual Handling. • Staff have all undertaken the manual handling training. • Staff only to lift what they are comfortable with. • Staff to utilise full team to move multiple loads while maintaining physical distancing • Staff should wear appropriate PPE to reduce/remove risk of injury. I.E. Boots, gloves, glasses, etc. • To prevent any injury and take breaks prevent fatigue. No heavy survey equipment permitted on slope, this shall remain at carriageway level or on suitable verge. • Only survey kit required on slope is a lightweight alloy detail pole (prism) approx. 1.5m length. Staff will be working at distances greater than 2m at all times. During any handling of heavy equipment 2 person working may be closer than the 2m requirement but will be of the minimum time required to carry out manual handling, expected to be for 30 Seconds and possibly up to 10 times per day. Once the equipment is moved one staff member will retreat to a distance >2m whilst the other carry's out the required work	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

T480: Site Visit Risk Assessment & Method Statement (RAMS)

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Risk Assessment Ref	V2 17/11/20	**Assessment Completed By**	[redacted]
Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Road traffic while pedestrian	WSP Staff and members of the public	• Staff to read, understand and adhere to MCHS244 - Working on or Near Highways. •Staff mobilised to hold valid Streetworks tickets at both operator and supervisor levels. • Use pedestrian pavements /designated walkways where possible. • Be observant of road users. • Use crossings. • The following PPE will be worn at all times: High visibility jackets with reflective stripes complying with EN471 class 3, high visibility trousers with two reflective stripes complying with EN471 class 1, and safety boots with a steel mid sole and toecap complying with EN345. • When visiting site, undertake appropriate parking. • Face traffic when carrying out survey.	Seldom Fatal Injury/Disease	**Moderate Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Slips, trips and falls	Employee Minor injury, lower/upper limb damage, bruising, impact injuries.	• Assess ground conditions before proceeding. Use predefined footpaths and tracks to access. • Additional care to be taken in wet and winter conditions - beware of ice patchs. • Inspect footware daily prior to starting work. Ensure boots have a sufficient tread. • Various covers, lids, cable trays, moss covered surfaces and other trip hazards may be present • Wear appropriate sturdy footwear whilst on site. I.E. safety wellingtons/boots or walking boots with toe caps and reinforced mid-sole as appropriate • Take extra care when ground is uneven.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Cuts / grazes & Sharps	Employee Injury from puncture, impaling, infection including hepatitis, contamination from needles including HIV.	• A first aid kit should be carried at all times, all kit should be in date and fit for use as per MCHS321 - First Aid. • Wear appropriate PPE as detailed below including long-sleeved t-shirts • Care will be taken if required to cross any stiles, gates and fences. • Any cuts / grazes will be covered by waterproof glove / plasters. • Needles may be expected as some areas are out of public view. Due care and attention should be taken. • Wear reinforced sole safety boots at all times on site. • Avoid barbed wire fences where possible. • Never put your hands where you cannot see them. • Check body for cuts and abrasions. For ANY puncture wounds, seek medical attention immediately.	Seldom Minor Injury/First Aid/Disease	**Low Risk - Proceed**
Inclement weather	Employee Dehydration, fatigue, hyperthermia, hypothermia	• Check updated weather forecast on internet/radio prior to leaving for site. • Ensure appropriate clothing is available for the weather conditions, with a change of clothes/extra layers if necessary. • Carry adequate water. • Monitor the weather conditions when on site and retreat to a safe place of shelter as required and seek on site welfare facilities.	Seldom Minor Injury/First Aid/Disease	**Low Risk - Proceed**

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Risk Assessment Date	22/10/2020	**Assessment Authorised By**	[redacted]

Interaction with the public	Employee & public Confrontation, harassment, assault	• Only areas with agreed access will be surveyed - if in doubt contact Fraser Bell. • Park your car in a sensible place to allow safe and suitable access and egress to/from site. • Do not obstruct gateways or access and egress to buildings used by other persons on site. • Members of the public will not be approached. If they do approach remain friendly at all times. Land owners may be approached if walking on their land or if attending meeting. • If staff are approached in an aggressive manner by any person they will remain calm and polite and leave the site immediately until the threat is no longer present. Retire to a vehicle and if required inform the police. • Always keep your charged mobile phone with you on site and ensure calling-in protocol is followed.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Illness or disease from vermin; illness, disease or injury from wild animals/insect bites/stings	Employee Disease, illness, injury, rash/itching, severe reactions, contamination, Ecoli, Leptospirosis	• Ensure hands are thoroughly washed after coming into contact with water. Wearing protective rubber gloves is advisable as a precaution, though thorough hand washing or sanitising before eating is adequate. • Staff to be aware of the symptoms and prevention measures for leptospirosis/Weil's disease & carry information cards at all times • Clean hands before eating/leaving site. • Cover up exposed skin to reduce likelihood of stings and bites. Long sleeved PPE to be worn at all times. • Staff should check themselves for ticks once off site and be aware of the symptoms and prevention measures for Lyme's disease. • Insect bites should be monitored to ensure they do not become infected. • It is the member of staff's responsibility to announce any known allergies prior to commencement of the survey and carry appropriate medication as required.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Vegetation	Employee Disease, illness, injury, rash/itching, severe reactions, environmental contamination	**Unlikely to be found on site but could be found in surrounding areas.** Giant Hogweed • Produces a poisonous sap that can cause blister and skin pigmentation. Himalayan Balsam • Presents no physical danger to either humans or animals but provides a significant ecological impact as it suppresses native flora and can lead to river bank erosion. Japanese Knotweed • The plant presents no physical danger to humans or animals but has significant ecological impact since it grows and spreads rapidly For plant description, refer to the factsheet kept in pool vehicle. These plants have a community protection notice. • Ensure skin is covered if required to approach giant hogweed • Where possible do not touch Himalayan balsam/Japanese knotweed to avoid spreading.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**

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Use of Lasers	Employee Members of the public, eyesight damage and potential blindness	• Employees to avoid looking directly at laser beam and damaging eyesight. • Avoid curious members of public, operators or contractors. • No real requirement for laser during daylight hours and it will be ineffective. • Reflectorless pointing to be manually 'eyed in' by the surveyor using sight and laser off on site.	Seldom Moderate Injury Beyond First Aid/Disease	**Low Risk - Proceed**
Working near water, close to water or in water	Employee, Slips or falls into watercourses, injury, soaking leading to cold/shock/hypothermia, drowning or engulfment	• Staff to read, understand and adhere to MCHS243 - Working on or near water. • Approach any water with caution. Safe access routes to be determined. • Staff to stay behind safety barriers/fences at all times where at all possible. • If in any doubt - Do not enter. • No lone working will take place near water • All staff mobilised for supervision have attended Cold Water Safety Training (H&S HS415). • Surveyor to make own self assessment of water levels on day of work (and subsequent days if required) and is to consider depth, speed of current and volume, do not work in or near to water if judged at all to be a risk. • Minimum of 2 members of staff present when working on/near water at all times. Ensure that shore support is in place before beginning, with a safety throw line and the ability to call for additional aid if required. • Dry-suits (and thermals where appropriate) , canoeing helmets, gloves and buoyancy aids/life jackets will be worn at all times on/near water.	Unlikely Moderate Injury Beyond First Aid/Disease	**Moderate Risk - Proceed**

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Working at Height	WSP Staff and members of the public	• Includes open manhole covers/culvers/structures/steep drops/stairs etc. • Do not leave covers open on a public site. Adopt the open/close policy. • Take care on steep slopes • Do not work adjacent to unprotected drops.	1 4	**Moderate Risk - Proceed**

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Environmental Impacts		T-E200: Project Environmental Risk Tool (PET).xlsx	

Plan of Work *(Briefly identify the steps that are required to complete the task, taking into account the precautions identified above and the steps required in implementing them, to ensure the risks are eliminated or reduced. Include consideration of how you are getting to site where appropriate.)*	
Description of step or task	Before commencing work Surveyors must complete the WorkTogether mandatory self-assessment app every day to get clearance before leaving for the office, client office or site - https://worktogetheruk.wspis.com/. They should undertake a Dynamic Risk Assessment (Point of Work Risk Assessment (PoWRA) at each area prior to each survey visit. If the risks present on site are different to those assessed in this RAMS, or there is a deviation from the scope of works, a review should be undertaken to ensure it is safe to procede. Report the observations back to the project team to allow subsequent WSP staff on future visits to be briefed.

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Description of step or task	A control network will be established from which water course and structure survey will be referenced to. Control will consist of nails in hard standing or pegs in soft ground. The position of the control points will be chosen for optimum survey considerations, and adequate clearance from members of the public.
Description of step or task	Details of the topographic transect locations are shown in Figure 2.1 and 2.2 (see in attached document), summarised as follows: •Site 10/11 – 9 long sections, 5 short ditch sections, and 20 x 20m topographic grid and bank profiling of primary locus area for fen meadow •Site 28 - 2 long sections, 8 short ditch sections, and 20 x 20m topographic grid and bank profiling of primary locus area for fen meadow Transect and grids will be surveyed using RTK techniques except where vegetation obscures satellite visibility. Metric units shall be used throughout. RTK survey will be related directly to the E1 control station, and RTK rover units will be set to work to a ±0.020m tolerance, relative to the base station. Points on transect lines will be surveyed at a nominal interval of 20 metres in densely vegetated areas and 10 metres in open areas, with additional points to define changes in slope, changes in vegetation, boundary features and other crossings. For the topographic grids, a 20 x 20 m grid of topographic shots is required in the areas marked on figures 2.1 and 2.2 as primary locus area for fen meadow. This will include top of bank profiling where the grid crosses a water feature.
Description of step or task	The following water-related features along the transect line will be surveyed: • Top of banks of all water features (both sides); • Surface water level at the time of the survey for any water feature along the transect line (to be indicated by a solid line annotated with a date and time of the measurement); • Surveys shall extend (where safe) approximately 1m (safe arm's length) into the watercourse from the water's edge; • Bed level (soft bed) of ditches and surface water features where possible. It may not be necessary to obtain a depth level for deeper water features such as the River Fromus (Site 10/11) or River Blythe (Site 28) if they are not wadable or safe to enter; • Direction of flow of watercourses (indicated by arrows on the plan); • Culvert/Pipe dimensions and invert levels; • Beaches, mudbanks, reedbeds and any other features that affect the width of the channel; and • All underwater features, e.g. concrete/brick aprons, piling alignments, will be surveyed where identifiable.
Description of step or task	The survey will be conducted using a combination of total station measurement and GNSS observations where access and conditions permit. Use of the total station will involve the setting up of tripods over the control points. Observations will then be made, using a detail pole and prism to locate the required detail. Should conditions permit, a detail pole and GNSS receiver may be used, which would not involve the setting up of tripods.

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Description of step or task	Once the survey has been completed the equipment will be packed away and carried back to the vehicle via the same route that was used to access the site.
Description of step or task	Both 2D and 3D AutoCad drawings will be produced. In addition, raw (x,y,z) triplets of all survey points will be presented in csv format. Deliverables are to include a clear statement of any limitations and assumptions supported in a report of survey (a brief report of survey quoting accuracies, survey methods and any other relevant comments will be submitted with the survey drawings, PDF format).

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People *(List any specific people or skills/competencies that are required and any supporting documents (eg. CSCS cards))*

All surveyors to have a briefing before leaving for site

All surveyors to have an in date CSCS card as per MCHS212 - CSCS Cards

All surveyors entering the water will have undertaken cold water training

All surveyors driving for work will have undertaken the WSP internal permit to drive training.

All surveyors hold valid First Aid Training certificates

Plant, Equipment, Materials, Environment *(List the materials and equipment required to complete the activity and any additional supporting documents that may be required to demonstrate that equipment is safe, the environment is safe, etc)*

The following PPE must be worn by all personnel remaining on bank at all times:
• Safety Helmet/Canoeing helmet
• High Visibility long-sleeved jacket, waistcoat & trousers (NRSW Chapter 8). The surveyor shall decide whether wear either the jacket or waist coat. Whichever is worn; it must be fastened and not allowed to be open at the front.
• Safety Boots
• Life Jacket/buoyancy aid
• Packable (minimum 15m) Throw Line that team have been trained with and confident using
• Gloves
• Lifesystems Survival Bag & First Aid Kit
• Mobile phone or 2-way link radio
• Hand sanitizer, Anti-bac wipes and water

For those entering/potentially entering the water the following must be worn at all times:
• Dry suit inc sock (with thermals if required)
• Canoeing Helmet
• Safety boots for protection, grip when walking on river bed and protection for drysuit rubber socks
• Gloves
• Buoyancy aid/Life Jacket
• High Visibility Long-Sleeved vest UNDER lifejacket. (either under or over buoyancy aid)
• Hand sanitizer, Anti-bac wipes and water

First Aid Kit (one per survey team, to be carried at all times). Must include Lifesystems Survival Bag (orange). All first aid kit will be fit for use and in date as per MCHS321- First Aid.

Survey pack (one per survey team) to include:
• Hard copies of maps showing waterbody locations;
• Copy of RAMS with relevant telephone contact numbers;
• Inspection schedule, access letter, ID; and
• Survey Brief

Clothing, suitable for the weather conditions must be worn and a change of clothes to be carried within vehicle

Total station and detail pole	GNSS receiver
Tripods and prism targets	Level and staff
Notebook and pencils	Tape measure
Hand tools	Survey nails and ground markers

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Site Rules *(List any specific site rules or procedures to be followed, eg. Site Operator Permit to Work?)*

Appropriate PPE (as stated above) will be worn at all times.

Any land owners with specific requests must have those requests adhered to. Care must be taken when accessing third party land to avoid damage to crops, livestock or property.

No Personnel will enter the water without first having had a briefing from the site safety team and the team in place at the survey location.

Welfare Arrangements *(Outline the welfare arrangements in place (sanitary facilities, place to eat and drink, etc))*

Public Toilets Bakers Mews, Saxmundham IP17 1FX, UK - Surveyors to stagger breaks and maintain physical distancing at all time. Surveyors to provide hand sanitizer, soap, towels and toilet roll.

Nearest Supermarket - 1 Church St, Saxmundham IP17 1EP, United Kingdom

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RAMS Briefing *(Please ensure that, prior to signing on to this RAMS, you have the appropriate level of Site Safety Clearance (as part of your H&S Checklist) for the activity planned)*

Name	Signature	Date
[redacted]	[redacted]	21/11/2020
[redacted]	[redacted]	23/11/2020
[redacted]	[redacted]	23/11/20

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Dynamic Risk Assessment *(Take a few minutes on arrival at site before commencing the work activity to determine if there are additional hazards/changes?*

Are there any significant new risks?	Yes / No

If No, there is no requirement to identify specific hazards in the table below; if Yes, identify these hazards/risks and the necessary controls below

Significant Hazards	**Risk** *(Who might be harmed and how)*	**Site Specific Risk Assessments & Controls** (*What is being done to control the risk on this job?)*	**Risk Grading** Low/Medium/High

Comments / Other *(State any assumptions or exclusions/lessons learnt/observations or any technical and commercial implications)*

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Specific Actions in Case of Emergency *(As and where warranted detail any site specific requirements in case of emergency - procedure to follow, who to contact, where to go, etc - most pertinent for out of hours working - nights/weekends - or remote working)*

http://www.nhs.uk/service-search/accident-and-emergency-services/locationsearch/428#

In case of emergency phone 999 A&E (Tel: 01896 826000)

Nearest A&E: Ipswich Hospital, Heath Rd, Ipswich IP4 5PD, United Kingdom - Tel: +441473712233, 999

Assessor's Signature	[redacted]	**Authoriser's Signature** (Project Manager or Project Director)	[redacted]

(Insert Digital Signatures or hard copy sign and scan)

ZERO HARM

24/7 Incident Report Line - 0870 240 8822

Issue 3.8

B) Site 10&11 Topographic Survey

N

BHALL_LS1

BHALL_LS8
No access to river beyond this point

XS_SNPGB04

BHALL_LS1

WL 3.93
2411 1027

WL 3.49
2411 1353

WL 3.52
2411 1518

SNP-GB04

SNP-SF04

WL 3.61
2411 1031

WL 3.78
2411 1528

Trees

Grass

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

- Bottom of Bank/Batter
- Fence(Metal Rail)
- Fence(Post & Wire)
- Fence(Wooden Rail)
- Foliage
- Flow Direction
- Flow Meter
- String Line
- Top of Bank/Batter
- O/H Electricity
- O/H BT
- Verge Wood
- Borehole
- Gate
- Gate Post
- Top of Gaugeboard
- Outfall Pipe
- Post
- Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

wsp
7 Lochside View, Edinburgh Park, Edinburgh, EH12 9DH
T+ 44 (0) 131 344 2300
wsp.com

Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 1 OF 7

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

Bottom of Bank/Batter
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Fence(Post & Wire)
Fence(Wooden Rail)
Foliage
Flow Direction
Flow Meter
String Line
Top of Bank/Batter
O/H Electricty
O/H BT
Verge Wood
BH "x"m "y"m "z"m Borehole
Gate
Gate Post
Top of Gaugeboard
Outfall IL=m Dia=m Outfall Pipe
Post Post
TP Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
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Site 10&11
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Drawn By	**Checked By**	**Approved By**
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 2 OF 7

N

BHALL_LS2

XS_SNPGB03

No access beyond security fence

BHALL_DS3

XS_SNPGB
Unable to de

BHALL_DS2

BHALL_LS3

XS_SNPGB02

NOTES

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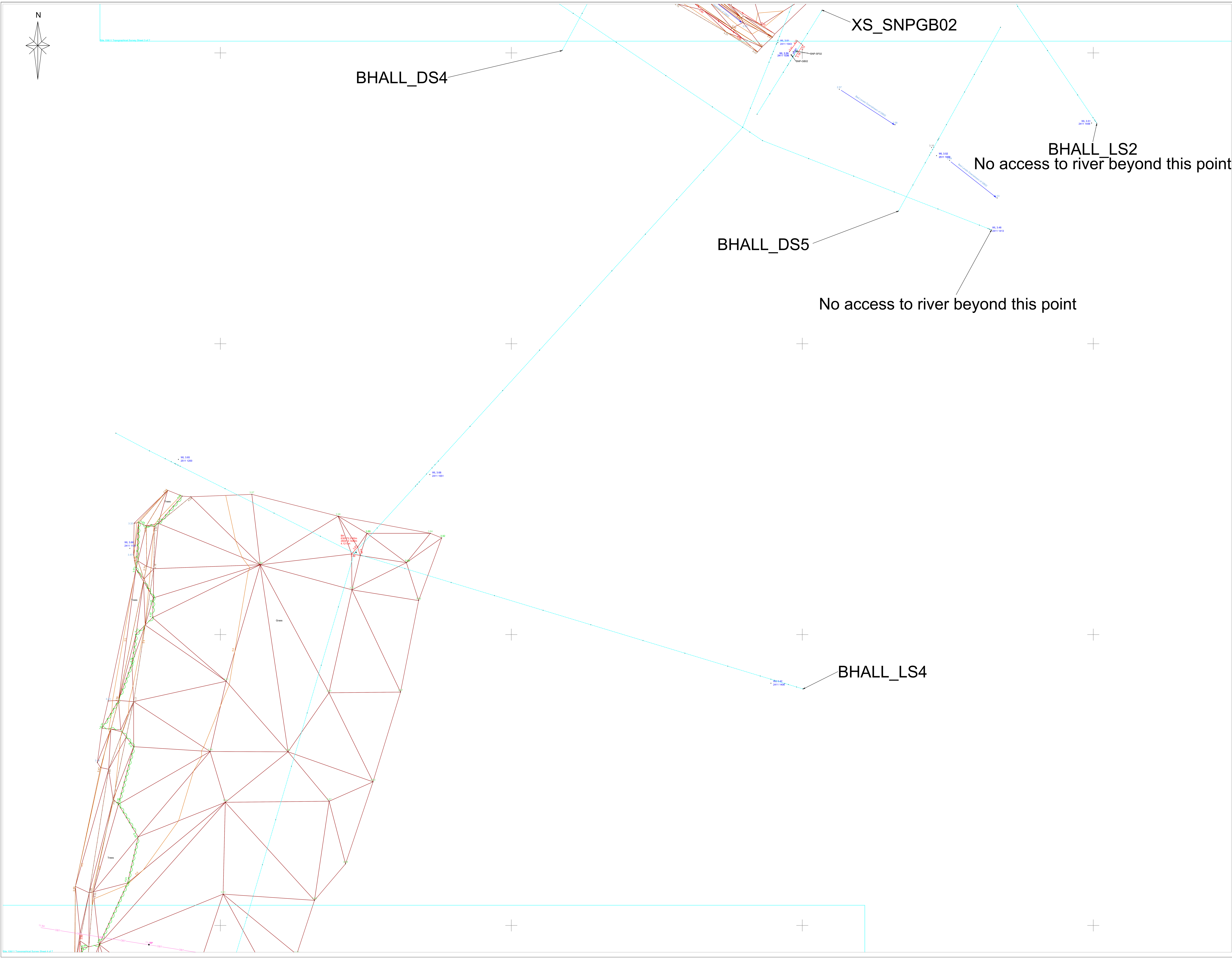
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 3 OF 7



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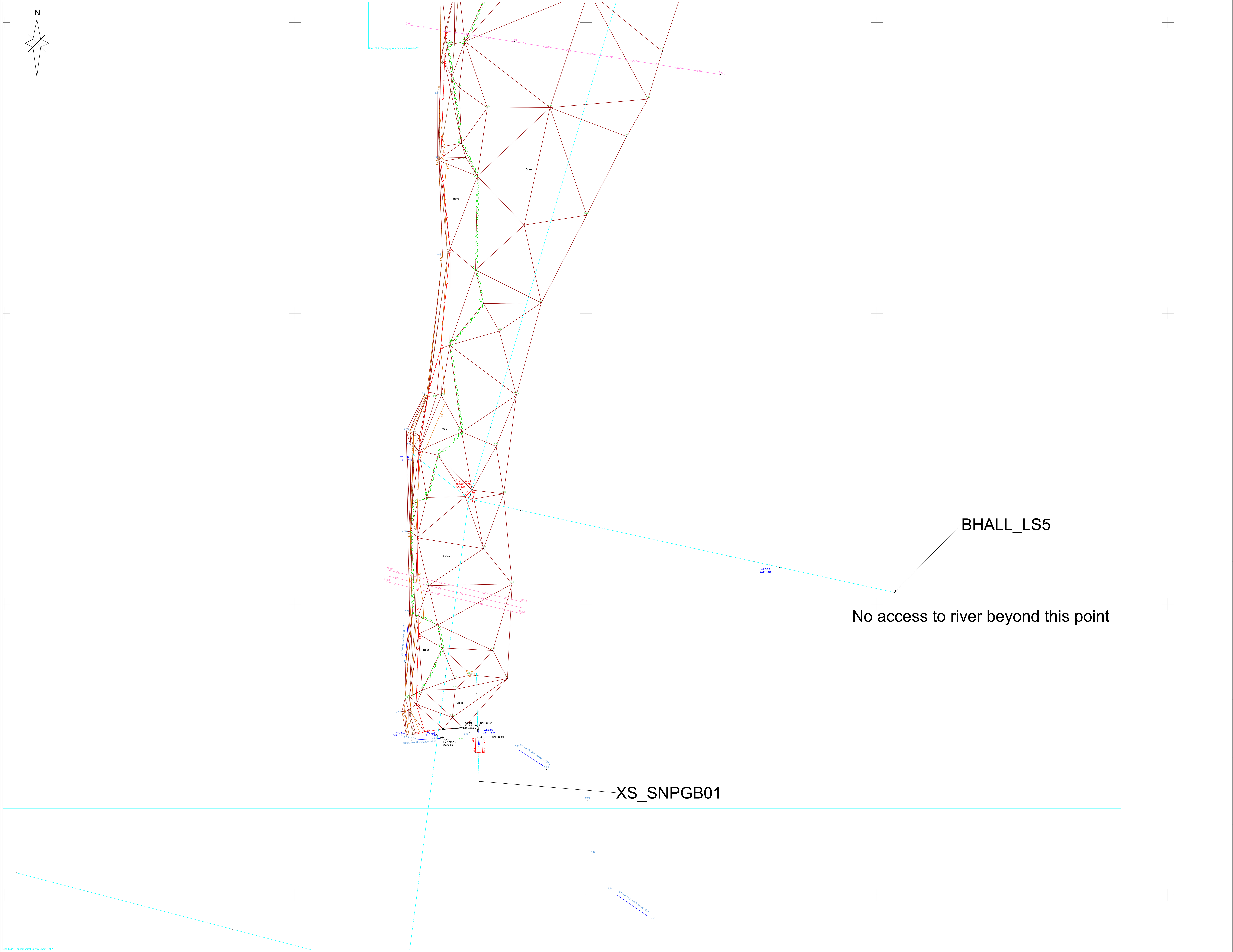
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020

Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 4 OF 7



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String Line
Top of Bank/Batter
O/H Electricty
O/H BT
Verge Wood
Borehole
Gate
Gate Post
Top of Gaugeboard
Outfall Pipe
Post
Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

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T+ 44 (0) 131 344 2300
wsp.com

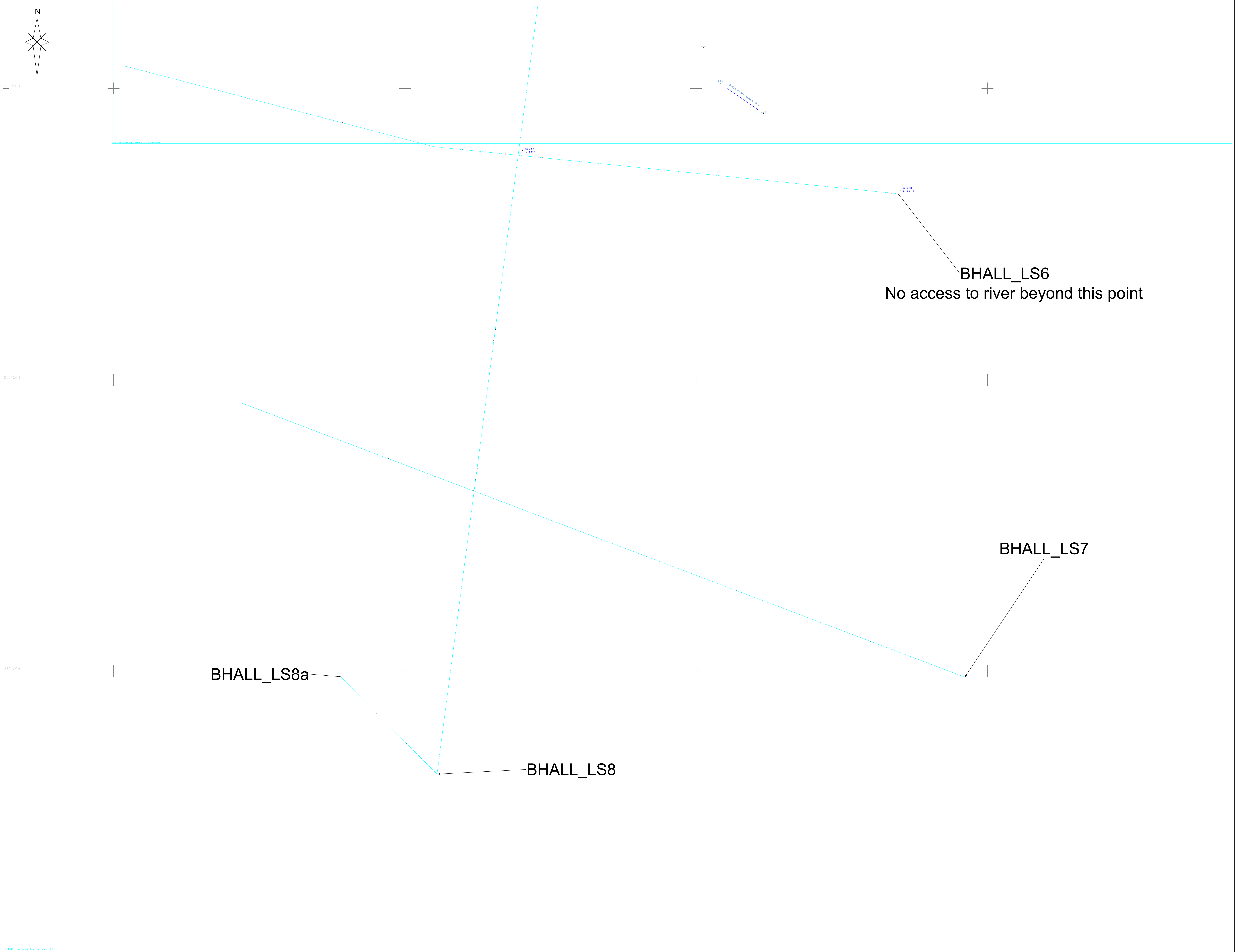
Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

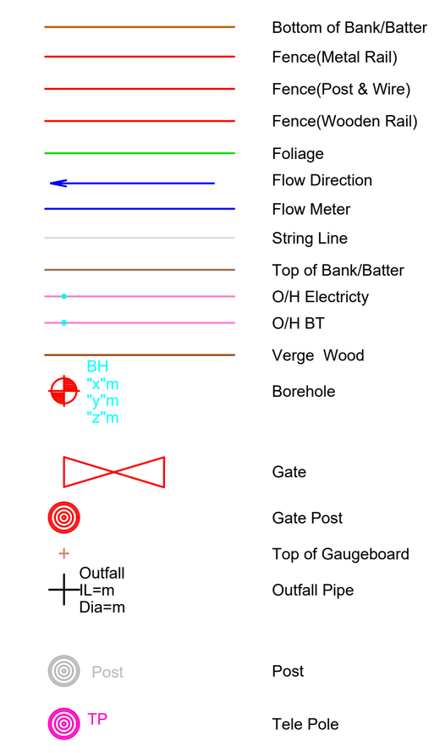
SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 5 OF 7



NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND



REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

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Project / Drawing Title

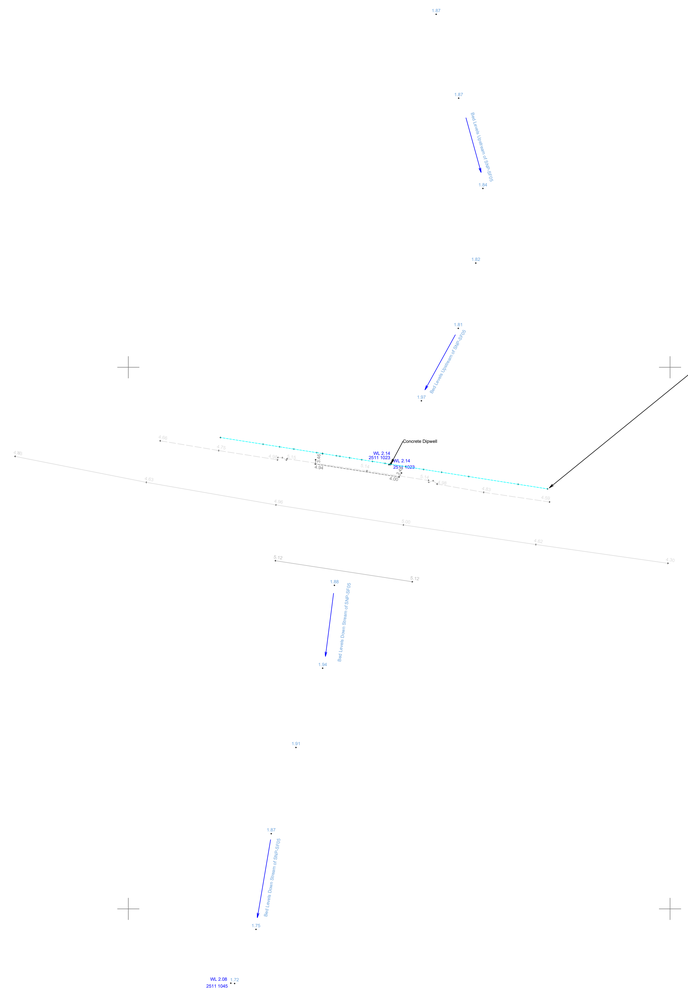
Sizewell C Hydro Survey
Site 10&11
Topographical Survey

Scale	Size	Date
1:200	A0	10/12/2020
Drawn By	Checked By	Approved By
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 6 OF 7

N



XS_SNPSF05

NOTES

Grid: Ordnance Survey Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

- Bottom of Bank/Batter
- Fence(Metal Rail)
- Fence(Post & Wire)
- Fence(Wooden Rail)
- Foliage
- Flow Direction
- Flow Meter
- String Line
- Top of Bank/Batter
- O/H Electricity
- O/H BT
- Verge Wood
- Borehole
- Gate
- Gate Post
- Top of Gaugeboard
- Outfall Pipe
- Post
- Tele Pole

REV.	DETAILS	DRN	CHKD	DATE
Rev1	Drawing amended to include section labels	IR	SS	12/01/2021

STATIONS

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Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

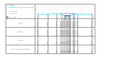
Scale	Size	Date
1:200	A0	10/12/2020
Drawn By: K Baillie	Checked By: A Moffat	Approved By: S Smith

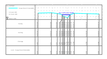
Drawing Name / Number

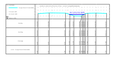
SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY 3D
SHEET 7 OF 7

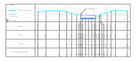
C) Site 10&11 Transects & Sections

Gauge Board/Dipwell Cross-sections

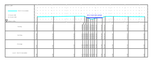


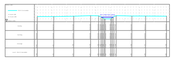




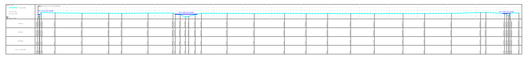


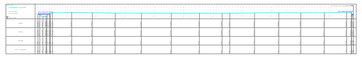
Ditch Cross-sections

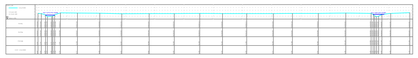


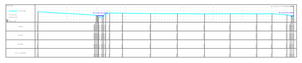


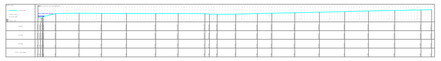
Long Sections

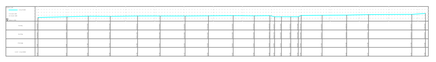


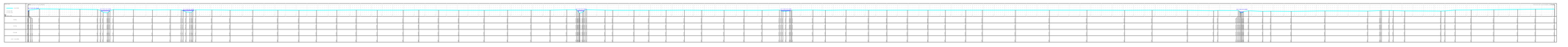


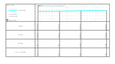












NOTES

Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

REV.	DETAILS	DRN	CHKD	DATE

STATIONS

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Project / Drawing Title

Sizewell C Hydro Survey
Site 10&11
Topographical Survey

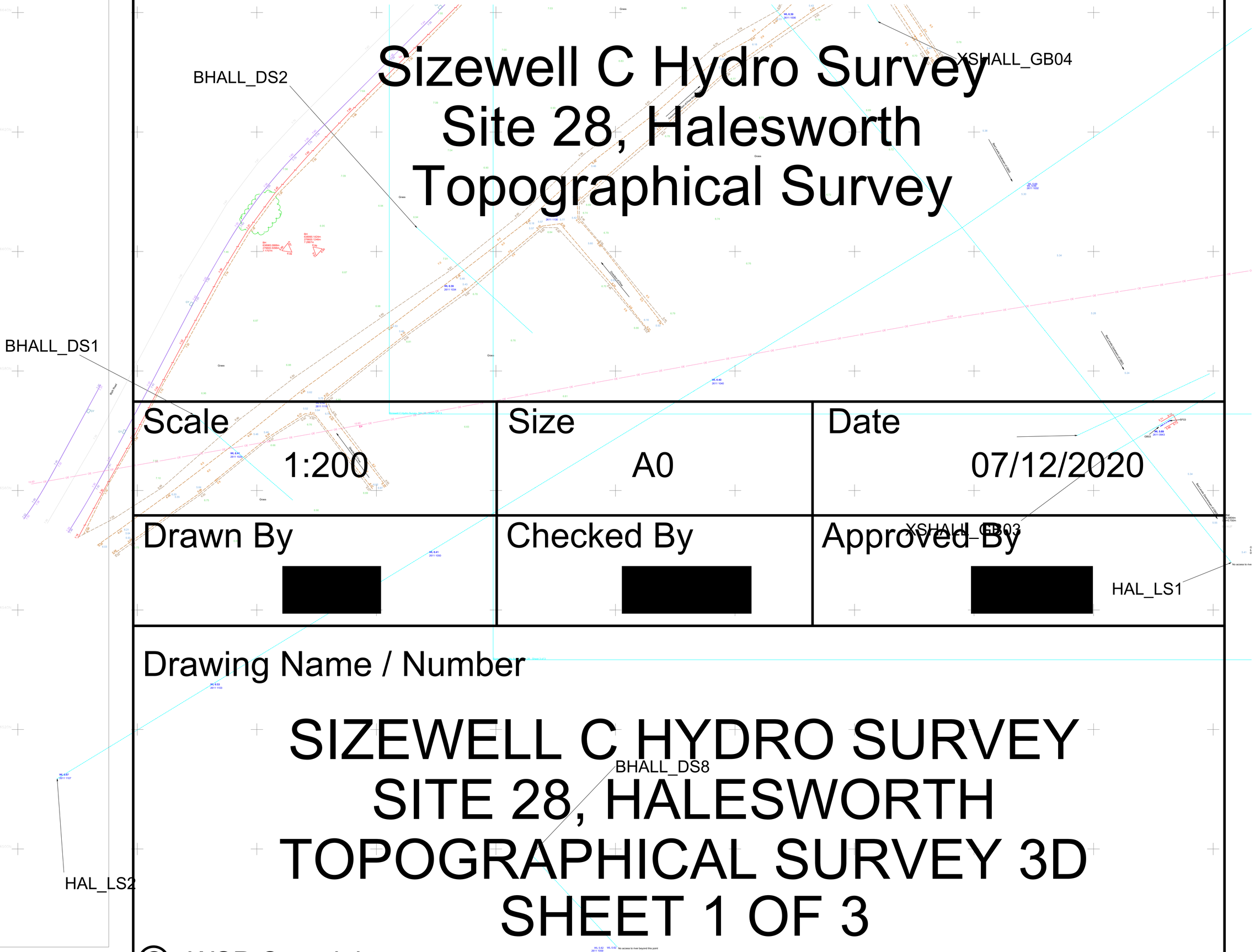
Scale	Size	Date
NTS	A0	10/12/2020
Drawn By	**Checked By**	**Approved By**
K Baillie	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
Site 10&11
TOPOGRAPHICAL SURVEY
SHEET 1 OF 1

D) Site 28 Topographic Survey

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey



Scale	Size	Date
1:200	A0	07/12/2020

Drawn By	Checked By	Approved By
[redacted]	[redacted]	[redacted]

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 1 OF 3

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey

Scale	Size	Date
1:200	A0	07/12/2020
Drawn By	**Checked By**	**Approved By**
[redacted]	[redacted]	[redacted]

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 2 OF 3

76540N

Sizewell C Hydro Survey
Site 28, Halesworth
Topographical Survey

Scale	Size	Date
1:200	A0	07/12/2020

Drawn By	Checked By	Approved By
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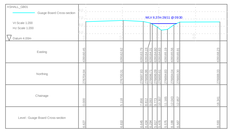
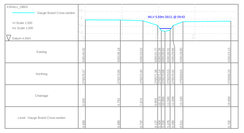
Drawing Name / Number

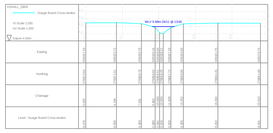
SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TOPOGRAPHICAL SURVEY 3D
SHEET 3 OF 3

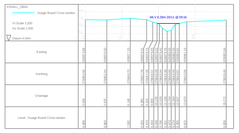
E) Site 28 Transects & Section

Guage Board Cross-sections

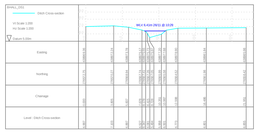


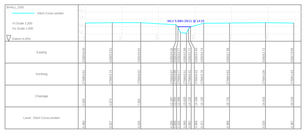


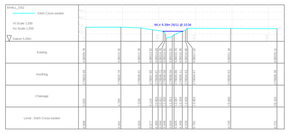


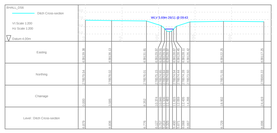


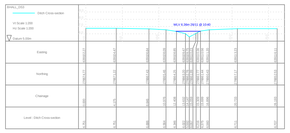
Ditch Cross-sections

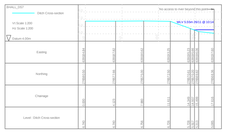


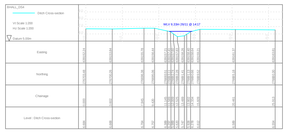


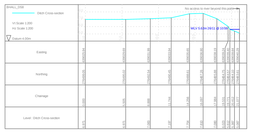




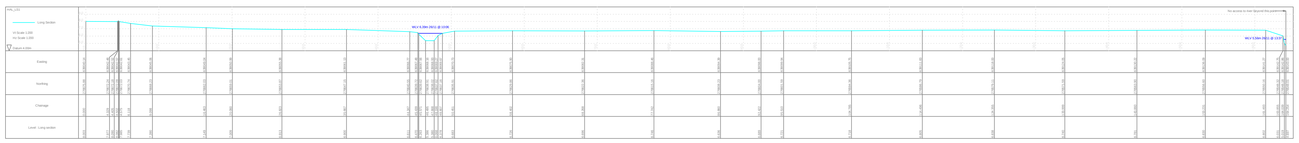


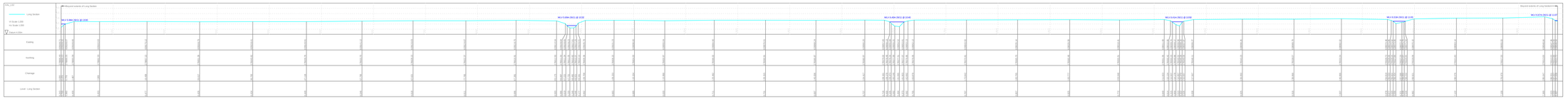






Long Sections





NOTES

Grid: OS Grid (OSTN15)
Datum: Ordnance Survey Datum (OSGM15)

SURVEY LEGEND

REV.	DETAILS	DRN	CHKD	DATE

STATIONS

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Project / Drawing Title

Sizewell C Hydro Survey
Site 28, Halesworth
Transects and Sections

Scale	Size	Date
1:200	A0	07/12/2020
Drawn By	**Checked By**	**Approved By**
I Ross	A Moffat	S Smith

Drawing Name / Number

SIZEWELL C HYDRO SURVEY
SITE 28, HALESWORTH
TRANSECTS AND SECTIONS
SHEET 1 OF 3

Appendix D
Soil Core Survey - April 2019

Core 1, TM3912676728
Location: On an elevated platform with a distinct, curving margin in the northeast field corner; possibly toeslope of Head.
Vegetation: Weedy grassland dominated by lush Perennial Ryegrass, with scatters of Chickweed, Red Dead-nettle, Shepherd's-purse and Nettle. Corresponds to the OV23 *Lolium perenne-Dactylis glomerata* community.
No phreatophytes.

Surface and topsoil a humic sand with occasional chipped sub-rounded flints.
Mottling first observed at a depth of 38 cm in humic sand.
Below here, strongly mottled in light yellow sand matrix.
From 66 cm bgl pale yellow sand with manganiferous streaks and yellow iron mottles, suggesting more intense redox reactions in zone of water table fluctuation.
Core ended at 82 cm when hit gravel.

Core 2, TM3916776674
Location: in widespread, low-lying area on the riverside of the catch-dyke.
Vegetation: Grass-dominated rush-pasture with abundant Creeping bent, frequent Soft Rush, White Clover and Creeping Buttercup with occasional Tufted Hairgrass and Cuckooflower. Corresponds to the Typical sub-community of the *Holco-Juncetum effusi* rush-pasture (MG10a). No phreatophytes present.
This group of species is indicative of surface rainwater detention.

Peaty top
Humic silt loam from 6cm. Very mottled red.
At 30cm light grey-brown silty clay with mottles.
[absence of silt loam?]
Peat again at about 40cm. Slightly sulphurous woody peat.
Water table struck at 62cm. Water starting to fill hole. Water table risen to 0.45m after 3 mins.
Base of core 1.25m.

Core 3, TM3918776606
Location: at base of rising slope onto river bund; likely to be the margin of an old meander section – off likely line of infill.
Vegetation: Short sward of Perennial Ryegrass with frequent White Clover and occasional Rough Meadow-grass, Cock's-foot and Hard Rush. Corresponds to the *Lolium perenne-Poa trivialis* leys of *Lolio-Plantaginion* grasslands (MG7b).

Surface peaty top of c.1 cm
Humic sandy silty loam with strong mottling to 31 cm
Light grey-brown silty clay with scattered mottles to 72 cm
Very dark grey (sulphidic) silty clay to end of core at 125 cm.
Water table at 82 cm, rising to 68 cm.
[N.B. No peat encountered.]

Core 4, TM3909476677
Location: in the jointed rush area on the upland side of the catch-dyke

Vegetation: On the upland margin of the *Juncus inflexus* sub-community of the *Holco-Juncetum effusi* rush-pasture (MG10b) where the appearance of Rough Meadow-grass with some Perennial Ryegrass and Meadow Foxtail indicate the transition over several metres to the *Lolium perenne-Poa trivialis* leys of *Lolio-Plantaginion* grasslands (MG7b).

A peaty top of 6 cm overlies.
Humic sand to 36 cm, over
Light yellow sand with occasional red mottles to 71 cm, over
Slightly green (glauconitic) light grey sand with manganiferous streaking to the end of the core at 92 cm
Water table was encountered at 62 cm, showing no rise.

Core 5, TM3903476627
Location: in the jointed rush area on the upland side of the catch-dyke
Vegetation: In the central part of the Hard Rush stand (MG10b), with jointed rush and Cuckooflower

Humic silt loam from the surface, with strong mottling evident from 7 cm bgl.
Light grey-brown silty clay from 18cm, with scattered mottles, becoming sandy silty clay from 35 cm to approximately 57 cm bgl.
At 57 cm, light grey wet sand with scattered red mottles to end of core at 97 cm.
Water table assumed at 57 cm bgl. with no rise.

Core 6, TM3905176603
Location: In the low-lying strip on the riverside of the catch-dyke.
Vegetation: Grass-dominated rush-pasture with abundant Creeping Bent, frequent Soft Rush, White Clover and Creeping Buttercup with occasional Cuckooflower and Marsh Thistle. Corresponds to the Typical sub-community of the *Holco-Juncetum effusi* rush-pasture (MG10a). No phreatophytes present.

Peaty top at the ground surface to 8 cm bgl., over
Initially humic silty clay [no evidence of silt loam] with strong mottles from the upper surface; abrupt boundary with
Peat at 41 cm to end of core at 125 cm.
Water table indicative at c.66 cm, not rising.

Core 7, TM3908376570
Location: on midslope of slightly elevated river bund, clearly above the level of the moist ground surface.
Vegetation: Perennial Ryegrass sward with few grass associates (mainly Rough Meadow-grass). Very occasional Hard Rush and scattered Creeping Thistle. Species-poor version of the Lolium perenne-Poa trivialis leys of Lolio-Plantaginion grasslands (MG7b).

No peaty top
Mid-brown rather sandy silt loam with earthworms and occasional mottles, to 29 cm bgl.
Sticky mid-grey silty clay (nearly clay) with no mottles, to 41 cm bgl, over
Peat (sapric) to end of core at 125 cm.
Water table indicative at c. 90 cm, not rising.

Core 8, TM3902876498
Location: On foot of slightly elevated river bund
Vegetation: Perennial Ryegrass dominant with some Rough Meadow-grass. Scattered Creeping Thistle. Species-poor version of the *Lolium perenne-Poa trivialis* leys of *Lolio-Plantaginion* grasslands (MG7b).

Mid-brown silt loam with occasional mottles from the surface to 39 cm bgl.
Mid-grey silty clay with occasional strong mottles, to 65 cm bgl

Peat, with woody inclusions; moist but hemic-sapric, until 116 cm bgl
Sand, coarse angular, mid grey in colour
No water table.

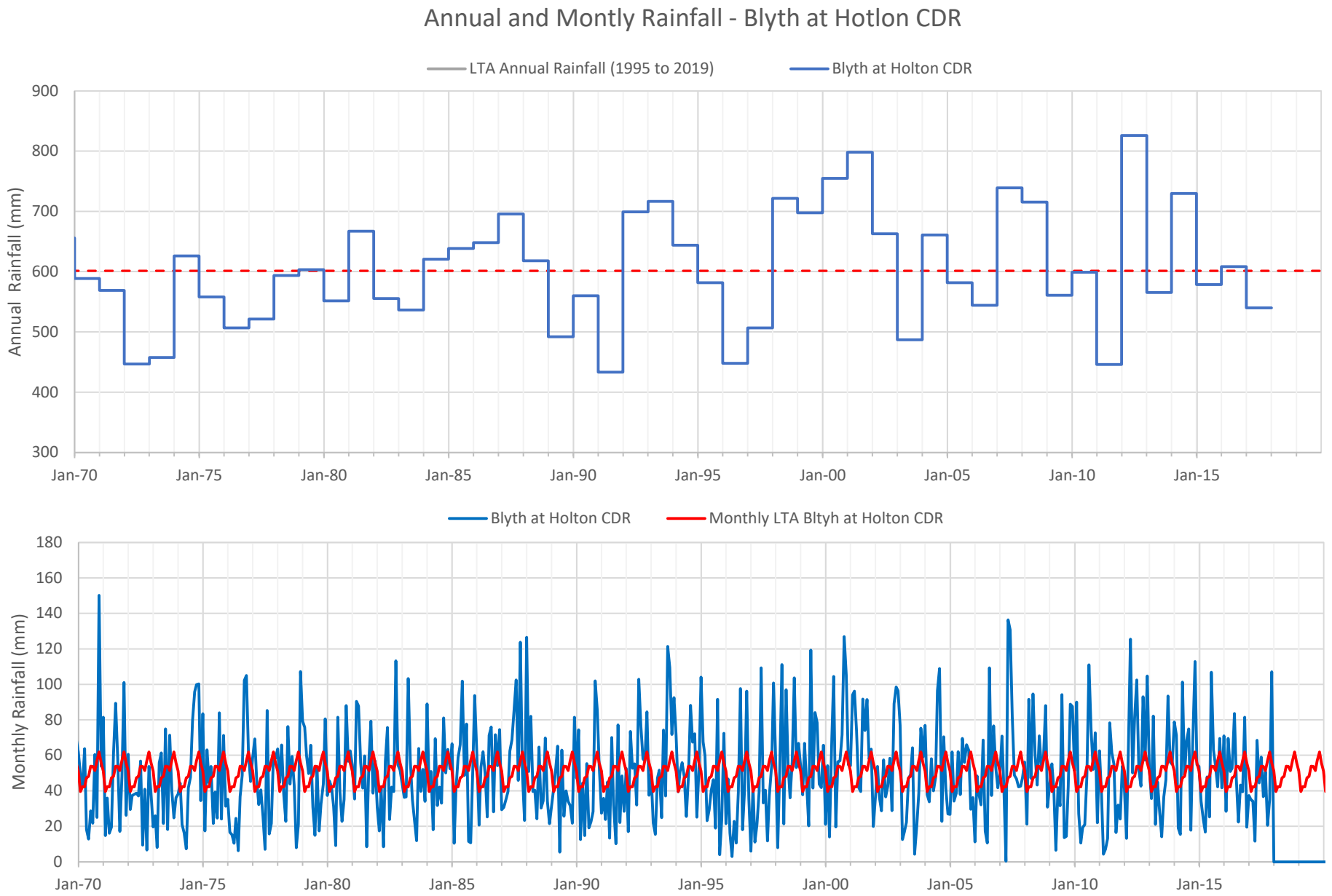
Core 9, TM3899876522
Location: towards northern margin of riverside grassland.
Vegetation: Perennial Ryegrass dominant with scattered Hard Rush and Creeping Thistle. Species-poor version of the *Lolium perenne-Poa trivialis* leys of *Lolio-Plantaginion* grasslands (MG7b).

Humic silt loam with scattered mottles to 29 cm
Mid-grey silty clay to 42 cm bgl
Peat to end of core at 125 cm.
No water table evident, wet peat from 89 cm bgl.

Core 10, TM3898476542
Location: On the upland side of the slightly lower lying tract south of the catch-dyke
Vegetation: Jointed rush and occasional Hard Rush, with Common Sorrel, Meadow Buttercup, Common Mouseear and Dandelion in a matrix of Rough Meadow-grass and Creeping Bent. Corresponds to the *Juncus inflexus* sub-community of the *Holco-Juncetum effusi* rush-pasture (MG10b).

Peaty top to 9 cm bgl.,
Grey-brown silty clay strongly mottled to 48 cm bgl.,
Peat to 125 cm at end of core.
No water table evident but wet from 72 cm bgl.

Appendix E
Rainfall, River Flow & Groundwater Level Data



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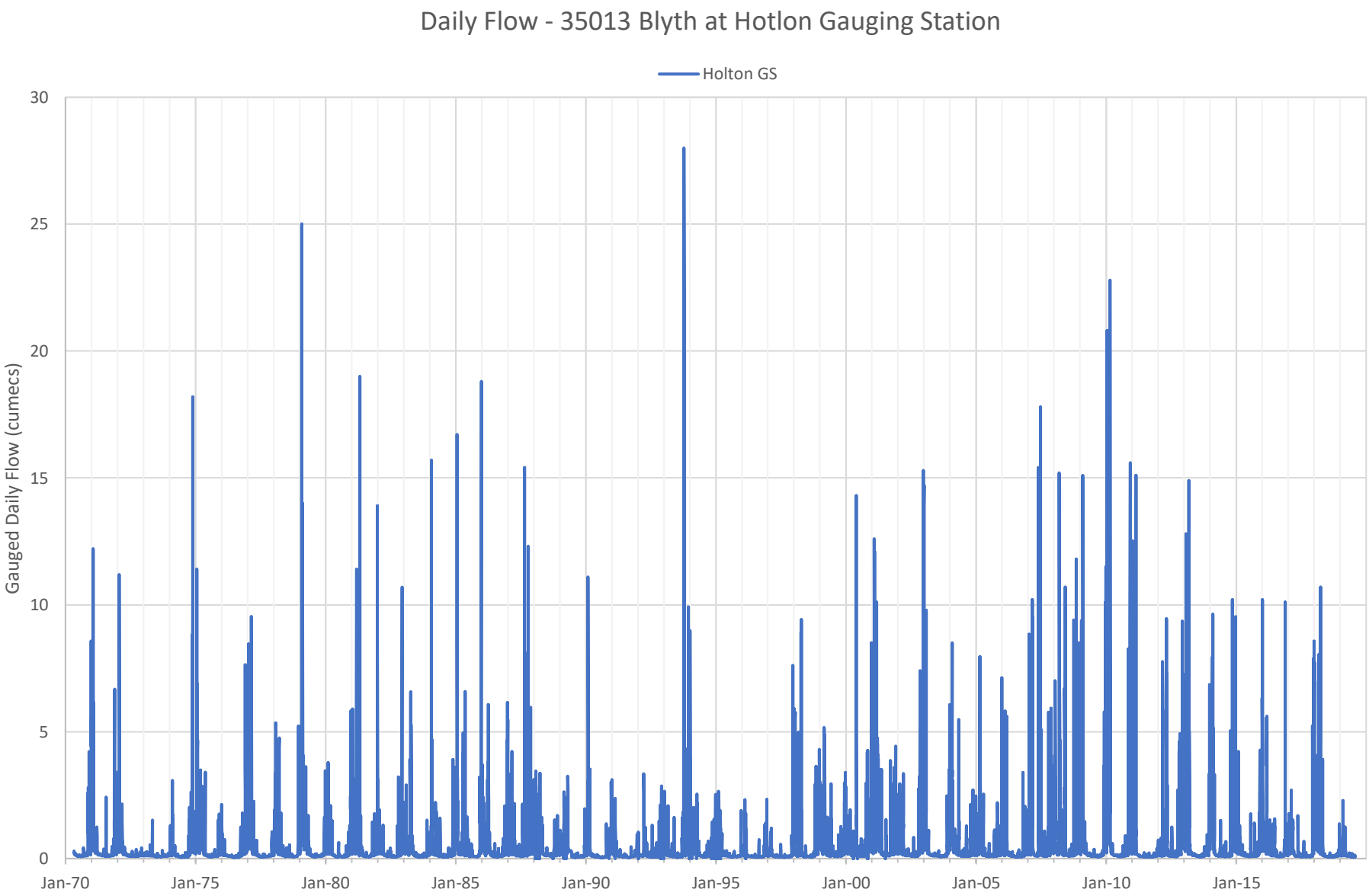

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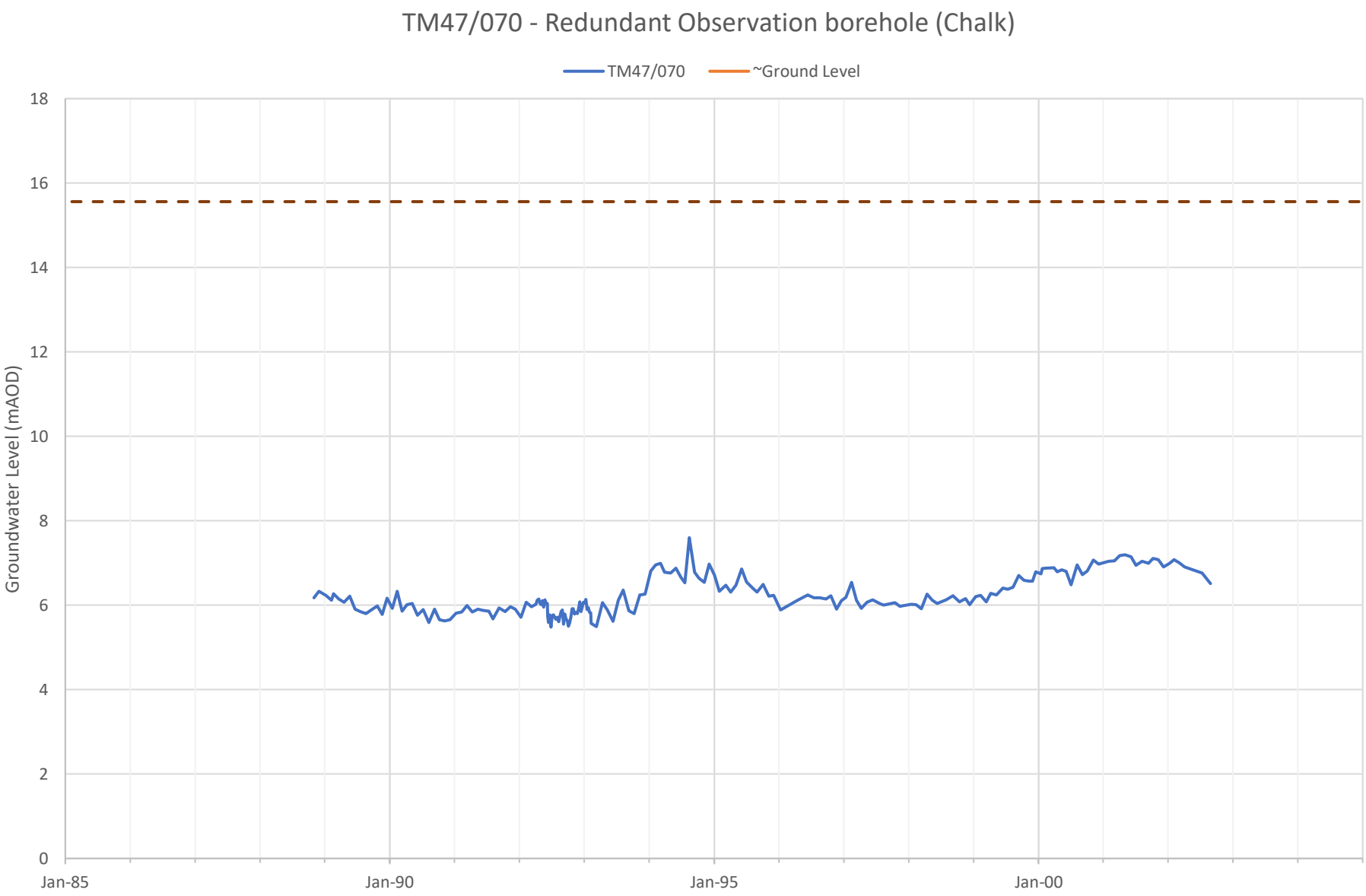

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APPENDIX G: WATER MONITORING SUMMARY – HALESWORTH SITE 28, NOVEMBER 2020 TO APRIL 2021

Technical note:
Sizewell C Fen Meadow Compensation
Water Monitoring Summary – Halesworth Site 28 November 2020 to Present

1. Introduction

The technical note summarises water monitoring data collected between November 2020 to present at the Halesworth site (hereafter referred to as 'the Site') which has been identified as a potential fen meadow development area. This technical note is a factual presentation of the data rather than an interpretive report.

Figure 1.1 shows a map of the Site and the installations referred to in this technical note.

2. Groundwater Level Monitoring

Seven groundwater monitoring points were installed at the Site between 5th and 23rd October 2020. Four shallow dipwells were installed to measure groundwater levels in the shallow superficial near surface deposits. Three piezometers were installed to measure groundwater levels in the Crag, one of which was originally planned to penetrate the underlying chalk but complications during drilling (collapse) resulted in completion of this installation near the base of the Crag deposits. Two of the Crag piezometers are nested (within the same borehole) with a dipwell. An installation summary is provided in Table 2.1 below.

Table 2.1 Summary of groundwater monitoring installations

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
HAL_2801_d	bh2801	TM 38990 76600	7.254	6.689	10	50	Nested with HAL_2801_s
HAL_2801_s	WS2801	TM 38990 76600	7.254	6.869	40	50	Nested with HAL_2801_d
HAL_2802_d	bh2802	TM 39098 76604	6.886	6.653	10	50	Nested with HAL_2802_s
HAL_2802_s	WS2802	TM 39098 76604	6.886	6.653	10	50	Nested with HAL_2802_d
HAL_2803_d	bh2803	TM 38985 76600	7.142	6.881	40	50	
HAL_2803_s	ws2803	TM 39051 76659	7.312	7.05	3	50	

Name	Drillers ID	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
HAL_2804_s	ws2804	TM 39143 76703	7.114	6.869	2	50	

s = shallow; d = deep
*m bgl = metres below ground level

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Table 2.2 summarises the data collected between November 2020 to present.

Table 2.2 Groundwater Levels (m bgl and mAOD)

Date	HAL_2801_d	HAL_2801_s	HAL_2802_d	HAL_2802_s	HAL_2803_d	HAL_2803_s	HAL_2804_s
m bgl							
20/11/20	-0.265	-0.063	0.202	0.319	0.226	0.421	0.381
10/12/20	-0.274	-0.094	0.096	0.169	0.12	0.468	0.233
14/01/21	0.28	-0.2	0.2	0.26	-0.2	0.42	0.66
18/02/21	-0.333	-0.214	0.012	0.117	-0.01	0.144	0.176
11/03/21	0.223	0.190	0.303	0.426	0.315	0.569	0.544
28/04/21	0.70	1.27	1.35	1.51	0.39	0.41	ND
mAOD							
20/11/20	6.954	6.932	6.451	6.334	6.655	6.448	6.669
10/12/20	6.963	6.963	6.557	6.484	6.761	6.401	6.817
14/01/21	6.974	7.454	6.686	6.626	7.342	6.694	6.652
18/02/21	7.022	7.083	6.641	6.536	6.891	6.725	6.874
11/03/21	7.031	7.064	6.583	6.460	6.827	6.743	6.570
28/04/21	6.554	6.684	6.456	6.176	6.752	6.704	ND

*m AOD = metres above ordnance datum

3. Surface Water Level Monitoring

Four gaugeboards were installed between 12th and 16th October 2020 to allow monitoring of surface water levels in site watercourses / drains. Three of the gaugeboards included stilling wells and water level data loggers. An installation summary is given in Table 3.1 below.

Table 3.1 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Bottom of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
HAL-GB01	TM 39161 76703	5.81	1	OTT Orpheus Mini	15
HAL-GB02	TM 39185 76674	5.43	1	OTT Orpheus Mini	15
HAL-GB03	TM 39132 76581	5.37	2	OTT Orpheus Mini	15
HAL-GB04	TM 39080 76655	6.00	1	n/a	n/a

*mAOD = metres above ordnance datum

Table 3.1 summarises the gaugeboard water level readings taken between November 2020 and present. The water level at the three gaugeboard locations are continuously monitored and are downloaded on a monthly basis during spot gauging visit. Hydrographs of surface water levels are presented in Appendix A.

Table 3.2 Surface Water Levels (mAOD)

Date	HAL-GB01	HAL-GB02	HAL-GB03	HAL-GB04*
20/11/20	6.412	5.972	5.672	6.416
10/12/20	6.446	6.011	5.842	6.445
14/01/21	6.471	6.059	6.160	6.480
18/02/21	6.451	6.019	5.831	6.450
11/03/21	6.442	6.01	5.768	6.441
09/04/21	6.34	5.995	5.645	6.335

*Manual reading only (no datalogger).

4. Spot Flow Gauging

Monthly spot flow gauging of three gaugeboard locations (HAL-SF01, 02 & 03) commenced in November 2020. Results to date are shown in Table 4.1 below. Negative flow readings in Table 4.1 indicate stagnant water where flow is not high enough to be measurable. An alternative gauging site is currently being considered as a substitute for HAL-SF02.

Table 4.1 Spot Flow (m^3/s)

Date	HAL-SF01	HAL-SF02*	HAL-SF03
20/11/20	-0.0008	Channel too deep to wade with very soft bed. Water appeared Static.	0.0006

10/12/20	-0.0001	Channel too deep to wade with very soft bed. Water appeared Static.	-0.0016
14/01/21	0.0015	No suitable gauging location. Channel too deep to wade with very soft bed along entire length. Water appeared static with no obvious inflow/outflow.	Too deep to gauge after prolonged period of rain and severe local flooding.
18/02/21	0.0008	0.63463	0.0013
11/03/21	0.0002	0.0008	0.0013
09/04/21	-0.0006	0.0001	0.0002

5. Water Quality Monitoring

In-situ water quality readings are collected from all groundwater and surface water installations on a monthly basis. In-situ water quality results are presented in Table 5.1 below.

In addition to this, water quality samples will also be collected quarterly at selected locations and sent for laboratory analysis. Quarterly sampling was undertaken in April 2021, with the next samples due to be collected in July 2021. The initial results for the quarterly sampling will be updated in this report after July 2021.

Table 5.1 In-situ Water Quality Results

Date	Ref.	Temp (ºC)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
20/11/20	HAL_2801_d	11.0	2.5	5969	12.63	-201.1	11.06
10/12/20	HAL_2801_d	8.5	38.7	387	12.22	-117.8	46.8
14/01/21	HAL_2801_d	6.7	22.5	1058	7.09	158.8	79.5
17/02/21	HAL_2801_d	7.6	21.7	1496	11.91	-160.5	25.2
11/03/21	HAL_2801_d	7.8	12	1169	11.59	172.3	16.98
28/04/21	HAL_2801_d	10.2	20.7	1258	11.13	-58.9	>1050
20/11/20	HAL_2801_s	10.5	4.9	16804	12.61	-169.5	5.6
10/12/20	HAL_2801_s	9.0	24.4	15101	12.32	-138.5	3.5
14/01/21	HAL_2801_s	6.3	21.8	1046	8.54	146.7	102.5
17/02/21	HAL_2801_s	7.5	36.9	1439	11.88	-119.9	6

Date	Ref.	Temp (ºC)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
11/03/21	HAL_2801_s	7.5	20.2	1437	11.59	172.7	1.8
28/04/21	HAL_2801_s	10.9	24.7	653	10.96	-37.5	26.1
20/11/20	HAL_2802_d	10.7	10.8	1022	7.04	54.7	30.1
10/12/20	HAL_2802_d	9.0	22.5	1024	6.98	20.6	31.9
14/01/21	HAL_2802_d	6.2	12.6	1078	8.11	141.3	81.2
17/02/21	HAL_2802_d	8.0	36	1057	7.01	-1.5	3
11/03/21	HAL_2802_d	8.7	27.5	1061	7.09	30	60.28
28/04/21	HAL_2802_d	10.1	62	901	7.08	-23.3	95.8
20/11/20	HAL_2802_s	10.6	11	1097	7.16	21.7	19.53
10/12/20	HAL_2802_s	8.4	36.2	979	6.91	9.3	27.2
14/01/21	HAL_2802_s	6.1	11.7	1025	7.05	139.3	>1050
17/02/21	HAL_2802_s	7.8	20.9	1128	6.92	-58.8	445
11/03/21	HAL_2802_s	8.1	19	988	6.79	29.4	108.5
28/04/21	HAL_2802_s	9.7	28.3	997	6.81	-33.3	365
20/11/20	HAL_2803_d	10.8	5.6	1165	7.65	2.5	4.2
10/12/20	HAL_2803_d	8.2	30.1	1117	6.98	34.9	17.5
14/01/21	HAL_2803_d	6.1	35.1	2153	12.2	131.1	65.4
17/02/21	HAL_2803_d	7.4	47.5	1142	7.03	12.6	10.4
11/03/21	HAL_2803_d	8.0	11.9	1142	7.07	22.4	0.92
28/04/21	HAL_2803_d	10.7	27.5	103.9	7.3	-54.3	30.6
20/11/20	HAL_2803_s	10.9	14.4	2094	6.45	101.7	91.5
10/12/20	HAL_2803_s	8.4	33.4	2239	8.29	-22.6	75
14/01/21	HAL_2803_s	6.2	33.2	688	6.7	165.4	130
17/02/21	HAL_2803_s	6.0	33.8	1144	8.04	5.7	18.2
11/03/21	HAL_2803_s	7.1	54.3	1038	8.23	-24.8	7.08

Date	Ref.	Temp (ºC)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
20/11/20	HAL_2804_s	10.7	4	822	6.67	-77.3	78.5
10/12/20	HAL_2804_s	7.4	255.7	811	6.68	-4.5	446.9
14/01/21	HAL_2804_s	6.2	15.4	1417	6.14	159	305
17/02/21	HAL_2804_s	6.5	47.8	749	7.13	-79.2	48.1
11/03/21	HAL_2804_s	7.3	25.6	763	7.24	162	100.83
20/11/20	HAL-GB01	5.9	28.6	1187	7.28	-0.09	14.2
10/12/20	HAL-GB01	4.9	38.8	1155	6.99	123.3	10.4
17/02/21	HAL-GB01	7.0	78.5	1459	7.2	-38	74.6
11/03/21	HAL-GB01	7.3	75.5	13.1	7.28	41.8	136.88
20/11/20	HAL-GB02	6.0	9.3	1478	6.94	-71.4	24.32
10/12/20	HAL-GB02	6.4	22.9	1319	6.67	-45.3	15.5
17/02/21	HAL-GB02	7.8	46.9	1255	6.95	-45.4	14.4
11/03/21	HAL-GB02	7.3	48.2	11.25	7	-14.5	175.88
28/04/21	HAL-GB02	10.5	83	726	7.06	-28.1	13.6
20/11/20	HAL-GB03	8.6	46	1067	7.08	19.6	1.96
10/12/20	HAL-GB03	7.3	33.9	1510	6.78	10.9	44.9
17/02/21	HAL-GB03	8.9	58.2	2120	6.82	-1.6	101.8
11/03/21	HAL-GB03	7.9	61.1	2162	7.06	-14.6	45.6
20/11/20	HAL-GB04	7.3	3.2	1420	7.02	-136.2	55.2
10/12/20	HAL-GB04	5.6	36.6	1190	6.94	-14.1	60.5
17/02/21	HAL-GB04	7.2	69.1	1639	6.99	-13.4	14.1
11/03/21	HAL-GB04	7.8	52	1324	7.1	103.6	441.55
28/04/21	HAL-GB04	13.8	92.4	207.4	7.91	-51.4	12.8
28/04/21	HAL-WAL	11.7	96.9	892	7.57	-33	30.4

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276800 276700 276600 276500 276400

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HAL_2804_s
HAL-SF01
HAL-GB01
HAL-GB02
HAL_2803_s
HAL-GB04
HAL_2803_d
HAL_2801_d
HAL_2801_s
HAL_2802_d
HAL_2802_s
HAL-SF03
HAL-GB03
HAL-SF02

Key

- Site boundary
- Gaugeboard
- Piezometer
- Dipwell
- Flow gauging

0 25 50 75 100 m

Scale at A3: 1:1,871

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

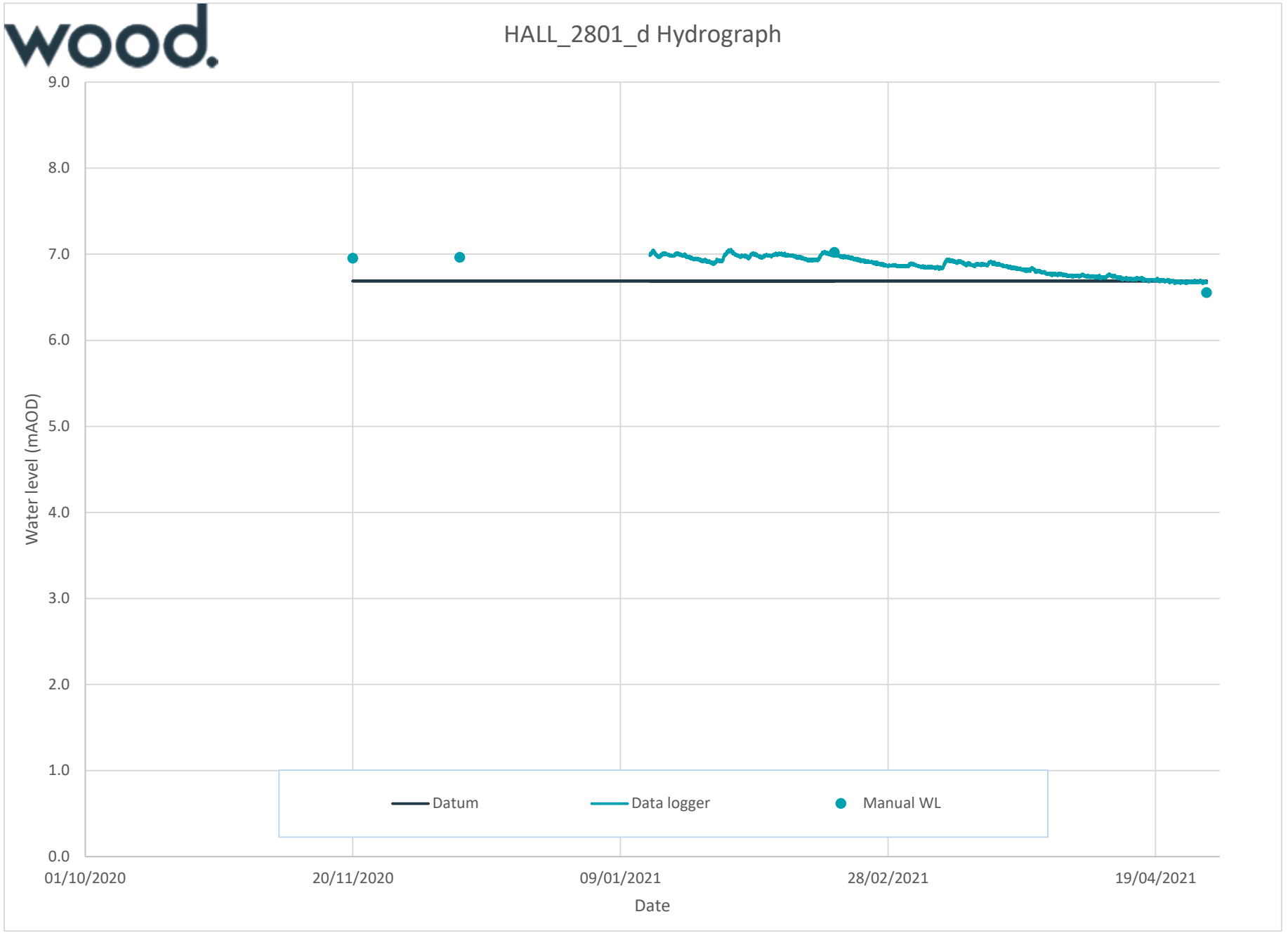
EDF Energy
Sizewell C
Fen Meadow Compensation Water Monitoring Summary

Figure 1.1
Monitoring locations
Site 28 Halesworth

June 2021

wood.

Appendix A
Groundwater Hydrographs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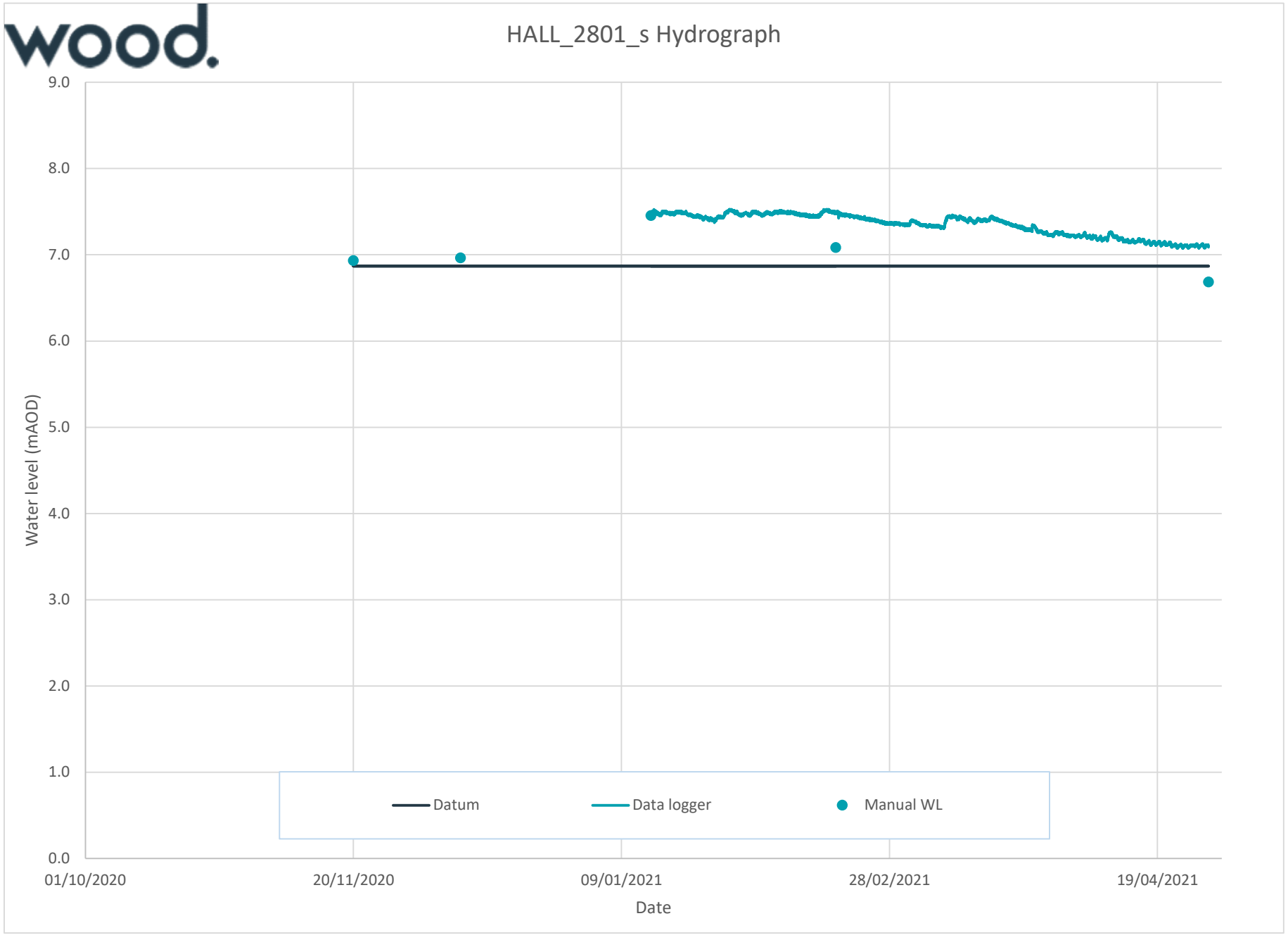
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL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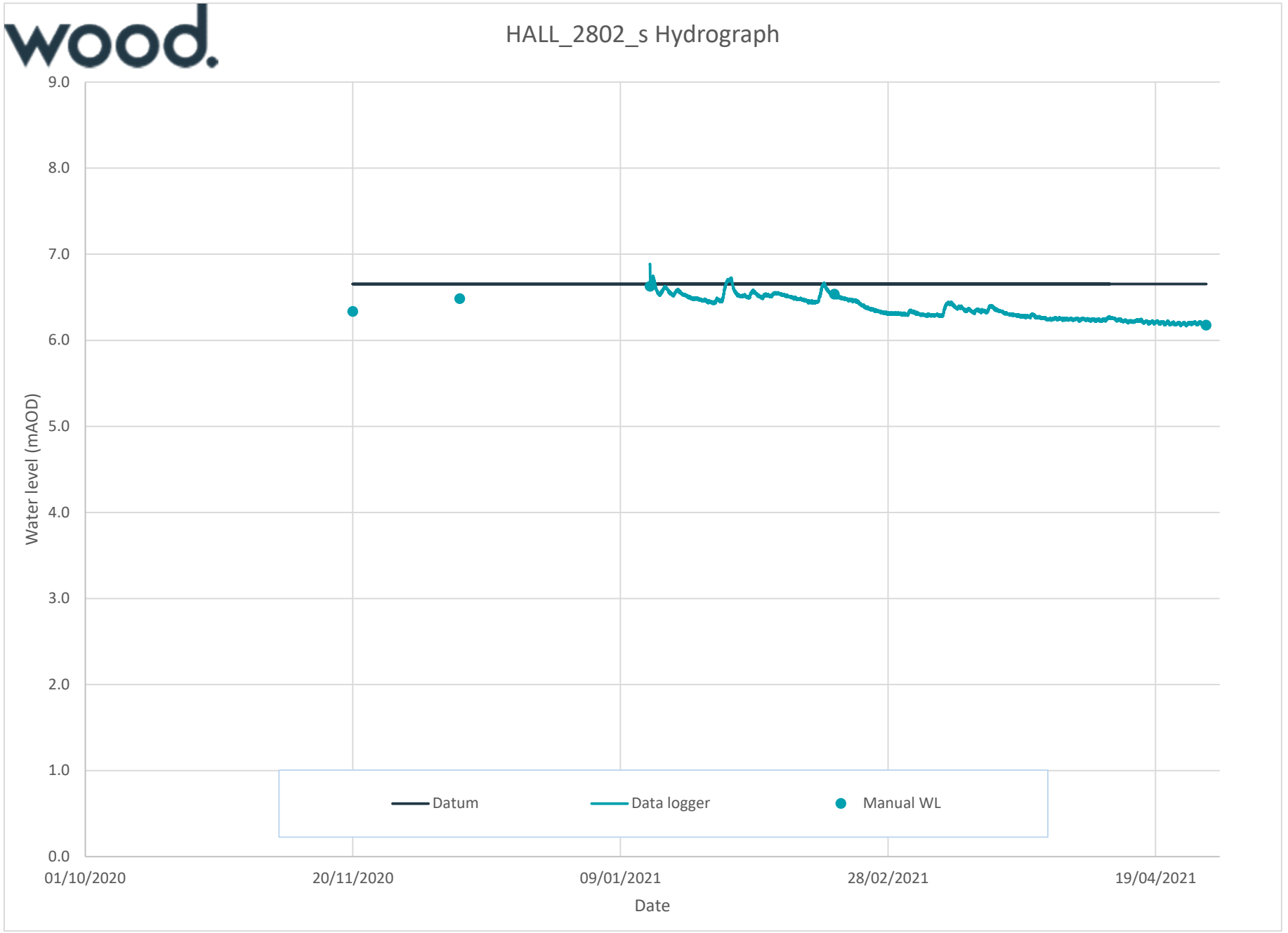
Date
Datum
Data logger
Manual WL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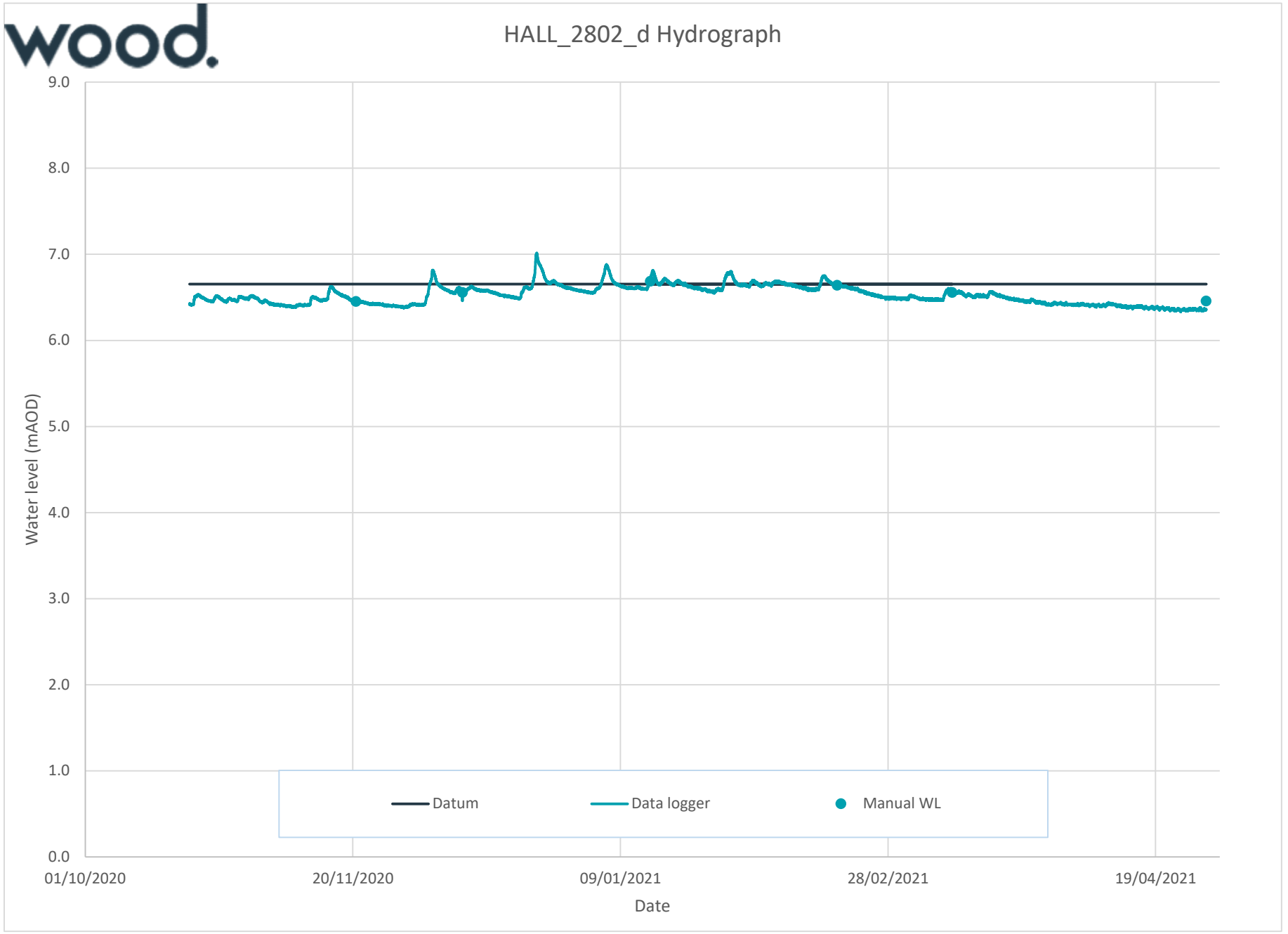
28/02/2021
19/04/2021
Date
Datum
Data logger
Manual WL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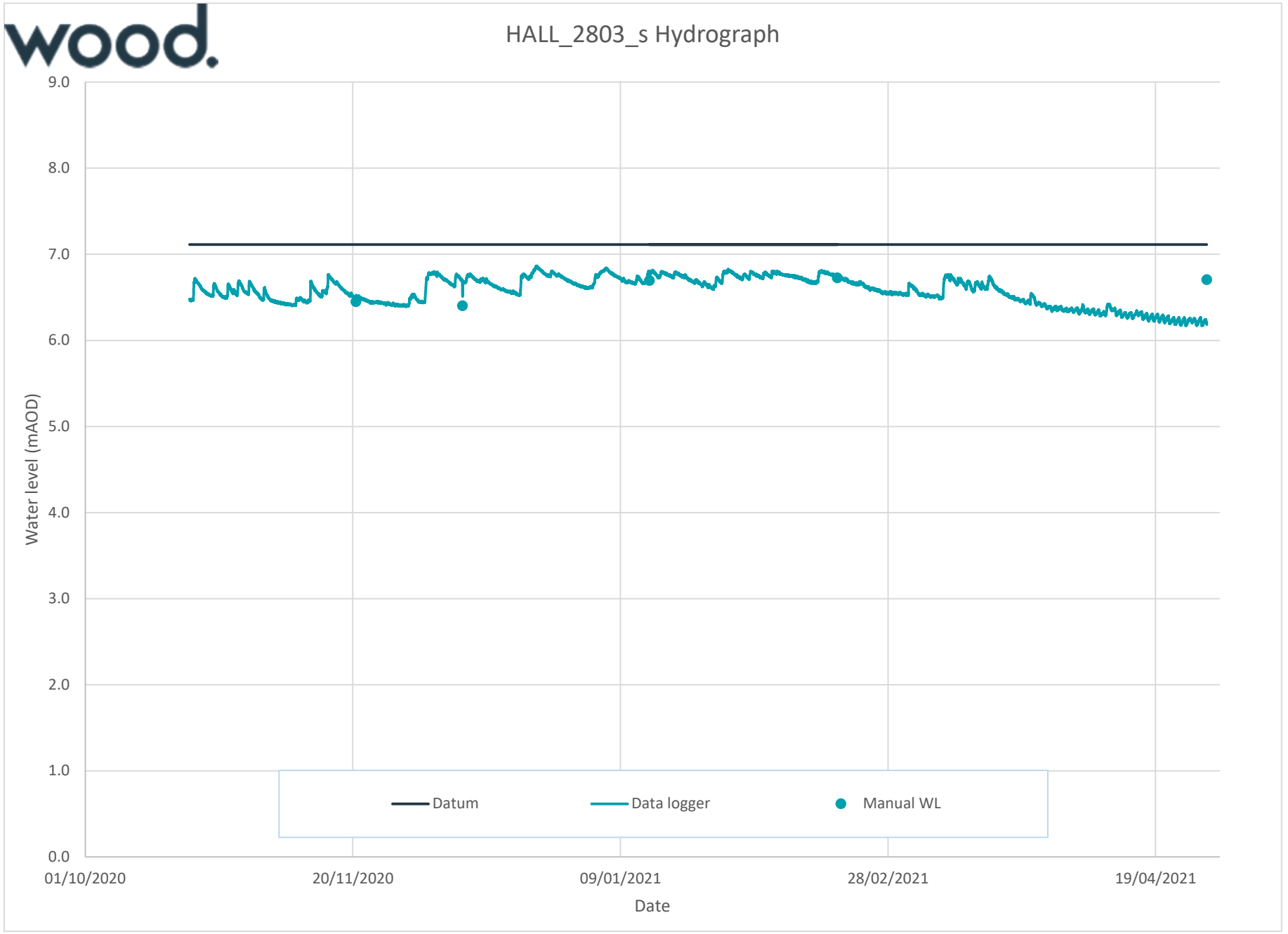
Data logger
Manual WL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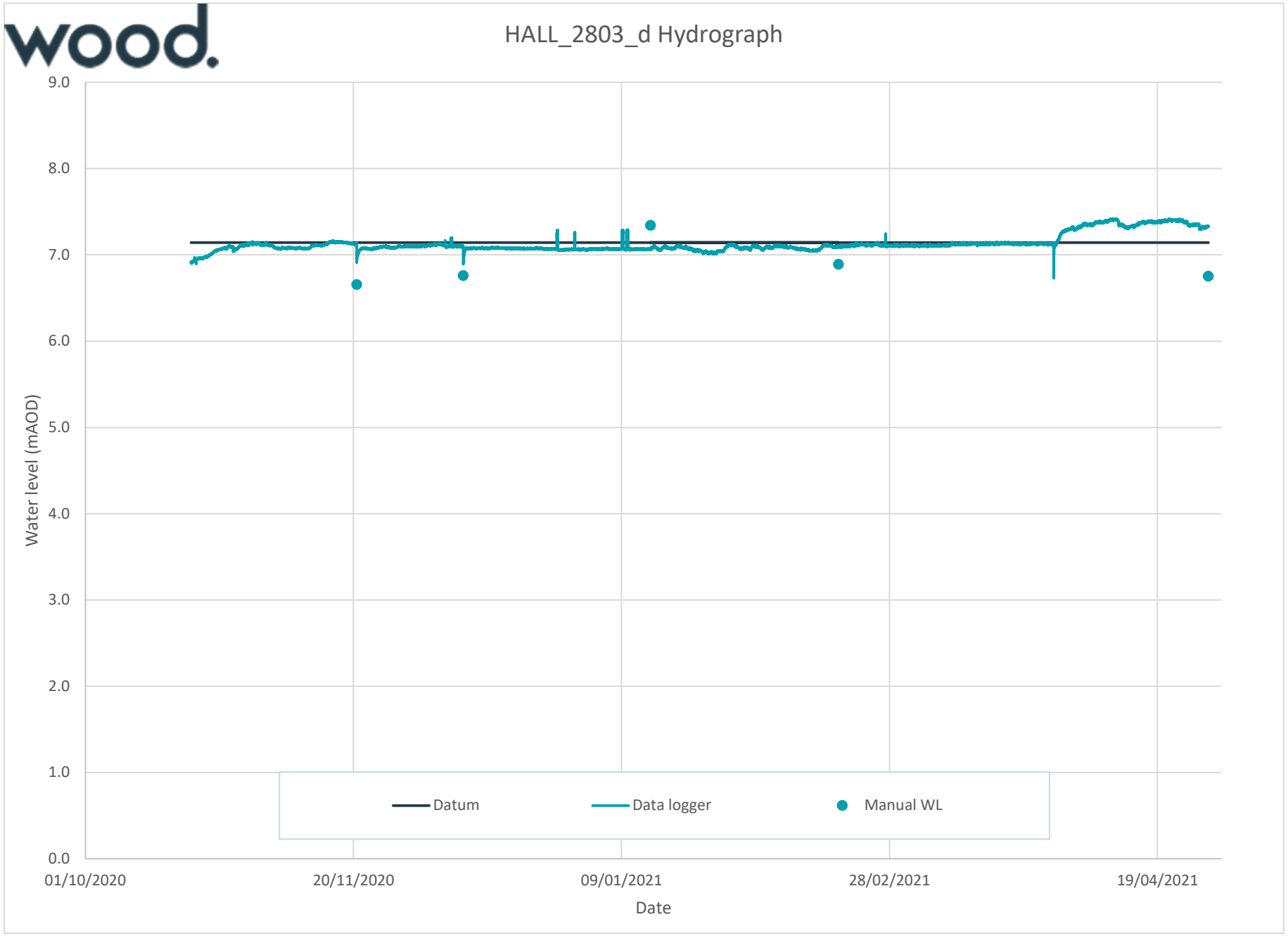
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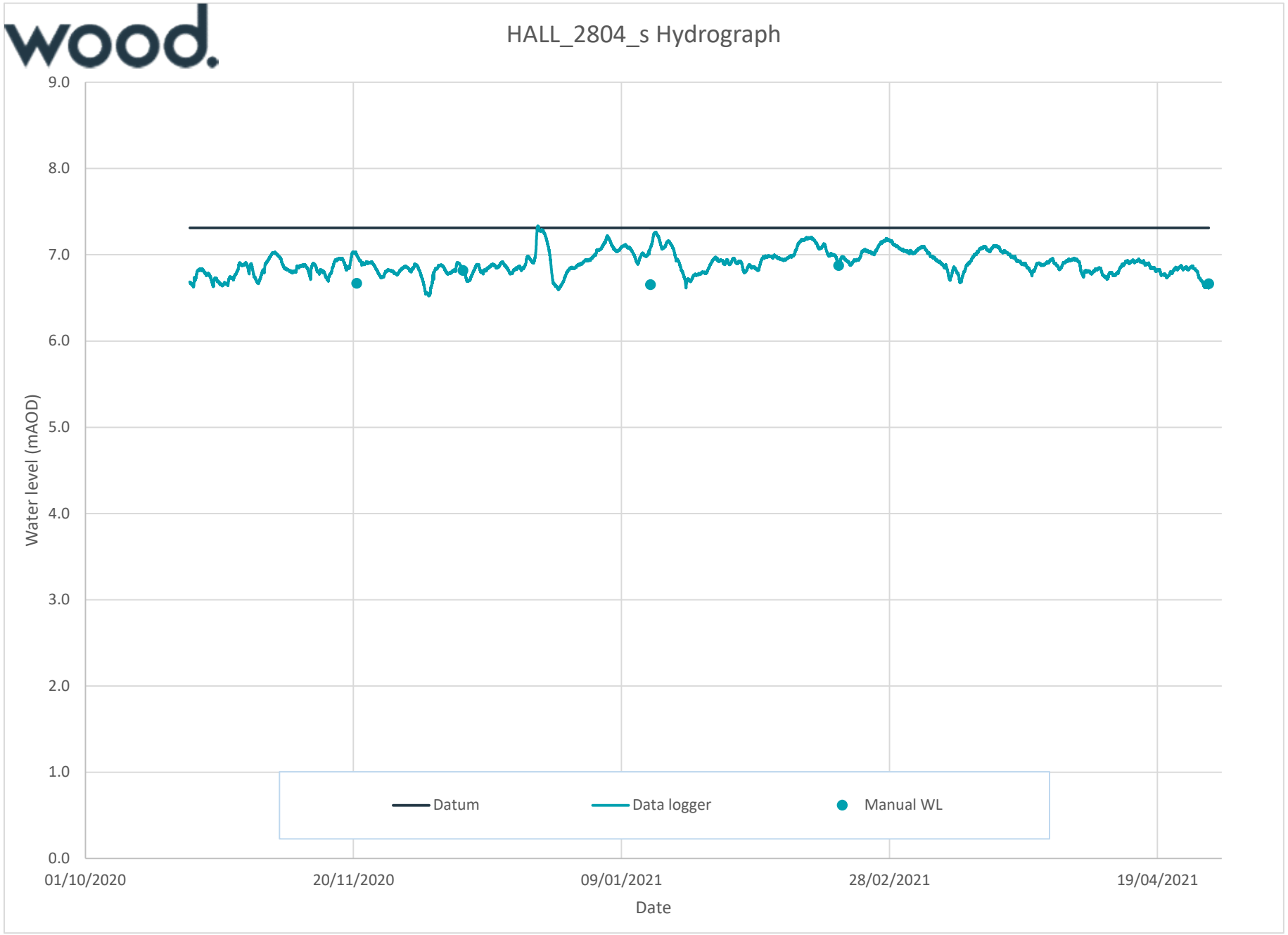
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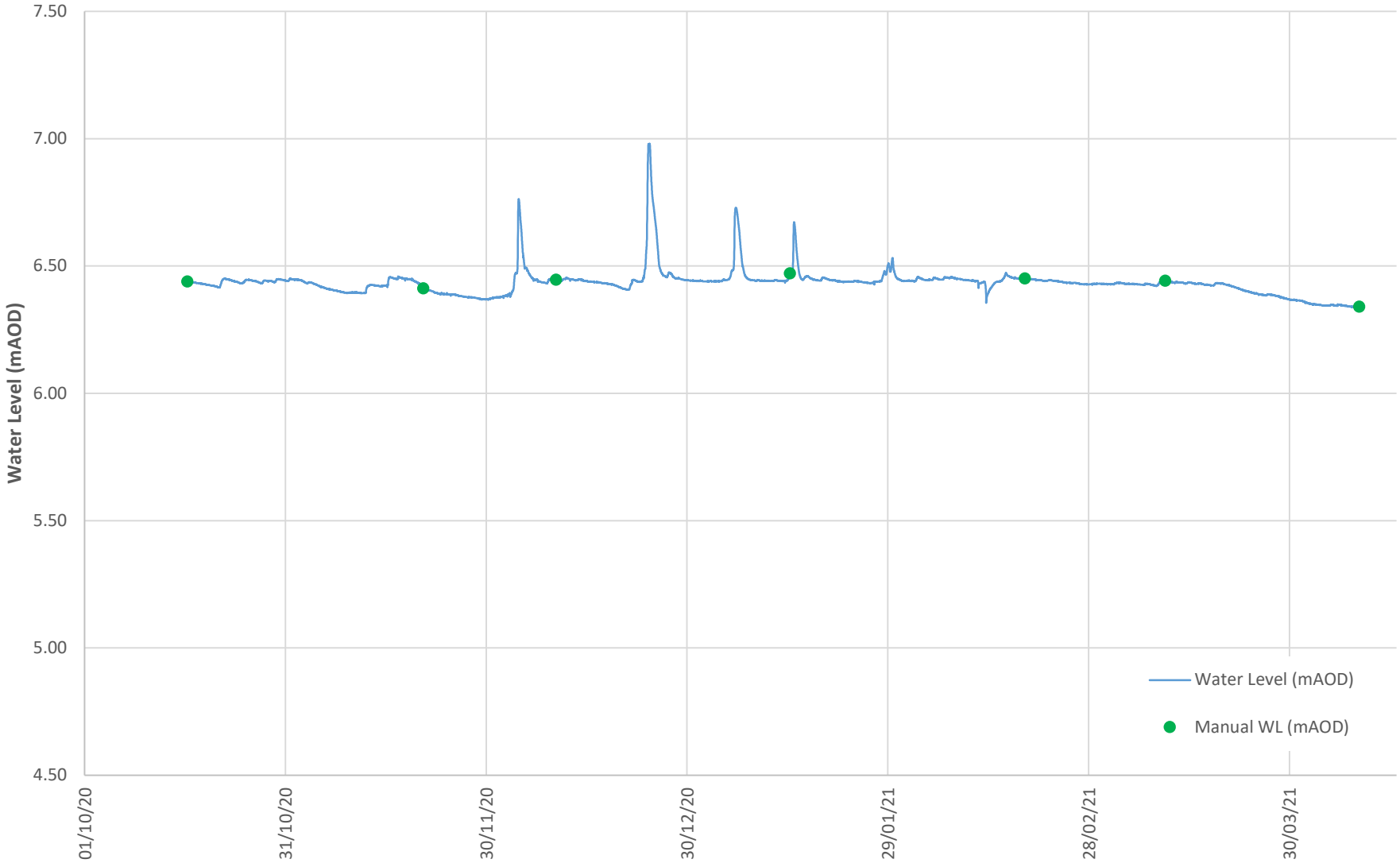
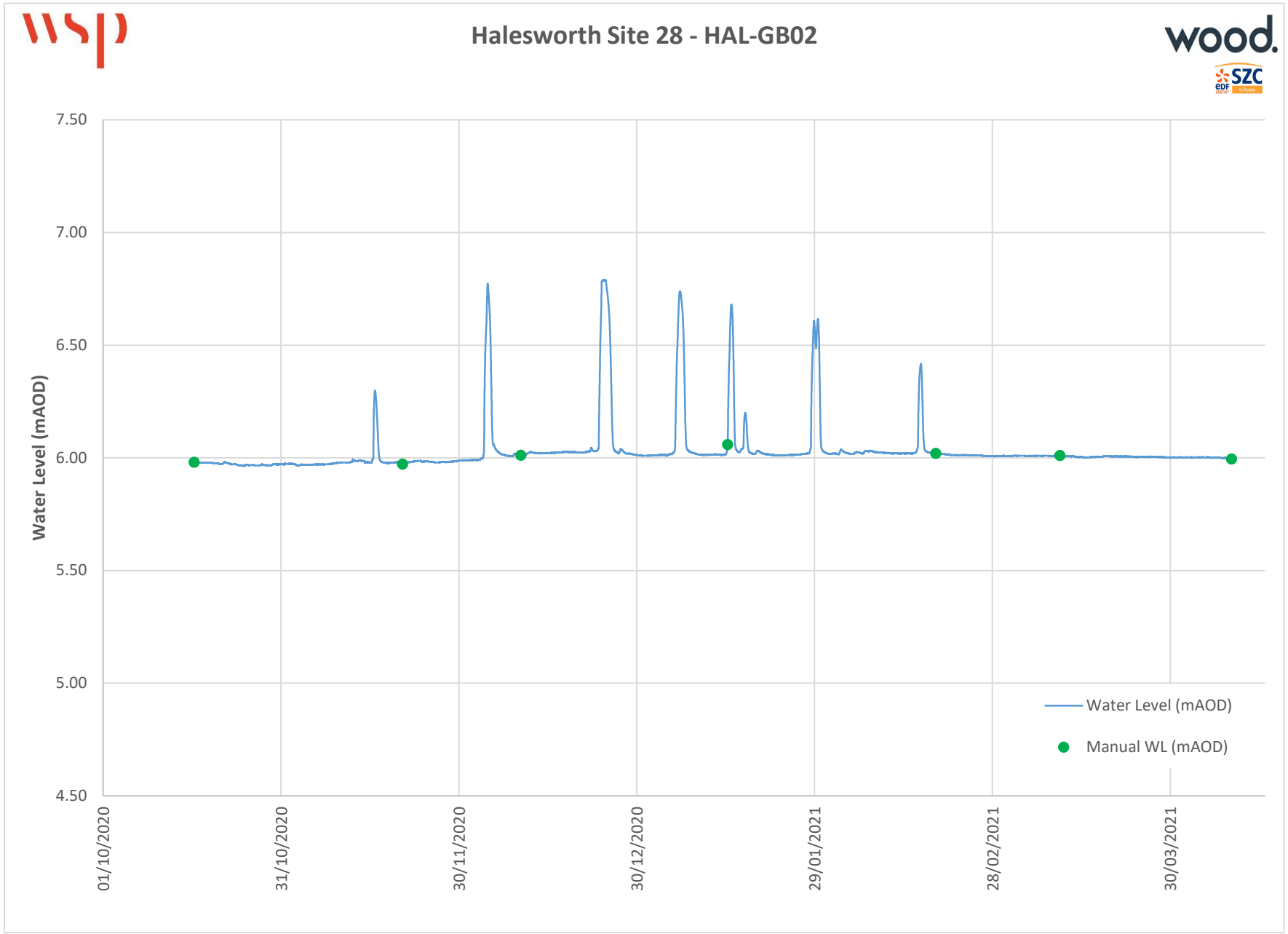
Data logger
Manual WL

Appendix B
Surface Water Hydrographs

Halesworth Site 28 - HAL-GB01

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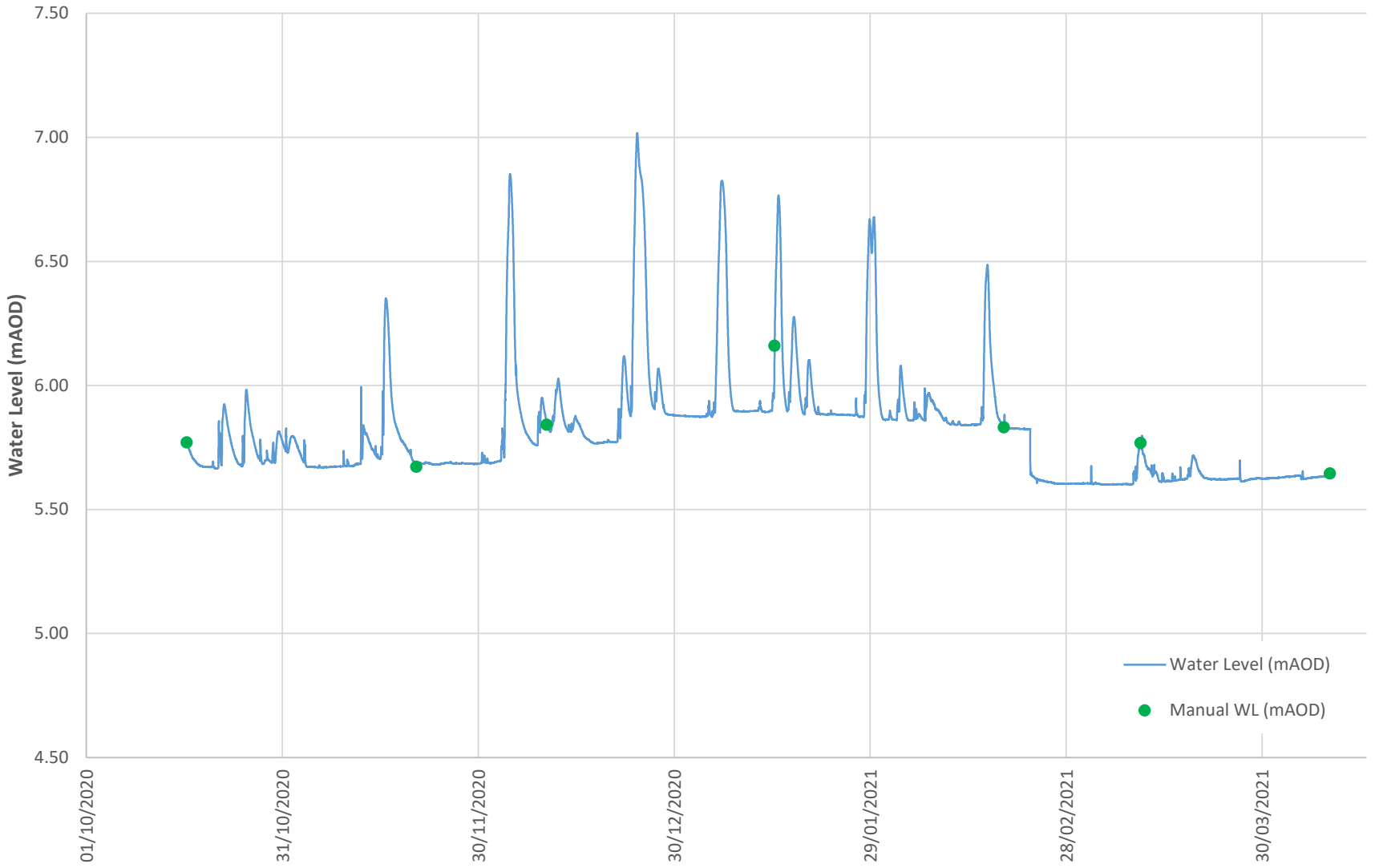
Water Level (mAOD)
Manual WL (mAOD)

Halesworth Site 28 - HAL-GB03

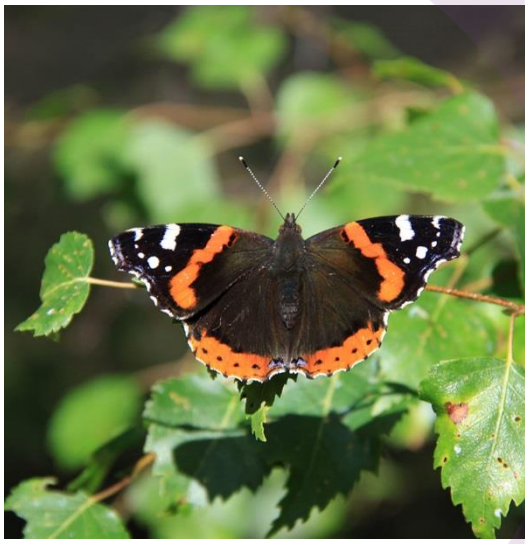


APPENDIX H: PAKENHAM SITE 54 - BASELINE HYDROGEOLOGICAL REPORT

EDF Energy

Sizewell C

Fen Meadow Compensation Site: Pakenham Site 54 Baseline Hydrogeological Report



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Document revisions

No.	Details	Date
1	Final	15/06/21

Contents

1. Introduction

1.1 Background

The proposed development platform for Sizewell C will extend a short distance into the eastern margins of Sizewell Marshes Site of Special Scientific Interest. The toe of the batter of the proposed platform will define the extent of permanent land-take but, additional to that, ditch re-alignment is required which will take a limited amount of further land.

Based on National Vegetation Classification (NVC) survey data the main affected habitats are M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, S26 *Phragmites australis - Urtica dioica* tall-herb fen, S4 *Phragmites australis* reedbed and some W5 *Alnus glutinosa – Carex paniculata* wet woodland.

Studies focussed on the provision of compensatory fen meadow habitat, particularly M22 *Juncus subnodulosus – Cirsium palustre* fen meadow, were reported in Wood (2018). Five sites were identified for further investigation, whilst 17 sites were put on hold subject to further assessment of the initial five sites. The five sites identified for further investigation (Wood (2018)) were:

- Site No. 10 – Aldecar Lane, Benhall;
- Site No. 11 – Watering Lane, Benhall;
- Site No. 28 – Halesworth;
- Site No. 33 – Stratford St Andrew; and
- Site No. 54 – Pakenham Fen.

Subsequently, one day site visits to Sites 10, 11, 28 and 54 were undertaken in April and May 2019. Site 33 was not visited as access had not been agreed at the time (Wood, 2019), however, following further consideration of the site characteristics and suitability for fen meadow creation, it was also concluded that the sites that were taken forward all provide greater potential for fen meadow creation than Site 33.

The one day site visits to Sites 10, 11, 28 and 54 comprised:

- A walkabout survey to identify areas where (1) the peat is currently influenced by groundwater or near-surface seepage; and (2) fen meadow species are present within or close to the Site margins;
- A reconnaissance hand-augering survey to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater; and
- Consideration of broad options for water management and potential for changes to land management.

Findings were reported in Wood (2019). Sites 10, 28 and 54 were all identified as having potential for the development of fen meadow as follows:

- Site 10: primary locus 1.5ha, further area 0.7ha (Site 11 has relatively limited potential (primary locus of 0.5ha although part already supports fen meadow species, and further area of 1.2ha) but is close to Site 10, so warrants further consideration in that context);
- Site 28: primary locus 1.2ha, further area 1.3ha;

- Site 54: primary locus 5.9ha, further area 9.5ha (previously split into Site 54 north and Site 54 South).

Subsequently EDF has progressed with detailed site conceptualisation and feasibility assessment work at Sites 10/11, 28 and 54.

The scope of the conceptualisation and feasibility assessment work can be summarised as follows:

- Ecological studies:
  - Desk based review of ecological data for the Sites and surrounding area; and
  - Targeted ecological surveys.
- Hydrological studies:
  - Desk based review of available hydrogeological data;
  - Collection of topographic data;
  - Collection of surface water level and groundwater level data to determine the relationship between groundwater and surface water levels on site. Also detailed study of the existing and wider ditch network to determine potential for water management without risk to upstream receptors; and
  - Collection of hydrochemical data.

1.2 This Report

This report presents the hydrogeological baseline for the current Site 54 at Pakenham Fen (hereafter the 'Pakenham site' or 'the Site') (Figure 1.1).

The structure of this report is as follows:

- Section 2 presents the methods and sources of data gathering and a summary of survey work undertaken;
- Section 3 presents the baseline environmental characteristics of the Site; and
- Section 4 presents an initial conceptual site model.

2. Data Gathering Methodology

2.1 Study Area

The geographical extent of the study area for this report focuses on the area within the Site boundary (Figure 1.1), together with relevant information obtained from a nominal 2km search area around the extension.

2.2 Desk Study Sources

A summary of the organisations that have supplied data, together with the nature of that data is summarised in Table 2.1 below.

Table 2.1 Sources of desk study information

Source	Data
Wood (and Subconsultants)	Details of soil core survey. Details of piezometry and exploration boreholes (Structural Soils Ltd). Details of gaugeboard installations (WSP UK Ltd). Topography of Proposed Development (WSP UK Ltd).
Ordnance Survey **OS, 1: 25,000, Explorer Sheet 211** **Bury St Edmunds & Stowmarket** **(Debenham & Elmswell)**	Topography, relief, springs, wells, watercourses, surface waterbodies.
Environment Agency (by enquiry)	Rainfall data for closest raingauge - Stanton rain gauge. Observation Borehole data for Chalk borehole TL96_010. Locations of licensed and deregulated surface water and groundwater abstractions and consented discharges.
Environment Agency (Online) **Catchment Data Explorer** http://environment.data.gov.uk/catchment-planning/ **Main Rivers Map** https://environment.maps.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386 **Cam and Ely Ouse WFD Management Area Abstraction Licencing Strategy** https://www.gov.uk/government/publications/cam-and-ely-ouse-abstraction-licensing-strategy/cam-and-ely-ouse-abstraction-licensing-strategy	WFD waterbody status and objectives. River designations. Abstraction licensing strategies.
Centre for Ecology and Hydrology - National River Flow Archive On-line https://nrfa.ceh.ac.uk/data/station/info/33013	Sapiston at Rectory Bridge gauging station – flows, statistics, catchment daily rainfall, and catchment descriptors.
Cranfield University Land Information System http://www.landis.org.uk/soilscapes/	Soil types.

Source	Data
British Geological Survey (BGS) **British Geological Survey, 1982. Bury St. Edmunds England and Wales Sheet 189. Solid and Drift Geology. 1:50 000. (Keyworth, Nottingham: British Geological Survey)** **British Geological Survey, 1990. Geology of the country around Bury St Edmunds: memoir for 1:50000 geological sheet 189 (England & Wales) (Author: Bristow et. al.)** **BGS Digital Mapping** **BGS Online** https://www.bgs.ac.uk/geoindex/	Geological mapping (1:50 000 scale). Geological sheet description. Stratigraphic and lithological information. Borehole locations.
BGS Major Aquifer Properties Manuals (Allen *et al.*, 1997) **BGS Minor Aquifer Properties Manuals (Jones *et al.*, 2000)**	Hydrogeological characteristics.
MAGIC On-line http://magic.defra.gov.uk/MagicMap.aspx	Conservation sites, groundwater vulnerability map, aquifer designation map, Nitrate Vulnerable Zones, Source Protection Zones.
Natural England https://designatedsites.naturalengland.org.uk/	Locations and citations of protected sites.
Open Government Data On-line https://data.gov.uk/	Authorised and historic landfills.
Pakenham Mill	Visit and discussion with volunteer on Mill working
West Suffolk District Council	Information regarding private water supplies.

2.3 Survey Work

2.3.1 Initial Survey

An initial hand augering survey was undertaken in April 2019 to identify general peat quality (substrate condition), sub-surface geological materials, presence of water table and areas of upwelling groundwater. Findings were reported in Wood (2019).

Following the findings of the Wood (2019) report a programme of hydrogeological monitoring was designed to enable collection of site specific baseline data, aid site conceptualisation and inform options for fen meadow compensation.

2.3.2 Installations and Monitoring

Following an initial site walkover to establish suitable monitoring locations in July 2020, a programme of installation works commenced on 2nd March 2021 for 4 weeks. Details are provided below and are presented in Figure 2.1.

Surface Water Monitoring

Four gaugeboards were installed between 16th and 20th March 2021 to allow monitoring of surface water levels in site watercourses / drains. All four of the gaugeboards included stilling wells and water level data

loggers. Installation reports will be provided in Appendix A and a summary of the current available information is given in Table 2.2 below.

Table 2.2 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Base of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
PAK-GB01	TL 93239 68817	29.027	2	OTT Orpheus Mini	15
PAK-GB02	TL 93064 68381	31.200	2	OTT Orpheus Mini	15
PAK-GB03	TL 93175 68400	29.917	2	OTT Orpheus Mini	15
PAK-GB04	TL 92873 67891	31.084	2	OTT Orpheus Mini	15

*mAOD = metres above ordnance datum

A programme of monthly monitoring visits commenced in April 2021 to download and record surface water data at the gaugeboard locations and obtain in-situ water quality readings. Monthly spot flow gauging at selected watercourses and drains will also be taken from April 2021. The results of this will be made available in quarterly reports.

Groundwater Monitoring

Nine groundwater monitoring points were installed at the Site between 2nd and 10th March 2021. Six shallow dipwells were installed to measure groundwater levels in the superficial near surface deposits. One nested Chalk piezometer (within the same borehole) with a dipwell and one further borehole into the buried channel deposits. Drilling logs are presented in Appendix B and an installation summary is provided in Table 2.3 below.

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Water quality samples will also be collected quarterly and sent for laboratory analysis. In addition to the quarterly monitoring a programme of monthly monitoring will be undertaken to manually record groundwater levels and in-situ water quality readings.

The groundwater level data will give insight into the groundwater gradient across the Site and will help to identify vertical head gradients (if present) between aquifers.

Table 2.3 Summary of groundwater monitoring installations

Name	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (mbgl*)	Diameter (mm)	Notes
PAK-BH-1	TL 93282 68982	32.986	31.87	5	150	5m borehole into buried channel deposits.
PAK-BH-2D	TL 93102 68394	33.652	32.22	33	50	Nested piezometer – Chalk BH Borehole diameter 200mm-150mm. Dual 50mm diameter water monitoring pipes installed with PAK-BH-2S.
PAK-BH-2S	TL 93102 68394	33.652	32.22	4	50	Nested piezometer – Shallow BH.

Name	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (mbgl*)	Diameter (mm)	Notes
						Borehole diameter 200mm-150mm. Dual 50mm diameter water monitoring pipes installed with PAK-BH-2D.
PAK-HA-1	TL 93319 68927	31.753	30.69	3	19	Dipwell into near surface deposits
PAK-HA-2	TL 93161 68834	31.656	30.65	3	19	Dipwell into near surface deposits
PAK-HA-3	TL 93262 68662	31.727	30.58	3	19	Dipwell into near surface deposits
PAK-HA-4A	TL 93168 68446	32.021	30.93	2	19	Dipwell into near surface deposits
PAK-HA-5	TL 92935 68197	31.859	30.91	2	19	Dipwell into near surface deposits
PAK-HA-6	TL 93075 68079	31.685	30.75	3	19	Dipwell into near surface deposits

s = shallow; d = deep
*mbgl = metres below ground level

Topographic Survey

A topographic survey of the Site was conducted in April 2020. The purpose of the survey is to allow profiling of the land surface and channels so that water levels and ground levels can be related to a common datum to further inform potential water management options.

The survey will include six cross sections and a topographic grid of the primary locus area for fen meadow. The results of the survey are presented in Appendix C.

3. Baseline Environmental Characteristics

3.1 Site Description

The Pakenham Site (Figure 1.1) is situated 7km north east of the town of Bury St Edmunds in Suffolk. It is located just north of the small village of Pakenham on the Pakenham Fen. The site covers an area of 32.7 ha.

The site is accessed off Thurston Road to the west of the site and is bounded for the most part to the east by the Pakenham Stream, a headwater channel that drains a calcareous sub-catchment of the Sapiston River (, sometimes also referred to as the Black Bourn). The Pakenham Stream generally flows south to north along the site boundary. To the very north of the site, the Pakenham Stream flows under Fulmer Bridge between Thieves Lane/ Broadway and then under Mill Road before joining the Sapiston River just south of Ixworth. The site is bounded to the west by a break of slope separating the upland from the valley floor. As well as the Pakenham Stream, the site is dissected by a number drainage ditches, most noteworthy is a straight drain that runs south – north through the centre of this site, bisected to the north by a second primary west – east drain; both ditches appear to be carriers for near-surface groundwater. The Pakenham Stream itself is, at least in appearance, elevated above the floodplain.

The site is considered to support areas of improved (*Lolio-Plantaginion* (MG7b)) grassland with areas of perennial ryegrass, rush pasture with abundant hard rush, some areas of block of fen meadow, with abundant pond-sedges and blunt-flowered rush and a small area of incipient rush pasture with frequent hard rush. A large block of adjacent land – the eastern side of Pakenham Stream – is designated as Pakenham Meadow Site of Scientific Special Interest (SSSI), for which wet grassland (i.e. fen meadow) is the primary interest feature. The SSSI is also the subject of a short hydro-ecological account in Wheeler & Shaw (2000)[1].

The redline boundary for the Site area is shown on Figure 1.1. Figure 1.1 also shows the primary locus area for fen meadow (5.9 ha) and potential additional area for fen meadow (9.5 ha).

3.2 Landscape and Topography

The site is positioned between the villages of Pakenham, to the south, and Ixworth, to the north. Ordnance survey maps shows that the site falls from highs of approximately 35 mAOD west of the site to 32 mAOD at Fulmer Bridge just north of the site, and most likely representative of the valley floor elevations. There is a buried valley that runs NNW to SSE across the northern half of the site. Outside of the valley floor elevations rise to the west and east to around 45-50mAOD.

In terms of land use, the area is predominately used for agriculture. The site itself is isolated from grazing and appears to be used for rough shooting.

The recent topographic survey of the Site (Appendix C and Figure 3.1) shows the topographic relief at the north, central and southern land parcels across the site (primary locus areas). The site is mostly flat.

To the north, the site is very flat, with the highest land in the north-west of the site at PAK-BH-1 at 31.7 mAOD, dropping in the centre at 30.5 mAOD and up to 31.7 mAOD to the east along the boundary of the Pakenham Stream.

In the central land parcel, the land is also highest in the west (c. 31.2 mAOD) and shows that the land is towards the central drain to the east (30.5 mAOD). There are no survey points east of the central drain, but cross sections of the Pakenham Stream indicate that the stream is above the Pakenham Fen (left bank at

[1] Wheeler B.D. & Shaw S.C. (2000) A Wetland Framework for Impact Assessment at Statutory Sites in Eastern England. Site Accounts. R&D Technical Report W6-068/TR2. Environment Agency, Almondsbury.

c. 31.5 mAOD). The southern land parcel shows a similar picture with small undulations of around 1m to the west, and minimum ground level at 30.6 mAOD.

The long sections and cross sections provided also provide further details on the topography of the site, and indicate very shallow variations in ground level. Transect 3 shows that the bed level of the Pakenham Stream (30.1 mAOD) appears to be above that the of the central drain (29.5 mAOD).

3.3 Climate

Daily rainfall data for the period 1999 to 2020 has been supplied by the EA for the nearest raingauge at Stanton (Station Number 188373) which is located 6.5km north-east of Pakenham (Figure 3.2). The long-term average (LTA) rainfall is calculated to be 570 mm/a (1999-2020). The Environment Agency also provided data for a raingauge at Barton Mere, which is closer to the Site but the data set only spans 3 years and therefore no longer term inferences can be made.

A long-term time series (1961-2017) of catchment daily rainfall (CDR) data has also been downloaded from the Centre for Ecology and Hydrology (CEH) National River flow Archive (NRFA) website. The catchment averaged daily rainfall data have been derived from a 1km gridded rainfall dataset generated from all daily and monthly observed rainfall data available from the Met Office. Catchment daily rainfall data are shown graphically in Appendix E on a monthly and annual scale. The data has been taken from the Sapiston gauge which covers the catchment. The annual average rainfall value over the catchment for the River Sapiston at Rectory Bridge for the period 1949 to 2017 is 602 mm/a, which is slightly higher than the average calculated from the Stanton raingauge data.

3.4 Hydrology

OS Mapping, data received from the Environment Agency, data from the CEH Website, the FEH Web Service, and information from site visits were used to characterise the baseline hydrology. The key locations and watercourses within the search are shown on Figure 3.2.

3.4.1 Main Rivers: Pakenham Stream (minor tributary to the Sapiston River)

The Pakenham Stream demarks the eastern extent of the Pakenham site (Figure 3.2). The Pakenham Stream flows north-easterly and joins the Sapiston River (the upper reaches of the Sapiston River are sometimes referred to as the Black Bourn) approximately 650m northeast of the Site. Both the Pakenham Stream and Sapiston River are defined as a main river:

"Main rivers are usually larger rivers and streams. Other rivers are called 'ordinary watercourses'. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk. Environment Agency powers to carry out flood defence work apply to main rivers only. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on ordinary watercourses. The Environment Agency decides which watercourses are main rivers. It consults with other risk management authorities and the public before making these decisions. The main river map is then updated to reflect these changes". Taken from the Environment Agency website (July 2020).

There are no permanent gauging stations on the Pakenham Stream. The closest permanent flow gauging station is located on the lower reaches of the Sapiston River at Rectory Bridge approx. 15km downstream (north) of the Site at Euston (Ref No. 33013). Table 3.1 displays the catchment and flow parameters for the Sapiston at Rectory Bridge and a daily hydrograph is presented in Appendix E.

Table 3.1 River Flows and Catchment Information

	35013 – Sapiston at Rectory Bridge (downstream of site)
NGR	TL 895 790
Catchment area (km^2)	205.9
BFI (Base Flow Index)	0.65
Q10 flow (m^3/s)	1.48
Q95 flow (m^3/s)	0.091
Mean flow (m^3/s)	0.681
Flow records for	1949 - 2019
Mean Annual Rainfall from CDR (mm)	602
Mean annual catchment runoff (mean flow/catchment area) (mm/year)	104.4
Mean annual catchment runoff as % Rainfall	17%

Source: National River Flow Archive, https://nrfa.ceh.ac.uk/data/station/spatial/33013, 30/03/2021.

3.4.2 Ordinary Watercourses

There are no ordinary watercourses at the Site, but a series of land drainage ditches dissect the floodplain.

Ditch Network

The drainage network of the south site (Figure 3.3) drains towards the central drain (W12) which channels water up to the north site. There is an existing dam (W11) which disconnects the southern drainage ditch from Pakenham Stream. The southern ditch was dry at the time of the visit (April 19) and again when visited in June 2021 indicating that drainage in this area is directed towards the central drain rather than to Pakenham Stream. There is potential to introduce water level control structures either on the central drain or within the internal ditches to raise water levels in this area, however this could potentially impact on the water supply to the north site. Conditions during the monitoring installation, and discussion with the volunteer at Pakenham Mill also indicated that the southern ditch and fen can be very wet in winter, when flow from the Pakenham Stream may overtop the dam and the woodland to the south of the site becomes very wet. It has also been reported that the dam was reinforced by the landowner in winter 2020.

The central drain (W5) is the key water carrier in the north site, receiving water from the south and distributing via the main perpendicular drain (W2). Both these ditches also appear to be carriers of near-surface groundwater. There does not seem to be an abundant supply of water in the western ditches (W1, W3 and W4) and the freeboard increases towards the north, limiting the potential to introduce water control structures of any use. The central drain would therefore be focus for potential water management structures and/or a supply of water for irrigating the land. The impact of such structures or water use would need to be considered in relation to the existing fen meadows areas in the north site.

A further site visit in May 2021 identified a breach in the Pakenham Stream bank where the stream crosses over the main perpendicular drain (W2), which is culverted at this location. A subsequent visit in June 2021 confirmed that the flow, from east to west, in to the site in W2 is being supported by flow from Pakenham Stream via this breach. This 'leak' was also confirmed by Pakenham Mill.

A visit to the Mill site also confirmed that the central drain (W12) flows north from the site, under the road before entering a culvert within which is crosses back under the Pakenham Stream and discharges downstream of the Pakenham Mill Pond.

A mill has been present at the site of Pakenham Mill for around 1000 years and is mentioned in the Doomsday Book. Staff at the mill indicated that the right to water is stabled by an 1802 Act of Parliament. The mill is operational with milling every Thursday. A head of around 2 feet is generated in the mill pond using boards to back the level up in the pond from Wednesday afternoon, which is then used to power the water wheel Mill on a Thursday.

A summary of observation made in relation to the ditch network during a site visit by Wood in April 2019 are given in Table 3.2 and are shown on Figure 3.3.

Table 3.2 Ditch network observation summary

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes	Water level (April 2021 Topographic Survey) (mAOD)
W1	Western boundary ditch	1.5	2 to west, 1.5 to east		No apparent flow	There is a track crossing here and the ditch contains some water on the north side but is dry on the south side.	No information collected
W2	Drainage ditch	4	0.7	0.7	No apparent flow	Wide drainage ditch containing water, but not clearly flowing. Interconnected at right angles with central channel (W5).	30.397
W3	Western boundary ditch	3	0.5	0.4	No apparent flow	Very shaded ditch on western boundary.	No information collected
W4	Western boundary ditch	2.5	3.5	0.3	No apparent flow	Western boundary ditch with culvert connection beneath track. Much lower level than adjacent land to the east.	No information collected

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes	Water level (April 2021 Topographic Survey) (mAOD)
W5	Central channel	2-4	0.5-2	0.2-0.7	Flow to north	This channel cuts south to north across the centre of the site. The freeboard varies but is greatest in the centre of the site and shallows out to the north and south. Northwards flow can be observed in the southern half of the site but as the channel widens and interconnects in the northern half of the site the flow is no longer obvious.	No information collected
W6	Pakenham Stream (north)	4	1	0.3-0.5	Flow to north	Shallow and low flowing. Peaty silt on bed.	No information collected
W7	Field scrapes	2	0.4	Boggy	No flow	Two field scrapes in the northern field. Not interconnected with other ditches.	No information collected
W8	Pakenham Stream (central)	5	0.5	0.3-0.5	Flow to north	Shallow and low flowing. Peaty silt on bed. Banks are raised 0.5-1m above land level.	31.115
W9	Drainage ditch	3	2.5	0.1	No apparent flow	Pakenham Stream dissects these two W-E ditches but is not interconnected.	No information collected
W10	Eastern boundary ditch	1	1.5	0.1	No apparent flow	This ditch borders the back of the houses on Fen Road.	No information collected

ID	Description	Width (m)	Freeboard (m)	Water depth (m)	Flow	Notes	Water level (April 2021 Topographic Survey) (mAOD)
W11	Dam	3	1		No flow	A dam separates the southern boundary ditch from Pakenham Stream. The southern boundary ditch is dry so the presence of the dam implies that the ditch may have previously been taking water from the stream or that water in encouraged to drain to the central channel rather than to Pakenham Stream.	No information collected
W12	Central channel	2	2	0.3	Flow to north	The central channel passes through a culvert at this location.	No information collected
W13	Dry western boundary ditch	2	1	Dry	No flow		31.480
W14	Eastern boundary ditch	2	3	0.2	Low flow to the south		No information collected
W15	N-S drainage ditch	3	0.5	0.2	No apparent flow	Lots of leaf litter in ditch. The ditch dries to the north and water deepens to the south.	No information collected
W16	W-E drainage ditch	3	0.5	0.2	No apparent flow	Lots of leaf litter in ditch. Woodland to the south but land suggest the ditch drains to the east.	No information collected

Note: Dimensions are approximate. The ID field references label on Figure 3.3.

3.4.3 Surface Waterbodies

The Pakenham stream is present across the entire eastern boundary of the site. Information gathered from site visits and from OS maps indicates that there are 26 waterbodies which have been identified within 500m of the Site boundary are shown in Figure 3.2. The Site is a network of drains also being present within the wider area.

Table 3.3 Water bodies within 500m of the Site

Water bodies	NGR	Distance and direction from Site	Description
W1	TL 9338 6956	279m north	Large waterbody, may contain fish.
W2	TL 9373 6959	479m north	Waterbody likely to be connected to drainage network and may contain fish.
W3	TL 9369 8315	425m north-east	Pond
W4	TL 9369 7414	350m north-east	Pond.
W5	TL 9369 6714	290m north-east	Pond
W6	TL 9369 6107	195m north-east	Large waterbody may contain fish.
W7	TL 9369 6904	268m north-east	Large waterbody may contain fish.
W8	TL 9368 4675	52m east	Waterbody likely to be connected to drainage network and may contain fish.
W9	TL 9368 5553	8m east	Pond
W10	TL 9368 6423	283m east	Pond
W11	TL 9368 6112	299m east	Large waterbody may contain fish.
W12	TL 9368 7707	478m east	Pond
W13	TL 9367 6797	379m east	Large waterbody may contain fish.
W14	TL 9367 2789	121m south-east	Large waterbody may contain fish.
W15	TL 9367 3879	291m south-east	Detached waterbody.
W16	TL 9367 1779	153m south-east	Waterbody likely to be connected to drainage network and may contain fish.
W17	TL 9267 9752	375m south	Waterbody likely to be connected to drainage network and may contain fish.
W18	TL 9267 8992	155m south-west	Large waterbody may contain fish.
W19	TL 9268 8932	63m west	Pond
W20	TL 9268 8370	283m west	Large waterbody may contain fish.
W21	TL 9327 6821	79 m east	Pond
W22	TL 9268 7783	314m west	Large waterbody may contain fish.
W23	TL 9268 8587	260m west	Large waterbody may contain fish.
W24	TL 9268 8991	203m west	Pond
W25	TL 9268 8391	255m west	Pond
W26	TL 9369 0242	372m north-west	Pond
W27	TL 9322 6805	49m east	Pond

3.4.4 Flood Risk

Fluvial flood risk

The Environment Agency Flood Map for Planning Service (2021), https://flood-map-for-planning.service.gov.uk (accessed 30/03/2021) shows that the Pakenham site is located within Flood Zone 3 (high probability of flooding). The site has pockets which fall within the high risk category with more than a 3.3% chance of flooding from rivers each year), but the majority of the site falls with the medium risk category with a 1% to 3.3% chance of flooding from rivers each year map (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 30/03/2021).

Surface water flood risk

The Environment Agency surface water flood risk map (Environment Agency Flood Warning Information Service (2018), https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (accessed 30/03/2021) indicates that flood risk from surface water flooding ranges from very low or low risk across the site, with a small pocket of medium risk in the centre of the southern area associated with a topographic low point.

3.4.5 Surface Water Abstractions

There are eight licensed surface water abstractions within 2km of the Site, details of which are given in Table 3.4. The surface water abstractions licensed are primarily for agricultural purposes. The Hardwick Farms licence abstracts from two locations on the ditches within the Site, while the Whitwell licence abstracts from the Pakenham Stream directly adjacent to the site. The Whitwell abstraction is for winter storage and is also understood to be piped from the stream under the site to the west. The remaining seven licences are located outside the site boundary, of those only the Nether Hall farms licences abstract from upstream of the Pakenham Site.

Table 3.4 Details of licensed surface water abstractions

Licence	Abstraction Name	Grid ref	Use	Point	Distance from site (km)	Max Daily Abstraction Quantity (Ml/d)
6/33/41/*S/0186/R01	Hardwick Farms	TL9368	Spray Irrigation – Storage and Direct	Pakenham Fen Ditch 1 And 2	On Site	1.44
AN/033/0037/022	S R Whitwell & Co	TL9368	Spray Irrigation – Storage	Pakenham Stream	Adjacent to Site	0.132
6/33/41/*S/0194	A Johnson & Son	TL9468	Spray Irrigation – Storage	Black Bourn River	1.2	1.09
6/33/41/*S/0196/R01	A Johnson & Son	TL9468	Spray Irrigation – Storage and Direct	Black Bourn at Stowlangtoft	1.2	1.08
6/33/41/*S/0178	Barton Place Farms	TL9468	Spray Irrigation – Storage and Make-Up or Top-Up Water	River Sapiston at Pakenham	1.3	0.86

Licence	Abstraction Name	Grid ref	Use	Point	Distance from site (km)	Max Daily Abstraction Quantity (Ml/d)
6/33/41/*S/0182	Nether Hall Farms	TL9267	Spray Irrigation – Storage	Pakenham Mill Stream	1.3	0.93
6/33/41/*S/0160	Nether Hall Farms	TL9266	General Farming & Domestic	Watercourse - Nether Hall Lake	1.6	1.3
6/33/41/*S/0048	Reeve Farms	TL9370	Spray Irrigation – Direct	Black Bourn River	1.8	0.13

3.4.6 Surface Water Discharges

The Environment Agency confirmed eight active licensed discharge consent within 2 km of the Pakenham site. A table of the location and type can be seen in Table 3.5, and the location is shown on Figure 3.2. At the time of writing this report, the Environment Agency have not confirmed the licensed discharge volumes.

Table 3.5 Details of surface water discharges

Site Name	Discharge Consent No.	Operator	Discharge Grid Ref	Type	Receiving Water	Distance from Site (km)	Licenced Discharge Volume (Ml/d)
Pakenham TPS	ASCNF10336	Anglian Water Services Limited	TL927673	Sewage - Water Company	Pakenham Stream	1.2	Unknown
1 Micklemere	EPRDP3027XQ	Mr Mark Salmon	TL935697	Sewage - Not Water Company	Tributary of The River Bourn	1.4	Unknown
2, The Old Pumping Station	EPRCB3893RL	Tiverton Homes Limited	TL939697	Sewage - Not Water Company	The Black Bourn	1.6	Unknown
The Old Pumping Station Development	EPRCB3893EN	Tiverton Homes Limited	TL939697	Sewage - Not Water Company	The Black Bourn	1.6	Unknown
Thurston Water Recycling Centre	ASCNF1315	Anglian Water Services Limited	TL917668	Sewage - Water Company	Pakenham Stream River Sapiston	2.2	Unknown
Thurston Depot	PRCNF05841	Christopher Blades and Leslie Crix	TL915668	Miscellaneous	Tributary Pakenham Stream	2.3	Unknown

3.5 Soils

The Cranfield University Soilscapes website indicates that in the valley bottom of Site 54 the soils consist of naturally wet, fen peat soils. On the higher ground east, south and west of the immediate vicinity of the site the soil in freely draining lime-rich loamy soils, to the north; slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. The main risk to water protection is associated with the drainage of

cultivated soils. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients applied to the land. Drainage of peat containing sulphides will release extremely acid drainage water. The predominant land use is arable and horticulture.

3.5.1 Soil Survey

The site was sampled by 17 cores on 30 April and 1 May 2019, as shown in Figure 3.4. The figures also indicate the location of two zones suggested by the coring results. The valley floor zone is sub-divided by the dominant sediment encountered. A summary of the soil survey is provided as a log of soil cores in Table 3.6; full site notes are given in Appendix D.

Overall, the site is notable for the prolonged groundwater influence evident from the beds of fen peat and calcareous marl deposited at or near the ground surface. Beds of precipitated marl were widely encountered and their extent – as indicated by the core samples – is given in Figure 3.4. Most cores exhibited the deposition of peat over sand, with chalky boulder clay or 'putty' chalk proved in cores in the centre of the survey or the southwest corner, respectively. Beds of marl varied widely in thickness and disposition, typically occurring within the peats but also found above it. A wetland-forming environment was only absent in 3 cores: core 3 sampled an area of the upland toeslope, but cores 9 and 14 lie within the modern floodplain; these soils all support Lolio-Plantaginion grasslands.

The remaining floodplain cores were taken from areas which now support fen meadow, rush pasture and improved grasslands. It is likely that the areas currently supporting fen meadow denote locations with groundwater upwelling, while the main area of rush pasture is a weakly flushed slope. Unfortunately, low rainfall levels meant that the water table was seldom encountered, and Table 3.6 therefore reports (in brackets) the depth at which wet soils were first encountered. It is likely that the historical water table relates to the zones of sapric peat or, in Core 9, where manganiferous streaks were proved. It is also evident that where peat is at the ground surface, it is in poor condition, and recorded as earthy peat. The reduction of the water table from the ground surface is clearly long-standing.

Table 3.6 Pakenham Fen North and South sites – Log of soil cores

Core / Soil type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
					cm b.g.l												
Peaty sand	0				0												
Humic sand					3		0										
Sand	8				22												
Earthy peat		0		0		0		0			0	0	0		0	0	0
Humic sand						15						24					
Hemic peat	29	12				30				0		43					
Marl				24	34		23			15	18					24	
Hemic peat				65	61											45	
Hemic-Fibric peat		52								25							
Sapric peat	71	110		85	70		28	34		57	31	58			35		38
Hemic peat																	82
Humic sand			0						0				42				
Sand			25				102	54	30				59	0			
Chalky Boulder Clay								84	99								
Putty' Chalk										98		75					
End of core	125	125	37	125	125	125	125	125	125	125	125	125	100	60	125	125	125
Mottling	12				22			57	41					38			

Core / Soil type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Manganiferous streaks									62								
Sulphurous odour				110	110												
Initial water table (or wet)	(82)	52		70		(62)	(66)	(84)		62	(73)	(58)	(80)		(50)	(80)	(63)
Final water table		46		53		62				43							

3.6 Geology

3.6.1 Superficial Deposits

BGS geological mapping indicates that the Pakenham area is underlain almost entirely by Peat. Further to the west of the site, the superficial geology incudes River Terrace Deposits and Head deposits (Gravel, Sand, Silt and Clay) which crop out along the western margin of the valley. Anecdotal evidence suggests that superficial deposits are relatively thin to the south but increases significantly in thickness over a relatively short distance towards the north. There is a buried valley running roughly south of the course of the River Sapiston (Black Bourn) and another which dissects the site which is filled with Glacial Till/ Boulder Clay. To the east of the site, there are also Till deposits present on the higher ground in the vicinity of the site. The superficial geology mapping for the site is shown in Figure 3.6 and includes the buried valley centrelines.

3.6.2 Solid Geology

The solid geology below the site is White Chalk of the Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation and Culver Chalk Formation (undifferentiated). The bedrock geology mapping for the site is shown in Figure 3.5.

A generalised geological succession for the local area is presented in Table 3.7.

Table 3.7 Simplified Stratigraphy of the Pakenham site

Age	Group	Formation	Description
Recent and Holocene		Alluvium	Silt, sand, clay, gravel
		Peat	Organic accumulations.
		Head	Peat, silt, sand, clay, gravel
		River Terrace Deposits	Sand and Gravel
Pleistocene		Glacial Till/ Boulder Clay	Clay
Upper Cretaceous	Chalk Group	Chalk	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

3.6.3 BGS borehole logs

There are two historic boreholes located within 100m of the boundary of the Pakenham Site (Locations shown on Figure 3.5). The borehole logs for these are available on the BGS data catalogue and show the following:

- TL96NW1 is 31.5m deep. The logs show sand and gravel to 0.5m, chalky boulder clay to 25m, soft chalky silts to 27m and very soft chalk to 31.5m.
- TL96NW57 is 18.6m deep. The log shows silt, sand and peat to 1m, boulder clay to 17.9m and upper chalk to 18.6m.

There are five further historic boreholes located within 500m from the Pakenham site. The borehole logs are available on the BGS data catalogue and are summarized in Table 3.9.

Table 3.8 Geology of historic borehole within 500m to the Pakenham site

Borehole ID	National Grid reference	Depth (m)	Geological classifications*
TL96NW3	TL 92830 68840	90	Glacial Sand & Gravel (0-2) Chalky Boulder Clay Becoming Gravely (2-84) Glacial Sand & Gravel (84-88) Chalk (88-90)
TL96NW68	TL 92900 68800	No data	No data
TL96NW33	TL 93680 68070	82.6	Boulder Clay (0-59) Dirty chalk + Clay (89-73) Upper Chalk (73-82.6)
TL96NW51	TL 92400 68080	2.5	Head Gravel (0-1.2) Upper Chalk (1.2-2.5)
TL96NW56	TL 93770 68730	18.7	Cover Sand (0-0.8) Boulder Clay (0.8-18.7)

*Geological strata upper boundary to lowest depth below ground level in meters

In addition, there are 26 boreholes within 1km from the site. Those closest to the site confirm that the site is underlain by Chalk at depths an overlain variably by sands, gravels and clays.

3.6.4 Drilling programme

Geological information was recorded during the borehole drilling and installation programme between 2nd March and 10th March 2021. Drilling logs are presented in Appendix B and a summary of the geology encountered is provided in Table 3.8 below. The monitoring network is shown in Figure 3.5.

The deeper borehole (PAK-BH-2D) confirmed the presence of Chalk at a depth of 37 mbgl overlain by substantial thickness of Till as expected. The dipwells confirm that the Pakenham Site is underlain by predominately HEAD deposits made up of Alluvial Sands and Gravels, Peat and Till (clay) which overly the Chalk across the site. The PAK-BH-1 borehole in the buried valley also confirms the presence of Clay dominant HEAD/Till material here.

Table 3.9 Summary of Pakenham site geology

Name	Drillers ID	NGR	Ground Level (mAOD)	Drilled Depth (mbgl)	Depth to base of (mbgl)				Notes
					Topsoil	HEAD – mixed sand, gravel, clay and silt	Peat	Chalk	
PAK-BH-1	PAK-BH-1	TL 93282 68982	31.87	5	0.3	5			5m borehole into buried channel deposits
PAK-BH-2D	PAK-BH-2	TL 93102 68394	32.22	37		30.8		37	Nested piezometer – Chalk BH
PAK-BH-2S	PAK-BH-2	TL 93102 68394	32.22	4		4.0			Nested piezometer – Shallow BH
PAK-HA-1	PAK-HA-1	TL 93319 68927	30.69	3	0.3		3.0		Dipwell into near surface deposits
PAK-HA-2	PAK-HA-2	TL 93161 68834	30.65	3	0.10		3.0		Dipwell into near surface deposits
PAK-HA-3	PAK-HA-3	TL 93262 68662	30.58	3		0.55	3.0		Dipwell into near surface deposits
--	*PAK-HA-4*	*TL 93173 68424*	*30.64*	*2.1*		*2.10*			*Exploratory hole ONLY*
PAK-HA-4A	PAK-HA-4A	TL 93168 68446	30.93	2	0.1	0.6 1.65 2.0	0.9 1.85		Dipwell into near surface deposits *Layered peat and HEAD deposits*
PAK-HA-5	PAK-HA-5	TL 92935 68197	30.91	2.14	0.2	2.14			Dipwell into near surface deposits. Peat pockets between 0.8 and 1.9m
PAK-HA-6	PAK-HA-6	TL 93075 68079	30.75	3.00	0.1	0.4	3.0		Dipwell into near surface deposits

3.7 Hydrogeology

3.7.1 Aquifer designation

The Chalk Group is designated as a Principal aquifer which is characterised as consisting of 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.

Groundwater resources are also assigned a vulnerability class based on soil type and the underlying geology. The groundwater resources in the area of the Proposed Development are mapped on the Magic web site[2] as Medium and Medium-High groundwater vulnerability.

3.7.2 Aquifer properties

Information on the hydraulic properties of the Chalk near the Site has been obtained from BGS Major and Minor Property Manuals (BGS, 1997 and 2000) and from scanned borehole logs from BGS GeoIndex Onshore records online. Chalk transmissivity values are available from borehole scans in and around water supply boreholes in Pakenham and values ranges from approximately 760 m^2/d to 5200 m^2/d in the Upper Sapiston Catchment.

3.7.3 Springs

There are no springs identified within the vicinity of the Site on OS maps.

3.7.4 Groundwater levels and flow

The closest EA observation borehole (TL96_077) is located approximately 0.3km west of the Site at Watermill Farm. The borehole monitored groundwater levels in the Chalk between 2008 and present. During that period Chalk groundwater levels fluctuated between 28 mAOD and 30 mAOD and showed typical seasonal fluctuations (Appendix E).

The Hydrogeological Map of Southern East Anglia (Institute of Geological Sciences, 1981) maps the Chalk piezometric surface during August/September 1976. At the Pakenham site the Chalk groundwater levels are mapped at approximately 30 mAOD. Regional groundwater flow is towards the main Little Ouse River to the north (Institute of Geological Sciences, 1981).

The soils core surveys carried out in April 2019 indicated that the water table was generally between 0.43m and 0.84 mbgl. The deeper piezometer (PAK-BH-2D) was drilled through the Glacial Till and into the Chalk to a depth of 40m and the piezometer was measuring groundwater levels at 34.7 mAOD during the initial drilling programme. This is slightly above the ground level at this installation. Groundwater levels have since reduced below ground level. During the drilling programme, groundwater levels in the surface deposits range from 0.05m and 1.3 mbgl.

Groundwater levels will be monitored at all installations listed in Table 2.3 for period of 12 months from April 2021 using electronic dataloggers set at 15-minute recording intervals.

3.7.5 EA Regional Groundwater Modelling

The Environment Agency's North East Anglian Chalk (NEAC) Model has been developed through the Anglian Region Groundwater Strategy Framework. Data from the EA model has been made available to EDF Energy under a licence agreement for use in this study. The use of the regional groundwater model is the best

[2] http://magic.defra.gov.uk/MagicMap.aspx

available tool to represent the transient groundwater conditions that may affect the Site thus enabling better definition of long-term water level variation, drought conditions and the influence of abstraction pressures on water levels and flows.

The NEAC model comprises two main components:

- A recharge and runoff model that provides input data to the uppermost boundary of the groundwater flow model. This model uses the routing of rainfall, runoff and recharge (4R) code (Entec, 2006) to process the soil moisture balance, actual evapotranspiration (AE), interflow, runoff and recharge data on a daily time interval; and
- An eleven-layer groundwater model that simulates flow in the saturated zone, including the Sandringham Sands, Carstone, Chalk and Crag aquifers, as well as in the post-Chalk Eocene and Quaternary deposits. In the vicinity of Pakenham, the layers representing pre-Chalk geology are inactive in the model.

The modelled representation of the observed geology is shown in Table 3.10. The model layers which are most relevant to this study are Layers 1-6.

Table 3.10 Geological Composition of Model Layers in NEAC

Layer Number	Description
1	Unconsolidated permeable recent and glacial deposits, e.g. Alluvium, Peat, River Terrace Deposits, upper Glacial Sands and Gravel.
2	Unconsolidated clays e.g. Glacial Till.
3	Unconsolidated sands and gravels which pre-date the Till e.g. lower Glacial Sands and Gravels, pre-glacial fluvial deposits (e.g. Bytham/Kesgrave Sands and Gravel), Crag.
4	London Clay.
5	Upper 20 m of saturated Chalk. The Lower London Tertiaries are also included in this layer where they exist in the model area.
6	Nominally, 80 m of saturated, 'lower' Chalk. The whole Chalk thickness (Layer 5 plus Layer 6) is nominally 100 m.

The Environment Agencies NEAC model extends over a total area of almost 15,500 km^2; a common 200 m by 200 m fixed-mesh grid is used for both the 4R and MODFLOW components of the model, orientated parallel to the Ordnance Survey National Grid. The 4R and MODFLOW models were developed and calibrated on the basis of the field-based conceptual understanding and by comparison with observations of river flow and groundwater levels. The model simulation period is effectively between 1970 and 2018, nominally comprising monthly stress periods. For the purposes of providing input to the groundwater model the daily output from 4R is aggregated according to the number of days within each monthly stress period. The calibration status of the model in the vicinity of the Pakenham Site (Little Ouse catchment) is considered 'Very high'.

Modelled Groundwater Levels

Modelled groundwater levels for observation boreholes used in regional model calibration have been obtained to assess the overall performance of the groundwater model in the vicinity of the Pakenham Site. Comparing modelled and measured data for the observation borehole (OBH) at TL96/077 (Pakenham) 0.5 km to the north-east of the site, shows that the timing of seasonal and longer-term fluctuations in the Chalk groundwater level are well represented by the model.

Modelled historic groundwater levels in the Chalk show that the general flow of groundwater is towards the north-east in historic 'dry' (August 1991) and 'average' (May 1994) months, and more northerly with increased deflection to the Pakenham Stream in the historic 'wet' (March 2001) month. Chalk groundwater levels are modelled at between 32 mAOD and 36 mAOD, indicating artesian water levels.

The historic water table modelled at the site shows that the water table flow is towards the Pakenham Stream in all the example months; wet, dry and average flow towards the Pakenham Stream as would be expected. The modelled groundwater levels are between 32mAOD and 36 mAOD. The model shows that for the most part, the depth the water table in the model cells around between 0.3 m and 1 m below ground level in the example 'average' month. The modelled data indicated an average annual water level fluctuation of between 3 cm and 20 cm a year.

Comparing the historic modelled time series to theoretical Full Licensed (FL) abstraction conditions (where all abstractions are operating at maximum abstraction quantities throughout the modelled time series) indicates that FL abstraction would lower water levels by a further 1 m (compared to historical abstraction) at TL96/077 in the underlying Chalk. For the example 'dry' period, Chalk groundwater levels would reduce between 0.3 and 1.6 m across the Site.

3.7.6 Groundwater abstractions and protection zones

Licensed groundwater abstractions

The Environment Agency lists three groundwater abstraction licences within 2km of the Pakenham Site, as summarised in Table 3.11. The locations of licensed groundwater abstractions within 2km of the Pakenham Site are shown on Figure 3.7. All the abstractions identified by the Environment Agency as being located within the 2km of the site are abstracted from the underlying chalk groundwater water from multiple boreholes.

Table 3.11 Licensed groundwater abstractions within 2km of the Pakenham site.

Licence No.	Operator (Name)	Purpose	Description of Source	Aquifer	Max annual Abstraction Quantity (TCMA)	Max Daily Abstraction Quantity (Ml/d)	Distance from site (km)
6/33/41/*G/0165	Anglian Water Services Ltd	Water Supply	Two BHs	Chalk	2953	10.0	1.0
6/33/41/*G/0174	Nether Hall Farms	Agriculture. General Farming and Spray Irrigation	Three BHs	Chalk	50	2.0	1.6 to 1.9
6/33/41/*G/0188/R02	Barton Place Farms	Agriculture (Spray Irrigation) and Environmental (Transfer between sources)	Two BHs	Chalk	364	5.5	1.7

Deregulated groundwater abstractions

The Environment Agency has provided details of six deregulated groundwater abstractions points (under five historic licences) within 2km of the Pakenham Site. These abstractions are generally related to agricultural purposes of less than 20 m^3/d. The current status of these abstractions is not known.

Private water supplies

Records of private water supplies (unlicensed) are held by West Suffolk Council. West Suffolk Council have provided maps showing the locations the single private water supply located within 2km of the Site, approximately 750m south of the site. The supply abstracts just 5 m^3 per day and is abstracted from a single source. No other details are provided.

Source protection zones

Groundwater source protections zones (SPZ) identified in relation to the Pakenham site are shown on Figure 3.8. The Pakenham site does not intersect any groundwater SPZs.

3.7.7 Nitrate vulnerable zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. The Pakenham site is located within an NVZ.

3.7.8 Groundwater quality

Groundwater quality will be monitored at all installations listed in Table 2.3 for period of 12 months with a mix of monthly in-situ water quality readings and quarterly water quality sampling and laboratory analysis for major determinands.

3.8 Water Framework Directive water body status

River Basin Management Plans (RBMPs) are drawn up for the eleven river basin districts in England and Wales as a requirement of the WFD. The plans have been developed by the Environment Agency through consultations with organisations and individuals. The plans are designed to protect and improve the quality of the water environment, providing information on what needs to be done to tackle water issues, i.e., measures to improve water quality in rivers, lakes, estuaries, coasts and in groundwater. The Pakenham site is located within the area covered by the Anglian RBMP (Environment Agency, 2015). River Basin Districts are divided into Management Catchments, which are further divided into Operational Catchments, within which there are sub-catchment water bodies.

With respect to surface water, the Pakenham site is in the Pakenham Stream surface waterbody (GB105033043300) which has been designated as heavily modified. In the 2019 WFD classification (Cycle 2) the water body had an overall classification of 'Moderate' based on a 'Moderate ecological status and failing chemical status.'

The ecological elements were classified as 'Good' (near natural conditions) for invertebrates, 'Supports Good' for the hydrological regime elements class, and 'Moderate' for the physico-chemical quality elements.

The chemical status fails due to the presence of Polybrominated diphenyl ethers (PBDE), a priority hazardous substance. All other chemicals were classified as 'Good' or 'Does not require assessment'. Prior to 2019 the chemical status of the Pakenham stream was 'Good'.

In terms of groundwater, the Pakenham site is located within the Cam and Ely Ouse Chalk groundwater body (GB40501G400500). In the 2019 WFD classification (Cycle 2) the Cam and Ely Ouse Chalk groundwater body

was classified as at 'Poor' quantitative status due to the quantitative dependent surface water body status of 'Poor'. The groundwater chemical status was also classified as 'Poor'.

3.9 Water resources

The Pakenham site lies within the Environment Agency's East Anglia (Map area 10) Abstraction Licencing Strategies (ALS) (CAMS process) area. The Cam and Ely Ouse ALS covers a catchment area of approximately 3,664 km^2 and includes the Pakenham site. Water availability is calculated at Assessment Points (APs) and AP11 is relevant to the Pakenham Site because it covers the River Sapiston at Rectory Bridge.

At AP11, downstream of the Pakenham site, water is restricted for licensing at Q30 and Q50 and not available at Q70 and Q95 flows. Water becomes available for licensing at Q22 and there is a Hands-Off Flow (HOF) restriction of 73.0 Ml/d which reflects the status of the downstream critical AP17 (Denver Sluice).

Groundwater management units (GWMUs) are assigned to the groundwater bodies (Principal aquifers) for the purposes of local groundwater availability assessment in ALSs. The Pakenham Site is located within the Cam and Ely Ouse GWMU, where resource availability is designated as 'water not available' from the Chalk in the Sapiston catchment.

3.10 Designated conservation sites

3.10.1 Designated Sites

Adjacent to the east of the site is the Pakenham meadows SSSI and east of the sites are two ancient woodlands: Pakenham wood is a replanted woodland located less than 1km south of the site and Stockings Wood is an Ancient & semi-natural woodland located 2.8km east of the site.

3.11 Landfills

One historic landfill is located approximately 2km south east to the site and just south of Stowlangtoft (NRG TL 9525 6766). A second historic landfill is located approximately 2.8km east of the site at Kiln Farm (NRG TL 9613 6913).

4. Conceptual Site Model

This section presents a summary of the conceptual understanding for the Pakenham site and focuses on the main elements which will influence the feasibility of creating fen meadow habitat at this site. The conceptual model is illustrated by a schematic cross section (Figure 4.1) across the Pakenham River valley through the centre of the Site, showing the relationship between ground level, groundwater levels, surface water levels and logged geological strata.

The conceptual site model has been developed using all information presented in this desk study including results of the topographic survey and drilling logs for the groundwater monitoring installation points.

The conceptual model for the Pakenham site is outlined as follows:

- The Pakenham site covers an area of 32.7 ha. The primary locus area for fen meadow has an area of 6.1 ha and the potential additional area for fen meadow is 12.05 ha.
- Annual average rainfall is for the area is c.602mm.
- The surface elevation slopes gently from northern boundary towards the central drain and then rises slightly back up to the Pakenham Stream, which is a main river that flows north-easterly towards Grimstone End. Ground elevations between 30.5 and 31 mAOD across the Site.
- The Pakenham site is in Flood Zone 3 (high probability of flooding) and falls within the medium risk category with a 1% to 3.3% chance of flooding from the Pakenham Stream each year.
- The Pakenham site is criss-crossed by a network of land drainage ditches. The main ditch across the site runs from south to north parallel with the Pakenham Stream. This central drain is bisected by a second west-east primary drain; both ditches appear to be carriers for near-surface groundwater. The Pakenham stream is, at least in appearance, elevated above the floodplain. There are several small boundary drains which appear to drain along the upland margin and run to the main central drain.
- Site visits have identified a breach in the Pakenham Stream bank where the stream crosses over the west-east drain, which is culverted at this location. The flow, from east to west, in to the site in this drain, and subsequently in to the central drain, is being supported by flow from Pakenham Stream via this breach. This 'leak' was also confirmed by Pakenham Mill.
- A visit to the Mill site also confirmed that the central drain (W12) flows north from the site, under the road before entering a culvert within which is crosses back under the Pakenham Stream and discharges downstream of the Pakenham Mill Pond.
- Data obtained from the topographic surveys initially indicate that water level in the central drain is around 30.4 mAOD. The lowest channel elevation recorded in the topographic survey was 28.6 mAOD. Groundwater levels across the site recorded at between around 29.5 mAOD and 30.6 mAOD for the same day.
- Data obtained from the topographic surveys initially indicate that water level in the Pakenham Stream is around 31.1 mAOD. The lowest elevation of the channel bed on the short Pakenham Stream reach surveyed was 29.9 mAOD. The Pakenham Stream is at a higher elevation that the central drain, although there is still likely continuity between the Pakenham Stream and groundwater levels.
- The Pakenham Site covers the valley floor of the Pakenham Stream. The bedrock geology underlying the Site is Chalk. The chalk is overlain by superficial deposits of varying thicknesses; the most dominant is Peat, but there are also river terrace sands and gravels and Head deposits

which thin towards the western margin. The boundary to the west is the upland toeslope. The margin of this upland is composed of sands and gravels. The upland also has a pronounced sandy terrace toeslope occupying much of the northern part of this site. To the east, the site is bounded by the Pakenham Stream.

- There is a buried valley that dissects the site which is infilled with Glacial Till.
- Regionally, groundwater flow in the Chalk is towards the Little Ouse but is considered to deflect towards the Pakenham Stream locally and to the north-east regionally. Chalk groundwater levels are generally considered to be at between 32 mAOD and 36 mAOD.
- Locally, the water table in the superficial deposits is modelled as flowing towards the Pakenham Stream and is considered to be at between 32 mAOD and 36 mAOD.
- Development of Peat has occurred at the site and is encountered between 0.1 and 0.6 mbgl with a thickness of up to 2.9 m at borehole PAK-HA-2. Soils cores show that where present the peat is between 30 and 110 cm thick. Most cores exhibited the deposition of peat over sand, with chalky boulder clay or 'putty' chalk proved in cores in the centre of the survey or the southwest corner, respectively.
- The soils cores also showed little in terms of the water. It is likely that the historical water table relates to the zones of sapric peat or, in Core 9, where manganiferous streaks were proved. It is also evident that where peat is at the ground surface, it is in poor condition, and recorded as earthy peat. The reduction of the water table from the ground surface is clearly long-standing.
- The only significant groundwater abstraction nearby is for public water supply from two boreholes within 1km of the Pakenham site. The abstraction is sourced from the Chalk aquifer and their potential impact on near surface groundwater levels below the Site is likely to be minimal due presence of the buried valley, and given the groundwater protection zone follows up the Black Bourne River and does not intersect the site.
- Two surface water abstraction points, from one abstraction licence, are located on the ditches on site. One further abstraction, which abstracts during the winter, is located on the Pakenham Stream adjacent to the site and piped to the west under the site.

Water levels will be continuously monitored at all groundwater and surface water installations for period of 12 months from April 2021 to further develop and refine this conceptual understanding. Hydrochemical sampling (monthly in-situ readings and quarterly laboratory analysis) will also take place at selected installations to aid conceptualisation of water supply mechanisms to the site and to quantify the extent/variability of distinctive/essential chemistry associated with ecological features.

5. References

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Figures

591000 591500 592000 592500 593000 593500 594000 594500 595000 595500

270500 270000 269500 269000 268500 268000 267500 267000

N

Key

- Site 54 boundary
- River
- Primary locus for fen meadow
- Potential additional area for fen meadow

0 250 500 750 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 1.1
Site location plan

April 2021

wood.

H:\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OW-0030_S0_P01.1.mxd jacqui.parkin

592500 593000 593500 594000

269000 268500 268000

N

A143

PAK-BH-1
PAK-HA-1
PAK-HA-2
PAK-GB01
PAK-HA-3
PAK-HA-4A
PAK-BH-2D
PAK-BH-2S
PAK-GB02
PAK-GB03
PAK-HA-5
PAK-HA-6
PAK-GB04

Old Hall Farm
Grimstone End
Broadway
Fen Rd
The Black Bourn
Pakenham Fen

Key

- Site 54 boundary
- River
- Gaugeboard
- Dipwell
- Piezometer
- Borehole
- Long section
- Cross section
- Ditch section

0 100 200 300 m

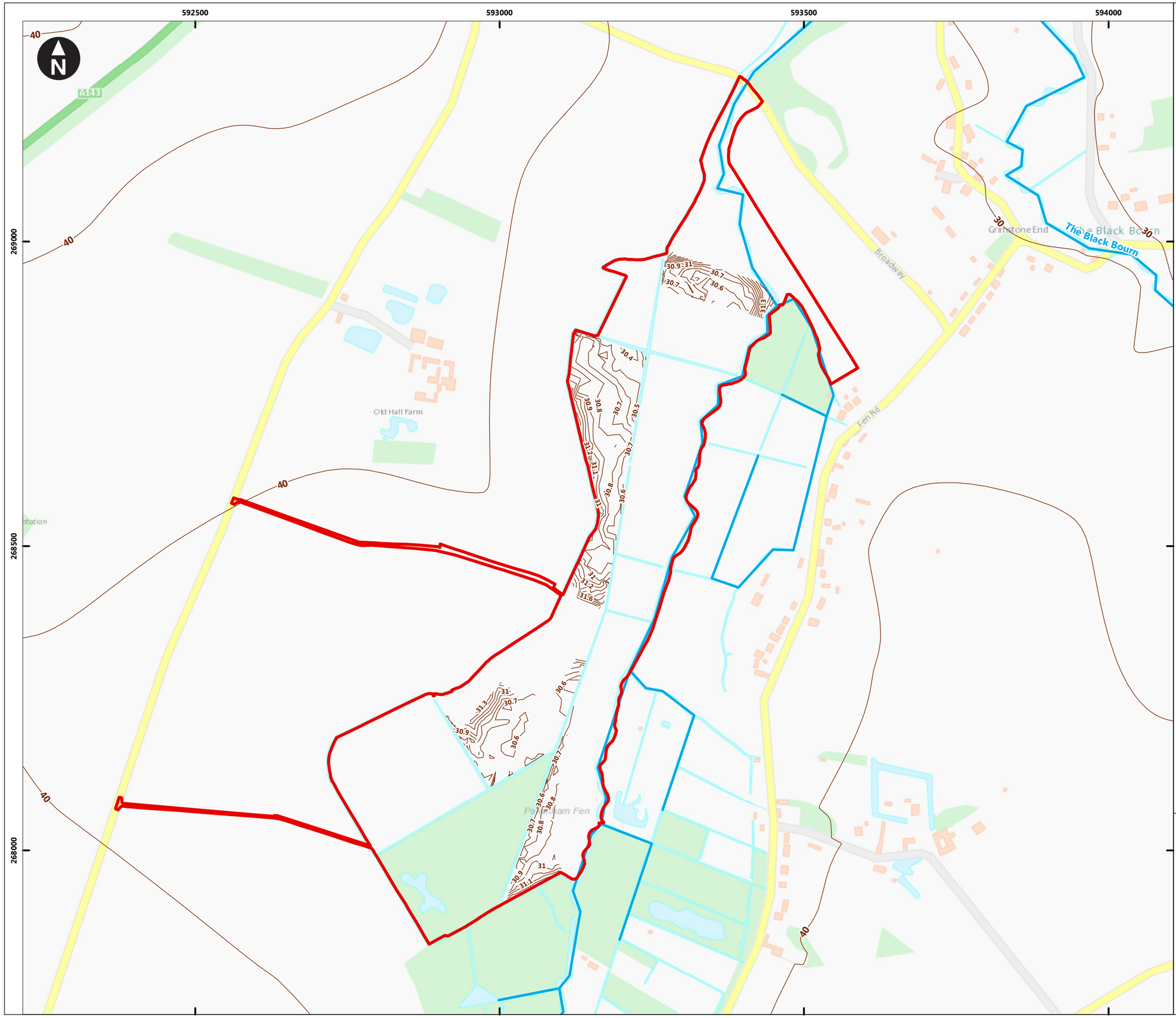
Scale at A3: 1:6,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 2.1
Monitoring installations and topographic section lines

June 2021

wood.



Key

- Site 54 boundary
- River
- Topographic contour (m AOD)

0 100 200 300 m

Scale at A3: 1:6,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.1
Topography for Primary Locus Areas

June 2021

wood.

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592000
593000
594000
269000
268000

N

33013 Sapiston
188373 Stanton
41_09 Barton Mere
185617 Rushbrooke WSW
A134
A143
A14
Bury St Edmunds

EPRCB3893EN
EPRCB3893RL
EPRDP3027XQ
TL96_077
41M14
TL96_010
PAK-GB01
PAK-GB02
PAK-GB03
PAK-GB04
ASCNF10336

W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27

A143
A1088
Slow La
Baileypool La
Cutter's La
Thieves La
Broadway
Grimstone End
Sandy La
The Black Bourn
Fen Rd
Hall Farm
Nursery Plantation
Pakenham Fen
Pakenham
Upper Town
Pakenham Rd
The Owell
The Meadows
The St
Bull
Beaum Ha
Broom Cove

Key

- Waterbody (W1)
- Site 54 boundary
- River
- Discharge
- Flow gauge
- Groundwater level monitoring point
- Water quality sample point
- Raingauge
- Gaugeboard

0 200 400 600 m

Scale at A3: 1:10,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.2
Monitoring Installations

June 2021

wood.

E:\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OW-0032_S0_P01.1.mxd
katyjames

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592500 593000 593500 594000

269000 268500 268000

A143

Old Hall Farm

Plantation

Pakenham Fen

Grimstone End

The Black Bourn

Broadway

Fen Rd

W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16

Key

- Site 54 boundary
- River
- Direction of flow
- No apparent flow
- W1 Ditch number

0 100 200 300 m

Scale at A3: 1:6,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.3
Ditch network

April 2021

wood.

592500 593000 593500 594000

269000 268500 268000

A143

Old Hall Farm

Grimstone End

The Black Bourn

Broadway

Fen Rd

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Key

- Site 54 boundary
- River
- Soil core sample location
- Peat and marl
- Peat
- Sand
- Upland

0 100 200 300 m

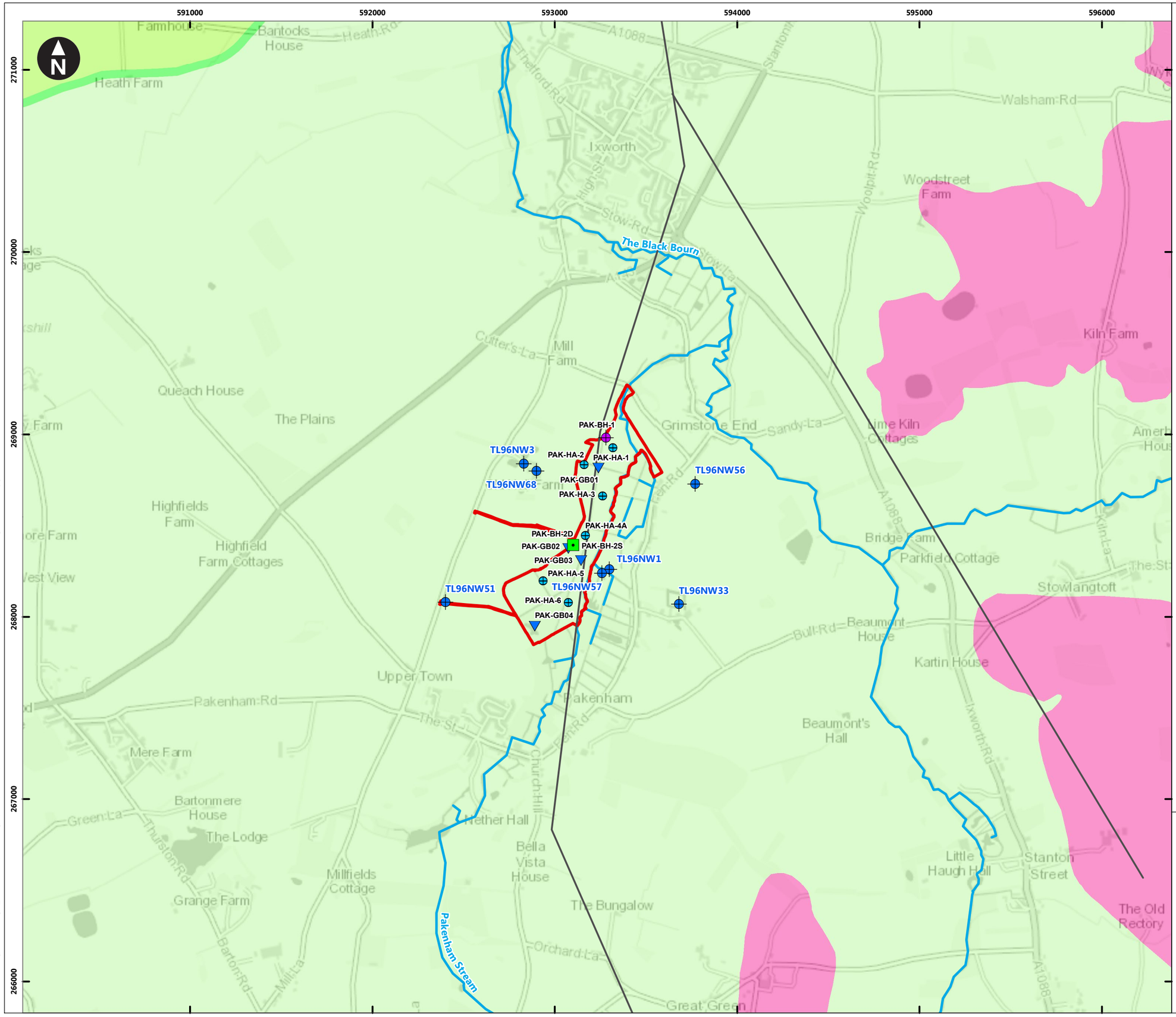
Scale at A3: 1:6,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.4
Soil core survey

June 2021

wood.



Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.5
Bedrock geology

June 2021

wood.

591000 592000 593000 594000 595000 596000

271000 270000 269000 268000 267000 266000

N

Key

- Site 54 boundary
- River
- Buried valleys (centrelines)
- BGS borehole
- Borehole
- Dipwell
- Gaugeboard
- Piezometer
- ALLUVIUM - CLAY, SILT, SAND AND GRAVEL
- RIVER TERRACE DEPOSITS - SAND AND GRAVEL
- CROXTON SAND AND GRAVEL MEMBER
- LOWESTOFT FORMATION - DIAMICTON
- INGHAM SAND AND GRAVEL FORMATION
- COVER SAND
- HEAD - CLAY, SILT, SAND AND GRAVEL
- PEAT

PAK-BH-1
PAK-HA-1
PAK-HA-2
PAK-GB01
PAK-HA-3
PAK-HA-4A
PAK-BH-2D
PAK-GB02
PAK-BH-2S
PAK-GB03
PAK-HA-5
PAK-HA-6
PAK-GB04
TL96NW3
TL96NW68
TL96NW56
TL96NW1
TL96NW57
TL96NW51
TL96NW33

Ixworth
Woodstreet Farm
Walsham Rd
A1088
Thelford Rd
High St
Stow Rd
Woolpit Rd
The Black Bourn
Stow La
Mill Farm
Cutlers La
Queach House
The Plains
Grimstone End
Sandy La
Lime Kiln Cottages
Kiln Farm
Old Hall Farm
Heath Farm
Bantocks House
Farmhouse
Highfields Farm
Highfield Farm Cottages
Upper Town
Pakenham
Pakenham Rd
The St
Church Hill
Fen Rd
Bull Rd
Beaumont House
Beaumont's Hall
Kartin House
Bridge Farm
Parkfield Cottage
Stowlangtoft
Ixworth Rd
Kiln La
Mere Farm
Bartonmere House
The Lodge
Green La
Thurston Rd
Grange Farm
Millfields Cottage
Barton Rd
Mill La
Nether Hall
Bella Vista House
The Bungalow
Orchard La
Pakenham Stream
Little Haugh Hall
Stanton Street
The Old Rectory
Great Green

0 250 500 750 1,000 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.6
Superficial geology

June 2021

wood.

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591500 592000 592500 593000 593500 594000 594500 595000 595500

270000 269500 269000 268500 268000 267500 267000 266500

6/33/41/*S/0048
6/33/41/*S/0186/R01
6/33/41/*G/0092
6/33/41/*G/0165
6/33/41/*S/0196/R01
6/33/41/*S/0194
6/33/41/*S/0178
6/33/41/*G/0053
AN/033/0037/022
6/33/41/*G/0004
6/33/41/*G/0085
6/33/41/*G/0188/R02
6/33/41/*S/0182
6/33/41/*S/0160
6/33/41/*G/0078
6/33/41/*G/0174

The Black Bourn
Pakenham Stream

Key

- Site 54 boundary
- River
- Groundwater abstraction (PWS)
- Groundwater abstraction (Non-PWS)

0 200 400 600 800 m

Scale at A3: 1:15,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.7
Groundwater abstractions

April 2021

wood.

H:\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OW-0038_S0_P01.1.mxd Originator: jacqui.parkin

590500 591000 591500 592000 592500 593000 593500 594000 594500 595000 595500 596000

271000 270500 270000 269500 269000 268500 268000 267500 267000 266500 266000

N

Farmhouse
Chalet Bungalow
Heath Farm
Ixworth
A143
Woodstreet Farm
6/33/41/*S/0048
The Black Bourn
Stow Lane
Mill Farm
Kiln Farm
Queach House
The Plains
6/33/41/*S/0186/R01
6/33/41/*G/0165
Lime Kiln Cottages
6/33/41/*G/0092
Old Hall Farm
6/33/41/*S/0196/R01
6/33/41/*S/0194
A1088
Highfields
Highfields Farm
Highfield Farm Cottages
6/33/41/*S/0178
6/33/41/*G/0053
AN/033/0037/022
Parkfield Cottage
Stowlangtoft
6/33/41/*G/0004
Beaumont House
Kartin House
6/33/41/*G/0085
Upper Town
Pakenham
6/33/41/*G/0188/R02
Ixworth Road
Mere Farm
6/33/41/*S/0182
Bartonmere House
6/33/41/*S/0160
The Lodge
Nether Hall
6/33/41/*G/0078
Bella Vista House
Millfields Cottage
6/33/41/*G/0174
The Bungalow
Little Haugh Hall
Stanton Street
Grange Farm
Pakenham Stream
The Old Rectory
Great Green

Key

- Site 54 boundary
- River
- Groundwater abstraction (PWS)
- Groundwater abstraction (Non-PWS)

Groundwater Source Protection Zone

- SPZ 1
- SPZ 2
- SPZ 3

0 200 400 600 800 1,000 1,200 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.8
Groundwater source protection zones

June 2021

wood.

H:\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\Deliver Stage\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OW-0039_S0_P01.1.mxd Originator: jacqui.parkin

590000 590500 591000 591500 592000 592500 593000 593500 594000 594500 595000 595500 596000

271000 270500 270000 269500 269000 268500 268000 267500 267000 266500 266000

N

Farmhouse
Chalet Bungalow
Heath Farm
Ixworth
A143
Woodstreet Farm
The Black Bourn
Puttocks Cottage
Stow Lane
Kiln Farm
Mill Farm
Queach House
The Plains
Paltry Farm
Grimstone End
Lime Kiln Cottages
Old Hall Farm
Pakenham Meadows
A1088
Highfields Farm
Ashmore Farm
Highfield Farm Cottages
Bridge Farm
Parkfield Cottage
West View
A143
Stowlangtoft
Beaumont House
Stockings Wood
Kartin House
Upper Town
Pakenham
Pakenham Wood
Beaumont's Hall
Ixworth Road
Mere Farm
Bartonmere House
The Lodge
Hether Hall
Bella Vista House
Millfields Cottage
Little Haugh Hall
Stanton Street
Grange Farm
The Bungalow
Pakenham Stream
Great Green

Key

- Site 54 boundary
- River
- Site of Special Scientific Interest (SSSI)
- Ancient & Semi-Natural Woodland
- Ancient Replanted Woodland

0 200 400 600 800 1,000 1,200 m

Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.9
Designated conservation sites

April 2021

wood.

591000 592000 593000 594000 595000 596000

271000 270000 269000 268000 267000 266000

N

Heath Farm
Bungalow
Ixworth
A143
Woodstreet Farm
The Black Bourn
Stow Lane
Kiln Farm
Mill Farm
Queach House
The Plains
Grimstone End
Lime Kiln Cottages
Old Hall Farm
Highfields Farm
Highfield Farm Cottages
West View
A1088
Bridge Farm
Parkfield Cottage
Stowlangtoft
Beaumont House
Kartin House
South of Stowlangtoft Spinney
Upper Town
Pakenham
Beaumont's Hall
Ixworth Road
Mere Farm
Bartonmere House
The Lodge
Nether Hall
Bella Vista House
Millfields Cottage
Grange Farm
The Bungalow
Little Haugh Hall
Stanton Street
Pakenham Stream
Great Green

Key

- Site 54 boundary
- River
- Historic landfill site

0 200 400 600 800 1,000 1,200 m

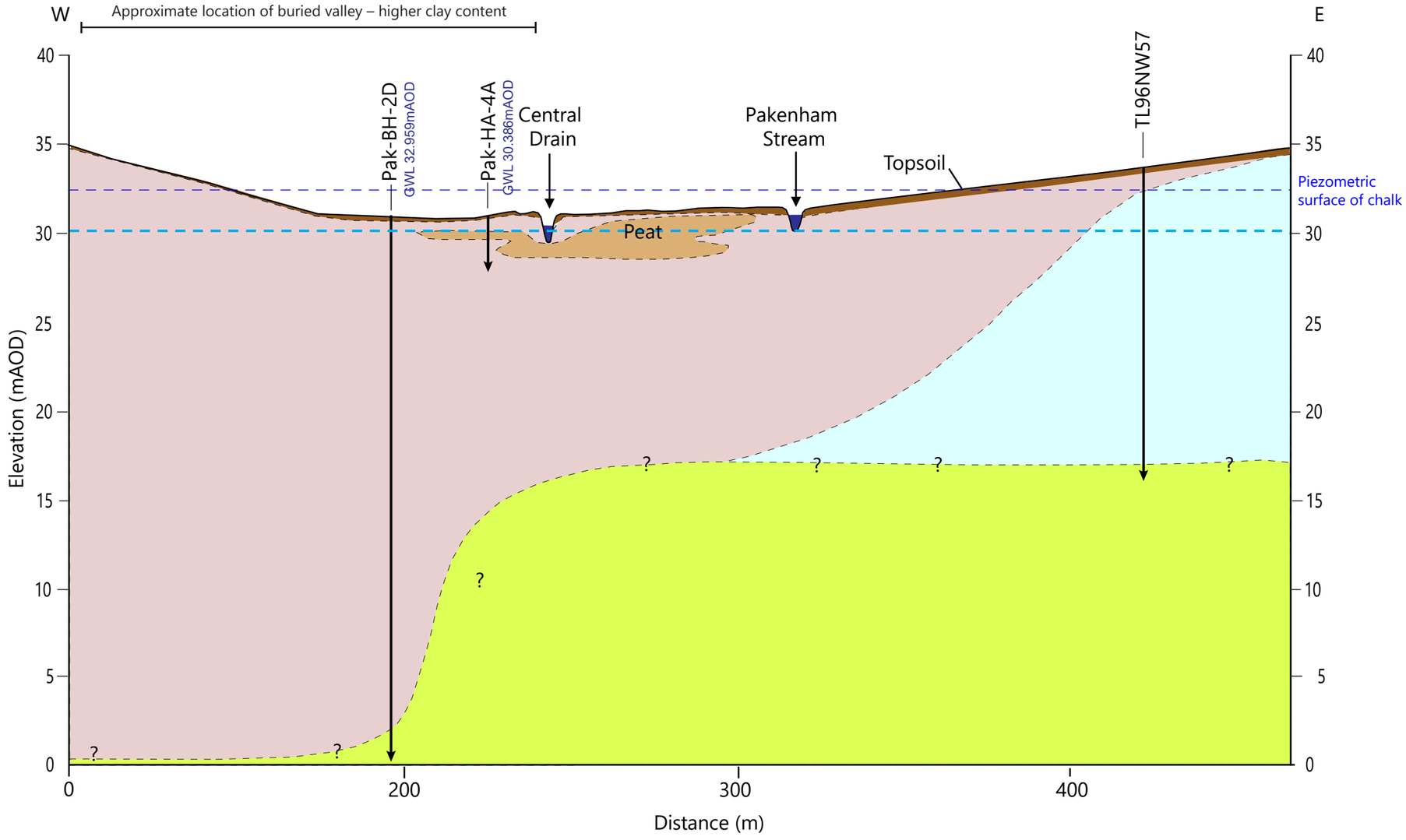
Scale at A3: 1:20,000

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 3.10
Landfills

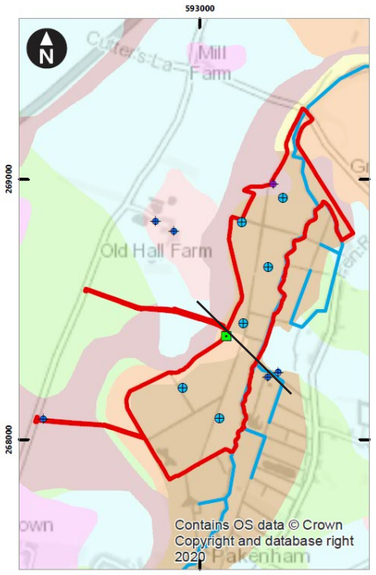
April 2021

wood.



Key

- Topsoil
- Peat
- Till
- Chalk
- Head
- Groundwater level



Not to scale

Fen Meadow Compensation Sites:
Pakenham Site 54
Baseline Hydrogeological Report

Figure 4.1
Schematic cross section

June 2021

wood.

Appendix A
Gaugeboard Installation Report

SIZEWELL C – PAKENHAM FEN INSTALLATION REPORT

TO	[redacted]	**FROM**	[redacted]
DATE	**13 May 2021**	**CONFIDENTIALITY**	**Confidential**
AUTHOR	[redacted]	**REVIEWED**	[redacted]
PROJECT	**70075143 - Sizewell C Hydrometric Monitoring**		
SUBJECT	**SIZEWELL C - FEN MEADOW MONITORING INSTALLATION REPORT – PAKENHAM FEN**		

INTRODUCTION

This report documents the surface water level monitoring installations installed across a potential fen meadow compensation site at Pakenham, Suffolk by WSP and OTT Hydrometry. This programme of works took place over the period 16th – 20th March 2021 and was undertaken as part of the Sizewell C Fen Meadow Strategy, on behalf Wood.

Access routes, monitoring equipment locations, data logger specifications and datum information is presented in this document.

INSTALLATION SUMMARY

Pakenham Fen

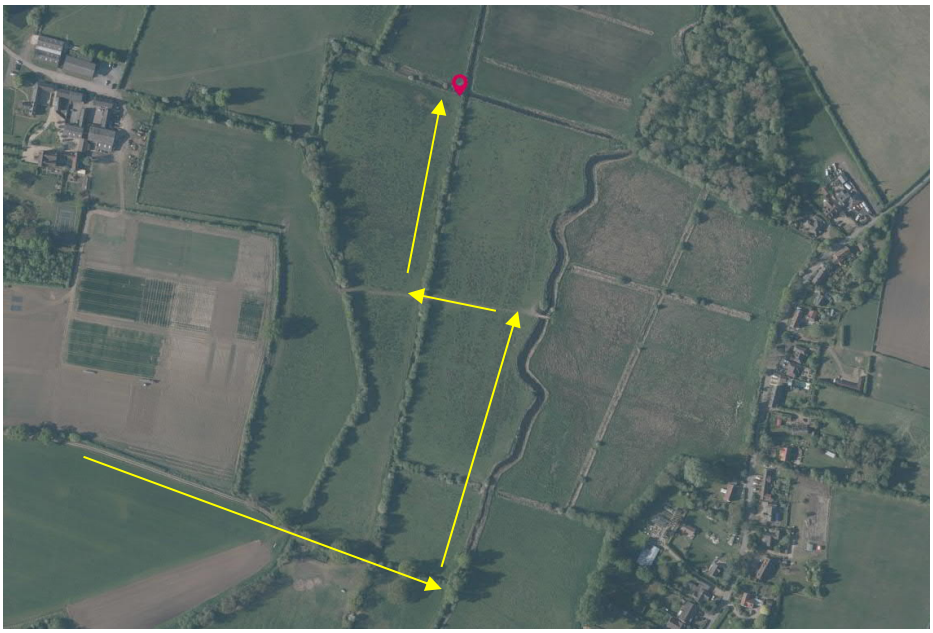
A total of four gaugeboards (of which all 4 include stilling wells and water level data loggers) were installed at Pakenham.

Pakenham Fen				
Ref.	**PAK-GB01**	**PAK-GB02**	**PAK-GB03**	**PAK-GB04**
Grid Ref.	TL 93239 68817	TL 93064 68381	TL 93175 68400	TL 92873 67891
Gaugeboard Length (m)	2	2	2	2
Data Logger	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini	OTT Orpheus Mini
Range (m)	4	4	4	4
Cable Length (m)	4	4	4.5	8.5

PAKENHAM FEN – PAK-GB01

Installation Name: PAK-GB01		
Equipment Installed: OTT Orpheus Mini	**Logging Interval:** 15 minutes	**OS Grid Reference:** TL 93239 68817
Datum Level: 29.027mAOD	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:



Installation Notes: Deep water, stilling well installed vertically attached to footbridge.

PAKENHAM FEN – PAK-GB02

Installation Name: PAK-GB02		
Equipment Installed: OTT Orpheus Mini	**Logging Interval:** 15 minutes	**OS Grid Reference:** TL 93064 68381
Datum Level: 31.2mAOD	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

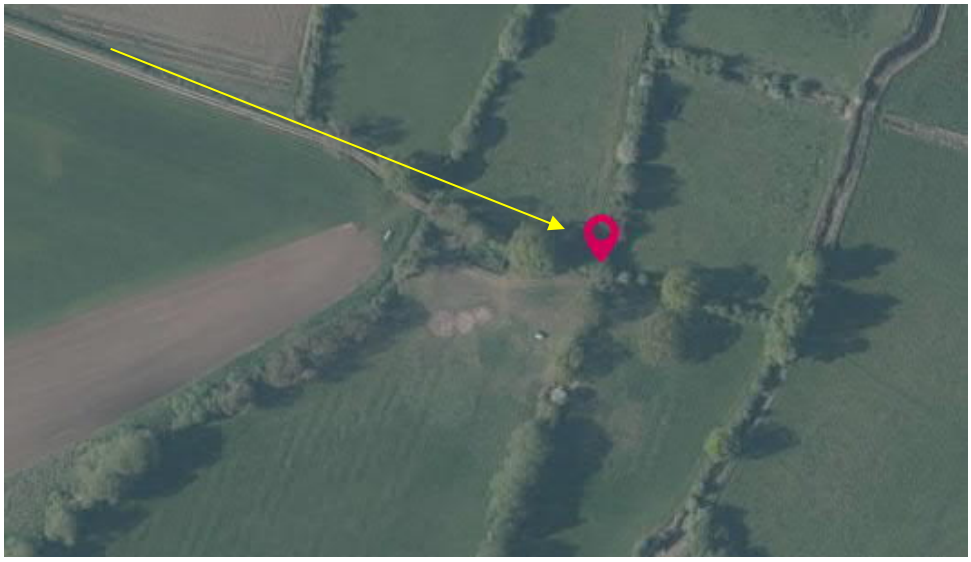
Location Map:

Installation Notes: Stilling well secured to channel bank.

PAKENHAM FEN – PAK-GB03

Installation Name: PAK-GB03		
Equipment Installed: OTT Orpheus Mini	**Logging Interval:** 15 minutes	**OS Grid Reference:** TL 93175 68400
Datum Level: 29.917mAOD	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:



Installation Notes: Deep water, silty bed.

PAKENHAM FEN – PAK-GB04

Installation Name: PAK-GB04		
Equipment Installed: OTT Orpheus Mini	**Logging Interval:** 15 minutes	**OS Grid Reference:** TL 92873 67891
Datum Level: 31.084mAOD	**Datum:** Base of Gaugeboard	**Gaugeboard Length**: 2m

Location Map:

Installation Notes: 8.5m stilling well secured into the bank.

Appendix B
Drilling Logs – Groundwater Monitoring Installations

Your Ref: SZC Fenland Creation Area Pakenham Fen

Our Ref: 735656/AD

Date: 27 April 2021

STRUCTURAL SOILS LTD

SITE INVESTIGATION

SOIL, ROCK & MATERIAL TESTING

GEOTECHNICAL CONSULTANCY

CONTAMINATED LAND ASSESSMENT

Wood Environment & Infrastructure Solutions UK
Block 2, Booths Park,
Knutsford,
Cheshire,
WA16 8QZ

For the attention of Candace Jackson

Dear Sirs,

GROUND INVESTIGATION
SIZEWELL C FENLAND CREATION AREA GROUND INVESTIGATION
PAKENHAM FEN

Introduction

We write to report on the findings of the ground investigation carried out by Structural Soils Limited (SSL) at the above site on the instructions of and on behalf of Wood Environment & Infrastructure Solutions UK Limited (Wood).

The works undertaken included cable percussion boreholes and hand auger exploratory holes, groundwater monitoring well installation and the preparation of this report. The report contains a description of the site and the works carried out, and the exploratory hole logs.

The ground investigation has been carried out in accordance with the contract specification, the general requirements of BS 5930:2015 and other relevant standards.

Site Description

The investigation was undertaken at a single site, approximately 0.5 km north of the village of Pakenham, Suffolk. The British National Grid Reference of the site is TM 931 684.

The site is elongated and irregular in shape, and approximately 1500 m by 445 m in size (at its largest extents) and set at an elevation of approximately 31.0 m above Ordnance Datum (AOD). The site

THE OLD SCHOOL
STILLHOUSE LANE
BEDMINSTER
BRISTOL
BS3 4EB
TEL: 0117 947 1000

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www.soils.co.uk

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Tonbridge
Wigan

Registered No. 828694 England
Registered Office: Spring Lodge, 172 Chester Road, Helsby WA6 0AR

comprises a series of undeveloped interconnected farmland fields, presently pastural, used for cattle grazing, which are crosscut by multiple drainage ditches and bounded on its eastern side by a tributary of the Black Bourn River. The site is generally flat, but locally very gently undulating across its length.

The surrounding area comprises further agricultural land (arable and pastoral) in all directions with sporadic residential properties associated with the land.

Geology

Information on the geology of the site was obtained from the following sources published by the British Geological Survey (BGS):

- BGS map (sheet 189, scale 1:50,000, published 1982).
- The BGS digital geology map, which utilises the most up to date names for geological units (www.bgs.ac.uk/data).
- The BGS Lexicon of Named Rock Units, which provides typical descriptions for most geological units (www.bgs.ac.uk/lexicon).

The site is shown to be largely underlain by Quaternary peat deposits and Head (silt, sand, gravel) overlying the Lewes Nodular Chalk Formation (chalk). Locally, the eastern boundary of the site is shown to be underlain by Diamicton of the Lowestoft Formation (an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays).

Fieldwork

The ground investigation was carried out by SSL between 1 and 19 March 2021. The following works were completed:

- 2 no. cable percussion boreholes up to 37 m depth.
- 7 no. hand auger boreholes up to 3 m depth.
- Construction of protective wooden fencing around the borehole installations
- Construction of protective wooden fencing around gauge board installations
- Modification of an existing electric fence to allow access to a pedestrian footbridge over a stream.

The exploratory hole logs are enclosed. These provide information including the equipment and methods used, water observations and descriptions of the strata encountered. Explanation of the terms and abbreviations used on the logs is given in the Key to Exploratory Hole Records which is also enclosed.

The investigation was supervised by an engineer from SSL. The scope of works and positions were selected by Wood, set out by SSL and adjusted where necessary to take account of buried or overhead services, or other restrictions. The exploratory hole locations are shown on the enclosed Exploratory Hole Location Plans.

The holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1). Detailed descriptions, together with relevant comments, are given on the logs.

In-situ Sampling & Laboratory Testing

No in-situ testing or sampling (other than for on-site logging purposes) was undertaken as a part of this investigation.

Groundwater Monitoring Installations

On completion of the exploratory holes, groundwater monitoring wells were installed as instructed by Wood. The monitoring wells comprised 50 mm diameter (ID) pipes within the boreholes and 19 mm diameter (ID) pipes within the hand auger exploratory holes.

The tables below give details of the ground elevation, pipe elevation and protective cover elevation for each exploratory hole.

Exploratory Hole GPS Survey Data

Exploratory Hole	Measurement Point	Easting	Northing	Elevation	Notes
PAK-BH-1	Cover Level	593282.651	268982.423	32.986	
PAK-BH-1	Ground Level	593282.687	268982.356	31.871	
PAK-BH-1	Pipe Level	593282.598	268982.469	32.629	
PAK-BH2	Cover Level	593102.747	268394.861	33.652	
PAK-BH2	Pipe Level	593102.697	268394.978	33.569	'Deep' Installation
PAK-BH2	Ground Level	593102.642	268394.809	32.222	
PAK-BH2	Pipe Level	593102.675	268394.911	33.361	'Shallow' Installation
PAK-HA1	Cover Level	593319.739	268927.773	31.753	
PAK-HA-1	Ground Level	593319.609	268927.782	30.694	
PAK-HA-1	Pipe Level	593319.738	268927.735	31.662	
PAK-HA-2	Cover Level	593161.079	268834.229	31.656	
PAK-HA-2	Ground Level	593161.022	268834.37	30.654	
PAK-HA-2	Pipe Level	593161.174	268834.224	31.527	
PAK-HA-3	Cover Level	593262.016	268661.66	31.687	
PAK-HA-3	Ground Level	593262.206	268661.738	30.583	
PAK-HA-3	Pipe Level	593261.963	268661.662	31.532	
PAK-HA-4	Ground Level	593173	268424	30.64	Backfilled – no installation
PAK-HA-4A	Cover Level	593168.508	268445.909	32.021	
PAK-HA-4A	Ground Level	593168.775	268446.086	30.934	
PAK-HA-4A	Pipe Level	593168.687	268445.932	31.966	
PAK-HA-5	Cover Level	592935.754	268197.352	31.921	
PAK-HA-5	Ground Level	592935.83	268197.478	30.905	
PAK-HA-5	Pipe Level	592935.716	268197.322	31.817	
PAK-HA-6	Cover Level	593075.133	268079.935	31.685	

Exploratory Hole	Measurement Point	Easting	Northing	Elevation	Notes
PAK-HA-6	Ground Level	593075.233	268079.804	30.747	
PAK-HA-6	Pipe Level	593075.079	268079.916	31.524	

Closing Remarks

All information, comments and opinions given in this report are based on the ground conditions encountered during the investigation.

Whilst every attempt is made to record full details of the strata encountered in the exploratory holes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations and water conditions between or below exploratory holes.

This report was prepared by SSL for the sole and exclusive use of Wood Environment & Infrastructure Solutions UK Limited in response to particular instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded. No liability will be accepted after a period of 6 years from the date of the report.

This concludes our work on this project. If you have any queries please do not hesitate to contact us.

Yours faithfully,
STRUCTURAL SOILS LIMITED

[redacted]

BSc (Hons) FGS.

[redacted]

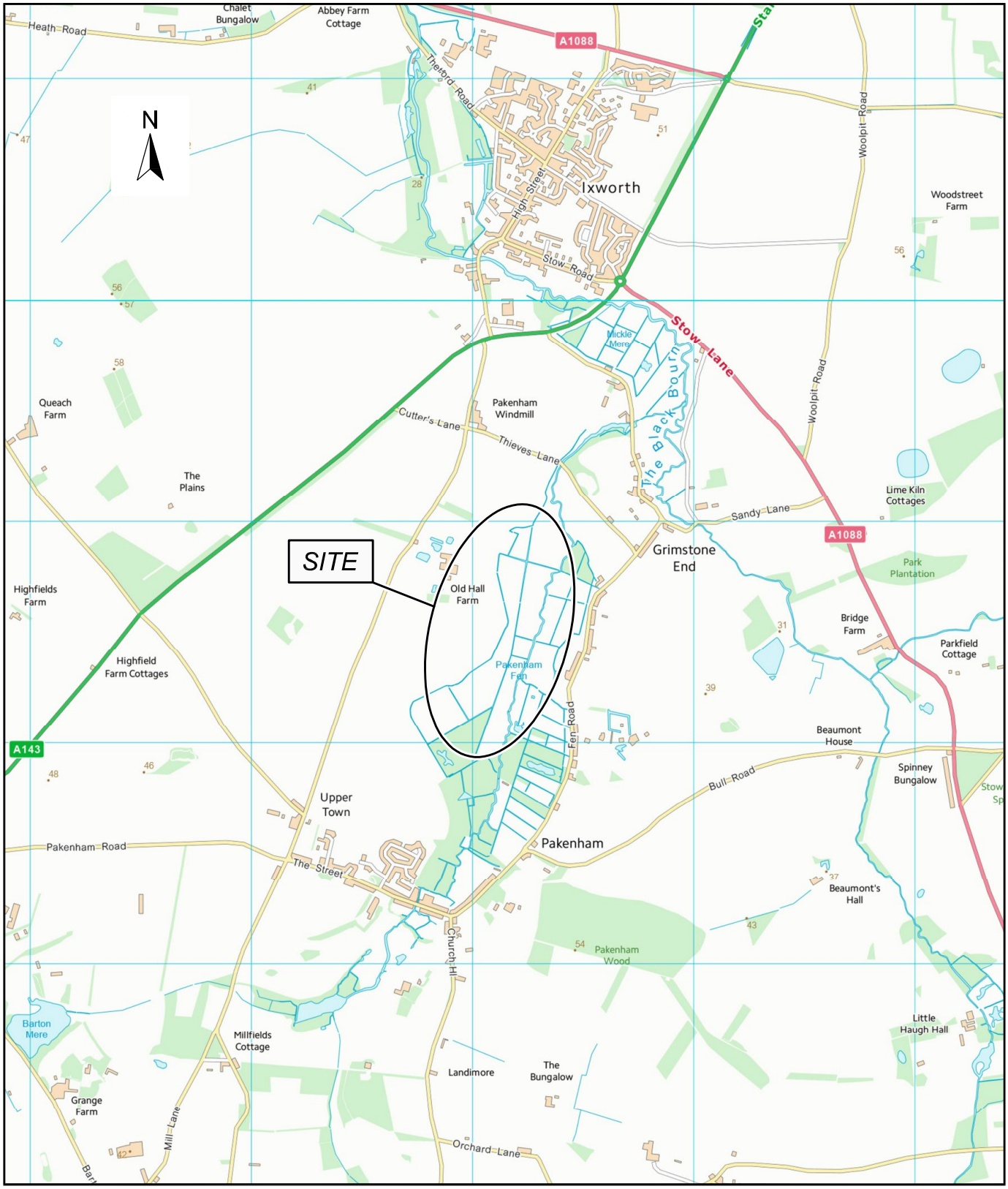
BSc (Hons) MSc CGeol FGS.

References:

1. BS 5930:2015 *Code of practice for ground investigations*
2. British Geological Survey sheet 189, scale 1:50,000, published 1982

Encs:

1. Site Location Plan
2. Exploratory Hole Location Plan
3. Key to Exploratory Hole Logs
4. Borehole Logs
5. Hand Auger Logs



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CLIENT: Wood Environment & Infrastructure Solutions UK Ltd

PROJECT: Sizewell C Fenland Creation Area GI Pakenham Fen

TITLE: SITE LOCATION MAP

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
00	12.04.2021	-	NP	AD	-

DIMENSION	SCALE	DRAWING STATUS
m	1:25,000	-

JOB NO	GRID REF	SCALE BAR	ORIGIN SIZE	FIGURE
735656	TL 931 684	0 250 500 750 1,000m	A4	1

LEGEND

- Hand Auger Location
- Borehole Location

REV	DATE	DESCRIPTION	BY	CHD	APR
00	12.04.2021	-	NP	AD	-

DIMENSION	SCALE	ORIGIN SIZE
m	1:1000	A4

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CLIENT

Wood Environment & Infrastructure Solutions UK Ltd

PROJECT

Sizewell C Fenland Creation Area GI Pakenham Fen

TITLE

EXPLORATORY HOLE LOCATION PLAN

JOB NO	FIGURE
735656	2

DRAWING STATUS	REV
-	00

SCALE BAR

0 10 20 30 40 50m

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF ABBREVIATIONS

ADDITIONAL NOTES

1. All soil and rock descriptions and legends in general accordance with BS EN ISO 14688-1, 14688-2, 14689-1, and BS5930:2015.
2. Material types divided by a broken line (- - -) indicates an unclear boundary.
3. Fracture spacings (If) quoted in the Description of Strata for specific strata or specific fracture sets are also quoted in mm, e.g. (25/80/230) referring to (Min/Avg/Max).
4. The data on any sheet within the report showing the AGS icon is available in the AGS format.

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STRUCTURAL SOILS

Contract Reference: **735656**

KEY TO EXPLORATORY HOLE LOGS - SUMMARY OF GRAPHIC SYMBOLS

WATER COLUMN SYMBOLS

First water strike, second water strike etc.

Standing water level following first strike, standing water level following second strike etc.


Seepage.


Standing water level recorded at documented date.

MATERIAL GRAPHIC LEGENDS


Clayey gravelly SAND


Chalk


Clayey PEAT


Sandy clayey GRAVEL with COBBLES


PEAT


Gravelly sandy CLAY


Sandy gravelly CLAY


Sandy gravelly silty CLAY


Sandy gravelly CLAY with COBBLES


Sandy gravelly silty CLAY with COBBLES


Sandy gravelly SILT


Sandy clayey SILT


Sandy SILT


Topsoil


Silty gravelly SAND


Gravelly silty SAND with COBBLES


Silty gravelly SAND with COBBLES


Silty PEAT


Silty SAND


Silty sandy GRAVEL with COBBLES

INSTRUMENTATION SYMBOLS


Backfill


Bentonite cement pellets


Concrete


Gravel filter


Upstanding cover


Plain pipe


Slotted pipe

GINT_LIBRARY_V10_01.GLB|GrfcText G - LEGEND - 2 OF 2 | 735656-PACKENHAM-FENLAND-CREATION.GPJ - v10_01 | 29/03/21 - 15:32 | AD2
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STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-1**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**10.03.21** End: **10.03.21**	**31.87**	**E:593282.7 N:268982.4**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying brown very silty slightly gravelly fine to medium sand with a low cobble content and frequent rootlets up to 3mm thickness. Gravel is angular to subangular medium to coarse of flint. Cobbles are angular flint up to 70 mm.	31.57	0.30	
						Multicoloured (brown, yellowish brown, dark brown) very silty gravelly fine SAND with a low cobble content. Gravel is subangular to rounded fine to medium flints. Cobbles are angular to subangular flints up to 90mm across. (HEAD)	30.97	(0.60) 0.90	
						Yellowish brown mottled greyish brown silty very gravelly fine to coarse SAND. Gravel is angular to subangular fine to coarse of flints. (HEAD)	27.97	(3.00) 3.90	
						Stiff becoming very stiff dark grey slightly sandy gravelly CLAY with a low cobble content. Sand is fine to coarse. Gravels is angular to subangular fine to coarse of chalk and flints. Cobbles are angular flints up to 78mm across. (HEAD)	26.87	(1.10) 5.00	
						Terminated at design depth of 5.00m			

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
10/03/21		5.00	5.00	150	Dry

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. Soil 'damp' below 2.70m depth.
5. 50mm diameter water monitoring pipe installed

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	AGS

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-1**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**10.03.21** End: **10.03.21**	**31.87**	**E:593282.7 N:268982.4**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

on completion.

6. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**03.03.21** End: **08.03.21**	**32.22**	**E:593102.6 N:268394.8**	**1** of **5**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Dark brown very silty gravelly fine to medium SAND. Gravel is subrounded to subangular fine to coarse of flint.	31.92	0.30	
						Dark brown gravelly slightly silty SAND with a medium cobble content. Gravel is subrounded to subangular fine to coarse of flint. Cobbles are subangular to angular flint fragments up to 120mm across. (HEAD)	31.72	0.50 (1.00)	
						Orangish brown slightly silty sandy fine to coarse GRAVEL with a medium cobble content. Sand is fine to coarse. Cobbles are subrounded to subangular of mixed lithologies up to 130mm across. (HEAD)	30.72	1.50	
						Firm greenish grey sandy gravelly CLAY with occasional lenses of fine sand up to 120mm x 80mm. Sand is fine to coarse. Gravel is rounded to subangular fine to coarse of mixed lithologies predominantly chalk. (HEAD)		(1.40)	
						Stiff becoming very stiff grey slightly silty sandy gravelly CLAY with a low cobble content, and occasional shell fragments up to 10mm x 5mm. Sand is fine to coarse. Gravel is rounded to subangular fine to coarse of mixed lithologies predominantly weak chalk and flint. Cobbles are subrounded weak chalk up to 88mm across. (HEAD)	29.32	2.90 (7.50)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
03/03/21		17.60	15.00	200	Dry
04/03/21		17.60	15.00	200	17.50
04/03/21	13:40	24.90	-	150	24.90
04/03/21	14:00	24.90	-	150	15.80
04/03/21		28.50	28.50	150	13.60
05/03/21		27.90	28.50	150	-

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. Dual 50mm diameter water monitoring pipes installed on completion.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**03.03.21** End: **08.03.21**	**32.22**	**E:593102.6 N:268394.8**	**2** of **5**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Stiff becoming very stiff grey slightly silty sandy gravelly CLAY with a low cobble content, and occasional shell fragments up to 10mm x 5mm. Sand is fine to coarse. Gravel is rounded to subangular fine to coarse of mixed lithologies predominantly weak chalk and flint. Cobbles are subrounded weak chalk up to 88mm across. (HEAD) *(stratum copied from 2.90m from previous sheet)*			
							21.82	10.40	
						Very stiff grey slightly silty slightly sandy very gravelly CLAY with a low cobble content. Sand is medium to coarse. Gravel is rounded to subrounded fine to coarse predominantly fine to medium of flint, chalk and mudstone. Cobbles are subrounded flints up to 120mm (HEAD)		(7.80)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

5. 1.5m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**03.03.21** End: **08.03.21**	**32.22**	**E:593102.6 N:268394.8**	**3** of **5**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Very stiff grey slightly silty slightly sandy very gravelly CLAY with a low cobble content. Sand is medium to coarse. Gravel is rounded to subrounded fine to coarse predominantly fine to medium of flint, chalk and mudstone. Cobbles are subrounded flints up to 120mm (HEAD) *(stratum copied from 10.40m from previous sheet)*			
							14.02	18.20	
						Very stiff grey slightly silty slightly sandy very gravelly CLAY with a low cobble content and occasional pockets of fine sand up to 30mm x 10mm . Sand is fine to medium. Gravel is surrounded to subangular fine to coarse of oollitic limestone, chalk and flints. Cobbles are subrounded to subangular flints and chalks up to 70mm across (HEAD)		(6.70)	
				1			7.32	24.90	
						Stiff to very stiff greenish grey very sandy gravelly silty CLAY with occasional lenses of yellowish green fine silty sand up to 30mm x 15mm. Sand is fine to coarse. Gravel is subangular to	6.92	25.30	

Boring Progress and Water Observations						Chiselling / Slow Progress			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**03.03.21** End: **08.03.21**	**32.22**	**E:593102.6 N:268394.8**	**4** of **5**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						rounded fine to coarse of chalk and flints. (HEAD)			
						Greyish brown very sandy clayey fine to coarse angular GRAVEL of mixed lithologies with a medium cobble content. Sand is fine to coarse. Cobbles are angular to subangular flints up to 130mm across. (HEAD)	5.72	(1.20) 26.50	
						(stratum copied from 25.30m from previous sheet) Stiff to very stiff greenish grey very sandy gravelly silty CLAY with a high cobble content and occasional lenses of yellowish green fine silty sand up to 30mm x 15mm. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of chalk and flints. Cobbles are angular flints up to 120mm across (HEAD)		(4.30)	
						Structureless CHALK composed of firm greyish white sandy gravelly SILT with a medium cobble content. Sand is fine to coarse chalk. Gravel is angular fine to coarse lumps of weak chalk with occasional black specks and flints. Cobbles are angular flints up to 105mm across. (Grade Dm) (LEWES NODULAR CHALK FORMATION)	1.42	30.80 (6.20)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
	Dando 2000	**D Hubbard**	**KBooker**	[redacted]

STRUCTURAL SOILS

FINAL

BOREHOLE LOG

Contract:	Client:	Borehole:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-BH-2**

Contract Ref:	Start:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**03.03.21** End: **08.03.21**	**32.22**	**E:593102.6 N:268394.8**	**5** of **5**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						Structureless CHALK composed of firm greyish white sandy gravelly SILT with a medium cobble content. Sand is fine to coarse chalk. Gravel is angular fine to coarse lumps of weak chalk with occasional black specks and flints. Cobbles are angular flints up to 105mm across. (Grade Dm) (LEWES NODULAR CHALK FORMATION) *(stratum copied from 30.80m from previous sheet)*	-4.78	37.00	
						Borehole terminated at 37.00m			

Boring Progress and Water Observations						Chiselling / Slow Progress			General Remarks
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth	From	To	Duration (hh:mm)	

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used: **Dando 2000**	Drilled By: **D Hubbard**	Logged By: **KBooker**	Checked By:

FINAL

STRUCTURAL SOILS

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-1**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**10.03.21**	**30.69**	**E:593319.6 N:268927.8**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying dark brown silty clayey amorphous PEAT with frequent rootlets up to 5mm thickness.	30.39	(0.30) 0.30	
						Spongy black silty pseudo-fibrous PEAT with pockets of medium to coarse sand up to 8mm x 10mm and shell fragments up to 5mm x 7mm. Strong putrid organic smell. (PEAT)	30.19	0.50	
						Firm brown silty fibrous PEAT with frequent gastropod shells 4mm x 3mm. (PEAT)	29.99	0.70	
						Spongy becoming plastic dark brown silty pseudo-fibrous PEAT with pockets of brown fibrous peat and intact gastropod shells up to 5mm x 6mm. (PEAT)		(2.30)	
						Hand auger terminated at 3.00m depth.	27.69	3.00	

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. 19mm diameter water monitoring pipe installed on completion.
5. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**KBooker**	[redacted]

AGS

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-2**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**08.03.21**	**30.65**	**E:593161.0 N:268834.4**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying dark brown very clayey PEAT with frequent rootlets up to 5mm thickness.	30.55	0.10	
				≈		Plastic dark brown pseudo-fibrous clayey PEAT with pockets of sandy silt up to 160mm x140mm and shell fragments. Sand is fine to medium. Strong putrid organic odour. (PEAT)		(0.70)	
				2			29.85	0.80	
						Spongy becoming firm brown slightly silty fibrous PEAT. Strong putrid organic odour. (PEAT)		(2.20)	
							27.65	3.00	
						Hand auger terminated at 3.00m			

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. 19mm diameter water monitoring pipe installed on completion.
5. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**KBooker**	[redacted]

AGS

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-3**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**09.03.21**	**30.58**	**E:593262.2 N:268661.7**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying dark brown sandy peaty gravelly SILT with frequent rootlets up to 4mm thickness. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed lithologies.	30.43	0.15	
						Soft to firm dark brown sandy peaty gravelly SILT. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed lithologies. (HEAD)	30.03	(0.40) 0.55	
				1		Firm becoming spongy slightly sandy silty pseudo-fibrous PEAT with frequent gastropod and bivalve shells up 7mm x 4mm . sand is fine to medium. Strong putrid organic odour. (PEAT)	27.58	(2.45) 3.00	
						Hand auger terminated at 3.00m depth.			

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. Groundwater seepage at 0.55m depth.
5. 19mm diameter water monitoring pipe installed on completion.
6. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**KBooker**	

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-4**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**09.03.21**	**30.64**	**E:593173.0 N:268424.0**	**1** of **1**

Samples and In-situ Tests				Water	Backfill	Description of Strata	Reduced Level	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results						
						Grass overlying dark brown very silty fine to coarse SAND with frequent rootlets up to 4mm thickness.	30.49	0.15	
						Dark brown very gravelly silty fine to coarse SAND with a medium cobbles content. Gravel is angular to subrounded flints . Cobbles are angular flints up to 170mm. (HEAD)	30.04	(0.45) 0.60	
						Brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flints. (HEAD)	29.74	(0.30) 0.90	
						Brownish white sandy carbonaceous SILT. Sand is fine. (Possible re-worked / weathered chalk). (HEAD)	28.54	(1.20) 2.10	
						Hand auger terminated at 2.10m depth due to presense of silt material.			

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. Exploratory hole backfilled on completion.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand tools**	**KBooker**	[redacted]

FINAL

STRUCTURAL SOILS

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-4A**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**09.03.21**	**30.93**	**E:593168.8 N:268446.1**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying dark brown sandy SILT with frequent rootlets up to 4mm thickness. Sand is fine to coarse.	30.83	0.10	
						Dark brown slightly gravelly peaty SILT with occasional gastropod shell fragments. Gravel is angular fine to coarse fine to coarse flints. (HEAD)	30.33	(0.50) 0.60	
				≈ 1 ▼		Spongy dark brown amorphous PEAT with occasional shell fragments. Strong putrid organic odour. (PEAT)	30.03	(0.30) 0.90	
						Brownish white sandy SILT. Sand is fine to medium chalk. (Possible re-worked / weathered chalk) (HEAD)	29.28	(0.75) 1.65	
						Spongy dark brown amorphous PEAT with occasional shell fragments up to 5mm x 7mm.Strong putrid organic odour. (PEAT)	29.08	1.85	
						Greyish brown silty fine to coarse SAND with occasional gastropod shell fragments up to 2mm x 3mm. (HEAD)	28.93	2.00	
						Hand auger terminated at 2.00m depth due to difficulties hand augering the material.			

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 0.90 m depth.
4. 19mm diameter water monitoring pipe installed on completion.
5. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**KBooker**	[redacted]

FINAL

STRUCTURAL SOILS

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-5**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**02.03.21**	**30.91**	**E:592935.8 N:268197.5**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying very sandy slightly gravelly SILT with frequent rootlets up to 3mm thickness. Sand is fine to medium. Gravel is subrounded medium to coarse of flint.	30.71	0.20	
						Soft multicoloured (brown, greenish grey, reddish brown) sandy slightly gravelly CLAY with frequent gastropod shells fragments and occasional rootlets. Sand is fine to coarse. Gravel is subrounded medium to coarse flint. (HEAD)	30.41	(0.30) 0.50	
						Spongy dark brown clayey pseudo-fibrous PEAT with pockets of fine to medium sand. Strong organic odour. (HEAD)	30.11	(0.30) 0.80	
						Dark greyish brown slightly clayey gravelly fine to coarse SAND with a low medium content. Gravel is subrounded to subangular fine to coarse flint. Cobbles are subangular to subrounded flint up to 89mm (HEAD)	29.01	(1.10) 1.90	
						Light grey very silty slightly gravelly fine to medium SAND. Gravel is angular to subangular flints. (HEAD)	28.77	2.14	
						Hand auger terminated at 2.14m - unable to continute hand auger due to stiff clay and gravels.			

General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. 19mm diameter water monitoring pipe installed on completion.
5. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**BKitchiner**	

STRUCTURAL SOILS

FINAL

HAND AUGER LOG

Contract:	Client:	Position:
Packenham Fenland Creation	**Wood Environment & Infrastructure**	**PAK-HA-6**

Contract Ref:	Date:	Ground Level (m AOD):	National Grid Co-ordinate:	Sheet:
735656	**04.03.21**	**30.75**	**E:593075.2 N:268079.8**	**1** of **1**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Reduced Level	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results						
						. . . Ground level: Log shows extended upstanding cover.			
						Grass overlying dark brown very sandy clayey SILT with frequent rootlets up to 7mm in thickness and frequent gastropod shell fragments. Sand is fine to medium.	30.65	0.10	
						Dark brown very clayey sandy gravelly SILT with occasional rootlets. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed lithologies. (HEAD)		(0.30)	
						Plastic dark brownish black clayey amorphous PEAT with frequent gastropod shell fragments. Strong organic putrid smell. (PEAT)	30.35	0.40	
								(2.60)	
						Hand auger terminated at 3.00m depth.	27.75	3.00	

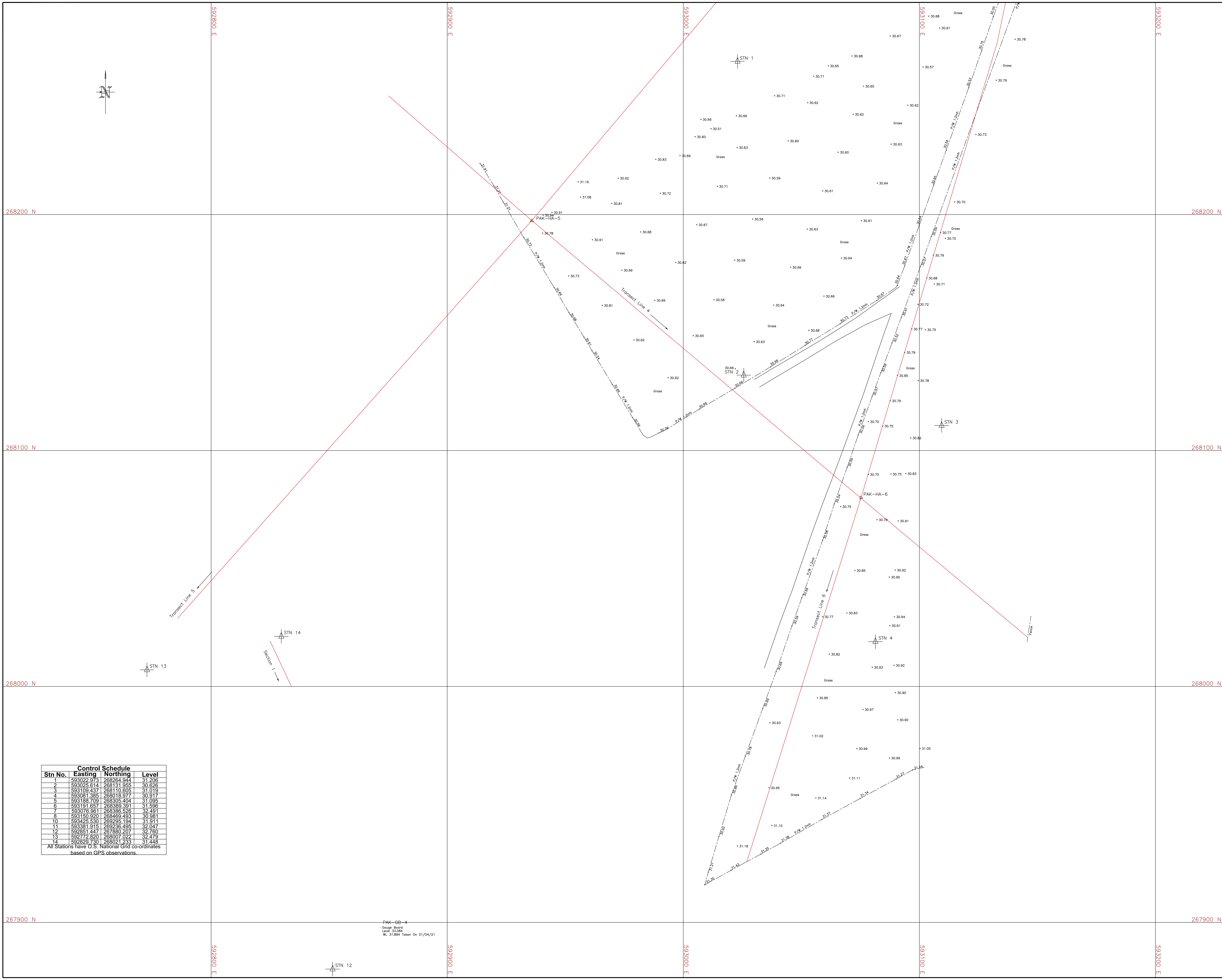
General Remarks

1. PAS128 Survey undertaken prior to commencement of works.
2. Position scanned with a CAT and Genny by SSL Engineer prior to excavation.
3. Inspection pit hand dug to 1.20 m depth.
4. 19mm diameter water monitoring pipe installed on completion.
5. 1m tall upstanding cover and wooden protective fencing installed on completion of works.

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Logged By:	Checked By:
Hand excavation	**Hand auger**	**BKitchiner**	

Appendix C
Topographic Survey Results



Control Schedule			
Stn No.	Easting	Northing	Level
1	593022.973	268264.944	31.206
2	593025.614	268131.955	30.626
3	593109.437	268110.605	31.019
4	593081.385	268018.977	30.917
5	593188.709	268305.404	31.095
6	593191.657	268389.391	31.596
7	593076.961	268386.526	32.491
8	593150.920	268469.493	30.981
10	593425.530	269295.194	31.911
11	593381.915	269236.495	32.047
12	592851.447	267880.207	32.760
13	592772.820	268007.022	32.479
14	592829.730	268021.233	31.448

All Stations have O.S. National Grid co-ordinates based on GPS observations.

CONTROL DATA

Survey stations — STN
Boundary posts — BP

LEVEL DATA

Spot levels +43.62
Contours 43
Steep slopes

TREES

1,4,7 Girth (Circumference) , spread (radius), height
Cmp Clump
Trees shown on this drawing have been identified to the best of the surveyors' ability. Where guaranteed identification of tree species may become important in the project design we would strongly recommend that the services of a specialist arboriculturist be employed. It should be noted that Randall Surveys LLP are not specialists in the field of tree identification.

Datum used : Newlyn. All units are metric.

FEATURES

Fences shown thus
Walls shown thus
Hedges shown thus
Undefined Boundary
Gates

FENCE TYPES

B/W	Barbed wire	I/R	Iron railing
C/B	Close boarded	P/F	Picket fence
C/I	Corrugated iron	P/R	Post and rail
C/L	Chain link	P/W	Post and wire
C/P	Chestnut paling	W/F	Wooden fence
C/W	Chicken Wire		

OVERHEAD CABLES

British Telecom
Electric

ABBREVIATIONS

AV Air valve	EP Electricity pole	RE Rodding eye
BB Beleisha beacon	ER Earth rod	Ret. Retaining
BD Back drop	FB Flower bed	RS Road sign
BH Borehole	FE Final effluent	RWP Rain water pipe
Bol Bollard	FH Fire hydrant	SC Stop cock
BT British Telecom cover	FL Floodlight	SL Sump level
BTJB BT junction box	G Gulley	SP Sign post
CATV Cable TV cover	GV Gas valve	ST Stand pipe
CDP Cable draw pit	IC Inspection cover	SV Stop valve
CH Chamber	IL Invert level	SVP Soil vent pipe
CL Cover level	JB Junction box	TCB Telephone call box
CM Cable marker	KO Kerb outlet	TCP Tactile paving
CNF Could not find	LP Lamp post	TL Traffic light
CNL Could not lift	MH Manhole	TP Telegraph pole
CNT Could not trace	Mkr Marker	TPL Top of pipe level
CPL Coping level	NB Name board	TS Traffic signal
DC Drainage Channel	OF Outfall	VP Vent pipe
DK Drop kerb	PB Post box	WL Weir level
EJB Elec. junction box	PM Parking meter	WO Washout
EOR End of record	PS Paving slabs	WM Water meter
EOT End of trace	RC Rising cable	WSC Water stop cock

IMPORTANT NOTES

The details and information shown hereon relating to underground drains, cables etc, are as obtained by normal field survey observations subject to the restrictions listed in the NJHSC guidelines. Service Co. and sewer records will only have been consulted on specific request and, although all reasonable effort will have been made, no guarantee of accuracy of these records can be given.

Sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be guaranteed. Where precise sewer details will be critical to the project design we would recommend that entry into the chamber be undertaken using a specialist team, appropriately qualified for confined space entry. These teams can be supplied upon request.

The pipe and cable routes shown on this drawing have been located using electronic surface detection equipment and/or ground penetrating radar, no trial holes have been dug in order to confirm their presence and position. Whilst the information presented is believed to be correct at the time of the survey due care must be taken when any excavation is undertaken on the site. Trace depths are quoted in metres.

The portrayal of a service on this drawing may indicate the presence of multiple cables/pipes. The exact number will only be indicated where this could be accurately determined.

Hatching denotes an area containing possible services which could not be traced electronically or by GPR, where used, but have been abstracted from service drawings.

The plan position and depth of any service portrayed on this drawing is accurate to +/- 10% of the depth of that service.

Where the precise location and/or depth of a service is critical to design and/or construction, trial holes are recommended to confirm the details provided on this drawing.

This drawing should be read in conjunction with any record drawings available from the statutory authorities.

UNDERGROUND SERVICES

Foul Sewer
Surface Water Sewer
Combined Sewer
Overflow Sewer
Undetermined Sewer

SHEET LAYOUT

1
2
3

NOTES

1. Survey Grid is O.S. National Grid.
2. Levels are related to the O.S. National GPS network.

SCALE	1/500	DRAWN	JJD
DATE	April 2021	CHECKED	DRD

PLAN PRODUCTION BY

RANDALL SURVEYS LLP

SURVEY & DESIGN CENTRE
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Land and Hydrographic Surveyors
Architectural Building Surveyors
Underground Services Location

THE SURVEY ASSOCIATION
ISO 9001 REGISTERED FIRM
RICS

RANDALL SURVEYS Dwg No. 16313/JD/1

anglianwater
TECHNOLOGY GROUP
Thorpe Wood House, Thorpe Wood, Peterborough
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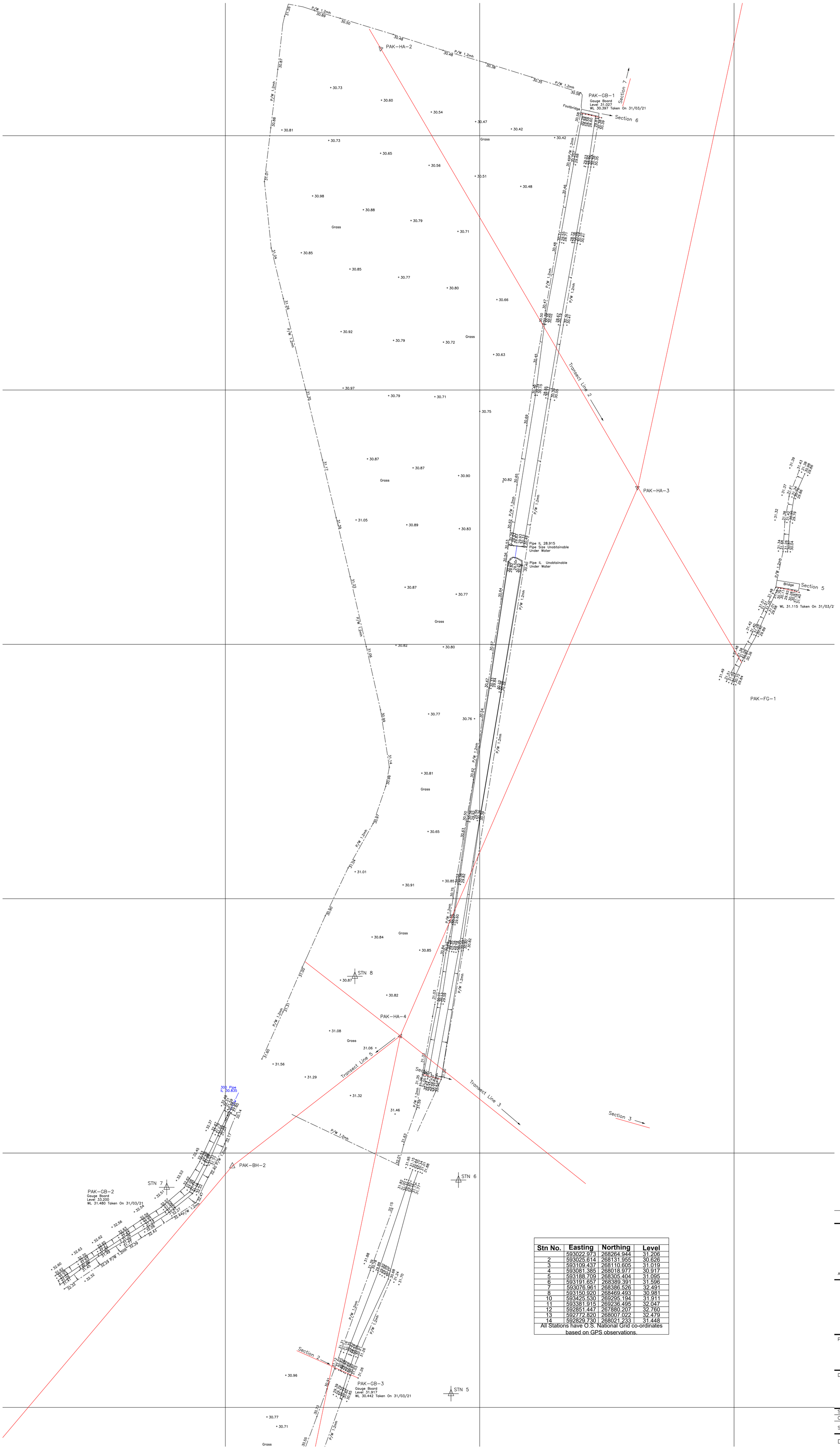
PROJECT TITLE

PAKENHAM FEN

DRAWING TITLE

EXISTING SITE LAYOUT

SURVEYED SURVEYED	DRAWN DRAWN	DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD	DATE DATE
SCALE SCALE A0		OCD CODE OCD_CODE
DRAWING No:– DRAWING_NO		REV REV



Stn No.	Easting	Northing	Level
	593022.973	268264.944	31.206
2	593025.614	268131.955	30.626
3	593109.437	268110.605	31.019
4	593081.385	268018.977	30.917
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10	593425.530	269295.194	31.911
11	593381.915	269236.495	32.047
12	592851.447	267880.207	32.760
13	592772.820	268007.022	32.479
14	592829.730	268021.233	31.448

All Stations have O.S. National Grid co-ordinates based on GPS observations.

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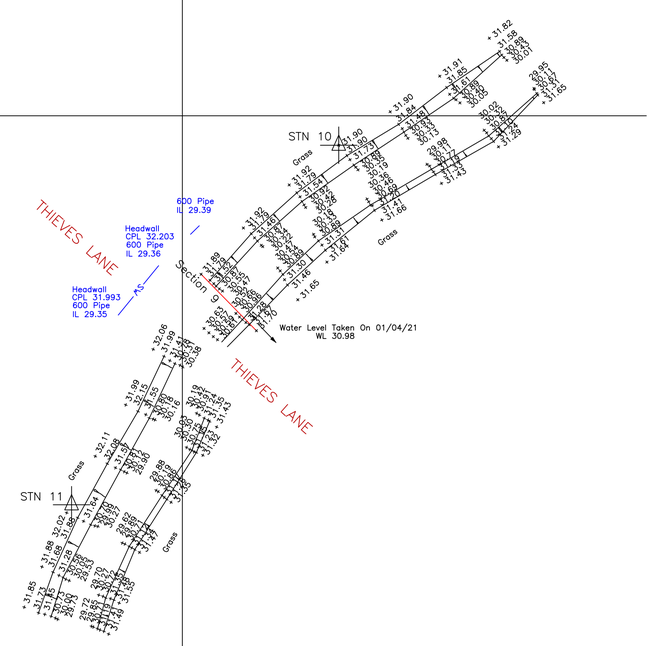
PROJECT TITLE

DRAWING TITLE

SURVEYED SURVEYED	DRAWN DRAWN		DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD		DATE DATE
SCALE SCALE	A0	OCD CODE OCD_CODE	
DRAWING No:– DRAWING_NO			REV REV



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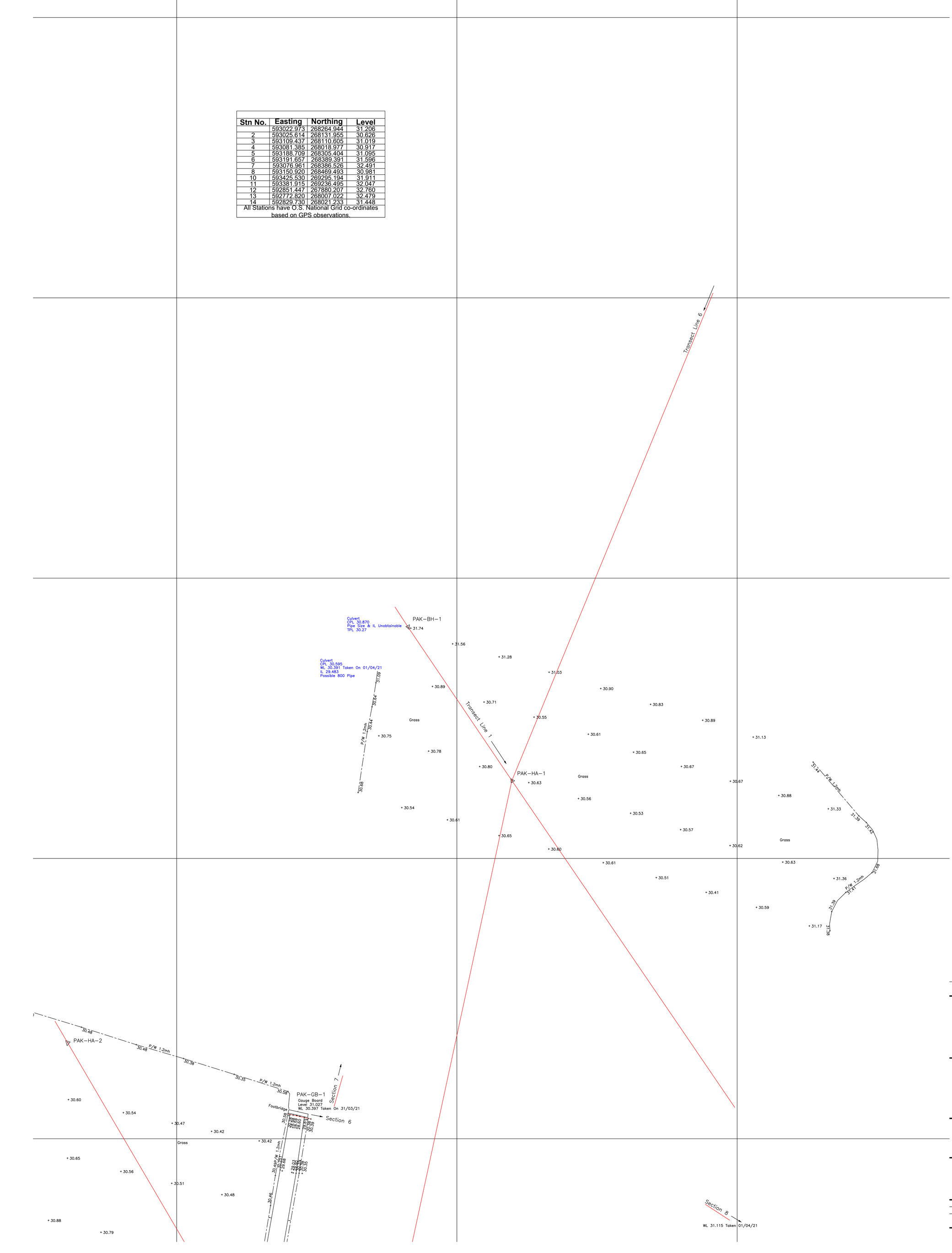

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PROJECT TITLE

DRAWING TITLE

SURVEYED SURVEYED	DRAWN DRAWN		DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD		DATE DATE
SCALE SCALE	AO	OCD CODE	OCD_CODE

DRAWING No:– DRAWING_NO REV REV

CONTROL DATA

Survey stations STN
Boundary posts BP

LEVEL DATA

Spot levels +43.62
Contours 43
Steep slopes

TREES

1,4,7 Girth (Circumference) , spread (radius), height

Trees shown on this drawing have been identified to the best of the surveyors' ability. Where guaranteed identification of tree species may become important in the project design we would strongly recommend that the services of a specialist arboriculturist be employed. It should be noted that Randall Surveys LLP are not specialists in the field of tree identification.

Datum used : Newlyn. All units are metric.

FEATURES

Fences shown thus
Walls shown thus
Hedges shown thus
Undefined Boundary
Gates

FENCE TYPES

B/W	Barbed wire	I/R	Iron railing
C/B	Close boarded	P/F	Picket fence
C/I	Corrugated iron	P/R	Post and rail
C/L	Chain link	P/W	Post and wire
C/P	Chestnut paling	W/F	Wooden fence
C/W	Chicken Wire		

OVERHEAD CABLES

British Telecom
Electric

ABBREVIATIONS

AV Air valve
BB Beleisha beacon
BD Back drop
BH Borehole
Bol Bollard
BT British Telecom cover
BTJB BT junction box
CATV Cable TV cover
CDP Cable draw pit

CL Cover level
CM Cable marker
CNF Could not find
CNL Could not lift
CNT Could not trace
CPL Coping level
DC Drainage Channel
DK Drop kerb
EJB Elec. junction box
EOR End of record
EOT End of trace

EP Electricity pole
ER Earth rod
FB Flower bed
FE Final effluent
FH Fire hydrant
FL Floodlight
G Gulley
GV Gas valve
IC Inspection cover
IL Invert level
JB Junction box
KO Kerb outlet
LP Lamp post
MH Manhole
Mkr Marker
NB Name board
OF Outfall
PB Post box
PM Parking meter
PS Paving slabs
RC Rising cable

RE Rodding eye
Ret. Retaining
RS Road sign
RWP Rain water pipe
SC Stop cock
SL Sump level
SP Sign post
ST Stand pipe
SV Stop valve
SVP Soil vent pipe
TCB Telephone call box
TCP Tactile paving
TL Traffic light
TP Telegraph pole
TPL Top of pipe level
TS Traffic signal
VP Vent pipe
WL Weir level
WO Washout
WM Water meter
WSC Water stop cock

IMPORTANT NOTES

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Sewer and manhole details shown on this drawing have been obtained by observation and measurement from the surface and as such cannot be guaranteed. Where precise sewer details will be critical to the project design we would recommend that entry into the chamber be undertaken using a specialist team, appropriately qualified for confined space entry. These teams can be supplied upon request.

The pipe and cable routes shown on this drawing have been located using electronic surface detection equipment and/or ground penetrating radar, no trial holes have been dug in order to confirm their presence and position. Whilst the information presented is believed to be correct at the time of the survey due care must be taken when any excavation is undertaken on the site. Trace depths are quoted in metres.

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NOTES

2. Refer to Dwg No.s 16313/JD/1 - 3 for the topographic survey and section locations.

SCALE	1/100 Hz 1/100 Vt	DRAWN	JJD
DATE	April 2021	CHECKED	DRD

LLP

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Land and Hydrographic Surveyors
Architectural Building Surveyors
Underground Services Location

ISO 9001 REGISTERED FIRM

RANDALL SURVEYS Dwg No. 16313/JD/4

anglianwater

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PROJECT TITLE

PAKENHAM FEN

DRAWING TITLE

CROSS SECTIONS 1 – 9

SURVEYED SURVEYED	DRAWN DRAWN	DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD	DATE DATE
SCALE SCALE	A0	OCD CODE OCD_CODE

DRAWING No:– DRAWING_NO REV REV

CONTROL DATA

Survey stations — STN
Boundary posts — BP

LEVEL DATA

Spot levels +43.62
Contours — 43 —
Steep slopes

TREES

1,4,7 Girth (Circumference) , spread (radius), height

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Datum used : Newlyn. All units are metric.

FEATURES

Fences shown thus
Walls shown thus
Hedges shown thus
Undefined Boundary
Gates

FENCE TYPES

B/W	Barbed wire	I/R	Iron railing
C/B	Close boarded	P/F	Picket fence
C/I	Corrugated iron	P/R	Post and rail
C/L	Chain link	P/W	Post and wire
C/P	Chestnut paling	W/F	Wooden fence
C/W	Chicken Wire		

OVERHEAD CABLES

British Telecom
Electric

ABBREVIATIONS

AV Air valve	EP Electricity pole	RE Rodding eye
BB Beleisha beacon	ER Earth rod	Ret. Retaining
BD Back drop	FB Flower bed	RS Road sign
BH Borehole	FE Final effluent	RWP Rain water pipe
Bol Bollard	FH Fire hydrant	SC Stop cock
BT British Telecom cover	FL Floodlight	SL Sump level
BTJB BT junction box	G Gulley	SP Sign post
CATV Cable TV cover	GV Gas valve	ST Stand pipe
CDP Cable draw pit	IC Inspection cover	SV Stop valve
	IL Invert level	SVP Soil vent pipe
CL Cover level	JB Junction box	TCB Telephone call box
CM Cable marker	KO Kerb outlet	TCP Tactile paving
CNF Could not find	LP Lamp post	TL Traffic light
CNL Could not lift	MH Manhole	TP Telegraph pole
CNT Could not trace	Mkr Marker	TPL Top of pipe level
CPL Coping level	NB Name board	TS Traffic signal
DC Drainage Channel	OF Outfall	VP Vent pipe
DK Drop kerb	PB Post box	WL Weir level
EJB Elec. junction box	PM Parking meter	WO Washout
EOR End of record	PS Paving slabs	WM Water meter
EOT End of trace	RC Rising cable	WSC Water stop cock

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This drawing should be read in conjunction with any record drawings available from the statutory authorities.

NOTES

2. Refer to Dwg No.s 16313/JD/1 - 3 for the topographic survey and section locations.

SCALE	1/500 Hz 1/100 Vt	DRAWN	JJD
DATE	April 2021	CHECKED	DRD

LLP

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Underground Services Location

ISO 9001 REGISTERED FIRM

RANDALL SURVEYS Dwg No. 16313/JD/5

anglianwater

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PROJECT TITLE

PAKENHAM FEN

DRAWING TITLE

TRANSECTS 1 – 4

SURVEYED SURVEYED	DRAWN DRAWN	DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD	DATE DATE

SCALE SCALE	A0	OCD CODE OCD_CODE

DRAWING No:– DRAWING_NO — REV REV

CONTROL DATA

Survey stations — STN
Boundary posts — BP

LEVEL DATA

Spot levels +43.62
Contours — 43 —
Steep slopes

TREES

1,4,7 Girth (Circumference) , spread (radius), height

Trees shown on this drawing have been identified to the best of the surveyors' ability. Where guaranteed identification of tree species may become important in the project design we would strongly recommend that the services of a specialist arboriculturist be employed. It should be noted that Randall Surveys LLP are not specialists in the field of tree identification.

Datum used : Newlyn. All units are metric.

FEATURES

Fences shown thus
Walls shown thus
Hedges shown thus
Undefined Boundary
Gates

FENCE TYPES

B/W	Barbed wire	I/R	Iron railing
C/B	Close boarded	P/F	Picket fence
C/I	Corrugated iron	P/R	Post and rail
C/L	Chain link	P/W	Post and wire
C/P	Chestnut paling	W/F	Wooden fence
C/W	Chicken Wire		

OVERHEAD CABLES

British Telecom
Electric

ABBREVIATIONS

AV Air valve	EP Electricity pole	RE Rodding eye
BB Beleisha beacon	ER Earth rod	Ret. Retaining
BD Back drop	FB Flower bed	RS Road sign
BH Borehole	FE Final effluent	RWP Rain water pipe
Bol Bollard	FH Fire hydrant	SC Stop cock
BT British Telecom cover	FL Floodlight	SL Sump level
BTJB BT junction box	G Gulley	SP Sign post
CATV Cable TV cover	GV Gas valve	ST Stand pipe
CDP Cable draw pit	IC Inspection cover	SV Stop valve
	IL Invert level	SVP Soil vent pipe
CL Cover level	JB Junction box	TCB Telephone call box
CM Cable marker	KO Kerb outlet	TCP Tactile paving
CNF Could not find	LP Lamp post	TL Traffic light
CNL Could not lift	MH Manhole	TP Telegraph pole
CNT Could not trace	Mkr Marker	TPL Top of pipe level
CPL Coping level	NB Name board	TS Traffic signal
DC Drainage Channel	OF Outfall	VP Vent pipe
DK Drop kerb	PB Post box	WL Weir level
EJB Elec. junction box	PM Parking meter	WO Washout
EOR End of record	PS Paving slabs	WM Water meter
EOT End of trace	RC Rising cable	WSC Water stop cock

IMPORTANT NOTES

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This drawing should be read in conjunction with any record drawings available from the statutory authorities.

NOTES

2. Refer to Dwg No.s 16313/JD/1 - 3 for the topographic survey and section locations.

SCALE	1/1250 Hz 1/250 Vt	DRAWN	JJD
DATE	April 2021	CHECKED	DRD

LLP

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Underground Services Location

ISO 9001 REGISTERED FIRM

RICS

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PROJECT TITLE

PAKENHAM FEN

DRAWING TITLE

TRANSECTS 5 & 6

SURVEYED SURVEYED	DRAWN DRAWN	DESIGNED DESIGNED
CHECKED CHKD	APPROVED APPRD	DATE DATE
SCALE SCALE	A0	OCD CODE OCD_CODE

DRAWING No:– DRAWING_NO

REV REV

Appendix D
Soil Core Survey - April 2019

Core 1, TL 93162 68772
Location: This core represents part of the gently sloping upland toeslope.
Vegetation: Poor semi-improved grassland extensively colonised by Hard Rush; corresponds to the *Juncus inflexus* sub-community of the *Holco-Juncetum effusi* community (MG10b).

Peaty sand to 8 cm b.g.l.
Brown sands with occasional stones – with mottling from 12 cm – to 29 cm b.g.l.
Peat: hemic, mid-brown (fen peat) to c.71 cm b.g.l.
Peat: sapric, very dark brown to black
Wet from 82 cm, but no water table
End of core at 125 cm b.g.l.

Core 2, TL 93214 68880
Location: The core samples the low-lying soils occupied by fen meadow.
Vegetation: Greater Pond-sedge stand with constant Blunt-flowered Rush and a suite of fen-meadow associates; corresponds to a mown *Juncus subnodulosus-Cirsium palustre* fen-meadow, Typical sub-community (MG22a).

Earthy peat, very dark brown to 12 cm b.g.l.
Hemic peat, mid brown, to 52 cm b.g.l.
Hemic-fibric fen peat with occasional shell fragments to 110 cm b.g.l.
Sapric peat, very dark brown-grey to end of core at 125 cm b.g.l.
Water table at 52 cm, rising to 46 cm.

Core 3, TL 93345 69005
Location: This core represents part of an elevated area distinct from the modern floodplain.
Vegetation: Improved grassland, abundant Perennial Ryegrass, though with several other grass species occasional; Creeping Thistle and Common Sorrel occasional, Ribwort Plantain rare. Broadly corresponds to the *Lolio-Plantaginion* grasslands (MG7).

Humic sand to 25 cm b.g.l.
Light brown sand with occasional mottling; stony, to 37 cm b.g.l.
End of core 37 cm – too stony to penetrate.

Core 4, TL 93392 68917
Location: The core samples an area some 30 m south of the margin of an elevated platform fringing the modern floodplain.
Vegetation: Open Greater Pond-sedge sward (abundant) with Water Horsetail and Common Sorrel (frequent), with a number of grassland associates, including Cuckooflower and Red Fescue (both occasional). Close to more species-rich fen meadow (M22) with mown Common Valerian (frequent) flowering.

Earthy peat, very dark brown, with molehills showing subsurface marl, to 24 cm b.g.l.
Marl, grading from light brown to yellow-white to 65 cm b.g.l.
Peat, mid-brown, hemic, to 85 cm b.g.l.
Sapric peat, very dark grey-brown, faint sulphurous odour from c.110 cm, to end of core
Water table from c.70 cm, rising to 53 cm b.g.l.

End of core at 125 cm b.g.l.

Core 5, TL 93179 68667
Location: This core represents part of the gently sloping upland toeslope.
Vegetation: Hard Rush (abundant) pasture with strong ruderal element including Rough Meadow-grass and Curled Dock (both frequent), occasional Nettle.

Peaty top to 3 cm b.g.l.
Hemic sand to 22 cm b.g.l.
Light yellow-brown sand with occasional mottle. Evidence for burning and some gravel-sized brick fragments to 34 cm b.g.l.
Marl – light yellow-brown to 61 cm b.g.l.
Hemic peat, mid brown to 70 cm b.g.l
Sapric peat, very dark grey-brown, slightly sulphorous odour from c.110 cm
End of core 125 cm b.g.l.

Core 6, TL 93290 68649
Location: The core is close to the modern river on the low-lying soils occupied by rush pasture.
Vegetation: Abundant Perennial Ryegrass with Hard Rush, Hairy Sedge and Dandelion (all frequent).

Earthy peat to 15 cm b.g.l
Sand, humic at surface becoming light brown, to 30 cm b.g.l.
Marl, light yellow brown to 125 cm b.g.l.
Water table no evident on coring, but established at 62 cm b.g.l.
End of core at 125 b.g.l.

Core 7, TL 93225 68447
Location: Paired with Core 15, this core lies near the margin of low-lying land beside an elevated area that intrudes into the floodplain.
Vegetation: Perennial Ryegrass (abundant) with Rough Meadow-grass, White Clover and Dandelion (all frequent) and Hard Rush (occasional). Closest to *Lolio-Plantaginion* grassland (MG7).

Humic, rather silty sand to 23 cm b.g.l
Marl, light yellow-brown to 28 cm b.g.l.
Sapric peat, becoming wet at c.66 cm but no water table (no final water table evident), to 102 cm b.g.l
Rather bleached (albic) sand (damp only) to end of core at 125 cm

Core 8, TL 93355 68416
Location: The core samples part of an extensive area of low-lying land in improved grassland south of the main block of fen meadow.
Vegetation: *Lolio-Plantaginion* grassland (MG7) with some False Oat-grass (occasional) and Meadow Buttercup (rare).

Earthy peat with occasional shell fragments to 34 cm b.g.l
Sapric peat, almost black, to 54 cm b.g.l.
Rather bleached sand, with first mottle at 57 cm, to 84 cm
Boulder Clay with abundant small chalk pebbles (wet) to end of core at 125 cm b.g.l
No water table: likely to have been within sapric peat layer formerly; area may be sensitive to current rainfall conditions.

Core 9, TL 93323 68302

Location: The core samples part of an extensive area of low-lying land in improved grassland south of the main block of fen meadow.
Vegetation: Abundant Perennial Ryegrass with frequent Crested Dogs'-tail and White Clover; Dandelion occasional. Typical sub-community of *Lolio-Cynosuretum cristati* grasslands (MG6a).

Humic silty sand to 30 cm b.g.l
Yellow sand, first mottle at 41 cm, manganiferous streaks at c. 62, to 83 cm b.g.l.
Grey sand with chalk stones, to 99 cm b.g.l.
Boulder Clay with many chalk stones, to end of core at 125 cm b.g.l.

South site

Core 10, TL 92811 68038
Location: This core samples the soft peat soils within an area of fen meadow, near its upland margin.
Vegetation: Blunt-flowered Rush sward (abundant) with frequent Water Horsetail and occasional Hard Rush over a mixed carpet of the mosses *Brachythecium rutabulum* (abundant) and *Calliergonella cuspidata* (frequent). Corresponds to a recently unmown *Juncus subnodulosus-Cirsium palustre* fen-meadow, Typical sub-community (MG22a).

Hemic peat, mid-brown to 15 cm b.g.l.
Marl, light yellow-brown with white calcite concretions, to 25 cm b.g.l.
Hemic-fibric fen peat (light brown), to 57 cm b.g.l.
Sapric peat, with water table at 62 rising to 43 cm, to 98 cm b.g.l.
'Putty' chalk (periglacial weathering product: chalk pebbles in matrix of chalk paste) to end of core at 125 cm b.g.l.

Core 11, TL 92931 68113
Location: This core samples firm ground within an area of damp grassland in low-lying land beside an area of fen meadow.
Vegetation: Flushed circum-neutral grassland with abundant Red Fescue and the moss *Calliergonella cuspidata*, frequent Hard Rush and Dandelion and a range of occasional associates including Tawny Sedge *Carex hostiana*, a regional rarity. There is no clear association with the NVC but the species noted at the core location often occur together within the *Caricion davallianae* alliance.

Earthy peat, very dark brown, to 18 cm b.g.l.
Marl, pale yellow-brown, to 31 cm b.g.l.
Sapric peat, dark charcoal in colour, wet from 73, but not water table; no change, with fibric inclusions.
End of core at 125 cm b.g.l.

Core 12, TL 92764 68152
Location: This core samples the soft peat soils within an area of fen meadow, near its upland margin.
Vegetation: Blunt-flowered Rush sward (abundant) with frequent Water Horsetail and Yorkshire Fog and occasional Hard Rush over a mixed carpet of the mosses *Brachythecium rutabulum* (abundant) and *Calliergonella cuspidata* (frequent). Corresponds to a recently unmown *Juncus subnodulosus-Cirsium palustre* fen-meadow, Typical sub-community (MG22a).

Earthy peat to 24 cm b.g.l.
Humic sand to 43 cm b.g.l.
Hemic peat to 58 cm b.g.l.
Sapric peat, wet but no water table, to 75 cm b.g.l.
'Putty' chalk (see Core 10) to end of core at 125 cm b.g.l.

Core 13, TL 92844 68213
Location: The core represents part of the gently sloping upland toeslope.
Vegetation: Abundant Perennial Ryegrass with Frequent Hairy Sedge and Yorkshire Fog, with Hard Rush occasional. Transitional between *Lolio-Plantagion* grassland (MG7) and the *Juncus inflexus* sub-community of the *Holco-Juncetum effusi* community (MG10b).

Earthy peat, slightly sandy and noticeably more compact than other cores, to 42 cm b.g.l.
Humic sand, wetter from 52 cm, to 59 cm b.g.l.
Grey sand, heavily mottled, saturated by 80 cm but no water table evident.
End of core at 100 cm due to gravel.

Core 14, TL 93045 68320
Location: This core represents part of the gently sloping upland toeslope.
Vegetation: Perennial Ryegrass dominant with scattered Annual Meadow-grass, Chickweed and Sow-thistle; corresponds to the *Lolium perenne-Trifolium repens* ley grassland of *Lolio-Plantaginion* (MG7a).

Light brown sand (fine, compact sand with occasional stones); occasional mottles from 38 cm b.g.l.
End of core at 60 cm (compaction)

Core 15, TL 93201 68329
Location: Paired with Core 7, this core lies near the margin of low-lying land beside an elevated area that intrudes into the floodplain.
Vegetation: Perennial Ryegrass abundant with frequent Creeping Buttercup; Creeping Bent and Rough Meadow-grass were occasional and Hard Rush rare. This grassland is best placed within the *Lolium perenne-Poa trivialis* leys of the *Lolio-Plantaginion* grasslands (MG7b).

Earthy peat to 35 cm b.g.l.
Sapric peat, with shell fragments and woody inclusions from 70 cm; wet from c.50 cm but no water table.
End of core at 125 cm b.g.l.

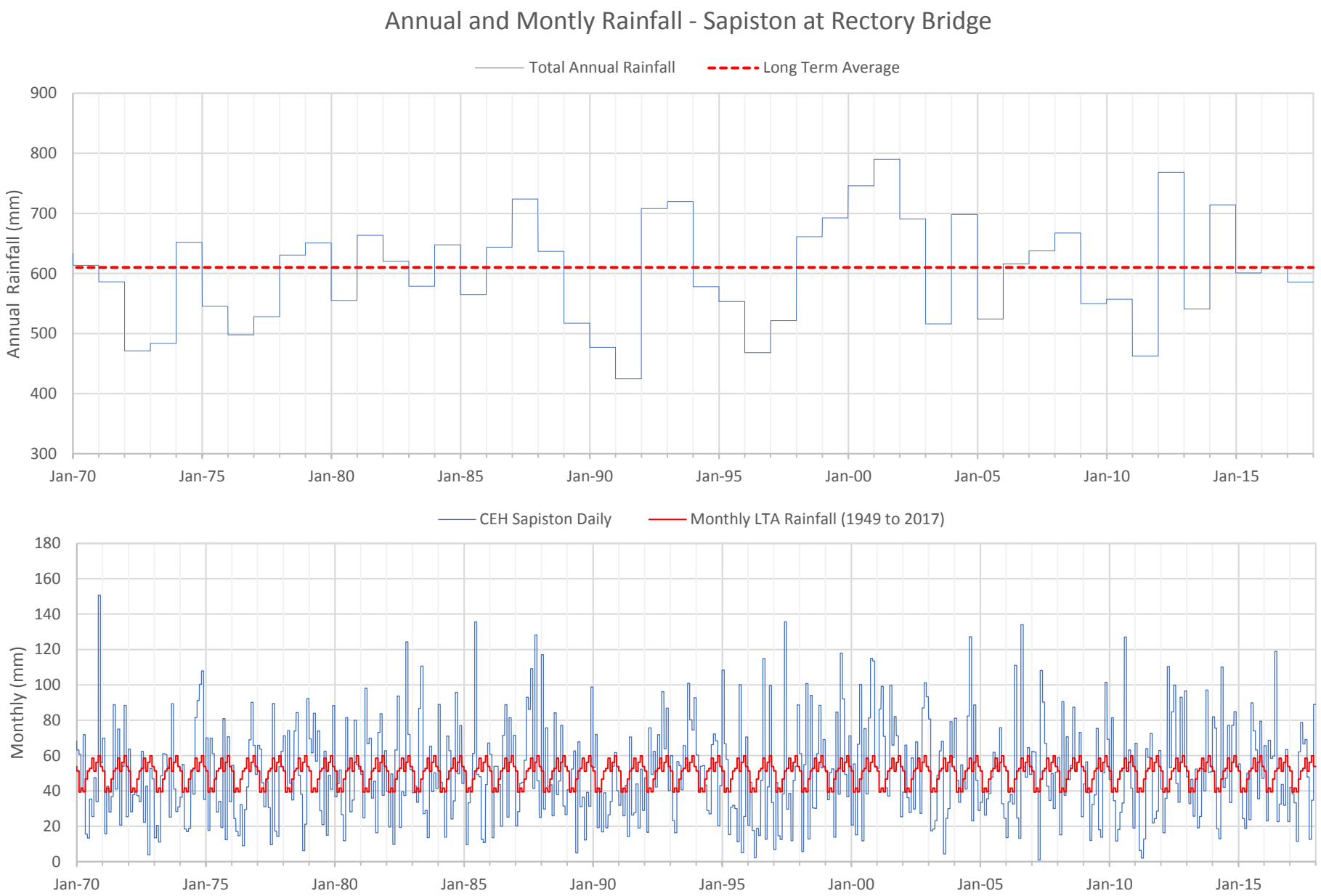
Core 16, TL 93102 68017
Location: The core represents the soils of a large area of drier grassland near the river.
Vegetation: Perennial Ryegrass abundant with frequent Hairy Sedge and Creeping Buttercup; Dandelion and White Clover occasional with Common Mouse-ear rare. This grassland is best placed within the *Lolium perenne-Poa trivialis* leys of the *Lolio-Plantaginion* grasslands (MG7b).

Earthy peat to 24 cm b.g.l.
Marl to 45 cm b.g.l.
Hemic peat, becoming wet at c.80 cm but no water table, to end of core at 125 cm b.g.l.

Core 17, TL 93019 68171
Location: This core samples a block of damp grassland below the margin of the upland toeslope.
Vegetation: Perennial Ryegrass abundant with frequent Rough Meadow-grass; Dandelion, Daisy and Creeping Buttercup; White Clover occasional. This grassland is best placed within the *Lolium perenne-Poa trivialis* leys of the *Lolio-Plantaginion* grasslands (MG7b).

Earthy peat, with occasional stones, to 38 cm b.g.l.
Sapric peat, wet from 63 cm but no water table, to 82 cm b.g.l.
Hemic peat to end of core at 125 cm b.g.l.

Appendix E
Rainfall, River Flow & Groundwater Level Data



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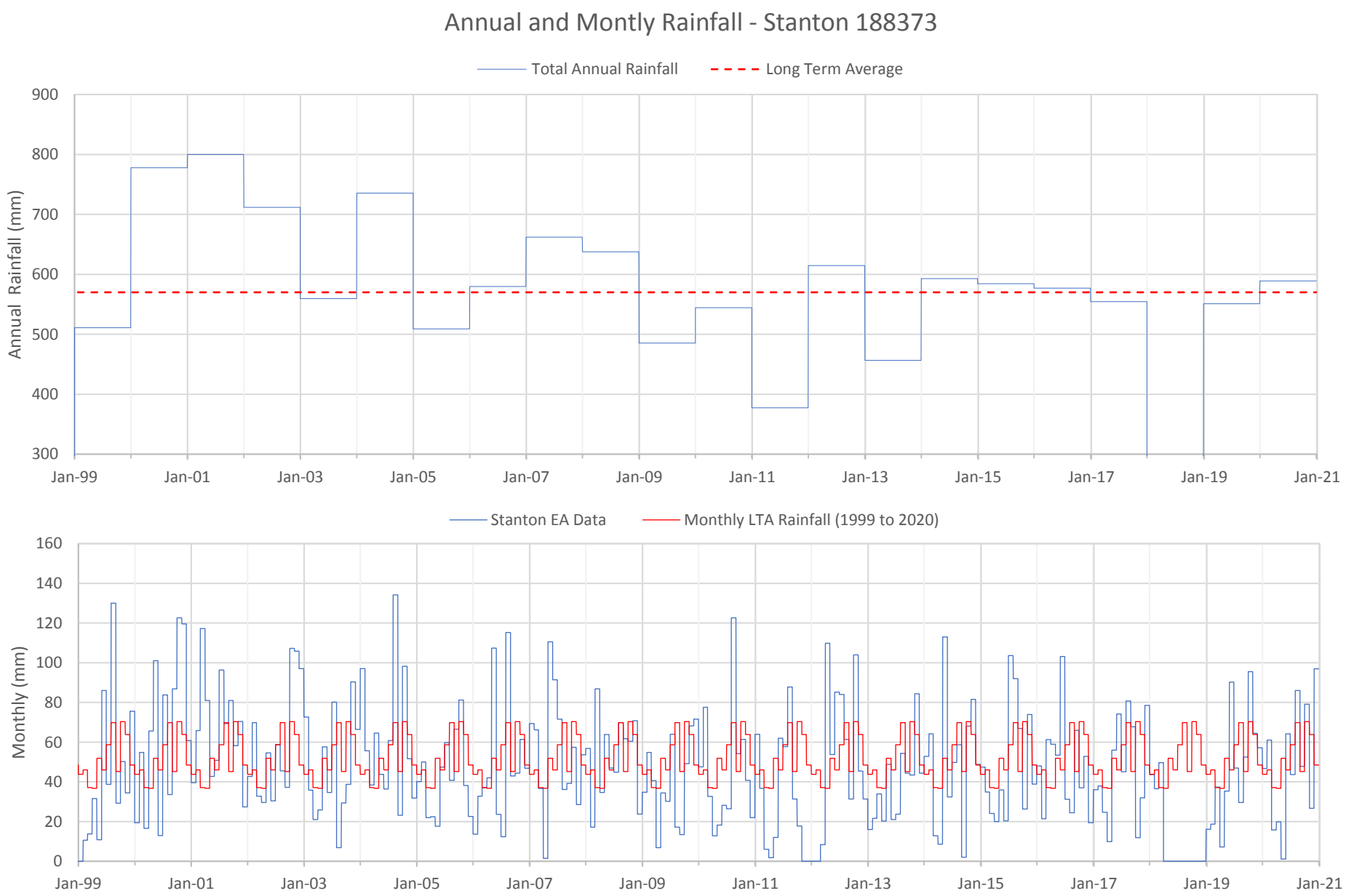
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Total Annual Rainfall
Long Term Average
Annual Rainfall (mm)
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800
700
600
500
400
300
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Jan-13
Jan-15
Jan-17
Jan-19
Jan-21
Stanton EA Data
Monthly LTA Rainfall (1999 to 2020)
Monthly (mm)
160
140
120
100
80
60
40
20
0
Jan-99
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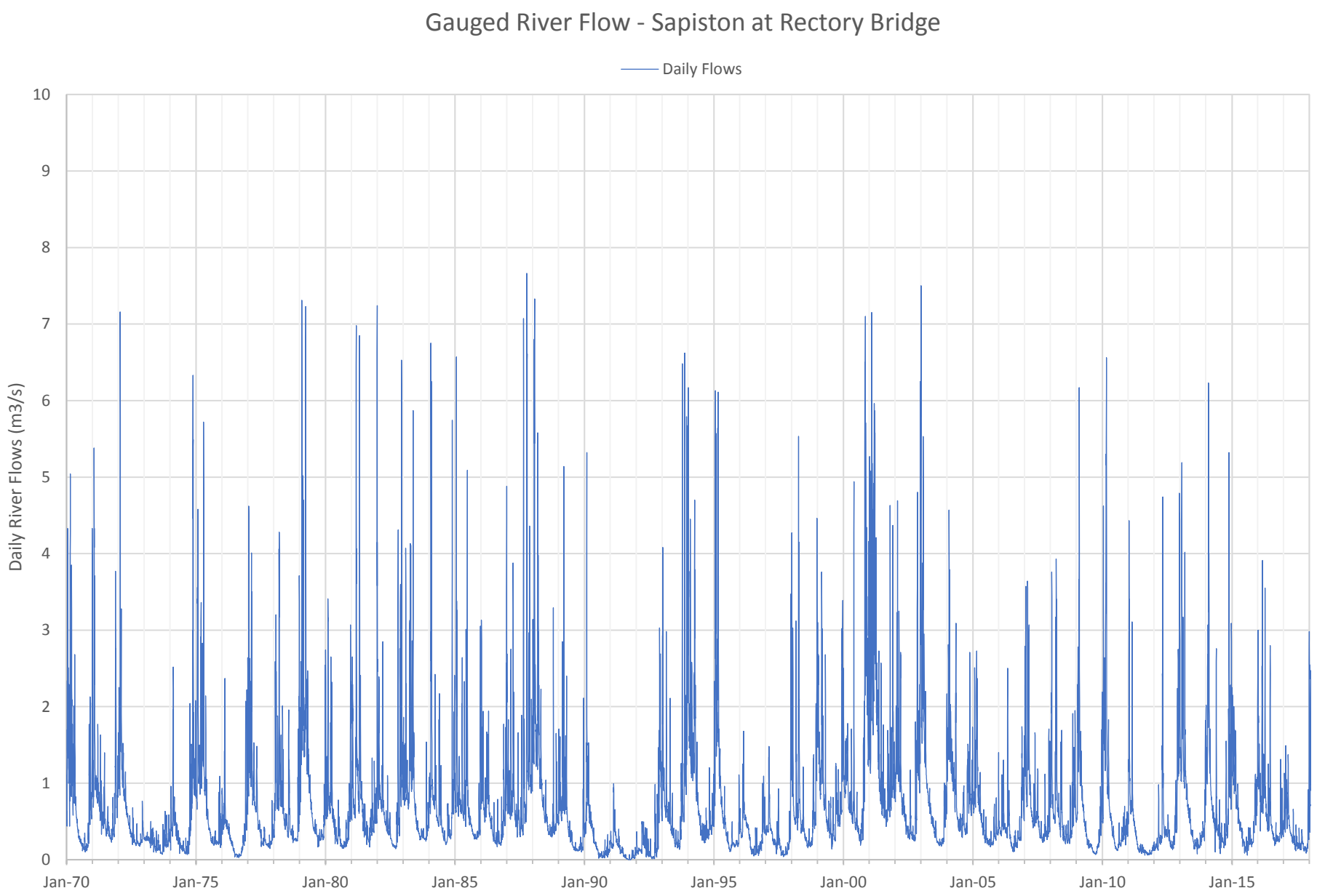
Jan-17
Jan-19
Jan-21



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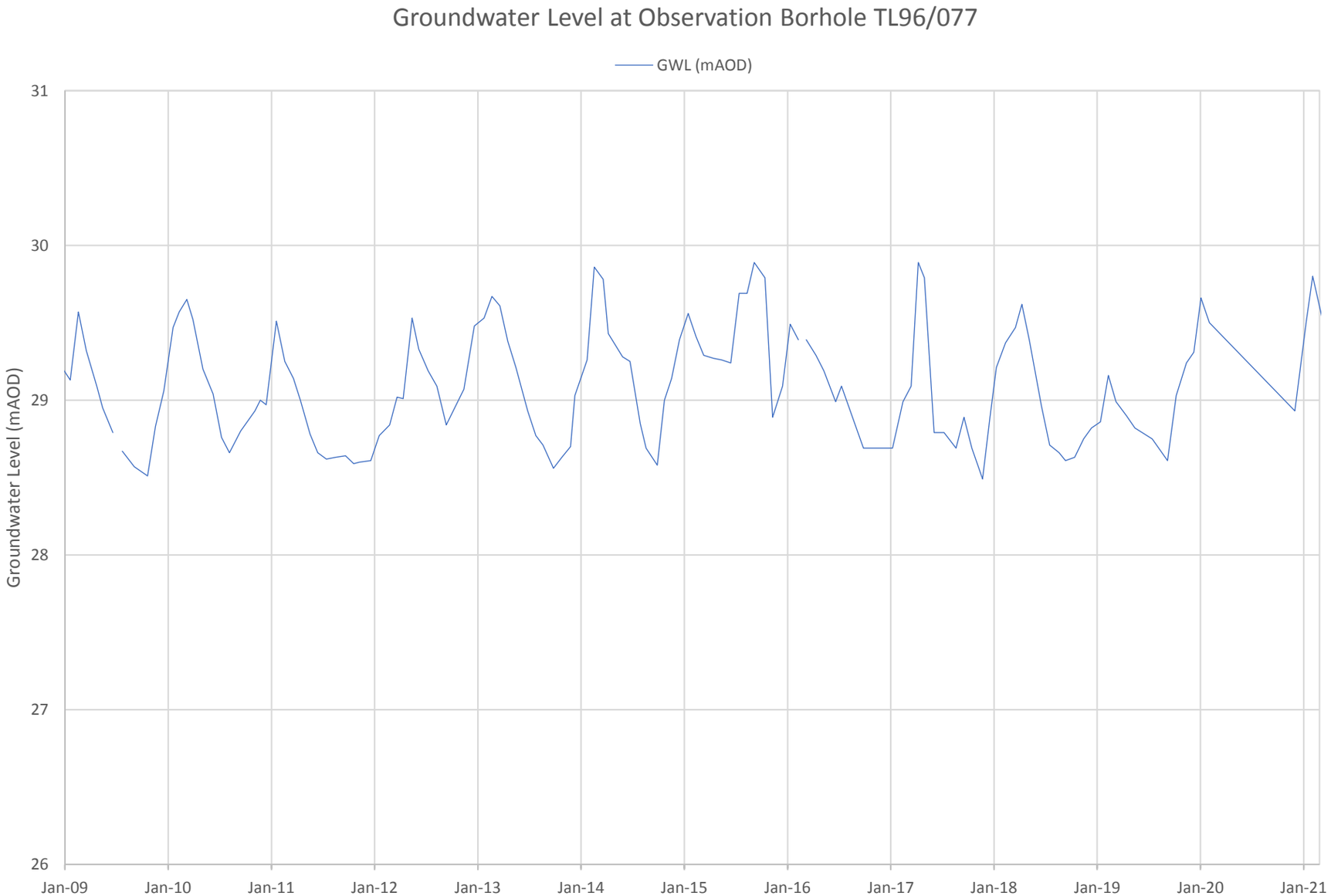

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APPENDIX I: WATER MONITORING SUMMARY – PAKENHAM SITE 54, APRIL 2021

Technical note:
Sizewell C Fen Meadow Compensation
Water Monitoring Summary – Pakenham Site 54 April 2021 Summary

1. Introduction

The technical note summarises water monitoring data collected in April 2021 at the Pakenham site (hereafter referred to as 'the Site') which has been identified as a potential fen meadow development area. This technical note is a factual presentation of the data rather than an interpretive report.

Figure 1.1 shows a map of the Site and the installations referred to in this technical note.

2. Groundwater Level Monitoring

Nine groundwater monitoring points were installed at the Site between 22nd and 26th March 2021. Seven shallow dipwells were installed to measure groundwater levels in the shallow superficial near surface deposits and three piezometers were installed to measure groundwater levels in the underlying sands and gravels. Two of the sands and gravels piezometers are nested (within the same borehole) with a dipwell. An installation summary is provided in Table 2.1 below.

Table 2.1 Summary of groundwater monitoring installations

Name	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
PAK-BH-1	TL 93282 68982	32.986	31.68	5	19	
PAK-BH-2D	TL 93102 68394	33.652	34.7	33	19	Nested with BH-2S
PAK-BH-2S	TL 93102 68394	33.652	32.68	4	19	Nested with BH-2D
PAK-HA-1	TL 93319 68927	31.753	31.703	3	19	
PAK-HA-2	TL 93161 68834	31.656	31.585	3	19	
PAK-HA-3	TL 93262 68661	31.727	31.826	3	19	
PAK-HA-4A	TL 93168 68445	32.021	31.603	2	19	
PAK-HA-5	TL 92935 68197	31.859	31.518	2	19	

Name	NGR	Datum: Metal Cover (mAOD)	Ground Level (mAOD)	Depth (m bgl*)	Diameter (mm)	Notes
PAK-HA-6	TL 93075 68079	31.685	31.512	3	19	

*m bgl = metres below ground level

Each installation is fitted with a water level datalogger which will be downloaded on a quarterly basis. Table 2.2 and 2.3 summarises the data collected in April 2021. Hydrographs of groundwater levels are presented in Appendix A.

Table 2.2 Site 54 Groundwater Levels (m bgl and mAOD)

Date	PAK-BH-1	PAK-BH-2D	PAK-BH-2S	PAK-HA-1	PAK-HA-2	PAK-HA-3	PAK-HA-4	PAK-HA-5	PAK-HA-6
m bgl									
28/04/21	2.24	0.61	3.23	2.14	2.1	1.05	1.58	2.14	1.1
mAOD*									
28/04/21	30.389	32.959	30.131	29.522	29.427	30.482	30.386	29.677	30.424

*m AOD = metres above ordnance datum
Note: negative m bgl value indicates positive hydrostatic pressure

3. Surface Water Level Monitoring

Five gaugeboards were installed between 22nd and 26th March 2021 to allow monitoring of surface water levels in site watercourses / drains. All gaugeboards included stilling wells and water level data loggers. An installation summary is given in Table 3.1 below.

Table 3.1 Summary of gaugeboard installations

Ref.	GPS Grid Ref.	Bottom of Gaugeboard Datum (mAOD*)	Gaugeboard Length (m)	Datalogger	Log Interval (minutes)
PAK-GB01	TL93239 68817	29.027	2	Yes (install in May 2021)	15
PAK-GB02	TL93064 68381	31.2	2	Yes (install in May 2021)	15
PAK-GB03	TL93175 68400	29.917	2	Yes (install in May 2021)	15
PAK-GB04	TL92873 67891	31.084	2	Yes (install in May 2021)	15

*mAOD = metres above ordnance datum

Table 3.2 summarises the gaugeboard water level readings taken in April 2021. The water level at all gaugeboard locations is continuously monitored and are downloaded on a monthly basis during spot gauging visit.

Table 3.2 Surface Water Levels (mAOD)

Date	PAK-GB01	PAK-GB02	PAK-GB03	PAK-GB04
14/04/21	30.372	31.475	29.917	31.084

*Manual reading from dip point (no gaugeboard or datalogger).

4. Spot Flow Gauging

Monthly spot flow gauging of six locations commenced in April 2021. Results to date are shown in Table 4.1 below.

Table 4.1 Spot Flow (m^3/s)

Date	PAK-SF01	PAK-SF02	PAK-SF03	PAK-SF04	PAK-SF05	PAK-SF06
14/04/21	0.0502	0.0003	0.0201	0.1602	0.0701	0.1102

5. Water Quality Monitoring

In-situ water quality readings are collected from all groundwater and surface water installations on a monthly basis. In-situ water quality results are presented in Table 5.1 below.

In addition to this, water quality samples will also be collected quarterly at selected locations and sent for laboratory analysis. Quarterly sampling was undertaken in April 2021, with the next samples due to be collected in July 2021. The initial results for the quarterly sampling will be updated in this report after July 2021.

Table 5.1 In-situ Water Quality Results

Date	Ref.	Temp (°C)	Diss. Oxygen (%)	Conductivity (SPC)	pH	Redox (ORP)	Turbidity (NTU)
28/04/21	PAK_BH2_D	10.3	41.3	694.2	7.23	111.9	268
28/04/21	PAK_BH2_S	9.2	27	1154	6.98	92.5	>1050
28/04/21	PAK_HA5	9.2	36.1	778	7.21	68.6	>1050
28/04/21	PAK_HA1	10.6	13.7	682	7.12	59.4	>1050
28/04/21	PAK_HA2	10.6	19.8	766	6.74	-35.2	790
28/04/21	PAK_HA4	10.1	22.2	573.7	6.99	34.6	6.82

cns = could not sample. Insufficient water / blockage

Issued by

[redacted]

Approved by

[redacted]

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Management systems

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\\sal-fs12.global.amec.com\shared\Projects\40773 Sizewell C Fen Meadow Compensation and Marsh Harrier Mitigation Strategies\D Design_Technical\Drawings\GIS\MXDs\40773-WOOD-XX-XX-FG-OW-0044_S0_P01.1.mxd Originator: jon.mainhagu2

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N

PAK-FG-2
PAK-SF05
PAK-FG-3
PAK-SF06
PAK-BH-1
PAK-HA-1
PAK-HA-2
PAK-SF01
PAK-GB-1
PAK-HA-3
PAK-SF04
PAK-FG-1
PAK-HA-4
PAK-SF03
PAK-SF02
PAK-GB-2
PAK-BH-2
PAK-GB-3
PAK-HA-5
PAK-HA-6
PAK-GB-4

Key

- Site boundary
- Gaugeboard
- Dipwell
- Flow gauging

0 100 200 300 400 500 m

Scale at A3: 1:8,538

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

EDF Energy
Sizewell C
Fen Meadow Compensation Water Monitoring Summary

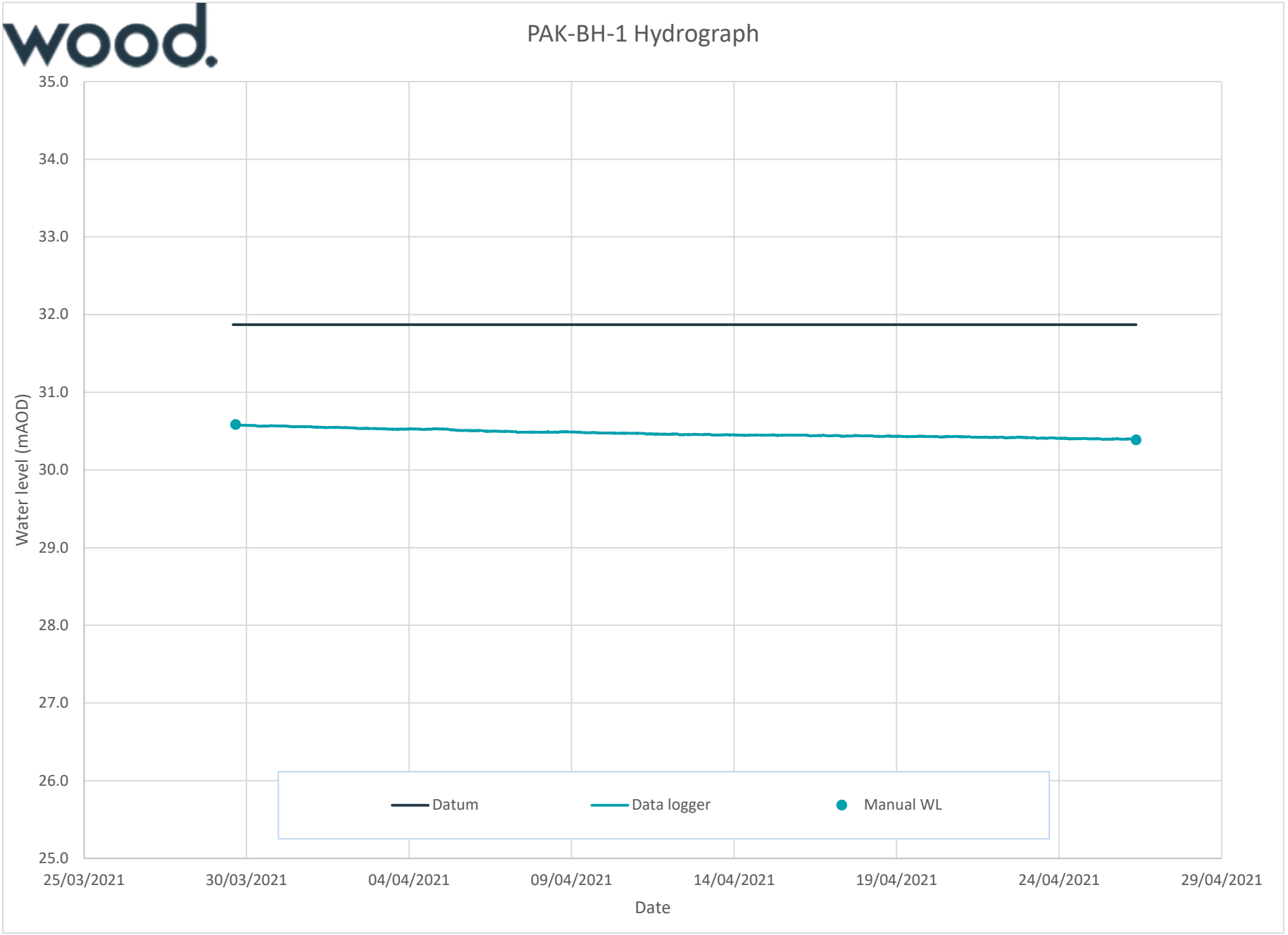
Figure 1.1
Monitoring locations
Site 54 Pakenham

June 2021

wood.

40773-WOOD-XX-XX-FG-OW-0044_S0_P01.1

Appendix A
Groundwater Hydrographs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34.0
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32.0
31.0
30.0
29.0
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26.0
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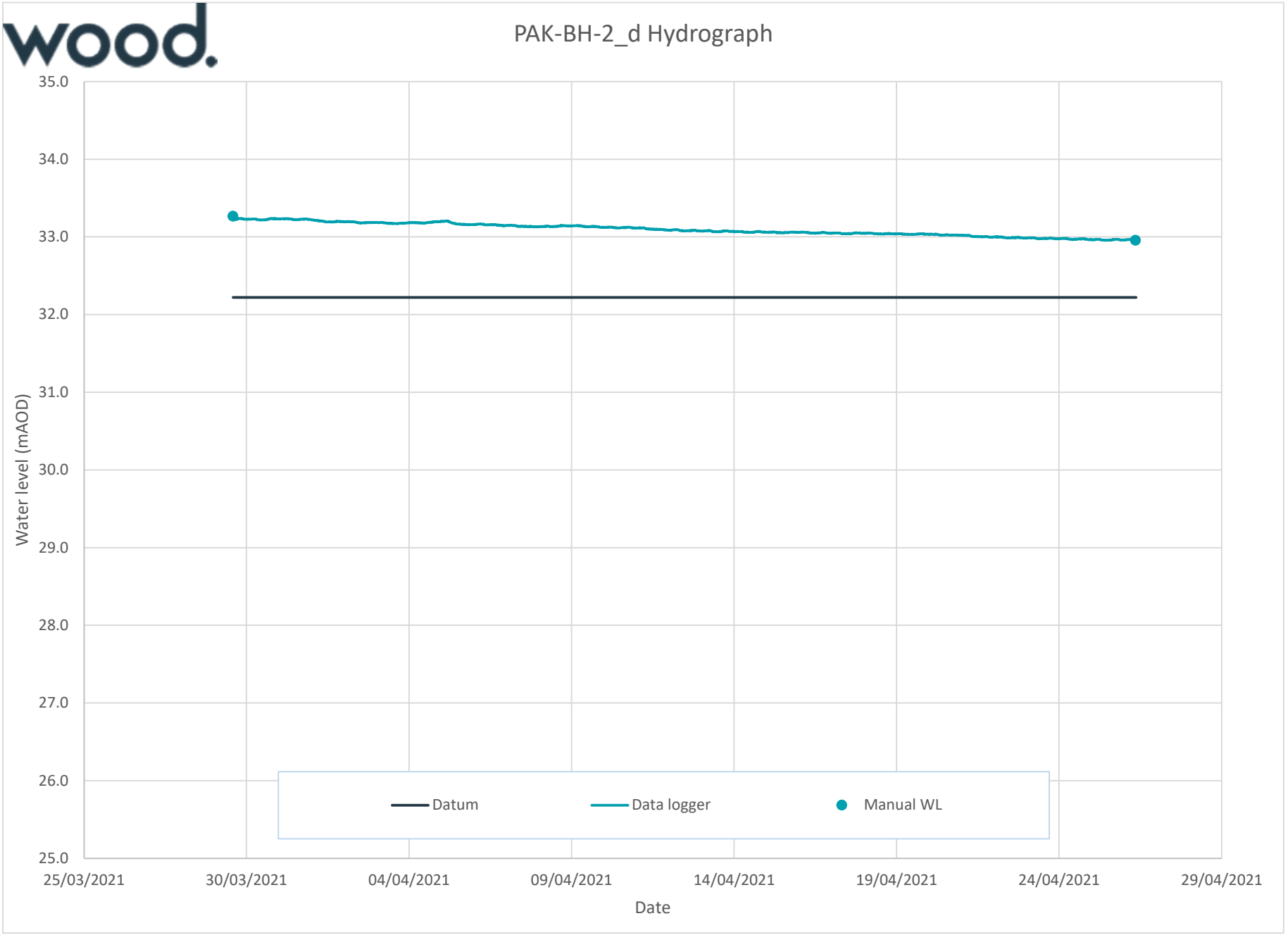
Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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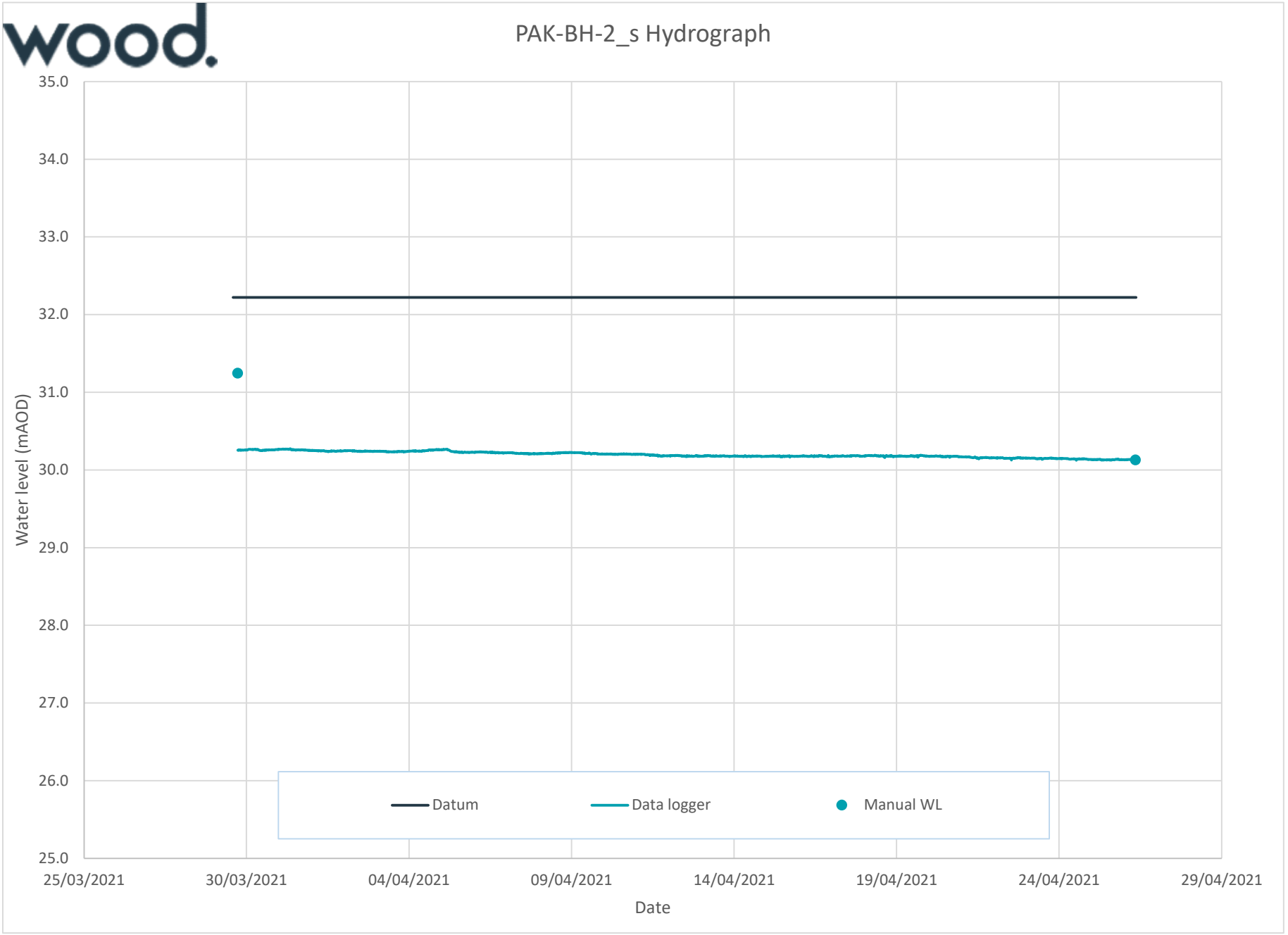
Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
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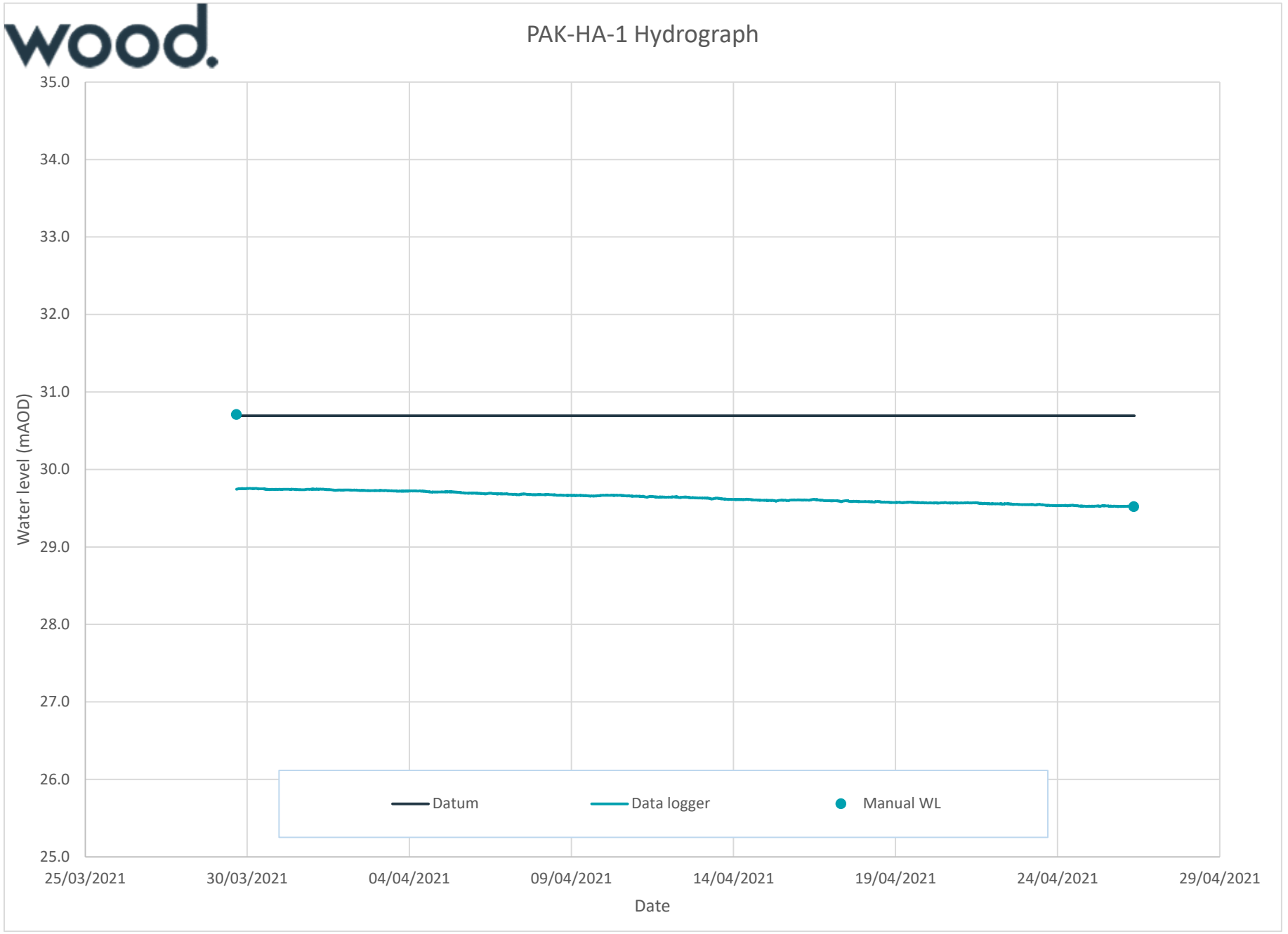
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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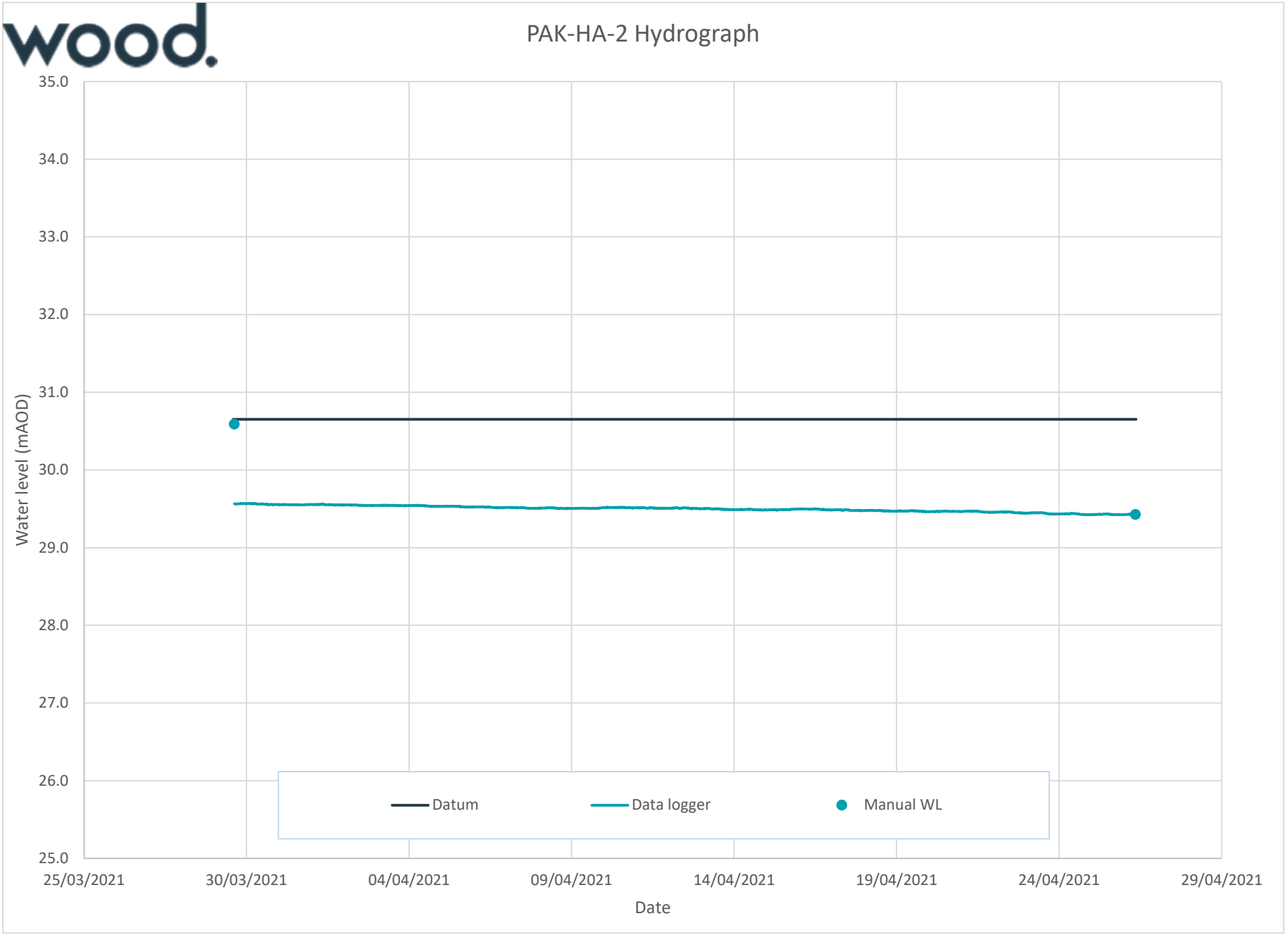
Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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Water level (mAOD)
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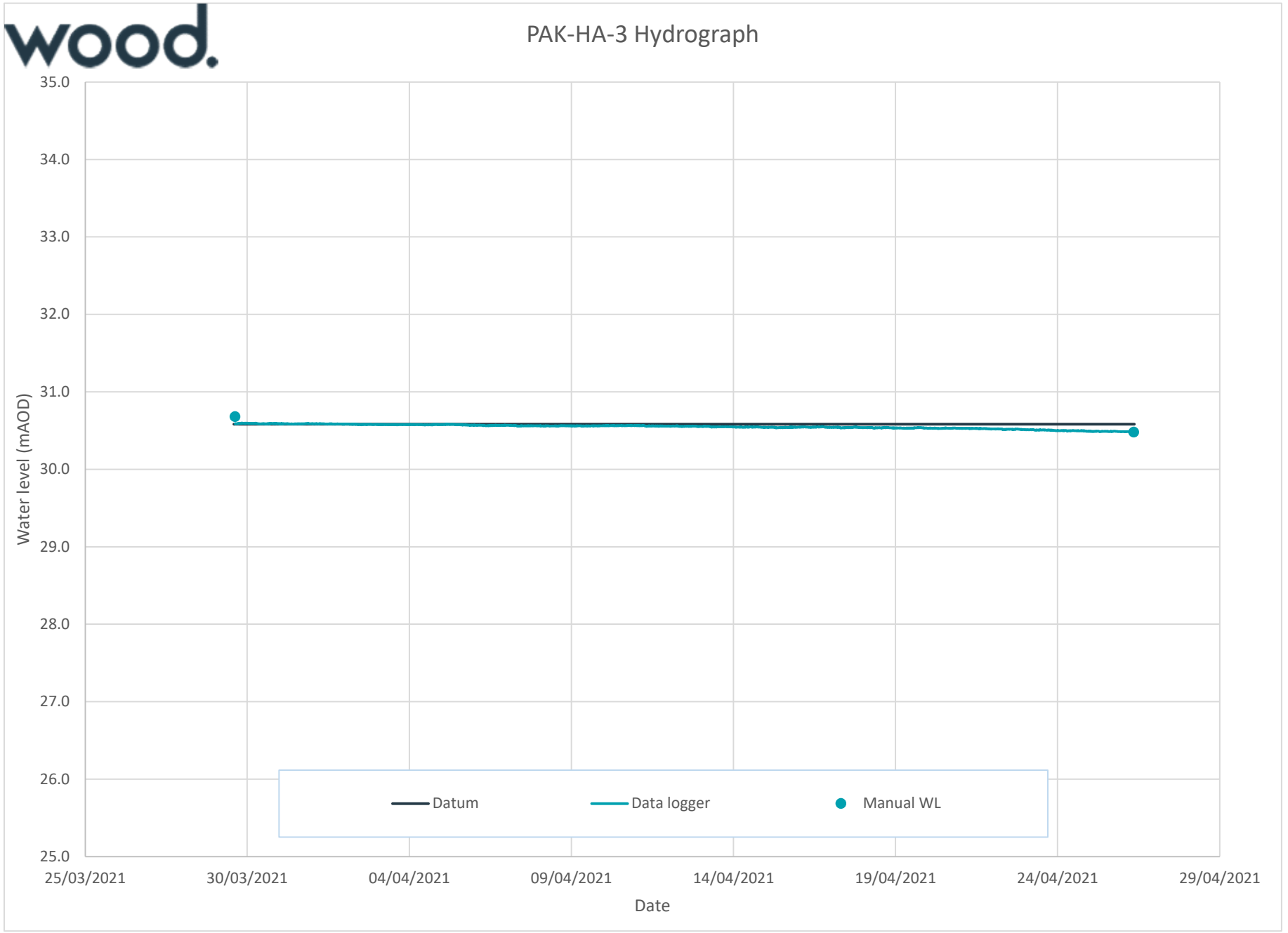
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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30.0
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26.0
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Water level (mAOD)
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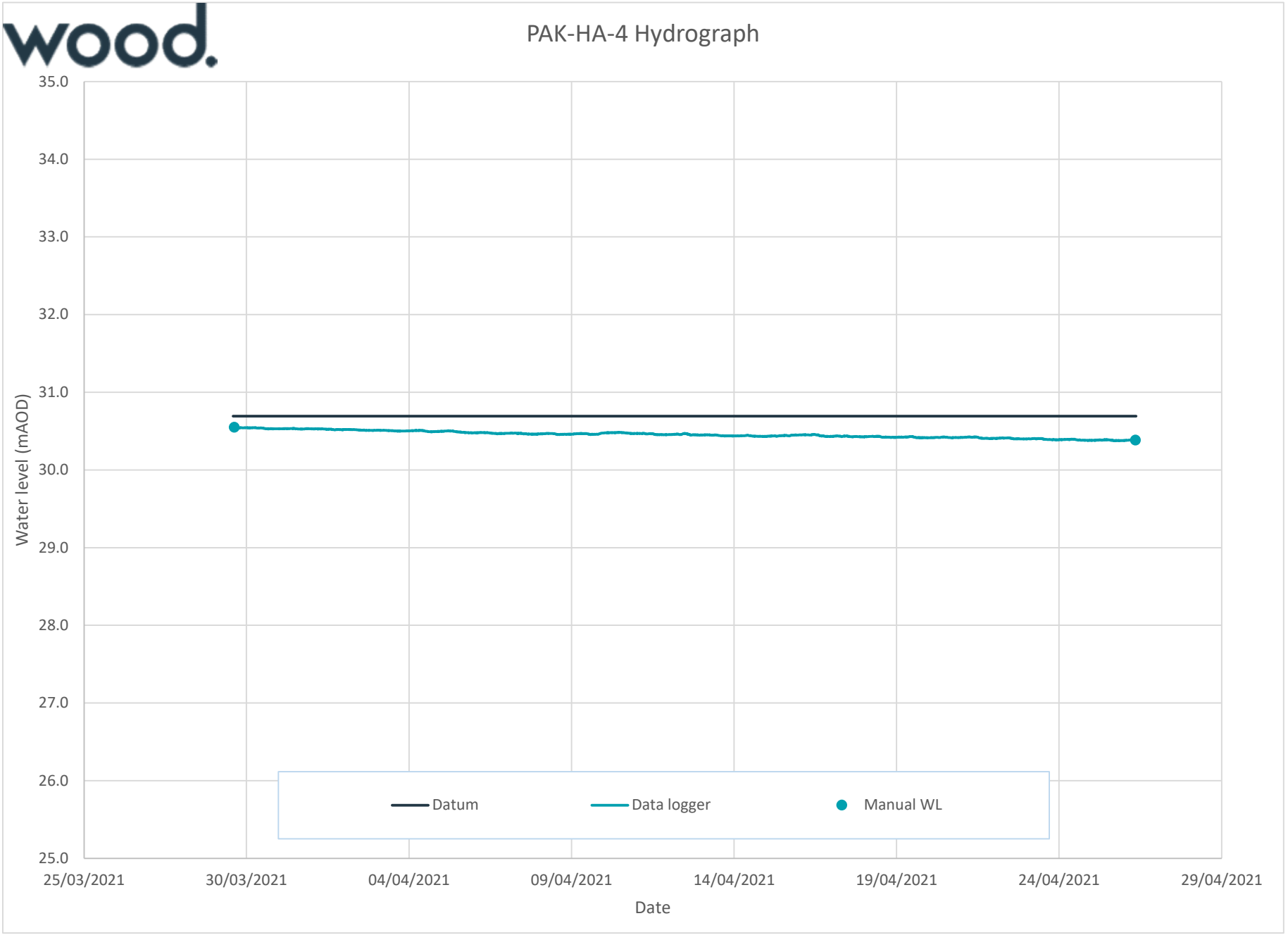
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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31.0
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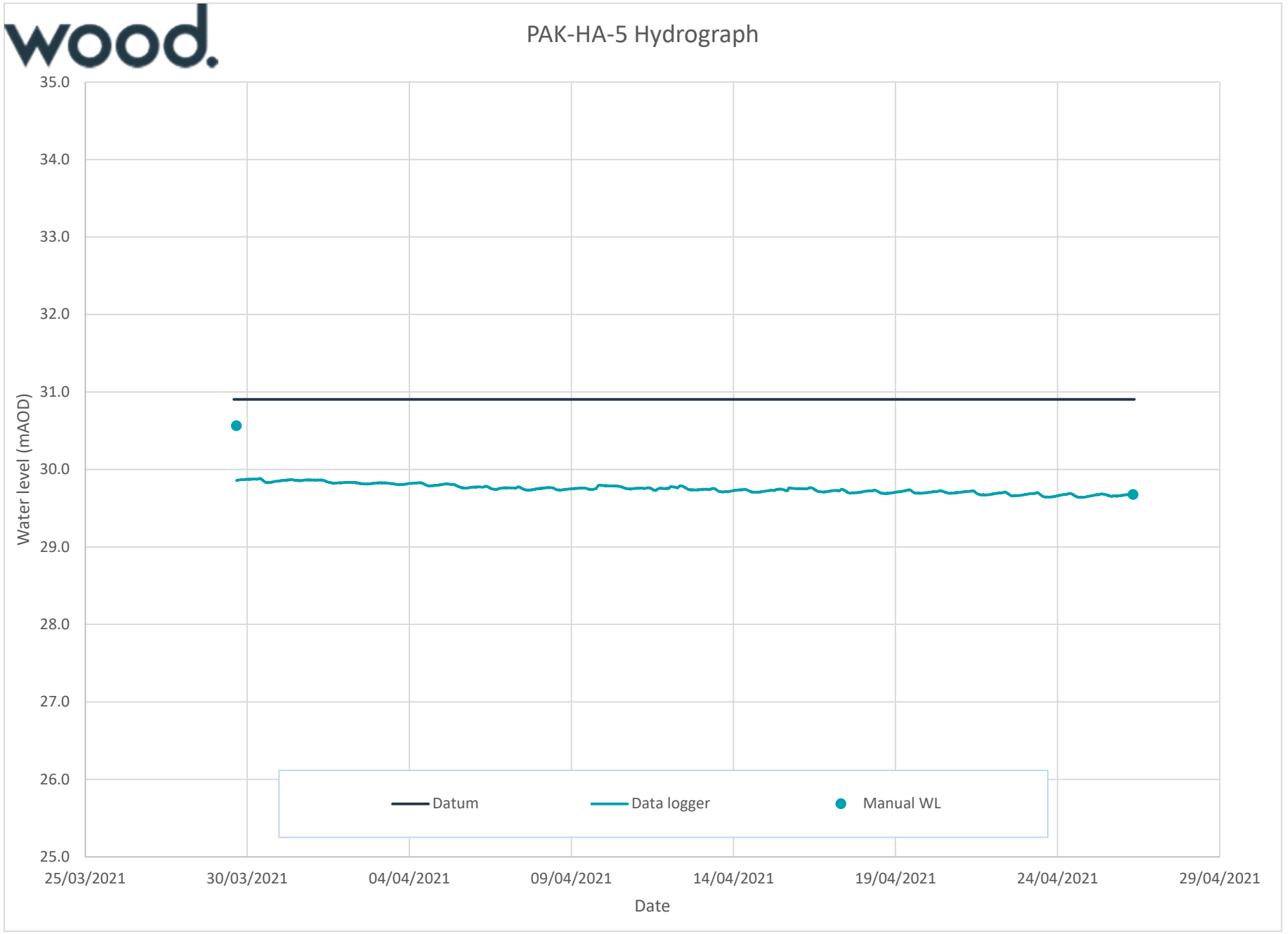
28.0
27.0
26.0
25.0
Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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28.0
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Water level (mAOD)
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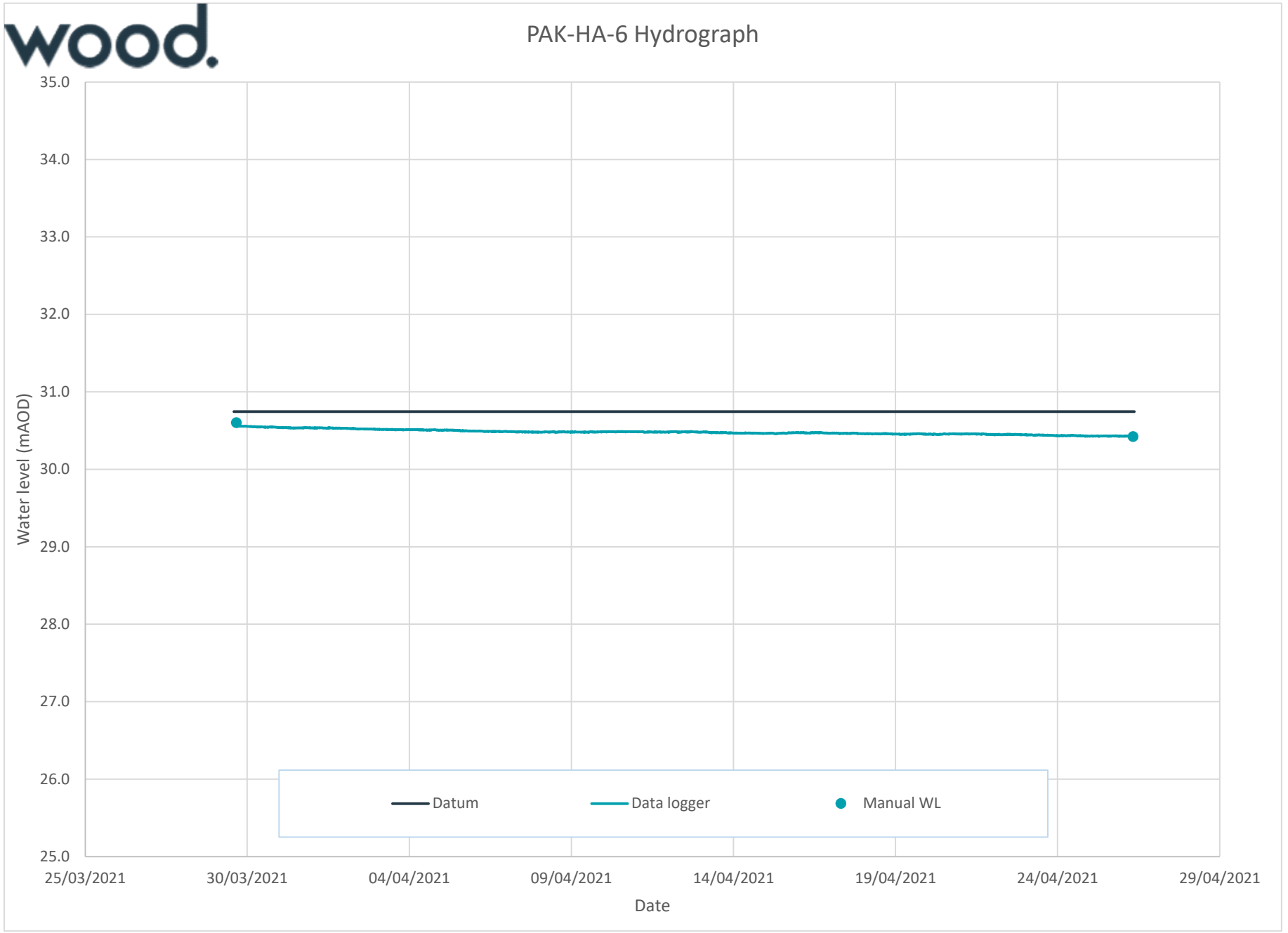
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL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26.0
25.0
Water level (mAOD)
25/03/2021
30/03/2021
04/04/2021
09/04/2021
14/04/2021
19/04/2021
24/04/2021
29/04/2021
Date
Datum
Data logger
Manual WL