A12 Chelmsford to A120 widening scheme
TR010060

6.3 ENVIRONMENTAL STATEMENT
APPENDIX 14.4 GROUNDWATER ASSESSMENT

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ENVIRONMENTAL STATEMENT
APPENDIX 14.4 GROUNDWATER ASSESSMENT

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1 Introduction

1.1.1 This report forms the groundwater impact assessment as part of the A12 Chelmsford to A120 Widening Scheme (the proposed scheme). The aim of this report is to provide an outline of the baseline groundwater characteristics within the proposed scheme and assess any significant environmental effects it may have on the groundwater regime and any associated receptors. This includes the impacts from dewatering during construction on groundwater flow and quality. This report has informed Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1].

2 Hydrogeology baseline

2.1 Geology and aquifers

Superficial and bedrock geology

2.1.1 A detailed description of the geology in the vicinity of the proposed scheme is included in Chapter 10: Geology and soils, of the Environmental Statement [TR010060/APP/6.1] and summarised here.

2.1.2 Geological maps of the route are presented on Figure 10.1 of the Environmental Statement [TR010060/APP/6.2], with additional relevant information on Figures 14.2 and 14.3 [TR010060/APP/6.2].

2.1.3 The study area (defined as 1km from the Order Limits for the purposes of the geology) is underlain by superficial deposits mainly comprising head deposits, glaciofluvial deposits, Lowestoft Formation, Brickearth and localised alluvium and River Terrace Deposits (BGS, 2021a). There are also localised deposits of glaciolacustrine materials and Kesgrave Catchment Subgroup.

2.1.4 Areas of Made Ground, worked ground and infilled ground are within the study area associated with historical land uses and landfill. Details of historical land use and contaminated land is discussed in Chapter 10: Geology and soils, of the Environmental Statement [TR010060/APP/6.1]. Along the existing A12 carriageway made ground is likely present but is not shown on British Geological Survey (BGS) maps.

2.1.5 Underlying the superficial deposits, the study area is mainly directly underlain by London Clay although the Thanet Sand Formation subcrops to the north of Witham while the Thanet Formation and Lambeth group is shown to subcrop to the southwest of Kelvedon (BGS, 2021a). In these locations the London Clay is likely to be absent. The Chalk underlies the Thanet Sand at depth.

2.1.6 There are no faults indicated by BGS along the route of the proposed scheme or within the vicinity of the study area. BGS mapping shows a buried (drift-filled) channel with a southwest- northeast orientation. This feature stretches from Witham to approximately 1.5km northeast of Kelvedon and covers the existing A12 route between these two towns.

Aquifer designations

2.1.7 The Environment Agency designates aquifers with the following classifications:

- Principal – These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- Secondary A – Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers;
- Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

- Secondary Undifferentiated - is assigned in cases where it has not been possible to attribute either category A or B to a rock type; and
- Unproductive Strata - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

2.1.8 The mapped superficial deposits (Defra, 2021) are classified mainly as Secondary A and Secondary Undifferentiated aquifers with pockets of Secondary B aquifer between junctions 19 and 20b (Hatfield Peverel North interchange).

2.1.9 The London Clay Formation which covers the majority of the site is unproductive strata and is thought to be relatively thick across the study area, therefore offers significant protection to the underlying Secondary A and Principal aquifer. The exception to this is where there are small outcrops of the Thanet and Lambeth groups within the centre of the study area classified as Secondary A aquifers.

2.1.10 Table 2.1 summarises aquifer characteristics and designations for each geological unit, both superficial and bedrock, within the study area. The superficial and bedrock aquifer designations are included in Figure 14.2 of the Environmental Statement [TR010060/APP/6.2].

Table 2.1 Superficial and bedrock aquifer descriptions and designations

Geological unit	Description	Aquifer designation	Flow mechanism and permeability	Hydrogeology
Superficial Aquifers				
Lowestoft Formation (Glacial Till)	Variable lithology, typically sandy, silty clay, with pebbles, but can contain gravel-rich, or laminated sand layers.	Secondary Undifferentiated	Intergranular flow, typically low permeability but also very variable in composition and can range from very low to moderate	Can act as an aquitard or aquiclude but typically highly heterogeneous and can locally comprise productive sand and gravel horizons, which may yield limited amounts of groundwater, although groundwater abstraction is unlikely.
Peat	Accumulation of wet, dark brown, partially decomposed vegetation, or an organic rich clay.	Unproductive strata	Intergranular flow, low to very low permeability	Typically comprises 90% water and acts as an aquitard, limiting recharge to deeper horizons. Permeability varies with the degree of decomposition and soil compression and often reduces with depth.
Interglacial lacustrine deposits	Devensian clay and silt.	Unproductive strata	Intergranular flow, low to very low permeability	Clay constituent typically causes this unit to act as an aquitard or aquiclude. Despite containing occasional productive silt/sand horizons, the limited extent and thickness of these deposits makes groundwater abstraction unlikely.

Geological unit	Description	Aquifer designation	Flow mechanism and permeability	Hydrogeology
Glaciofluvial/ glaciofluvial ice contact deposits	Sand and gravel, locally with lenses of silt, clay or organic material.	Secondary A	Intergranular flow, typically high permeability but can be variable with lenses of silt and clay, ranging from moderate to high permeability	Sand and gravel constituents may locally yield significant groundwater volumes where deposits are of sufficient thickness. The aquifer may contain perched water tables above discontinuous clay lenses. Local groundwater abstraction possible.
Alluvium	Typically soft to firm, consolidated compressible silty clay, that can contain layers of silt, sand, peat, basal gravel, and a desiccated surface zone.	Secondary A	Intergranular flow, high to low permeability	Where sand/gravel layers are thick and continuous, groundwater yields will be high, making local groundwater abstraction possible, although the dominance of clay in this unit may limit its potential as an aquifer.
Head	Comprises sand and gravel, locally with lenses of silt, clay or peat and organic material.	Secondary Undifferentiated	Intergranular flow, high to very low permeability	The extent and thickness of these deposits limits the available groundwater yield contained within the more productive sand and gravel horizons and groundwater abstraction is therefore unlikely. The unit may contain multiple perched water tables above discontinuous clay/peat lenses.
River Terrace Deposits	Sand and gravel, locally with lenses of silt, clay and peat.	Secondary A	Intergranular flow, typically high permeability but can be variable with lenses of silt and clay, ranging from moderate to high permeability	Sand and gravel deposits will typically comprise high porosity and high permeability and can locally yield significant groundwater volumes if clay lenses are infrequent and sand/gravel deposits are of sufficient thickness. Local groundwater abstraction possible.

Geological unit	Description	Aquifer designation	Flow mechanism and permeability	Hydrogeology
Kesgrave Catchment Subgroup	Mainly gravels characterized by quartz and quartzite. Comprise bodies of cross-bedded and massive, moderately sorted sand and gravel.	Secondary A	Intergranular flow, very high to high permeability	Gravel deposits will typically comprise high porosity and high permeability and can locally yield significant groundwater volumes Local groundwater abstraction possible.
Brickearth	Varies from silt to clay, usually yellow-brown and massive.	Secondary B	Intergranular flow, moderate to low permeability	Predominantly silts and clays with lower permeability which may store and yield limited amounts of groundwater.
Bedrock Aquifers				
London Clay Formation	Mainly comprises 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	Unproductive Strata	Fracture flow, low to very low permeability	Rocks with essentially no groundwater. Predominantly clayey sequence up to 140 m thick confining underlying aquifers. Occasional springs at base have very hard water.
Lambeth Group*	Vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate.	Secondary A	Dual flow, high to low permeability	Variable productivity ranging from moderate to low. Variable sequence of clays, shell beds, fine sands, silts and pebble beds giving low yields. Sometimes in hydraulic continuity with underlying Chalk aquifer. The range of permeability that can be expected from all units of the Lambeth Group is very wide, perhaps 1 × 10−4 to 1 × 10−10 m/s.2

Geological unit	Description	Aquifer designation	Flow mechanism and permeability	Hydrogeology
Thanet Formation**	sequence of upwardly-coarsening fine-grained, green-grey or grey-brown sand	Secondary A	Dual flow, high to low permeability	Moderately productive aquifer. Poorly cemented sands yielding moderate supplies where saturated.
Chalk Group (Upper and Middle Chalk)***	Chalk, with or without flint and discrete limestone, marl (calcareous mudstone), sponge, calcarenite, phosphatic, hardground and fossil-rich beds.	Principal	Dual flow, very high to moderate permeability	Highly productive aquifer Principal aquifer in UK up to 450 m thick and yielding 50 to 100 L/s from large diameter boreholes and up to 300 L/s from adit systems.

**at depth and does not occur at the surface in the study area apart from one small area*

*** at depth and does not occur at the surface in the study area apart from two small areas*

**** at significant depth and does not occur at the surface in the study area*

2.1.11 The Secondary A aquifers are generally associated with the alluvium, River Terrace Deposits, glaciofluvial deposits and in the northeast of the proposed scheme the Kesgrave Catchment Subgroup. Secondary undifferentiated aquifers are associated with the Head and Lowestoft formations which have variable lithologies throughout their formations. Brickearth is the only geology associated with Secondary B aquifers.

2.1.12 Areas where the Secondary A aquifers are present at the surface will have a higher sensitivity given their importance as local aquifers. This is especially true given that they supply most of the licensed abstractions (see Table 2.7 for details on abstractions) and likely the unlicenced abstractions in the study area.

2.1.13 In the area between Witham and Kelvedon these Secondary A aquifers are exposed at the surface. The alluvium and the River Terrace Deposits are widespread in this area following the paths of the main watercourses. Where the glaciofluvial deposits are exposed around Hatfield Peverel higher sensitivity will be assigned given the more permeable nature of these deposits and their status as a Secondary aquifer.

2.1.14 Within the Secondary Undifferentiated aquifers (Lowestoft formation and Head deposits) groundwater is more likely to be found in small, isolated bodies in the more permeable sandy layers. The extent of these deposits overlying the glaciofluvial deposits will offer some degree of protection to the Secondary A aquifer.

2.1.15 Small pockets of unproductive strata are shown in the vicinity of Rivenhall End and the northeast of Witham associated with interglacial lacustrine deposits. These will have a low sensitivity given their impermeable nature and are likely to provide protection for underlying Secondary A and B aquifers.

2.2 Groundwater flows and levels

Conceptualisation of groundwater flows and aquifer interactions

2.2.1 Shallow groundwater present in the superficial deposits is expected to generally reflect the ground surface contours. Groundwater is expected to flow from the interfluves to the lower-lying valleys of the major rivers including the River Chelmer, River Brain, River Blackwater, Domsey Brook and Roman River.

2.2.2 Groundwater is likely to flow through the more permeable units such as the glaciofluvial and River Terrace Deposits. Within the Lowestoft Formation which is present across the majority of the study area (not necessarily at the surface) groundwater is likely to be found in discreet, isolated bodies within more permeable layers.

2.2.3 The glaciofluvial deposits are present across the majority of the study area at depth and are likely to contain most of the regional groundwater flows, which in some cases may be confined by the overlying Lowestoft Formation.

2.2.4 Groundwater interactions between the glaciofluvial, River Terrace Deposits and alluvium are likely, especially where the lower permeability Lowestoft formation is absent. In these locations regional recharge from the glaciofluvial deposits into the overlying alluvium and River Terrace Deposits is likely. Where the alluvium is present, groundwater within is likely to be in hydraulic continuity with the watercourses contributing to baseflow or in times of high flow could be indirectly recharged by the river.

2.2.5 Within the lower permeability units such as the head deposits and the Lowestoft formation, interaction with other more productive units is likely limited by the lower permeability clay layers which dominate these formations. These can also act as confining units to any underlying aquifer units and in times when the water table is high could experience upwelling from these below units through preferential flow paths.

2.2.6 BGS data show that across the central area of the proposed scheme the susceptibility to groundwater flooding is very high to moderate as is the very south and very north (BGS, 2021b). In general, the northern area (apart from the very north) has no susceptibility to groundwater flooding. There are some areas in the south which this is also applicable to, however here there are more areas with a low risk. Annex F of the Flood Risk Assessment (Appendix 14.5 of the Environmental Statement [TR010060/APP/6.3]) displays the groundwater flooding susceptibility across the proposed scheme. In general, the flooding susceptibility corresponds with mapped superficial deposits in that area. More permeable units such as alluvium, River Terrace Deposits and glaciofluvial deposits seem to present a higher risk of groundwater flooding, while low permeability units such head deposits and the Lowestoft formation seem to not be usually associated with groundwater flooding.

GI specific data review

2.2.7 Three phases of ground investigation (GI) took place from November 2019, with the monitoring data being collected until September 2021 used in this report. Information from the Ground Investigation Reports (GIR) is provided in Chapter 10: Geology and soils [TR010060/APP/6.1], and Appendix 10.1: Land quality risk assessment [TR010060/APP/6.3], of the Environmental Statement. The GI covered the following geographical areas:

- Phase 1: Junction 19 Boreham Interchange to Junction 21 Lynfield Motors Exchange (also includes borrow pit locations)
- Phase 2: Junction 21 Lynfield Motors Interchange to Junction 23 Kelvedon South
- Phase 3: Junction 23 Kelvedon South to Junction 25 Marks Tey

2.2.8 Groundwater strikes or seepages were recorded in exploratory holes during the GIs. However, the use of water flush during rotary drilling meant determining groundwater strikes was not always possible. Trial pits typically reached 4m depth and therefore water strikes were less common. As such, it was generally in the window sample holes and cable percussive holes that the strikes were recorded as shown in Table 2.2.

Table 2.2 Groundwater strikes across all phases of GI

Hole type	Total number of holes	No. of holes recording a water strike	% of holes recording a water strike
Cable percussion and rotary follow on (BH+RC)	85	19	22%
Cable percussion (BH)	173	69	40%
Trial pit (TP)	306	30	10%
Window sample (WS)	137	48	35%
Logging While Drilling (LWD)	5	2	40%
IP	2	2	100%
All holes	708	170	24%

2.2.9 Across all three phases of the GI, groundwater strikes/seepages were generally within 4m of the ground surface as shown in Table 2.3. Within the Phase 3 area (to the north of the proposed scheme) approximately 50% of the groundwater strikes were recorded at depths less than 2mbgl.

Table 2.3 Water strike depths across study area

Water strike depth (mbgl)	No. of holes/trial pits
0 to <2	54
2 to <3	31
3 to <4	30
4 to <8	36
Deeper than 8	19

2.2.10 Where groundwater was encountered in the boreholes and window sample holes, the hole was left to stand, and the water level measured again after 20 minutes to record the rise in groundwater level.

2.2.11 The data show that generally, little rise in the groundwater level was recorded in the 20 minutes, with a rise of less than 2m recorded in 59% of the boreholes measured. 28% of the boreholes measured showed a rise of 3m or greater, with the largest rise at chainage 23300 northeast of Witham where a rise of 12.07m was recorded.

2.2.12 The groundwater strikes with the largest rises were encountered in relatively deep sandy horizons of the Glaciofluvial deposits beneath a clay horizon of the Lowestoft Formation indicating a degree of confinement. However, generally the shallow water strike data which have been recorded do not show confined groundwater conditions.

2.2.13 Across the proposed scheme groundwater strikes were typically encountered in the sand and gravel deposits associated with the Glaciofluvial Deposits and River Terrace Deposits (Table 2.4). However, 46 water strikes were recorded as being in either predominantly silt or clay deposits, mainly associated with the Lowestoft Formation.

Table 2.4 Geological horizon in which water strikes were encountered

Horizon of water strike	No. of holes/trial pits
Alluvium	7
Head Deposits	0
River Terrace Deposits	26
Lowestoft Formation	46
Glaciofluvial Deposits	54
Made ground	5
Interglacial lacustrine deposits	3
Kersgrave Catchment Subgroup	2

2.2.14 Groundwater monitoring has taken place with manual dip measurements at monthly intervals and by installing groundwater level data loggers in 99 boreholes within all the GI Phases. Information from data loggers is plotted in Annex A of this report.

2.2.15 Data collected from the Phase 1 and 2 boreholes provide one full year of groundwater level information, between August 2020 and September 2021. The data available for the Phase 3 boreholes is limited to between May and September 2021 and so no seasonal trends are observable in this part of the proposed scheme.

2.2.16 In general, the data from the Phase 1 and 2 locations indicated a general seasonality with maximum groundwater elevations recorded between January and March, following a gradual rise from October, with a slow decline in levels following this into summer 2021.

2.2.17 The data indicate that groundwater fluctuation in the monitoring boreholes varies by about 3m or less in general over a yearly monitoring period, with the majority showing a change less than 1m. Within this data there are two types of responses shown, one which indicates gentle rises and falls in the groundwater level over the winter and summer in response to seasonal variation.

2.2.18 The other response shows rapid spikes in the water levels which are likely in response to high rainfall events. These larger variations in groundwater levels occur around Witham, from Hatfield Peverel to Rivenhall End.

2.2.19 All monitoring locations are screened within the superficial deposits. As shown in Table 2.5, the groundwater monitoring shows that measured groundwater levels are typically within 4m of the ground surface across the study area with the majority of shallowest groundwater levels found within 2m of the ground surface. There is no clear pattern to the distribution of the depth to groundwater levels.

Table 2.5 Shallowest monitoring points in each borehole

Shallowest groundwater level recorded (mbgl)	No. of boreholes
0 to 2	127
2 to 4	58
4 to 6	29
>6	30

2.3 Connection to hydrological features

2.3.1 The local groundwater may be connected (either directly or indirectly) to watercourses (as baseflow, sinks, sources, spreads, collects, issues etc.), and spring discharges. Changes to groundwater quality and levels beneath the proposed scheme may therefore influence water quality and/or flows in these watercourses/hydrological features. Table 2.6 provides details of the springs, sinks, spreads and collects identified from Ordnance Survey maps within the groundwater study area.

Table 2.6 Groundwater features located within 1km of the proposed scheme

Location	National Grid reference (NGR)	No. of discharge points/features
Springs		
Boreham House	TL 7498 0940	1
Moor Gardens Wood	TL 5811 2107	1
Langford Road	TL 5827 2116	1
Station Road	TL 5828 2116	1
Ishams Barn	TL 5833 2134	1
Fabians Plantation	TL 5858 216	1
Kelvedon Lodge	TL 5855 2163	1
Parsonage Farm	TL 5888 2185	1
Messing Park	TL 5890 2182	1
Hornigals Barn	TL 5889 2226	1
Coggeshall Road (Feering)	TL 5870 2206	1
Ewell Hall Chase	TL 5864 2181	1
Witham Hockey Club	TL 5821 2141	1
Berwick Farm	TL 5773 2115	2
Wallace's Farm Cottage	TL 5756 2115	1

Location	National Grid reference (NGR)	No. of discharge points/features
Sinks		
Chelmer Village Way	TL 5735 2081	1
Church Road	TL 5755 2096	1
Mowden Hall	TL 5778 2109	1
Crix Corner Cottage	TL 5780 2111	1
Crab's Hill	TL 5790 2108	1
Crab's Hill Farm	TL 5791 2111	1
Wickham Bishop Road	TL 5806 2116	2
Moor Gardens Wood	TL 5811 2107	1
Parklands	TL 5819 2114	1
Sparkey Wood	TL 5833 2126	1
Kelvedon Lodge	TL 5853 2163	1
Chase House North	TL 5883 2202	1
Coggeshall Hall	TL 5864 2204	1
Church Hill	TL 5856 2186	1
Blunts Hall Road South	TL 5808 2141	1
Termitts Farm	TL 5790 2133	1
Hatfield Wick Farm	TL 5780 2121	1

**there were no collects or spreads within the study area*

2.3.2 Across the site evidence from the GI suggests that groundwater flows from the interfluves to the lower-lying valleys of the major rivers including the River Chelmer, River Brain, River Blackwater, Domsey Brook and Roman River. In these topographic lows it is likely that the groundwater discharges to the river, contributing as baseflow. Alluvium and River Terrace Deposits underline the majority of the watercourse throughout the study area. Groundwater contained within the alluvium/ River Terrace Deposits are likely to interact with the watercourses they surround by either contributing as baseflow or in times of high flow receiving indirect recharge from the river.

2.4 Groundwater as a resource

2.4.1 The groundwater source protection zone (SPZ) map (Defra, 2021) shows that the northern section of the proposed scheme, north of Kelvedon, lies within a total catchment protection zone (SPZ3). This SPZ3 is associated with multiple Chalk abstractions to the north, the closest of which lies approximately 8km northwest of the proposed scheme.

2.4.2 Due to the protection offered by the overlying London Clay, there would not be any impacts from the proposed scheme on the abstractions for which the SPZ3 is defined.

2.4.3 A further SPZ is defined for a public water supply abstraction 3km to the south of the Order Limits which abstracts from the shallow gravel aquifer. The SPZ3 for this abstraction extends to within 1km of the Order Limits.

2.4.4 In total, 45 licensed groundwater abstractions have been identified within 2km of the Order Limits of the proposed scheme (Landmark Information Group, 2016) (Figure 14.3 of the Environmental Statement [TR010060 /APP/6.2]). Within this data 11 of these supplies are also shown on a more recent map of licensed abstractions produced by the Environment Agency (2021). It is unclear whether the groundwater licensed abstractions recorded in the 2016 Landmark report and not listed by the Environment Agency have become inactive. To ensure that no groundwater abstraction is omitted in this assessment, the licensed abstractions recorded in 2016 have been assumed to be still active.

2.4.5 Table 2.7 records multiple licensed abstractions for domestic and or agricultural purposes, but for which the Environment Agency has not defined SPZ. For these abstractions, in line with the Environment Agency guidance a default SPZ1 of 50m and a SPZ2 of 250m around each of these abstractions has been applied (Environment Agency, 2018). These default SPZ1 and 2 are shown on Figure 14.3 of the Environmental Statement [TR010060/APP/6.2].

Table 2.7 Groundwater licensed abstractions within 2km of the Order Limits

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Gravel Pit,Stocks Farm, Boreham	LGA-1	1546m north of Order Limits	8/37/36/*G/0036	45,500	Superficial deposits	TL 5754 2120	Environment Agency GIS data set and Envirocheck report	Agriculture, spray irrigation-direct
Small Acres, Hatfield Peverel (2)	LGA-2	106m southwest	8/37/38/*G/0042	2,280	Superficial deposits	TL 5798 2117	Environment Agency GIS data set and Envirocheck report	General agriculture, spray irrigation-anti frost, spray irrigation-direct
Churches Nursery, Witham	LGA-3	86m north	8/37/32/*G/0028	3,410	Glacial Sand and Gravel	TL 5805 2128	Environment Agency GIS data set and Envirocheck report	Agriculture, spray irrigation-direct
Excavation At Olivers Farm Nurseries, Witham	LGA-4	357m south	8/37/31/*G/0049	9,100	Unknown but assumed to be from superficial deposits (abstraction from an excavation).	TL 5824 2124	Environment Agency GIS data set and Envirocheck report	Agriculture, spray irrigation-direct
Well At Olivers Farm Nurseries, Witham	LGA-5	80m south	8/37/31/*G/0049	9,100	Gravel-glaciofluvial deposits	TL 5821 2127	Environment Agency GIS data set and Envirocheck report	Agriculture, spray irrigation-direct

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Reservoir at Benton Hall, Witham	LGA-6	112m east	8/37/31/*G/0145	18,200	Unknown but assumed to be from superficial deposits (abstraction from a reservoir).	TL 5826 2128	Environment Agency GIS data set and Envirocheck report	Industrial, Commercial and public Services-golf course spray irrigation-direct
Borehole At Station Maltings	LGA-7	594m west	8/37/32/*G/0026	77,000	Gravel-glaciofluvial deposits	TL 5822 2152	Environment Agency GIS data set and Envirocheck report	Industrial, Commercial and public Services
Well At Station Maltings, Witham.	LGA-8	553m west	8/37/32/*G/0026	77,000	Gravel-glaciofluvial deposits	TL 5822 2153	Environment Agency GIS data set and Envirocheck report	Industrial, Commercial and public Services
Gt. Domsey Farm, Feering. (2)	LGA-9/LGA-35	371m north	8/37/31/*G/0066 8/37/31/*G/0203	4,750	Glacial Sand and Gravel	TL 5891 2219	Environment Agency GIS data set and Envirocheck report	Agriculture, General Farming & Domestic, Spray Irrigation - Direct
Mascotts Farm, Copford	LGA-10	52m south	8/37/24/*G/0067	22,700	Fluvial Sand and Gravel	TL 5924 2238	Environment Agency GIS data set and Envirocheck report	Agriculture, spray irrigation-direct

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Hill Broad Farm, Gt. Braxted	LGA-11	1350m southeast	8/37/23/*G/0083	6,000	Fluvial Sand and Gravel	TL 5848 2154	Environment Agency GIS data set and Envirocheck report	General Farming and Domestic
Old Hall, Boreham	LGA-12	725m south	8/37/36/*G/0017	Not supplied	Glacial Sand and Gravel;	TL 5759 2095	Envirocheck report	General Farming and Domestic
New Hall Farm, Boreham	LGA-13	720m northwest	8/37/36/*G/0021	Not supplied	Glacial Sand and Gravel	TL 5735 2103	Envirocheck report	General Farming and Domestic
New Hall Convent 1, Boreham (2)	LGA-14	897m northwest	8/37/36/*G/0020	Not supplied	Glacial Sand and Gravel	TL 5736 2107	Envirocheck report	General Farming and Domestic
Gravel Pit. Wallaces Fm, Boreham	LGA-15	810m north	8/37/36/*G/0039	Not supplied	Glacial Sand and Gravel	TL 5756 2115	Envirocheck report	Other Industrial/Commercial/ Public Services: General Use
Waltham Rd Gravel Pits, Boreham	LGA-16	1255m north	8/37/36/*G/0035	Not supplied	Glacial Sand and Gravel	TL 5755 2117	Envirocheck report	Mineral Products: Mineral Washing
Central Dairy, Hatfield Peverel (2)	LGA-17	10m east	8/37/38/*G/0029	Not supplied	Glacial Sand and Gravel	TL 5788 2120	Envirocheck report	General Farming and Domestic

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Ivy Barns Farm 2, Hatfield Peverel (2)	LGA-18	538m south	8/37/38/*G/0025	Not supplied	Glacial Sand and Gravel	TL 5801 2112	Envirocheck report	General Agriculture: Spray Irrigation – Direct. General Farming And Domestic
Brook Farm, Hatfield Peverel	LGA-19	660m southeast	8/37/31/*G/0102	Not supplied	Not supplied	TL 5806 2114	Envirocheck report	General Farming and Domestic
Ivy Barns Farm 1, Hatfield Peverel (2)	LGA-20	812m south	8/37/38/*G/0025	Not supplied	Glacial Sand and Gravel	TL 5801 2109	Envirocheck report	General Farming and Domestic
Wickham Bishops Rd. Hatfield Peverel	LGA-21	864m south	8/37/31/*G/0063	Not supplied	Unknown	TL 5812 2115	Envirocheck report	Mineral Products: Process Water
Wickham Bishops Road.	LGA-22	906m south	8/37/31/*G/0118	Not supplied	Glacial Sand and Gravel	TL 5814 2115	Envirocheck report	Mineral Products: Process Water
Trees, Hatfield Peverel (2)	LGA-23	1220m south	8/37/31/*G/0057	Not supplied	Glacial Sand and Gravel	TL 5817 2113	Envirocheck report	General Farming and Domestic
Rose Cottage, Rivenhall End	LGA-24	68m east	8/37/31/*G/0017	Not supplied	Not supplied	TL 5835 2154	Envirocheck report	General Farming and Domestic
Lea Lane Fruit Farm, Gt Braxted	LGA-25	1222m east	8/37/31/*G/0028	Not supplied	Fluvial Sand and Gravel	TL 5844 2140	Envirocheck report	General Farming and Domestic
Ashmans Farm 2, Kelvedon (2)	LGA-26	271m southeast	8/37/31/*G/0065	Not supplied	Glacial Sand and Gravel	TL 5856 2172	Envirocheck report	General Farming and Domestic

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Ashmans Farm 1, Kelvedon (2)	LGA-27	197m southwest	8/37/31/*G/0065	Not supplied	Glacial Sand and Gravel	TL 5857 2173	Envirocheck report	General Farming and Domestic
Kelvedon Hall Farm, Kelvedon	LGA-28	680m south	8/37/31/*G/0074	Not supplied	Glacial Sand and Gravel	TL 5865 2166	Envirocheck report	General Farming and Domestic
Point D (Two Boreholes At Inworth)**	LGA-29	5m south	8/37/23/*G/0071	Not supplied	Chalk	TL 5876 2190	Envirocheck report	Public Water Supply: Potable Water Supply – Direct (no longer used).
8 Boreholes At Kelvedon Oil Depot	LGA-30	72m east	8/37/31/*G/0222 8/37/31/*G/0219	Not supplied	Unknown. Assume to be shallow for remediation purposes.	TL 5860 2185	Envirocheck report	Environmental: Pollution Remediation
Borehole At Messing (2)	LGA-31	1466m east	8/37/31/*G/0204	Not supplied	Glacial Sand and Gravel	TL 5895 2185	Envirocheck report	General Agriculture: Spray Irrigation - Direct
Borehole At Messing	LGA-32	1432m east	8/37/33/1*/g204	3400	Glacial Sand and Gravel	TL 5895 2184	Envirocheck report	Well and borehole source. Spray Irrigation
Borehole - Domsey Ch. Feering (2)	LGA-33	49m north	8/37/31/*G/0195	Not supplied		TL 5891 2215	Envirocheck report	Private Water Undertaking: General Use
Borehole At, Great Domsey Farm	LGA-34	365m north	8/37/31/*g/203	50000	Glacial Sand and Gravel	TL 5891 2218	Envirocheck report	Agriculture (General). Well and borehole source

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
Great Domsey Farm, Feering, Marks Tey	LGA-36	353m north	8/37/31/*g/066	50000	Glacial Sand and Gravel	TL 5891 2219	Envirocheck report	Unspecified. Well and borehole source.
Borehole At Great Domsey Farm, Feering	LGA-37	353m north	8/37/31/*g/203	20000	Glacial Sand and Gravel	TL 5891 2219	Envirocheck report	Abstraction use not specified. Well and borehole source
Borehole At Feering (2)	LGA-38	343m north	8/37/31/*g/205	Not supplied	Glacial Sand and Gravel	TL 5888 2217	Envirocheck report	Abstraction use not specified. Well and borehole source
			8/37/31/*G/0205					Other Industrial/Commercial/ Public Services: General Use
Scotties Farm, Easthorpe	LGA-39	395m south	8/37/31/*G/0070	Not supplied	Glacial Sand and Gravel	TL 5896 2207	Envirocheck report	General Farming and Domestic
Wellpoint - Marks Tey	LGA-40	1064m northwest	8/37/31/*G/0220	Not supplied	Glacial Sand and Gravel	TL 5898 2233	Envirocheck report	General Agriculture: Spray Irrigation - Direct
			8/37/31/*G/0192					
Borehole At Livelands Nursery, Marks Tey	LGA-41	78m northeast	8/37/24/*G/0082	Not supplied		TL 5917 2236	Envirocheck report	Horticulture And Nurseries: Spray Irrigation - Direct

Location	ID	No. of discharge points/features	License number	Annual quantity (cubic metres)	Source (aquifer)	NGR	Data source	Use
By-Pass Nurseries, Marks Tey	LGA-42	299m northwest	8/37/31/*G/0054	Not supplied	Glacial Sand and Gravel	TL 5906 2231	Envirocheck report	General Agriculture: Spray Irrigation - Direct
Well At Brickworks, Marks Tey	LGA-43	496m northwest	8/37/24/*G/0017	Not supplied		TL 5911 2241	Envirocheck report	Private Water Undertaking: General Use
Claypit Brickworks, Marks Tey	LGA-44							Other Industrial/Commercial/ Public Services: General Use
Chippets Farm, Lexden Heath	LGA-45	876m north	8/37/24/*G/0015	not supplied		TL 5925 2252	Envirocheck report	General Farming and Domestic

**Envirocheck Report has additional abstractions not recorded by the Environment Agency. However, the Envirocheck report is dated 2016 therefore some of these abstractions may no longer exist (Landmark Information Group, 2016).*

*** The Environment Agency have confirmed (email on 13 May 2022) that these boreholes are no longer licenced by Anglian Water and the SPZ associated with them will be removed from the Environment Agency database.*

2.4.6 The abstractions are mainly associated with agricultural abstractions for spray irrigation although a small number of other uses are recorded.

2.4.7 The Envirocheck (Landmark Information Group, 2016) report notes two public water supply boreholes situated on Inworth Road less than 10m from the proposed scheme which are licensed to Anglian Water. BGS logs indicate that these boreholes abstraction locations were installed in the Chalk at depth and as such would be protected by the overlying London Clay deposits which are understood to extend to approximately 60m below ground level.

2.4.8 These locations were not included in the Environment Agency GIS dataset at the time of writing. Attempts were made to gather additional information from Anglian Water although no further details are available at the time of writing. However, liaison with the Environment Agency has confirmed that these locations were dropped from their licencing regime in 2016 (email 13 May 2022) and the Environment Agency would be removing the SPZ associated with these wells from their database.

2.4.9 Abstractions listed in the Envirocheck report record that they are in glacial sands and gravels, where this information is provided. The other abstractions of unknown sources are also likely to come from the shallow superficial deposits given the largely shallow nature of the boreholes from BGS records. Based on the information presented in the Envirocheck report and borehole logs available on the BGS GeoIndex site (BGS, 2021a), it is more likely that the groundwater is abstracted from the superficial deposits (most likely to be sand and gravel deposits which form the Secondary A superficial aquifers) as chalk has not been reached and the London Clay is an unproductive stratum.

2.4.10 Groundwater abstractions of less than 20m^3/day do not require a licence. Colchester Borough Council has identified 13 groundwater abstractions within the Study Area (PGA-1 to PGA-13) and these are shown on Figure 14.3 of the Environmental Statement [TR010060/APP/6.2]. A number of the PGA have been identified as being location at the same coordinates as licensed abstractions, suggesting that they relate to the same supply. Where applicable the labels on Figure 14.3 clearly show which licensed and unlicensed supplies overlay one another.

2.4.11 As shown in Table 2.8 there are 19 wells shown on current Ordnance Survey maps within the groundwater Study Area, and a further 31 wells shown on historical maps. Figure 14.3 [TR010060/APP/6.2] displays the location of current groundwater features identified on the OS maps. The closest well, according to present-day Ordnance Survey mapping, lies within the Order Limits at Inworth. This does not correlate with any of the licensed/unlicensed abstractions identified within the study area but is likely to be the former public water supply at Messing-cum-Inworth Pumping Station which is no longer active.

Table 2.8 Wells marked on Ordnance Survey maps in the groundwater study area

Location	NGR
Sandford Mill Lane	TL 5739 2060
River Chelmer South	TL 5737 2061
Sandford Mill Road	TL 5735 2066
Brook End Road South	TL 5737 2071
Mowden Hall lane	TL 5780 2101
Long Wood	TL 5783 2106
Sandpit Wood	TL 5785 2106
Sportmans Lane	TL 5791 2108
The Priory	TL 5797 2110
Drumochter Farm South	TL 5825 2116
Drumochter Farm West	TL 5825 2119
Sparkey Wood East	TL 5834 2123
Hill Broad House	TL 5847 2157
Inworth	TL 5880 2180
Stocks Green	TL 5877 2213
Termitts Farm	TL 5791 2133
Old School House	TL 5760 2114
Wallace's Farm Cottage (2)	TL 5756 2115

2.5 Groundwater dependent terrestrial ecosystems

2.5.1 At the Preliminary Environmental Information Report (PEIR) stage, 34 potential Groundwater Dependent Terrestrial Ecosystems (GWDTE) were identified within the initial 1km screening buffer, from the Order Limits (see Figure 14.3 of the Environmental Statement [TR010060/APP/6.2]). These were identified through a screening assessment of locally designated ecological sites such as Local Nature Reserves, Local Wildlife Sites and areas identified by ecologists as being potential GWDTEs through Phase 1 Habitat mapping (see Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1]).

2.5.2 This list has been refined to seven potential GWDTEs, which are located directly within or adjacent to the Order Limits and likely to be impacted by the proposed scheme. Details on the GWDTEs can be found in Section 5 of this appendix.

2.6 Groundwater vulnerability

2.6.1 Groundwater vulnerability maps provide an assessment of the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties. The groundwater vulnerability map (Defra, 2021) shows that the majority of the proposed scheme lies on aquifers with medium to low vulnerability. The low vulnerability relates to the Lowestoft formation while the medium-low relates to the Secondary A aquifer such as the alluvium, River Terrace Deposits and glaciofluvial deposits. Therefore, the centre of the proposed scheme between Witham and Kelvedon and the southern end of the proposed scheme have a medium-low vulnerability while the north is considered to have a low vulnerability.

2.6.2 The groundwater vulnerability map shows the areas of Thanet Formation and Lambeth Group outcrop are medium to high vulnerability, whilst there are also some areas shown as unproductive, which relate to the head deposits and areas where superficial deposits are absent exposing the London Clay.

2.7 Groundwater quality

2.7.1 The baseline groundwater quality is presented in Section 14.8 of Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1]. Locations where groundwater exceedances against relevant standards are recorded are shown on Figure 10.1 of the Environmental Statement [TR010060/APP/6.2], and described in Appendix 10.1: Land quality risk assessment [TR010060/APP/6.3].

2.7.2 The whole of the proposed scheme lies over a groundwater nitrate vulnerable zone (Sandlings and Chelmsford G78).

2.8 Water framework directive compliance

2.8.1 Large parts of the proposed scheme overlie the Essex Gravels Water Framework Directive (WFD (England and Wales) Regulations 2017) groundwater body (GB40503G000400) (Environment Agency, 2021b). This currently has ‘poor’ overall status due to its poor chemical quality, however the quantitative status remains ‘good’.

2.8.2 The only area which does not lie within this groundwater body is between the east of Feering at NGR TL 8786 2000 and Marks Tey NGR TL 9164 2382 where the proposed scheme does not lie within a designated WFD groundwater body.

2.8.3 Appendix 14.2: Water Environment Regulations (WFD Regulations) compliance assessment, of the Environmental Statement [TR010060/APP/6.3] reviews potential impacts on the Essex Gravels WFD groundwater body from a WFD compliance perspective.

3 Dewatering assessment

3.1 Introduction

3.1.1 This section provides an assessment of the potential dewatering impacts on groundwater receptors (surface water features, groundwater abstractions, GWDTE and buildings) present within the study area for the proposed scheme, supporting Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1].

3.1.2 Groundwater dewatering impacts could occur as a result of earthworks and excavations associated with features such as road cuttings and widenings, borrow pits, drainage attenuation ponds, and site compound construction that penetrate below the water table.

3.1.3 The assessment has been carried out in two stages. The initial screening considers the potential for excavations planned as part of the proposed scheme to intercept groundwater and generate a dewatering effect.

3.1.4 Potential impacts on all groundwater receptors within the potential zone of influence of dewatering at excavations were then assessed. An initial review based on the potential groundwater drawdown at each receptor was followed by a further detailed assessment for all potential impacts identified as of Moderate significance or greater.

3.1.5 In these assessments the magnitude of impact has been derived based on the expected degree of groundwater drawdown at the location of the receptor, assuming that a degree of hydraulic conductivity exists between groundwater and the receptor.

3.1.6 The sensitivity of the receptors is as reported in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1] and Section 2 of this appendix. For surface water features, these are based on the sensitivity adopted in the hydromorphology assessments also described in Chapter 14: Road drainage and the water environment [TR010060/APP/6.1].

3.1.7 The assumptions and limitations listed in Chapter 14: Road drainage and the water environment [TR010060/APP/6.1] apply to the assessments described in this section.

3.2 Initial screening

3.2.1 The initial screening identifies which proposed excavations are likely to intercept groundwater, based on the proposed depth of excavation and available information on groundwater levels from GI and groundwater level monitoring. Where groundwater level information is limited or not available a conservative approach has been taken, i.e. assuming levels to be high / closer to the ground surface.

Cuttings, widenings and borrow pits

3.2.2 The results of the initial screening of major excavations for proposed cuttings, widenings and borrow pits are presented in Table 3.1 for 28 cuttings, 17 widenings and four borrow pits. This indicates that 34 of the proposed excavations are likely to intercept groundwater.

Table 3.1 Potential groundwater interception at excavations

Cutting/ widening/ borrow pit ID	Approx. chainage start	Approx. chainage end	Maximum excavation depth (mbgl)*	Depth to groundwater (mbgl)*	Likelihood to intercept groundwater
C1	9950	10030	2.06	1.70	Likely
C2	10140	10450	2.79	2.14	Likely
C3	15190	15440	2.07	1.22	Likely
W1	15660	16100	4.36	2.08	Likely
W2	16100	16700	4.73	1.83	Likely
W3	16700	17200	4.81	>20.45	Unlikely
W4	18050	19190	8.10	2.00	Likely
W5	21650	22580	6.02	1.35	Likely
C4	22580	23060	6.44	1.65	Likely
C5	24200	24570	3.61	1.50	Likely
C6	24820	25110	4.30	0.90	Likely
W6	26640	27083	6.48	1.20	Likely
W7	30130	30750	7.06	5.31	Likely
C7	32100	32770	5.05	1.10	Likely
C8	33790	35090	6.41	1.10	Likely
C9	35600	35930	2.54	3.90	Unlikely
C10	36340	37510	3.71	1.05	Likely
W8	38170	38370	6.02	6.41	Unlikely
W9	38750	39220	2.16	3.60	Unlikely
WJ3	10460	10750	2.73	1.44	Likely
WJ4	11050	11260	3.79	2.11	Likely
CJ11	10980	11160	4.73	2.11	Likely
CJ1	16950	17160	3.07	2.70	Likely
CJ2	22830	23050	6.37	2.20	Likely

Cutting/ widening/ borrow pit ID	Approx. chainage start	Approx. chainage end	Maximum excavation depth (mbgl)*	Depth to groundwater (mbgl)*	Likelihood to intercept groundwater
CJ3	22830	23040	6.18	2.20	Likely
WJ5	23470	23650	1.53	4.50	Unlikely
CJ8	30780	31210	7.73	0.96	Likely
CJ9	30750	31200	5.33	0.96	Likely
CJ4a	31200	31295	9.61	0.96	Likely
CJ4b	31200	31320	7.75	0.96	Likely
CJ4c	31200	31320	7.66	0.96	Likely
CJ5	31300	31675	8.11	0.96	Likely
CJ6	31300	31520	7.13	0.96	Likely
CJ7	31300	31510	5.79	1.75	Likely
WJ2	38750	38950	1.56	0.75	Likely
WJ1	38950	39300	1.86	5.40	Unlikely
CJ10	38070	38150	2.03	3.00	Unlikely
WS1	24170	24320	3.20	8.00	Unlikely
CS3	24830	25000	1.73	4.00	Unlikely
CS1	19180	19395	1.74	1.93	Unlikely
CS2	24080	24180	1.75	3.80	Unlikely
WS2	25310	25450	1.75	3.20	Unlikely
CS4	34420	34510	1.92	8.00	Unlikely
CS5	33040	33075	2.13	5.20	Unlikely
WS4	33020	33180	2.81	2.00	Likely
BP-E	17400	18050	4.50	6.80	Unlikely
BP-F	18350	19000	4.00	0.35	Likely
BP-I	24400	25500	17.00	0.14	Likely
BP-J	30180	31200	7.00	0.40	Likely

** Depths are stated as m below ground level (mbgl)*

Drainage attenuation ponds

3.2.3 In addition to the excavations listed in Table 3.1, 71 attenuation ponds are proposed as part of the road drainage system. At this stage of assessment only preliminary design details are available and this assumes a maximum excavation depth of 2m for all attenuation ponds.

3.2.4 An initial screening has been carried out to identify which proposed attenuation pond locations are likely to intercept groundwater, based on the preliminary design depth of excavation and available information on groundwater levels from GI and groundwater level monitoring. Where groundwater level information is limited or not available a conservative approach has been taken, i.e. assuming levels to be high / close to the ground surface. The results of the initial screening are presented in Table 3.2.

Table 3.2 Potential groundwater interception at attenuation ponds

Attenuation pond name	Maximum excavation depth (mbgl)	Depth to groundwater (mbgl)	Likelihood to intercept groundwater
Pond for OU1	2.00	2.50	Unlikely
Pond for S1-OU7A	2.00	0.61	Likely
Pond for S1-OU11	2.00	0.34	Likely
Pond for S1-OU12	2.00	0.34	Likely
Pond for S1-OU13	2.00	1.91	Likely
Pond for S1-OU18	2.00	2.80	Unlikely
Pond for S1-OU19	2.00	3.95	Unlikely
Pond for S1-OU19A	2.00	3.70	Unlikely
Pond for S1-OU19C1	2.00	2.70	Unlikely
Pond for S1-OU19C	2.00	1.13	Likely
Pond for S1-OU23C	2.00	5.40	Unlikely
Pond for S1-OU23D	2.00	2.50	Unlikely
Pond for S1-OU24A	2.00	1.65	Likely
Pond for S1-OU24B	2.00	1.65	Likely
Pond for S1-OU23	2.00	1.52	Likely
Pond for S2-OU4	2.00	0.36	Likely
Pond for S2-OU9	2.00	5.30	Unlikely
Pond for S2-OU10	2.00	3.14	Unlikely
Pond for S2-OU11	2.00	4.90	Unlikely

Attenuation pond name	Maximum excavation depth (mbgl)	Depth to groundwater (mbgl)	Likelihood to intercept groundwater
Pond for S2-OU15A	2.00	5.67	Unlikely
Pond for S2-OU14	2.00	5.67	Unlikely
Pond for S2-OU15E	2.00	2.62	Unlikely
Pond for S2-OU15C	2.00	2.62	Unlikely
Pond for S2-OU15D	2.00	1.88	Likely
Pond for S2-OU15C1	2.00	0.73	Likely
Pond for S2-OU15G	2.00	0.73	Likely
Pond for S2-OU24A	2.00	0.51	Likely
Pond for S2-OU15H	2.00	1.57	Likely
Pond for S2-OU19	2.00	2.30	Unlikely
Pond for S2-OU18	2.00	2.30	Unlikely
Pond for S3-OU3	2.00	5.22	Unlikely
Pond for S3-OU1	2.00	5.22	Unlikely
Pond for S3-OU5	2.00	3.60	Unlikely
Pond for S3-OU4	2.00	1.28	Likely
Pond for S3-OU2	2.00	2.20	Unlikely
Pond for S3-OU13	2.00	8.63	Unlikely
Pond for S3-OU14	2.00	1.35	Likely
Pond for S3-OU7 + OU8A	2.00	0.96	Likely
Pond for S3-OU8	2.00	5.21	Unlikely
Pond for S3-OU8B (Pond 2)	2.00	0.91	Likely
Pond for S3-OU8B (Pond 1)	2.00	0.91	Likely
Pond for S3-OU8E	2.00	0.91	Likely
S3-OU-IWR2, S3-OU-IWR3, S3-OU-IWR5 and S3-OU-IWR7 along Inworth Road	2.00	9.50	Unlikely
Pond for S3-OU9	2.00	0.40	Likely

Attenuation pond name	Maximum excavation depth (mbgl)	Depth to groundwater (mbgl)	Likelihood to intercept groundwater
Pond for S3-OU10	2.00	0.60	Likely
Pond for S3-OU19	2.00	3.20	Unlikely
Swale for S3-OU20	2.00	1.00	Likely
Pond for S3-OU23	2.00	1.00	Likely
Pond for S3-OU21	2.00	1.21	Likely
Pond for S3-OU22	2.00	0.85	Likely
Pond for S3-OU24	2.00	1.12	Likely
Pond for S3-OU26	2.00	4.00	Unlikely
Pond for S3-OU26A	2.00	3.40	Unlikely
Swale for S3-OU27A	2.00	0.55	Likely
Pond for S3-OU27	2.00	3.54	Unlikely
Swale for S3-OU28	2.00	2.00	Unlikely
Pond for S3-OU29	2.00	0.55	Likely
Pond for S3-OU26B	2.00	0.00	Likely
Pond for S3-OU30	2.00	0.00	Likely
Pond for S3-OU31	2.00	2.98	Unlikely
Pond for S3-OU30A	2.00	1.05	Likely
Pond for S3-OU33	2.00	1.11	Likely
Pond for S3-OU32	2.00	>3.00	Unlikely
Pond for S3-OU15C	2.00	1.00	Likely
Pond for S3-OU15B	2.00	1.00	Likely
Pond for S3-OU15A	2.00	9.87	Unlikely
Pond for S3-OU16	2.00	0.55	Likely
Pond for S3-OU17	2.00	1.14	Likely

Other excavations

3.2.5 Shallow excavations are expected for gas mains diversions. These shallow excavations are discussed in the context of groundwater and groundwater receptors in Section 7 of this appendix.

3.2.6 The Flood Risk Assessment (FRA) (Appendix 14.5 of the Environmental Statement [TR010060/APP/6.3]) has identified the need for a number of flood compensation areas. These will require minor excavations. A summary of the geological and hydrogeological information, where available, has been reviewed in the FRA. Most flood compensation areas are expected to be located in the Lowestoft formation or London clay, and therefore no to unsignificant dewatering effects would be expected. Only the northern area of the flood compensation area associated with Minor watercourse 23 (east of Feering) is expected to be in River Terrace Deposits, however this flood compensation area is very small and should any groundwater be intercepted, it will be left to pond at in the flood compensation area. Therefore, no dewatering effect of significance would be expected.

Aquifers

3.2.7 Groundwater drawdown at excavations would impact aquifers due to the dewatering effect within the potential zone of influence. The proposed excavations would affect the superficial deposits and in places potentially the upper bedrock layers. No impact from the proposed works would be expected on the deeper chalk bedrock aquifers.

3.2.8 Considering the scale of the superficial aquifers across and beyond the study area, the proposed works would be expected to have a minor adverse magnitude of impact, resulting in a potential significance of effect of **Neutral** on Unproductive strata (Peat, Interglacial lacustrine deposits); **Slight** on Secondary B and Secondary Undifferentiated aquifers (Brickearth, Lowestoft Formation (Glacial Till), Head deposits); and **Slight** on Secondary A aquifers (Glacio-fluvial deposits, River Terrace Deposits, Alluvium, Kersgrave Catchment Subgroup (sand and gravel)).

3.2.9 Considering the scale of the bedrock aquifers across and beyond the study area, the proposed works would be expected to have a negligible magnitude of impact, resulting in a potential significance of effect of **Neutral** on Unproductive Strata (London Clay Formation) and Secondary A aquifers (Lambeth Group, Thanet Formation).

3.3 Assessment of impact on receptors

Methodology

3.3.1 The identification of groundwater receptors which may be impacted by dewatering is based on indicative estimates of the dewatering zone of influence around each excavation which may intercept groundwater.

3.3.2 Receptors could potentially be impacted be dewatering in several ways:

- Reduction in groundwater baseflow to surface water features.
- Reduction in capacity or total loss of groundwater abstractions.
- Lowering of the water table or reduction in groundwater discharge leading to alteration or loss of GWDTE habitats.
- Damage to buildings due to dewatering induced ground subsidence.

3.3.3 The potential magnitude of impact is based on the estimated degree of dewatering induced groundwater drawdown at the receptor and the significance of impact was derived based on the methodology described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], Section 14.5 (Assessment methodology), assuming that a degree of hydraulic conductivity exists between groundwater at the excavation and the receptor.

3.3.4 For those excavations where potential land contamination sources have been identified within the estimated zone of influence of groundwater drawdown, the potential for contaminated groundwater to be captured by the dewatering is considered in Table 3.7 and Table 3.8.

3.3.5 To assess the potential groundwater impacts within the estimated zones of influence the construction and operational phases have been considered together. This is due to the majority of construction effects (such as removal of excavated material or dewatering due to proposed cuttings) extending also to the operational phase. Where differences in impacts are predicted between the construction and operational phases these are noted, and impacts have been assessed for each in turn where appropriate.

3.3.6 The Sichardt method (e.g. Preene *et al*., 2016) was used to estimate the dewatering radius of influence around each excavation expected to intercept groundwater. This was applied using the estimated drawdown of groundwater levels to the base of the excavation. For this initial review step the maximum depth within the proposed excavation has been applied to the whole excavation, although in most cases depth varies across the footprint of the excavation.

3.3.7 Hydraulic conductivity values used in the calculation were based on GI or BGS boreholes in the vicinity of the excavations where available, or else BGS geological mapping. Generic values from the scientific literature (Domenico and Schwartz, 1990) appropriate to the materials recorded in the boreholes or mapping were applied.

3.3.8 Where the zone of influence estimated using the Sichardt equation, is quite small, the method is considered to be unreliable. Therefore, in order to ensure a suitable conservative assessment, a minimum zone of influence of 25 m has been assumed and applied in the review.

3.3.9 The degree of induced groundwater drawdown at a given receptor was estimated based on the distance of the receptor from the excavation and associated estimated groundwater drawdown depression at that location.

Surface water features

3.3.10 The outcome of the assessment of surface water features falling under the estimated zones of influence is presented in Table 3.3 and Table 3.4. Alluvium and River Terrace Deposits underline the majority of the watercourses throughout the study area and the nature of streambed deposits is unconfirmed. The degree of connectivity between groundwater and surface water is therefore unconfirmed and may be variable.

3.3.11 This assessment assumes that the local groundwater has a degree of hydraulic linkage (either directly or indirectly) to watercourses as baseflow. The potential magnitude of impact presented in Table 3.3 and Table 3.4 was assessed based on the predicted degree of groundwater drawdown at the surface water feature and does not take into account the size of the watercourse.

3.3.12 The review indicates only **Neutral** or **Slight** significance of impacts on surface water receptors. In the absence of potential significant impacts being identified (i.e. no potential impacts of Moderate or greater significance), no further assessment is required.

3.3.13 There are some surface water licensed abstractions present throughout the proposed scheme. Considering that no significant impacts on any surface water bodies as a result of groundwater dewatering are anticipated it is considered that there would be no consequent impact on surface water abstractions.

Table 3.3 Potential dewatering impacts on surface water features from road cuttings / widenings and borrow pits

Cutting ID	Water feature ID	Sensitivity of receptor	Magnitude of impact	Significance of effect
W1	River Ter	Medium	Negligible	Neutral
W2	1196	Low	Negligible	Neutral
W2	1197	Low	Negligible	Neutral
W5	1098, 1096	Low	Negligible	Neutral
W5	River Blackwater	High	Negligible	Neutral
W5	River Brain	Medium	Negligible	Neutral
W5	1100	Low	Minor	Neutral
W5	1114 *	Low	Minor	Neutral
W5	977	Low	Negligible	Neutral
W5	975	Low	Negligible	Neutral
C4	1114, 1112	Low	Negligible	Neutral
W6	878	Low	Negligible	Neutral
W6	876	Low	Negligible	Neutral
W6	872	Low	Negligible	Neutral
W6	870	Low	Negligible	Neutral
C7	862	Low	Negligible	Neutral
C7	861	Low	Negligible	Neutral
CJ11	1362	Low	Negligible	Neutral

Cutting ID	Water feature ID	Sensitivity of receptor	Magnitude of impact	Significance of effect
CJ11	1367	Low	Negligible	Neutral
C3	1183	Low	Negligible	Neutral
W2	1183	Low	Negligible	Neutral
W5	1115	Low	Negligible	Neutral
WJ2	Roman River	Medium	Negligible	Neutral
WJ2	447	Low	Negligible	Neutral
WJ4	1362	Low	Negligible	Neutral
BPI	Rivenhall Brook	Medium	Minor	Slight
BPJ	River Blackwater	High	Negligible	Neutral
BPJ	Domsey Brook	Medium	Negligible	Neutral

** Multiple receptors (nearest is 1114)*

Table 3.4 Potential dewatering impacts on surface water features from attenuation ponds

Attenuation Pond ID	Water feature ID	Sensitivity of receptor	Magnitude of impact	Significance of effect
Pond for S1-OU12	1367	Low	Negligible	Neutral
Pond for S2-OU4	River Brain	Medium	Negligible	Neutral
Pond for S2-OU15C1	984	Low	Negligible	Neutral
Pond for S2-OU15G	990	Low	Negligible	Neutral
Pond for S3-OU9	858	Low	Negligible	Neutral
Pond for S3-OU9	854	Low	Negligible	Neutral
Pond for S3-OU9	862	Low	Negligible	Neutral
Pond for S3-OU9	861	Low	Negligible	Neutral
Pond for S3-OU10	862	Low	Negligible	Neutral
Pond for S3-OU10	861	Low	Negligible	Neutral
Pond for S3-OU17	542	Low	Negligible	Neutral

Groundwater abstractions

3.3.14 The review was based on the estimated drawdown at the location of each abstraction, following ranges given in Table 3.5. The outcome of the assessment of groundwater abstractions falling under the estimated zones of influence is presented in Table 3.6.

Table 3.5 Magnitude of impact on groundwater abstractions

Magnitude of impact	Drawdown from (m)	Drawdown to (m)
Major	4.5	>
Moderate	1	4.5
Minor	0.25	1
Negligible	0	0.25

3.3.15 The review identified potential impacts of Moderate or greater significance to the following groundwater abstractions:

- LGA-17 - Central Dairy, Hatfield Peverel – as a result of Widening 2,
- LGA-24 - Rose Cottage - as a result of Widening 5; and
- PGA-7 - Ashmans Farm 1, Kelvedon – as a result of Widening 6.

3.3.16 Further detailed assessments of these three abstractions are presented in Section 3.4 of this appendix.

Table 3.6 Potential dewatering impacts on groundwater abstractions

Cutting ID	Abstraction ID	Sensitivity of receptor	Magnitude of impact	Significance of effect
W2	LGA-17 (Central Dairy)	Very High	Minor	Moderate
W2	PGA-1 (Hatfield Place)	Medium	Minor	Slight
W5	LGA-24 (Rose Cottage)	Very High	Minor	Moderate
W6	LGA-27 (Ashmans Farm 1, Kelvedon)	Very High	Minor	Moderate
W6	LGA-26, Ashmans Farm 2, Kelvedon	Very High	Negligible	Slight
W6	PGA-7, Ashman's Farm, Well	Medium	Negligible	Neutral
W6	PGA-8, Greenleaves, Well	Medium	Negligible	Neutral
BP-J	LGA-30, Kelvedon Oil Depot (Boreholes)	Medium	Negligible	Neutral
BP-J	LGA-27 (Ashmans Farm 1, Kelvedon)	Very High	Negligible	Neutral
BP-J	LGA-26, Ashmans Farm 2, Kelvedon	Very High	Negligible	Neutral
BP-J	PGA-7, Ashman's Farm, Well	Medium	Negligible	Neutral
BP-J	PGA-8, Greenleaves, Well	Medium	Negligible	Neutral

Buildings

3.3.17 Section 4 of this appendix discusses potential differential settlement impacts on buildings as a result of dewatering effects.

GWDTE

3.3.18 Section 5 of this appendix discusses potential impacts on GWDTE receptors, including dewatering impacts.

Groundwater quality from contaminated land

3.3.19 Historical and current potential sources of contamination are documented in Chapter 10: Geology and soils, of the Environment Statement [TR010060/APP/6.1].

3.3.20 The outcome of the identification of known potential contaminated land falling under the estimated zones of influence of dewatering at excavations is presented in Table 3.7 and Table 3.8. Chapter 10: Geology and soils [TR010060/APP/6.1] has assessed groundwater quality samples and leachability test results against Environmental Quality Standards (EQS). This is so that groundwater quality, which is expected to be intercepted during earthworks and would be discharged to surface water receptors, is placed within the context of the end receptor. The list of contaminants exceeding EQS at each excavation is listed in Table 3.7 and Table 3.8.

3.3.21 From 34 cuttings / widenings and borrow pits expected to intercept groundwater, this review identified 12 excavations with known potential contamination sources within the estimated zone of influence of groundwater drawdown. Nine of these have recorded groundwater quality exceeding EQS standards. A further five excavations with no identified potential contamination sources have also recorded groundwater quality exceeding EQS standards.

3.3.22 From 37 attenuation ponds expected to intercept groundwater, this review identified five excavations with known potential contamination sources within the estimated zone of influence of groundwater drawdown. Four of these have recorded groundwater quality exceeding EQS standards. One further excavation with no identified potential contamination sources has also recorded groundwater quality exceeding EQS standards.

3.3.23 The potential impacts associated with these groundwater quality exceedances are two-fold:

- Potential water quality discharge issue during the construction phase. This is further discussed in Appendix 14.1: Water quality assessment report, of the Environmental Statement [TR010060/APP/6.3].
- Long term road drainage water quality issues during the operational phase. This is further discussed in Appendix 14.1: Water quality assessment report [TR010060/APP/6.3].

Table 3.7 Summary of groundwater quality characteristics at dewatering locations from road cuttings / widening and borrow pits

Cutting ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
C1	No sources	No exceedances	No exceedances
C2	No sources	No exceedances	No exceedances
C3	No Sources	No exceedances	No exceedances
W1	No Sources	No exceedances	No exceedances
W2	Multiple discharge consents (4 No.), Industrial area, Garages (2 No.), Obsolete fuel station, fire station and ground associated with railway, brick works	Manganese, Copper, Total cyanide	Copper, naphthalene, anthracene, fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3cd)pyrene, selenium, manganese, arsenic, chromium (III and VI), lead and zinc
W4	No sources	No exceedances	Arsenic, lead, manganese and total cyanide
W5	Historical land fill sites (2 No.), sewage works, Maldon road landfill, Industrial area, rifle range, obsolete fuel station, gas governor	Cadmium, chloride, chromium, copper, lead, manganese, nickel, fluoranthene, sulphate (SO4)	Manganese, ammoniacal nitrogen (NH4), copper, total cyanide and lead
C4	Rifle Range	No exceedances	Manganese, total cyanide, copper and lead
C5	Historical mineral extraction site, fuel station	No exceedances	No exceedances
C6	No sources	No exceedances	Copper
W6	Waste transfer station, infilled ponds (5 No.), historical mineral extraction sites (3 No.), unspecified mill, brick pits, pump house, water pumping station, unspecified mound, infilled pit.	Total cyanide, sulphate, manganese, electrical conductivity, copper, nickel, nitrite (NO2), nitrate (NO3)	Manganese and lead

Cutting ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
W7	Brick pits, pump house, water pumping station, historical mineral extraction site, unspecified mound, infilled pit, infilled pond	Total cyanide, sulphate, manganese, electrical conductivity, copper, nickel, nitrite (NO2), nitrate (NO3)	Lead
C7	Infilled Pond	Nitrite (NO2), manganese, chromium (III)	No exceedances
C8	No Sources	Nitrite (NO2), manganese	Manganese
C10	No Sources	Manganese	Manganese
WJ3	No sources	No exceedances	No exceedances
WJ4	Industrial area, substation, garage, brick pits	Cadmium, lead, nickel, sulphate, zinc, total cyanide, chloride, hydrocarbons	Arsenic and copper
CJ11	Industrial area, fuel station, garage, substation, brick pits	Cadmium, lead, nickel, sulphate, zinc, total cyanide, chloride	No exceedances
CJ1	No sources	No exceedances	No exceedances
CJ2	No sources	No exceedances	No exceedances
CJ3	No sources	No exceedances	No exceedances
CJ5	No sources	No exceedances	Manganese
CJ6	No sources	No exceedances	No exceedances
CJ8	No Sources	Copper, manganese, nickel, nitrite (NO2), nitrate (NO3), total cyanide, chromium (III), sulphate (SO4), chloride,	Lead and manganese
CJ9	No sources	No exceedances	No exceedances
CJ4a	No Sources	Total cyanide, manganese, nitrite (NO2), nitrate (NO3)	No exceedances
CJ4b	No sources	No exceedances	No exceedances
CJ4c	No Sources	Total cyanide, manganese, nitrite (NO2), nitrate (NO3)	No exceedances

Cutting ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
CJ7	No Sources	Chromium (III), manganese, sulphate (SO4), nitrite (NO2)	Lead
WJ2	Industrial area, railway sidings, substations (3 No.), nursery, infilled pond, infilled pits (2 No.), historical landfill site, gas governor.	Chromium (III), ammoniacal nitrogen (NH4), nitrate (NO3), total cyanide, nitrite (NO2), manganese	Total cyanide, nitrite (NO2), and manganese
WS4	Nursery	No exceedances	No exceedances
BP-J	Infilled ponds (2 No.), licensed surface water abstraction, historical mineral extraction sites (8 No.), waste transfer station, unspecified mill, brick pits (2 No.), water pumping stations (4 No.), Pump houses (2 No.), infilled pits (3 No.), unspecified mound, nurseries (2 No.), industrial area, licensed groundwater abstractions (2 No.), discharge consents (2 No.) and a historical sewage works.	Total cyanide, chloride, anthracene, Fluoranthene, benzo(b)pyrene, indeno(1,2,3-cd)pyrene, benzo(ghi)perylene, total petroleum hydrocarbons (TPH), chromium (III), manganese, electrical conductivity, chromium (III), nitrate (NO3), sulphate (SO4), nitrite (NO2), manganese, copper, nickel	Manganese, lead, cadmium, copper, pH and benzene
BP-F	No sources	No exceedances	No exceedances
BP-I	No sources	No exceedances	No exceedances

Table 3.8 Summary of groundwater quality characteristics at dewatering locations from attenuation ponds

Attenuation Pond ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
Pond for S1-OU7A	No sources	No exceedances	No exceedances
Pond for S1-OU11	No sources	Cadmium, lead, nickel, sulphate and zinc	No exceedances
Pond for S1-OU12	No sources	No exceedances	No exceedances
Pond for S1-OU13	No sources	No exceedances	No exceedances

Attenuation Pond ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
Pond for S1-OU19C	No sources	No exceedances	No exceedances
Pond for S1-OU24A	No sources	No exceedances	No exceedances
Pond for S1-OU24B	No sources	No exceedances	No exceedances
Pond for S1-OU23	No sources	No exceedances	No exceedances
Pond for S2-OU4	Historic Landfill site, sewage works and industrial area	Chloride, manganese, cadmium, fluoranthene, lead, sulphate (SO4), chromium, copper, nickel	Manganese
Pond for S2-OU15D	No sources	No exceedances	No exceedances
Pond for S2-OU15C1	Sewage works and fuel station	No exceedances	No exceedances
Pond for S2-OU15G	No sources	No exceedances	Copper
Pond for S2-OU24A	No sources	No exceedances	No exceedances
Pond for S2-OU15H	No sources	No exceedances	No exceedances
Pond for S3-OU4	No sources	No exceedances	Lead
Pond for S3-OU14	No sources	No exceedances	No exceedances
Pond for S3-OU7 + OU8A	Pumping station (former sewage works)	No exceedances	No exceedances
Pond for S3-OU8B (Pond 2)	No sources	No exceedances	No exceedances
Pond for S3-OU8B (Pond 1)	No sources	No exceedances	No exceedances
Pond for S3-OU8E	No sources	No exceedances	No exceedances

Attenuation Pond ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
Pond for S3-OU9	Infilled Pit, historical mineral extraction site, brick pits and pump house	Nitrite (NO_2), manganese, total cyanide, chloride, anthracene, Fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(b)pyrene, indeno(1,2,3-cd)pyrene, benzo(ghi)perylene, total petroleum hydrocarbons, chromium (III), electrical conductivity	pH
Pond for S3-OU10	Infilled Pit, historical mineral extraction site and brick pits.	Nitrite (NO_2), manganese, total cyanide, chloride, anthracene, Fluoranthene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(b)pyrene, indeno(1,2,3-cd)pyrene, benzo(ghi)perylene, total petroleum hydrocarbons, chromium (III), electrical conductivity	pH
Swale for S3-OU20	No sources	No exceedances	No exceedances
Pond for S3-OU23	Nursery	No exceedances	No exceedances
Pond for S3-OU21	No sources	No exceedances	No exceedances
Pond for S3-OU22	No sources	No exceedances	No exceedances
Pond for S3-OU24	Nursery	No exceedances	No exceedances
Swale for S3-OU27A	No sources	No exceedances	No exceedances
Pond for S3-OU29	No sources	No exceedances	No exceedances
Pond for S3-OU26B	No sources	No exceedances	No exceedances
Pond for S3-OU30	No sources	No exceedances	No exceedances

Attenuation Pond ID	Land contamination sources	Groundwater quality exceedances against EQS	Soil leachate quality exceedances against EQS
Pond for S3-OU30A	No sources	No exceedances	No exceedances
Pond for S3-OU33	No sources	No exceedances	No exceedances
Pond for S3-OU32	No sources	No exceedances	No exceedances
Pond for S3-OU15C	No sources	No exceedances	No exceedances
Pond for S3-OU15B	No sources	No exceedances	No exceedances
Pond for S3-OU16	Nursery	No exceedances	Benzo(a)pyrene
Pond for S3-OU17	Sand and gravel pits, historical mineral extraction site, historic landfill site, garage, railway sidings and yard	Total cyanide, manganese, chromium (III), ammoniacal nitrogen (NH_4), nitrate (NO_3), chloride, electrical conductivity, nitrite (NO_2)	Manganese, arsenic, lead, pH

3.4 Detailed assessments

3.4.1 For each of the potential impacts identified in Section 3.3 above as of Moderate or greater significance a further detailed assessment has been carried out. These are presented below for each proposed cutting/widening.

3.4.2 These assessments consider the specific local circumstances and provide a more refined estimate of the potential magnitude of that impact. They are based on consideration of all available relevant information, primarily available GI and groundwater level monitoring data and the local topography, as well as the details of the receptor. The significance of impact was then predicted based on the methodology described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], Section 14.5 (Assessment methodology).

Widening 2

Groundwater abstraction: LGA-17 - Central Dairy, Hatfield Peverel

3.4.3 This abstraction was identified as a licensed groundwater abstraction (license no. 8/37/38/*G/0029) in the 2016 Envirocheck report, and the mapped coordinates are located approximately 185 m from Widening 2. The license information states that the source is from Glacial Sand and Gravel, however no further information is available. The use is stated as general farming and domestic but the abstraction rate is not available.

3.4.4 Based on BGS mapping, the abstraction's coordinates are located on Lowestoft Formation (glacial till diamicton) superficial deposits, which are classified as a Secondary (Undifferentiated) aquifer. The location is near (approximately 125 m) a boundary with Glaciofluvial Sand & Gravel deposits (Secondary A aquifer) which are likely to directly underly the Lowestoft Formation. The underlying bedrock is London Clay (clay, silt & sand), which is classified as Unproductive strata.

3.4.5 Ordnance Survey mapping suggests the abstraction is located at approximately 40m above Ordinance Datum (AOD), slightly downslope from the widening (where ground level is approximately 1 to 2 m higher). The base of the proposed widening at its deepest would be below ground level at the abstraction location.

3.4.6 The abstraction source could be a borehole or well, likely to be penetrating through the upper superficial till layer into the underlying sand and gravel, and therefore could be of relatively shallow depth.

3.4.7 This is supported by BGS borehole recording sandy gravel from around 4 to 6 mbgl in some locations, though this layer is less clear in others. London Clay is recorded from around 5 to 10 mbgl. Groundwater is recorded from around 2 mbgl.

3.4.8 The nearest GI boreholes to the northwest show London Clay from around 1.5 mbgl, with no sand & gravel present.

3.4.9 Considering the available borehole information and local topography, the groundwater catchment for this abstraction is likely to be to the east-northeast and may be relatively limited in extent. The exploited aquifer may be relatively thin.

3.4.10 The predicted potential groundwater drawdown at the abstraction location of around 0.9 m. It should be noted the estimate zone of influence for Cutting W2 is likely to be over-estimated as the deposits away from the cutting will vary and the permeability would be expected to reduce and so the estimated drawdown is also likely to be an over-estimate. However, the aquifer is expected relatively thin and limited in extent, and therefore the potential minor magnitude of impact identified in the initial review is increased to moderate and the significance of impact to **Large**.

Widening 5

Groundwater abstraction: LGA-24 - Rose Cottage

3.4.11 This abstraction was identified as a licensed groundwater abstraction (license no. 8/37/31/*G/0017) in the 2016 Envirocheck report, and the mapped coordinates are located approximately 475 m from Widening 5. The license information states that the use is as general farming and domestic. However, no further information on the source or the abstraction rate is available.

3.4.12 Based on BGS mapping, the abstraction's coordinates are located on River Terrace Deposits (sand & gravel) superficial deposits, these are classified as a Secondary A aquifer. The underlying bedrock is London Clay (clay, silt & sand), which is classified as Unproductive strata.

3.4.13 Ordnance Survey mapping shows the abstraction is located in a relatively flat area at approximately 16 mAOD elevation, around 2 to 3 m below ground level at the widening. The base of the proposed widening at its deepest would be above ground level at the abstraction location but is likely to be cross-gradient from it.

3.4.14 The abstraction is located close to a surface watercourse/drain, with other surface water features, including the River Blackwater (100 m), in the vicinity and between the abstraction and proposed widening. The abstraction lies within Flood Zone 3 surrounding the Blackwater. It is also in an area mapped as of Very High groundwater flooding potential from superficial deposits.

3.4.15 A BGS borehole record corresponds to and is likely to be a record of this abstraction. The record is dated 1969 but other than recording it to be an abstraction from a gravel aquifer, and noting a licensed quantity of 1300 gallons per day (5.9 m3/d), it does not contain any other useful information.

3.4.16 A nearby BGS borehole record records 6.4 m of sandy gravel River Terrace Deposits over lacustrine deposits (clay) and London Clay bedrock.

3.4.17 There are no closer GI boreholes likely to be of direct relevance to the abstraction.

3.4.18 This abstraction is therefore likely to be a shallow borehole or well exploiting a shallow sand and gravel (River Terrace Deposit) aquifer. The predicted potential groundwater drawdown at the abstraction location of around 0.3 m. While the widening may reduce groundwater levels at, and groundwater flow towards the abstraction to some degree, groundwater flows to this area are not expected to be significantly reduced. The aquifer feeding this abstraction is likely to be within the floodplain of and in hydraulic continuity with the River Blackwell, therefore feeding from a wider catchment away from W5. Considering this and the distance from the proposed widening, the potential magnitude of impact is considered to be negligible, resulting in a **Neutral** impact significance.

Widening 6

3.4.19 Groundwater abstraction: LGA-7 - Ashmans Farm 1, Kelvedon

3.4.20 The abstraction is located 419 m from Widening 6. No details of the abstraction source were available.

3.4.21 This abstraction was identified as a licensed groundwater abstraction (license no. 8/37/31/*G/0065) in the 2016 Envirocheck report, and the mapped coordinates are located approximately 419 m from Widening 6. The license information states that the source is Glacial Sand and Gravel, however no further information is available. The use is stated as general farming and domestic, but the abstraction rate is not available.

3.4.22 BGS mapping indicates the abstraction is located on River Terrace Deposits (sand & gravel) superficial deposits, these are classified as a Secondary A aquifer. The underlying bedrock is London Clay (clay, silt & sand), which is classified as Unproductive strata.

3.4.23 The abstraction is located in a valley bottom at approximately 19.5mAOD. The base of the proposed widening at its deepest would be just above ground level at the abstraction location.

3.4.24 The abstraction is located approximately 125 m from and slightly above the River Blackwater. The abstraction lies at the edge of Flood Zone 2 surrounding the Blackwater. It is also in an area mapped as of Very High groundwater flooding potential from superficial deposits.

3.4.25 There is no BGS borehole record corresponding to the location of this abstraction. However, BGS records of borehole logs corresponding to other abstractions in the vicinity (including one corresponding to LGA-26/PGA-8) indicate abstraction is likely to be from a gravel aquifer.

3.4.26 The nearest available GI boreholes are approximately 280 m and 350 m to the north. These record sandy gravel (identified as River Terrace Deposits) from 4 mbgl, below clay alluvium.

3.4.27 This abstraction is therefore likely to be a shallow borehole or well exploiting a sand and gravel (River Terrace Deposit) aquifer within the wider floodplain of the River Blackwell. These deposits may be in hydraulic connection with the river, but this is unconfirmed. The predicted groundwater drawdown at the abstraction is only around 0.4 m and the proposed widening is cross-gradient from the abstraction.

3.4.28 However, with the groundwater (and partly surface water) catchment expected to lie primarily to the southeast of the abstraction this might be affected by groundwater drawdown at the widening and groundwater flow towards the abstraction reduced. Consequently, the potential minor magnitude of impact and **Moderate** significance of impact is confirmed at this stage.

3.5 Results

3.5.1 Following detailed assessment, potential impacts of significance are expected on two groundwater abstractions (LGA-17 and LGA-7) as a result of indirect dewatering effects at excavations.

3.5.2 As indicated above, both were recorded as licensed abstractions in the 2016 Envirocheck report only. Ongoing consultation with the Environment Agency will continue during detailed design phase to confirm whether these licences are still active, whether any other licenced abstraction are present, and if so, request that all the details held by the Environment Agency be provided.

3.5.3 Should these abstractions be no longer licensed, the landowner would be consulted to determine whether these abstractions are still active.

3.5.4 Should the abstractions still be active (licenced or not), the following mitigation measures would be implemented during detailed design phase:

- Gather further information on the source (including nature, depth and confirming location of the abstraction) and update the impact assessment to confirm whether additional measures should be implemented;

- Should the revised assessment confirm that additional measures are required, monitoring the groundwater abstractions prior to and during construction, and potentially for a period post construction would be expected; and
- Should monitoring indicate an impact during the proposed work, a temporary replacement water supply would be provided. Should monitoring demonstrate a long-term impact, the supply source would be replaced.

3.5.5 In addition to the two groundwater abstractions identified at risk, uncertainty remains on the exact abstraction location of other groundwater abstractions which have been assessed as not being at significant risk. Should the abstraction location be located nearer than suggested by the coordinates provided by the Environment Agency or local authorities, then the risk profile of these groundwater supplies could increase. For this reason, further information on the source (including nature, depth and confirming location of the abstraction) would be gathered on the following groundwater abstractions during detailed design phase: LGA-24, PGA-1, LGA-26, LGA-27, PGA-7 and PGA-8.

3.5.6 Once the details are confirmed, should any of these groundwater abstractions be located nearer to the works than assessed initially, the assessment would be revisited and mitigation measures would be proposed as required, following the same principles as outlined for LGA-17 and LGA-7.

4 Settlement assessment

4.1 Introduction

4.1.1 Groundwater dewatering has the potential to create settlement effects in deposits, and the difference in settlement from one end to of a building to the other, also called differential settlement, can cause structural risks depending on the magnitude of the differential settlement and the building itself.

4.1.2 This Section undertakes a preliminary settlement assessment for buildings that are expected to fall under the zones of influences estimated in the dewatering assessment (Section 3 of this appendix). The assessment was undertaken using Settle 3 (version 5.010) software, which is a three-dimensional programme for performing settlement analyses for foundations, embankments and areas under surface loads.

4.1.3 Section 4.2 explains the approach and parameters applied to this assessment, and Section 4.3 provides the results of this preliminary assessment.

4.2 Approach, assumptions and limitations

Types of superficial deposits and bedrock

4.2.1 Based on BGS Geology mapping at the surface in the area of interest the following types of superficial deposits have been encountered:

- Head Deposits
- Glaciolacustrine deposits
- Lowestoft Formation
- Glaciofluvial deposits
- Alluvium
- River Terrace Deposits
- Interglacial Lacustrine Deposits Silt and Clay
- Kesgrave Catchment Subgroup (sands and gravels)
- Brickearth
- London Clay Formation (bedrock)

Ground parameters

4.2.2 The ground parameters for each type of geological stratum are based on the outcome of the ground investigations (Geotechnical Engineering Limited, 2021) and are presented in Table 4.1 below.

Table 4.1 Summary of soil parameters

Geological stratum	Bulk weight density - γ (1), (2)	Coefficient of volume compressibility- mv (3), (4)	Constrained modulus – $M = \frac{1}{m_v}$
	$\left[\frac{kN}{m^3}\right]$	$\left[\frac{m^2}{MN}\right]$	$[MPa]$
Head Deposit	19.5	0.176	5.7
Glaciolacustrine deposits	19.8	0.081	12.3
Lowestoft Formation	20.5	0.069	14.5
Glaciofluvial deposits	19.8 (cohesive) 21.0 (granular)	0.148	6.8
Alluvium	15.5 (for NMC>35%) 19.5 (for NMC<35%)	0.373	2.7
River Terrace Deposits	19.8 (cohesive) 21.0 (granular)	0.144	6.9
Interglacial Lacustrine Deposits Silt and Clay	19.6	0.147	6.8
Kesgrave Catchment Subgroup	19.5 (cohesive) 21.0 (granular)	0.074	13.5
Brickearth	18.0	Lack of results	Lack of results
London Clay Formation (bedrock)	18.8	0.076	13.2

Notes:

[1] Bulk weight density based on representative values of global soil index properties from GIR.

[2] For settlement analyses if different values have been presented (in GIR) for cohesive and granular material, the one with lower value of bulk weight density has been adopted to be more conservative (lower bulk weight density causes deeper range of cutoff).

[3] Coefficient of Volume of Compressibility based on average values presented in the GIR which based on SPT N60 and Plasticity Index correlation.

[4] Coefficient of Volume Compressibility has been derived only for cohesive soils, however for more granular layers also cohesive value has been adopted which represents more conservative approach.

Geometry of model

4.2.3 The following geometry was used in the model Settle 3:

- Size of analysing model is 100m width and 100m length.
- Depth of the model is 100m.

Assumptions

4.2.4 The following assumptions have been adopted:

- Value of settlement cutoff, load/in-situ vertical stress ratio of 0.2 has been adopted (which represents a depth when 20% of in-situ vertical stress is equal to applied load);
- Initial groundwater level has been assumed at 0.5m below ground level, which is a conservative assumption;
- Settlement has been calculated as immediate settlement;
- Boussinesq's stress computation method has been applied;
- Soil layer has been modelled as single layer (only one layer of 100m thickness has been considered for each type of geological stratum);
- The value of groundwater drawdown has been assessed as height of fill material (with unit weight of 9.81 kN/m^3) which causes 10mm of settlement for each type of stratum using Pre-load option in Settle 3. This is because a 10mm settlement or less is unlikely to cause differential settlement effects on buildings.
- Values of soil parameters are based on average values from the ground investigations;
- The assessment is mostly focused on superficial deposits which is conservative as deeper layers would be expected to have better ground properties.

Limitations

4.2.5 The following limitations have been identified:

- Ground parameters are based on average values however the ground conditions are expected to be variable.
- No in-situ data is available on the Coefficient of Volume Compressibility (mv) for Brickearth.

4.3 Results

4.3.1 The results of the Settle 3 assessment are presented in Table 4.2. The drawdown column indicates the value of drawdown which would cause 10mm of settlement for each of the geological strata.

Table 4.2 Drawdown resulting in 10mm of settlement

Geological stratum	Groundwater drawdown for 10mm of settlement [m]
Head Deposit	1.09
Glaciolacustrine deposits	1.57
Lowestoft Formation	1.85
Glaciofluvial deposits	1.16
Alluvium	0.56
River Terrace Deposits	1.17
Interglacial Lacustrine Deposits Silt and Clay	1.16
Kesgrave Catchment Subgroup	1.69
Brickearth	No results because of lack of value for Coefficient of Volume Compressibility
London Clay Formation (bedrock)	1.57

4.3.2 It should be noted that Alluvium and Head Deposits are localised and have average thicknesses (2.31m and 0.94m respectively based on data from the GIR) thinner than the associated cut-off depth (i.e. depth of deposits through which settlement can occur) derived from Settle 3 results (about 4m for Alluvium and 5m for Head Deposits respectively).

4.3.3 On the basis that such soils are typically non-load bearing it has been assumed that buildings have not been founded directly in those layers. Typically, a recommendation for such weak soils would be either soil replacement where the weak soil is shallow or ground improvement via surcharge which would improve the compressibility properties of the weak soil, or foundation via piling.

4.3.4 For these reasons, Alluvium and Head Deposits have been excluded from the range of values to apply widely within the study area at this stage.

4.3.5 As a result, a groundwater drawdown of 1.16m is considered to be a screening value which can be used to determine which buildings are unlikely to be at risks associated with settlement effects. That means that a drawdown of less than 1.16m is expected to generate no to negligible differential settlement impact, while a drawdown greater than 1.16m could generate minor to moderate differential settlement impacts. This screening assessment is captured in Table 4.3.

4.3.6 All buildings likely to experience a drawdown greater than 1.16m and highlighted in Table 4.3 could experience a differential settlement of **Moderate** to **Large** significance. For those receptors, a detailed differential settlement risk assessment would be carried out during the detailed design phase. This would comprise an updated dewatering assessment following the supplementary ground investigation to refine the predicted drawdowns at effected buildings and then where required, a detailed settlement risk assessment would be

undertaken at locations where risks of differential settlement are still identified. Should the detailed risk assessment(s) then identify buildings at risk of differential settlement, a condition survey would be undertaken for any such building(s) prior to the relevant works commencing. Asset protection measures as specified in the condition survey would be implemented, subject to landowner consent (where required), prior to relevant works commencing

4.3.7 Detail settlement assessments may require additional ground investigations to be undertaken to gather ground parameters in the vicinity of the analysed locations as well as refined in-situ hydrogeological characteristics to refine the expected drawdown effects.

4.3.8 Various cultural heritage assets and listed buildings have been identified within the zones of influences estimated in the dewatering assessment (Section 3 of this appendix). Table 4.3 indicates where cultural heritage assets have been identified. Further details and impact assessment for these can be found in Chapter 7: Cultural heritage, of the Environmental Statement [TR010060/APP/6.1].

Table 4.3 Buildings potentially impacted by drawdown effects

Cutting	Buildings impacted	Distance of closest building (m)	Drawdown at receptor (m)	Cultural heritage assets present	Listed buildings present
W2	Village of Hatfield Peverel (100+ houses)	0	2.90	Y	Y
W5	Village of Witham (100 + houses)	325	0.65	Y	Y
W5	Industrial estate	35	3.77		
C4	Industrial estate	97	0.08	Y	N
C5	4 buildings in Rivenhall end	74	0.36	Y	N
W6	Village of Kelvedon (100+ houses)	398	0.47	Y	Y
W6	~15 Buildings (on Ewell Hall Chase)	186	1.70		
W6	4 buildings (on Braxted Road)	321	0.75		
W6	~35 buildings (on London Road)	306	0.82		
W7	3 buildings (on Highfields lane)	47	1.32	Y	Y

Cutting	Buildings impacted	Distance of closest building (m)	Drawdown at receptor (m)	Cultural heritage assets present	Listed buildings present
W7	~15 buildings (on Ewell Hall Chase)	33	1.43		
C8	2 small areas of housing	33	1.86	Y	N
C10	2 buildings (Doggetts Lane)	38	1.31	Y	Y
C10	2 buildings (SE of cutting)	31	1.49		
CJ11	10 buildings (Chelmsford Service Area)	165	1.05	Y	Y
CJ11	16 buildings (on B1137 and Paynes Lane)	93	1.57		
CJ11	5 buildings (South of cutting)	232	0.73		
WJ4	12 buildings (on B1137 and Paynes Lane)	15	1.53	Y	Y
WJ4	5 buildings (South of cutting)	102	0.90		
WJ4	2 buildings (Chelmsford Service Area)	257	0.35		
WJ2	~ 50 buildings on London Road	79	0.65	Y	N
WJ2	3 Buildings on Adco Industrial Park	103	0.61		
WJ2	~ 20 buildings on North Lane	178	0.50		
C2	2 buildings (Springfield Business park)	39	0.41	N	N
Pond for S1-OU11	3 Buildings	48	0.47	N	N
Pond for S2-OU4	~ 25 buildings	111	0.83	N	N

Cutting	Buildings impacted	Distance of closest building (m)	Drawdown at receptor (m)	Cultural heritage assets present	Listed buildings present
Pond for S2-OU15C1	9 buildings	159	0.48	Y	N
Pond for S2-OU15G	4 buildings	65	0.86	Y	N
Pond for S3-OU9	14 buildings	92	0.91	Y	N
Pond for S3-OU17	~40 buildings	120	0.41	N	N
BP-J	5 buildings (east of borrow pit)	216	1.91	Y	Y
BP-J	~25 buildings (north east of borrow pit)	483	0.38		
BP-J	25 buildings (in Inworth)	444	0.48		
BP-J	11 buildings (on Highfields Lane)	16	6.44		
BP-J	10 buildings (south of borrow pit)	910	0.03		
BP-J	6 buildings (west of borrow pit)	623	0.16		
BP-J	16 buildings (on Ewell Hall Chase)	219	1.87		
BP-J	Majority of buildings in Village of Kelvedon (>100 buildings)	491	0.36		

5 GWDTE assessment

5.1 Introduction

5.1.1 This section follows the UK Technical Advisory Group (UKTAG) guidance (UKTAG, 2005) to identify, prioritise and assess the effects of the proposed scheme on groundwater dependent terrestrial ecosystems (GWDTE).

Assessment methodology

Site identification

5.1.2 An early identification of potential GWDTEs was undertaken at PEIR stage using the following information:

- Statutory designated sites of international importance, such as Special Areas of Conservation (SAC) and any associated site description;
- Statutory designated sites of national importance, such as Sites of Special Scientific Interest (SSSI) and Local Nature Reserves (LNR) and any associated site description;
- Non-statutory designated sites, such as Sites of Biological Interest (SBI), and any associated site description;
- Sites that are considered important for ecological conservation but that do not have a statutory or non-statutory designation (i.e. non-designated sites), such as Habitat of Priority Importance (HPI); and
- Areas identified as possible GWDTE by ecologists during Phase 1 habitat surveys.

Desk study

5.1.3 For each potential GWDTE identified at PEIR stage, a high-level desk study review was undertaken taking into consideration topographic, geological, hydrogeological, hydrological, and ecological information available from the following sources:

- Ordnance Survey mapping and aerial imagery (Google Earth, 2021);
- Historical maps;
- Light detection and ranging (LiDAR) digital terrain model;
- Geological maps (1:10,000 and 1:50,000 scale), borehole logs, and permeability index/aquifer properties datasets (where required) available at the British Geological Survey's (BGS's) GeoIndex website (BGS, 2021a);
- BGS Susceptibility to Groundwater Flooding mapping (BGS, 2021b);

- Statutory and non-statutory designated site boundaries (excluding SBIs), and HPI boundaries, available on Defra's MagicMap application (Defra, 2021); and
- National soils mapping (Cranfield University, 2021).

5.1.4 During this stage, three areas identified in the PEIR as potential GWDTE were screened out as being determined as non-GWDTE. These are Inworth Road Local Wildlife Site (LWS), Perry's Wood and Kelvedon Hall LWS, which were descoped on the basis that Inworth Road LWS and Perry's Wood are absent of superficial deposits with the London Clay not capable of storing groundwater. Kelvedon Wood LWS is located on Lowestoft formation which is unlikely to contain large enough volumes of groundwater to sustain any GWDTE habitats.

5.1.5 Therefore, these sites were not considered further in this assessment.

5.1.6 All potential GWDTEs identified as a result of this high-level desk-based review are shown on Figure 14.3 of the Environmental Statement [TR010060/APP/6.2].

Prioritisation of impacts

5.1.7 The scoping of potential GWDTE sites is shown in Table 5.1. A prioritisation of potential impacts was applied to all potential sites on the basis of the following criteria:

- Potential GWDTE sites with a direct interaction with the proposed scheme or in close proximity to the proposed scheme; and
- Potential GWDTE sites falling within at least one dewatering zone of influence, as per the dewatering assessment captured in Section 3 of this appendix.

5.1.8 This resulted in identifying seven potential GWDTE sites that could be impacted as a result of the proposed scheme.

Table 5.1 Potential GWDTEs prioritisation of impacts summary

Site Name	Scoped in/out	Comment
Boreham Road Gravel Pits LWS	Out	139m north
Braxted Park LWS	Out	624m southeast of Red Line Boundary (RLB)
Brockwell Meadows LNR and LWS	In	Adjacent to RLB
Coggeshall Hall Farm LWS	Out	407m north of RLB
Copford Hall Wood North LWS	Out	914m south of RLB
Domsey Brook Pasture LWS	Out	816m southeast of RLB
Feering Marsh LWS	Out	347m north of RLB
Hoo Hall Meadow LWS	Out	490m north of RLB

Site Name	Scoped in/out	Comment
Keeper's Cottage Wood LWS	Out	670m south of RLB
Long Wood Complex LWS	Out	363m south of RLB
Marks Tey Brick Pit LWS	Out	541m north of RLB
Marshy Grassland 1 and Wet Woodland 1	In	Partially within RLB and dewatering zone of influence
Marshy Grassland 2	Out	289m south of RLB
Marshy Grassland 3	Out	133m north of RLB
Mope Wood Complex LWS	Out	196m south of RLB
Pits Wood LWS	Out	470m south of RLB
River Chelmer LWS	Out	Within RLB, but no works nearby
Riverview Meadows LWS	In	Adjacent to RLB for access road
Sparkey Wood LWS	Out	254m south of RLB
Spitman's Gardens	Out	299m south of RLB
The Grove LWS	Out	234m north of RLB
The Old Rectory Meadows LWS	Out	715m north of RLB
Titbeech Wood LWS	Out	329m north of RLB
Toppinghall Wood LWS	Out	532m north of RLB
Wet Woodland 2	Out	130m south of RLB
Wet Woodland 3	Out	288m south of RLB
Wet Woodland 4	Out	342m south of RLB
Wet Woodland 5	Out	357m south of RLB
Wet Woodland 6	Out	148m south of RLB
Wet Woodland 7	In	Partially within RLB and dewatering zone of influence
Wet Woodland 8	In	Adjacent to RLB and dewatering zone of influence
Wet Woodland 9	In	Mostly within RLB
Wet Woodland 10	Out	374m south of RLB
Whetmead LNR	In	Partly within RLB and dewatering zone of influence

Conceptual site model

5.1.9 A Conceptual Site Model (CSM) was developed for the potential GWDTE sites scoped in (refer to Table 5.1). The CSM describes conceptually the relative importance of sources of water supporting the GWDTE identified, conceptual supply mechanisms, conceptual water flows, levels and quality, and the main physical factors determining these. The CSM is based on a detailed review of available geological and hydrogeological information derived from the phases of ground investigations associated with this project, as well as historical BGS log information and topography. The CSM is also supported in most cases by a hydrogeological site walkover which complemented and refined the initial information obtained from the Phase 1 habitat surveys.

5.1.10 As part of the CSM, the groundwater dependency of each site scoped in is determined using the following categorisations:

- Not groundwater dependent
- Low groundwater dependency
- Low to moderate groundwater dependency
- Moderate groundwater dependency
- High to moderate groundwater dependency
- High groundwater dependency

5.1.11 The CSM was then used to assess potential changes in groundwater levels, flows, and quality, which could result from the proposed scheme. The assessment of potential changes was made considering the type of development (i.e. cutting, embankment, etc.).

Assumptions, limitations and data gaps

- Ecology surveys supporting the development of the CSM comprise of Phase 1 Habitat mapping. No National Vegetation Classification (NVC) surveys were undertaken.
- In some cases, groundwater level information is limited to groundwater strikes and seeps recorded in borehole logs provided by the BGS.
- Embedded design and standard construction mitigations have been taken into account to determine potential effects.
- This section only discusses potential effects on groundwater levels, flows, and quality that support ecosystems. Other impacts on vegetation and habitats are discussed in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1].
- The general assumptions, limitations and data gaps relating to the groundwater environment, and that are listed in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], also apply to this section.

5.2 Site specific GWDTE assessments

Marshy Grassland 1 and Wet Woodland 1

Site setting, topography and hydrological catchment

5.2.1 The site is comprised of two small areas located north of the existing A12 along the banks of the River Ter: Marshy Grassland 1 and Wet Woodland 1 (Plate 5.1).

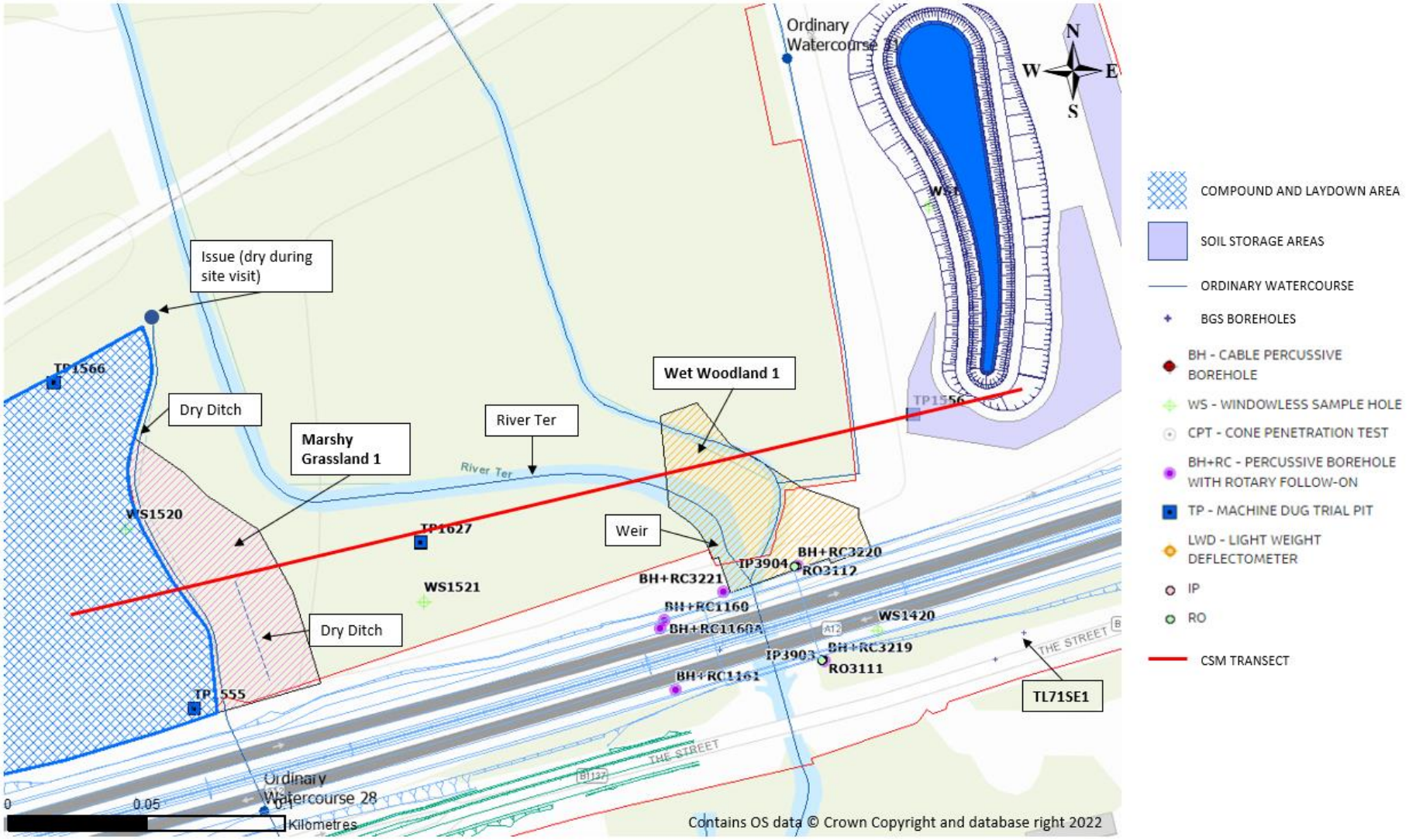
5.2.2 The River Ter flows along the western boundary of Wet Woodland 1 with a weir on the river in the south of the site. A diverging channel from the River Ter (thought to be a flood relief channel) flows south through the east of Wet Woodland 1 to join the River Ter south of the weir. A further small watercourse (Ordinary Watercourse 31) flows down the eastern boundary of the site to join the River Ter. Ordinary Watercourse 28 issues north of Marshy Grassland 1 and flows south through the west of this area, however during a hydrogeological walkover this issue and channel was found to be dry. All watercourses flow towards the south of the site and under the A12. The west of Wet Woodland 1 lies in flood zone 2 and 3 associated with the River Ter.

5.2.3 The site lies within the River Ter valley and is located riverside, with the valley sides steeper on the west than the east based on the Ordnance Survey (OS) map. Wet Woodland 1 is relatively flat with an elevation of approximately 19 mAOD. On the other hand Marshy Grassland 1 sits on more of a slope where elevations range from approximately 30m in the north to 21mAOD in the southeast.

5.2.4 A hydrogeological site walkover took place in September 2021. Marshy Grassland 1 was observed to sit within a small topographic low, with what looked to be built up ground to the east leading to the A12. A drainage ditch running from north to south through the centre of Marshy Grassland 1 (Plate 5.1) was observed which contained different vegetation along the edge and looked to be elevated slightly, however this was dry during the survey. This is in addition to the ditch running long the western boundary shown on the OS map, and which was also dry the day of the survey.

5.2.5 The total hydrological catchment for the site includes sub-catchments to the north, northeast and west, with the largest extending 280m northeast, where the ground reaches an elevation of 30mAOD.

Plate 5.1 Location Map for Marshy Grassland 1 and Wet Woodland 1



Soils and geology

5.2.6 There are two soils types present within the site. Wet Woodland 1 is underlain by soils described as 'slowly permeable seasonally waterlogged clayey soils mostly with brown subsoils'. These soils have impeded drainage. Marshy Grassland 1 is underlain by soils described as 'Deep stoneless well drained silty soils and similar soils affected by groundwater, over gravel locally'. These soils are freely draining. During the hydrogeological site visit loamy soils were observed within Marshy Grassland 1.

5.2.7 Both parts of the site are underlain by alluvium, described as clay, silt, sand and gravel (BGS, 2021a), with the exception of the eastern edge of Wet Woodland 1, which has no recorded superficial deposits. Head deposits, described as clay and silt, are recorded to the west of the alluvium and Marshy Grassland 1, outside of the site boundary. Glaciofluvial deposits, described as sand and gravel, are recorded to the north and west of the head (BGS, 2021a), and may similarly extend beneath parts of the site in sub-crop.

5.2.8 Bedrock across the site is comprised of the London Clay Formation (BGS, 2021a).

5.2.9 There is one BGS historical borehole located southeast of Wet Woodland 1 (TL71SE1). This records Made Ground over alluvium to 3.35 metres below ground level (mbgl) overlying the London Clay Formation. There are no GI boreholes within the site boundaries however there are multiple within the vicinity of the site (Plate 5.1), details of these can be found in Table 5.2. In all GI boreholes there is a layer of made ground overlying the superficial deposits. Across the site the depth of bedrock is variable and is identified to be as shallow as 1.1mbgl in TP1556. In general, the BGS geology correlates with the geology observed during the GI apart from the head deposits which are absent in TP1555, TP1566 and WS1520 suggesting that the head deposits do not extent as far east as shown on BGS mapping. This also indicates that the alluvium spreads further west than shown on BGS mapping.

Table 5.2 Borehole records for Marshy Grassland 1 and Wet Woodland 1

BH	Description
TL71SE1	Made ground: 0-1.68m Alluvium: 1.68-3.35m London Clay Formation
WS1520	Made Ground: 0-0.45mbgl Alluvium: 0.45-2.35mbgl Glaciofluvial deposits: 2.35-4.2mbgl London Clay Formation
TP1566	Made Ground: 0-0.5mbgl Alluvium: 0.5-2.5mbgl Glaciofluvial deposits: 2.6-3.7mbgl London Clay Formation

BH	Description
TP1555	Made Ground: 0-0.3mbgl Alluvium: 0.3- >4.1mbgl
TP1627	Made Ground: 0-2.4mbgl Alluvium: 2.4- >4mbgl
WS1521	Made Ground: 0-0.15mbgl Alluvium: 0.15->5.45mbgl
BH+RC1160A	Made Ground: 0-4.5mbgl Glaciofluvial deposits: 4.5-8.45mbgl London Clay Formation
BH+RC1160	Made Ground: 0->0.5mbgl
BH+RC1161	Made Ground (includes embankment fill?): 0-5.2mbgl Glaciofluvial deposits: 5.2-9.2mbgl London Clay Formation
WS1420	Made Ground: 0->3.7mbgl
TP1556	Made Ground: 0-0.5mbgl Alluvium: 0.5-1.1mbgl London Clay Formation

Groundwater

5.2.10 Available GI groundwater level information is summarised in Table 5.3. This includes both strikes and seepages encountered during drilling and monitoring information where available.

5.2.11 In most locations groundwater was either not recorded or not encountered during drilling, however subsequent monitoring shows groundwater levels mainly within 5m of the surface. The trial pits do not have monitoring equipment within them and therefore the values shown for maximum water level below represents the rise in groundwater after the initial strike.

Table 5.3 Groundwater level information extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
WS1520	3mbgl	2.9	2.41- 3.55	21/07/2020 – 12/08/2021. Maximum level recorded on 15/01/2021
TP1555	Seepage at 3.8mbgl	3.8	n/a	07/05/2020
TP1627	Seepage at 4mbgl	4	n/a	07/05/2020
WS1521	None recorded	n/a	3.81- 4.6	22/10/2020 – 12/08/2021. Maximum level recorded on 15/04/2021
BH+RC1160A	None recorded	n/a	4.69 – 6	06/04/2021- 07/09/2021. Maximum level recorded on 31/01/2021
BH+RC1160	None recorded	n/a	n/a	-
BH+RC1161	None recorded	n/a	1-5.62	10/03/2020- 25/06/2020 (only two readings). Maximum level recorded on 10/03/2020
WS1420	None recorded	n/a	Dry	-
TP1556	Not encountered	n/a	n/a	06/05/2020

5.2.12 During the hydrogeological walkover no evidence of springs or groundwater seepages were identified. However, Marshy Grassland 1 was found to be damp underfoot, which could have been due to the heavy rainfall the day before at midday. Wet Woodland 1 was inaccessible due to access restrictions and the presence of the three different channels within the site, however from the western bank of the River Ter, the area looked to be wet. The central area of Wet Woodland 1 is between the river and a channel and sits directly upstream of the weir. Therefore, the slowing of surface water as it approaches the weir may allow flooding of this area.

5.2.13 There is one issue shown approximately 45m north of Marshy Grassland 1 on Ordnance Survey maps. However, during the walkover this issue and watercourse was dry. No other groundwater features are shown on OS

mapping. However, BGS data suggests that the site has a very high groundwater flooding susceptibility (BGS, 2021b), indicating a shallow water table. Where superficial deposits are not recorded in the southeast of Wet Woodland 1, there is no susceptibility for groundwater flooding.

Habitats and vegetation

5.2.14 A Phase 1 Habitat Survey was carried out for the site on the 29/07/2020.

5.2.15 Marshy Grassland 1 is described as an area of marshy grassland located in a low-lying area next to recently clear-felled area, dominated by rushes with abundant wetland tall-herbs. However, during the hydrogeological survey wetland tall herbs were found to be sporadic rather than abundant.

5.2.16 Wet Woodland 1 is described as a broadleaved semi-natural woodland with small stand of secondary woodland along River Ter, with canopy of alder, ash and grey willow, and mature white willow extending up watercourse to north. This vegetation was confirmed during the hydrogeological site visit.

5.2.17 There are no ecological designations present within the site.

Conceptual site model

5.2.18 Plate 5.2 shows a conceptualised cross-section running west to east through the centre of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.19 Shallow groundwater across the site, if any, is likely contained to the alluvium, as the London Clay formation is a non-groundwater bearing unit. However, monitoring data from the GI suggests the shallowest water level at the site is approximately 1mbgl, with other areas containing groundwater between 2 and 6 mbgl.

5.2.20 Groundwater is thought to follow topography and generally flow towards the River Ter which lies within Wet Woodland 1. Wet Woodland 1 sits in a slight topographic low therefore encouraging surface runoff to congregate here. The presence of a weir immediately downstream of the site will likely slow the watercourse down in the area immediately upstream hence promoting flooding in this area. The underlying alluvium at this site has a high storage potential however clayey soils would impede infiltration, which in turn could increase surface water flooding across the area. From the GI, groundwater levels across the site are not expected to be shallow in the alluvium, where most groundwater levels are recorded between 4.69 and 6m bgl immediately adjacent to Wet Woodland 1.

5.2.21 The alluvium is likely to be indirectly recharged by the surface water from the river as well as receiving regional recharge from the underlying glaciofluvial deposits which are present under the alluvium to the west. Where the bedrock crops at the surface there is potential for groundwater seepages at the boundary between the bedrock and the alluvium as groundwater cannot penetrate the London Clay.

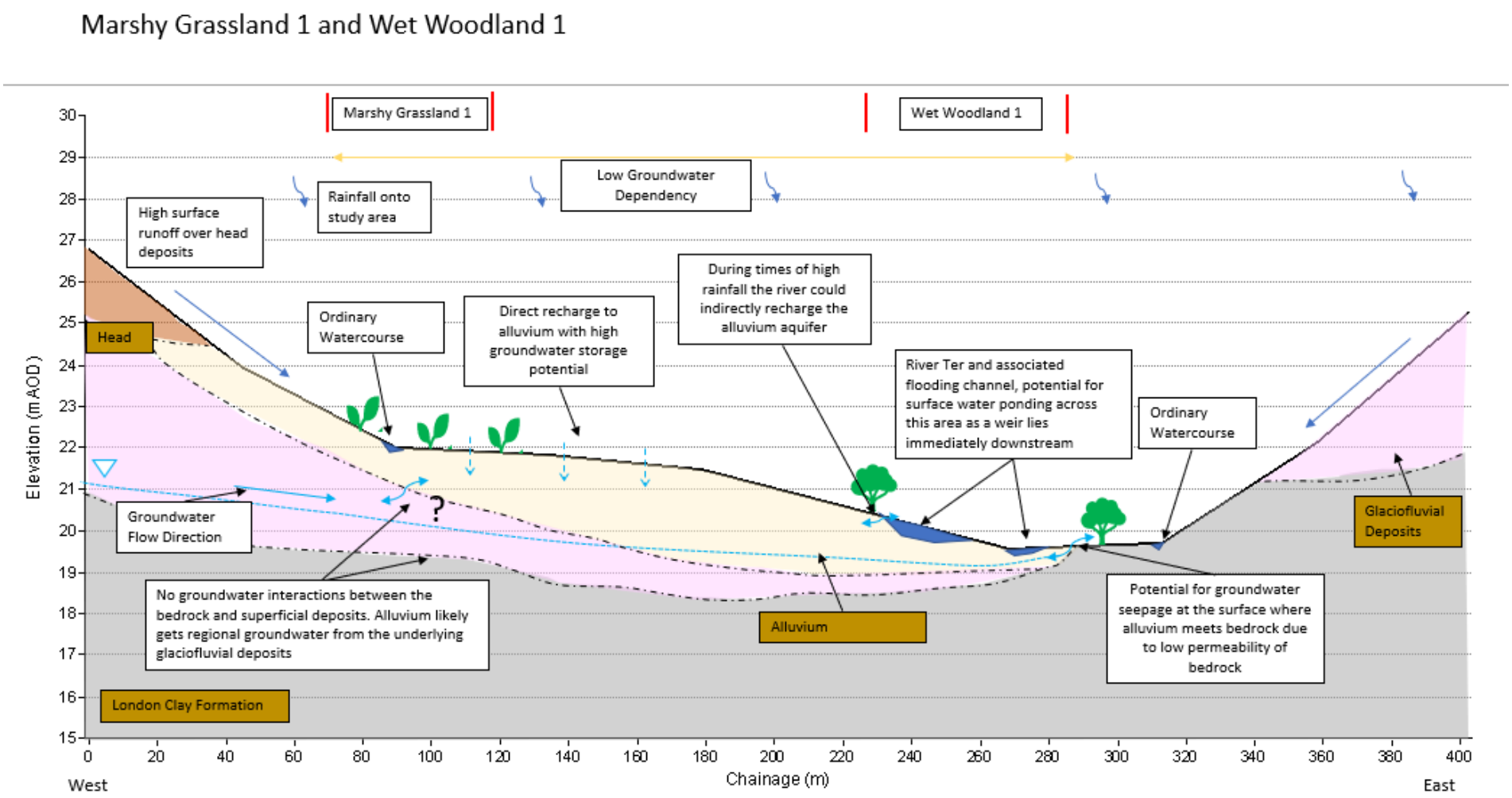
5.2.22 Across the site, bedrock is thought to be relatively shallow, cropping at the surface to the east. Considering the impermeable nature of the London Clay formation all groundwater will be contained within the overlying alluvium and glaciofluvial deposits. In times of high rainfall groundwater could emerge at the surface in the topographic lows when the alluvium reaches its full storage potential.

5.2.23 Considering the likely high surface water input to the site, groundwater input is thought to be limited, if not absent. Therefore, Wet Woodland 1 is conservatively attributed a **low groundwater dependency.**

5.2.24 Marshy Grassland 1 sits slightly uphill of the River Ter. This part of the site is very slightly sloped towards the east and itself lies in a small topographic low. Surface runoff from the west is likely to infiltrate once it encounters the alluvium and freely draining soils. This direct infiltration could allow the water table to be close to the surface, especially in times of high rainfall. However, the GI does not support this as groundwater seepages were encountered at 3.8 and 4mbgl in the trial pits. During the hydrogeological site walkover this part of the site was found to be relatively dry with some slightly damp areas underfoot which could have been due to the heavy rainfall the day before at midday, and the presence of wetland vegetation was observed to be very sporadic.

5.2.25 Considering the lack of shallow groundwater recorded through the GI this part of the site and sporadic evidence of wetland vegetation, Marshy Grassland 1 is conservatively attributed a **low groundwater dependency.**

Plate 5.2 Conceptual Site Model for Marshy Grassland 1 and Wet Woodland 1



Assessment of potential effects

5.2.26 The south eastern area of Wet Woodland 1 lies within the Order of Limits, with the southern and the western boundaries of Marshy Grassland 1 located immediately adjacent to the boundary north of the A12. The proposed scheme would run along the southern boundary of Marshy Grassland 1. A compound area is proposed adjacent and upgradient of the western boundary of Marshy Grassland 1. Two soil storage areas and an attenuation pond are proposed 73m upgradient of Wet Woodland 1 to the east.

Construction

5.2.27 Even though no specific works are scheduled in the south eastern area of Wet Woodland 1, the fact that this area falls within the Order of Limits, direct compactions effects could locally disturb groundwater flows. These could be of moderate magnitude and could result in a **Slight** potential significance of impact.

5.2.28 The southern part of Marshy Grassland 1 lies within the estimated dewatering zone of influence for cutting C3. However, given the distance from the cutting, drawdown is predicted to be of the order of 0.48m at the southern boundary. This could result in a localised potential moderate effect (**Slight** potential significance). The impacts are likely to propagate into the site from the south gradually becoming more minor towards the edge of the zone of influence. The northern half of the site is located outside the dewatering zone of influence therefore groundwater levels are not predicted to be impacted in that area.

5.2.29 Wet Woodland 1 lies within the edge of the estimated dewatering zone of influence for W2 and the most south-eastern part falls under the estimated dewatering zone of influence for W1: W1 could generate a localised maximum drawdown of 0.4m in the south-east corner only and W2 could generate a drawdown of 0.2m in the east. However, W2 is expected to draw groundwater from permeable deposits, and the estimate zone of influence for W2 is likely to be over-estimated as the deposits away from the cutting will vary and the permeability would be expected to reduce. This would result in minor potential effects across the site from W2 and minor potential effects in the southeast for W1, resulting in a **Neutral significance of effect.**

5.2.30 No dewatering for the construction of the attenuation pond located east of Wet Woodland 1 is predicted. Therefore, no impacts to the site are expected as a result of this feature.

5.2.31 During construction, there could also be short-term impacts on groundwater quality at the GWDTE due to mobilisation of suspended solids and associated solutes, leaks and spills of fuels and chemicals during construction. In particular, part of the site is located within or very close to the Order of Limits.

5.2.32 However, as described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], there are several best-practice mitigation measures which are incorporated into the first iteration of the Environmental Management Plan (EMP) [TR010060/APP/6.5] for pollution prevention including managing silt pollution (for suspended solids transport). These measures would reduce the likelihood of contaminating

groundwater. Considering best-practice mitigation measures, the magnitude of change on existing groundwater quality in the west and east of the site is expected to be minor on groundwater quality. Impacts of a negligible magnitude would likely propagate downgradient towards the west of Wet Woodland 1 and the east of Marshy Grassland 1.

Operation

5.2.33 There are no permanent below ground structures or embankments proposed within the vicinity of the site to locally alter groundwater levels and flows supporting GWDTE. No impacts to the site from these assets are therefore predicted. Any long-term changes in recharge rates as a result of increased impermeable surface areas are expected to be of negligible magnitude, and therefore potential **Neutral** significance.

5.2.34 Dewatering impacts associated with road cuttings / widenings are expected to be long term and remain at the level of significance assessed during construction.

5.2.35 The spillage assessment in Appendix 14.1: Water quality assessment report, of the Environmental Statement [TR010060/APP/6.3] indicates that the risk is well within the most stringently defined significance threshold of 0.5% AEP (200-year). In addition, considering the distance of the proposed scheme from the GWDTE, any accidental leaks/spills of fuels and chemicals and/or routine runoff associated with the road are also expected to be negligible, resulting in a potential **Neutral** significance of effect.

Summary

5.2.36 A summary of the potential impacts to the site is provided in Table 5.4.

Table 5.4 Summary of potential effects to Marshy Grassland 1 and Wet Woodland 1

Groundwater dependency	Ecological designation	Importance	Effect	Phase	Highest magnitude of impact	Highest significance of effect
Low	None	Low	Accidental leaks / spills of fuels and chemicals (groundwater quality)	Construction	Minor adverse	Neutral
			Mobilisation of suspended solids (groundwater quality)	Construction	Minor adverse	Neutral
			Short-term disturbance of groundwater flows (groundwater levels / flows) from compaction	Construction	Moderate Adverse	Slight
			Dewatering (groundwater levels / flows)	Construction / Operation	Moderate to Neutral adverse	Slight to Neutral
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	Negligible	Neutral
			Long-term disturbance of groundwater flows from below ground / embankments (groundwater levels / flows)	Operation	Negligible	Neutral

Mitigation and residual effects

5.2.37 As shown in Table 5.4, potential impacts on groundwater flows and levels to Marshy Grassland 1 and Wet Woodland 1, during both phases, have been assessed as of Slight, or Neutral significance.

5.2.38 No mitigation measures are therefore required.

Wet Woodland 7

Site setting, topography and hydrological catchment

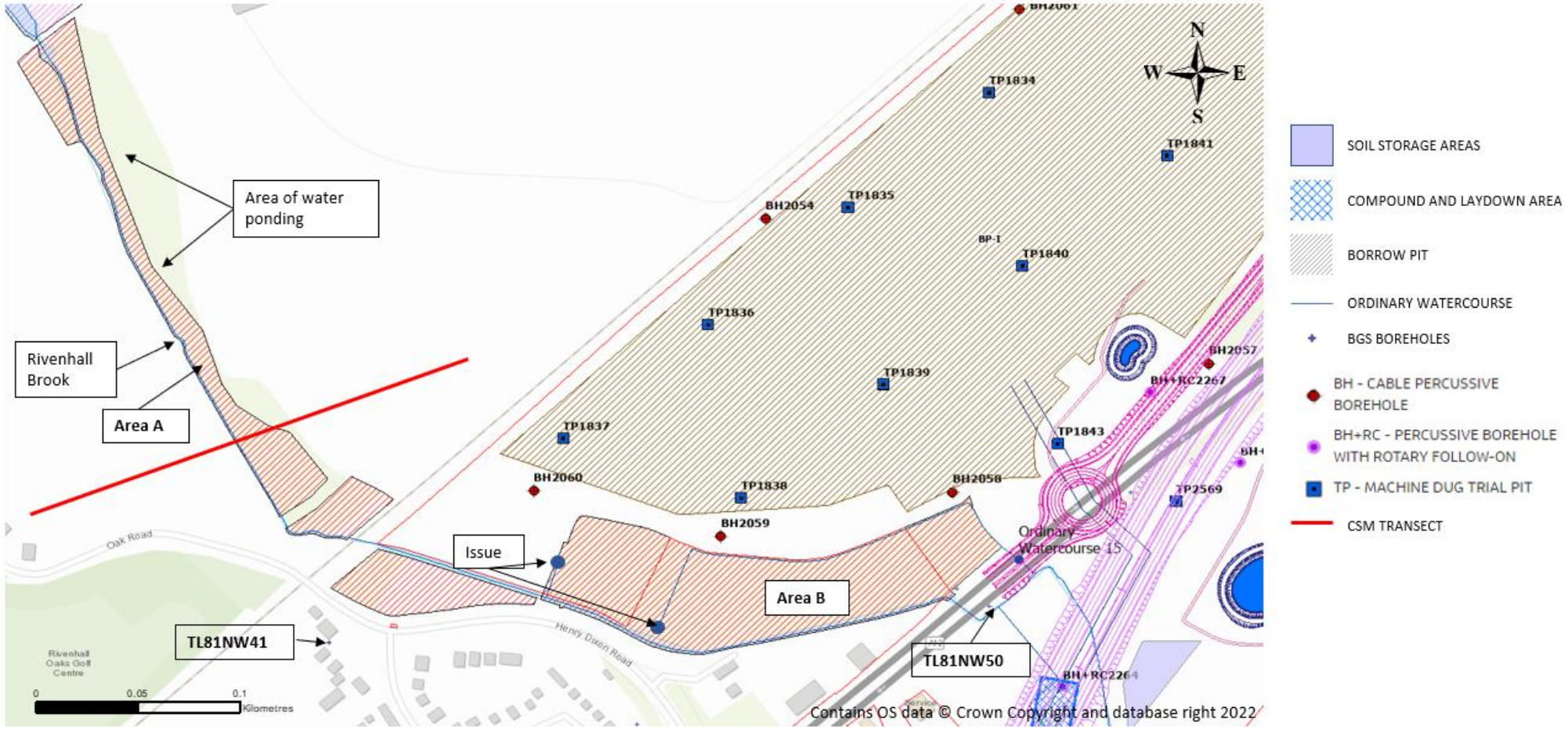
5.2.39 The site is located in a wooded area along the banks of Rivenhall Brook (Ordinary Watercourse 15) which bounds the site to the west, apart from one small area in the centre which is located on the opposite side of the watercourse (Plate 5.3). A railway line runs through the centre of the site and the southeast of the site is bound by the existing A12. The site is split into two areas; Area A, west of the railway line, and Area B, east of the railway line.

5.2.40 Rivenhall Brook flows south and then east with the site located mainly on the eastern and northern banks, with one small area found on the southern bank. Two issues are located within Area B (Plate 5.3), with one of these issues feeding into the brook while another watercourse flows north from the second issue then east along the site boundary to form Ordinary Watercourse 15.

5.2.41 The site lies within the base of a small valley associated with Rivenhall Brook in a riverside setting. Elevations range from 23mAOD in the north to 21mAOD in the south. The majority of the site lies within the surface flood zone associated with Rivenhall Brook. It can be suggested that the alluvium within the site is likely to be hydraulically connected to the watercourse. The majority of the area is at a high/ medium risk of flooding from surface water. A hydrogeological site walkover took place in September 2021 during which the land directly adjacent to the brook was observed to be very flat.

5.2.42 The hydrological catchment comprised sub-catchments to the north, northeast, east and west, with the furthest extending 780m to the west where elevations reach 40mAOD. The catchment to the north is likely limited by the presence of the railway line which runs southwest to northeast through the north of the site.

Plate 5.3 Location Map for Wet Woodland 7



Soils and geology

5.2.43 Soils present in the north of the site (Area A) are described as 'Deep fine loamy over clayey and clayey soils with slowly permeable subsoils and slight seasonal waterlogging. Some slowly permeable seasonally waterlogged fine loamy over clayey soils. Calcareous subsoils in places.' These soils have an impeded drainage. During the hydrogeological survey the soils in this area were observed to be sandier than what is suggested above, however the waterlogging properties of these soils were observed in the north of Area A where large areas of saturated soils were observed. A small area in the far south and east of the site (Area B) has soils described as 'Well drained fine loamy soils often over gravel associated with similar permeable soils variably affected by groundwater'. These soils are freely draining. Soils in the southern part of the site were observed to be siltier than what is suggested above.

5.2.44 From BGS mapping the southern half of the site (Area B) is underlain primarily by alluvium (BGS, 2021a) which roughly follow the course of the brook. The northern part of the site (Area A) is underlain by peat on the eastern side of the brook. The Lowestoft formation is present to the east and west of the site (BGS, 2021a).

5.2.45 The extent of the Lowestoft formation surrounding the site indicates that it may underlie the peat and alluvium present within the site. To the west of the site there are some glaciofluvial deposits present which may extend beneath the alluvium.

5.2.46 Bedrock at the site is the London Clay Formation.

5.2.47 There are two publicly available BGS historical boreholes located close to the site. There is also one GI borehole located just outside the site boundary to the east and two to the north of the southern part of the site (Plate 5.3). Details on both the GI and BGS historical boreholes can be found in Table 5.5 below. In BH2058 and BH2060 glaciofluvial deposits underlie the Lowestoft formation suggesting that this could also be the case within the site boundaries at depth under the alluvium. From the records provided below there is one location where head deposits are present (BH2059) which is shown on BGS mapping as Lowestoft Formation. This suggests that the head deposits could extend further north than what is shown on BGS mapping. No GI or BGS boreholes were located in Area A, indicated to be covered by peat on BGS mapping, therefore this cannot be verified. However, where peat is shown on BGS mapping ground conditions correlated with an area observed as very wet during the hydrogeological survey.

Table 5.5 Borehole records for Wet Woodland 7

BH	Description
TL81NW41	Glacial till: 0-6.1mbgl 'Chelmsford gravels' (Glaciofluvial deposits): 6.1-17.1mbgl Till: 17.1-21.9mbgl London Clay Formation
TL81NW50	Glacial till: 0->1.37mbgl
BH2058	Made Ground: 0-0.5mbgl Head: 0.5-1.1mbgl Lowestoft Formation: 1.1-4.35mbgl Glaciofluvial deposits: 4.35-7.3mbgl London Clay Formation
BH2059	Made Ground: 0-0.5mbgl Head: 0.5-1mbgl Lowestoft formation: 1->10mbgl
BH2060	Made Ground: 0-0.7mbgl Lowestoft Formation: 0.7-3.2mbgl Glaciofluvial deposits:3.2->10mbgl

Groundwater

5.2.48 Available GI groundwater level information is summarised in Table 5.6. This includes both strikes and seepages encountered during drilling and monitoring information where available.

5.2.49 Where encountered the strikes have been found to be relatively shallow, with subsequent monitoring showing rest groundwater levels within 1m of the surface indicating shallow groundwater during winter periods.

Table 5.6 Groundwater level information extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
TL81NW41	6.1mbgl	6.1	n/a	August 1968
TL81NW50	None recorded	n/a	n/a	13/06/1962
BH2058	4.30mbgl	0.9	0.14-1.22 (high value of 7.73, however this is an outlier of the rest of the readings and likely an error)	21/04/2020-19/08/2021. Maximum level recorded on 01/06/2020

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
BH2059	None recorded	n/a	0.63-3.7 (high value of 6.8, however this is an outlier of the rest of the readings and likely an error)	01/06/2020-22/07/2021. Maximum level recorded on 15/03/2021
BH2060	3.1mbgl	0.62	0.03-0.55	26/05/2020-19/08/2021. Maximum level recorded on 07/02/2021

5.2.50 During the hydrogeological walkover no springs were identified. However, in Area A north of the railway line very wet conditions were observed with areas of ponding water and very saturated soils, the contribution of groundwater to this was difficult to determine on site but given the separation between this area and the brook groundwater contribution is likely. These areas correlate with where BGS mapping has identified peat. In the most southern part of the site (Area B) wet conditions were observed, however these were not as extreme as the conditions found in the north.

5.2.51 There are two issues shown within Area B on Ordnance Survey maps. During the hydrogeological site visit, the issue which flows into the brook was found to be flowing from underneath a concrete block therefore the origin of this water was unclear. The other issue associated with a watercourse along the northern boundary of this part of the site was found to be dry during the walkover, with a ditch marking the location.

5.2.52 BGS data suggests that the site has a very high groundwater flooding susceptibility where alluvium is present (BGS, 2021b), indicating a shallow water table in this part of the site. The rest of the site has no groundwater flooding susceptibility recorded.

Habitats and vegetation

5.2.53 A Phase 1 Habitat Survey was carried out for the site on 7/10/2019 for the northern part of the site and on 14/07/2020 for the part south of the railway.

5.2.54 The Phase 1 Habitat Survey classified the southern part of the site as A1.1.2. and is described as ‘dominated by wetland and ruderal tall herb vegetation, with abundant creeping thistle and great willowherb, hedge bindweed, false oat-grass, cleavers and hemlock, and bramble forming low tangle and scattered large dense stands. Large open areas with abundant tall herb fen of common reed, hemp agrimony and common valerian’. The northern part of the site is classified as broad-leaved semi-natural woodland and described as ‘willow dominated wet woodland’.

5.2.55 The vegetation observed during the hydrogeological walkover correlates with the information above. One observation would be that in the centre/north of Area A rushes were sporadically located within areas that were very wet underfoot.

5.2.56 There are no ecological designations at this site.

Conceptual site model

5.2.57 Plate 5.4 shows a conceptualised cross-section running west to east through the southern part of area A. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.58 The site lies in a valley associated with Rivenhall Brook, with the majority of the site lying in the surface water flood zone. Groundwater is expected to flow to the site from the west and east where topography is higher. Within the topographic low, groundwater is expected to be relatively close to the surface, possibly with some groundwater emergence during times of high rainfall, which is aligned with groundwater level monitoring available immediately to the north of Area B.

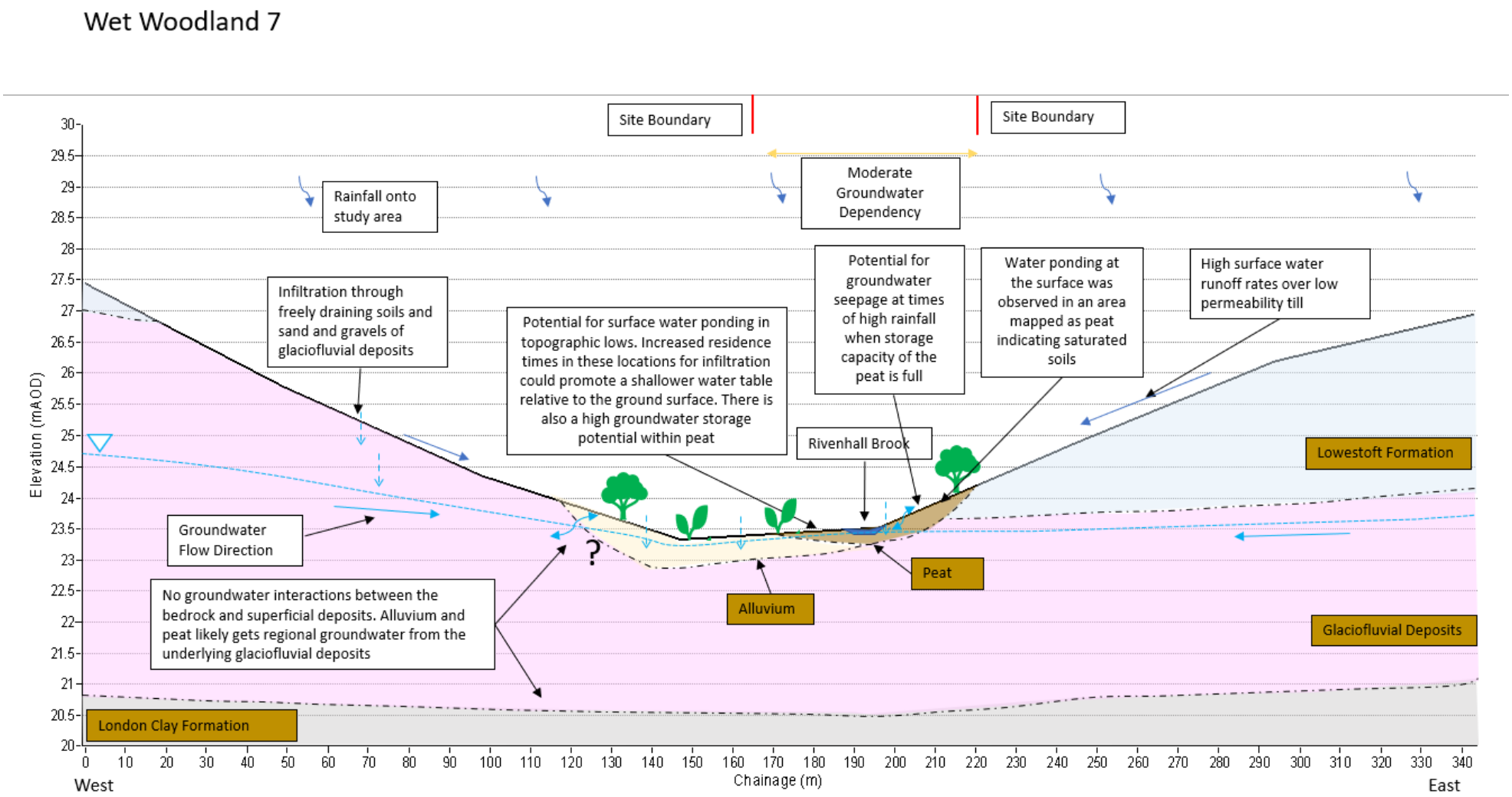
5.2.59 The proportion of surface runoff is likely to be higher from the east than the west in Area A due to the less permeable nature of the Lowestoft formation, based on BGS mapping (no borehole logs available in this area), with the glaciofluvial deposits to the west allowing some infiltration into the aquifer.

5.2.60 Peat deposits surrounding the watercourse in Area A have a high storage potential. During the hydrogeological site walkover, the area shown to be covered by peat in BGS mapping was very wet underfoot suggesting a high water table and saturated soils. This area broadly correlates with the boundary of the flood zones to the east of the brook, falling just outside the surface water flood zone.

5.2.61 However, considering the sites location riverside surface water contributions in times of high rainfall is also expected. This area is therefore said to have a **moderate groundwater dependency**.

5.2.62 In Area B, alluvium covers the site which is likely getting regional groundwater from interactions with the underlying glaciofluvial deposits. During the hydrogeological site walkover, these areas were slightly drier than the north however GI monitoring indicates that groundwater is present at less than 1mbgl in this area, during winter periods. This suggests shallow groundwater conditions which was emphasised by the abundance of wetland vegetation such as reeds etc. Therefore, Area B seems to receive contribution from both groundwater and surface water and can be said to have a **moderate groundwater dependency**.

Plate 5.4 Conceptual Site Model for Wet Woodland 7



Assessment of potential effects

5.2.63 Two portions of Area B are located within the Order of Limits. Borrow pit I lies 20m northeast of the southern area. The main proposed scheme is located 68m to the southeast of the site and this area is proposed to be built on embankments, with a small side road located 7m from the south-eastern corner. There are three proposed attenuation ponds located within 250m of the site to the north, east and southeast.

Construction

5.2.64 Area B and the southern part of Area A lies within the dewatering zone of influence for Borrow Pit I. Borrow Pit I is a deep excavation in a mixed geological deposit. To represent the variable geology of the ground, a medium k value has been taken to account for both the higher and lower k values which are found throughout the proposed Borrow Pit I location and the dewatering effect within Wet Woodland 7 could be significant. In addition to this, dewatering of the borrow pit is happening immediately upgradient of Area B and this has the potential to impact the recharge to Area B. This would be temporary and result in a potential major magnitude of effect, resulting in a potential **Large** significance of effect.

5.2.65 Dewatering is predicted for the construction of attenuation pond S2-OUI5G, with the western part of Area B falling within the zone of influence. As a result, a drawdown of the order of 0.4 m is predicted in the western part of Area B. Therefore minor effects resulting in a **Slight** significance of effect is predicted. The site lies beyond the calculated zones of influence for attenuation pond S2-OUI24A, and S2-OUI15C is not expected to require dewatering.

5.2.66 Even though no specific works are scheduled in the portions of Area B falling within the Order of Limits, direct compactions effects could locally disturb groundwater flows. These could be of moderate magnitude and could result in a **Slight** potential significance of impact.

5.2.67 Area A is not predicted to be impacted by any dewatering or other groundwater flow impacts.

5.2.68 During construction, there could also be short-term impacts on groundwater quality at the GWDTE due to mobilisation of suspended solids and associated solutes, leaks and spills of fuels and chemicals during construction. In particular, part of the site is located within or very close to the Order of Limits.

5.2.69 However, as described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], there are several best-practice mitigation measures which are incorporated into the first iteration EMP [TR010060/APP/6.5] for pollution prevention including managing silt pollution (for suspended solids transport). These measures would reduce the likelihood of contaminating groundwater. Considering best-practice mitigation measures, the magnitude of change on existing groundwater quality in Area B is expected to be minor, given its position downgradient of the works area. This would result in a potential **Slight** significance of effect. Impacts of a negligible magnitude would likely propagate downgradient towards the

southwest of Area B. No impacts to groundwater quality are expected throughout Area A.

Operation

5.2.70 There are no permanent below ground structures or embankments proposed within the vicinity of the site to locally alter groundwater levels and flows supporting GWDTE.

5.2.71 The borrow pit will be left to fill with water, therefore groundwater levels should equilibrate within these ponds and return to pre-construction levels. No operational impacts to groundwater flows and levels at the site are therefore predicted.

5.2.72 Considering the distance of the proposed scheme from the GWDTE, and likely groundwater flow directions in the area, any accidental leaks/spills of fuels and chemicals and/or routine runoff associated with the road are also expected to be negligible, resulting in a potential **Neutral** significance of effect.

Summary

5.2.73 A summary of the potential impacts to the site is provided in Table 5.7.

Table 5.7 Summary of potential effects to Wet Woodland 7

Groundwater dependency	Ecological designation	Importance	Effect	Phase	Highest magnitude of impact	Highest significance of effect
Moderate	None	Medium	Accidental leaks / spills of fuels and chemicals (groundwater quality)	Construction	Minor adverse to None	Slight to None
			Mobilisation of suspended solids (groundwater quality)	Construction	Minor adverse to None	Slight to None
			Short-term disturbance of groundwater flows (groundwater levels / flows) from compaction	Construction	Minor Adverse to None	Slight to None
			Dewatering (groundwater levels / flows / quality)	Construction	Major	Large
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	Negligible	Neutral
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	Negligible	Neutral
			Long-term disturbance of groundwater flows from below ground / embankments (groundwater levels / flows)	Operation	Negligible	Neutral

Mitigation and residual effects

5.2.74 As shown in Table 5.7, potential impacts on groundwater flows and levels to GWDTEs in Area B of Wet Woodland 7, during the construction phase, have been assessed as of Moderate significance.

5.2.75 Firstly, more details would be gathered on the functioning of Wet Woodland 7. Groundwater level monitoring using dataloggers will continue at boreholes BH2058, 59 and 60, but also along borrow pit I and the A12. This would be complemented by an NVC to refine baseline habitat at the site during detailed design phase, as currently only high -level Phase 1 habitat mapping has been conducted.

5.2.76 Additional ground investigation would include pumping tests at borrow pit I to support a more detailed dewatering impact assessment during detailed design phase. BH2058, 59 and 60 would continue to be monitored during the pumping tests.

5.2.77 A Water Balance Compensation strategy would be put in place to compensate the loss of natural groundwater recharge to the site by the Contractor by diverting extracted groundwater from borrow pit I towards Wet Woodland 7. The volume of water to be diverted would be based on the detailed dewatering impact assessment and long term groundwater monitoring around the site. The Water Balance Compensation strategy will determine whether monitoring of boreholes BH2058, 59 and 60 should continue during construction of borrow pit I and up until groundwater has rebounded.

5.2.78 Post-construction NVC monitoring would be undertaken by the Contractor to verify that no significant change in vegetation has taken place during construction.

Wet Woodland 8

Site setting, topography and hydrological catchment

5.2.79 The site is located east of Kelvedon and south of Feering, with a western and eastern area in relation to the existing A12 and along the northern banks of Domsey Brook (Plate 5.5). The A12 runs southwest to northeast in between the two areas) while Inworth road runs north to south along the eastern boundary of the western area, hence will likely alter the natural catchment of the site to both areas on either side of the road.

5.2.80 Domsey Brook flows east to west along the southern boundary of the eastern part of the site, acting as the site boundary. The majority of the site lies within flood zones 2 and 3 associated with this watercourse. A small pond is located in the eastern part of the site, north of Domsey Brook (Plate 5.5).

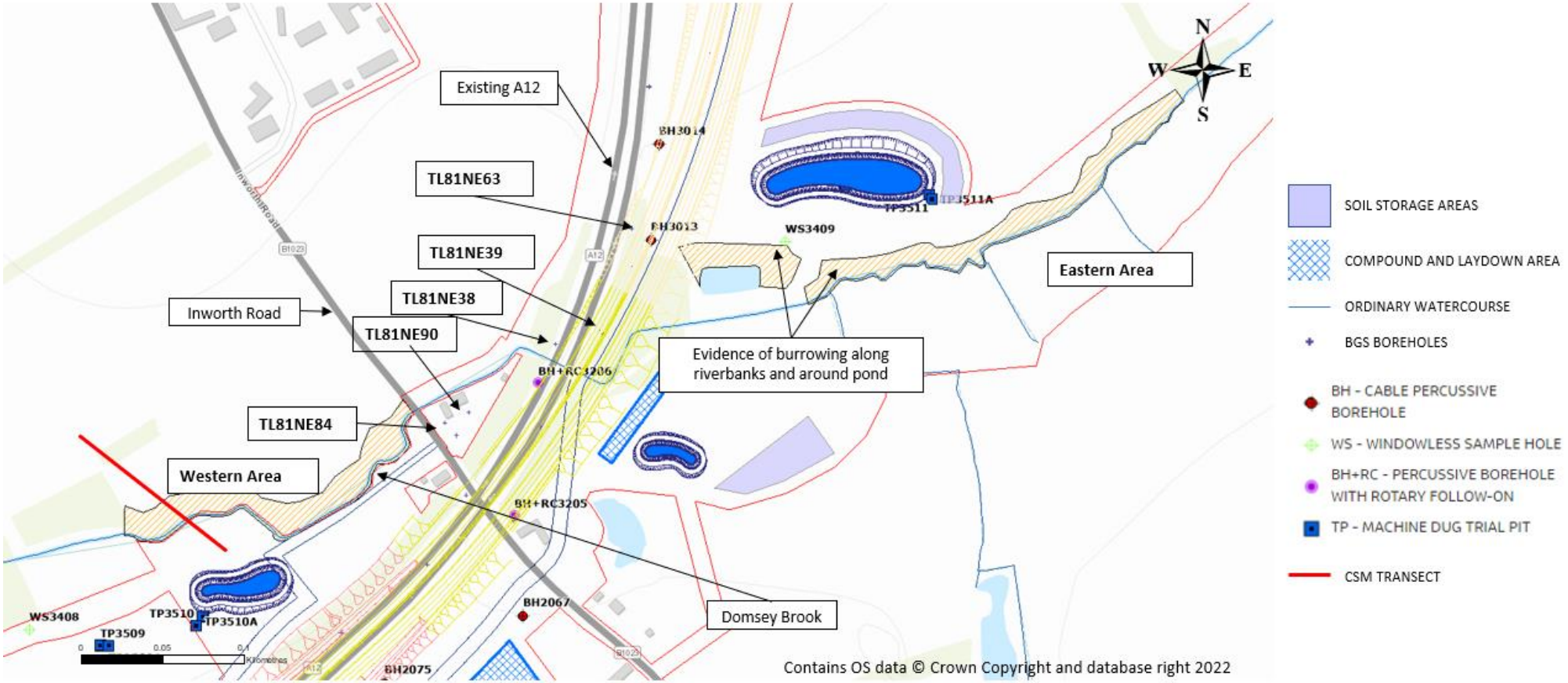
5.2.81 The site lies waterside within the base of a small valley associated with Domsey Brook. Elevations range from 26mAOD in the northeast to 23mAOD in the west.

5.2.82 A hydrogeological walkover survey was undertaken for the site in September 2021. Within the site along the course of Domsey Brook, it was observed that the western area has riverbanks reaching up to 2m high with steep sided drops down to the river. In the eastern area, this height was observed to be reduced to about 1-1.5m. Around the pond steeper slopes were observed leading down

to the topographic low where the pond is located. However the rest of the site remained relatively flat, with the land around the pond slightly raised above the pond and brook.

5.2.83 The hydrological catchment comprises sub-catchments to the north and south, with the furthest extending 464m to the north where elevations reach 34mAOD.

Plate 5.5 Location Map for Wet Woodland 8



Soils and geology

5.2.84 The majority of the site is underlain by soils described as 'Fine loamy over clayey soils with slowly permeable subsoils and slight seasonal waterlogging associated with similar but wetter soils. Some calcareous and non-calcareous slowly permeable clayey soils'. These soils have slightly impeded drainage.

5.2.85 In the west, the soils are described as 'Well drained fine loamy soils often over gravel associated with similar permeable soils variably affected by groundwater'. These soils are freely draining.

5.2.86 Both soil types within the site were confirmed by the hydrogeological survey.

5.2.87 The site is underlain by alluvium (BGS, 2021a). Head deposits, comprised of clay, silt, sand and gravel are located very close to the northern boundary of the site but not within and likely underlie the alluvium deposits to an extent. River terrace deposit (RTD) and the Lowestoft formation are also likely to underlie parts of the site, with the RTD present in the north and Lowestoft present in the south. Made ground deposits are recorded by BGS in the centre of the site adjacent to either side of the existing A12. The site is underlain by the London Clay Formation.

5.2.88 There are no GI boreholes within the site itself, however two GI boreholes lie north of the eastern sub zone within 25m of the site (Plate 5.5). An additional GI borehole lies along the existing eastbound carriageway of the A12. There are also no historical BGS boreholes within the site boundary, however there are multiple along the route of the existing A12 close to the site. Details on the available boreholes are presented in Table 5.8. Two BGS boreholes indicate the presence of RTD closer to the site boundary that what is show on BGS mapping, with the RTD shown to be at the surface in TL1NE39. However, the GI boreholes contradict this and suggest that the alluvium and RTD do not extend as far as shown on BGS maps are they were not recorded by the GI.

Table 5.8 Borehole records for Wet Woodland 8

BH	Description
TL81NE38	Silty clay (alluvium): 0-1.8mbgl Sands and gravels (River Terrace Deposits): 1.8-3.6mbgl Lowestoft formation: 3.6->18mbgl
TL81NE39	Sand and gravels (River Terrace Deposits): 0-3.6mbgl Lowestoft Formation: 3.6- >12.49mbgl
TL81NE63	Clay and chalk chippings:0->1.83mbgl
TL1NE90 and TL81NE84	Glacial drift: 0 -67.2 mbgl
WS3409	Made Ground: 0-0.3mbgl Lowestoft formation:0.3->5.45mbgl
BH3013	Made ground: 0-0.3mbgl Head deposits: 0.3-0.9mbgl Lowestoft Formation: 0.9->15mbgl

BH	Description
BH+RC3206	Clay, sand and gravel (MBRO): 0-4.2mbgl River Terrace Deposits: 4.2-7.4mbgl Lowestoft Formation: 7.4->40.2mbgl

Groundwater

5.2.89 Available GI groundwater level information is summarised in Table 5.9. This includes both strikes and seepages encountered during drilling and monitoring information where available.

5.2.90 Where encountered, the majority of groundwater strikes were found to be less than 3m from the surface with no rise recorded suggesting that the aquifer is unconfined. No monitoring in the BGS boreholes was available. Based on monitoring in WS3409, the groundwater level in the east lie very close to the surface at 0.6mbgl.

Table 5.9 Groundwater level information extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
TL81NE38	1.8mbgl	1.8	n/a	28/07/1962
TL81NE39	3.2mbgl	3.2	n/a	02/08/1962
TL81NE63	None recorded	n/a	n/a	1962
TL1NE90	1.2mbgl	1.2	n/a	1933
TL81NE84	2.4mbgl	2.4	n/a	August 1954
WS3409	3.2mbgl	2.2	0.9-3.04	22/04/2021- 19/08/2021. Maximum level recorded on 22/04/2021
BH3013	Not encountered	n/a	0.6-1.45	22/04/2021- 19/08/2021. Maximum level recorded on 22/04/2021
BH+RC3206	Not recorded	n/a	n/a	05/01/2021

5.2.91 During the hydrogeological walkover no groundwater features were identified. However, in the western area the soil was very slightly damp. Drier conditions prevailed to the eastern area, with soils along the slopes of the brook being dry with evidence of burrowing.

5.2.92 There are no groundwater features shown on Ordnance Survey Maps within the site. However, BGS data suggests that the whole site has a very high groundwater flooding susceptibility (2021b).

Habitats and vegetation

5.2.93 A Phase 1 Habitat Survey was carried out on 14/07/2020.

5.2.94 The Phase 1 Habitat Survey classified the site as A1.1.1, with the western part described as 'Wet woodland along Domsey Brook. Canopy of large white willow trees with frequent mature alder trees along brook and abundant semi-mature secondary growth in adjacent floodplain. Field layer dominated by common nettle.' The hydrogeological survey confirmed these site conditions, however the area of woodland was found to be slightly damp underfoot but did not appear to be wet woodland as suggested above. The damp conditions could have been a result of rain showers the previous day rather than an indication of shallow groundwater levels.

5.2.95 Around the pond, the vegetation is described as being 'Woodland around eastern end of pond basin, dominated by grey willow and white willow. Partly cleared along bank, with abundant regrowth of trees and tall herb fen of meadowsweet and purple loosestrife'. During the hydrogeological survey, the wetland vegetation described here was observed to be located within the pond rather than on the banks. This indicates that this part of the site is not a GWDTE.

5.2.96 The eastern part of the site is described as 'Woodland along the Domsey Brook. Dominated by white willow, with shrub layer dominated by large grey willows, frequent large hazel coppice stools and old field maples. Some stands of dog's mercury but otherwise field layer dominated by common nettle or densely shaded'. The hydrogeological site survey confirmed these conditions on site, which suggest that this part of the site is not a GWDTE.

5.2.97 There are no ecological designations at this site.

Conceptual site model

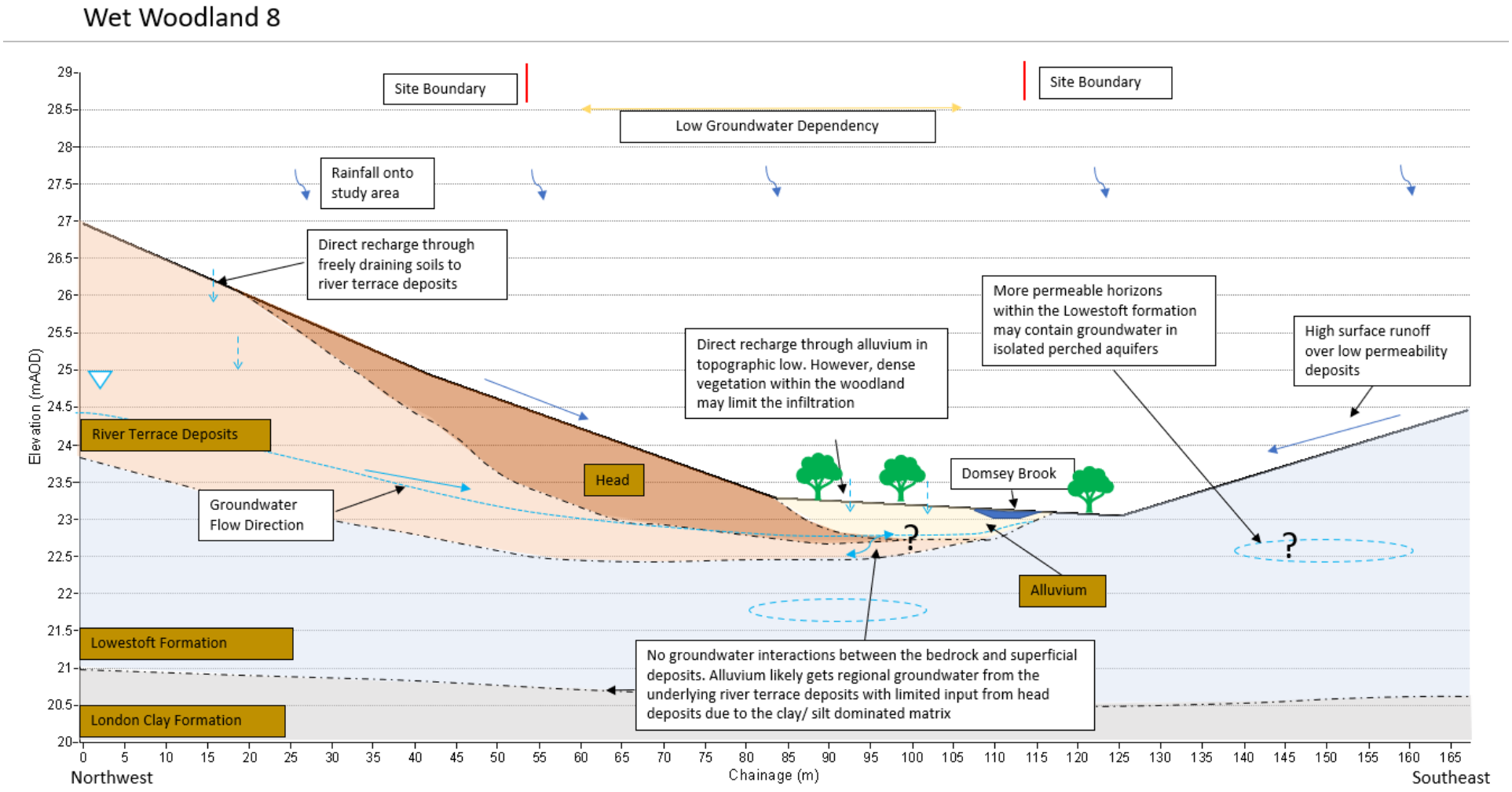
5.2.98 Plate 5.6 shows a conceptualised cross-section running northwest to southeast through the western part of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.99 The site lies in a valley filled with alluvium that follows the course of Domsey Brook. Groundwater is expected to follow the topography and flow from the north and south towards the site, to discharge into the brook, therefore groundwater levels within the site could be moderately shallow. The groundwater data available only indicates however shallow groundwater conditions along the existing A12 and immediately to the north of the pond. Groundwater level information available around the western area records groundwater strikes between 1.2 and 2.4 mbgl. Recharge to the aquifer through the alluvium is expected however, the dense vegetation cover at the eastern part of the site will likely reduce the infiltration rates. The large extent of the RTD to the north of the site likely provides regional recharge to the site through the base of the alluvium.

5.2.100 During the hydrogeological site walkover, no groundwater features were identified, however the western part of the site was found to be slightly damp underfoot. The clayey nature of the soils could slow infiltration which could encourage surface water ponding. It is unclear whether the slightly damp soils in this area is a result of the clayey soils conditions or a result of shallow groundwater levels. The majority of the site lies within flood zones 2 and 3, and therefore the contribution of surface water for this area, especially during high rainfall events, is likely to be more than groundwater therefore the western part of the site could have a **low groundwater dependency** at most.

5.2.101 On the eastern side of the A12 there was little indication of shallow groundwater and a lack of groundwater dependent vegetation. Therefore, this part of the site is assessed as having **no groundwater dependency.**

Plate 5.6 Conceptual Site Model for Wet Woodland 8



Assessment of potential effects

5.2.102 The eastern area falls entirely within the Order of Limits. In the eastern area there is a proposed haul road to an attenuation pond some 20m to the north of the site. The widening of the A12 encroaches directly onto a portion of the eastern area which surrounds the pond. This section of widening is on embankment.

5.2.103 However, the eastern area has been assessed as not being a GWDTE, therefore is not further assessed. The focus will be on the western area.

5.2.104 The western area lies immediately north of the Order of Limits, with an adjacent haul road on the southern bank of Domsey Brook.

Construction

5.2.105 The majority of the GWDTE lies within the zone of influence of borrow pit J, which is located 391m southeast of the site at its nearest point but expected to draw groundwater from permeable deposits in this area. A drawdown of the order of 0.66 to 0.19 m is predicted in the western area. The zone of influence could also affect groundwater flows more globally within the wider catchment area which feeds groundwater associated with the site. However, the estimate zone of influence is likely to be over-estimated as the deposits away from the cutting will vary and the permeability could reduce. Therefore, as a precaution, moderate adverse impacts have been applied. This results in a **Slight** significance of effect across the entire site.

5.2.106 Dewatering for the construction of attenuation pond S3-OU9 189 m to the west of the site is likely to impact the east of the western area. Given the distance, a drawdown of 0.48 m is predicted. However, as with borrow pit J, this estimate zone of influence is likely over-conservative. In any case, precautionary minor impacts have been applied resulting in a potential **Slight** significance of effect across the east of the western area. The remainder of the site is not expected to be impacted.

5.2.107 Given that the site likely receives groundwater from the north, no impacts are expected to groundwater flows and levels throughout the site from the construction of the proposed cuttings, embankments, or drainage assets, given their distance from the site and their position south/east.

5.2.108 During construction, there could also be short-term impacts on groundwater quality at the GWDTE due to mobilisation of suspended solids and associated solutes, leaks and spills of fuels and chemicals during construction.

5.2.109 However, as described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], there are several best-practice mitigation measures which are incorporated into the first iteration EMP [TR010060/APP/6.5] for pollution prevention including managing silt pollution (for suspended solids transport). These measures would reduce the likelihood of contaminating groundwater. In addition, the site is located on the opposite bank of Domsey Brook from the proposed haul road. Therefore, the magnitude of change on existing groundwater quality across the site, due to the mobilisation of suspended solids and/or accidental spills and leaks is expected to be negligible, resulting in a **Neutral** significance of effect.

Operation

5.2.110 Given the distance of the western area from any embankments no impacts to groundwater levels and flows are expected.

5.2.111 Any long-term changes in recharge rates as a result of increased impermeable surface areas are expected to be of negligible magnitude, and therefore potential **Neutral** significance.

5.2.112 The borrow pit will be left to fill with water, therefore groundwater levels should equilibrate within these ponds and return to pre-construction levels. No operational impacts to groundwater flows and levels at the site are therefore predicted.

5.2.113 Considering the distance of the proposed scheme from the GWDTE, and likely groundwater flow directions in the area, any accidental leaks/spills of fuels and chemicals and/or routine runoff associated with the road are expected to be negligible in the western area, resulting in a potential **Neutral** significance of effect.

Summary

5.2.114 A summary of the potential impacts to the site is provided in Table 5.10.

Table 5.10 Summary of potential effects to Wet Woodland 8

Groundwater dependency	Ecological designation	Importance	Effect	Phase	Highest magnitude of impact	Highest significance of effect
Low	None	Medium to Low	Accidental leaks / spills of fuels and chemicals (groundwater quality)	Construction	Negligible	Neutral
			Mobilisation of suspended solids (groundwater quality)	Construction	Negligible	Neutral
			Dewatering (groundwater levels / flows / quality)	Construction	Moderate Adverse	Slight
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	Negligible	Neutral
			Long-term disturbance of groundwater flows (groundwater levels / flows)	Operation	Negligible	Neutral

Mitigation and residual effects

5.2.115 As shown in Table 5.10, potential impacts on groundwater flows and levels to GWDTEs at Wet Woodland 8, during the construction phase, have been assessed as of Slight, or Neutral significance. No mitigation measures are therefore required.

Wet Woodland 9

Site setting, topography and hydrological catchment

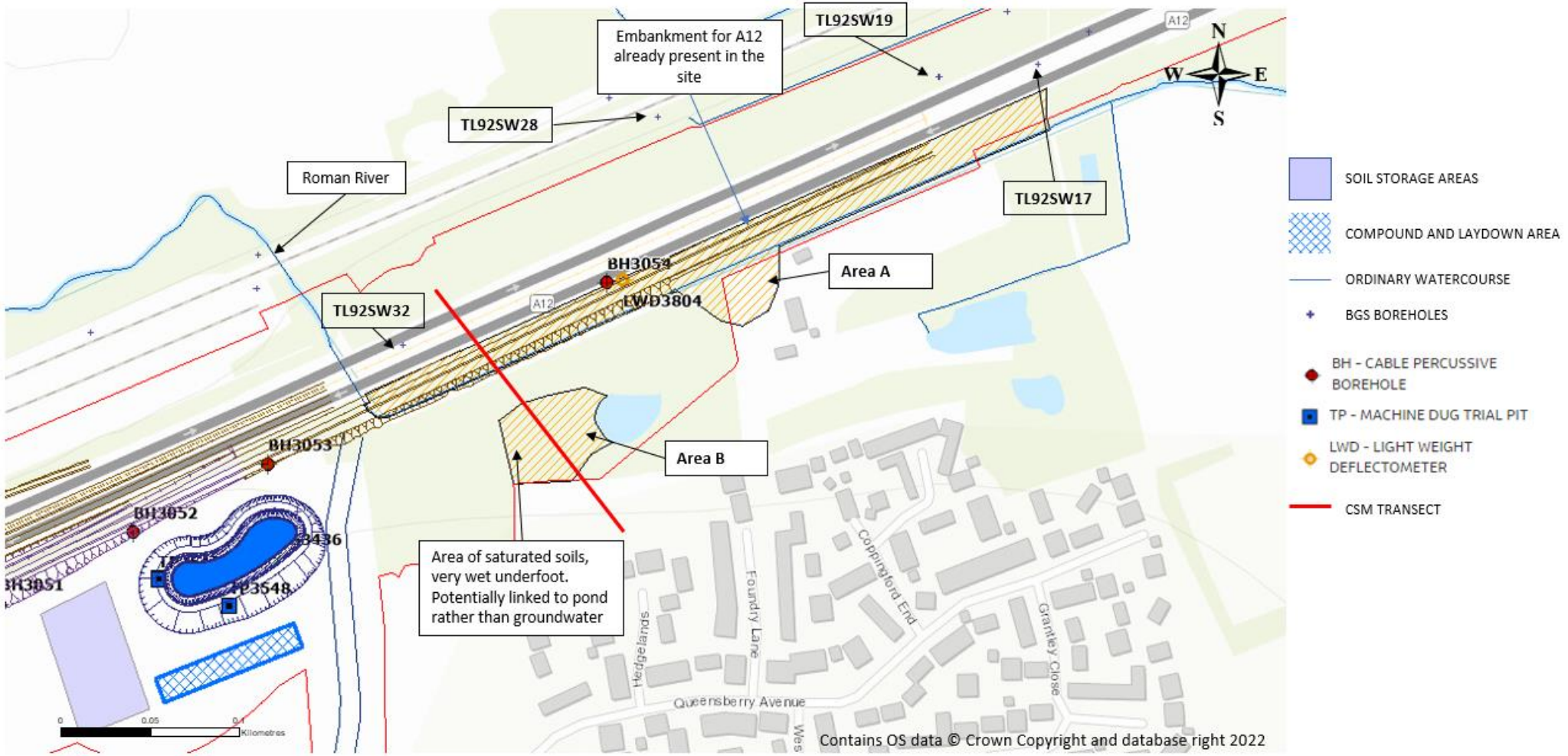
5.2.116 The site is located along the westbound carriageway of the existing A12 at Copford. The site is split into two areas, with the larger (Area A) bound between the existing A12 and Roman River. The smaller area (Area B) surrounds a small pond just north of a residential area in Copford (Plate 5.7).

5.2.117 The Roman River flows west to east along the southern boundary of Area A. A small tributary which originates at a pond in Area B flows east then north through the site into the Roman River. A hydrogeological walkover survey was undertaken for the site in September 2021 and the pond was noted to be stagnant with no tributary observed.

5.2.118 The site lies in a flat area with rising slopes to the south and very gentle slopes to the north associated with the embankment of the A12. The site is located along the banks of the Roman River, with a proportion of Area A lying within the zone 2 and 3 flood plain. Elevations range from 28mAOD in the west to 26mAOD in the east.

5.2.119 The hydrological catchment comprises sub-catchments to the north, south and southwest, with the furthest extending 400m to the southwest where elevations reach 37mAOD. The current A12 to the north of the site is on embankment and likely alters natural run off, potentially preventing the natural expansion of the Roman River floodplain.

Plate 5.7 Location Map for Wet Woodland 9



Soils and geology

5.2.120 The site is underlain by soils described as 'Deep permeable coarse loamy soils affected by groundwater. Associated with well drained sandy and coarse loamy soils and some slowly permeable seasonally waterlogged fine loamy over clayey and clayey soils giving patterned ground locally.' These soils have a slightly impeded drainage. During the hydrogeological site visit the presence of loamy sands was confirmed.

5.2.121 From BGS mapping the majority of the site is underlain by alluvium (BGS, 2021a). Area B south of Area A is overlain by the interglacial lacustrine deposits, comprised of clay and silt.

5.2.122 The site is underlain by bedrock of the London Clay Formation.

5.2.123 There are two GI boreholes located within the Area A along the A12, and a further GI borehole located 70m west of the site (Plate 5.7). There are also three available BGS historical borehole records within the 35m of the site. A further BGS borehole lies approximately 80m north of the site. Details of these boreholes are described in Table 5.11. The clay, silt, sand and gravel layers found at shallow depth demonstrates the variation of deposits that can be found within the superficials. Across Area A, alluvium is mapped at the surface with RTD underlying this. Therefore, these sands, silts, gravels and clays could be referring to either the alluvium or RTD unit making it is difficult to delineate. No GI or BGS boreholes are available in or close to Area B surrounding the pond, therefore the geology could not be verified at this location.

Table 5.11 Borehole records for Wet Woodland 9

BH	Description
TL92SW17	Clay: 0-0.76mbgl Sands and gravels (River Terrace Deposits): 0.76-1.68mbgl Grey to brown organic shale: 1.68mbgl->3.05mbgl
TL92SW32	Sand and gravels: 0-2.1mbgl Clay and silt: 2.1-5.2mbgl Silty blue clay (Lowestoft Formation): 5.2->9.1mbgl
TL92SW19	Topsoil: 0-0.46mbgl Clay: 0.46-1.07mbgl Sandy clay with stones and flints: 1.07-1.52mbgl Gravels and flints: 1.52-2.44mbgl Organic shale: 2.44-2.9mbgl Shale and small gravels: 2.9->3.05mbgl
TL92SW28	Sand and gravel with little clay: 0-1.52mbgl Dark sandy peat:1.52-4.5mbgl Blue sandy clay:4.5-14.48mbgl Silty sand:14.48-18.90mbgl Sand and large gravel: 18.90->19.81mbgl

BH	Description
BH3053	Made Ground: 0-0.5mbgl Alluvium:0.5-2.3mbgl River Terrace Deposits:2.3-4.1mbgl Kesgrave Catchment Subgroup: 4.1->10.45mbgl
BH3054	Made ground: 0-0.4mbgl Gravel (MBRO): 0.4-0.6mbgl Clay (MBRO): 0.6-1.2mbgl Alluvium: 1.2-5.7mbgl Clay and silt (ISC): 5.7-9.2mbgl Silt and sand (ISC): 9.2-10.4mbgl Sand (Kesgrave Catchment subgroup): 10.4->13.20mbgl
LWD3804	Clay (MBRO): 0-0.2mbgl Gravel (MBRO): 0.2-0.4mbgl

Groundwater

5.2.124 Available GI and BGS groundwater level information is summarised in Table 5.12. This includes both strikes and seepages encountered during drilling and monitoring information where available, suggesting shallow groundwater conditions. Where recorded groundwater is encountered less than 3mbgl.

Table 5.12 Groundwater levels extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
TL92SW17	Not recorded	n/a	n/a	No date
TL92SW32	Not recorded	n/a	n/a	No date
TL92SW19	Not recorded	n/a	n/a	No date
TL92SW28	2.7mbgl and 14mbgl	2.7	n/a	17/09/1962
BH3053	1.2mbgl	1.2	1.14-1.38	19/02/2021-26/08/2021. Maximum level recorded on 26/08/2021
BH2054	0.6mbgl and 1.9mbgl	0.6	1.78-4.08	20/05/2021-15/90/2021. Maximum level recorded on 09/06/2021
LWD3804	Not recorded	n/a	n/a	15/12/2020

5.2.125 During the hydrogeological walkover no evidence of groundwater was observed. Area B adjacent to the pond was found to be very wet underfoot and boggy with saturated soils. This area was located slightly lower than the surrounding ground and merged into the pond.

5.2.126 There are no groundwater features shown on Ordnance Survey Maps within the site. However, BGS data suggests that the majority of the site has a very high groundwater flooding susceptibility, indicating relatively shallow groundwater levels. This is with the exception of Area B not being shown as susceptible to groundwater flooding.

Habitats and vegetation

5.2.127 A Phase 1 Habitat Survey was carried out on 15/07/2020.

5.2.128 The Phase 1 Habitat Survey classified Area A as A1.1.1, with the larger area described as 'Stand of mature and early mature alder trees along Roman River. Understorey species-poor, banks of river sparsely vegetated. Wild garlic on bank toward east.'. This vegetation was confirmed during the hydrogeological survey, indicating that this part of the site is not a GWDTE.

5.2.129 The smaller area east of the pond (Area B) is described as 'Stand of crack willow dominated woodland at end of basin in which pond sits. Abundant fallen dead wood, field layer dominated by wetland tall herbs'. These habitats and vegetation were confirmed during the hydrogeological site visit. However, in the smaller area wetland tall herbs was more sparce in appearance and not dominating like described above. It is difficult to ascertain whether these wetland tall herbs are associated with shallow groundwater or surface water ponding. However, given the low permeability of the underlying geology surface water inputs are more likely. Therefore, this part of the site is unlikely to be a GWDTE.

5.2.130 There are no ecological designations at this site.

Conceptual site model

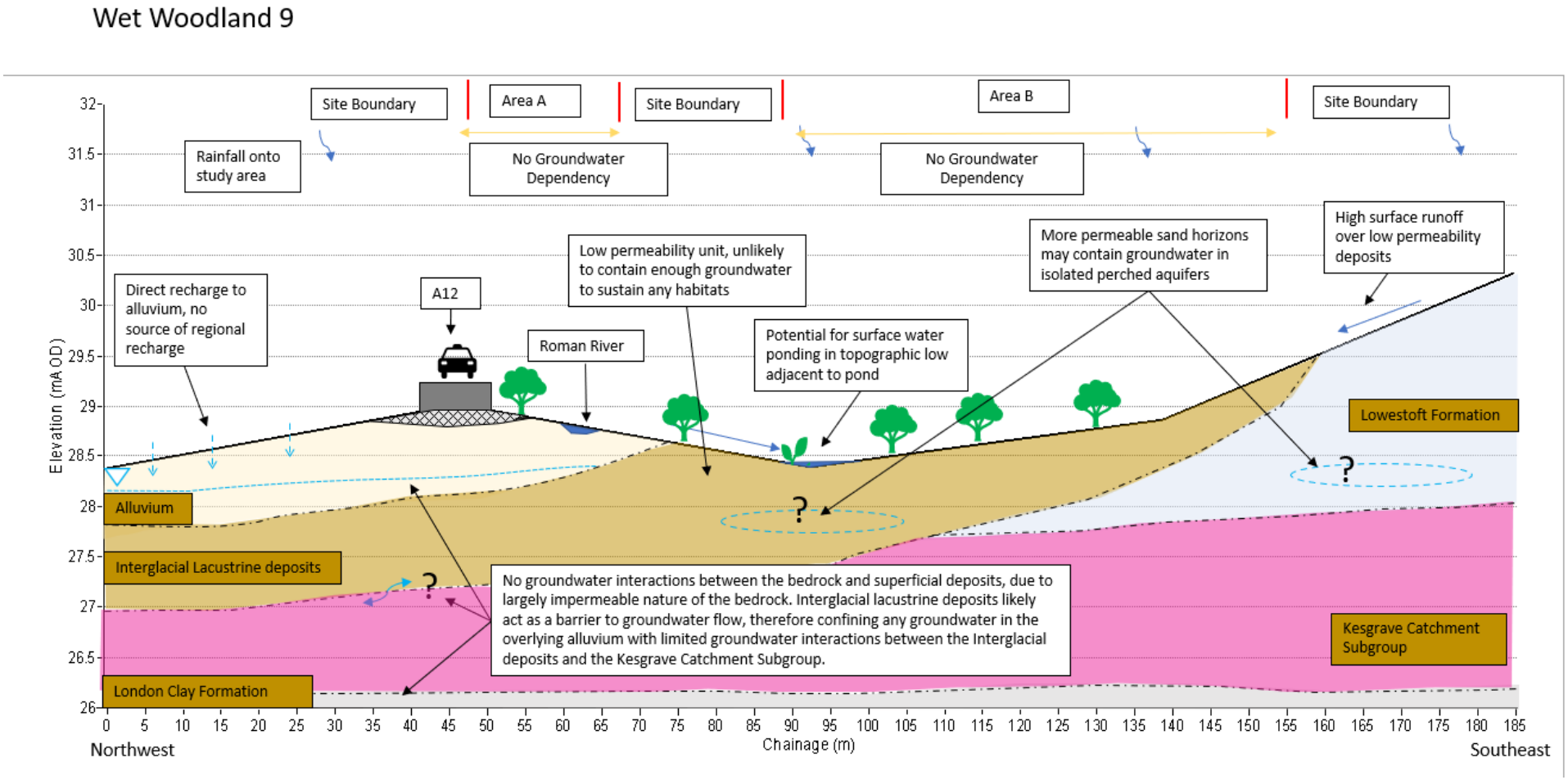
5.2.131 Plate 5.8 shows a conceptualised cross-section running northwest to southeast through the west of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.132 Area B lies in a topographic low where surface water ponding is likely to be the main source of water based on the type of vegetation and given the largely impermeable nature of the underlying lacustrine deposits which are unlikely to be able to store and provide enough groundwater contributions to sustain a wetland habitat. The areas of wetness found in this part of the site during the site walkover is more likely a result of surface water ponding within the topographic low rather than shallow groundwater. Therefore, this part of the site is assessed as having **no groundwater dependency.**

5.2.133 Any groundwater within the site is likely found in the alluvium in the north (Area A). The alluvium is expected to recharge locally through the deposits on site with unlikely sources of regional recharge given the low permeability of the underlying interglacial lacustrine deposits which likely acts as a low permeability

layer. Locally, the GI records groundwater levels ranging from 1 to 4m bgl. The embankment of the A12 likely limits any groundwater flow to this part of the site. Therefore, given the depth of groundwater through monitoring and the presence of the embankment this site has been assessed as having **no groundwater dependency**.

Plate 5.8 Conceptual Site Model for Wet Woodland 9



Assessment of potential effects

5.2.134 The majority of the site lies within the Order of Limits associated with the A12 mainline. An embankment associated with the widening of the A12 is located within the northern part of the site and is proposed to be widened (Plate 5.7). A proposed attenuation pond lies 70m east of the site.

5.2.135 However, from the hydrogeological survey and the information above this site is not considered to be a GWDTE therefore no further assessment is required.

Whetmead LNR

Site setting, topography and hydrological catchment

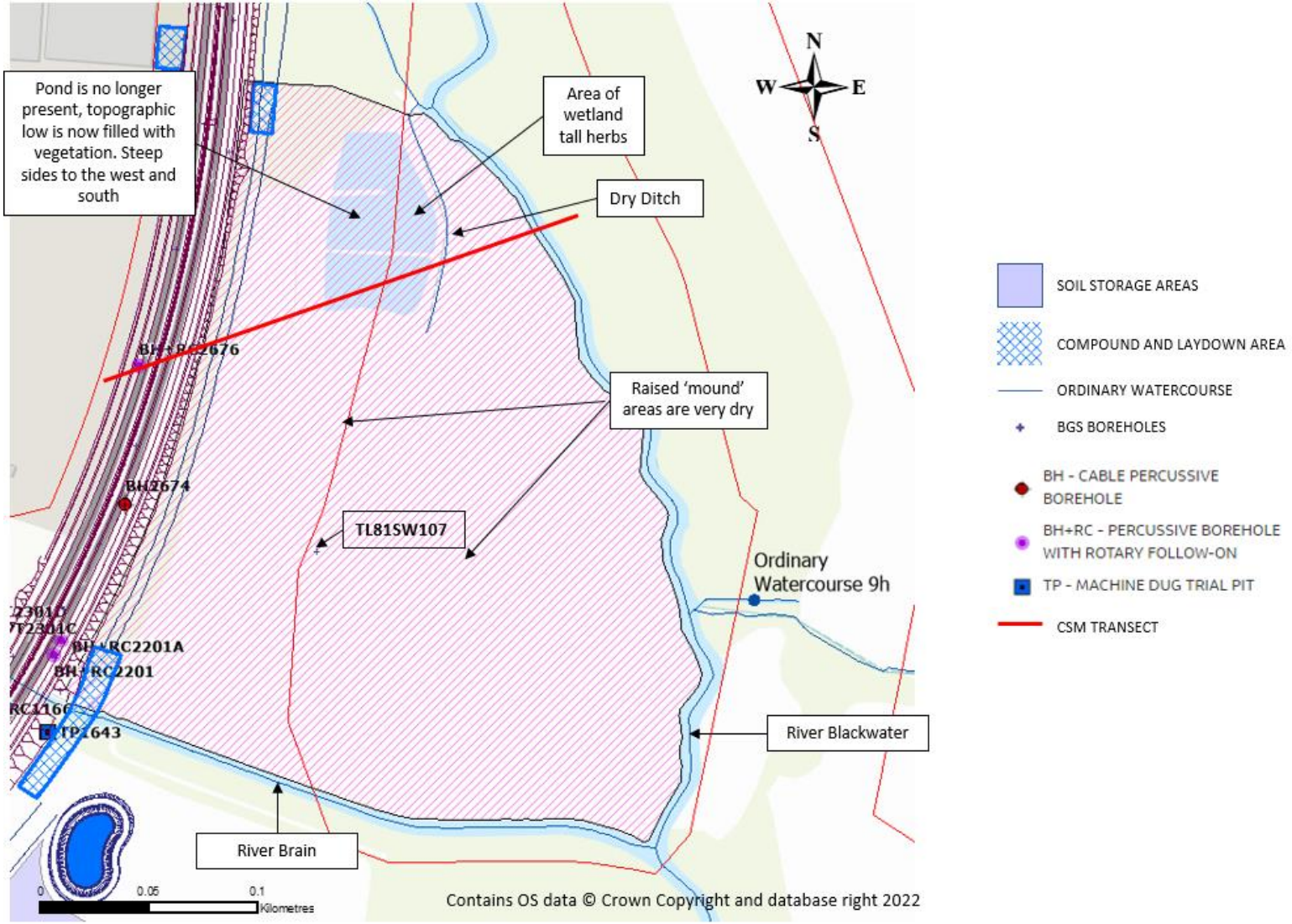
5.2.136 The site is located on top of a historical landfill adjacent to the existing A12, east of Witham (Plate 5.9). The site sits topographically higher than the A12. It is bounded to the east by the River Blackwater and to the south by the River Brain, joining at the boundary of the southeast corner.

5.2.137 Ordnance Survey maps show a track following the boundary of the site along both rivers. A small area of the site in the north is part of the flood plain, corresponding to a mapped pond, but the majority of the site is outside. The pond is likely resulting from a localised low topography man-made landfill artefact, and a drain which flows from the east of the pond north.

5.2.138 Within the site there are two mounds which have a higher topography than the surrounding land, which are the result of the past landfilling activities. These mounds reach an elevation of 19mAOD, while the lowest elevation is found along the banks of the River Blackwater at 14mAOD. These mounds likely act as local catchments for the site.

5.2.139 A hydrogeological walkover survey was undertaken for the site in September 2021. Moderately sloped land from the riverside to the raised centre of the site was encountered, with a high plateau in the centre of the site.

Plate 5.9 Location Map for Whetmead LNR



Soils and geology

5.2.140 The majority of the site is underlain by soils described as 'Stoneless clayey soils, in places calcareous variably affected by groundwater.' These soils are naturally wet. In the northwest soils described as 'deep loam over gravel' are present. These soils are freely draining. During the hydrogeological site walkover clay loam soils were found within the site.

5.2.141 From BGS mapping the south and east of the site is underlain by alluvium, whilst the northwest of the site is underlain by RTD (BGS, 2021a). The RTD are considered likely to extend beneath the alluvium at the site to an extent. Made ground, likely associated with the historical landfill is recorded in the east and southwest corner of the site (BGS, 2021a). This likely extends across the majority of the site, given the footprint of the old landfill. The landfill was operational between 1964 and 1974 and would therefore be expected to operate as a dilute and disperse landfill.

5.2.142 Bedrock at the site is the London Clay Formation.

5.2.143 There is one BGS borehole located within the centre of the site (Table 5.13), This borehole is dated from 22nd January 1969 and records natural deposits hence predating the landfill at this exact location. GI boreholes are located along the margins of the existing A12 but not within the site (Plate 5.9), details of these are presented in Table 5.13.

5.2.144 The geology recorded in the GI boreholes broadly correlates with the BGS mapping. No GI boreholes are available within the old landfill to determine the nature of the made ground here. Drilling of the BGS borehole likely predates the landfill in this location given the lack of waste and made ground identified during drilling.

Table 5.13 Borehole records for Whetmead LNR

BH	Description
TL81SW107	Silty sandy clay with some fine medium coarse gravel (alluvium): 0-2.44mbgl Grey silty clay: 2.44->3.65mbgl
BH+RC2201A	fill: 0-4.7mbgl alluvium:4.7->6.2mbgl River Terrace Deposits: 6.2->7.2mbgl
BH2674	Concrete (made ground):0-0.5mbgl Clay (MBRO): 0.5-3.4mbgl River Terrace Deposits:3.4-4.8mbgl London clay:4.8->6.5mbgl
BH+RC2676	Sand and clay:0-1.2mbgl River Terrace Deposits: 1.2->4.4mbgl

Groundwater

5.2.145 Available GI groundwater level information is summarised in Table 5.14. This includes both strikes and seepages encountered during drilling and monitoring information where available. No groundwater was encountered during drilling prior to use of water flush. However, monitoring results show that moderately shallow groundwater conditions are present in all the GI boreholes with levels ranging from 2.4 to 5mbgl over a period of 14 months along the A12.

Table 5.14 Groundwater levels extracted from borehole records

BH	Water Strike	Maximum Water Level after 20 minutes (mbgl)	Monitoring Range (max/min) (mbgl)	Date
TL81SW107	Dry	n/a	n/a	22/01/1969
BH+RC2201A	Not recorded	n/a	2.73-5 (14.12-11.85 mAOD)	26/06/2020-09/09/2021. Maximum level recorded on 26/06/2021
BH2674	Not recorded	n/a	2.86-4.6(13.94-12.2 mAOD)	26/06/2020-09/09/2021. Maximum level recorded on 04/12/2020
BH+RC2676	Not recorded	n/a	2.38-3.76 (14.02-12.64 mAOD)	06/07/2020-08/09/2021. Maximum level recorded on 31/01/2021 and 01/02/2021

5.2.146 During the hydrogeological walkover no groundwater features were identified. The area where the pond was shown to be located on OS mapping was found to be dried out but filled with vegetation and was observed to be wet underfoot. This area was located in a topographic low with steep sides, assumed to be man-made as part of the landfill system.

5.2.147 There are no groundwater features shown on Ordnance Survey Maps within the site. However, BGS data suggests that the majority of the site has a moderate-high susceptibility to groundwater flooding, indicative of a relatively shallow water table. The areas with a lower topography along the course of the rivers has a very high susceptibility indicating shallower groundwater levels closer to the river.

Habitats and vegetation

5.2.148 A Phase 1 Habitat Survey was carried out on 30/07/2020.

5.2.149 The Phase 1 Habitat Survey classified the majority of the site as B2.2, described as ‘Mosaic of short rabbit-grazed or trampled grassland, tall rank grassland and tall ruderal, with scattered hawthorn and rose scrub. Some areas with more diverse grassland, with drought tolerant species such as lady's-bedstraw and perforate St John's-wort, but grassland is species-poor, mostly dominated by false oat-grass, and the non-native hoary cress is abundant across the whole area’. This was confirmed during the hydrogeological walkover where the majority of the site, especially at the higher

topography in the centre was observed to be very dry. Around the edge of the site along the course of the Rivers Blackwater and Brain nettles dominated (where there was no path) and the ground also appeared to be dry. The vegetation and dry nature of the majority of the site makes it unlikely to be a GWDTE.

5.2.150 The vegetation around the pond margins is describes as 'Stand of sedges, reed and wetland tall-herbs in seasonally wet hollow. Fringed with large grey willow bushes and crack willow trees'. During the hydrogeological walkover no pond was visible, however conditions underfoot were very wet and there was an abundance of vegetation as described above present. This area was found to be in a small topographic low with steep sides to the west and south leading up to the mounds of the historical landfill.

5.2.151 The entire site is designated as a local nature reserve (LNR).

Conceptual site model

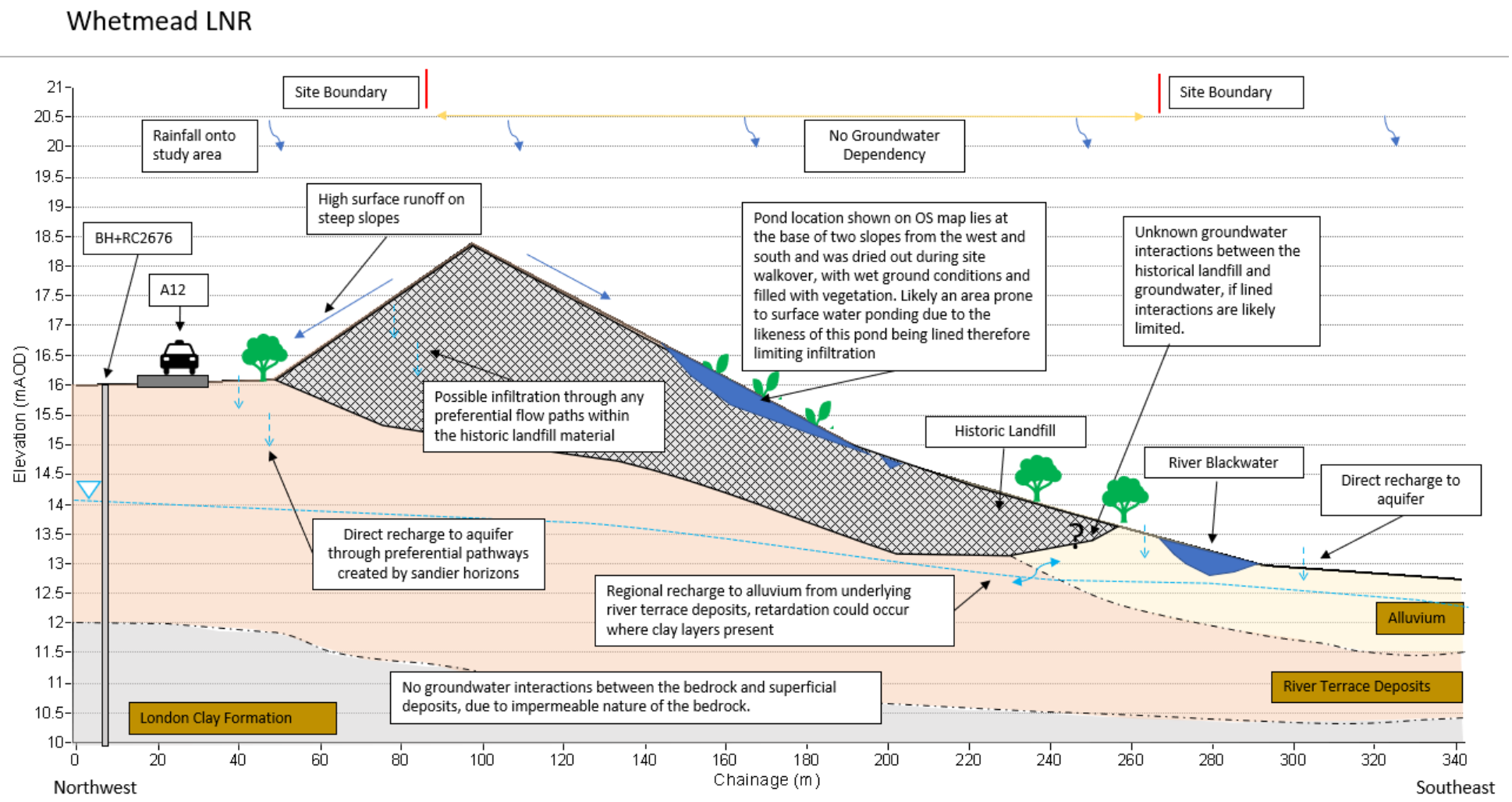
5.2.152 Plate 5.10 shows a conceptualised cross-section running northwest to southeast through the north of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.153 The site contains a historical landfill which could be interacting at depth with groundwater, as the depth of wastes is unknown. The site is artificially raised as a result of the historical landfill and the natural groundwater level is expected to be of the order of 14.12-11.85mAOD. This means that the groundwater level is expected to be well below the current site level, as shown on Plate 5.10.

5.2.154 The area shown on OS maps as a pond was dry during the site walkover and looked like it had been that way for years given the established trees and vegetation growing within the topographic low. This area was surrounded by steep slopes which looked to be manmade. The pond location likely contained some kind of former treatment lagoons for the landfill at one point. These may have been lined and if so, any surface runoff would not be able to infiltrate which could lead to surface water ponding in this area. The groundwater level is clearly not supporting this vegetation and is expected to be about 3m below ground levels. Given that this area sits at the base of the slope it is likely to act as a surface water pooling area which could explain the wet ground conditions found. This part of the site is therefore assessed as having **no groundwater dependency** due to the likely contributions of surface water to the habitats rather than groundwater.

5.2.155 Towards the river the groundwater is likely to be shallower, however during the walkover there was no groundwater features or any indications of wet conditions across the site. This was the same across the rest of the site, especially on the topographic highs which were very dry at the time of the visit with no indication of wetland vegetations. Therefore, the rest of the site is said to have **no groundwater dependency.**

Plate 5.10 Conceptual Site Model for Whetmead LNR



Assessment of potential effects

5.2.156 The western part of the site lies within the Order of Limits. A proposed embankment is located along the sites western boundary. Two small compound and lay down areas are proposed in the north-western and south-western corners of the site. A proposed attenuation pond is located 48m south of the site.

5.2.157 This site has been assessed as not being a GWDTE therefore no further assessment is required.

Brockwell Meadows LNR

Site setting, topography and hydrological catchment

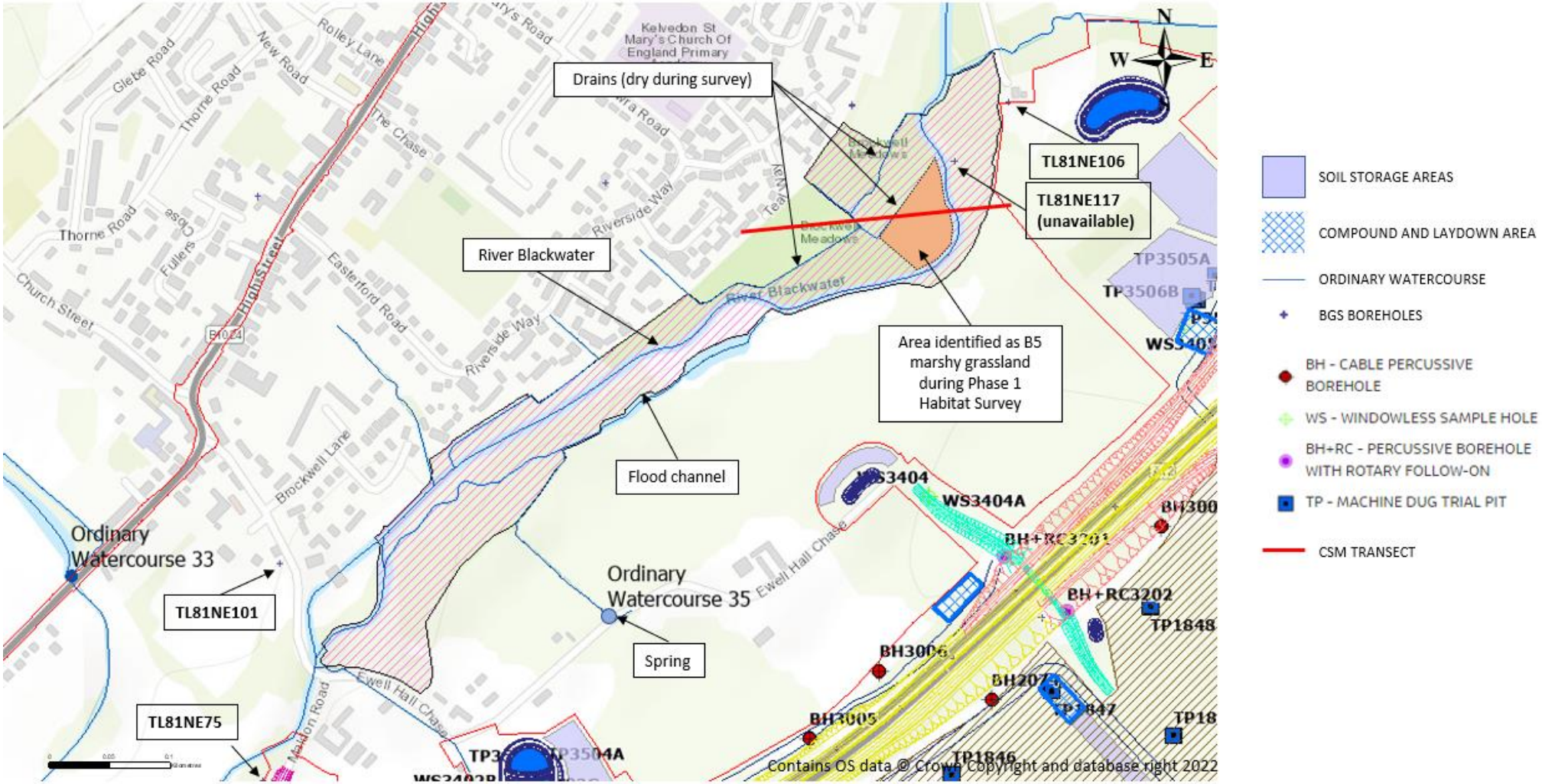
5.2.158 The site is located along the banks of the River Blackwater, along the southeast margin of Kelvedon (Plate 5.11). The site expands to both sides of the river and stretches from a small tributary in the north (Domsey Brook) to Maldon Road in the southwest.

5.2.159 The River Blackwater flows northeast to southwest through the centre of the site. There are three drains shown within the site as well as one small tributary (Ordinary Watercourse 35) which all flow into the River Blackwater in the centre of the site. A hydrogeological walkover survey was undertaken for the site in September 2021 and all these surface water features were found to be dry, however the ground within these was damp. On the eastern bank of the river there is an additional channel (flood channel) which re-joins the river to the south of the site, during the walkover this had a limited amount of water within it. Domsey Brook flows into the River Blackwater along the north eastern boundary of the site.

5.2.160 The site is very flat (between 20 and 21mAOD) and lies entirely within the floodplain of the river.

5.2.161 The hydrological catchment comprises sub-catchments to the northwest and southeast, with the furthest extending 285m to the southeast where elevations reach 33mAOD. The residential area of Kelvedon to the northwest likely limits the natural groundwater catchment of the site.

Plate 5.11 Location Map for Brockwell Meadows LNR



Soils and geology

5.2.162 The site is primarily underlain by soils described as 'Stoneless clayey soils, in places calcareous variably affected by groundwater.' These soils are naturally wet. The margins of the site are underlain by soils described as 'Well drained fine loamy soils often over gravel associated with similar permeable soils variably affected by groundwater'. These soils are well draining. The hydrogeological walkover confirmed the presence of silt loam soils very similar to the first description above.

5.2.163 From BGS mapping, the site is primarily underlain by superficial deposits of alluvium, described as clay, silt, sand and gravel (BGS, 2021a). The margins of the site, and the immediately surrounding area, is underlain by RTD. The site is located within the margins of a buried valley (BGS, 2021a), suggesting that the superficial deposits in this location could be relatively thick.

5.2.164 The west of the site is underlain by bedrock of the Thanet Formation, described as clay, silt and sand. The east of the site is underlain by bedrock of the London Clay Formation.

5.2.165 There are no available BGS boreholes within the site boundary, however there is one BGS borehole located in the north-eastern corner of the site with a further two BGS boreholes lying outside the site boundary some 96m and 161m to the southwest (Plate 5.11). Details of these boreholes are available in Table 5.15 below. There are no GI boreholes within the site, with the nearest lying over 100m from the site boundary to the south and is therefore considered of limited use to characterise the site.

Table 5.15 Borehole records for Brockwell Meadows LNR

BH	Description
TL81NE106	Made ground: 0-0.6mbgl Sandy alluvium: 0-2.4mbgl Silty clay with chalk fragments and gravel: 2.4->9.14mbgl
TL81NE101	No geological information given
TL81NE75	Alluvium: 0-3.05mbgl River gravels (River Terrace Deposits): 3.05-8.53mbgl Chalky boulder clay (Lowestoft Formation): 8.5->48.01mbgl Chalky bounder clay and laminated silts and clays: 48.01-65.38mbgl Thanet Beds: 65.38-79.40mbgl Upper chalk: 79.40->82.70mbgl

Groundwater

5.2.166 Available BGS groundwater level information is summarised in Table 5.16. This includes seepages encountered during drilling and monitoring information where available. As seen below in Table 5.16 limited groundwater information is available and no monitoring has taken place.

5.2.167 In TL81NE106 groundwater seepage was encountered at 2.4mbgl. A standpipe was installed at 9.6mbgl with the water resting at 6.67mbgl after 24 hours. Groundwater levels were not recorded in TL8NE75 or TL81NE101.

Table 5.16 Groundwater levels extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
TL81NE106	Seepage at 2.4mbgl	n/a	n/a	14/10/1972
TL81NE101	Not recorded	n/a	n/a	No date
TL81NE75	Not recorded	n/a	n/a	29/04/1970

5.2.168 During the hydrogeological walkover no groundwater features were identified. The ground was relatively dry across the whole site. Access to the south-eastern bank of the River Blackwater could not be gained due to the channel which could not be crossed.

5.2.169 No groundwater features are shown on OS mapping. However, BGS data suggests that the site has a very high groundwater flooding susceptibility (2021b), indicating a shallow water table.

Habitats and vegetation

5.2.170 A Phase 1 Habitat Survey was carried out on 28/09/2016 for the area north of the river and 19/07/2017 for the area south of the river.

5.2.171 The Phase 1 Habitat Survey showed variable classifications across the site. The majority of the site was described as A1.1.2 Broad-leaved plantation woodland, which was confirmed through the hydrogeological walkover survey noting the willows were located in lines like a plantation. Given the vegetation and lack of groundwater features the parts of the site covered by plantation are not classed as a GWDTE.

5.2.172 A small area of B5, marshy grassland was identified along the western bank of the river where it bends towards the southwest (Plate 5.11). However, during the hydrogeological site walkover, no marshy grassland was identified in this area, but there was instead a mixture of abundant vegetation.

5.2.173 Along the margins of the site the habitats were described as A1.1.1 Broadleaved semi-natural woodland.

Conceptual site model

5.2.174 Plate 5.12 shows a conceptualised cross-section running west to east through the north of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and derived groundwater dependencies supporting vegetation and habitats present.

5.2.175 Throughout the site the alluvium is thought to be in hydraulic continuity with the River Blackwater, and in times of high flow the river could be indirectly recharging the aquifer rather than groundwater providing baseflow. Direct recharge to the alluvium on site is likely as well as regional recharge from the underlying River Terrace Deposits which extent out of the site.

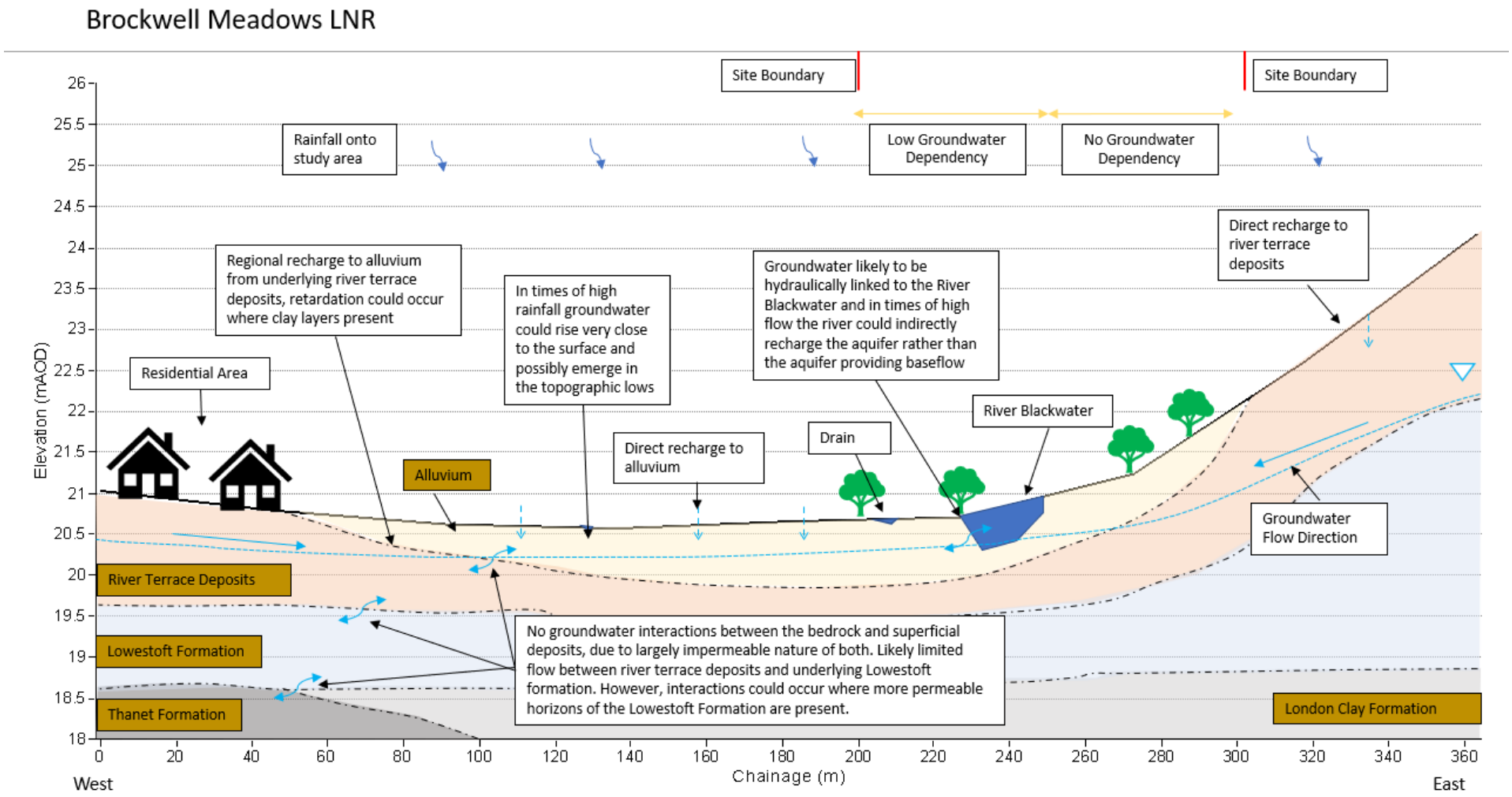
5.2.176 Given the topography of the site, groundwater is expected to flow towards the river. During the hydrogeological site walkover, ground vegetation was very thick and the drains shown on OS mapping were dried out, however the ground within these was damp. This was the only area where damp conditions were identified, and a large rain shower had preceded the hydrogeological walkover.

5.2.177 No groundwater level data is available for the site or its immediate vicinity. It is considered however that the water table could be relatively shallow on the basis of the river receiving groundwater baseflow contribution. The alluvium is capable of storing large volumes of groundwater which in times of high rainfall could emerge at the surface, however during the visit there was no evidence of this. The majority of the site was covered by plantation, with shrubbery of dock leaves which is not considered to be a GWDTE. Only a small area of B5, marshy grassland was identified during the phase 1 survey along the western bank of the river where it bends towards the southwest. The hydrogeological survey determined however that the vegetation was more mixed, with no actual grassland present, but a degree of groundwater dependency supporting this vegetation could not be ruled out.

5.2.178 Consequently, the area originally mapped as B5 is assessed as having a **low groundwater dependency**.

5.2.179 The rest of the site is not thought to be groundwater dependent, given the type of vegetation and lack of groundwater features.

Plate 5.12 Conceptual Site Model for Brockwell Meadows LNR



Assessment of potential effects

5.2.180 The north-eastern corner of the site lies adjacent to the Order of Limits. An attenuation pond is located 176m northeast of the site. Borrow pit J lies 380m south of the site.

5.2.181 The majority of the site has been classified as not being groundwater dependent therefore will not be discussed further.

5.2.182 The area identified as B5 marshy grassland originally (Plate 5.11) is the only part identified as potentially having groundwater contributions and is assessed below.

Construction

5.2.183 No impacts to groundwater levels and flows are predicted from the various proposed developments, such as construction of the proposed cuttings, embankments, or drainage assets, given their distance from the site and their position south/east.

5.2.184 The entire site lies within the dewatering zone of influence for borrow pit J. The borrow pit is located 380m southeast of the site at its nearest point but expected to draw groundwater from permeable deposits in this area. A drawdown of the order of 0.7 to 0.43 m is predicted at the site. However, the estimate zone of influence is likely to be over-estimated as the deposits away from the cutting will vary and the permeability could reduce. As a result, this could result in moderate impacts across the site, resulting in a **Slight** significance of effect.

5.2.185 The site lies outside of the zone of influence for cutting W6 therefore impacts to groundwater flows and levels are not expected.

5.2.186 During construction, there could also be short-term impacts on groundwater quality at the GWDTE due to mobilisation of suspended solids and associated solutes, leaks and spills of fuels and chemicals during construction. In particular, part of the site is located within or very close to the Order of Limits.

5.2.187 However, as described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], there are several best-practice mitigation measures which are incorporated into the first iteration EMP [TR010060/APP/6.5] for pollution prevention including managing silt pollution (for suspended solids transport). These measures would reduce the likelihood of contaminating groundwater. Considering best-practice mitigation measures, the magnitude of change on existing groundwater quality in the site is expected to be negligible, resulting in a **Neutral** significance of effect.

Operation

5.2.188 There are no permanent below ground structures or embankments proposed within the vicinity of the site to locally alter groundwater levels and flows supporting GWDTE. No impacts to the site from these assets are therefore predicted. Any long-term changes in recharge rates as a result of increased impermeable surface areas are not expected to impact the site, given the distance from the proposed scheme.

5.2.189 The borrow pit will be left to fill with water, therefore groundwater levels should equilibrate within these ponds and return to pre-construction levels. No operational impacts to groundwater flows and levels at the site are therefore predicted.

5.2.190 Considering the distance of the proposed scheme from the GWDTE, no impacts from any accidental leaks/spills of fuels and chemicals and/or routine runoff associated with the road are also expected at the site.

Summary

5.2.191 A summary of the potential impacts to the site is provided in Table 5.17.

Table 5.17 Summary of potential effects to Brockwell Meadows LNR

Groundwater dependency	Ecological designation	Importance	Effect	Phase	Highest magnitude of impact	Highest significance of effect
Low	LNR	Low	Accidental leaks / spills of fuels and chemicals (groundwater quality)	Construction	Negligible	Neutral
			Mobilisation of suspended solids (groundwater quality)	Construction	Negligible	Neutral
			Cutting dewatering (groundwater levels / flows / quality)	Construction	Moderate Adverse	Slight
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	No Impact	N/A
			Long-term disturbance of groundwater flows (groundwater levels / flows)	Operation	No Impact	N/A

Mitigation and residual effects

5.2.192 As shown in Table 5.17, potential impacts on groundwater flows and levels to Brockwell Meadows LNR, during both phases, have been assessed as of Slight, or Neutral significance. No mitigation measures are therefore required.

Riverview Meadows LWS

Site setting, topography and hydrological catchment

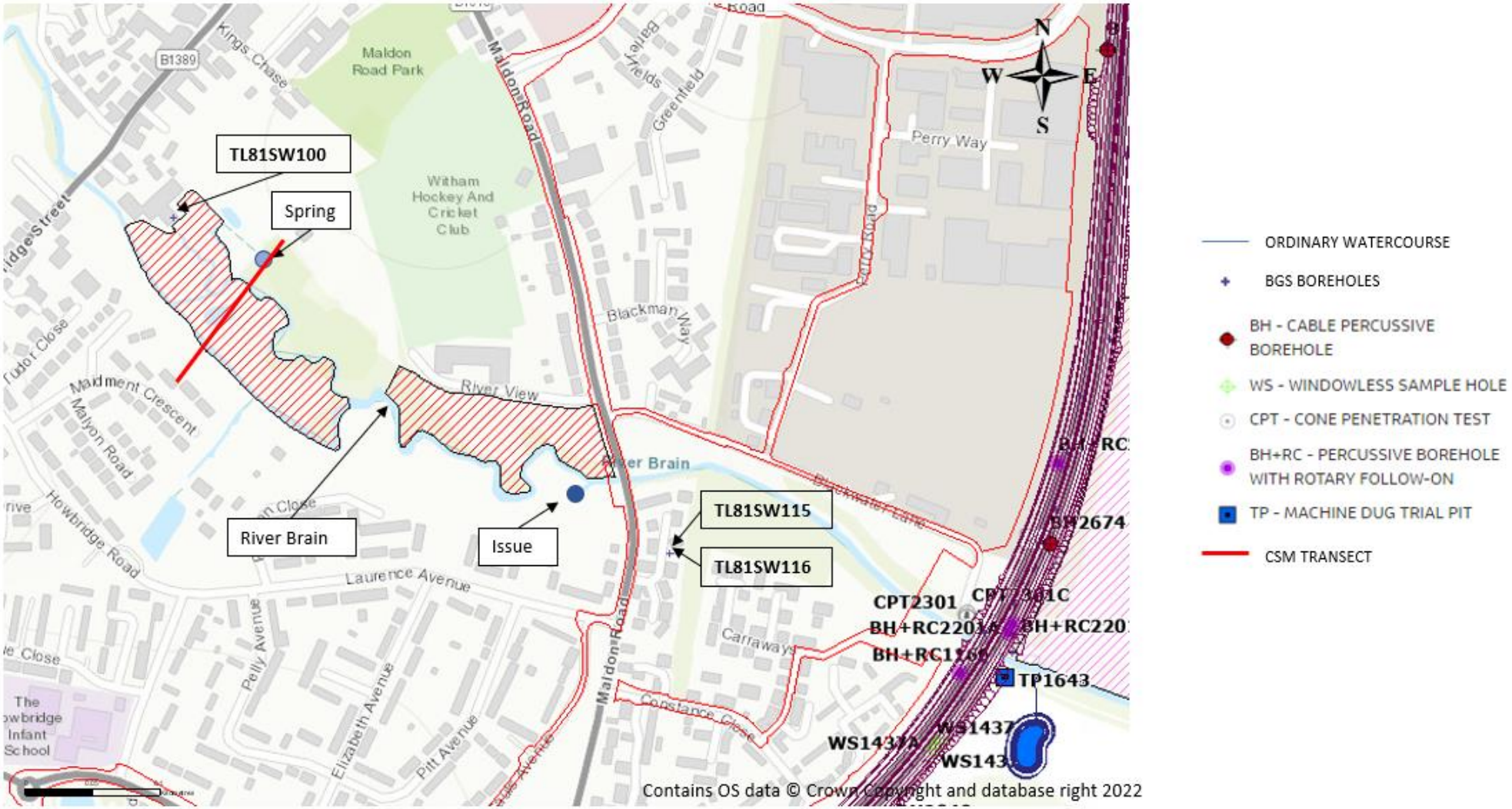
5.2.193 The site is located in an open grassland area between Bridge Street and Maldon Road in the centre of Witham. This site is situated along the banks of the River Brain (Plate 5.13) and splits into two areas along the northern bank. The more northern area is primarily located on a parcel of land between the River Brain and an additional channel which branches off the east and re-joins the Brain further south. The southern area is located just west of Maldon Road, which borders the site to the east.

5.2.194 The River Brain flows northwest to southeast along the southern boundary of the site. A small channel branches off the river in the north and re-joins at the southern part of the northern area. There are also two channels feeding from the northeast, with one of these being spring fed. A pond is shown on OS mapping in the centre of the northern part of the site between the two watercourses. The majority of the site is located within flood zone 2 and 3 for the River Brain, excluding a small part of the north of the southern area.

5.2.195 The site is very flat and lies within the floodplain of the river, with the site sitting at an elevation between 15 and 17mAOD.

5.2.196 The hydrological catchment extends to the north where elevations reach 22mAOD. Bridge Street, Maldon Road and the residential area of Witham to the northwest, northeast and south likely limits the natural groundwater catchment of the site.

Plate 5.13 Location Map for Riverview Meadows LWS



Soils and geology

5.2.197 The majority of the site is underlain by soils described as 'Well drained fine loamy soils often over gravel associated with similar permeable soils variably affected by groundwater'. These soils are freely draining.

5.2.198 From BGS mapping the site is primarily underlain by alluvium (BGS, 2021a). The northern part of both areas is underlain by RTD, which likely extend under the alluvium on site. The site is located within the margins of a buried valley (BGS, 2021a), suggesting that the superficial deposits in this location could be relatively thick.

5.2.199 Bedrock at the site is comprised of the London Clay Formation (BGS, 2021a).

5.2.200 There are no GI boreholes within the vicinity of the site, with the nearest located approximately 460m to the east. Therefore, no meaningful extrapolation could be undertaken. However, there are three BGS borehole located within the vicinity of the site, with the nearest located 5m northwest of the site (Plate 5.13). Details of these are presented in Table 5.18.

5.2.201 The geology recorded in the BGS boreholes broadly correlates with the BGS mapping. The clays and gravels found at shallow depth in TL81SW115 and TL1SW116 could be part of either alluvium or RTD, given their varied compositions. Bedrock was encountered in TL81SW100 at 21.03mbgl.

Table 5.18 Borehole records for Brockwell Meadows LNR

BH	Description
TL81SW100	Made ground: 0-0.91mbgl Terrace sands and gravels: 0.91-4.42mbgl Interglacial silt: 4.42- 12.19mbgl Chalky boulder clay: 12.19-21.03mbgl London Clay: 21.03-68.12mbgl Reading Beds: 68.12-76.35mbgl Thanet Beds: 76.35-83.67mbgl Upper Chalk: 83.67->152mbgl
TL81SW115	Clay: 0-0.7mbgl Gravel: 0.7-4.2mbgl Clay: 4.2->11.5mbgl
TL81SW116	Clay: 0-0.9mbgl Gravel: 0.9-4.4mbgl Silt: 4.4-7.5mbgl Clay:7.5->14mbgl

Groundwater

5.2.202 Available BGS groundwater level information is summarised in Table 5.19. This includes both strikes and seepages encountered during drilling and monitoring information where available.

5.2.203 In TL81SW115 and TL81SW116 groundwater strikes were encountered at 1.5mbgl. Groundwater levels were not recorded in TL81SW100.

Table 5.19 Groundwater levels extracted from borehole records

BH	Water strike	Maximum water level after 20 minutes (mbgl)	Monitoring range (max/min) (mbgl)	Date
TL81SW100	Not recorded	n/a	None	1868
TL81SW115	1.5mbgl	1.5	None	9/12/1987
TL81SW116	1.5mbgl	1.5	None	10/12/1987

5.2.204 No groundwater features are shown on OS mapping within the site boundary. However, 30m to the north of the site there is a spring mapped suggesting shallow groundwater within the vicinity of the site may be present. Similarly, an issue is annotated to the south of the eastern end of the site, on the opposite bank of the River Brain.

5.2.205 BGS data suggests that the entire site has a very high groundwater flooding susceptibility (2021b), indicating a shallow water table.

5.2.206 No hydrogeological survey was undertaken at this site.

Habitats and vegetation

5.2.207 A Phase 1 Habitat Survey was carried out on 04/11/2019 and 29/10/2019 for the southern area. No habitat surveys have been undertaken for the northern part of the site. Aerial imagery shows this part of the site being covered in trees therefore no interpretations of the ground conditions can be made from the aerial photography.

5.2.208 The southern area displays a variety of habitats, with the majority being described as ‘Large stand of common nettle and creeping thistle, with trees planted in central area and small areas of amenity grassland dominated by perennial ryegrass’. This is unlikely to be a GWDTE given the lack of wetland vegetation.

5.2.209 Along the banks of the river, areas of ‘Wet woodland, canopy of crack willow with understorey of elder, field layer of bramble, common nettle, hedge bindweed and hops’ are described.

5.2.210 On OS mapping the northern area is indicated to be marshy, however no Phase 1 mapping or walkover survey has been undertaken to confirm this.

5.2.211 The site is designated as a local wildlife site (LWS).

Conceptual site model

5.2.212 Plate 5.14 shows a conceptualised cross-section running southwest to northeast through the north of the site. The CSM highlights the indicative movement of groundwater and surface water through the site, and initial groundwater dependencies supporting vegetation and habitats present.

5.2.213 Throughout the site the alluvium is thought to be in hydraulic continuity with the River Brain and associated channels, and in times of high flow the river could be indirectly recharging the aquifer rather than groundwater providing baseflow. Direct recharge to the alluvium and RTD on site is likely through the freely draining soils as well as the alluvium receiving regional recharge from the underlying RTD which extent out of the site.

5.2.214 In the southern part of the site, the majority of the vegetation described does not align with being a GWDTE. However, there is a section of wet woodland located on the verge of the river.

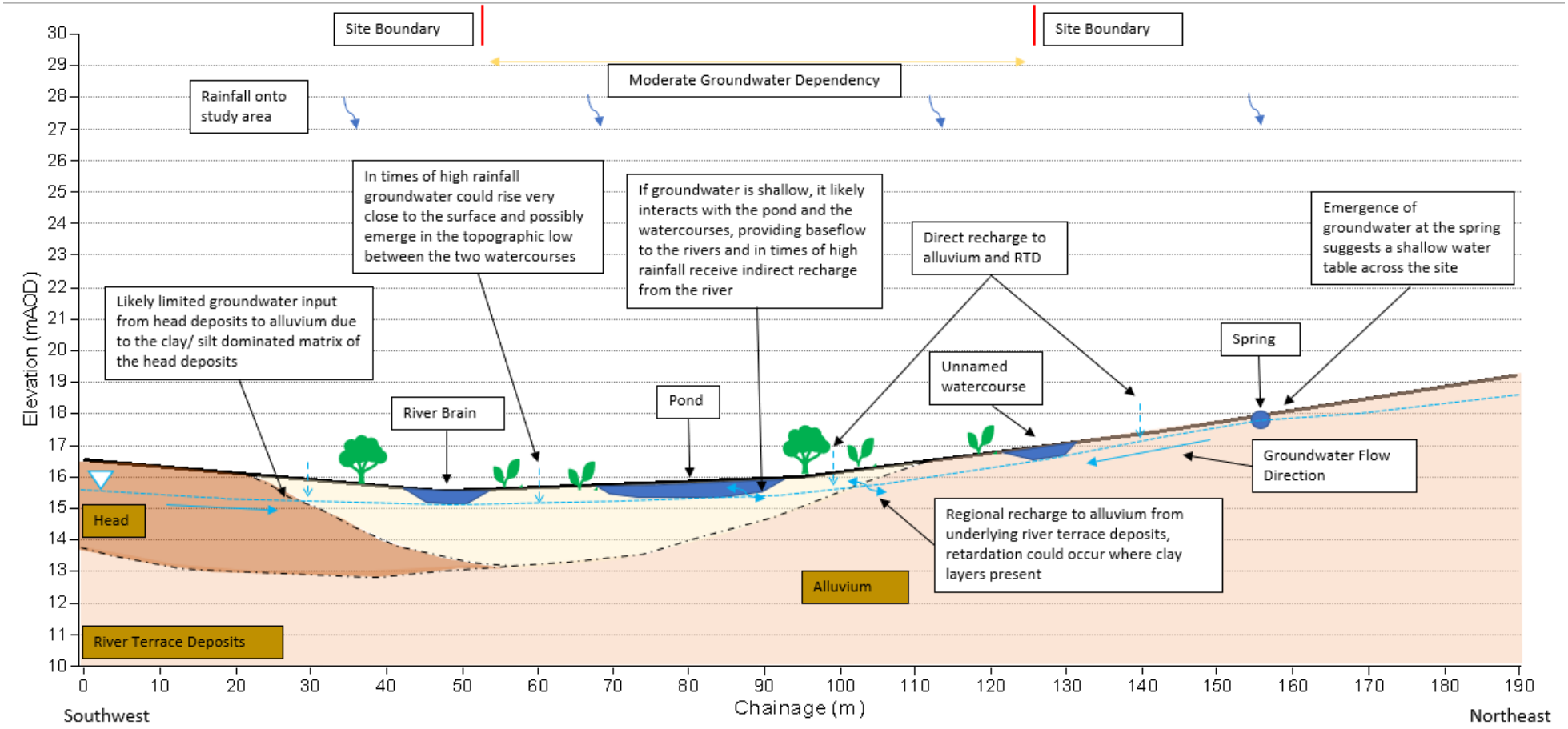
5.2.215 BGS boreholes found southeast of the site indicate groundwater strikes at 1.5mbgl, which could become shallower closer to the river. In addition to this, an issue on the opposite bank could be spring fed therefore indicating shallow groundwater. Therefore, this part of the site can be said to have a **moderate** groundwater dependency.

5.2.216 In the northern part of the site, the topography is such that groundwater is expected to flow towards the river. The presence of a spring uphill to the north indicates shallow groundwater conditions which likely prevail downhill to within the site.

5.2.217 Globally, the site sits within the flood zone of the river Brain. The habitats and vegetation is therefore likely to be fed by both surface water and groundwater. Therefore, groundwater dependency in the northern section is likely to be **moderate**.

Plate 5.14 Conceptual Site Model for Riverview Meadows LWS

Riverview Meadows LWS



Assessment of potential effects

5.2.218 The eastern boundary of the site lies adjacent to the Order of Limits. Minor reworking of Maldon Road, adjacent to the site, is expected for access purposes. The nearest proposed A12 widening is located approximately 609m northeast of the site.

Construction

5.2.219 The southern part of the site lies within the dewatering zone of influence for a widening (W5). The proposed widening is located 609m northeast of the site at its nearest point but expected to draw groundwater from permeable deposits in this area. A drawdown of the order of 0.11 to 0 m is predicted at the site. However, the estimate zone of influence is likely to be over-estimated as the deposits away from the cutting will vary and the permeability could reduce. Given all these elements, a conservative minor magnitude has been attributed across the south of the site adjacent to the River Brain. It would result in a **Slight** significance of effect. The northern part of the site lies outside of the zone of influence therefore is not expected to be impacted.

5.2.220 During construction, there could also be short-term impacts on groundwater quality at the GWDTE due to mobilisation of suspended solids and associated solutes, leaks and spills of fuels and chemicals during construction.

5.2.221 However, as described in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1], there are several best-practice mitigation measures which are incorporated into the first iteration EMP [TR010060/APP/6.5] for pollution prevention including managing silt pollution (for suspended solids transport). These measures would reduce the likelihood of contaminating groundwater. Considering best-practice mitigation measures, the magnitude of change on existing groundwater quality, due to the mobilisation of suspended solids and/or accidental spills and leaks is expected to be negligible in the east of the southern area where the site is adjacent to the Order of Limits, resulting in a **Neutral** significance of effect. The rest of the site is not expected to be impacted given the distance from the works.

Operation

5.2.222 There are no permanent below ground structures or embankments proposed within the vicinity of the site to locally alter groundwater levels and flows supporting GWDTE. Any long-term changes in recharge rates as a result of increased impermeable surface areas are not expected to impact the site, given the distance from the proposed scheme.

5.2.223 Dewatering impacts associated with widenings are expected to be long term and remain at the level of significance assessed during construction.

5.2.224 Considering the distance of the proposed scheme from the GWDTE, no impacts from any accidental leaks/spills of fuels and chemicals and/or routine runoff associated with the road are expected at the site.

Summary

5.2.225 A summary of the potential impacts to the site is provided in Table 5.20.

Table 5.20 Summary of potential effects to Riverview Meadows LWS

Groundwater dependency	Ecological designation	Importance	Effect	Phase	Highest magnitude of impact	Highest significance of effect
Moderate	LWS	Medium	Accidental leaks / spills of fuels and chemicals (groundwater quality)	Construction	Negligible	Neutral
			Mobilisation of suspended solids (groundwater quality)	Construction	Negligible	Neutral
			Cutting dewatering (groundwater levels / flows / quality)	Construction / Operation	Minor Adverse to None	Slight to None
			Groundwater contamination from routine runoff, or accidental leaks / spills (groundwater quality)	Operation	No Impact	N/A

Mitigation and residual effects

5.2.226 As shown in Table 5.20, potential impacts on groundwater flows and levels to Riverview Meadows LWS, during both phases, have been assessed as of Slight, or Neutral significance. No mitigation measures are therefore required.

5.3 Results

5.3.1 A summary of the initial assessment of groundwater dependency of each GWDTE, along the associated magnitude of impact to existing groundwater levels, flows, and quality, is provided in Table 5.21.

Table 5.21 Summary of potential GWDTEs and associated impacts

Potential GWDTE	Assessment of groundwater dependency	Highest magnitude of impact		Highest significance of effect	
		Construction	Operation	Construction	Operation
Marshy Grassland 1 and Wet Woodland 1	Low	Moderate Adverse	Moderate Adverse	Slight	Slight
Wet Woodland 7	Moderate	Moderate Adverse	Negligible	Moderate	Neutral
Wet Woodland 8	Low	Moderate Adverse	Negligible	Slight	Neutral
Wet Woodland 9	None	n/a	n/a	n/a	n/a
Whetmead LNR	None	n/a	n/a	n/a	n/a
Brockwell Meadows LNR	Low	Moderate Adverse	No Impact	Slight	n/a
Riverview Meadow LWS	Moderate	Minor Adverse	Minor Adverse	Slight	Slight

5.3.2 As observed in Table 5.21 above. Mitigation measures beyond what is in the EMP will be required for the construction phase of the A12 in Wet Woodland 7 only. No significant effects are expected as a result of the operational phase therefore no long-term mitigation measures such as monitoring will be required.

6 Water quality impacts on groundwater abstractions

6.1.1 All groundwater abstractions are either known or assumed to be sourced from shallow superficial deposits, except LGA-29 which was from the chalk bedrock. Given the shallow nature of the abstractions they will be more susceptible to surface water quality impacts during the construction phase. Water quality issues are of particular relevance to groundwater abstractions which are used for drinking purposes, or for food production purposes.

6.1.2 Taking into account embedded and standard mitigation measures, sensitive nearby groundwater abstractions could see minor changes to groundwater quality during construction. An assessment has been undertaken considering the water usage, the distance between the proposed works and the coordinates of the groundwater abstraction, as well as its localisation in relation to the proposed works (i.e. upgradient, downgradient or cross-gradient), with a view to scope in / out groundwater abstractions which could be at risk of minor changes in groundwater quality. This scoping exercise is captured in Table 6.1.

6.1.3 From this screening, 12 groundwater abstractions have been scoped in. One public water supply well (LGA-29) was reported to be present approximately 5m from the proposed scheme, licenced to Anglian Water at Inworth Road (Landmark Information Group, 2016), known as the Messing-Cum-Inworth Pumping Station. The Environment Agency has confirmed this location is no longer licenced (email 13 May 2022) and they are planning to remove the SPZ1 associated with it from their database and hence this location has been scoped out.

6.1.4 In addition to this:

- 7 licensed groundwater abstractions (LGA-2, LGA-3, LGA-5, LGA-17, LGA-24, LGA-27 and LGA-33) are considered of high sensitivity and the potential works would typically fall within a default SPZ2. This could result in a potential significance of effect of **Moderate**.
- 5 private groundwater abstractions (PGA1, PGA-2, PGA-3, PGA-5 and PGA-13) are considered of medium sensitivity. Two of them (PGA-2 and PGA-5) are located in very close proximity to the proposed works and this could result in a potential significance of effect of **Moderate**. The others (PGA1, PGA-3 and PGA-13) are located further away and the works could result in a potential significance of effect of **Slight**.

6.1.5 From the groundwater abstractions identified as being potentially at risk of water quality impairment during construction, LGA-17, LGA-24, LGA-27 and LGA-33 were recorded as licensed abstractions in the 2016 Envirocheck report only. Firstly, the Environment Agency would be consulted during detailed design phase to confirm whether these licences are still active, and if so, request that all the details held by the Environment Agency be provided.

6.1.6 Should these abstractions be no longer licensed, the landowner would be consulted to determine whether these abstractions are still active.

6.1.7 For all active abstractions (licenced or not) potentially significantly impacted (LGA-2, LGA-3, LGA-5, LGA-17, LGA-24, LGA-27, LGA-33, LGA-2 and LGA-5), the following mitigation measures would be implemented during detailed design phase:

- Gather further information on the source (including nature, depth and confirming location of the abstraction) and update the impact assessment to confirm whether additional measures should be implemented;
- Should the revised assessment confirm that additional measures are required, monitoring the groundwater abstractions prior to and during construction, and potentially for a period post construction would be expected; and
- Should monitoring indicate an impact during the proposed work, a temporary replacement water supply would be provided. Should monitoring demonstrate a long-term impact, an alternative source of water would be provided.

6.1.8 Because uncertainty remains on the exact abstraction location of these groundwater abstractions and the assessment rests on the coordinates provided by the Environment Agency and the local authorities, should an abstraction location be located nearer than suggested by the coordinates provided by the Environment Agency or local authorities, then the risk profile of these groundwater supplies could increase. This would apply to PGA1, PGA-3 and PGA-13, but also to LGA-10 which despite being expected to be upgradient is only potentially located 50m away from the RLB. For this reason, further information on the source (including nature, depth and confirming location of the abstraction) would be gathered on these groundwater abstractions during detailed design phase.

6.1.9 Once the details are confirmed, should any of these groundwater abstractions be located nearer to the works than assessed initially, the assessment would be revisited and mitigation measures would be proposed as required, following the same principles as outlined for groundwater identified at risk.

Table 6.1 Groundwater abstractions at which water quality could be impacted during construction

Abstraction ID	Use	Distance from RLB (m)	Distance from nearest activity (m)	Location in relation to proposed scheme	Scoped in/out
LGA-1	Agriculture, spray irrigation-direct	156m north	2006	Upgradient	Out
LGA-2	General agriculture, spray irrigation-anti frost, spray irrigation-direct	103m southwest	284	Downgradient	In
LGA-3	Agriculture, spray irrigation-direct	86m south	103	Cross-gradient	In

Abstraction ID	Use	Distance from RLB (m)	Distance from nearest activity (m)	Location in relation to proposed scheme	Scoped in/out
LGA-4	Agriculture, spray irrigation-direct	357m south	531	Downgradient	Out
LGA-5	Agriculture, spray irrigation-direct	112m east	168	Cross-gradient	In
LGA-6	Industrial, Commercial and Public Services- golf course spray irrigation-direct	105m west	271	Downgradient	Out
LGA-7	Industrial, Commercial and Public Services	371m south	656	Upgradient	Out
LGA-8	Industrial, Commercial and Public Services	553m west	615	Upgradient	Out
LGA-9/35	Farming and domestic	371m north	375	Cross-gradient	Out
LGA-10	Agriculture, spray irrigation-direct	52m south	233	Upgradient	Out
LGA-11	Farming and domestic	1350m southeast	1419	Upgradient	Out
LGA-12	Farming and domestic	725m south	1173	Cross-gradient	Out
LGA-13	Farming and domestic	720m northwest	792	Upgradient	Out
LGA-14	Farming and domestic	897m northwest	909	Upgradient	Out
LGA-15	Other Industrial/Commercial/Public Services: General Use	810m north	1612	Upgradient	Out
LGA-16	Mineral Products: Mineral Washing	1255m north	1722	Upgradient	Out
LGA-17	Farming and domestic	10m east	202	Downgradient	In
LGA-18	General Agriculture: Spray Irrigation – Direct. General Farming and Domestic	538m south	839	Downgradient	Out
LGA-19	Farming and domestic	660m southeast	881	Downgradient	Out
LGA-20	Farming and domestic	812m south	1137	Downgradient	Out
LGA-21	Mineral Products: process water	864m south	868	Downgradient	Out

Abstraction ID	Use	Distance from RLB (m)	Distance from nearest activity (m)	Location in relation to proposed scheme	Scoped in/out
LGA-22	Mineral Products: process water	903m south	916	Downgradient	Out
LGA-23	Farming and domestic	1120m south	1234	Downgradient	Out
LGA-24	Farming and domestic	68m east	207	Downgradient	In
LGA-25	Farming and domestic	1222m east	1529	Upgradient	Out
LGA-26	Farming and domestic	271m southeast	315	Cross-gradient	Out
LGA-27	Farming and domestic	197m southwest	223	Downgradient	In
LGA-28	Farming and domestic	680m south	963	Upgradient	Out
LGA-29	Public water supply	5m south	31	Cross-gradient	Out
LGA-30	Remediation	72m east	497	Upgradient	Out
LGA-31	Agriculture, spray irrigation-direct	1466m east	1468	Upgradient	Out
LGA-32	Spray irrigation	49m north	1447	Upgradient	Out
LGA-33	Private water undertaking: general use	49m north	87	Cross-gradient	In
LGA-34	Agriculture (General)	353m north	388	Cross-gradient	Out
LGA-36	Unspecified	353m north	388	Cross-gradient	Out
LGA-37	Not specified	353m north	388	Cross-gradient	Out
LGA-38	Not specified/ other industrial/commercial/ public services	343m north	393	Cross-gradient	Out
LGA-39	Farming and domestic	395m south	487	Downgradient	Out
LGA-40	General Agriculture: Spray Irrigation - Direct	1064m northwest	1091	Upgradient	Out

Abstraction ID	Use	Distance from RLB (m)	Distance from nearest activity (m)	Location in relation to proposed scheme	Scoped in/out
LGA-41	Horticulture and Nurseries: Spray Irrigation - Direct	78m northeast	97	Cross-gradient	Out
LGA-42	General Agriculture: Spray Irrigation - Direct	299m northwest	535	Cross-gradient	Out
LGA-43	Private Water Undertaking: General Use	496m northwest	516	Downgradient	Out
LGA-44	Other Industrial/Commercial/Public Services: General Use	496m northwest	516	Downgradient	Out
LGA-45	Farming and domestic	876m northwest	962	Upgradient	Out
PGA-1	Domestic (1 property)	115m south	136	Cross-gradient	In
PGA-2	Domestic (3 properties)	18m east	29	Cross-gradient	In
PGA-3	Domestic (1 property)	70m northwest	98	Cross-gradient	In
PGA-4	Domestic (1 property)	557m west	613	Upgradient	Out
PGA-5	Domestic (1 property)	7m north	14	Cross-gradient	In
PGA-6	Domestic (1 property)	526m north	544	Upgradient	Out
PGA-7	Single domestic dwelling	190m east	244	Cross-gradient	Out
PGA-8	Single domestic dwelling	271m southeast	315	Cross-gradient	Out
PGA-9	Serving 2 dwellings	697m southeast	744	Upgradient	Out
PGA-10	Single domestic dwelling	814m southwest	1028	Upgradient	Out
PGA-11	Domestic (1 property)	737m northwest	797	Upgradient	Out
PGA-12	Domestic (1 property)	371m northwest	402	Cross-gradient	Out
PGA-13	Domestic (5 properties)	49m north	87	Cross-gradient	In

7 Gas main diversion impact to groundwater

7.1 Introduction

7.1.1 Running parallel to the A12 between Maldon Road bridge (B1018) and Colemans bridge (B1389) and affected by the works is an existing high pressure (HP) gas pipeline owned and operated by Cadent. Adjacent to the Coleman Bridge works is an existing Cadent Above Ground Installation (AGI) called Little Braxted Pressure Reduction Station (PRS). The PRS has six pipelines either feeding into or out of it, one of which is the HP pipeline adjacent to the A12. As a result of the proposed scheme gas mains diversions are required to facilitate the permanent A12 widening and construction works associated with it.

7.1.2 As part of the Gas Mains diversions excavation trenches of up to 1.8 mbgl are required to lay down the new pipeline which could result in dewatering. This has the potential to impact nearby groundwater receptors.

7.1.3 This section undertakes a preliminary assessment for the proposed option to determine the impacts on groundwater.

7.2 Receptor review

7.2.1 The construction of the gas mains would intercept two Secondary A aquifers which are part of the Essex Gravel WFD groundwater body. This option lies upgradient of two licensed groundwater abstractions located approximately 120 and 150m south of the route (LGA-5 and LGA-6).

7.2.2 There is a spring located at Ishams Barn which lies approximately 100m cross-gradient and south of the corridor for the pipeline. On the eastern side of the river the construction would take place in mainly unproductive strata which is unlikely to contain groundwater in any large volumes.

7.3 Construction impact assessment

7.3.1 During construction groundwater may be intercepted where the gas main is to be tunnelled under the watercourses designated as main rivers and elsewhere in shallow trenches (up to 1.8m deep). However, any dewatering effect is expected to be localised and short lived. Given the scale of the aquifer and the expected localised effect, **slight** adverse effects to the Secondary A (WFD designated) aquifers are predicted.

7.3.2 During construction, the groundwater flow to the two nearby licensed abstractions could be partially intercepted hence reducing the abstractions yield. This could create minor adverse impacts in the short term resulting in a **Moderate** significance of effect.

7.3.3 Nearby the proposed route lies a spring which could potentially be impacted during construction of the gas mains diversion. This spring supplies a small tributary of the River Blackwater (Unnamed Watercourse 9f), however given the size of unnamed watercourse 9f compared to the river any impacts to the spring are unlikely to significantly impact the river. The tributary could however be affected, given the nature of the works. However, this watercourse was

observed as being largely dry, with an ephemeral flow regime, and heavily vegetated. Therefore, any impacts to this tributary would be of **Slight** significance.

7.4 Results

7.4.1 The gas main diversion route is not likely to generate any significant effects on the groundwater, however two licensed groundwater abstractions (LGA-5 and LGA-6) have been identified as potentially experiencing short term minor effects with a **Moderate** significance of effect. Mitigation measures similar to those described in Section 3.5 of this appendix would be required for LGA-5 and LGA-6 during construction of the pipeline.

Acronyms

Abbreviation	Term
BGS	British Geological Survey
CSM	Conceptual Site Model
EMP	Environmental Management Plan
EQS	Environment quality standards
GI	Ground Investigation
GWDTE	Groundwater dependent terrestrial ecosystem
LNR	Local Nature Reserve
LWS	Local Wildlife Site
NGR	National Grid Reference
NVC	National Vegetation Classification
mAOD	m Above Ordnance Datum
mbgl	m below ground level
RTD	River Terrace Deposits
SBI	Site of Biological Interest
SPZ	Source protection zone
SSSI	Site of Special Scientific Interest
UKTAG	UK Technical Advisory Group
WER	Water Environment Regulations
WFD	Water Framework Directive

Glossary

Term	Definition
Aquiclude	An impermeable body of rock or stratum of sediment that acts as a barrier to the flow of groundwater.
Aquitard	Poorly permeable underground layer that limits the flow of groundwater from one aquifer to another
Dewatering (groundwater)	Groundwater control which typically involves pumping groundwater from an array of wells or sumps, located in or around an excavation, to temporarily lower groundwater levels to allow excavation to be carried out in dry and stable conditions.
Interfluves	An area of higher ground between two rivers in the same drainage system
Seep/seepages	A seep or flush is a moist or wet place where groundwater reaches the surface from an underground aquifer.
Principal Aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale
Secondary A Aquifer	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
Secondary B Aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifer	Assigned in cases where it has not been possible to attribute either category Secondary A or B aquifers to a rock type
Springs	A point at which groundwater discharges onto the surface.
Strikes	The level at which water is first encountered when drilling.
Recharge	Recharge of an aquifer occurs water added to the aquifer through the unsaturated zone after infiltration and percolation following any storm rainfall event.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

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Annex A Groundwater datalogger monitoring

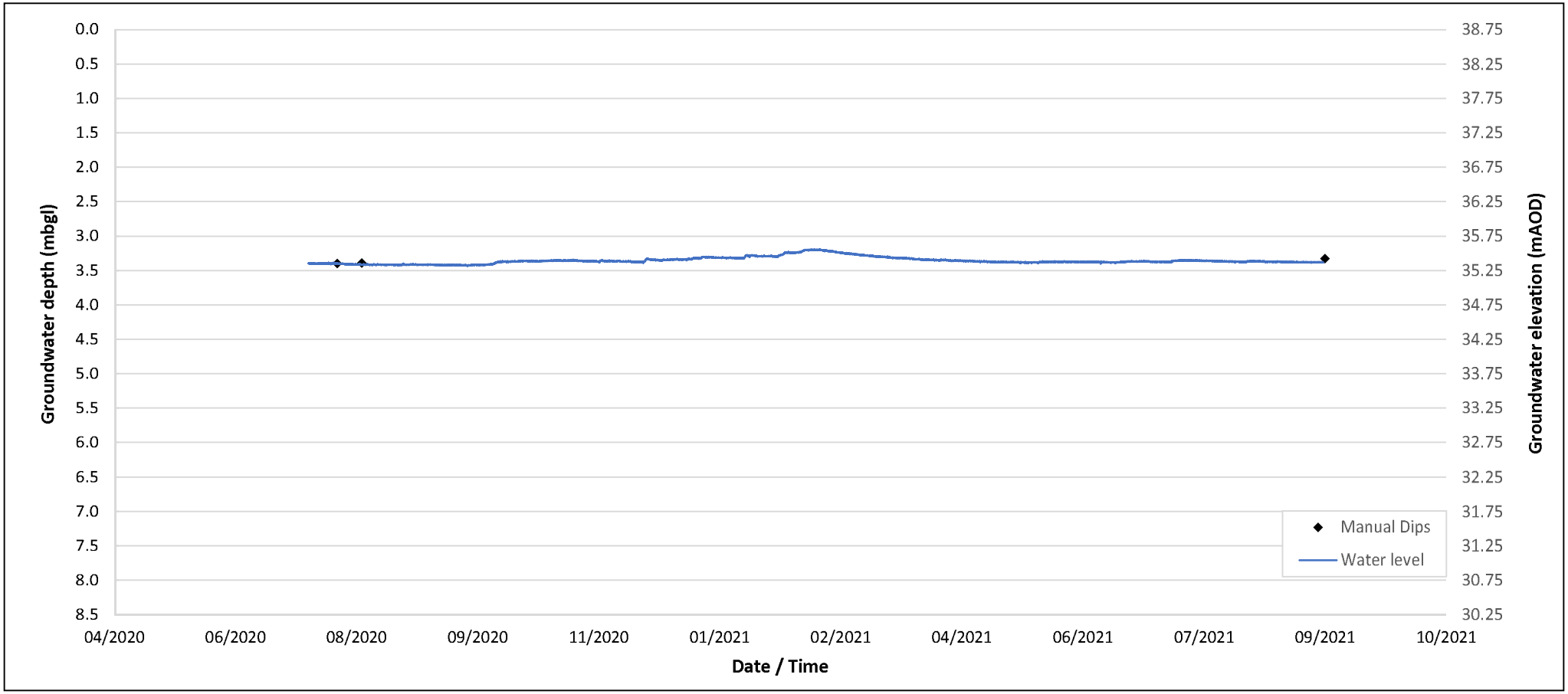
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1107**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39803648/AW634** INSTALLATION DATE: **24/06/2020**

NOMINAL INSTALLATION DEPTH: **6.00 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **29/07/2020 23:00:00 3.40mbgl.**

WELL DETAILS

EASTING (m): **579076.0** NORTHING (m): **211865.5** ELEVATION (mAOD): **38.75**

WELL DEPTH: **8.50 mbgl** TOP OF RESPONSE ZONE: **1.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **8.50mbgl**

REMARKS

Diver removed and monitoring completed 10/09/2021.

CONTRACT	CHECKED
35699	**DM**

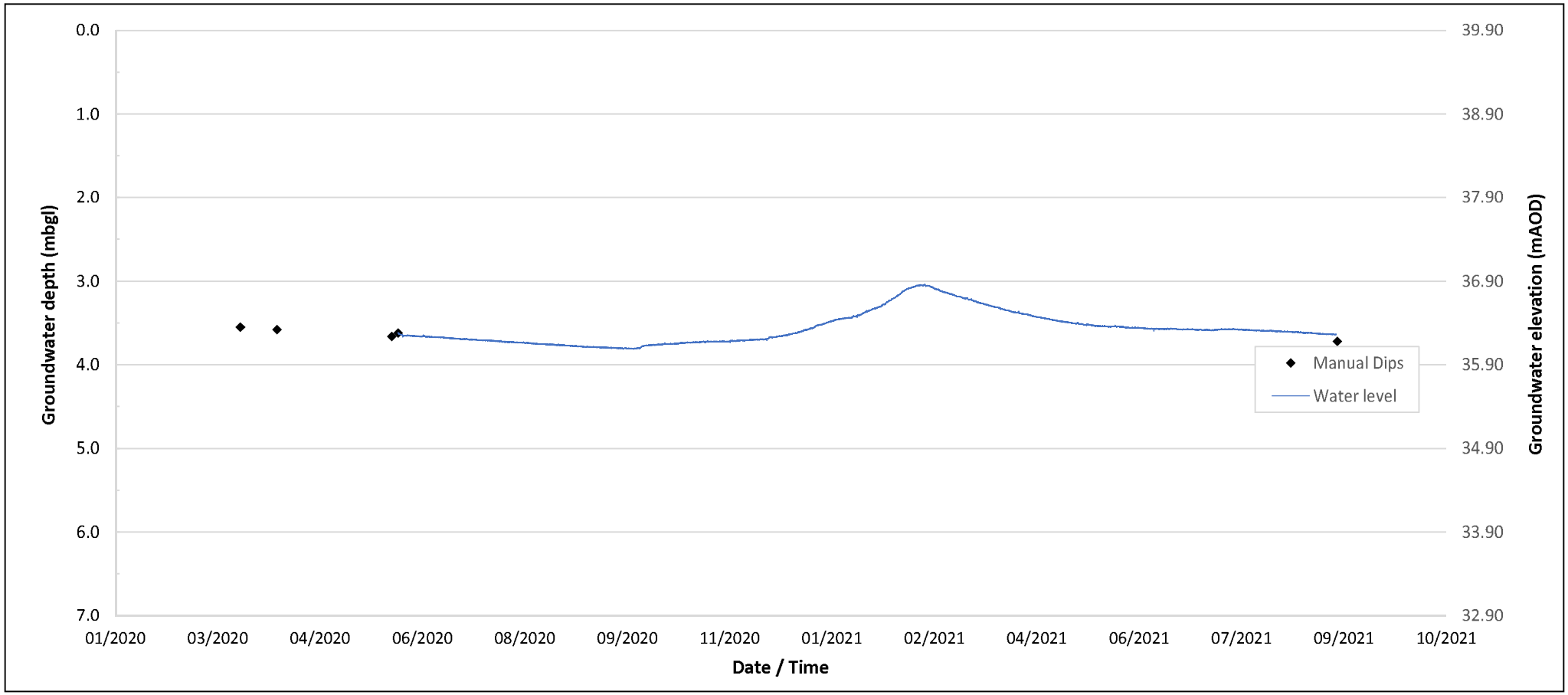
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1108**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39803617/BY313** INSTALLATION DATE: **06/06/2020**

NOMINAL INSTALLATION DEPTH: **7.00 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **06/06/2020 03:00:00 3.62mbgl.**

WELL DETAILS

EASTING (m): **579460.0** NORTHING (m): **212049.5** ELEVATION (mAOD): **39.90**

WELL DEPTH: **7.05 mbgl** TOP OF RESPONSE ZONE: **0.90 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **7.10 mbgl**

REMARKS

Diver removed and monitoring completed 07/09/2021.

CONTRACT	CHECKED
35699	**DM**

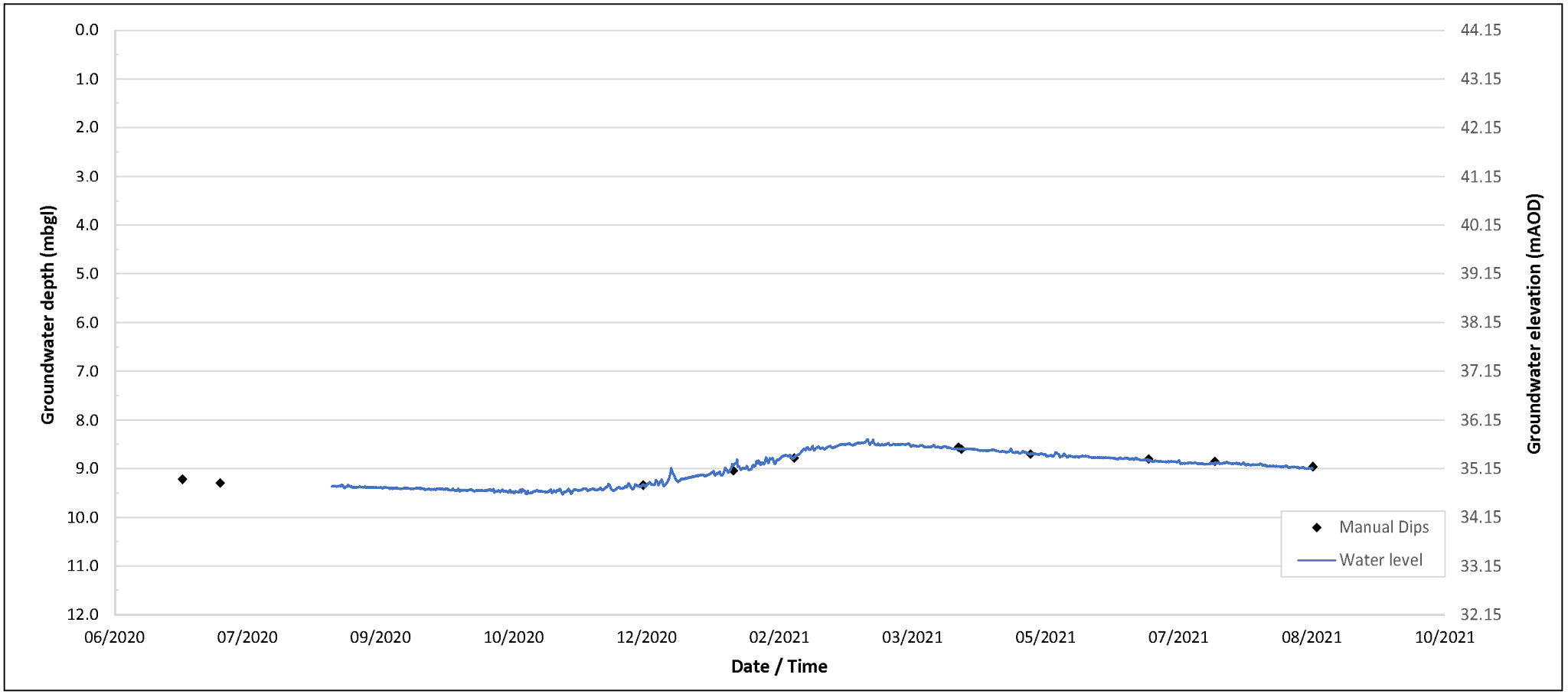
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1112**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AY267**	INSTALLATION DATE:	**21/02/2020**	**WELL DETAILS** EASTING (m):	**580371.0**	NORTHING (m):	**212479.5**	ELEVATION (mAOD):	**44.15**
NOMINAL INSTALLATION DEPTH:	**10 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**12.00 mbgl**	TOP OF RESPONSE ZONE:	**5.00 mbgl**		
CALIBRATION DIP:	**8.78 mbgl - 11/02/2021 12:42hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**12.00 mbgl**		

REMARKS

Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

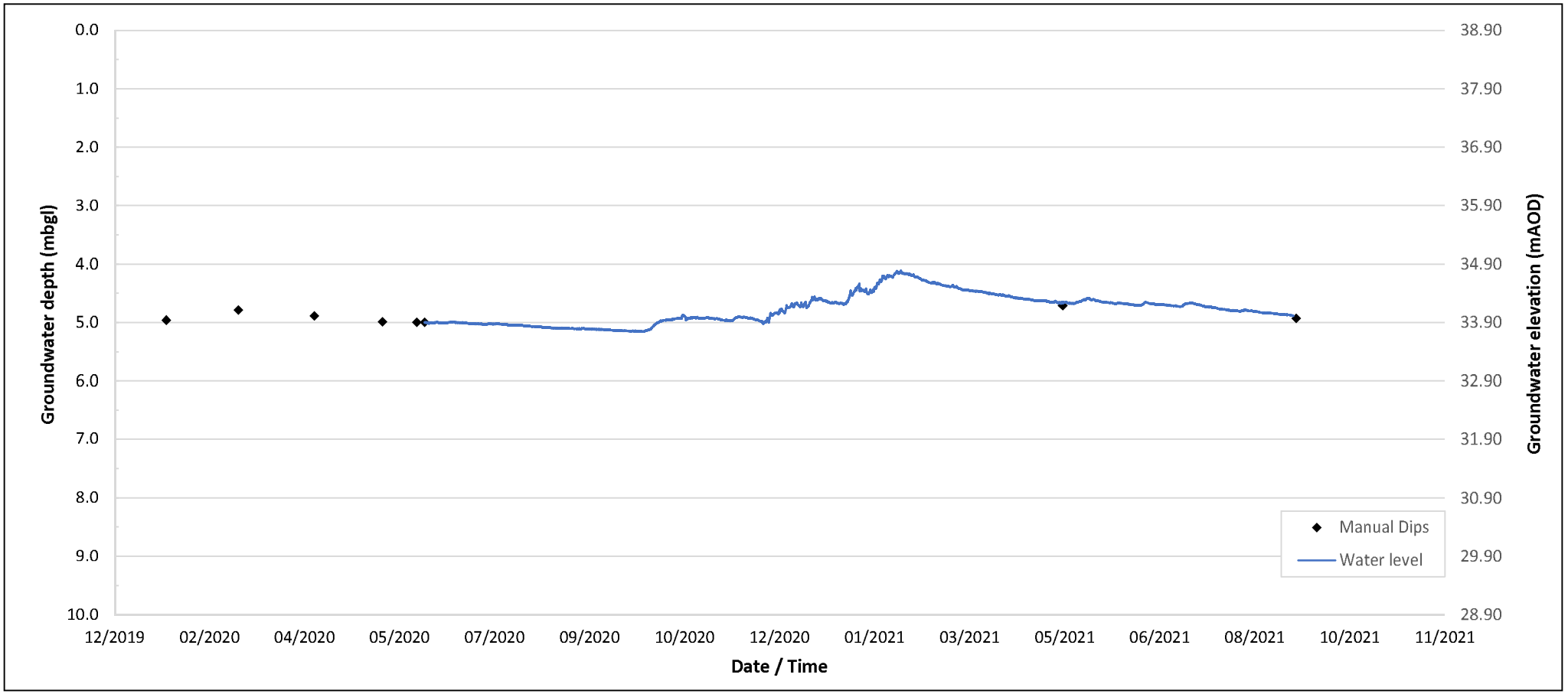
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1114**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39803638/BHY562** INSTALLATION DATE: **06/06/2020**

NOMINAL INSTALLATION DEPTH: **9.50 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **06/06/2020 02:17:00 5.00mbgl.**

WELL DETAILS

EASTING (m): **580707.0** NORTHING (m): **212789.0** ELEVATION (mAOD): **38.90**

WELL DEPTH: **10.00 mbgl** TOP OF RESPONSE ZONE: **3.80 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **10.45 mbgl**

REMARKS

Diver removed and monitoring completed 07/09/2021.

CONTRACT	CHECKED
35699	**DM**

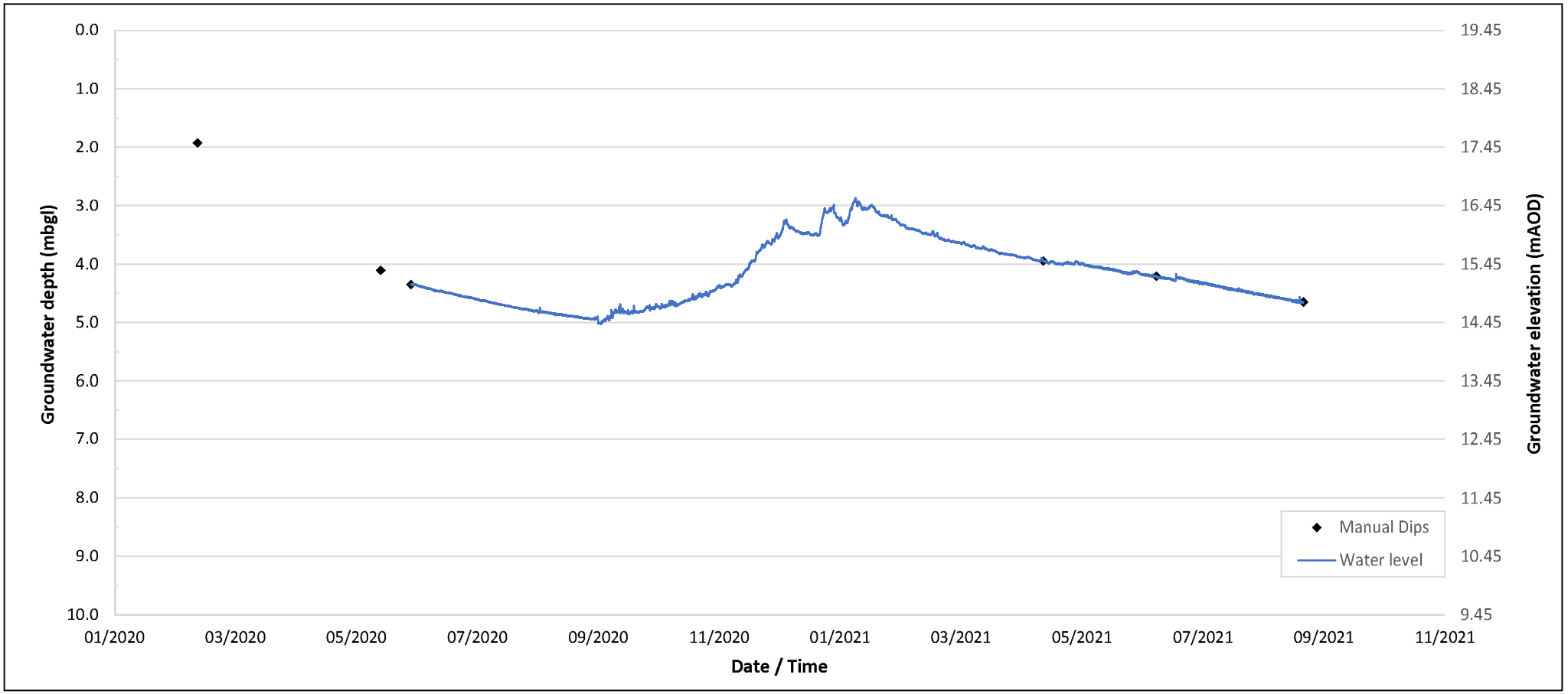
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1117**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**39744010/AY464**	INSTALLATION DATE:	**25/06/2020**
NOMINAL INSTALLATION DEPTH:	**6.60 mbgl**	RECORDING FREQUENCY	**1 hour**
CALIBRATION DIP:	**See below.**		

WELL DETAILS

EASTING (m):	**581843.0**	NORTHING (m):	**212980.0**	ELEVATION (mAOD):	**19.45**
WELL DEPTH:	**7.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.20 mbgl**		

REMARKS No data was transmitted to the online portal after 04/05/2021; suspected cause is lack of signal to the diver modem. Data prior to and including visit on 04/05/2021 calibrated against manual dip of 3.95mbgl on 04/05/2021 22:32hrs, data after visit on 04/05/2021 calibrated against an Offline barometer using manual dip of 4.21mbgl on 29/06/2021 22:18hrs. Diver removed and monitoring completed 10/09/2021.

CONTRACT	CHECKED
35699	**DM**

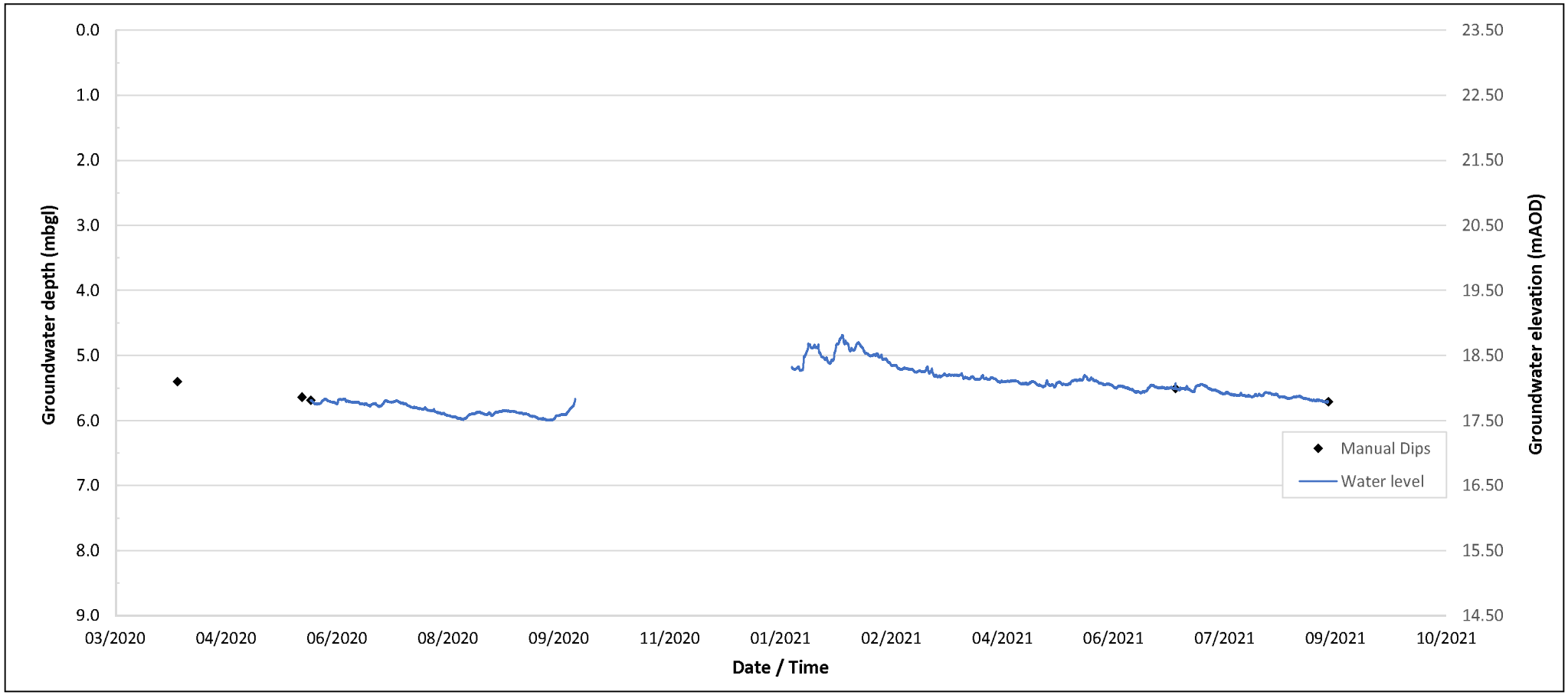
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1160A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**39744009/BY323**	INSTALLATION DATE:	**05/06/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**8.70 mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**578298.0**	NORTHING (m):	**211527.0**	ELEVATION (mAOD):	**23.50**
CALIBRATION DIP:	**See below.**			WELL DEPTH:	**9.00 mbgl**	TOP OF RESPONSE ZONE:	**4.00 mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**9.00 mbgl**		

REMARKS

Data missing between 03/10/2020 and 09/01/2021. Data prior to 03/10/2020 calibrated against manual dip of 5.69mbgl on 06/06/2020 02:02hrs; data after 09/01/2021 calibrated against manual dip of 5.71mbgl on 07/09/2021 21:01hrs. Diver removed and monitoring completed 07/09/2021.

CONTRACT	CHECKED
35699	**DM**

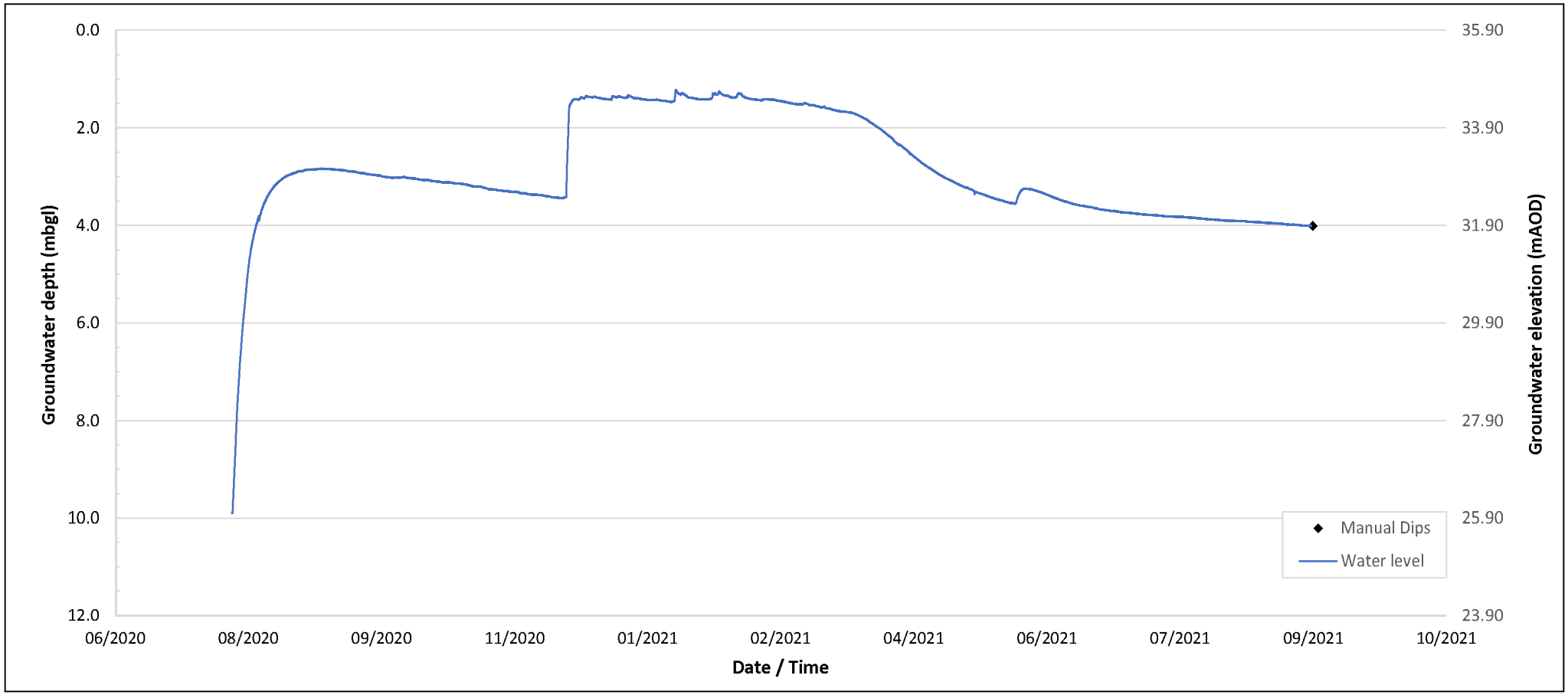
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1162**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39744008/AZ467** INSTALLATION DATE: **25/06/2020**

NOMINAL INSTALLATION DEPTH: **10.30 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **10/09/2021 21:45:00 4.01mbgl.**

WELL DETAILS

EASTING (m): **578754.0** NORTHING (m): **211698.0** ELEVATION (mAOD): **35.90**

WELL DEPTH: **20.00 mbgl** TOP OF RESPONSE ZONE: **1.50 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **30.45 mbgl**

REMARKS

Initial manual dip is dry following development. Diver removed and monitoring completed 10/09/2021.

CONTRACT	CHECKED
35699	**DM**

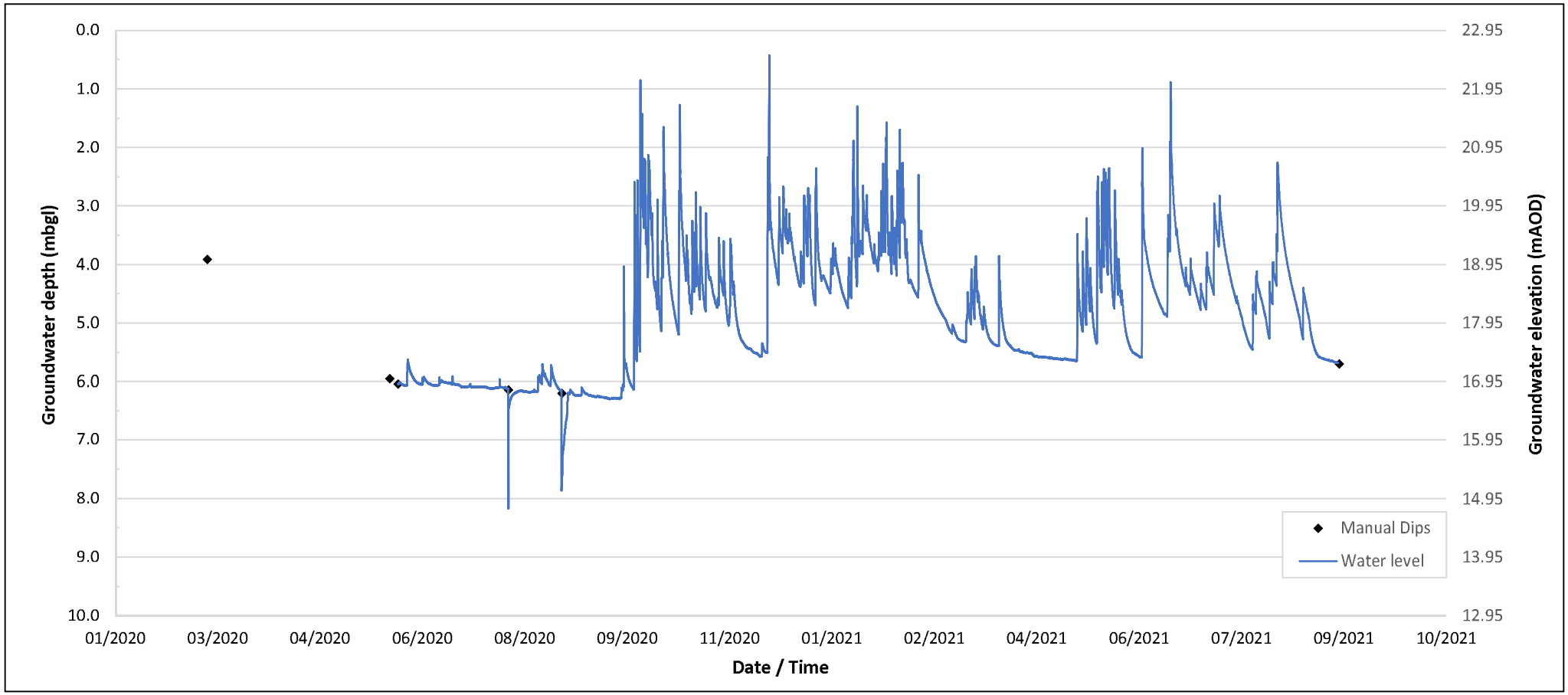
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1164A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39744047/BY565** INSTALLATION DATE: **06/06/2020**

NOMINAL INSTALLATION DEPTH: **8.20 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **06/06/2020 02:23:00 6.04mbgl.**

WELL DETAILS

EASTING (m): **582406.0** NORTHING (m): **213317.5** ELEVATION (mAOD): **22.95**

WELL DEPTH: **8.50 mbgl** TOP OF RESPONSE ZONE: **5.50 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **9.00 mbgl**

REMARKS

Water sampling carried out during monitoring visits on 29/07/2020 and 24/08/2020. Data following 23/09/2020 shows significant peaks and troughs attributed to rainfall - results to be treated with caution. Diver removed and monitoring completed 08/09/2021.

CONTRACT	CHECKED
35699	**DM**

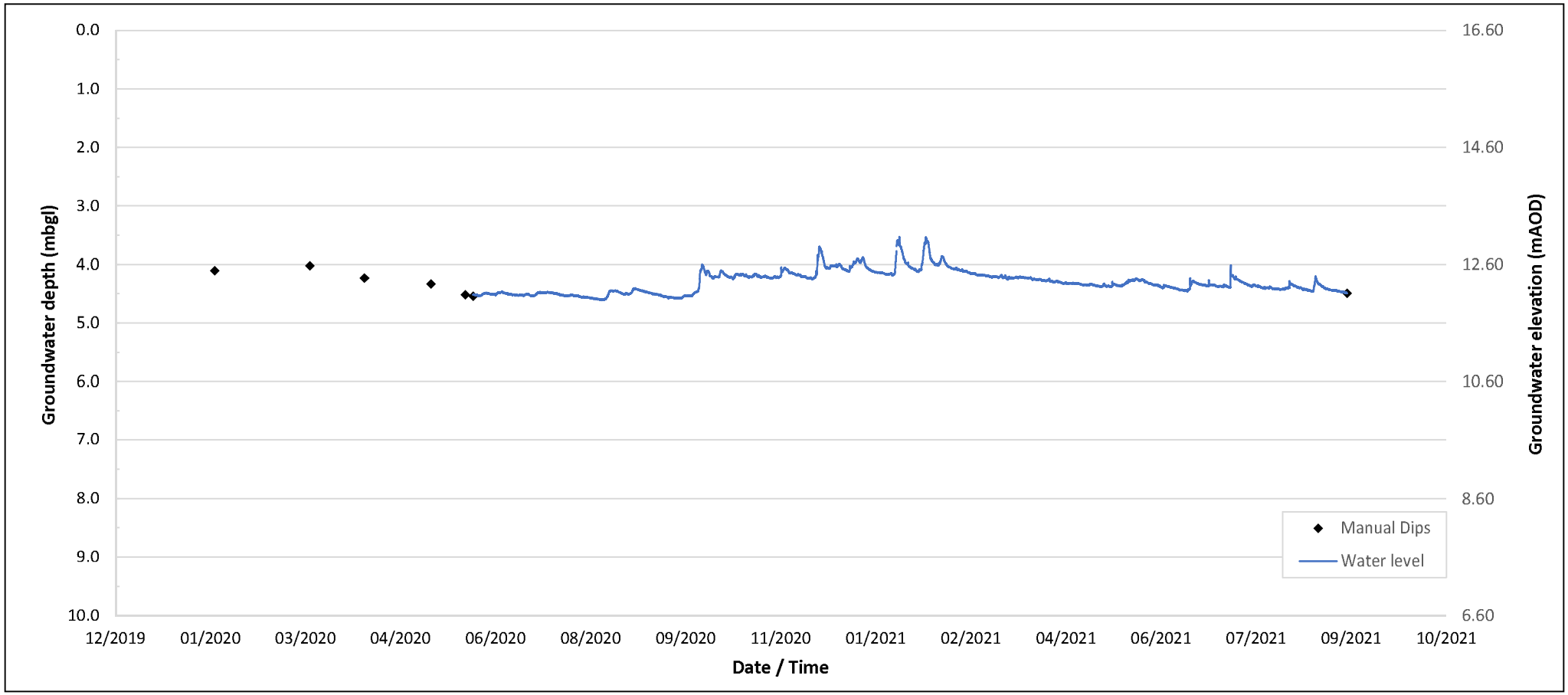
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1166**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**39803643/BY558**	INSTALLATION DATE:	**06/06/2020**	EASTING (m):	**582806.5**	NORTHING (m):	**213707.5**
NOMINAL INSTALLATION DEPTH:	**6.90 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**7.00 mbgl**	TOP OF RESPONSE ZONE:	**3.50 mbgl**
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.50 mbgl**

WELL DETAILS ELEVATION (mAOD): **16.60**

REMARKS

No data has been transmitted to the online portal since 25/05/2021; suspected cause is issues with the diver modem. Data up to this date is calibrated to manual dip at time of installation of 4.52mbgl. Data after 25/05/2021 is calibrated to manual dip of 4.49mbgl on 08/09/2021 21:50. Diver removed and monitoring completed 08/09/2021.

CONTRACT	CHECKED
35699	**DM**

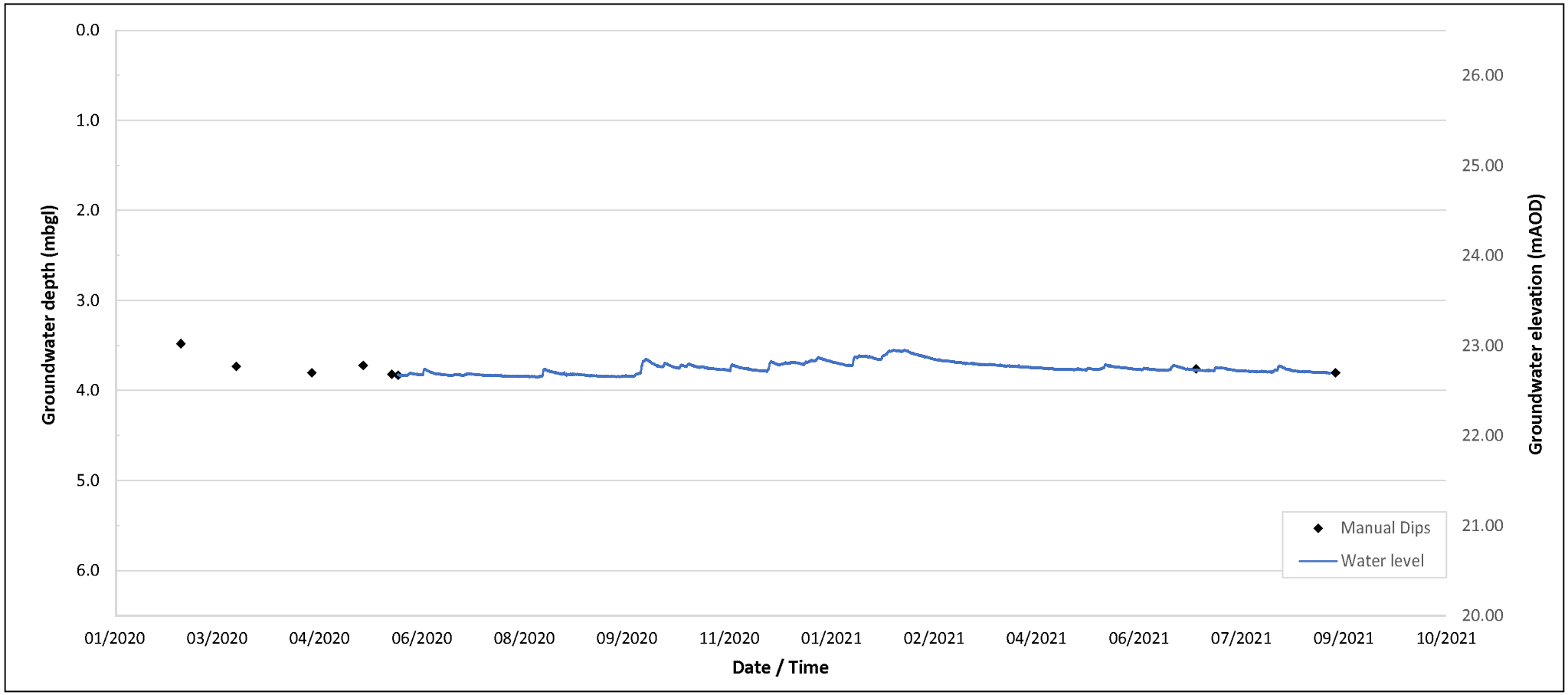
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH+RC1177A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39789021/BY558** INSTALLATION DATE: **06/06/2020**

NOMINAL INSTALLATION DEPTH: **6.50 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **06/06/2020 01:42:00 3.83mbgl.**

WELL DETAILS

EASTING (m): **574110.0** NORTHING (m): **209347.0** ELEVATION (mAOD): **26.50**

WELL DEPTH: **6.50 mbgl** TOP OF RESPONSE ZONE: **0.50 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **7.00 mbgl**

REMARKS

Diver removed and monitoring completed 06/09/2021.

CONTRACT	CHECKED
35699	**DM**

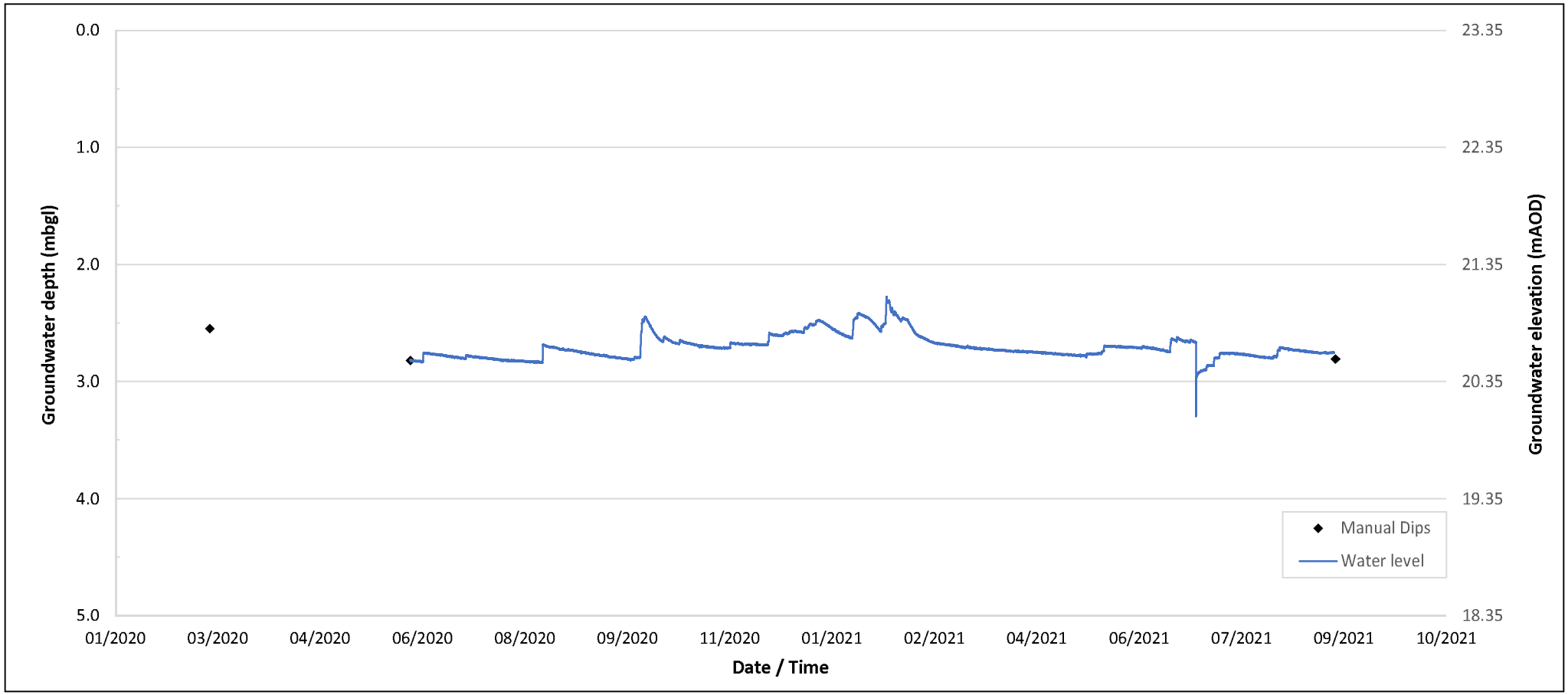
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH1001**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39789043** INSTALLATION DATE: **11/06/2020**

NOMINAL INSTALLATION DEPTH: **3.25 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **12/06/2020 01:48:00 2.82mbgl.**

WELL DETAILS

EASTING (m): **574055.0** NORTHING (m): **208676.0** ELEVATION (mAOD): **23.35**

WELL DEPTH: **3.30 mbgl** TOP OF RESPONSE ZONE: **2.30 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **3.50 mbgl**

REMARKS

Perm test carried out on 30/06/2021. Diver removed and monitoring completed 06/09/2021.

CONTRACT	CHECKED
35699	**DM**

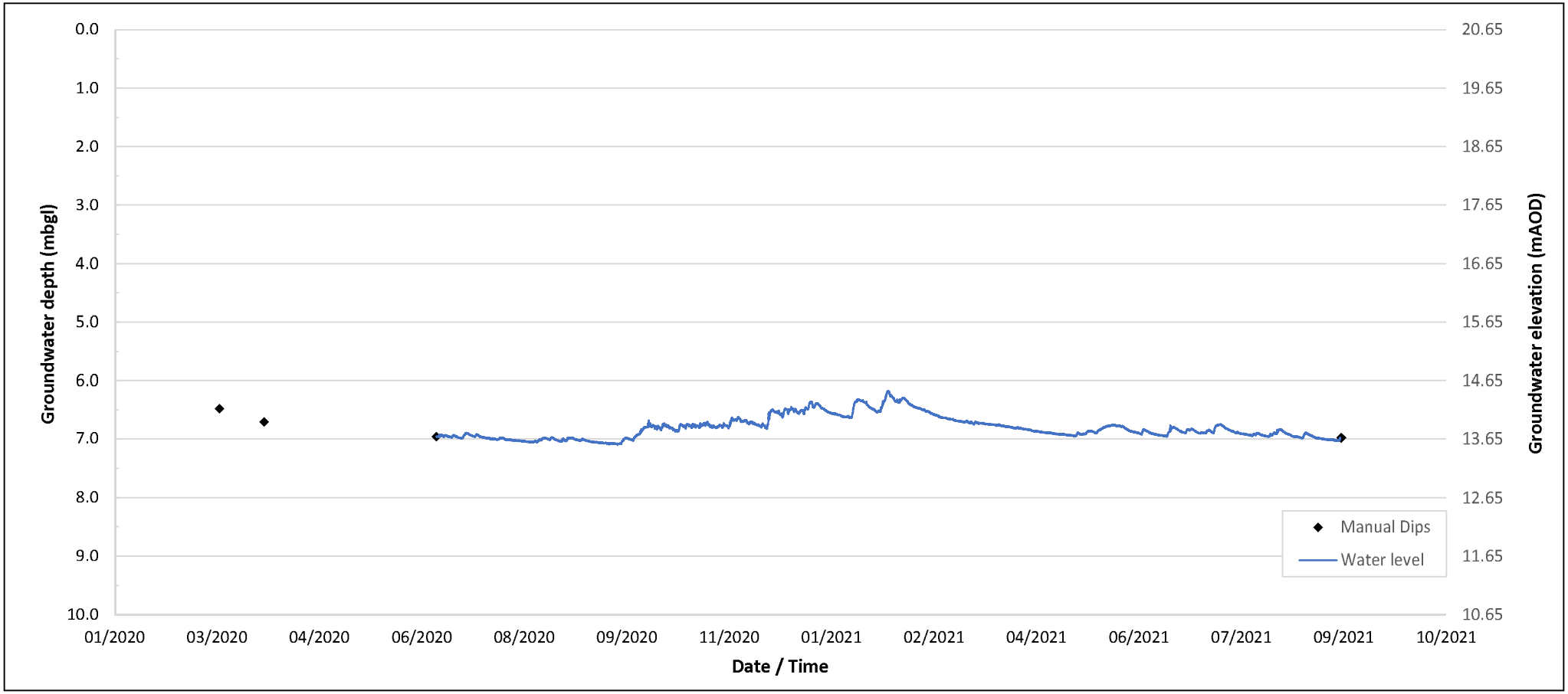
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH1014**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39744006/AZ474** INSTALLATION DATE: **24/06/2020**

NOMINAL INSTALLATION DEPTH: **9.95 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **25/06/2020 01:22:00 6.96mbgl.**

WELL DETAILS

EASTING (m): **582561.0** NORTHING (m): **213415.0** ELEVATION (mAOD): **20.65**

WELL DEPTH: **10.00 mbgl** TOP OF RESPONSE ZONE: **4.80 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **10.00 mbgl**

REMARKS

Permeability testing completed 18/12/2020; data removed 18/12/2020 22:00 to 23:00. Diver removed and monitoring completed 09/09/2021.

CONTRACT	CHECKED
35699	**DM**

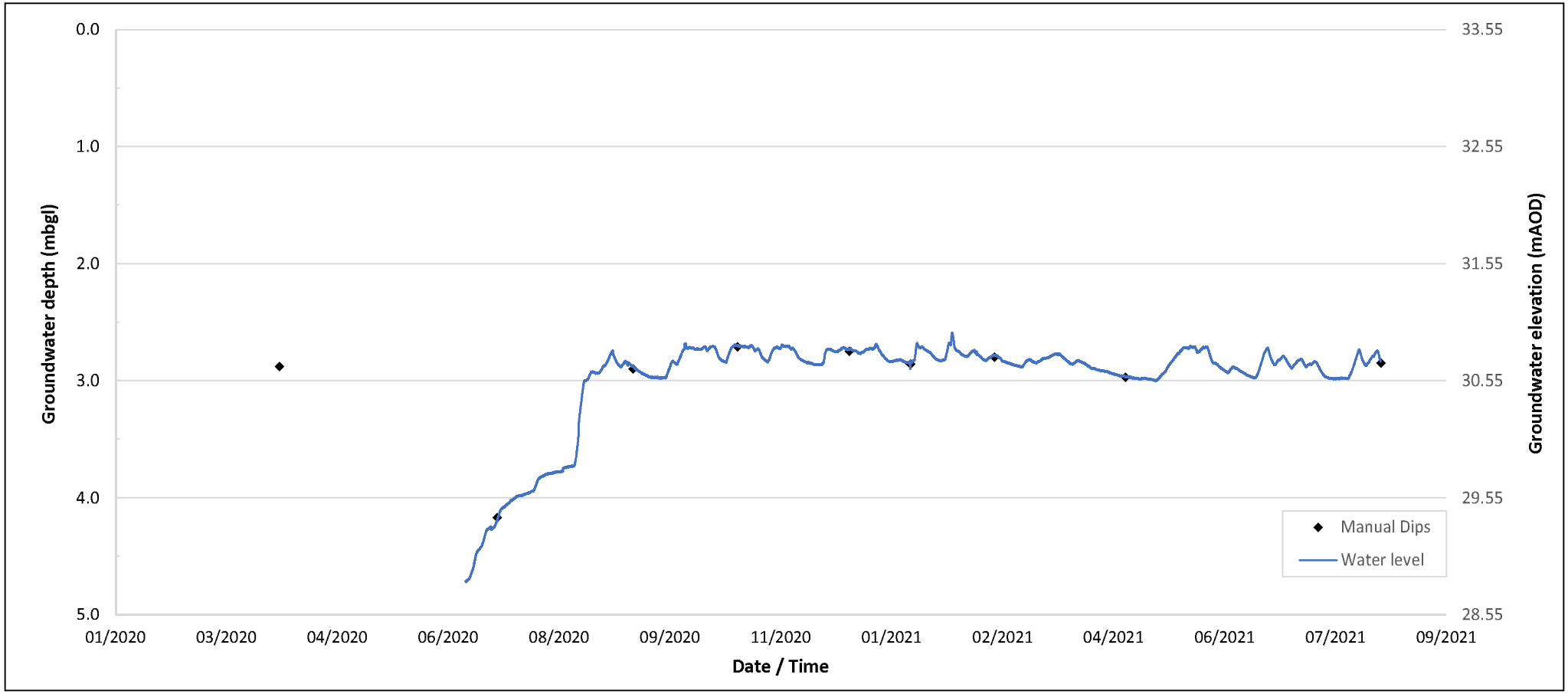
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH1103**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39803648/AW634** INSTALLATION DATE: **25/06/2020**

NOMINAL INSTALLATION DEPTH: **5.75 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **19/04/2021 09:46:00 2.97mbgl.**

WELL DETAILS

EASTING (m): **574257.0** NORTHING (m): **209515.0** ELEVATION (mAOD): **33.55**

WELL DEPTH: **6.00 mbgl** TOP OF RESPONSE ZONE: **1.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **6.00 mbgl**

REMARKS

Diver removed and monitoring completed 12/08/2021.

CONTRACT	CHECKED
35699	**DM**

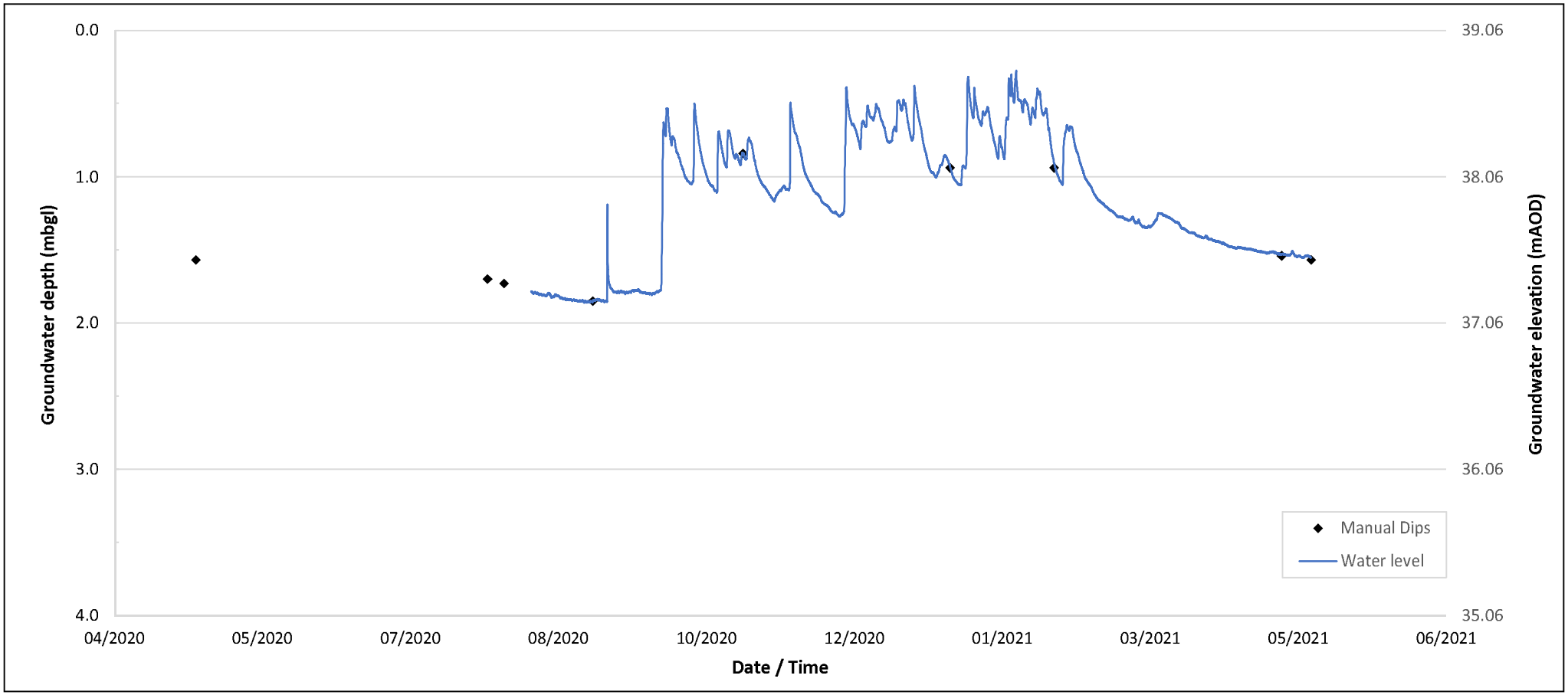
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2003**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ410**	INSTALLATION DATE:	**10/08/2020**	**WELL DETAILS** EASTING (m):	**577665.0**	NORTHING (m):	**210973.0**	ELEVATION (mAOD):	**34.05**
NOMINAL INSTALLATION DEPTH:	**4.00 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.00 mbgl**		

REMARKS

Data prior to visit on 14/09/2020 calibrated against manual dip 09/09/2020 12:45hrs, data post visit 14/09/2020 calibrated against manual dip 30/10/2020 09:30hrs. Permeability test undertaken on 14/09/2020. Diver removed and monitoring completed 10/05/2021.

CONTRACT	CHECKED
35699	**DM**

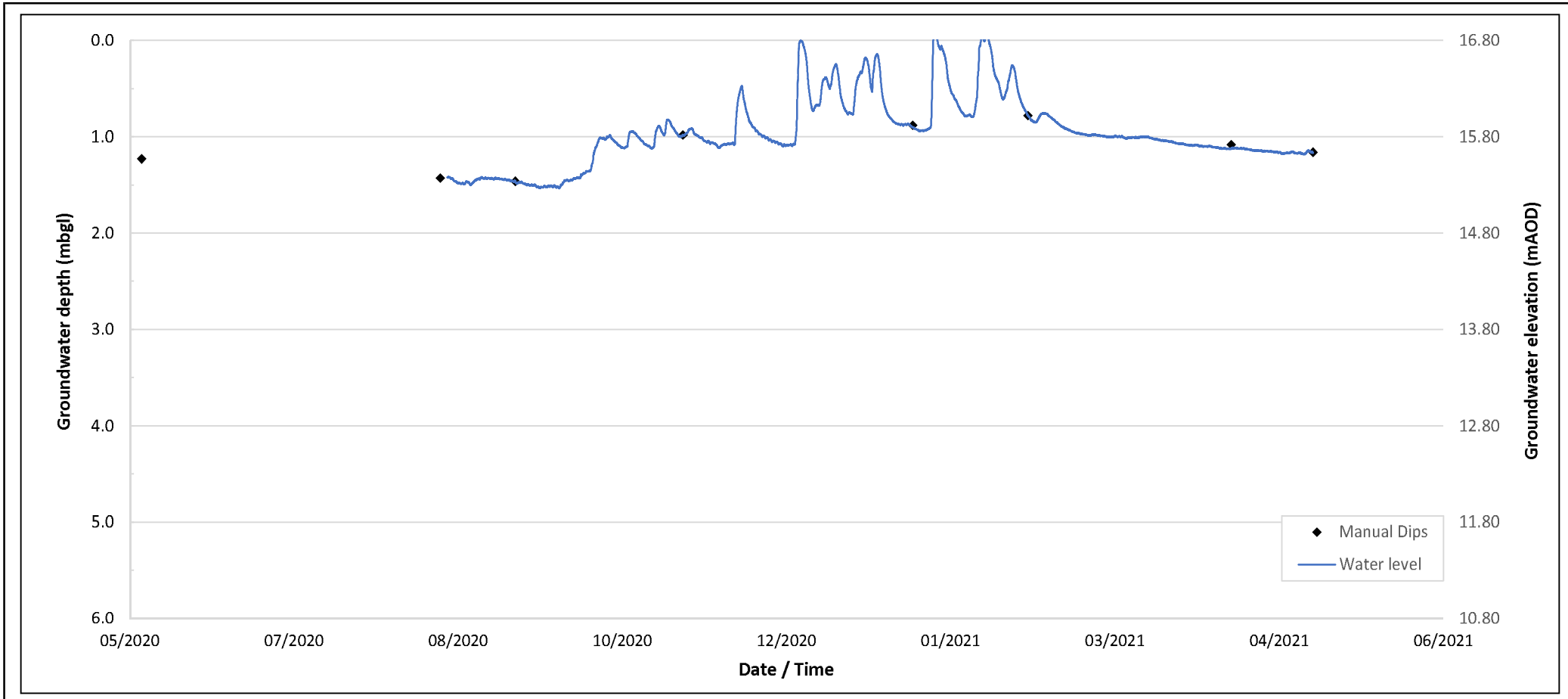
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2005**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AE760**	INSTALLATION DATE:	**17/08/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**5.5 mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**578449.5**	NORTHING (m):	**211065.5**	ELEVATION (mAOD):	**16.80**
CALIBRATION DIP:	**0.98m bgl on 30/10/2020 10:50hrs**			WELL DEPTH:	**6.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**6.2 mbgl**		

REMARKS

Diver removed and monitoring completed 10/05/2021.

CONTRACT	CHECKED
35699	**DM**

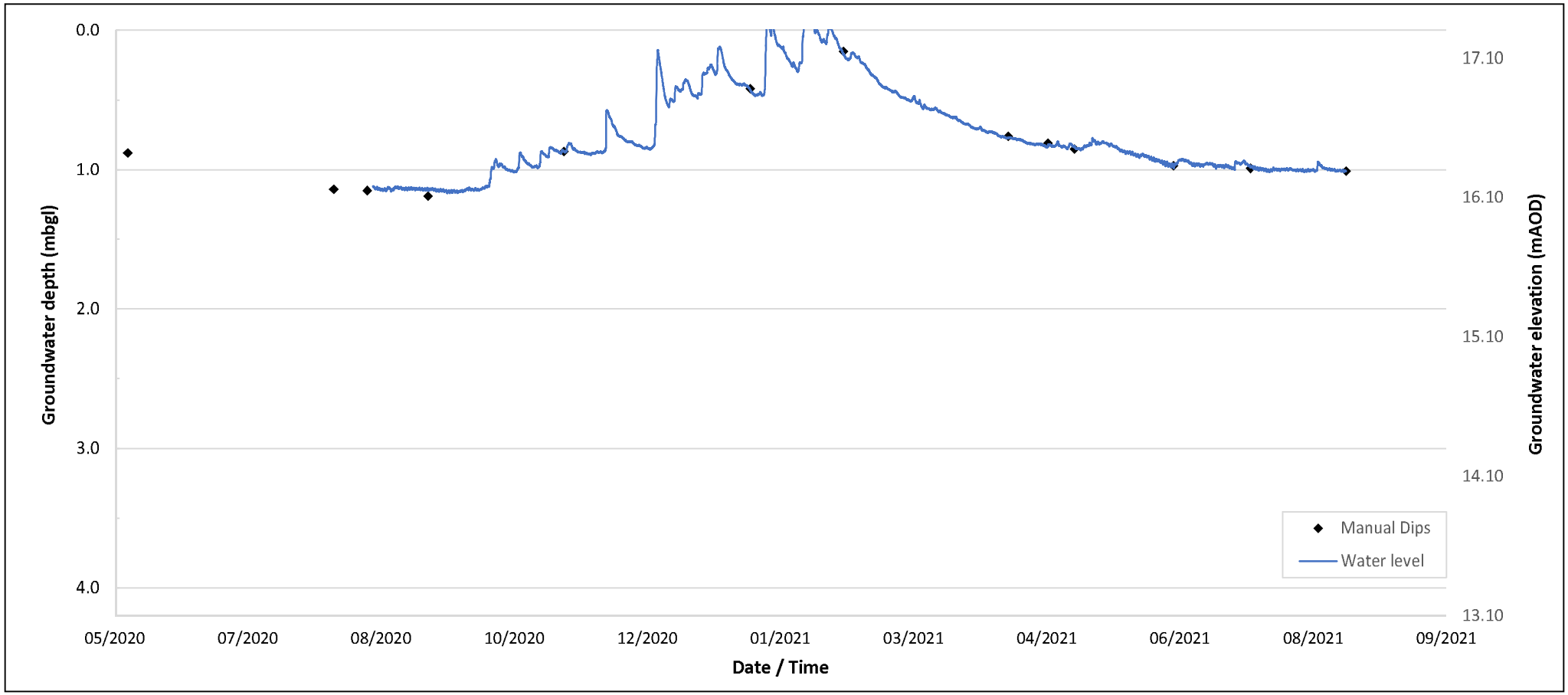
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2007**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AE703**	INSTALLATION DATE:	**17/08/2020**	EASTING (m):	**578344.0**	NORTHING (m):	**210826.5**	ELEVATION (mAOD):	**17.30**
NOMINAL INSTALLATION DEPTH:	**3.70mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.20 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**0.87m bgl on 30/10/2020 11:04hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.40 mbgl**		

REMARKS

Diver removed and monitoring completed 20/08/2021.

CONTRACT	CHECKED
35699	**DM**

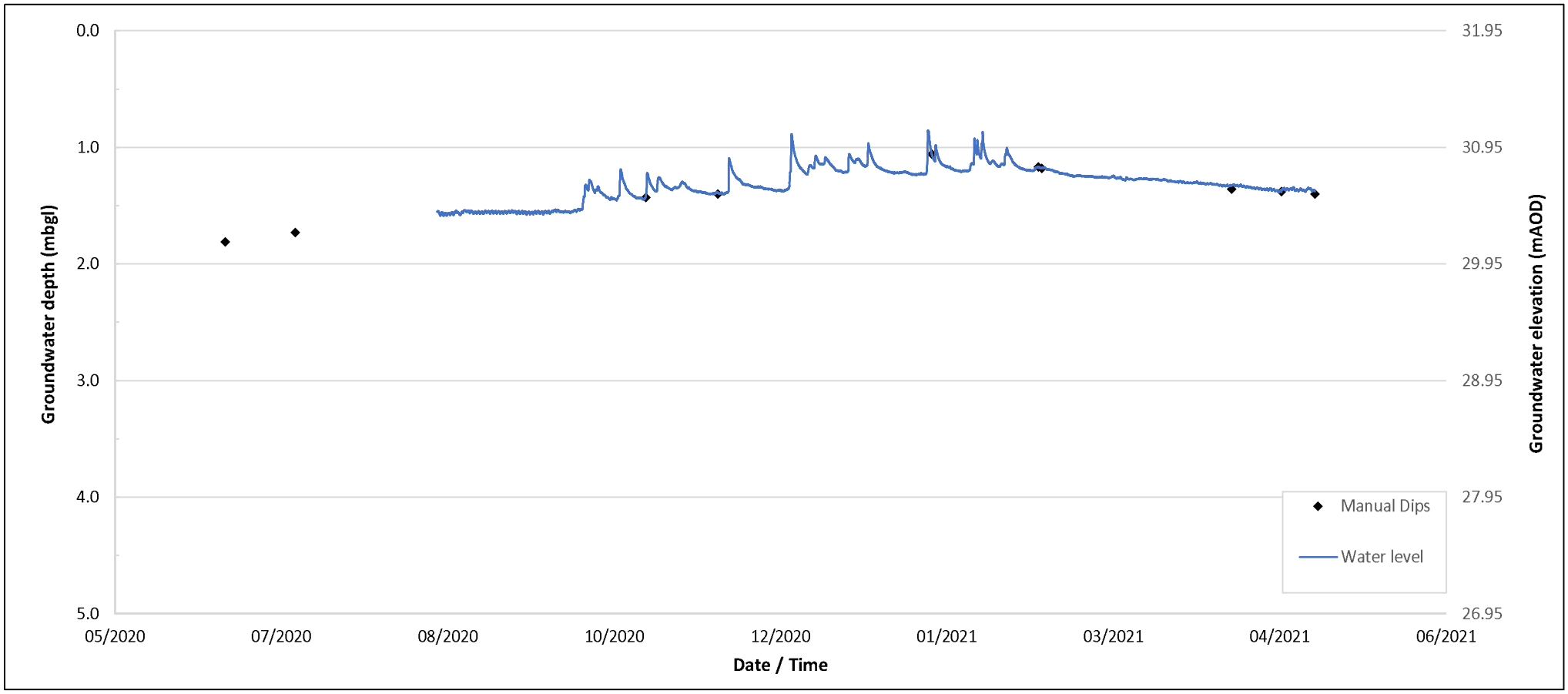
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2008**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ439**	INSTALLATION DATE:	**19/08/2020**
NOMINAL INSTALLATION DEPTH:	**5.00 m**	RECORDING FREQUENCY:	**1 hour**
CALIBRATION DIP:	**1.17m 16/02/2021 12:48hrs**		

WELL DETAILS

EASTING (m):	**578554.0**	NORTHING (m):	**212208.5**	ELEVATION (mAOD):	**31.95**
WELL DEPTH:	**5.00 mbgl**	TOP OF RESPONSE ZONE:	**0.80 mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00 mbgl**		

REMARKS

Diver removed and monitoring completed 13/05/2021.

CONTRACT	CHECKED
35699	**DM**

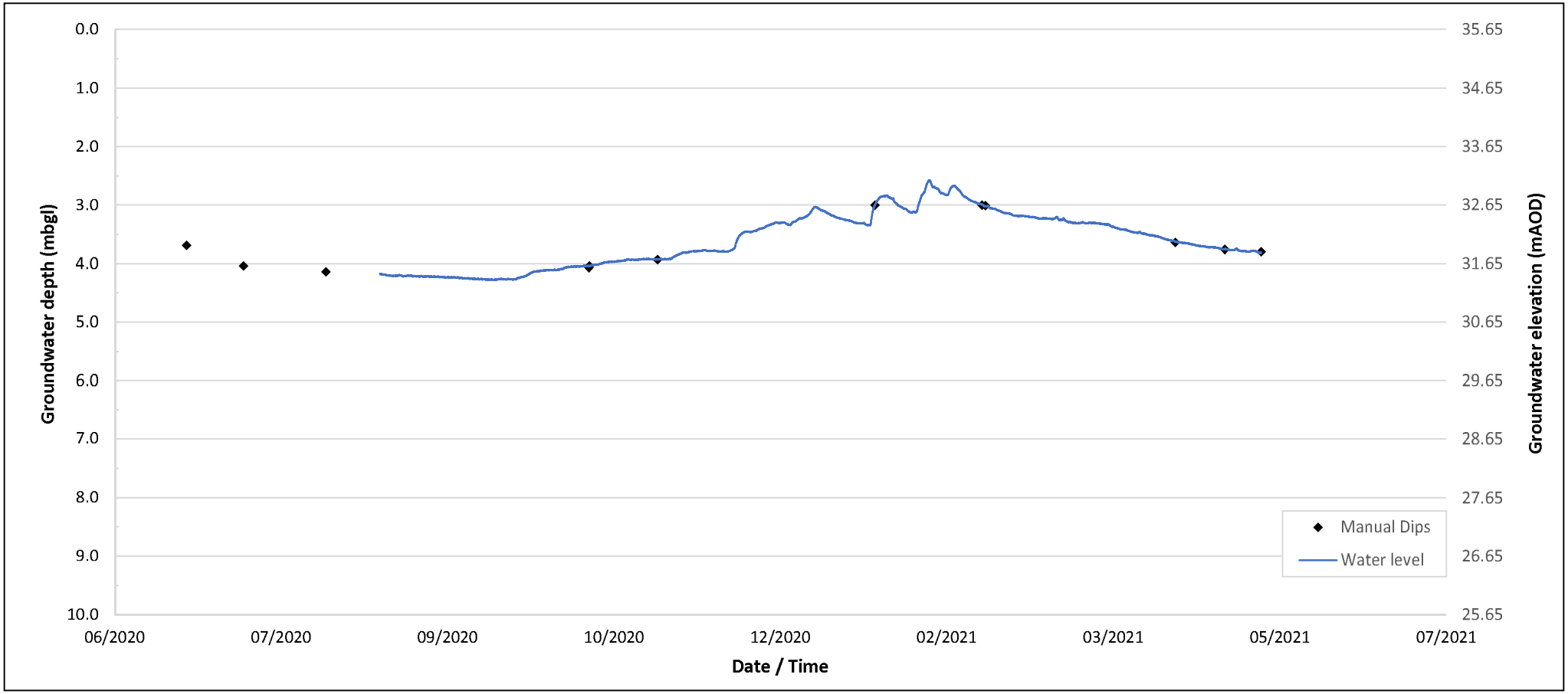
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2020**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ601**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**578668.0**	NORTHING (m):	**212470.0**	ELEVATION (mAOD):	**35.65**
NOMINAL INSTALLATION DEPTH:	**9.5 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:	**6.00 mbgl**		
CALIBRATION DIP:	**3.00m bgl on 15/01/2021 10:13hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Diver removed and monitoring completed 11/05/2021.

CONTRACT	CHECKED
35699	**DM**

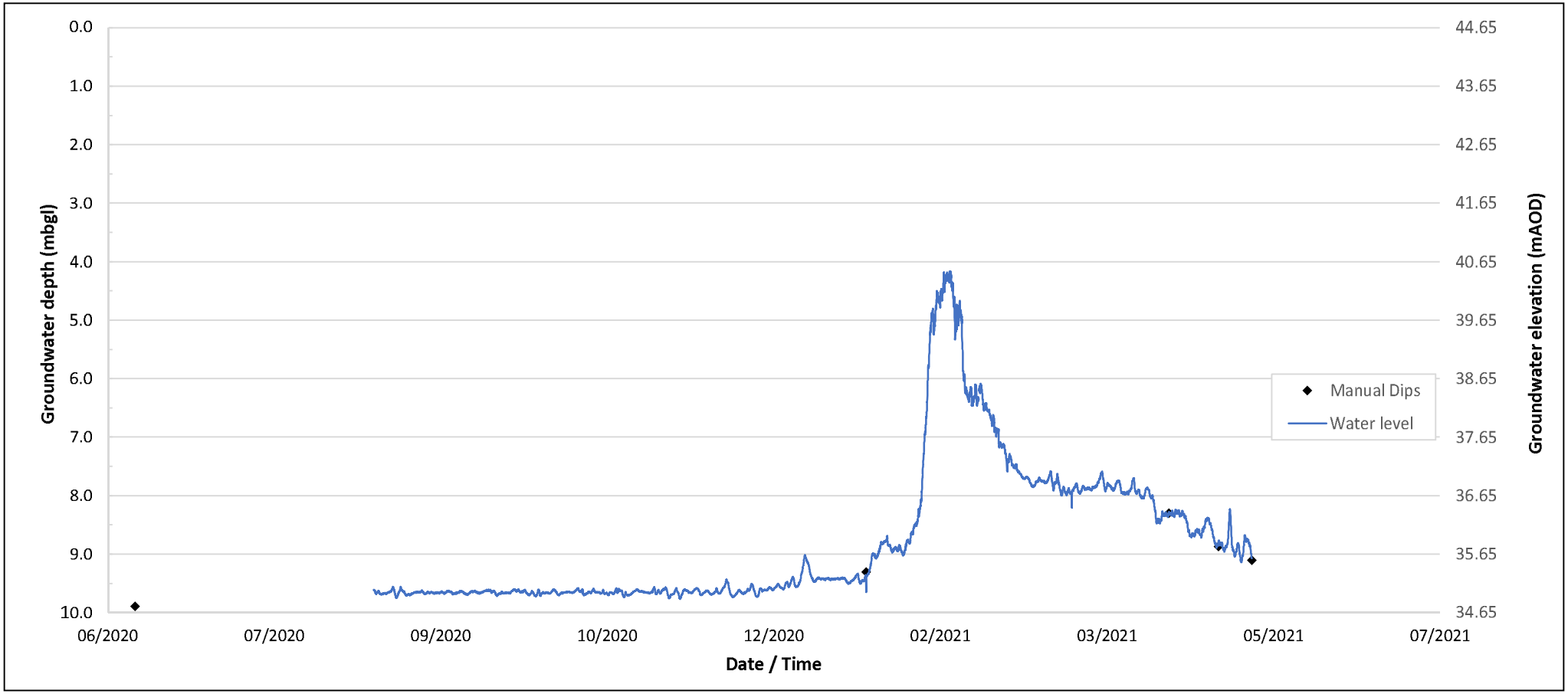
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2023**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ610**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**579647.5**	NORTHING (m):	**212356.0**	ELEVATION (mAOD):	**44.65**
NOMINAL INSTALLATION DEPTH:	**9.8 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:	**4.00 mbgl**		
CALIBRATION DIP:	**8.30m bgl on 15/04/2021 13:39hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Manual dips 10/07/2020, 21/10/2020 and 11/11/2020 all recorded as dry. Diver removed and monitoring completed 13/05/2021.

CONTRACT	CHECKED
35699	**DM**

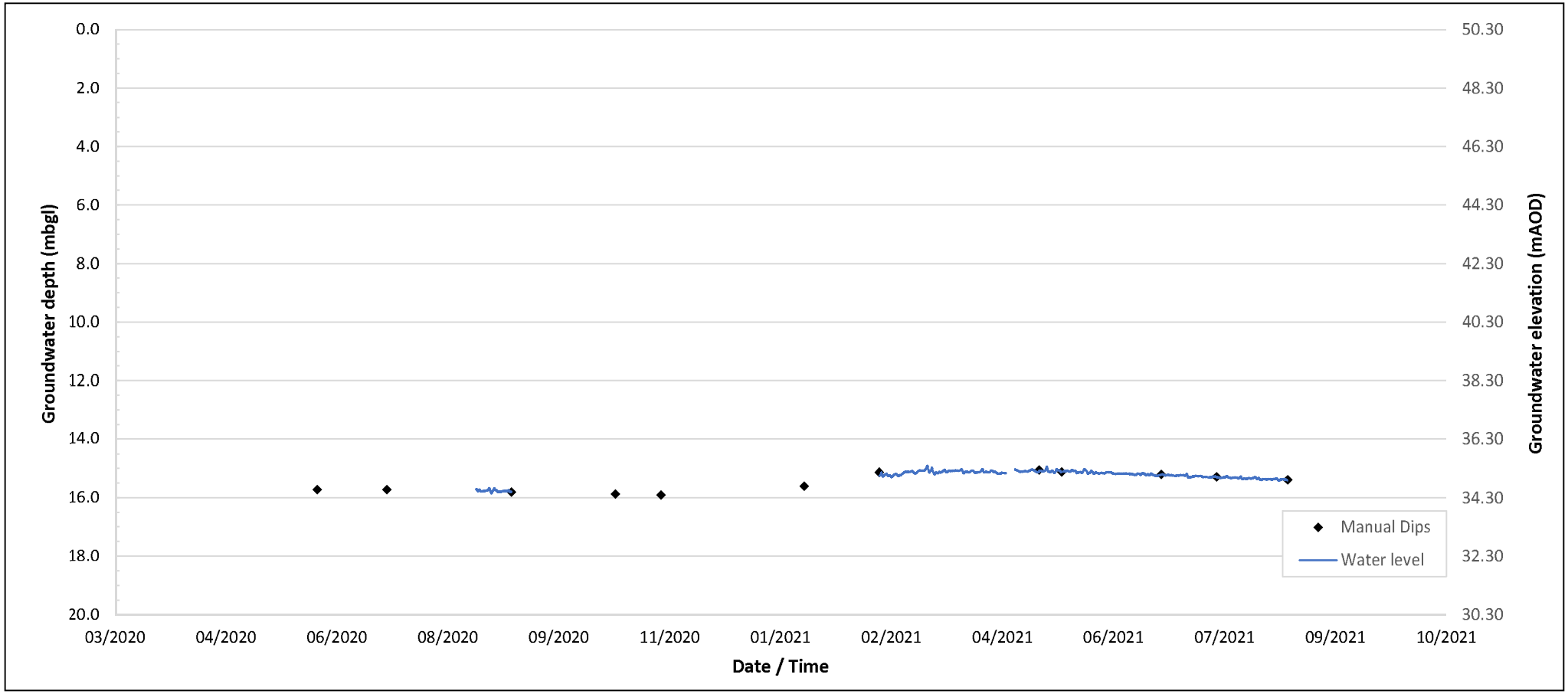
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2025**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ618**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**578793.0**	NORTHING (m):	**212782.0**	ELEVATION (mAOD):	**50.30**
NOMINAL INSTALLATION DEPTH:	**17.50mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**20.00 mbgl**	TOP OF RESPONSE ZONE:	**7.00 mbgl**		
CALIBRATION DIP:	**15.13m bgl on 04/09/2020 13:00hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**20.00 mbgl**		

REMARKS

Diver not recording water levels between visits on 04/09/2020 and 18/02/2021, and between 15/04/2021 to 19/04/2021. Data adjusted for diver movement 17/03/2021 to 15/04/2021. Diver removed and replaced on 20/04/2021. Diver removed and monitoring completed 20/08/2021.

CONTRACT	CHECKED
35699	**DM**

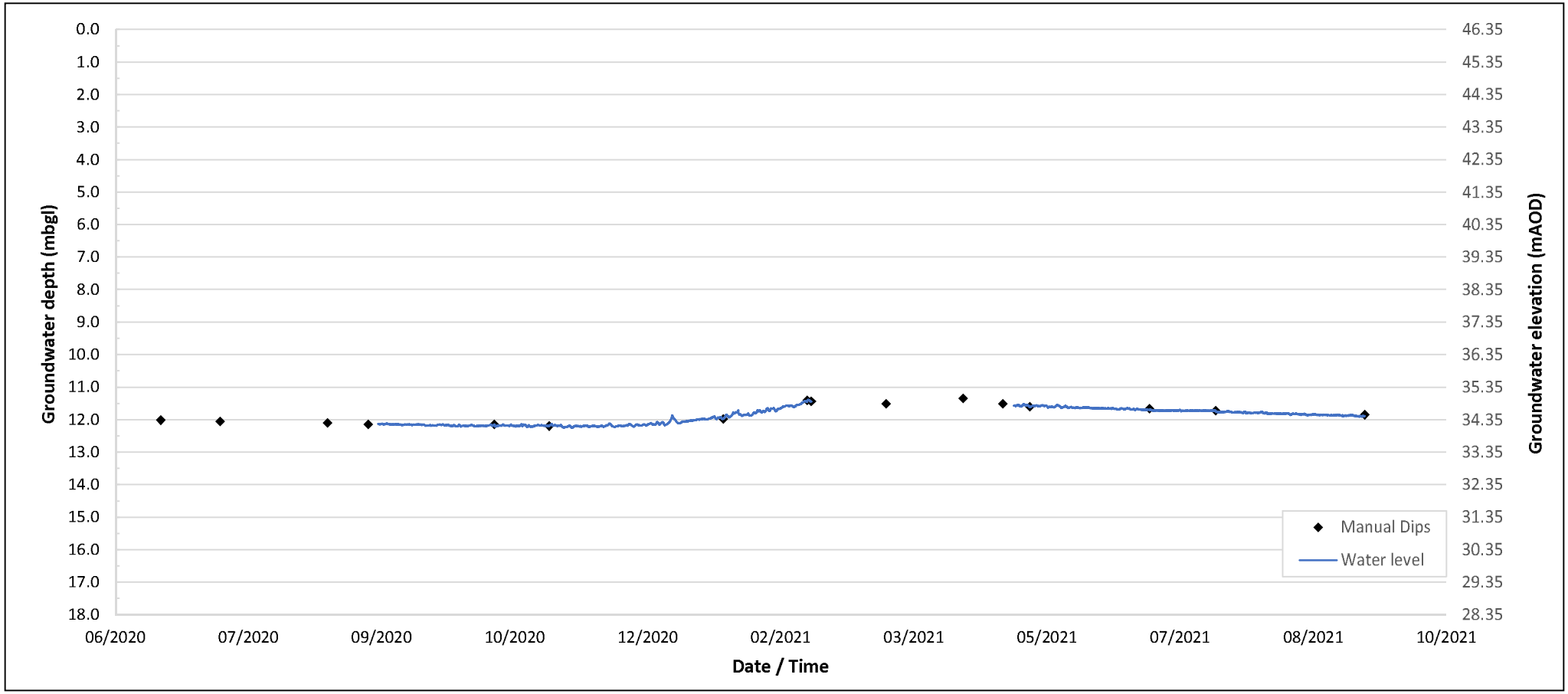
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2028**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ582**	INSTALLATION DATE:	**07/09/2020**	EASTING (m):	**580156.0**	NORTHING (m):	**212960.0**	ELEVATION (mAOD):	**46.35**
NOMINAL INSTALLATION DEPTH:	**13.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**18.00 mbgl**	TOP OF RESPONSE ZONE:	**6.00 mbgl**		
CALIBRATION DIP:	**12.15m bgl on 21/10/2020 09:58hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**18.50 mbgl**		

REMARKS

Data between 11/11/2020 10:00hrs and 14/1/2020 02:00hrs re-calibrated to address temporary movement of diver following monitoring visit on 11/11/2020. Further corrections made to data following visits on 15/01/2021 and 16/02/2021. Diver not recording data from 17/02/2021 until diver replaced on 04/05/2021. Diver removed and monitoring completed 13/09/2021.

CONTRACT	CHECKED
35699	**DM**

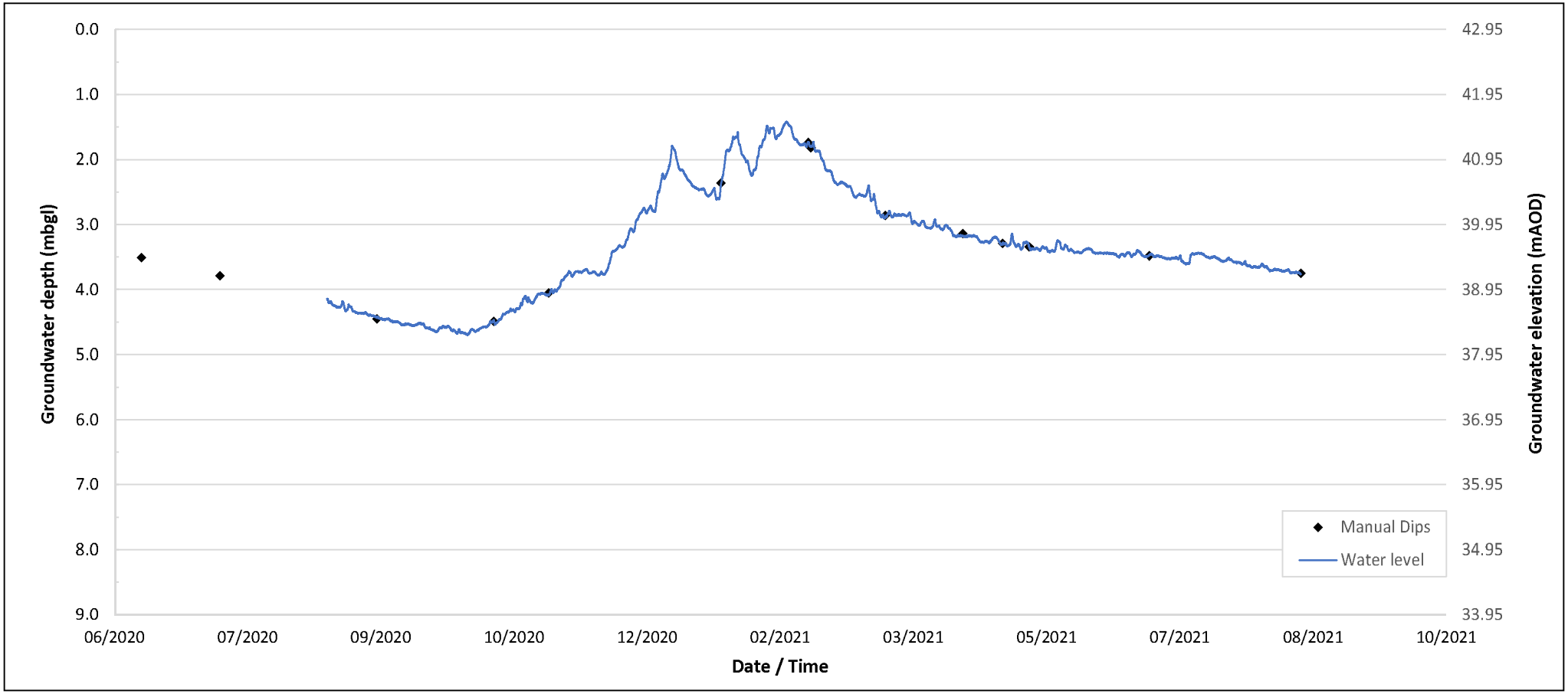
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2031**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ608**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**579888.5**	NORTHING (m):	**212330.5**	ELEVATION (mAOD):	**42.95**
NOMINAL INSTALLATION DEPTH:	**8.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**9.00 mbgl**	TOP OF RESPONSE ZONE:	**5.00 mbgl**		
CALIBRATION DIP:	**1.74m bgl on 16/02/2021 10:32hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**9.30 mbgl**		

REMARKS

Diver removed and monitoring completed 20/08/2021.

CONTRACT	CHECKED
35699	**DM**

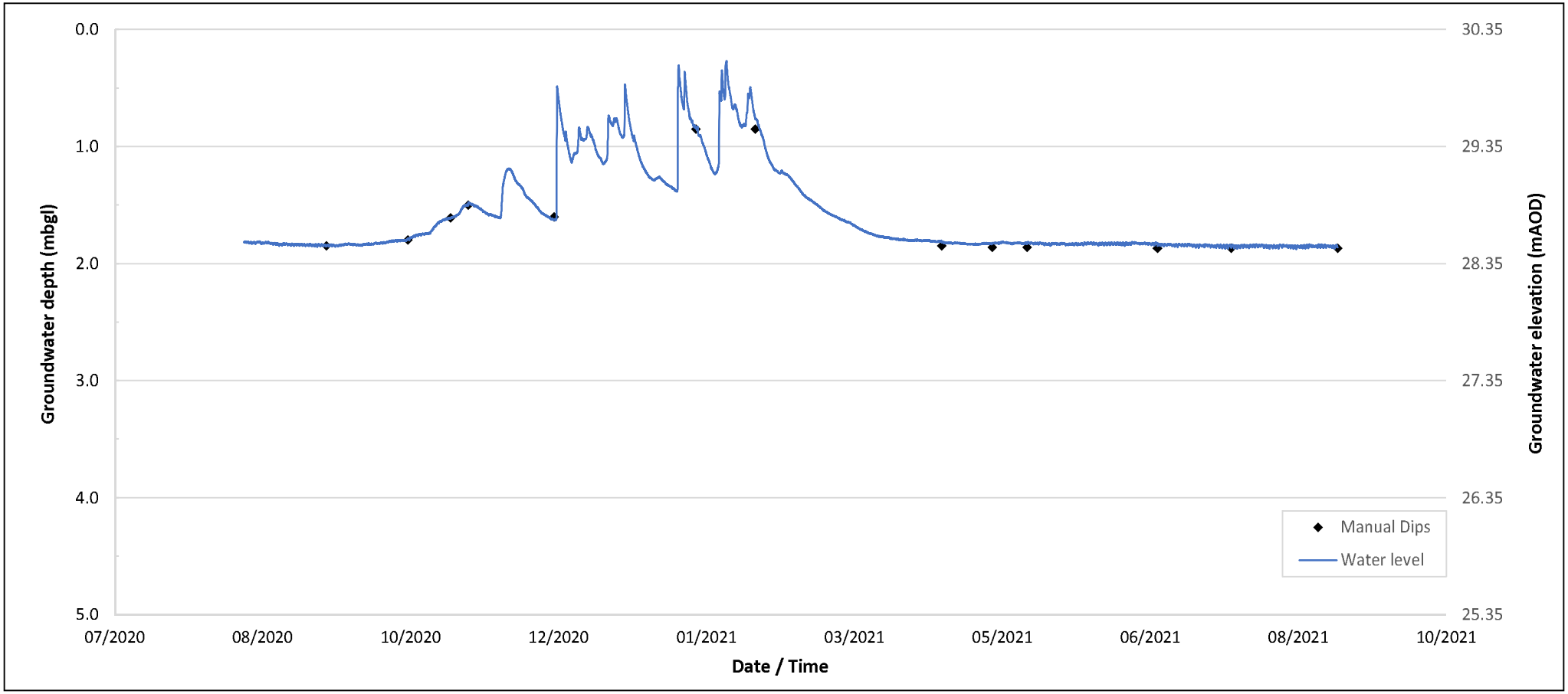
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2033**



DATALOGGER INSTALLATION DETAILS				WELL DETAILS					
DATALOGGER SERIAL NO.:	**AZ373**	INSTALLATION DATE:	**20/08/2020**	EASTING (m):	**581136.5**	NORTHING (m):	**212837.0**	ELEVATION (mAOD):	**30.35**
NOMINAL INSTALLATION DEPTH:	**4.70 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00 mbgl**		

REMARKS

Data prior to visit on 29/10/2020 calibrated against manual dip of 1.85mbgl on 17/09/2020 10:37hrs, data after visit on 29/10/2020 calibrated against manual dip of 1.50mbgl on 04/11/2020 10:14hrs. Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

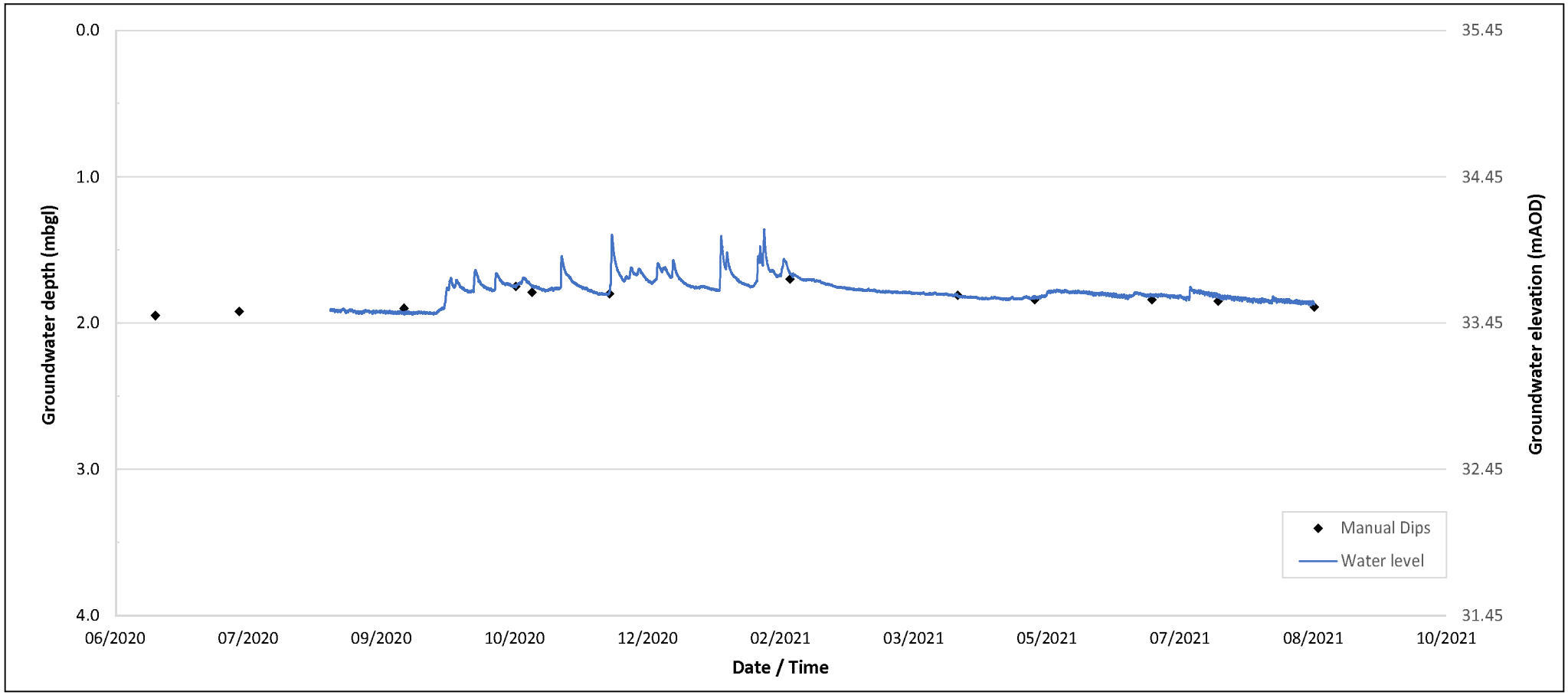
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2037**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ375**	INSTALLATION DATE:	**20/08/2020**	EASTING (m):	**580866.5**	NORTHING (m):	**212492.0**	ELEVATION (mAOD):	**35.45**
NOMINAL INSTALLATION DEPTH:	**3.80 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**1.75 mbgl - 29/10/2020 09:45hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.00 mbgl**		

REMARKS

Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

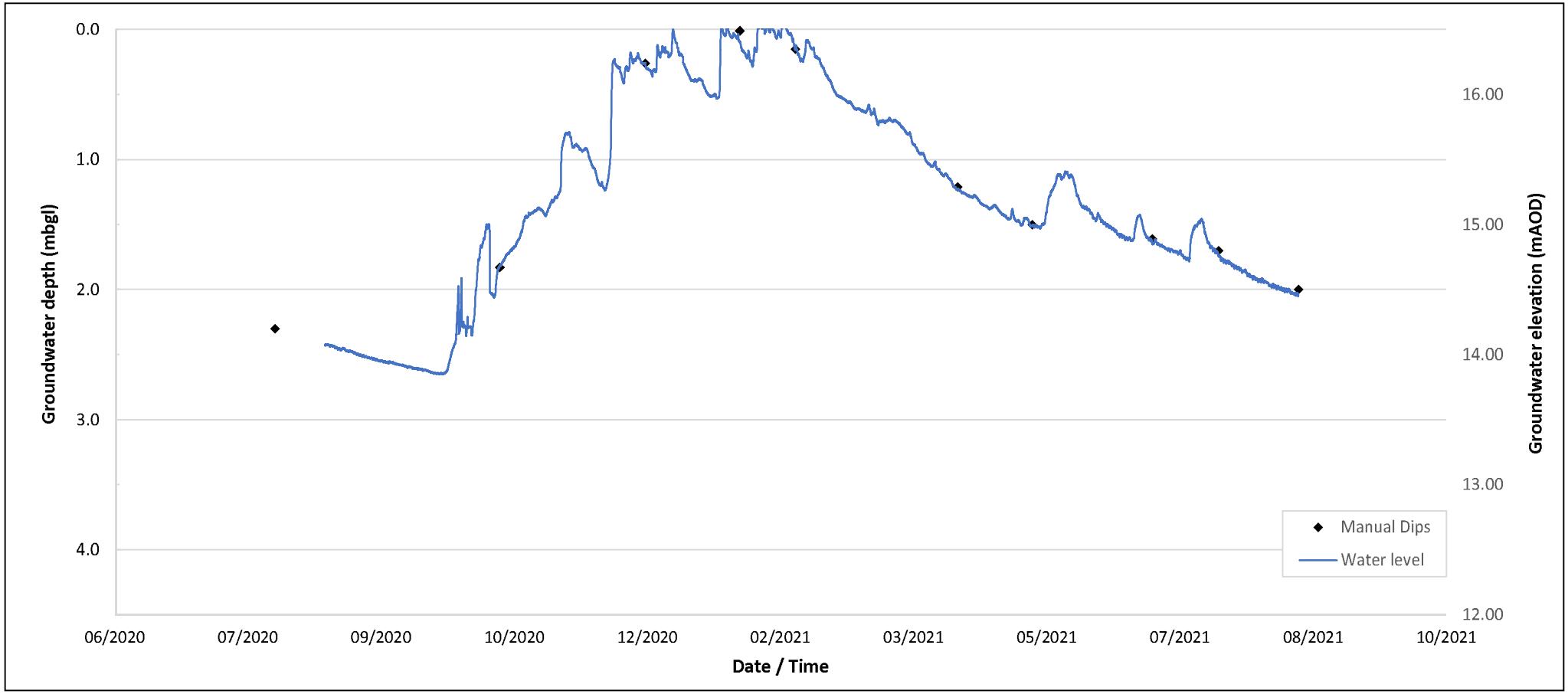
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2041**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ617**	INSTALLATION DATE:	**18/08/2020**	EASTING (m):	**581854.0**	NORTHING (m):	**212597.5**	ELEVATION (mAOD):	**16.50**
NOMINAL INSTALLATION DEPTH:	**4.40 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.50 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**1.83m bgl on 23/10/2020 10.41hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.80 mbgl**		

REMARKS

Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

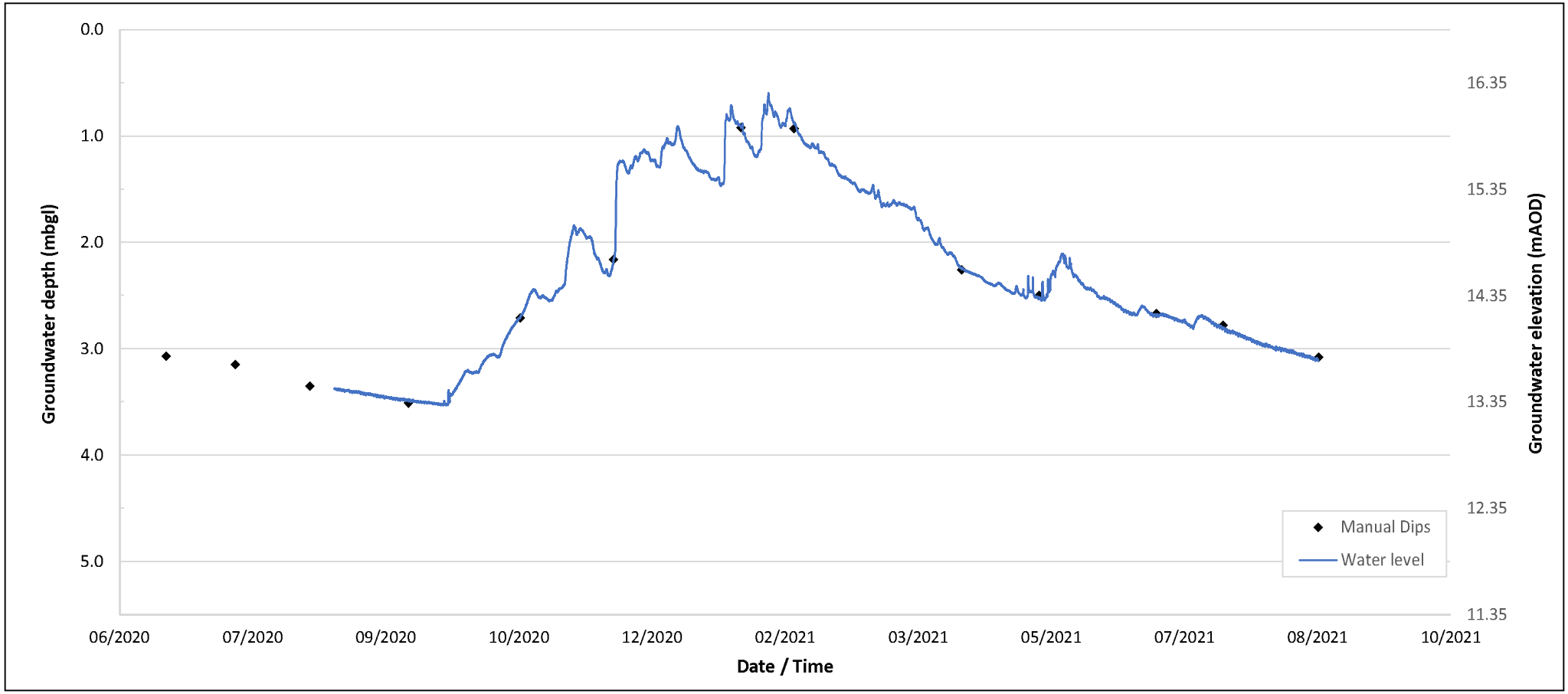
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2042A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ359**	INSTALLATION DATE:	**20/08/2020**	EASTING (m):	**581876.0**	NORTHING (m):	**212246.5**	ELEVATION (mAOD):	**16.85**
NOMINAL INSTALLATION DEPTH:	**4.70 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.50 mbgl**	TOP OF RESPONSE ZONE:	**1.80 mbgl**		
CALIBRATION DIP:	**2.16m bgl on 03/12/2020 14:15hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.50 mbgl**		

REMARKS

Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

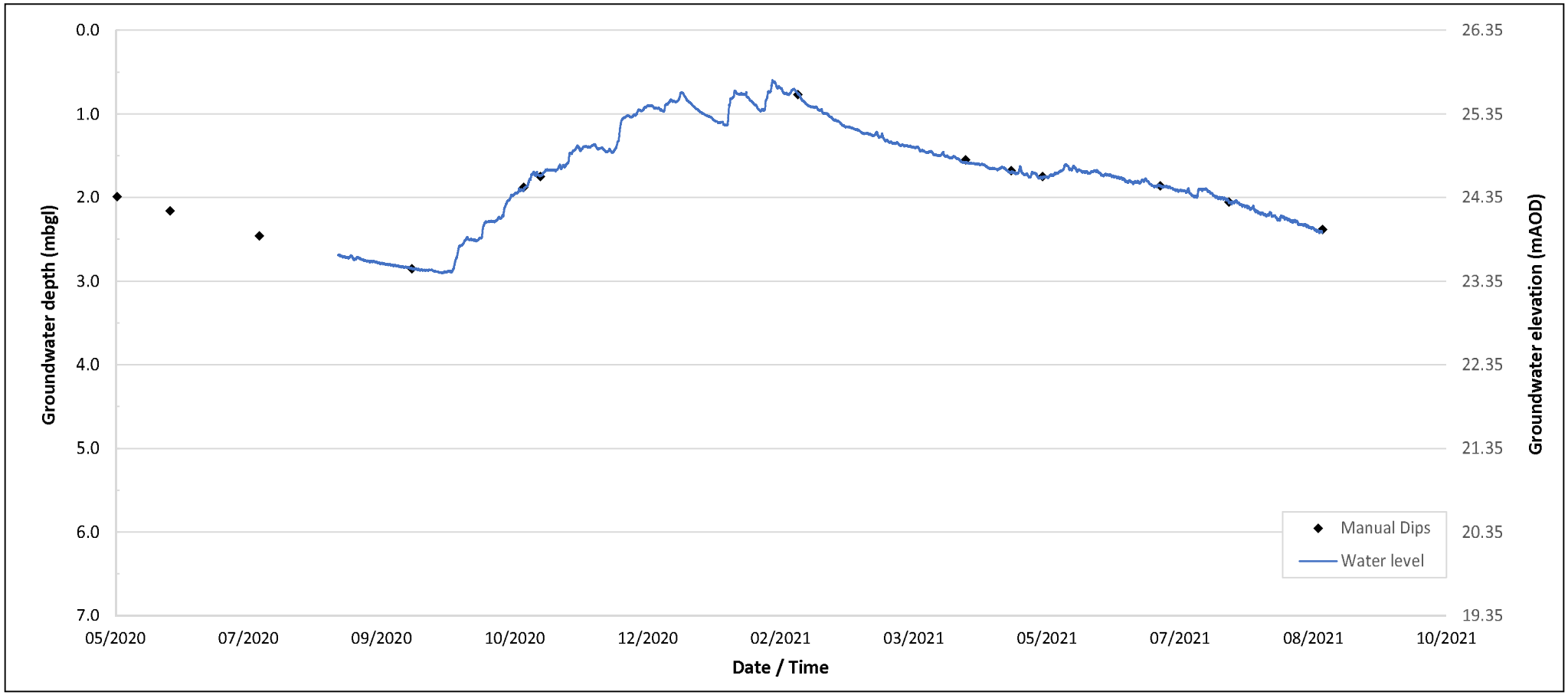
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2044**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ609**	INSTALLATION DATE:	**20/08/2020**	EASTING (m):	**581536.5**	NORTHING (m):	**211699.0**	ELEVATION (mAOD):	**26.35**
NOMINAL INSTALLATION DEPTH:	**6.70 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**7.00 mbgl**	TOP OF RESPONSE ZONE:	**2.00 mbgl**		
CALIBRATION DIP:	**2.85 mbgl - 17/09/2020 11:13hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.00 mbgl**		

REMARKS

Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

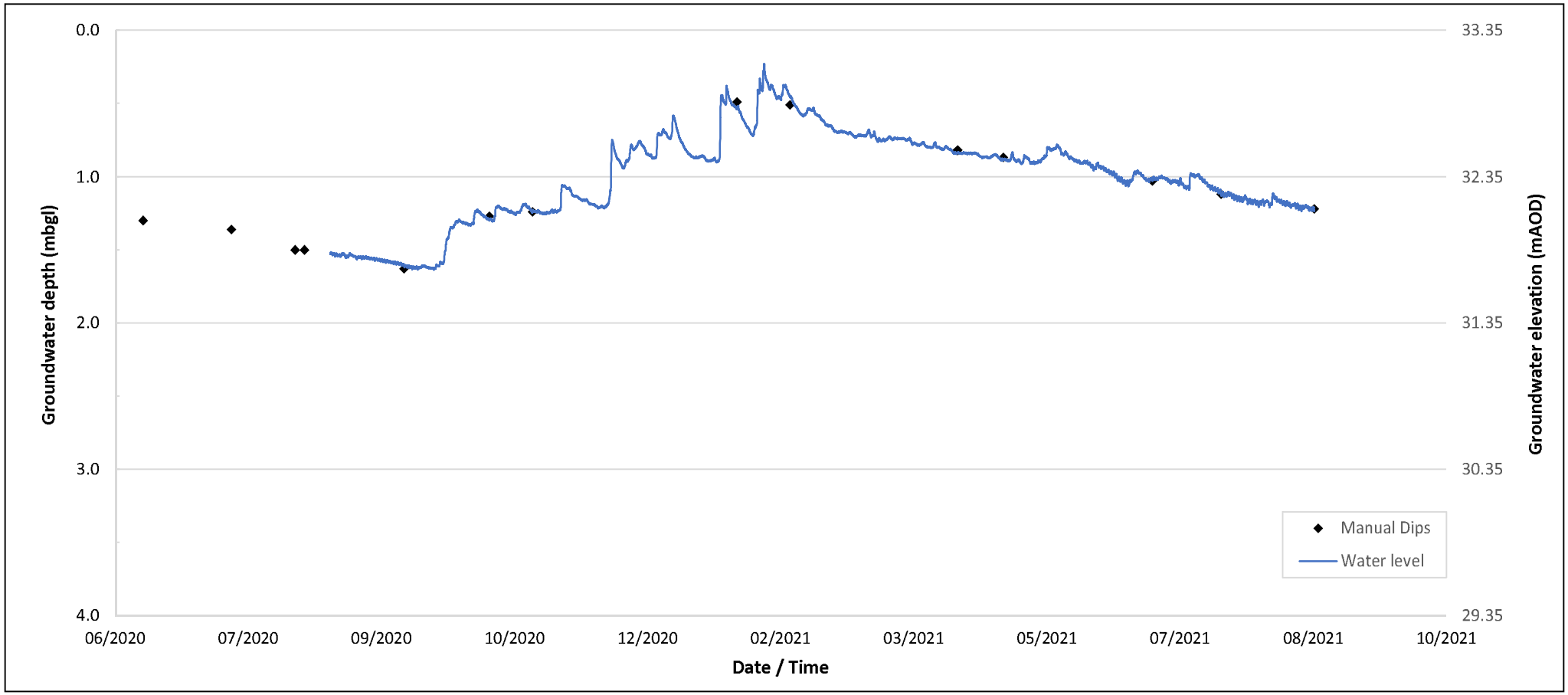
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2046**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ371**	INSTALLATION DATE:	**20/8/020**	EASTING (m):	**581255.0**	NORTHING (m):	**211824.5**	ELEVATION (mAOD):	**33.35**
NOMINAL INSTALLATION DEPTH:	**4.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.00 mbgl**	TOP OF RESPONSE ZONE:	**1.50 mbgl**		
CALIBRATION DIP:	**1.24m bgl on 04/11/2020 15:22hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.00 mbgl**		

REMARKS

Diver removed and monitoring completed 25/08/2021.

CONTRACT	CHECKED
35699	**DM**

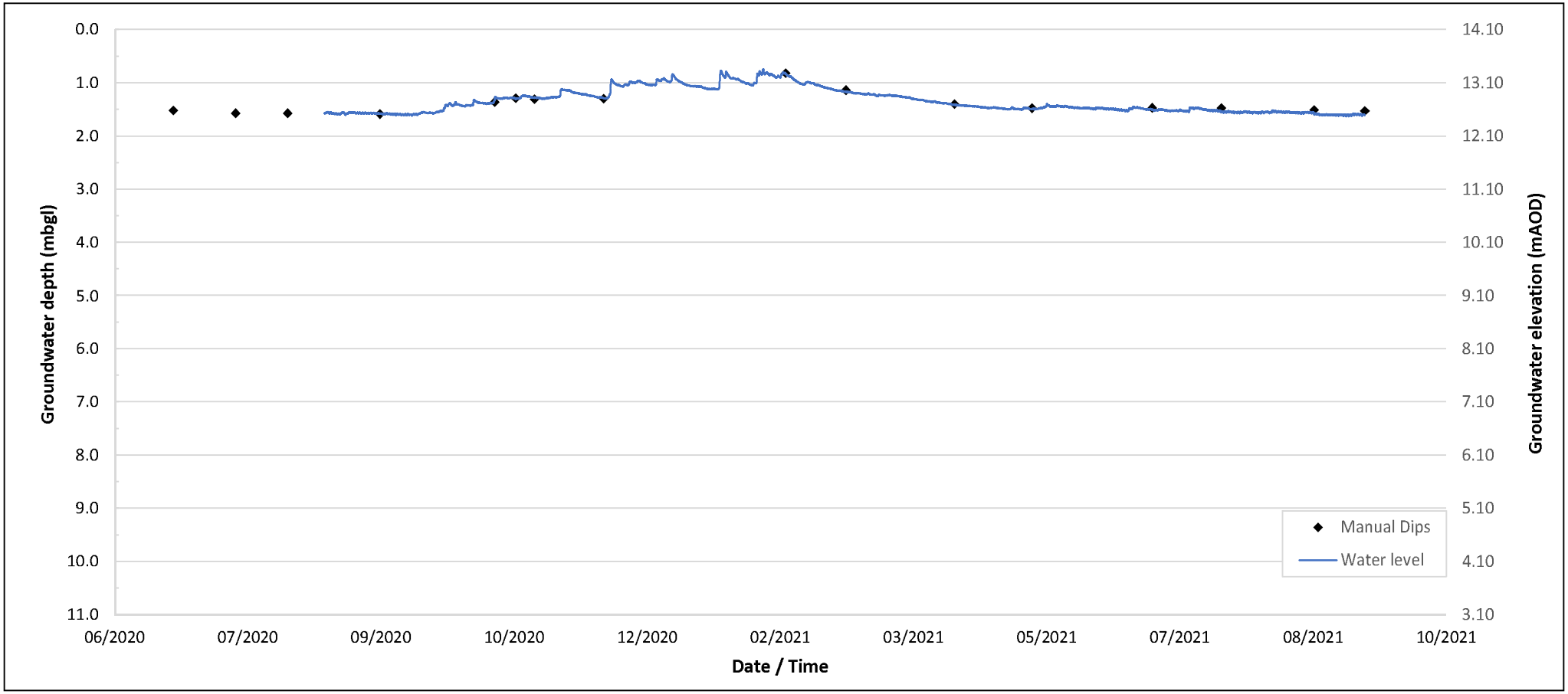
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2052**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ236**	INSTALLATION DATE:	**11/08/2020**	EASTING (m):	**582551.0**	NORTHING (m):	**213082.0**	ELEVATION (mAOD):	**14.10**
NOMINAL INSTALLATION DEPTH:	**10.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**11.00 mbgl**	TOP OF RESPONSE ZONE:	**2.00 mbgl**		
CALIBRATION DIP:	**1.59m bgl on 08/09/2020 12:47hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**11.00 mbgl**		

REMARKS

Diver removed and monitoring completed 13/09/2021.

CONTRACT	CHECKED
35699	**DM**

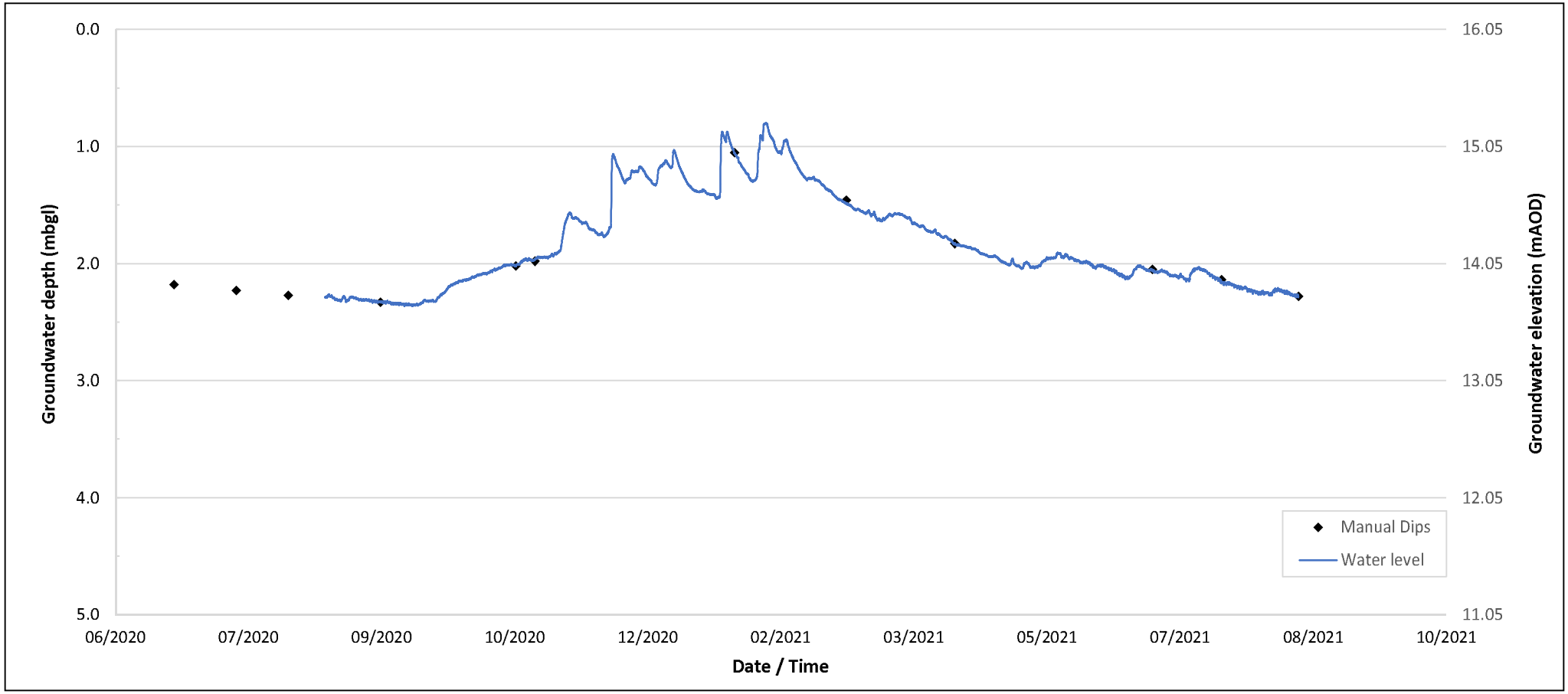
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2053**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ273**	INSTALLATION DATE:	**11/08/2020**	EASTING (m):	**582489.0**	NORTHING (m):	**213259.0**	ELEVATION (mAOD):	**16.05**
NOMINAL INSTALLATION DEPTH:	**5.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**2.33m bgl on 08/09/2020 12:12hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00 mbgl**		

REMARKS

Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

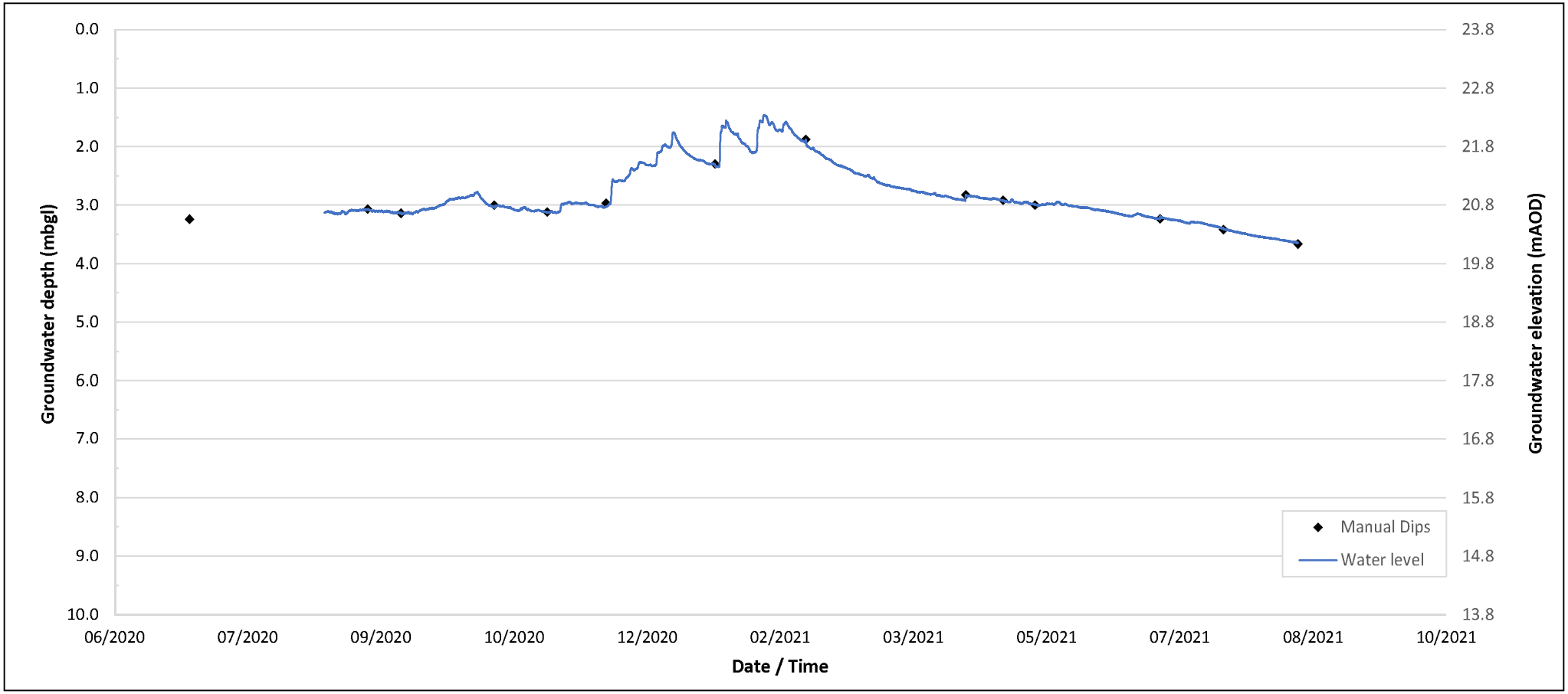
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2055**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ613**	INSTALLATION DATE:	**18/08/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**9.50mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**584480.0**	NORTHING (m):	**217110.0**	ELEVATION (mAOD):	**23.80**
CALIBRATION DIP:	**See below.**			WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:		**1.00 mbgl**	
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:		**10.45 mbgl**	

REMARKS

Data prior to visit on 16/04/2021 calibrated against manual dip of 3.14mbgl on 16/09/2020 11:30hrs, data after visit on 16/04/2021 calibrated against manual dip of 2.92mbgl on 30/04/2021 15:38hrs. Data manually corrected to address diver movement between 22/10/2020 and 10/11/2020. Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

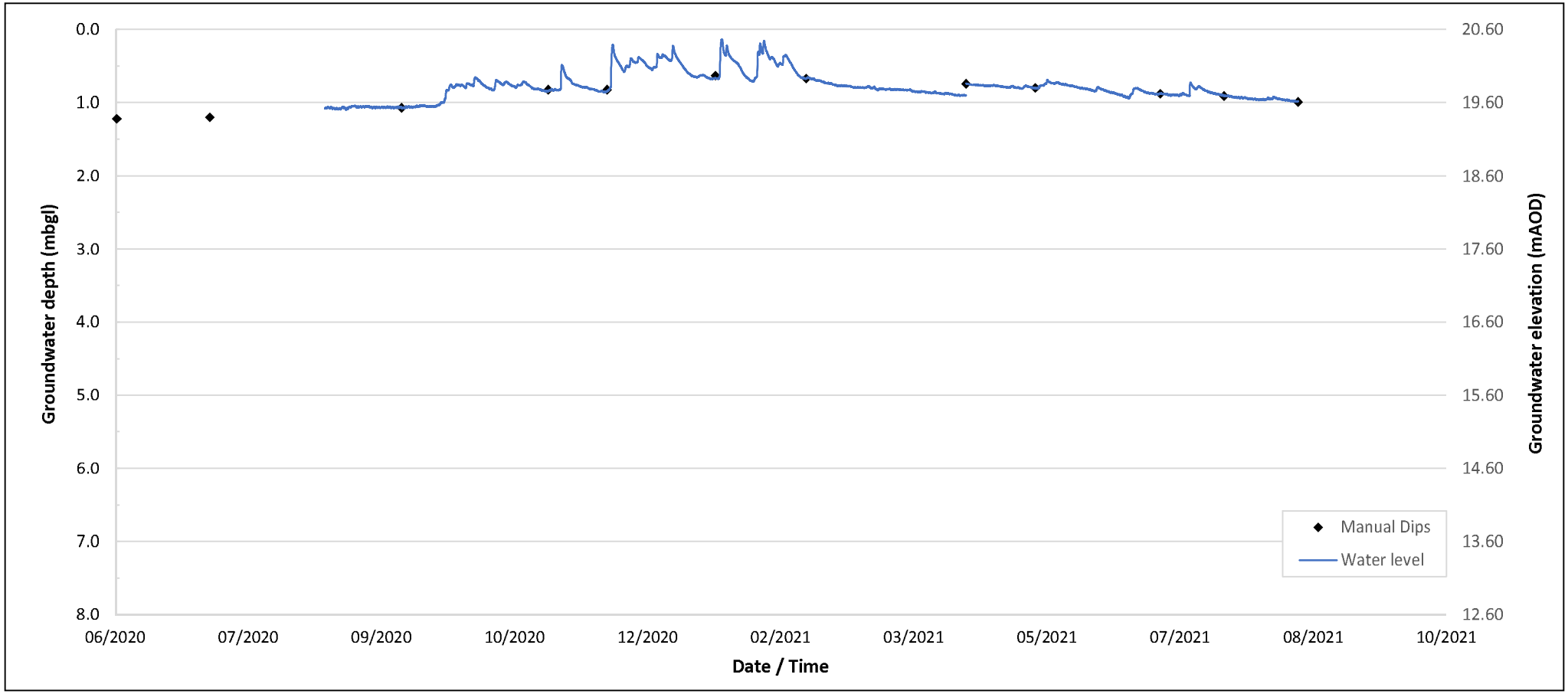
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2058**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ598**	INSTALLATION DATE:	**18/08/2020**
NOMINAL INSTALLATION DEPTH:	**7.50 mbgl**	RECORDING FREQUENCY	**1 hour**
CALIBRATION DIP:	**See below.**		

WELL DETAILS

EASTING (m):	**584177.0**	NORTHING (m):	**216845.0**	ELEVATION (mAOD):	**20.60**
WELL DEPTH:	**8.00 mbgl**	TOP OF RESPONSE ZONE:	**4.50 mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**8.00 mbgl**		

REMARKS

Data prior to visit on 16/04/2021 calibrated against manual dip of 1.07mbgl on 16/09/2020 10:50hrs, data including and after visit on 16/04/2021 calibrated against manual dip of 0.88mbgl on 28/06/2021 15:28hrs. Change of associated barometer 12/05/2020. Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

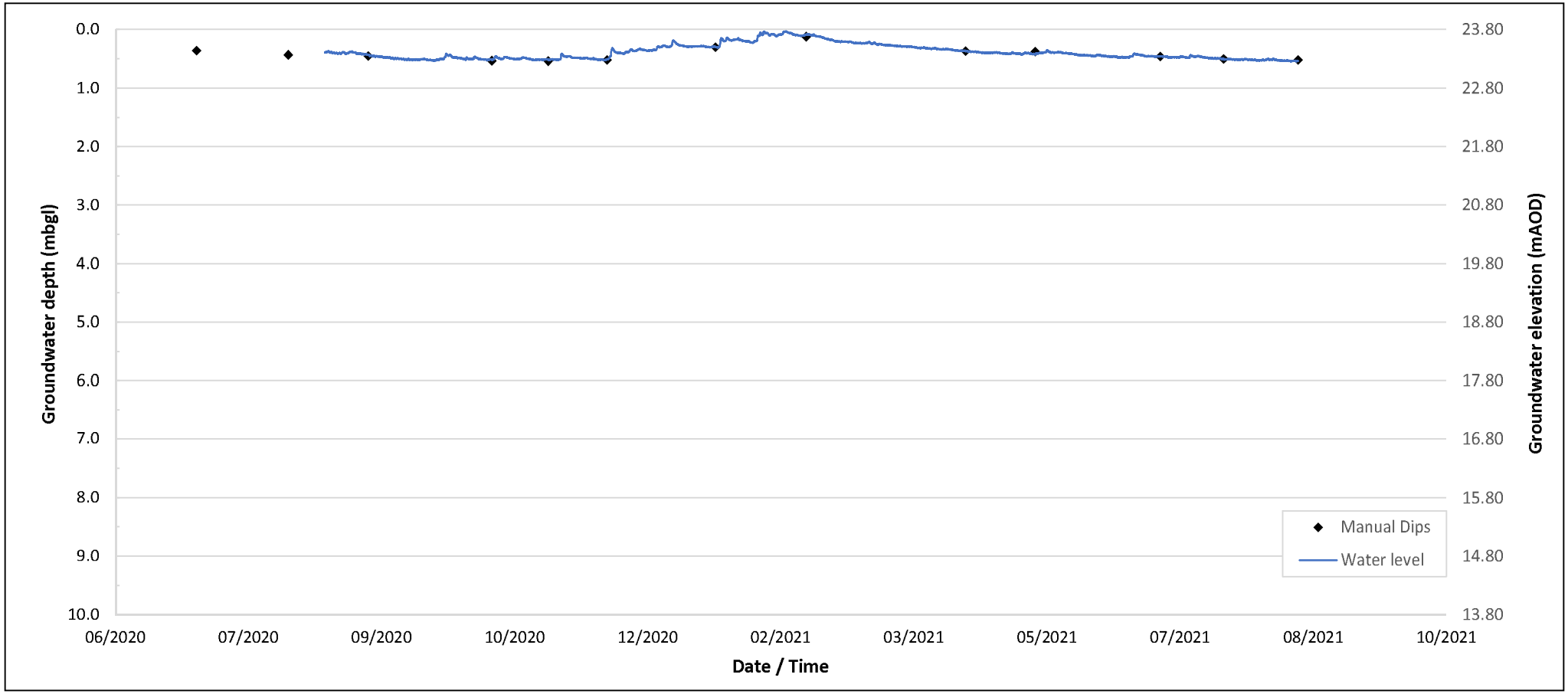
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2060**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ607**	INSTALLATION DATE:	**18/08/2020**	**WELL DETAILS** EASTING (m):	**583840.0**	NORTHING (m):	**216834.0**	ELEVATION (mAOD):	**23.80**
NOMINAL INSTALLATION DEPTH:	**9.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**9.70 mbgl**	TOP OF RESPONSE ZONE:	**2.50 mbgl**		
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Data prior to and including visit on 12/05/2021 calibrated against manual dip of 0.30mbgl on 12/01/2021 09:45hrs, data after visit on 12/05/2021 calibrated against manual dip of 0.46mbgl on 28/06/2021 16:52hrs. Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

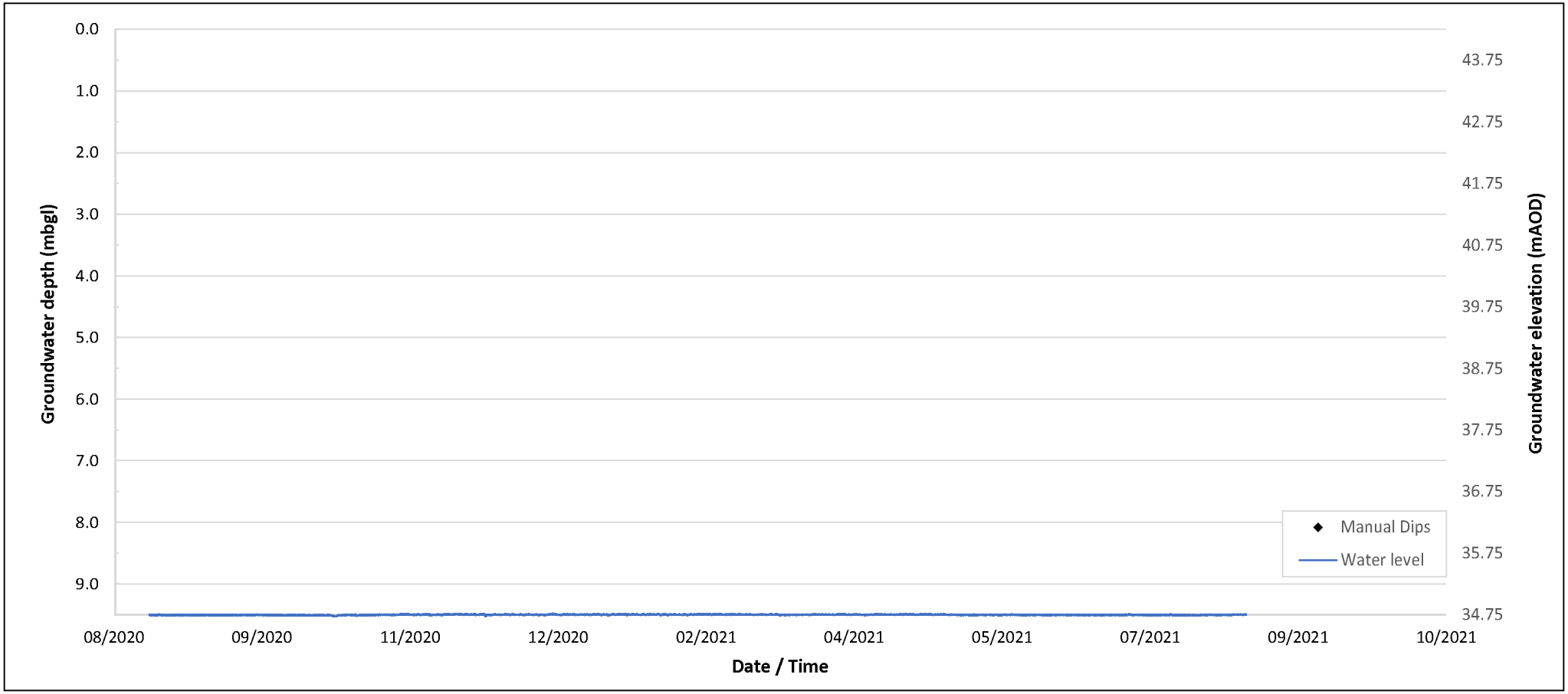
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2069**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ268**	INSTALLATION DATE:	**12/08/2020**	**WELL DETAILS** EASTING (m):	**587725.0**	NORTHING (m):	**218221.0**	ELEVATION (mAOD):	**44.25**
NOMINAL INSTALLATION DEPTH:	**9.50mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**9.50mbgl**	TOP OF RESPONSE ZONE:	**1.50 mbgl**		
CALIBRATION DIP:	**None**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Well recorded as dry during monitoring visits on 23/03/2020, 19/06/2020, 09/07/2020, 06/08/2020, 12/08/2020, 08/09/2020, 26/10/2020, 04/11/2020, 01/12/2020, 19/01/2020,09/02/2021, 24/03/2021, 12/04/2021, 13/05/2021, 29/06/2021, 26/07/2021 and 18/08/2021. Diver removed and monitoring completed 18/08/2021.

CONTRACT	CHECKED
35699	**DM**

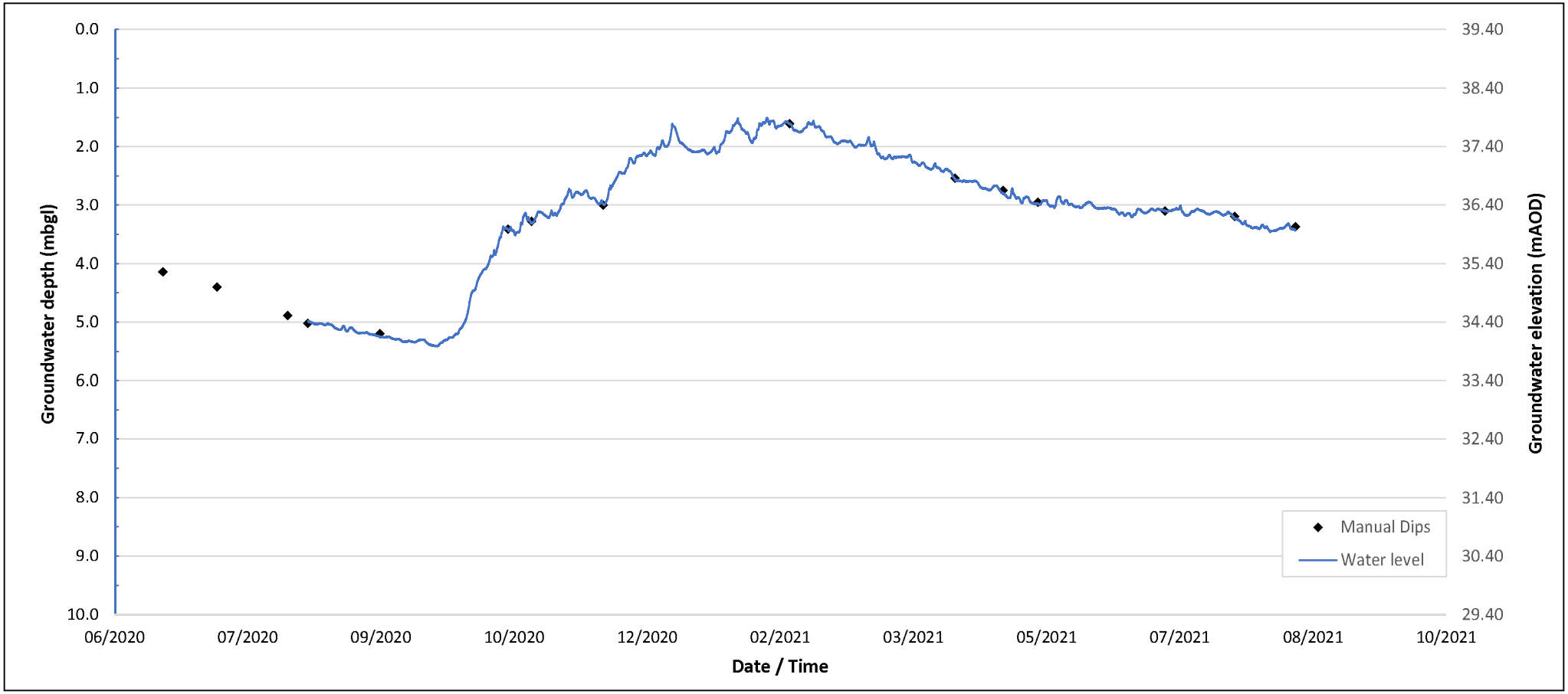
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2071**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ158**	INSTALLATION DATE:	**12/08/2020**	EASTING (m):	**587211.0**	NORTHING (m):	**217721.0**	ELEVATION (mAOD):	**39.40**
NOMINAL INSTALLATION DEPTH:	**8.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
CALIBRATION DIP:	**3.41m bgl on 26/10/2020 15.15hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Data manually corrected to remove step in data during monitoring visit on 09/09/2020. Diver removed and monitoring completed 18/08/2021.

CONTRACT	CHECKED
35699	**DM**

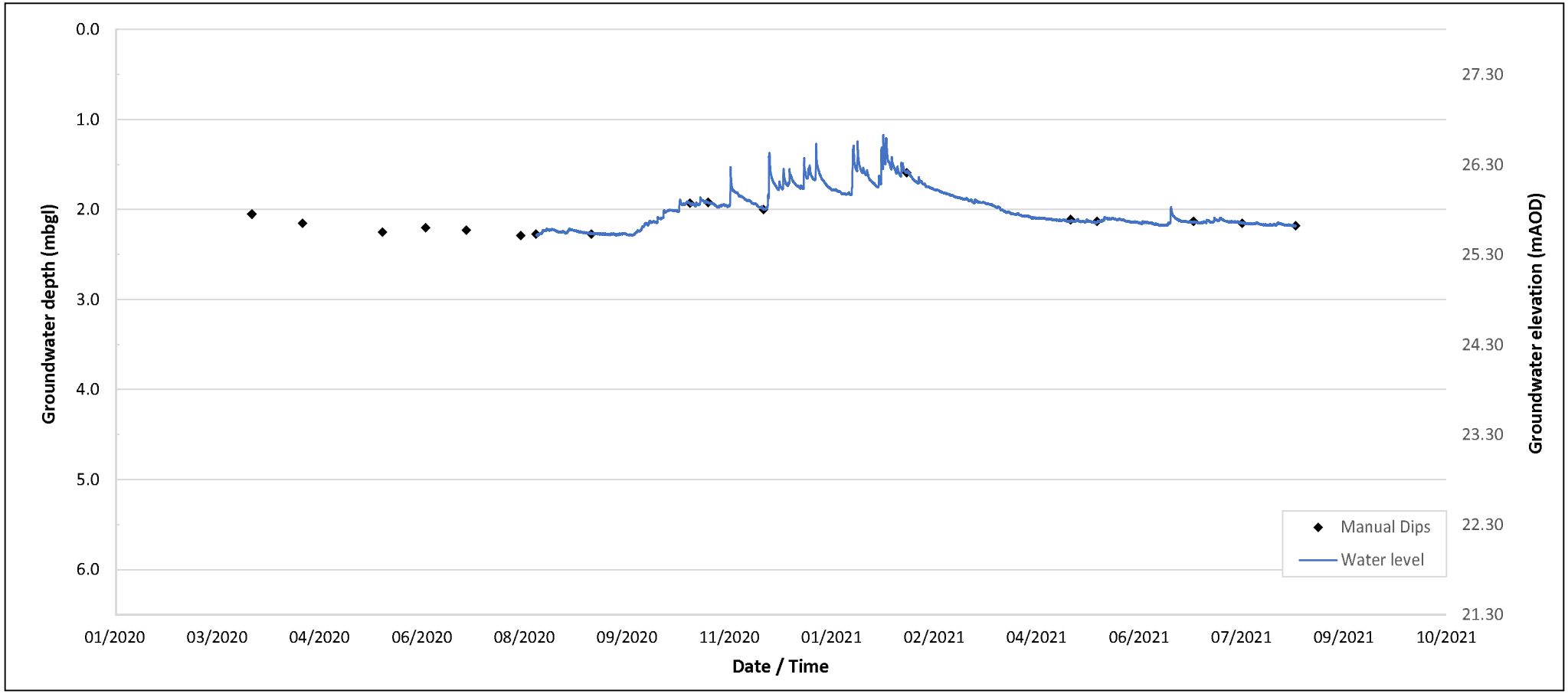
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2073**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ411**	INSTALLATION DATE:	**21/02/2020**	EASTING (m):	**586539.0**	NORTHING (m):	**217817.0**
NOMINAL INSTALLATION DEPTH:	**5.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**6.50 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**
CALIBRATION DIP:	**1.93m bgl on 26/10/2020 14.55hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**6.50 mbgl**

WELL DETAILS

ELEVATION (mAOD): **27.80**

REMARKS

Diver removed and monitoring completed 18/08/2021.

CONTRACT	CHECKED
35699	**DM**

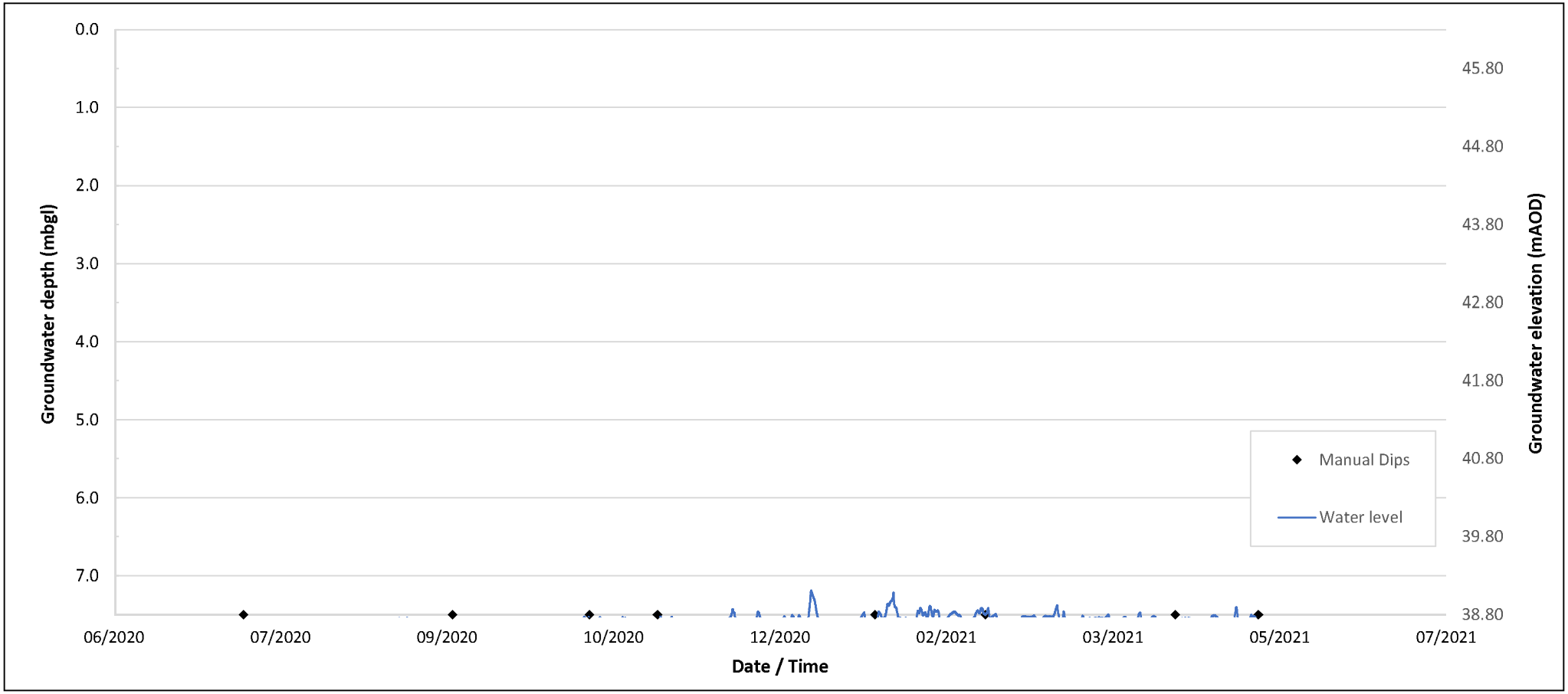
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2085**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ600**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**579351.5**	NORTHING (m):	**212971.0**	ELEVATION (mAOD):	**46.30**
NOMINAL INSTALLATION DEPTH:	**7.5 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**7.50 mbgl**	TOP OF RESPONSE ZONE:	**3.00 mbgl**		
CALIBRATION DIP:	**None**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.50 mbgl**		

WELL DETAILS

REMARKS

Well recorded as dry during monitoring visits on 09/07/2020, 10/09/2020, 21/10/2020, 11/11/2020, 15/01/2021, 17/02/2021, 15/04/2021 & 10/5/2021. No manual correlation of diver data possible - results should be treated with caution. Diver removed and monitoring completed 13/05/2021.

CONTRACT	CHECKED
35699	**DM**

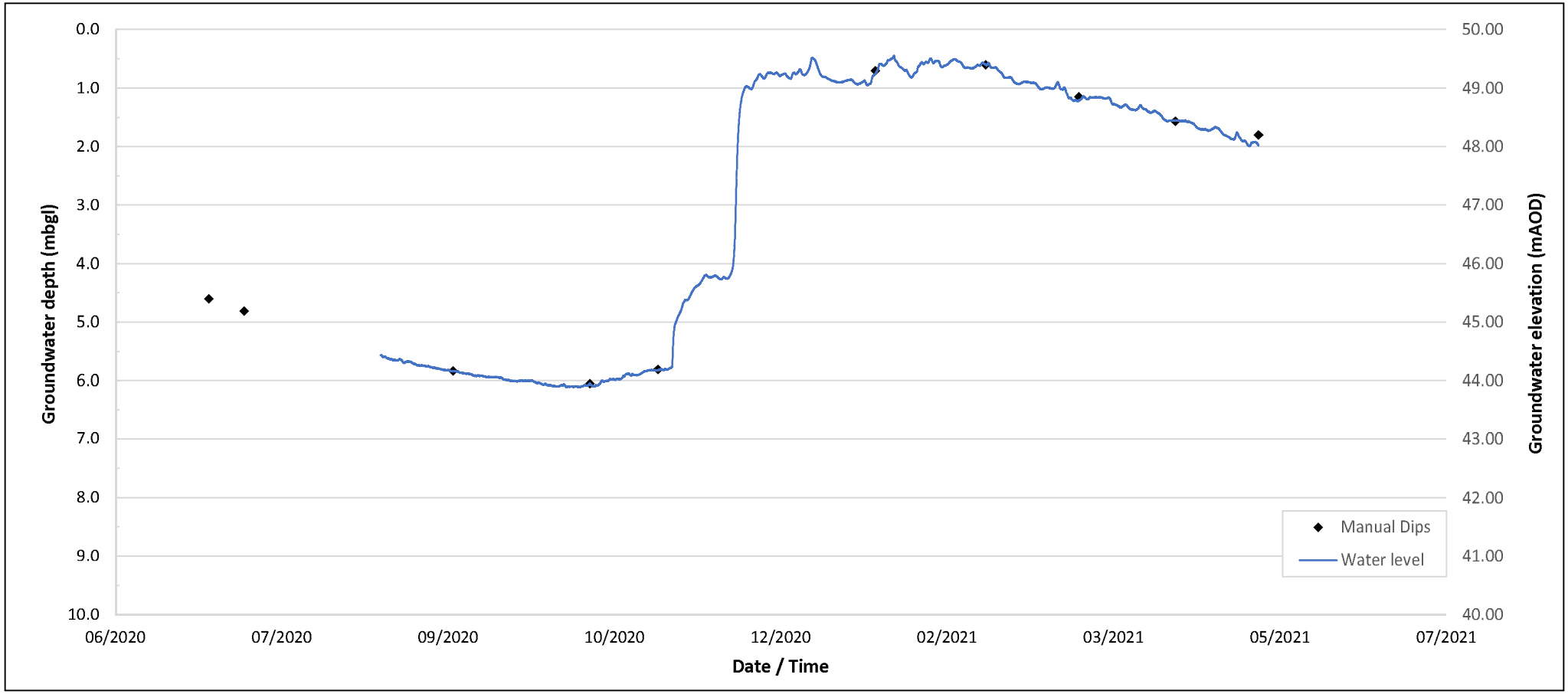
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2087**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ612**	INSTALLATION DATE:	**19/08/2020**	EASTING (m):	**579787.0**	NORTHING (m):	**213082.0**	ELEVATION (mAOD):	**50.00**
NOMINAL INSTALLATION DEPTH:	**9.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:	**4.80 mbgl**		
CALIBRATION DIP:	**6.05 mbgl - 21/10/2020 13:10hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.45 mbgl**		

REMARKS

Diver removed and monitoring completed 12/05/2021.

CONTRACT	CHECKED
35699	**DM**

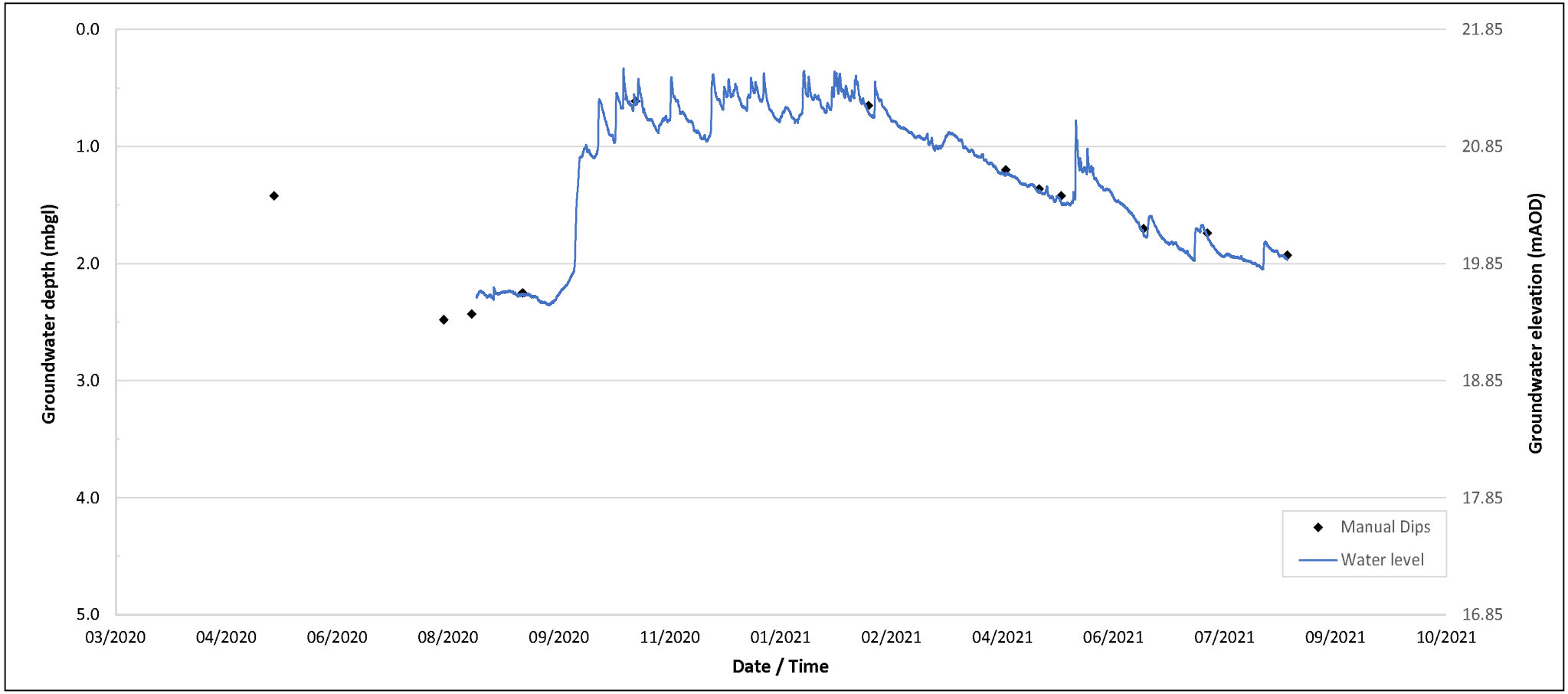
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2090**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ223**	INSTALLATION DATE:	**17/08/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**4.5 mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**578203.5**	NORTHING (m):	**210789.0**	ELEVATION (mAOD):	**21.85**
CALIBRATION DIP:	**0.61m bgl on 30/10/2020 11:19hrs.**			WELL DEPTH:	**5.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00 mbgl**		

REMARKS

Diver removed and monitoring completed 20/08/2021.

CONTRACT	CHECKED
35699	**DM**

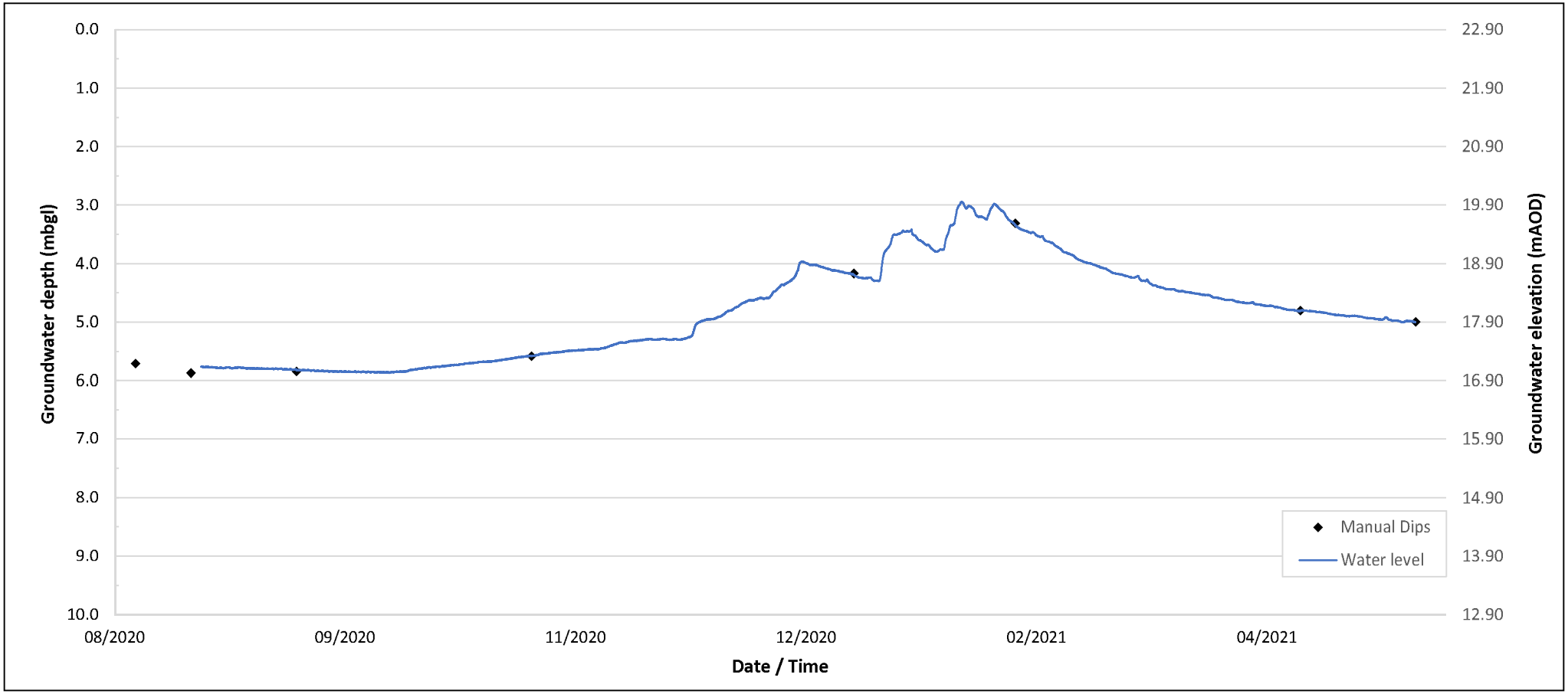
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **BH2092**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ281**	INSTALLATION DATE:	**21/02/2020**
NOMINAL INSTALLATION DEPTH:	**8 mbgl**	RECORDING FREQUENCY	**1 hour**
CALIBRATION DIP:	**5.58m bgl on 30/10/2020 10:30hrs.**		

WELL DETAILS

EASTING (m):	**578137.0**	NORTHING (m):	**210983.5**	ELEVATION (mAOD):	**22.90**
WELL DEPTH:	**10.00 mbgl**	TOP OF RESPONSE ZONE:	**3.00 mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00 mbgl**		

REMARKS

Diver removed and monitoring completed 13/05/2021.

CONTRACT	CHECKED
35699	**DM**

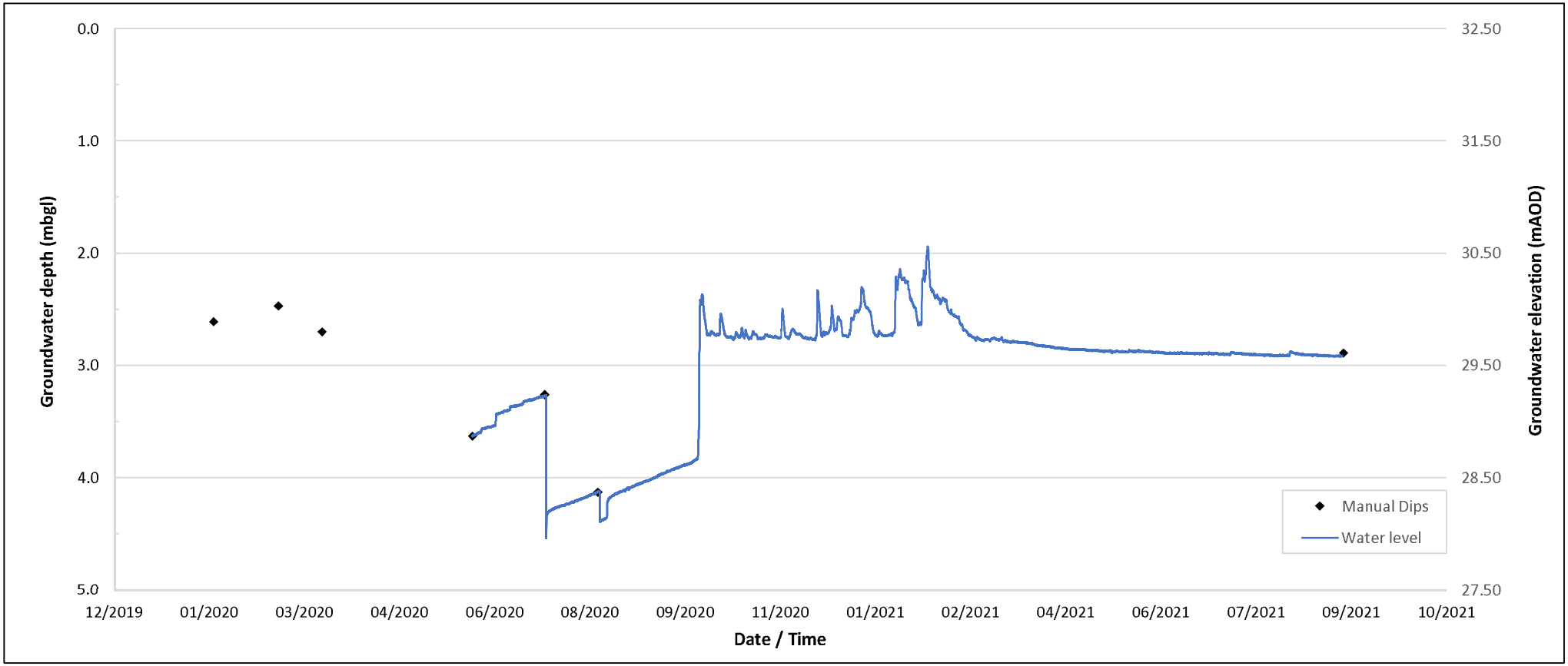
Geotechnical Engineering Limited

WATER LEVELS

CLIENT *COSTAIN*

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **WS1403**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**39803638/BY574**	INSTALLATION DATE:	**05/06/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**4.50 mbgl**	RECORDING FREQUENCY:	**1 hour**	EASTING (m):	**574272.5**	NORTHING (m):	**209649.5**	ELEVATION (mAOD):	**32.50**
CALIBRATION DIP:	**14/07/2020 00:00:00 3.26mbgl.**			WELL DEPTH:	**4.50 mbgl**	TOP OF RESPONSE ZONE:	**0.80 mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.50 mbgl**		

REMARKS

Water sampling visit 14/07/2020. Borehole purged dry 11/08/2020 for water sampling. Sharp increases in data attributed to rainfall. Diver removed and monitoring completed 07/09/2021.

CONTRACT	CHECKED
35699	**DM**

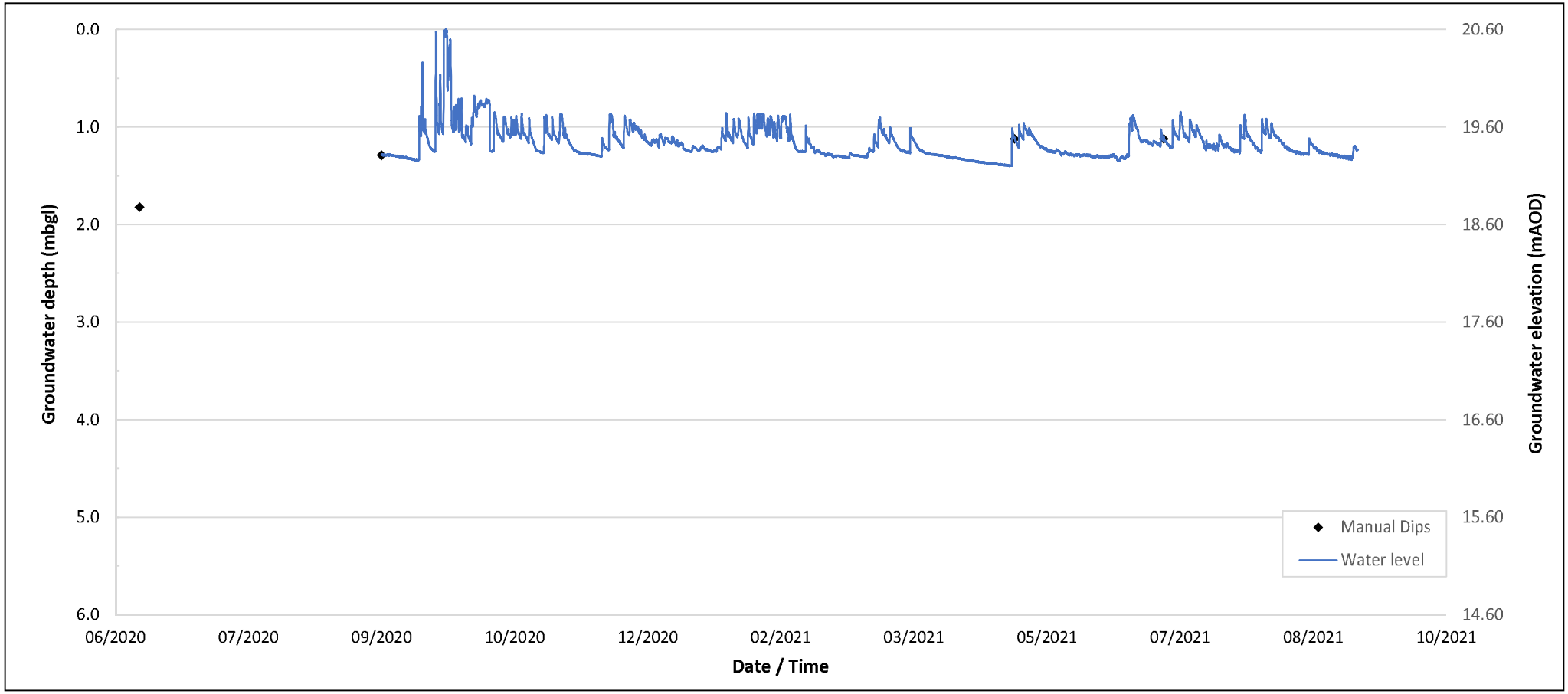
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **WS1434**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ587**	INSTALLATION DATE:	**07/09/2020**	EASTING (m):	**581465.5**	NORTHING (m):	**212933.0**	ELEVATION (mAOD):	**20.60**
NOMINAL INSTALLATION DEPTH:	**5.65 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**6.00 mbgl**	TOP OF RESPONSE ZONE:	**0.80 mbgl**		
CALIBRATION DIP:	**1.12m bgl on 04/05/2021 21:59hrs.**			WELL DATUM:	**0.00 mbgl**	BASE OF RESPONSE ZONE:	**6.45 mbgl**		

REMARKS

Diver removed and monitoring completed 10/09/2021.

CONTRACT	CHECKED
35699	**DM**

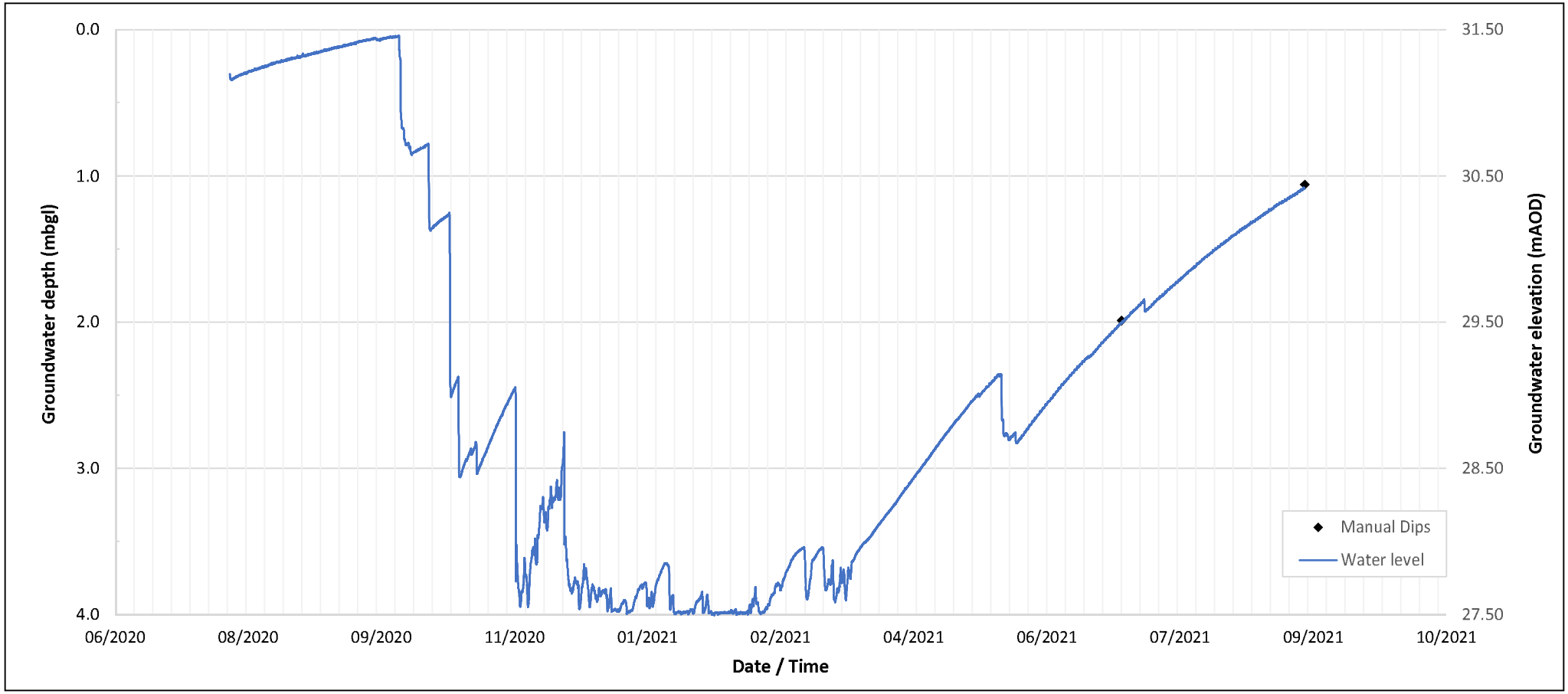
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 1 JUNCTION 19 TO 21 PRELIMINARY GI

BOREHOLE **WS1507**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39744005/BY307** INSTALLATION DATE: **30/07/2020**

NOMINAL INSTALLATION DEPTH: **4.00 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **1.99mbgl on 01/07/2021 01:15**

WELL DETAILS

EASTING (m): **578637.0** NORTHING (m): **211668.0** ELEVATION (mAOD): **31.50**

WELL DEPTH: **4.00 mbgl** TOP OF RESPONSE ZONE: **1.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **4.00 mbgl**

REMARKS

Manual dips indicate well was dry prior to development of hole on 30/07/2020. Diver removed and monitoring completed 07/09/2021.

CONTRACT	CHECKED
35699	**DM**

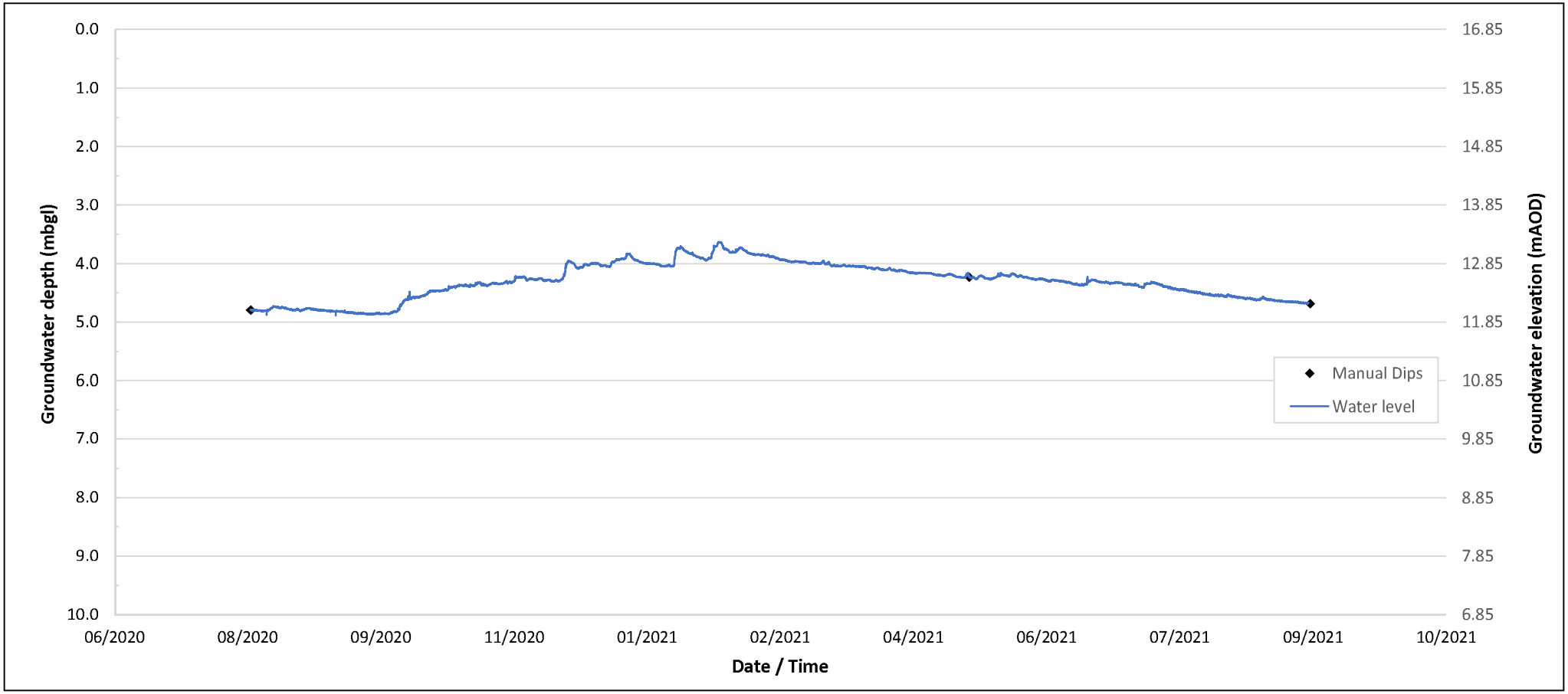
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2201A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39744007/AY452** INSTALLATION DATE: **08/08/2020**

NOMINAL INSTALLATION DEPTH: **9.20 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **08/08/2020 00:03:00 4.975mbgl.**

WELL DETAILS

EASTING (m): **582859.0** NORTHING (m): **213761.0** ELEVATION (mAOD): **16.85**

WELL DEPTH: **9.50 mbgl** TOP OF RESPONSE ZONE: **6.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **10.00 mbgl**

REMARKS

Diver data omitted 13/08/2020 23:00:00 to 14/08/2020 01:00:00 and 08/09/2020 13:00:00 to 23:00:00 (diver rebooted). Diver removed and monitoring completed 09/09/2021.

CONTRACT	CHECKED
35699	**DM**

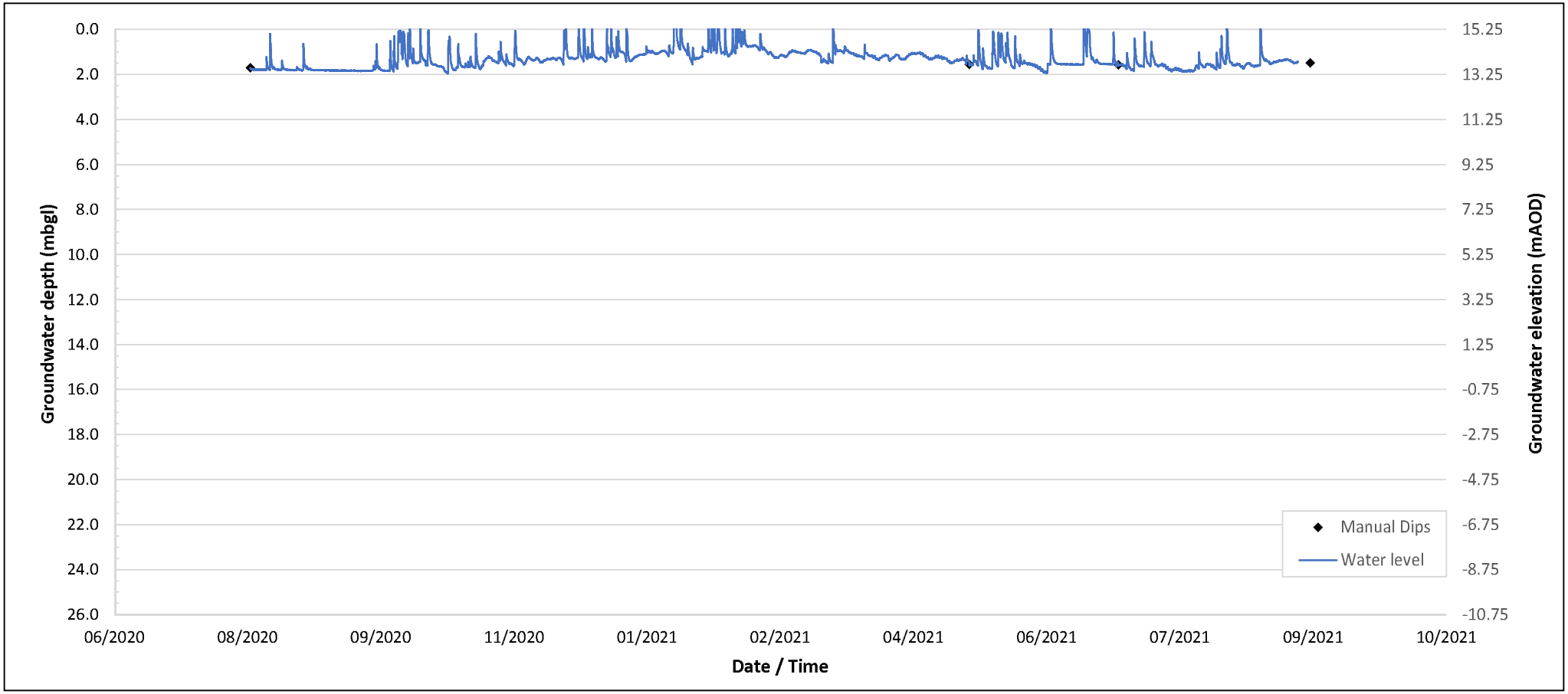
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2203**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40029514/DA051** INSTALLATION DATE: **07/08/2020**

NOMINAL INSTALLATION DEPTH: **24.80 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **04/05/2021 22:00:00 1.54mbgl.**

WELL DETAILS

EASTING (m): **582981.5** NORTHING (m): **214772.0** ELEVATION (mAOD): **15.25**

WELL DEPTH: **26.00 mbgl** TOP OF RESPONSE ZONE: **9.90 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **26.00 mbgl**

REMARKS

Diver removed and monitoring completed 09/09/2021.

CONTRACT	CHECKED
35699	**DM**

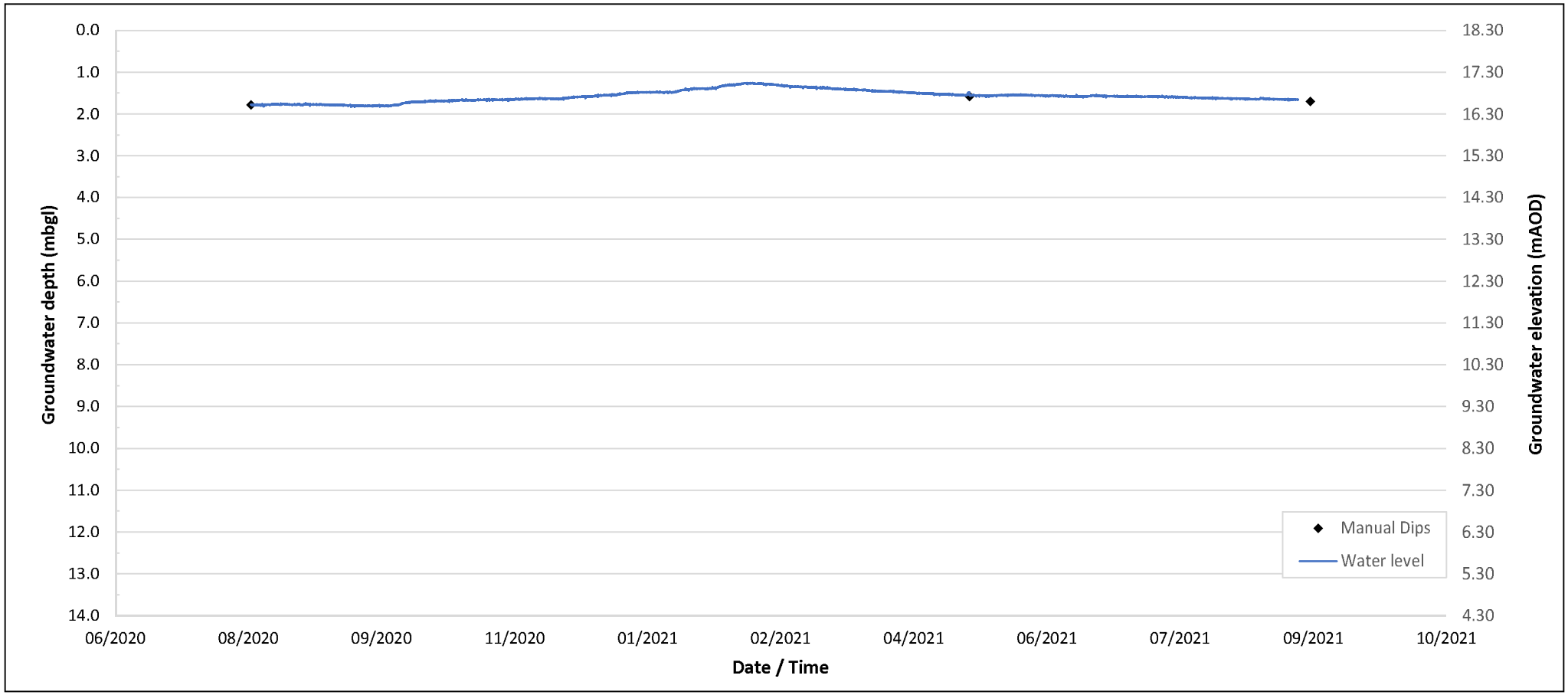
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC2205A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40029530/BZ602** INSTALLATION DATE: **07/08/2020**

NOMINAL INSTALLATION DEPTH: **10.50 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **04/05/2021 21:47:00 1.58mbgl.**

WELL DETAILS

EASTING (m): **583019.0** NORTHING (m): **215499.5** ELEVATION (mAOD): **18.30**

WELL DEPTH: **14.00 mbgl** TOP OF RESPONSE ZONE: **5.90 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **14.50 mbgl**

REMARKS

Diver removed and monitoring completed 09/09/2021.

CONTRACT	CHECKED
35699	**DM**

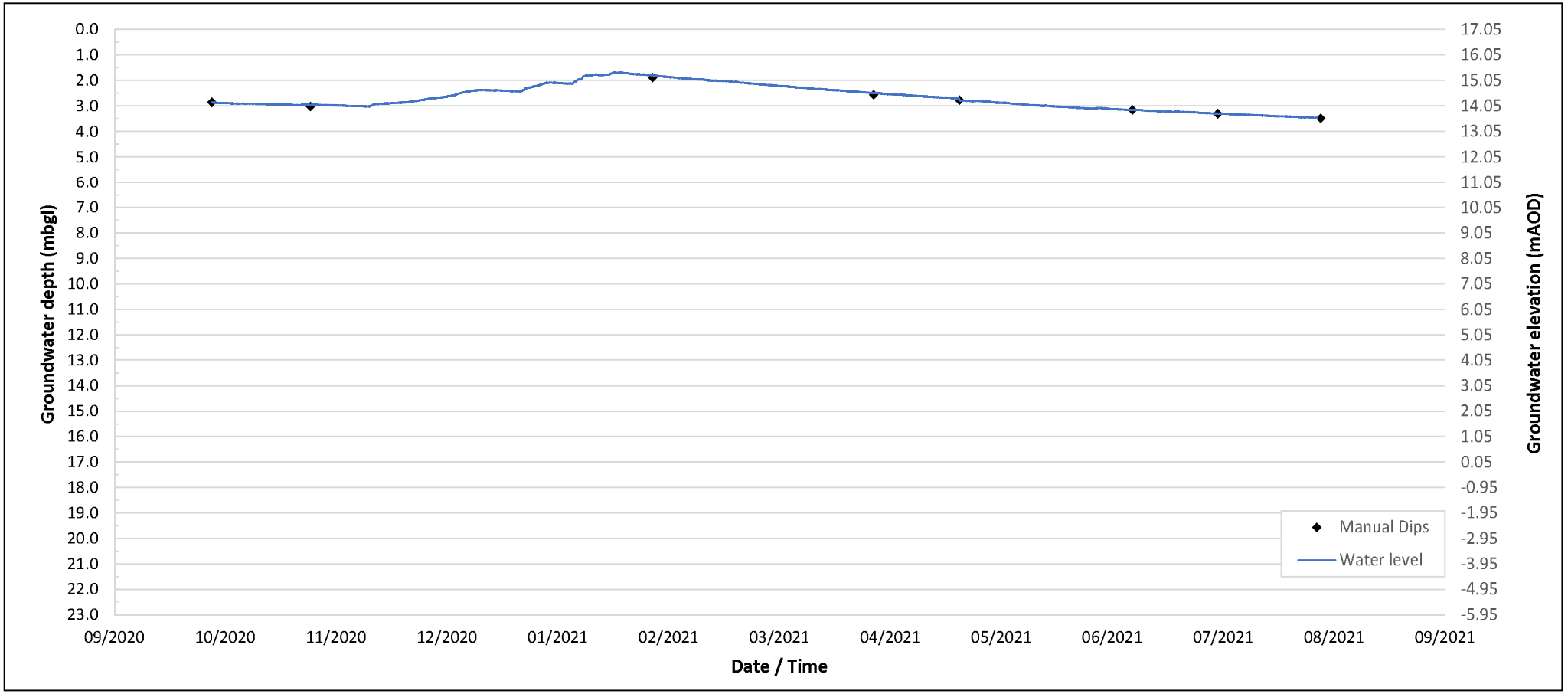
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2260**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ615**	INSTALLATION DATE:	**22/10/2020**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**10.00mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**584042.5**	NORTHING (m):	**216287.0**	ELEVATION (mAOD):	**17.05**
CALIBRATION DIP:	**See below.**			WELL DEPTH:	**23.00 mbgl**	TOP OF RESPONSE ZONE:	**3.00 mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**30.00 mbgl**		

REMARKS

Data prior to and including visit on 12/05/2021 calibrated against manual dip of 2.86mbgl on 22/10/2020 09:10hrs, data after visit on 12/05/2021 calibrated against manual dip of 3.16mbgl on 28/06/2021 13:23hrs.

CONTRACT	CHECKED
35699	**DM**

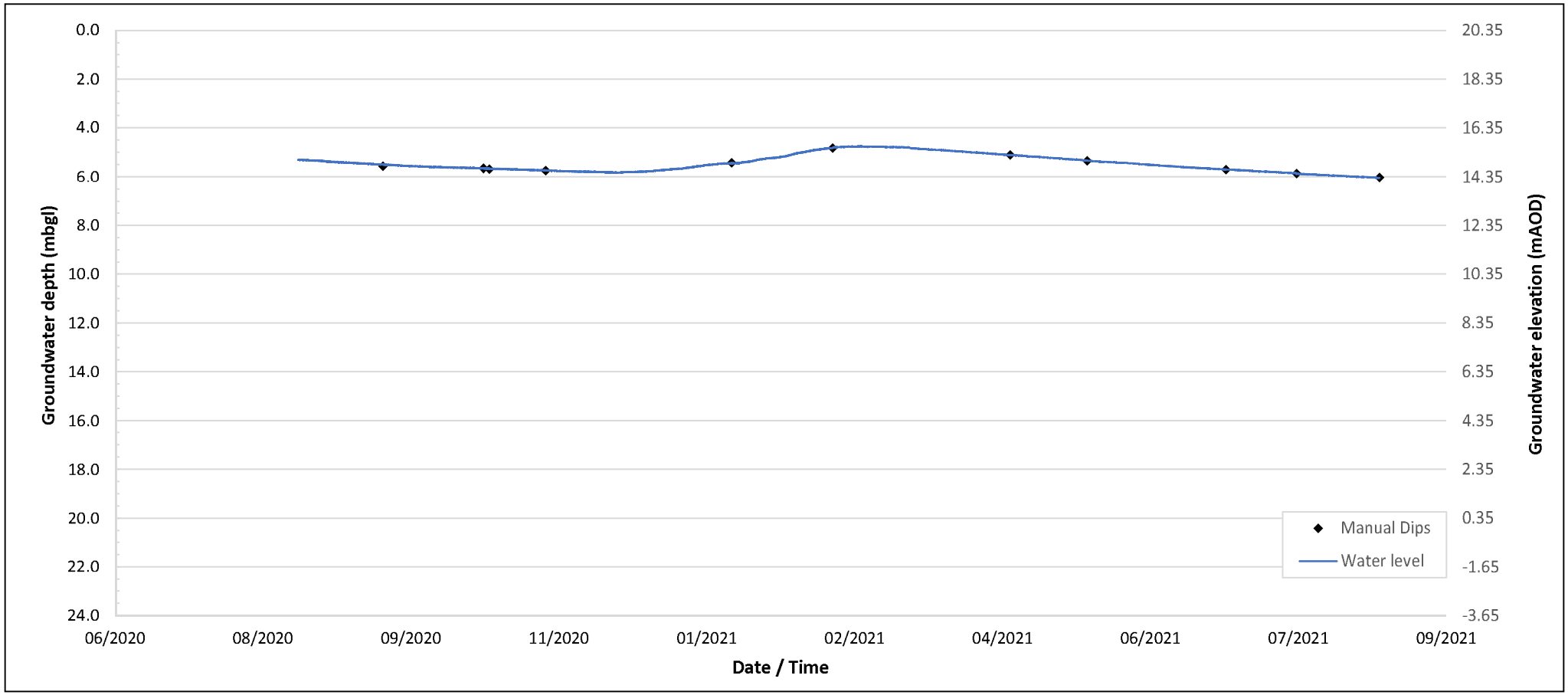
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2261**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ616**	INSTALLATION DATE:	**18/08/2020**	EASTING (m):	**584061.5**	NORTHING (m):	**216366.0**	ELEVATION (mAOD):	**20.35**
NOMINAL INSTALLATION DEPTH:	**10.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**24.00 mbgl**	TOP OF RESPONSE ZONE:	**18.00 mbgl**		
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**24.00 mbgl**		

WELL DETAILS

REMARKS

Data prior to and including visit on 12/05/2021 calibrated against manual dip of 5.75mbgl on 10/11/2020 10:52hrs, data after visit on 12/05/2021 calibrated against manual dip of 5.71mbgl on 28/06/2021 13:31hrs. Diver removed and monitoring completed 19/08/2021.

CONTRACT	CHECKED
35699	**DM**

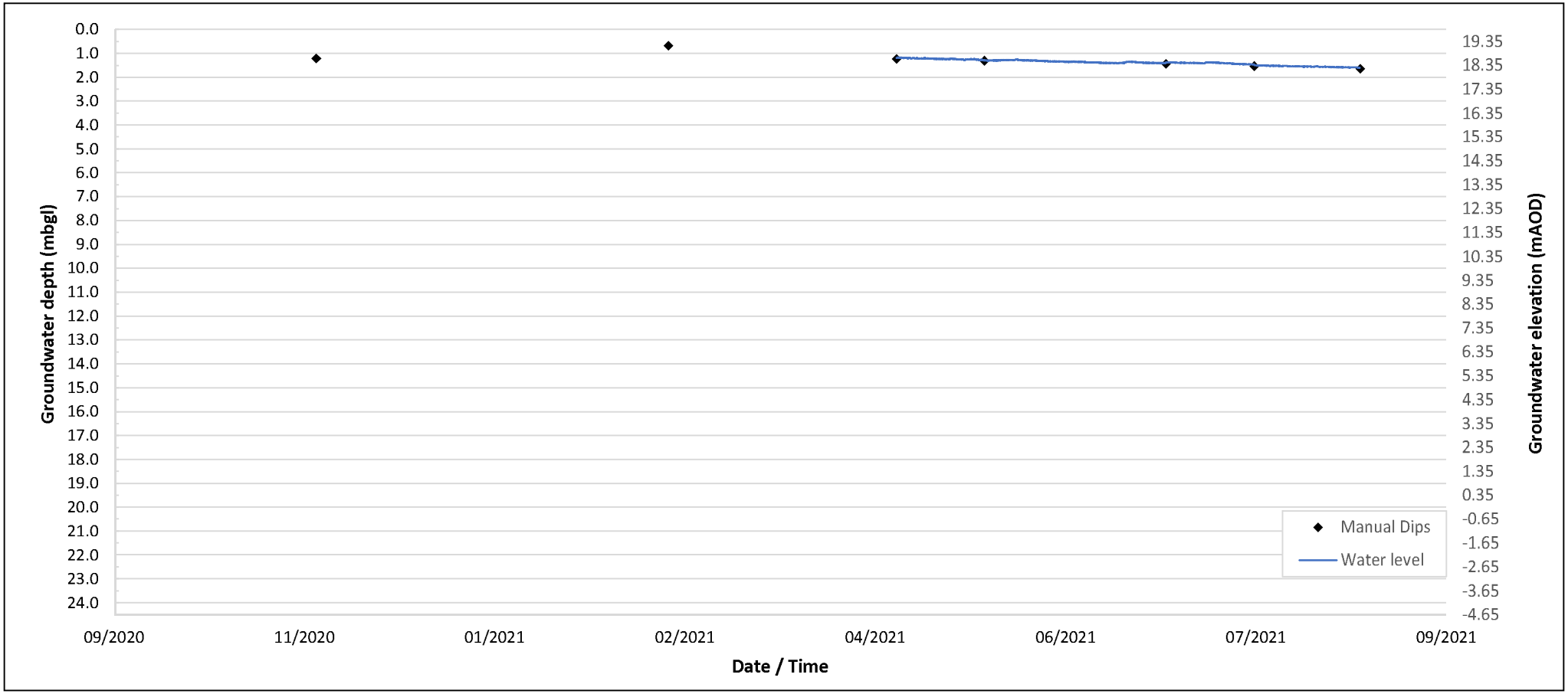
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2264**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AY890**	INSTALLATION DATE:	**03/09/2020**	EASTING (m):	**584271.5**	NORTHING (m):	**216684.5**	ELEVATION (mAOD):	**19.85**
NOMINAL INSTALLATION DEPTH:	**8.20mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**24.50 mbgl**	TOP OF RESPONSE ZONE:	**6.00 mbgl**		
CALIBRATION DIP:	**1.30m bgl on 12/05/2021 14:37hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**25.00 mbgl**		

REMARKS

Due to problems with the previously installed datalogger, data collected prior to 19/04/2021 has not been presented.

CONTRACT	CHECKED
35699	**DM**

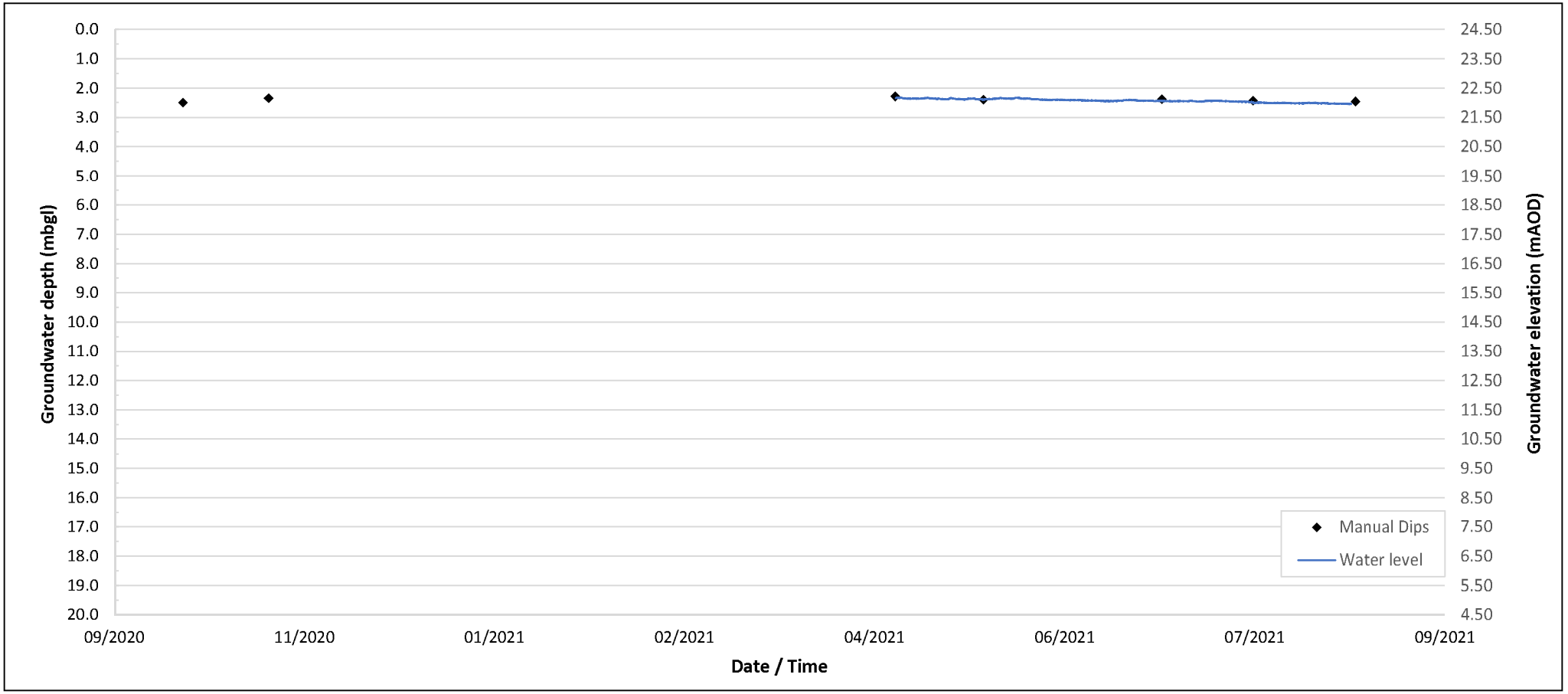
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2266**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ578**	INSTALLATION DATE:	**14/10/2020**	EASTING (m):	**584407.5**	NORTHING (m):	**216878.5**	ELEVATION (mAOD):	**24.50**
NOMINAL INSTALLATION DEPTH:	**10.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**37.00 mbgl**	TOP OF RESPONSE ZONE:	**7.00 mbgl**		
CALIBRATION DIP:	**2.40m bgl on 12/05/2021 14:53hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**37.00 mbgl**		

REMARKS

Due to problems with the previously installed datalogger, data collected prior to 19/04/2021 has not been presented.

CONTRACT	CHECKED
35699	**DM**

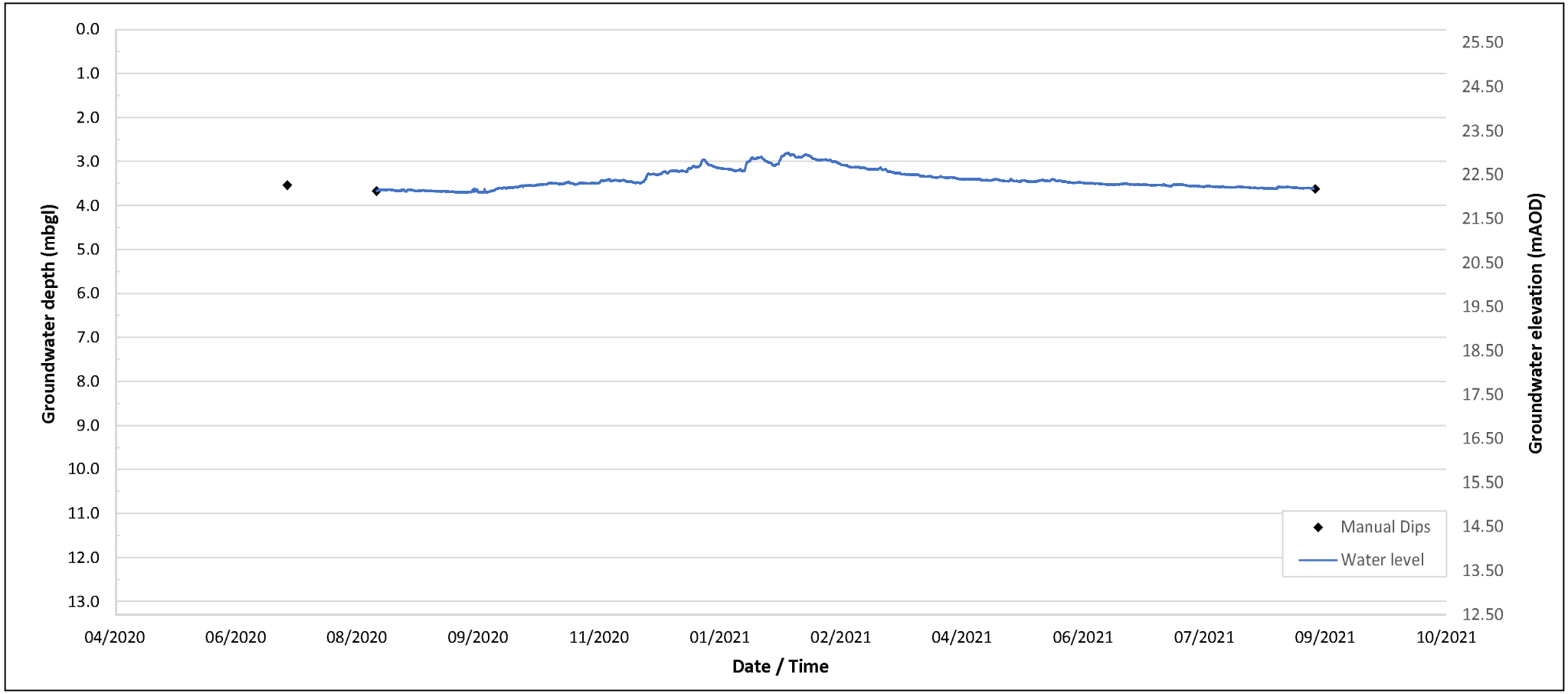
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2269**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40029535/DA041** INSTALLATION DATE: **14/08/2020**

NOMINAL INSTALLATION DEPTH: **10.70mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **14/08/2020 23:46:00 3.67mbgl.**

WELL DETAILS

EASTING (m): **584770.0** NORTHING (m): **217245.0** ELEVATION (mAOD): **25.80**

WELL DEPTH: **13.30 mbgl** TOP OF RESPONSE ZONE: **9.50 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **13.30 mbgl**

REMARKS

Diver removed and monitoring completed 06/09/2021.

CONTRACT	CHECKED
35699	**DM**

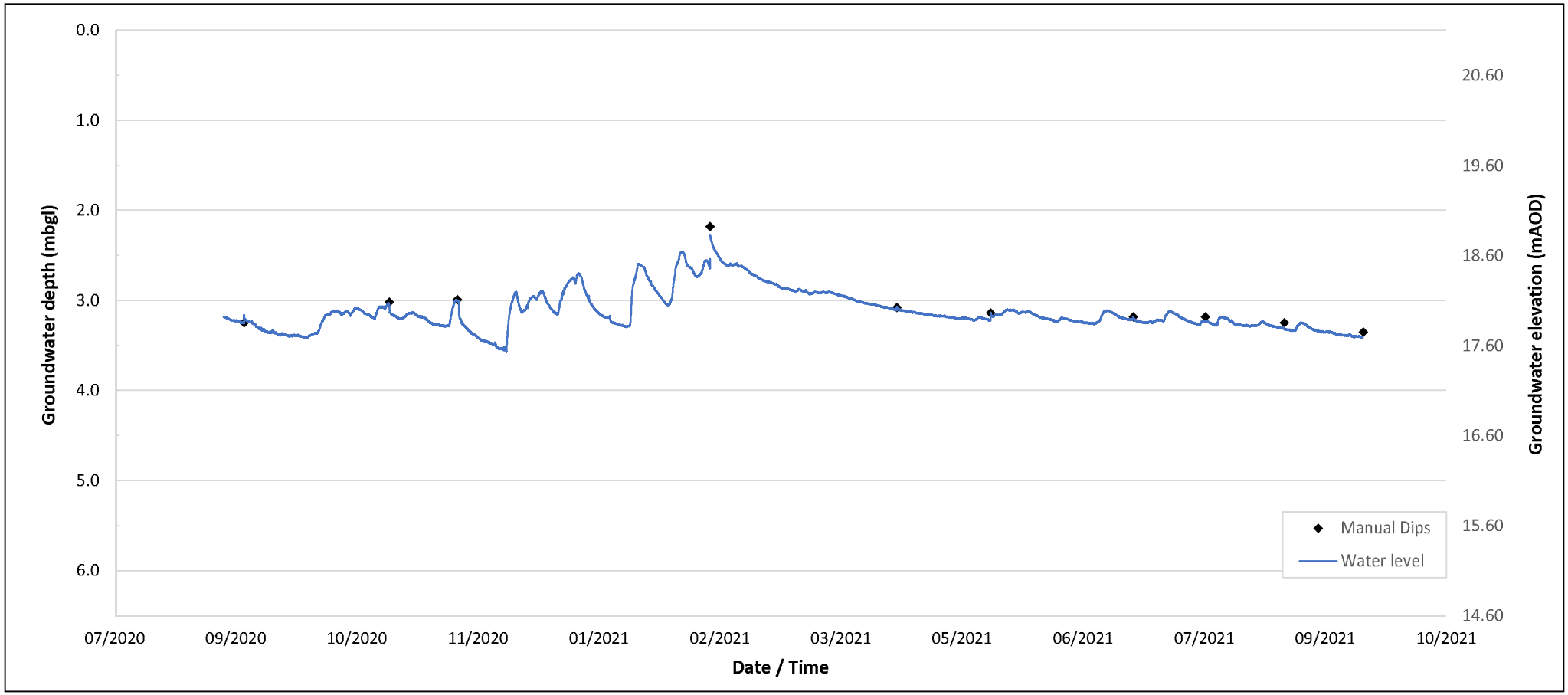
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2272A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ605**	INSTALLATION DATE:	**01/09/2020**	EASTING (m):	**585340.0**	NORTHING (m):	**217586.5**
NOMINAL INSTALLATION DEPTH:	**6.50 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**6.50 mbgl**	TOP OF RESPONSE ZONE:	**4.90 mbgl**
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**6.60 mbgl**

WELL DETAILS ELEVATION (mAOD): **21.10**

REMARKS

Data prior to visit on 09/02/2021 is calibrated to manual dip of 3.25mbgl on 08/09/2020 at 11:53. Data after and including visit on 09/02/2021 is calibrated to manual dip of 3.14mbgl on 13/05/2021 at 09:34. Diver removed and monitoring completed 13/09/2021.

CONTRACT	CHECKED
35699	**DM**

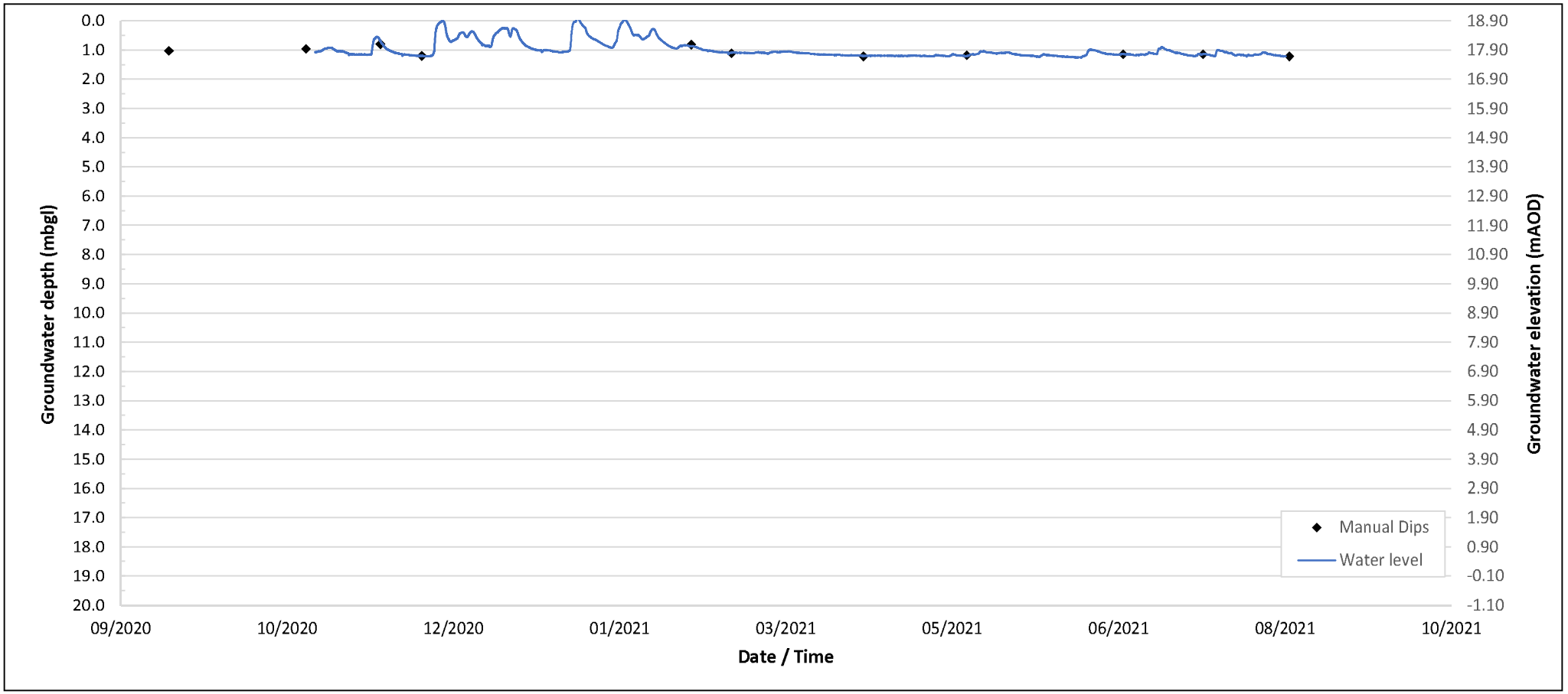
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2273**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **BZ579** INSTALLATION DATE: **29/10/2020**

NOMINAL INSTALLATION DEPTH: **9.80mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **1.20m bgl on 30/11/2020 11:30hrs**

WELL DETAILS

EASTING (m): **585596.5** NORTHING (m): **217656.0** ELEVATION (mAOD): **18.90**

WELL DEPTH: **20.00 mbgl** TOP OF RESPONSE ZONE: **7.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **20.00 mbgl**

REMARKS

CONTRACT	CHECKED
35699	**DM**

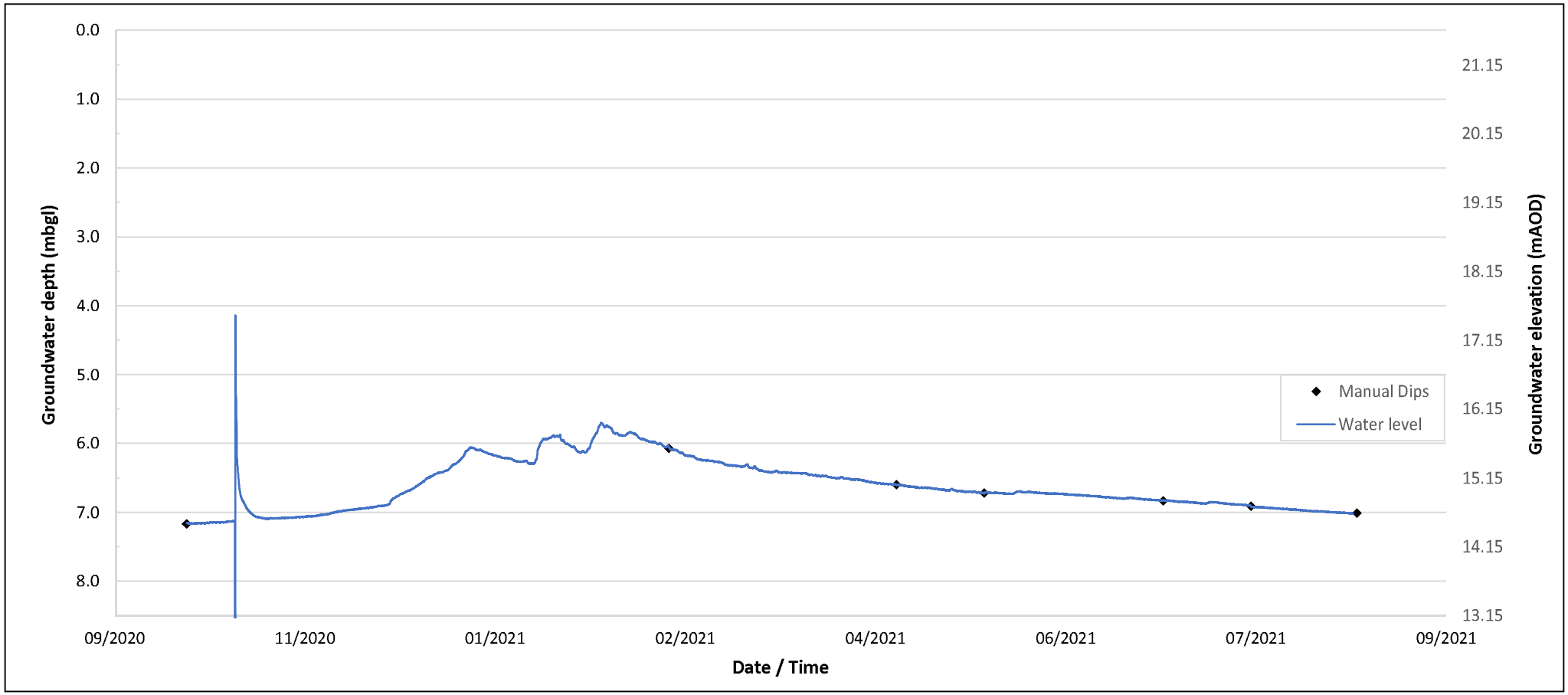
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2620**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ596**	INSTALLATION DATE:	**14/10/2020**	EASTING (m):	**583037.0**	NORTHING (m):	**215273.0**	ELEVATION (mAOD):	**21.65**
NOMINAL INSTALLATION DEPTH:	**8.25 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**8.5 mbgl**	TOP OF RESPONSE ZONE:	**6.00 mbgl**		
CALIBRATION DIP:	**6.60m bgl on 19/04/2021 11:12hrs**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**9.00 mbgl**		

REMARKS

Data prior to and including visit on 12/05/2021 calibrated against manual dip 19/04/2021 11:12hrs, data after visit on 12/05/2021 calibrated against manual dip 28/06/2021 12:35hrs. Permeability testing undertaken on 27/10/2020.

CONTRACT	CHECKED
35699	**DM**

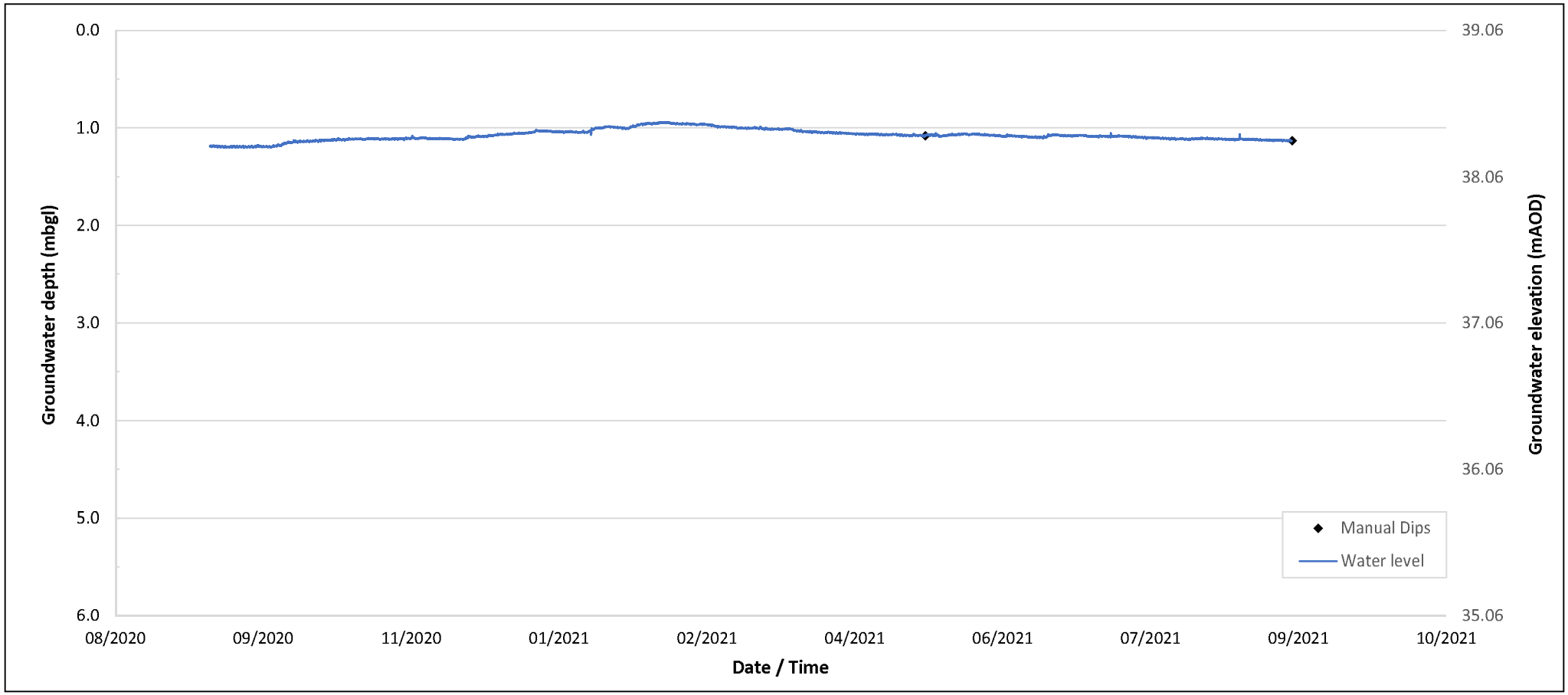
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2640**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **BZ627** INSTALLATION DATE: **07/09/2020**

NOMINAL INSTALLATION DEPTH: **5.50 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **1.08m bgl on 07/05/2021 23:11hrs.**

WELL DETAILS

EASTING (m): **582987.0** NORTHING (m): **215361.0** ELEVATION (mAOD): **17.60**

WELL DEPTH: **6.00 mbgl** TOP OF RESPONSE ZONE: **4.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **6.50 mbgl**

REMARKS Due to modem signal issues, no data transmitted to Online portal; all data compensated against Offline barometer. Data prior to 12/05/2021 calibrated against manual dip of 1.08mbgl on 07/05/2021 23:11hrs; data after 12/05/2021 calibrated against manual dip of 1.13mbgl on 08/09/2021 22:50hrs. Diver removed and monitoring completed 08/09/2021.

CONTRACT	CHECKED
35699	DM

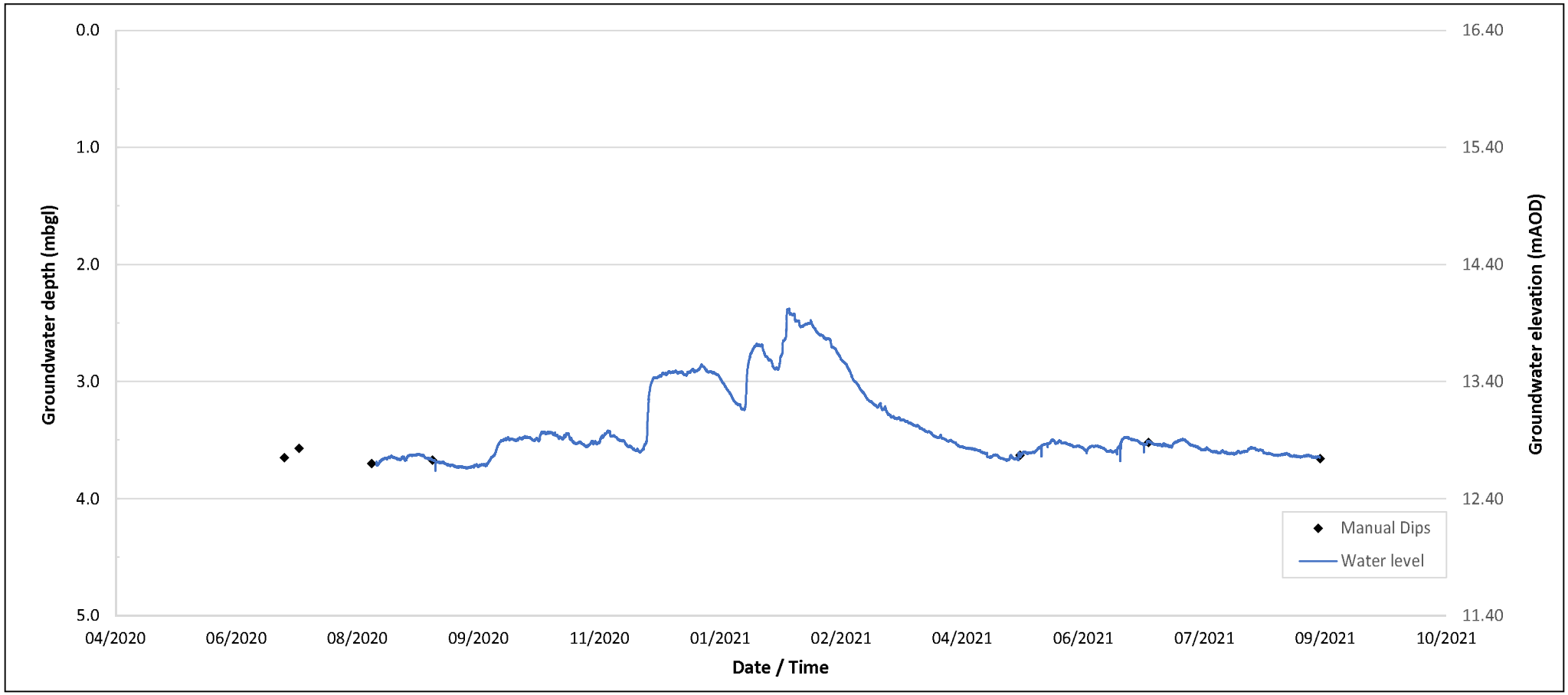
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH+RC2676**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40029511/AY359** INSTALLATION DATE: **14/08/2020**

NOMINAL INSTALLATION DEPTH: **5.00 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **07/05/2021 22:35:00 3.63mbgl.**

WELL DETAILS

EASTING (m): **582900.0** NORTHING (m): **213929.0** ELEVATION (mAOD): **16.40**

WELL DEPTH: **5.20 mbgl** TOP OF RESPONSE ZONE: **2.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **5.70 mbgl**

REMARKS

Due to modem signal issues, data after 29/06/2021 10:00 compensated against Offline barometer. Data prior to 29/06/2021 calibrated against manual dip of 3.63mbgl on 07/05/2021 22:35hrs; data after 29/06/2021 calibrated against manual dip of 3.66mbgl on 08/09/2021 21:56hrs. Diver removed and monitoring completed 08/09/2021.

CONTRACT	CHECKED
35699	**DM**

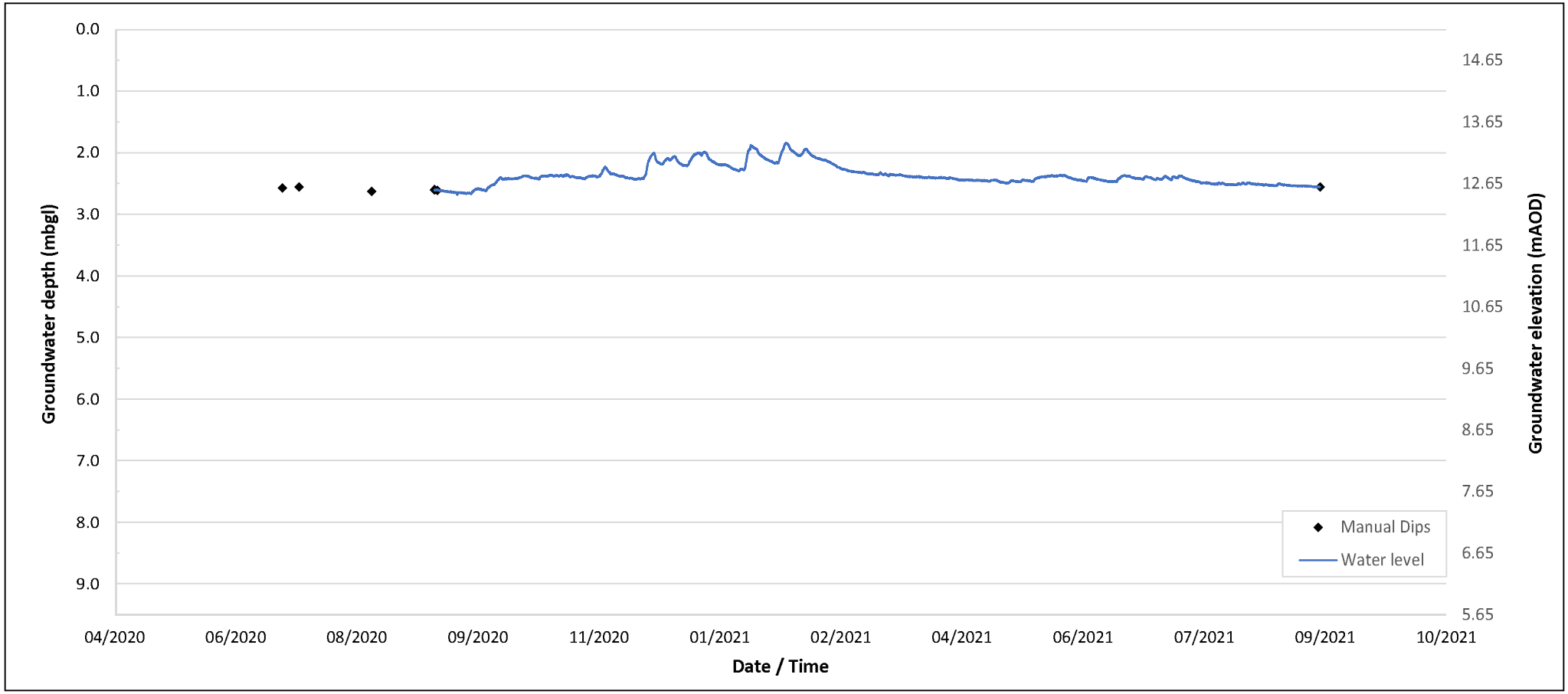
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH2603**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**40315122/BZ597**	INSTALLATION DATE:	**07/09/2020**	EASTING (m):	**582936.0**	NORTHING (m):	**214359.0**
NOMINAL INSTALLATION DEPTH:	**8.80 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**9.50 mbgl**	TOP OF RESPONSE ZONE:	**2.50 mbgl**
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.45 mbgl**

WELL DETAILS ELEVATION (mAOD): **15.15**

REMARKS

Installation cover damaged prior to completion of monitoring (suspected 09/04/2021). Data prior to 26/04/2021 calibrated against manual dip of 2.63mbgl on 12/08/2020 22:25hrs; data after 26/04/2021 calibrated against manual dip of 2.56mbgl on 08/09/2021 22:20hrs. Diver removed and monitoring completed 08/09/2021.

CONTRACT	CHECKED
35699	**DM**

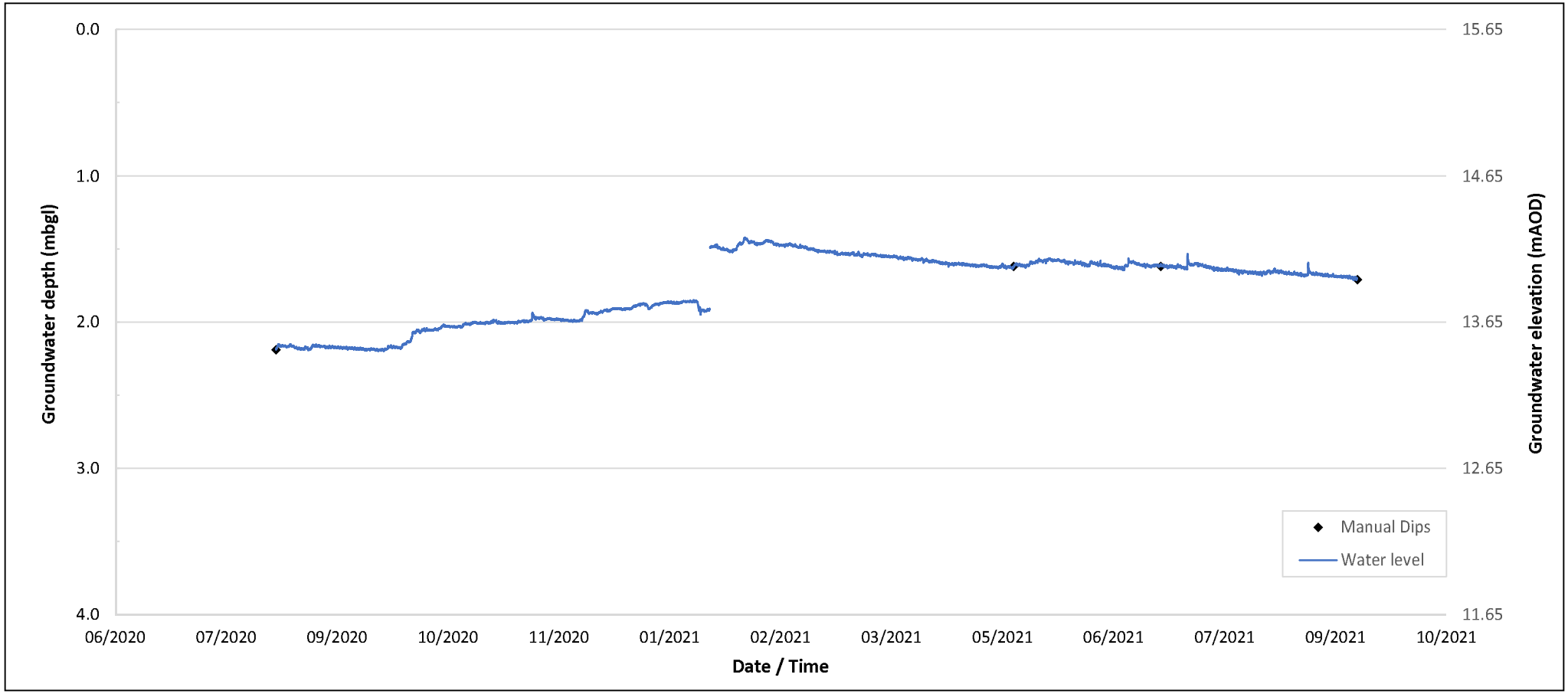
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH2604**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**39381343/BZ604**	INSTALLATION DATE:	**14/08/2020**	EASTING (m):	**582969.0**	NORTHING (m):	**214961.0**
NOMINAL INSTALLATION DEPTH:	**3.40 mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.00 mbgl**	TOP OF RESPONSE ZONE:	**1.00 mbgl**
CALIBRATION DIP:	**07/05/2021 23:59:00 1.62mbgl.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.50 mbgl**

REMARKS No data has been transmitted to the online portal since 18/01/2021 08:00; suspected cause is issues with the diver modem. Data up to 18/01/2021 08:00 is calibrated to manual dip at time of installation of 2.19mbgl. Data after 18/01/2021 08:00 is calibrated to manual dip of 1.62mbgl on 07/05/2021 at 23:59. Diver removed and monitoring completed 08/09/2021.	CONTRACT **35699**	CHECKED **DM**

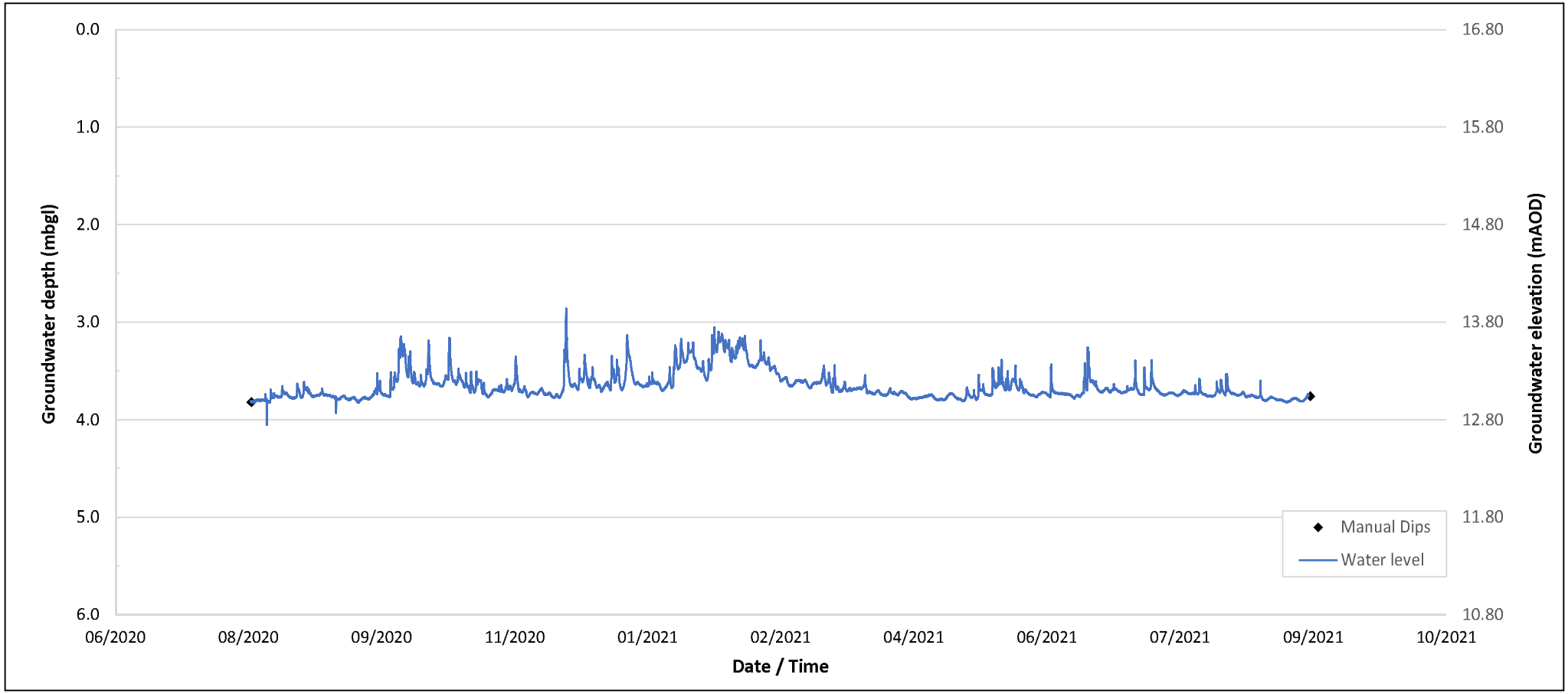
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 2 JUNCTION 21 TO 23 PRELIMINARY GI

BOREHOLE **BH2674**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40029510/BZ592** INSTALLATION DATE: **07/08/2020**

NOMINAL INSTALLATION DEPTH: **5.50 mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **07/08/2020 23:50:00 3.82mbgl.**

WELL DETAILS

EASTING (m): **582895.0** NORTHING (m): **213844.5** ELEVATION (mAOD): **16.80**

WELL DEPTH: **6.00 mbgl** TOP OF RESPONSE ZONE: **3.00 mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **6.50 mbgl**

REMARKS

Diver removed and monitoring completed 09/09/2021.

CONTRACT	CHECKED
35699	**DM**

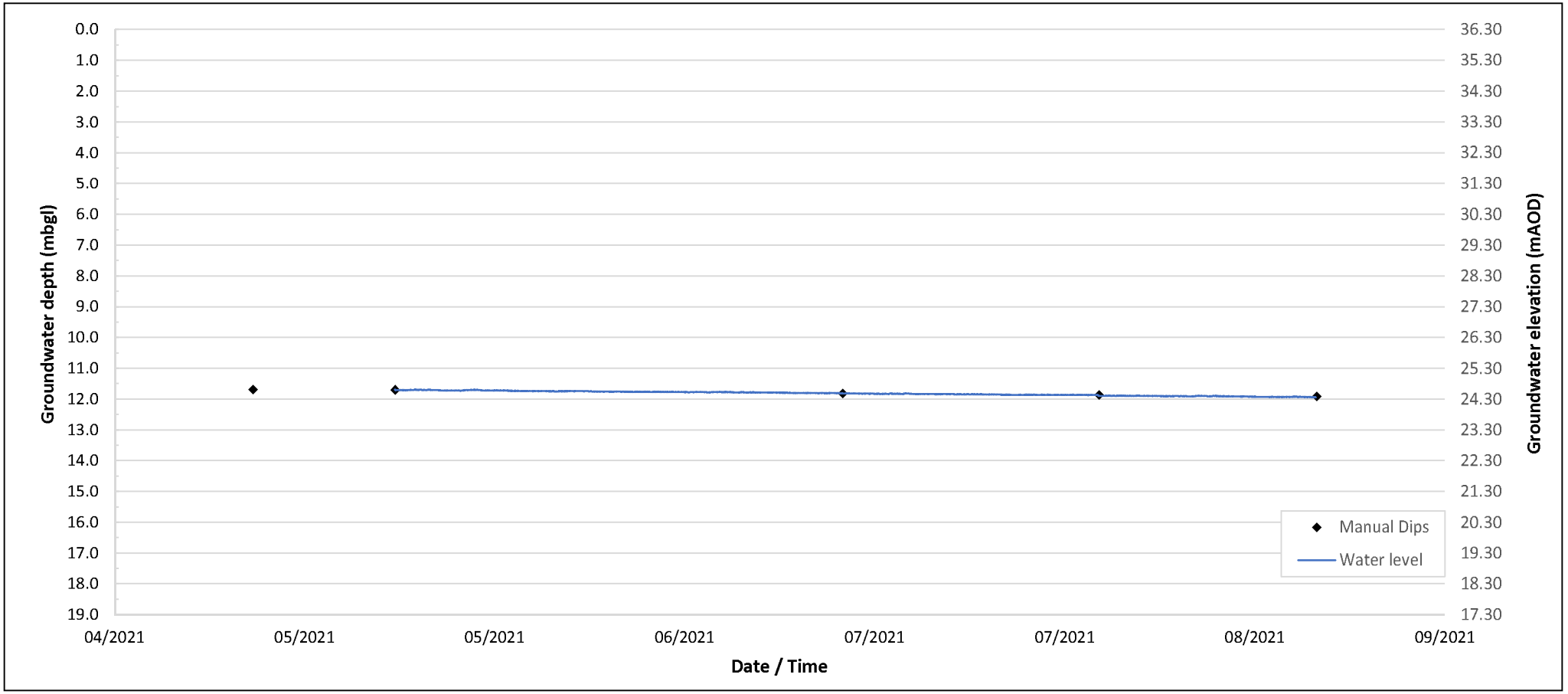
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3202**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ600**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**586939.0**	NORTHING (m):	**218198.5**	ELEVATION (mAOD):	**36.30**
NOMINAL INSTALLATION DEPTH:	**15.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**19.00mbgl**	TOP OF RESPONSE ZONE:	**5.40mbgl**		
CALIBRATION DIP:	**11.70mbgl on 13/05/2021 12:19**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**19.10mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

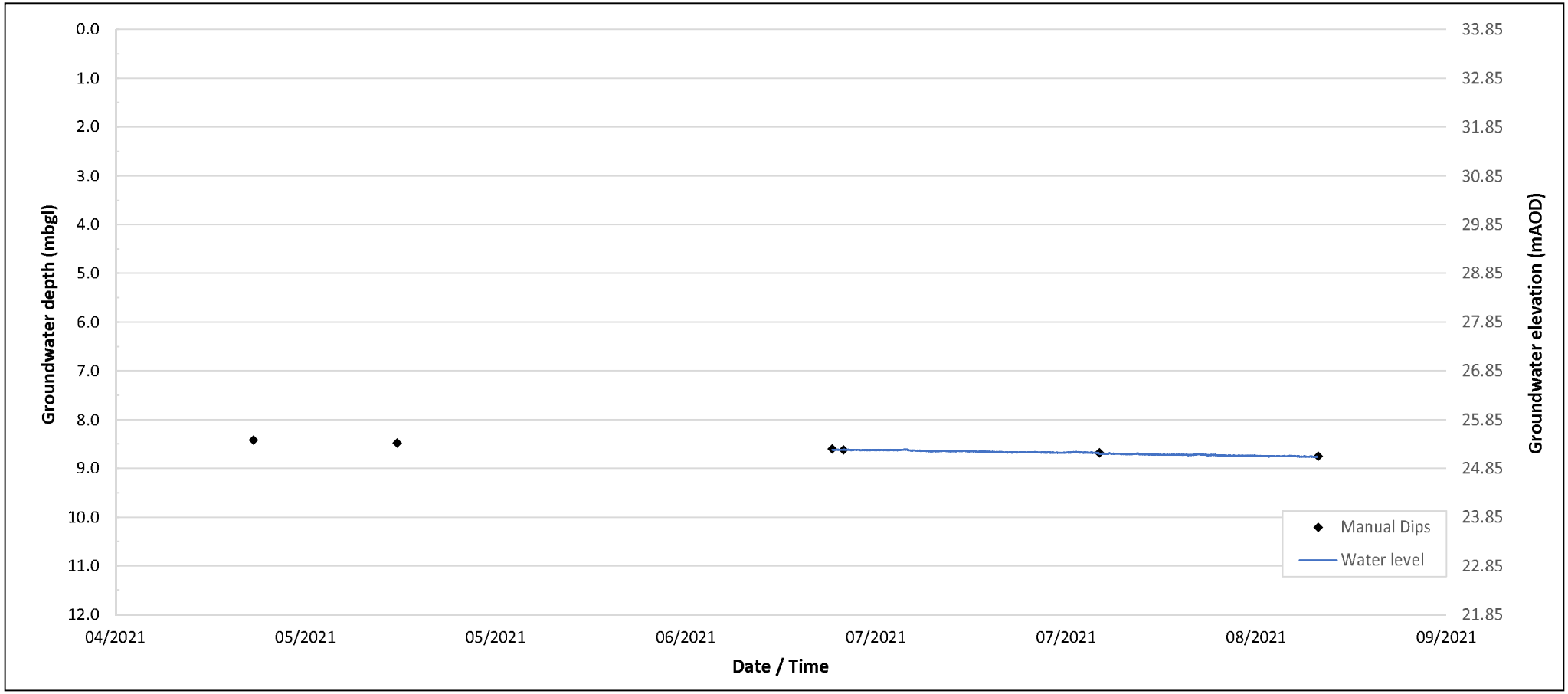
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3203**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ477**	INSTALLATION DATE:	**28/06/2021**	EASTING (m):	**587269.5**	NORTHING (m):	**218555.5**
NOMINAL INSTALLATION DEPTH:	**11.35mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**12.00mbgl**	TOP OF RESPONSE ZONE:	**3.40mbgl**
CALIBRATION DIP:	**8.62mbgl on 29/06/2021 14:10**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**12.00mbgl**

WELL DETAILS ELEVATION (mAOD): **33.85**

REMARKS

CONTRACT	CHECKED
36104	**DM**

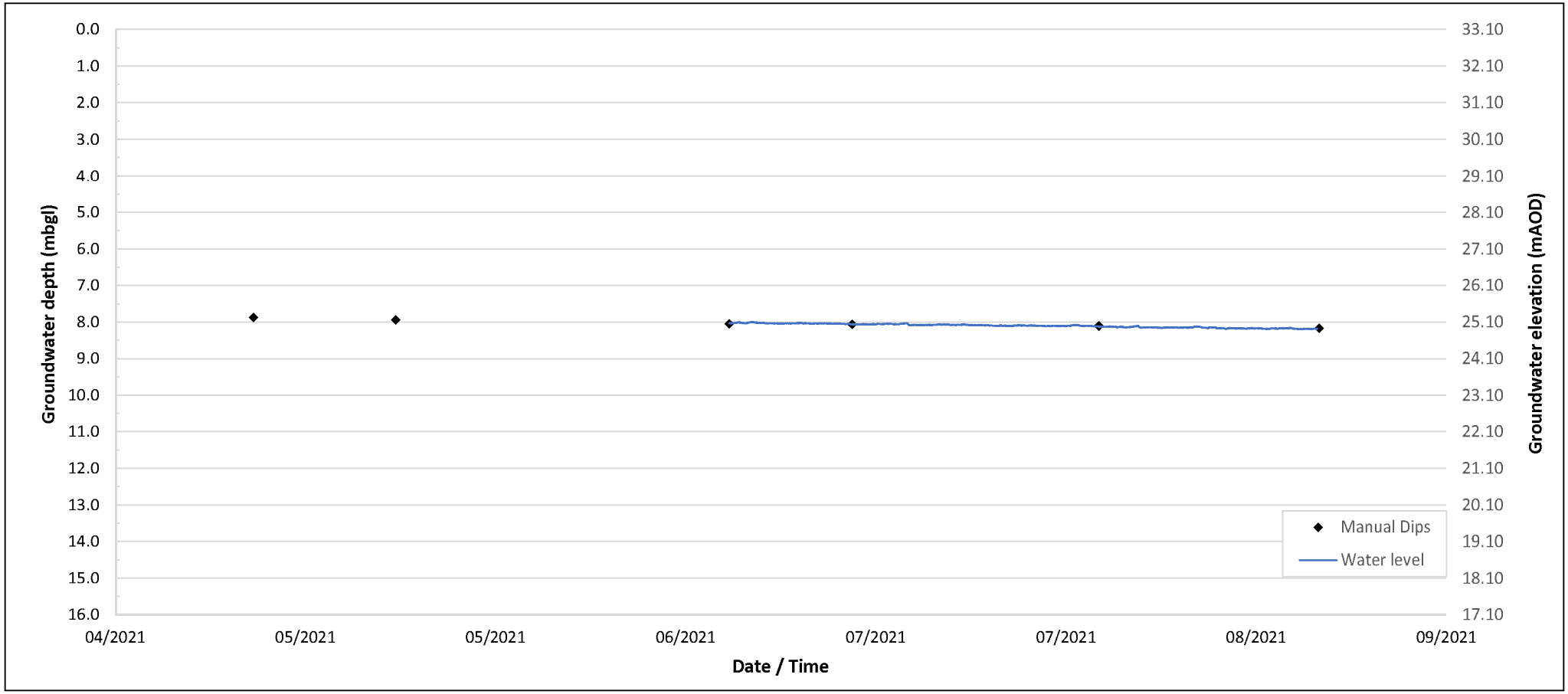
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3204**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**DG835**	INSTALLATION DATE:	**17/06/2021**	EASTING (m):	**587234.5**	NORTHING (m):	**218599.5**	ELEVATION (mAOD):	**33.10**
NOMINAL INSTALLATION DEPTH:	**14.08mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**16.00mbgl**	TOP OF RESPONSE ZONE:	**8.40mbgl**		
CALIBRATION DIP:	**8.06mbgl on 30/06/2021 12:08**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**16.50mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

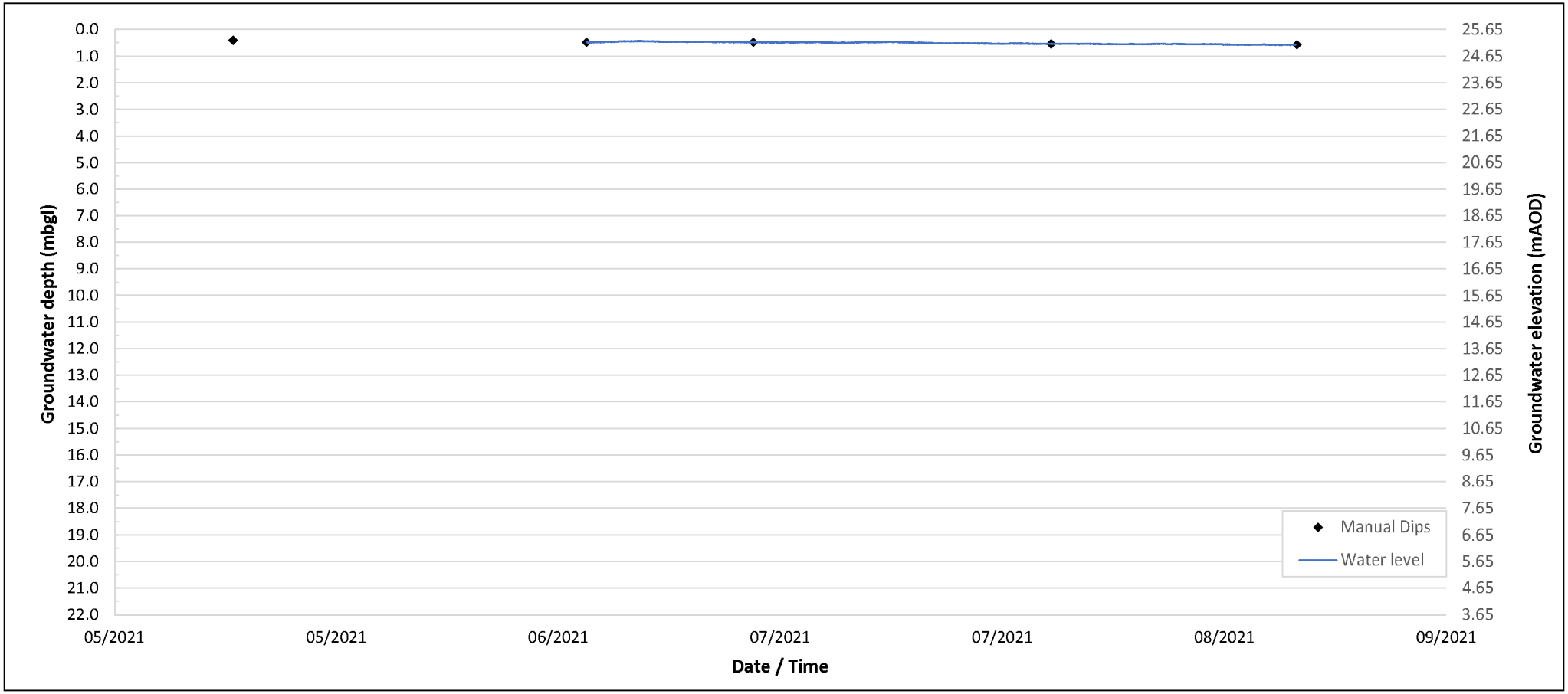
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3205**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD773**	INSTALLATION DATE:	**15/06/2021**	EASTING (m):	**587641.0**	NORTHING (m):	**218944.5**	ELEVATION (mAOD):	**25.65**
NOMINAL INSTALLATION DEPTH:	**6.25mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**22.00mbgl**	TOP OF RESPONSE ZONE:	**9.90mbgl**		
CALIBRATION DIP:	**0.48mbgl on 30/06/2021 12:53**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**22.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

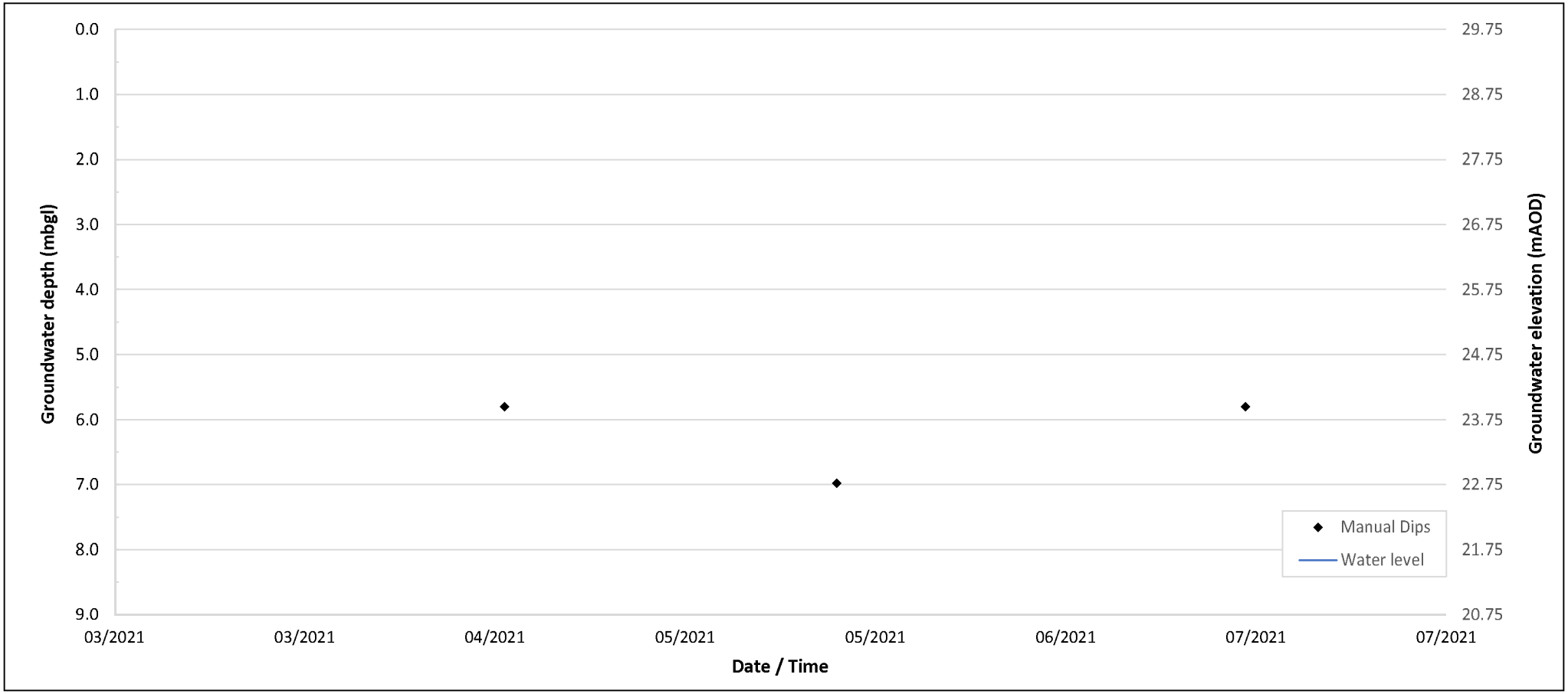
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3206**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39789044/DE688** INSTALLATION DATE: **19/05/2021**

NOMINAL INSTALLATION DEPTH: **8.10mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **5.80mbgl on 01/07/2021 21:38**

WELL DETAILS

EASTING (m): **587657.0** NORTHING (m): **219057.0** ELEVATION (mAOD): **29.75**

WELL DEPTH: **9.00mbgl** TOP OF RESPONSE ZONE: **5.00mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **9.50mbgl**

REMARKS

At the time of reporting, no data has been transmitted to the online portal since the installation of the datalogger, suspected cause is lack of signal to the diver modem.

CONTRACT	CHECKED
36104	**DM**

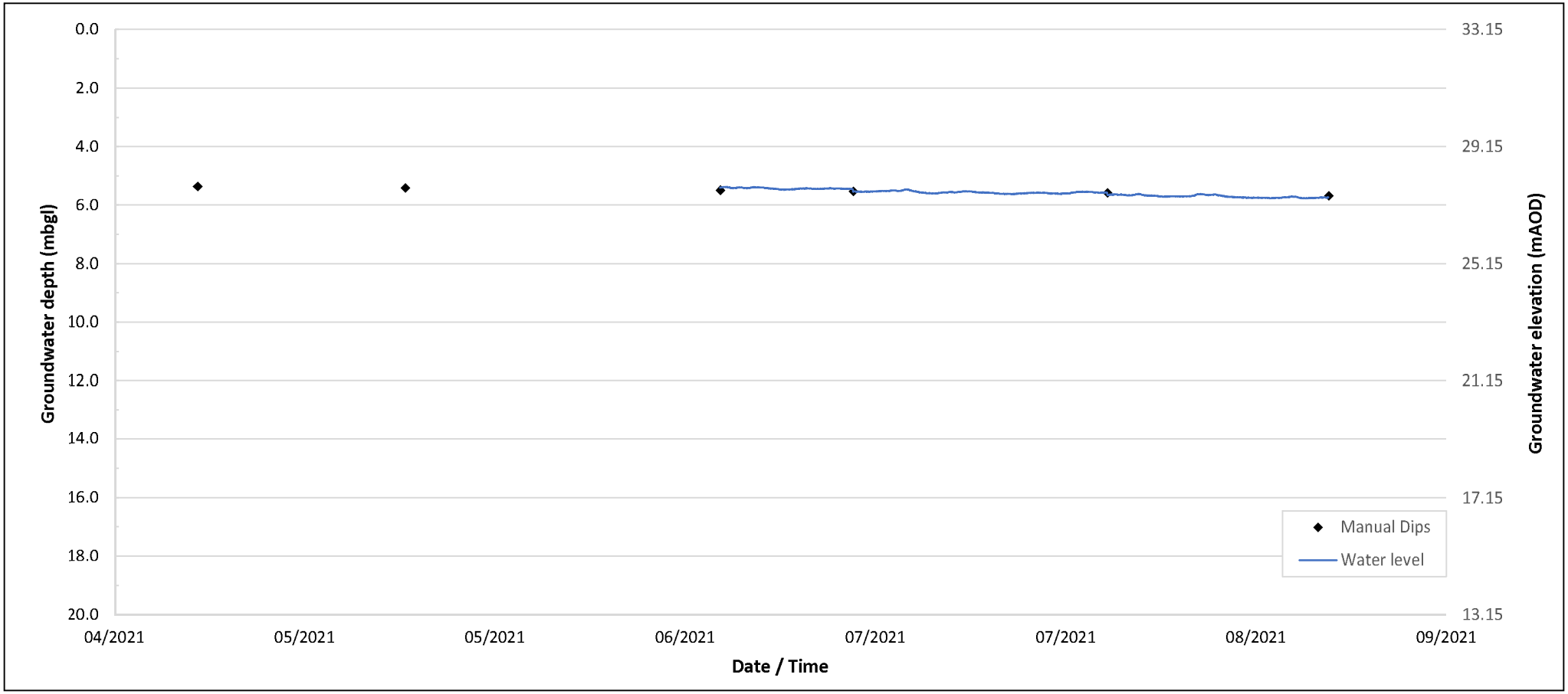
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3208**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**DG890**	INSTALLATION DATE:	**16/06/2021**	EASTING (m):	**587825.5**	NORTHING (m):	**219457.0**	ELEVATION (mAOD):	**33.15**
NOMINAL INSTALLATION DEPTH:	**19.60mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**40.00mbgl**	TOP OF RESPONSE ZONE:	**37.00mbgl**		
CALIBRATION DIP:	**5.54mbgl on 30/06/2021 16:20**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**40.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

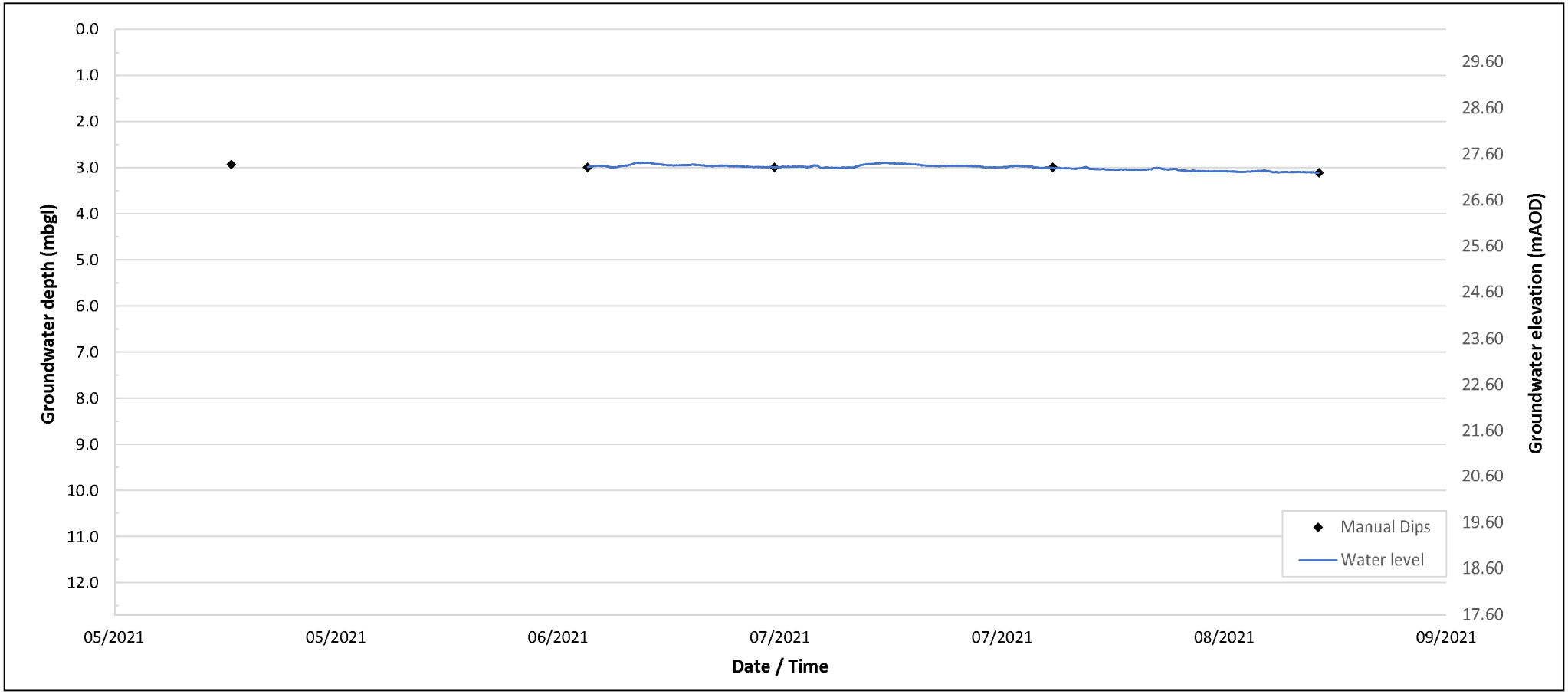
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3210**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD715**	INSTALLATION DATE:	**15/06/2021**
NOMINAL INSTALLATION DEPTH:	**10.02mbgl**	RECORDING FREQUENCY	**1 hour**
CALIBRATION DIP:	**2.99mbgl on 02/07/2021 10:56**		

WELL DETAILS

EASTING (m):	**587989.5**	NORTHING (m):	**220009.5**	ELEVATION (mAOD):	**30.30**
WELL DEPTH:	**12.70mbgl**	TOP OF RESPONSE ZONE:	**6.40mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**12.80mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

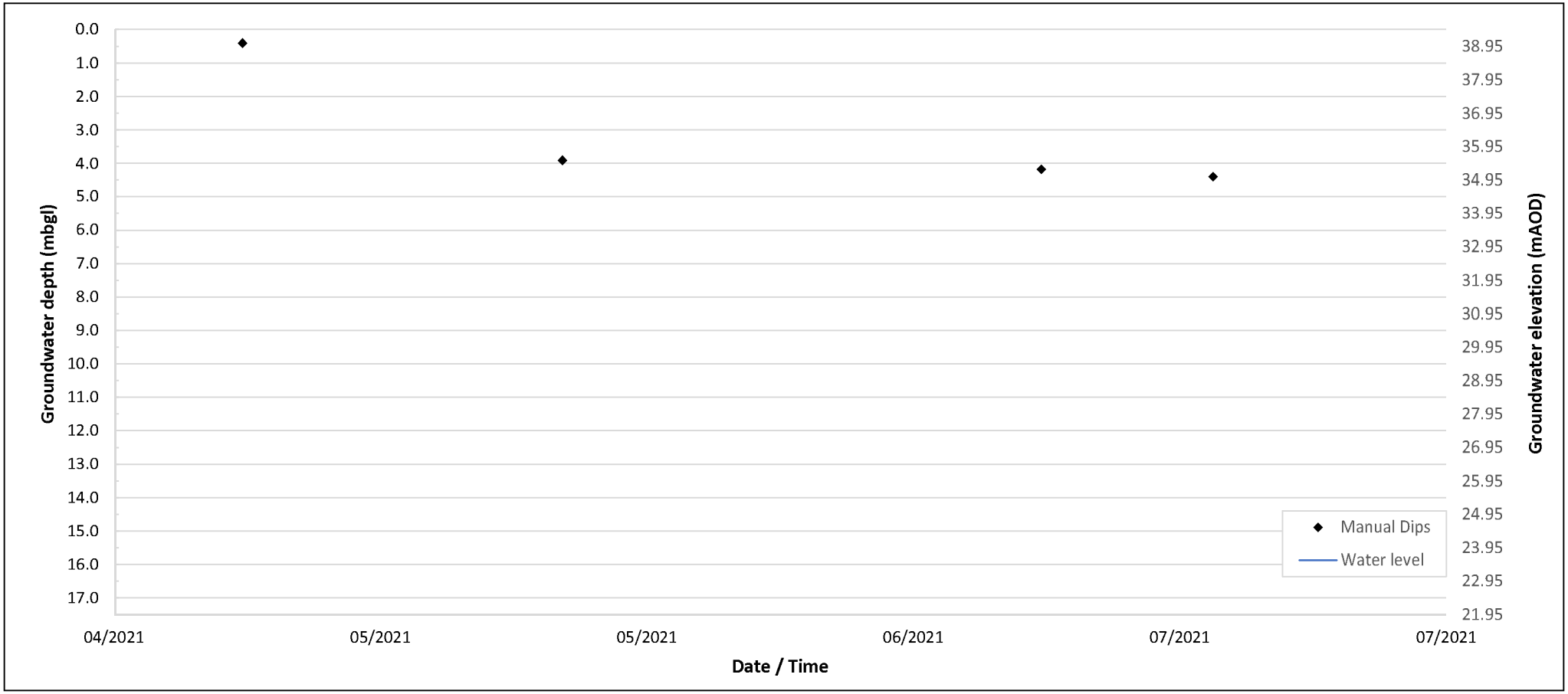
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3213**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40798749/DG834** INSTALLATION DATE: **22/06/2021**

NOMINAL INSTALLATION DEPTH: **17.30mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **4.40mbgl on 05/07/2021 11:51**

WELL DETAILS

EASTING (m): **590670.5** NORTHING (m): **222314.0** ELEVATION (mAOD): **39.45**

WELL DEPTH: **17.50mbgl** TOP OF RESPONSE ZONE: **1.90mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **17.60mbgl**

REMARKS

At the time of reporting, no data has been transmitted to the online portal since the installation of the datalogger, suspected cause is lack of signal to the diver modem. Earliest recorded dip was taken prior to development of the monitoring well.

CONTRACT	CHECKED
36104	**DM**

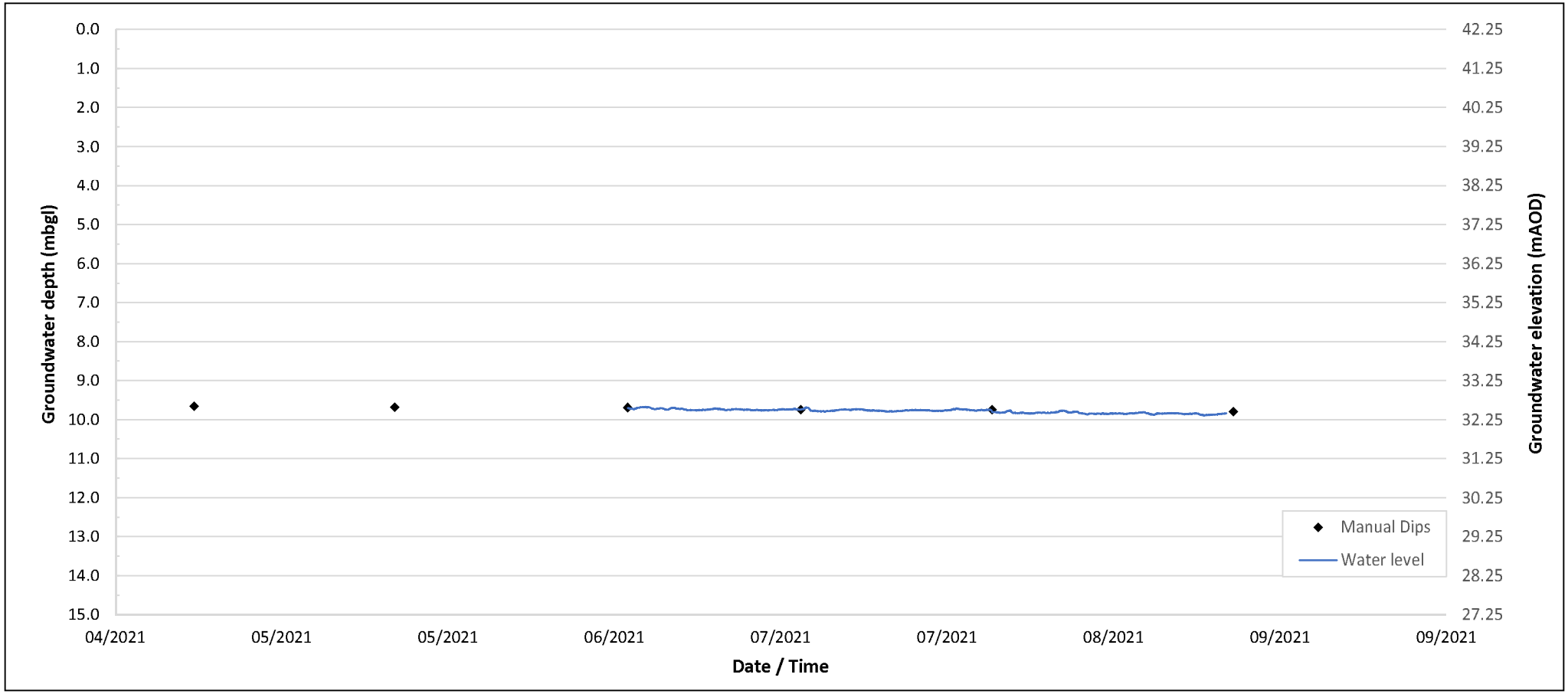
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3215**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **CD730** INSTALLATION DATE: **14/06/2021**

NOMINAL INSTALLATION DEPTH: **15.00mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **9.74mbgl on 05/07/2021 10:15**

WELL DETAILS

EASTING (m): **591122.5** NORTHING (m): **222619.5** ELEVATION (mAOD): **42.25**

WELL DEPTH: **15.00mbgl** TOP OF RESPONSE ZONE: **6.90mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **15.10mbgl**

REMARKS

CONTRACT	CHECKED
36104	**DM**

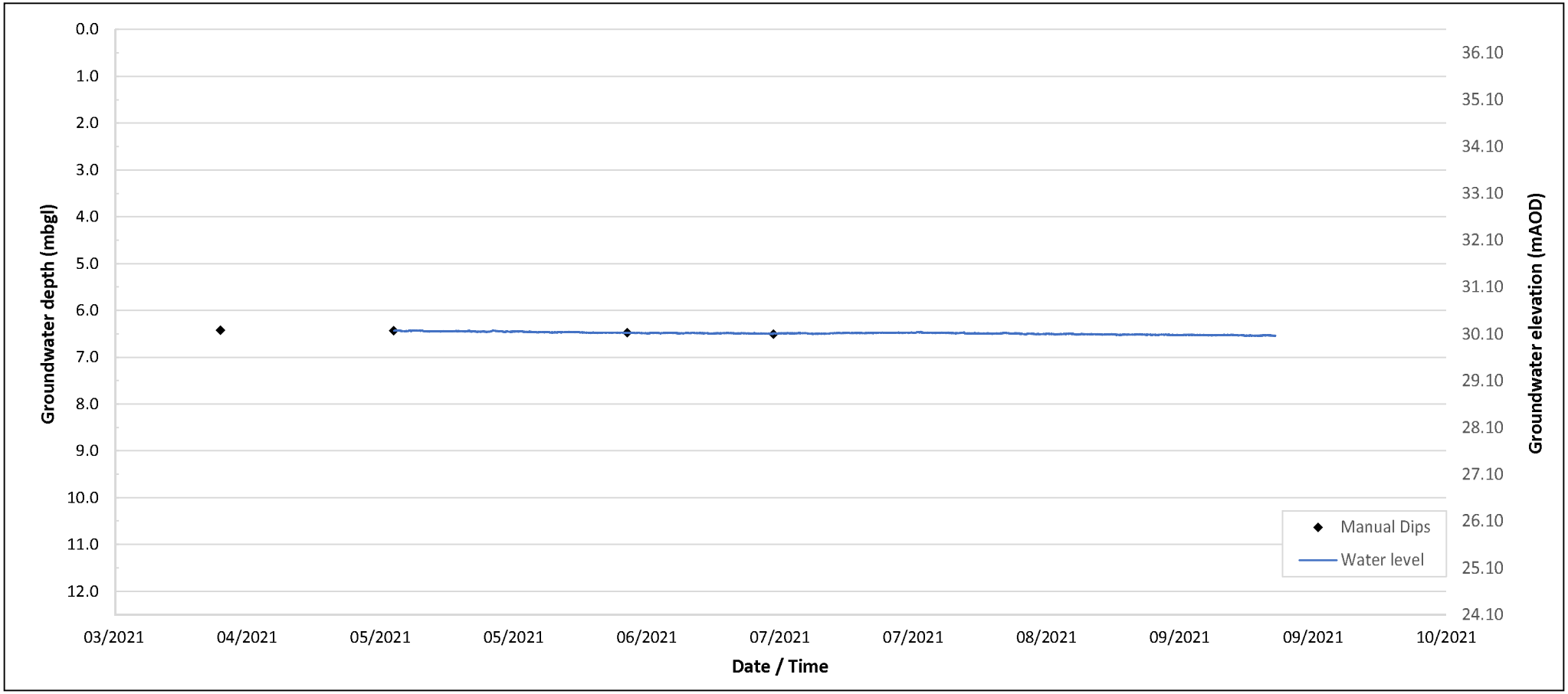
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH+RC3218**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **39803635/DE687** INSTALLATION DATE: **05/05/2021**

NOMINAL INSTALLATION DEPTH: **10.35mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **6.42mbgl on 05/05/2021 21:54**

WELL DETAILS

EASTING (m): **591641.0** NORTHING (m): **223757.0** ELEVATION (mAOD): **36.60**

WELL DEPTH: **12.50mbgl** TOP OF RESPONSE ZONE: **3.90mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **12.50mbgl**

REMARKS

CONTRACT	CHECKED
36104	**DM**

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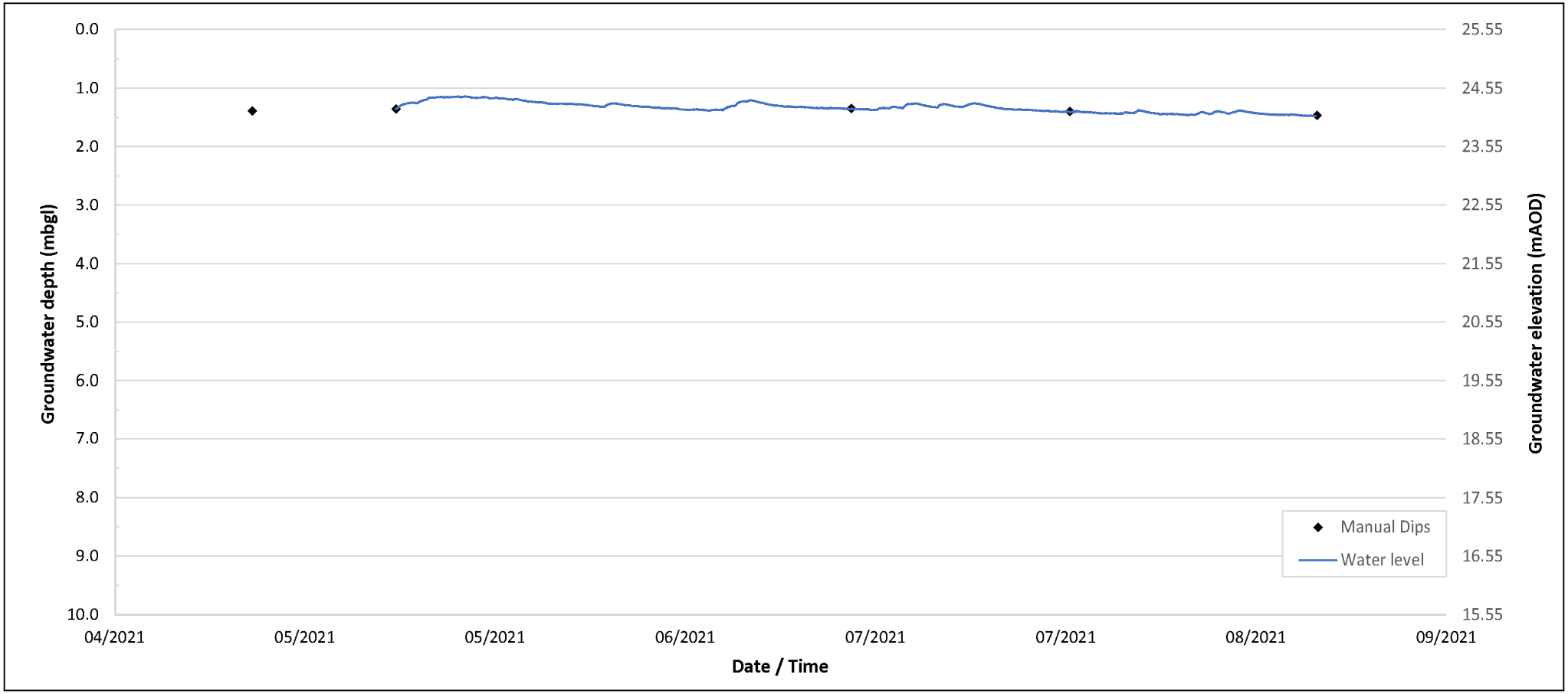
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3002**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ439**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**586350.0**	NORTHING (m):	**217773.5**
NOMINAL INSTALLATION DEPTH:	**9.50mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**1.00mbgl**
CALIBRATION DIP:	**1.36mbgl on 13/05/2021 13:27**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.45mbgl**

WELL DETAILS

ELEVATION (mAOD): **25.55**

REMARKS

CONTRACT	CHECKED
36104	**DM**

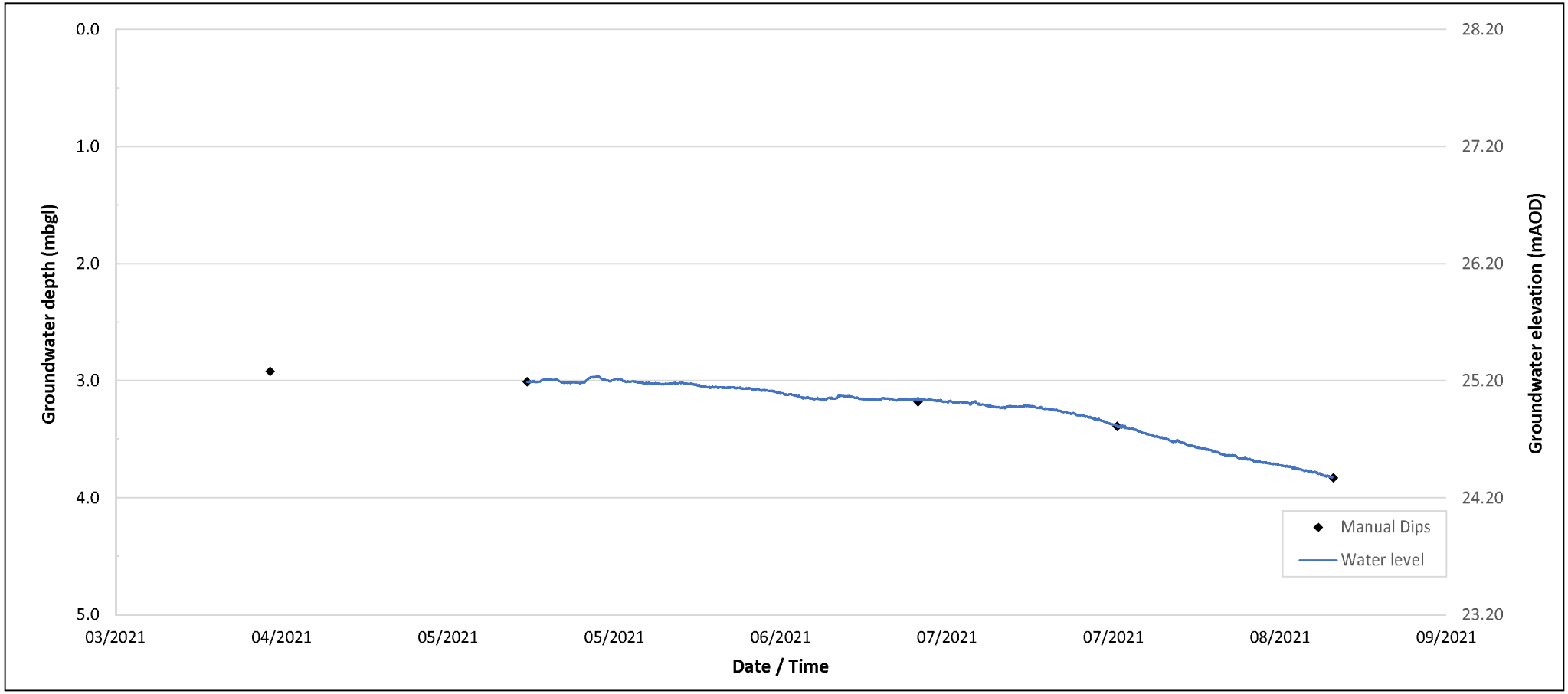
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3004**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ281**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**586529.0**	NORTHING (m):	**217882.0**	ELEVATION (mAOD):	**28.20**
NOMINAL INSTALLATION DEPTH:	**4.30mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**1.00mbgl**		
CALIBRATION DIP:	**3.01mbgl on 13/05/2021 12:04**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

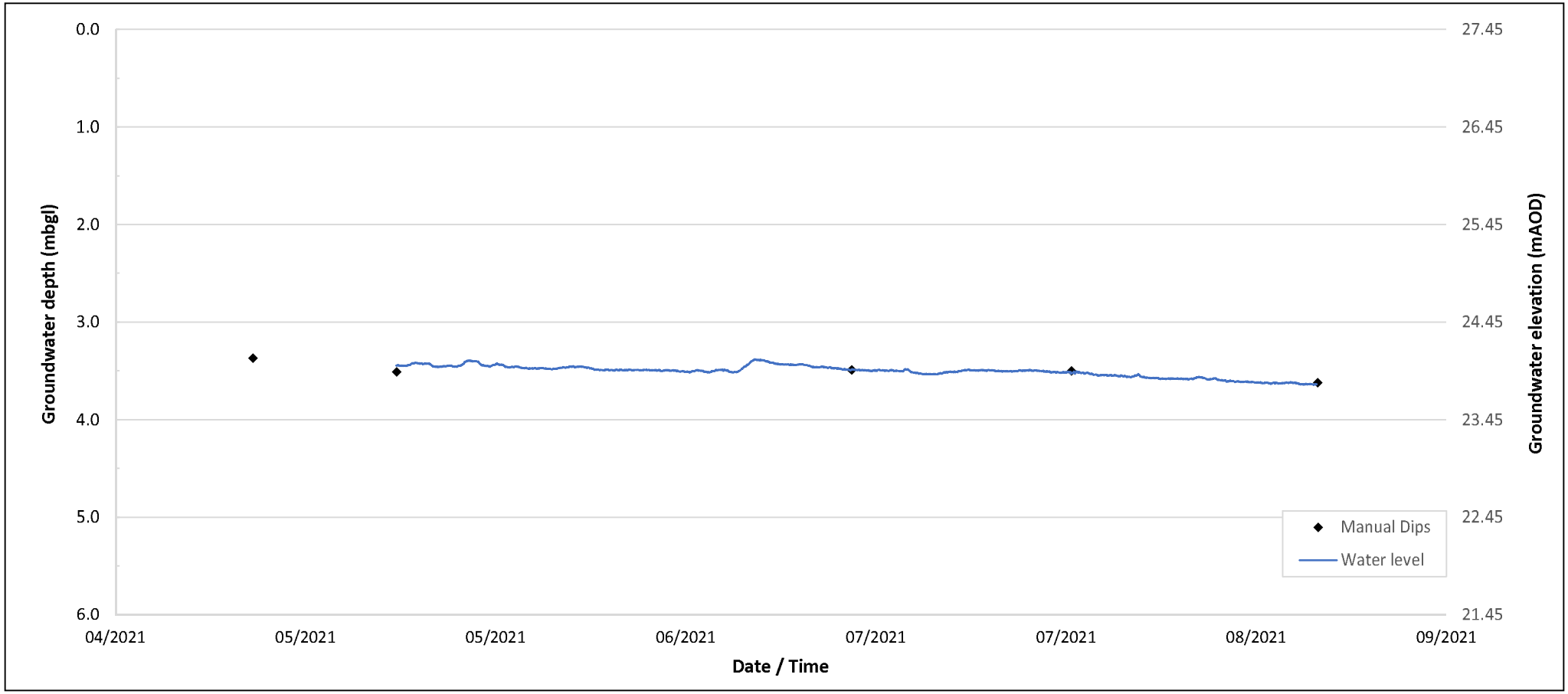
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3005**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ601**	INSTALLATION DATE:	**13/05/2021**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**5.50mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**586645.5**	NORTHING (m):	**218044.0**	ELEVATION (mAOD):	**27.45**
CALIBRATION DIP:	**3.49mbgl on 30/06/2021 11:05**			WELL DEPTH:	**6.00mbgl**	TOP OF RESPONSE ZONE:	**4.00mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**6.00mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

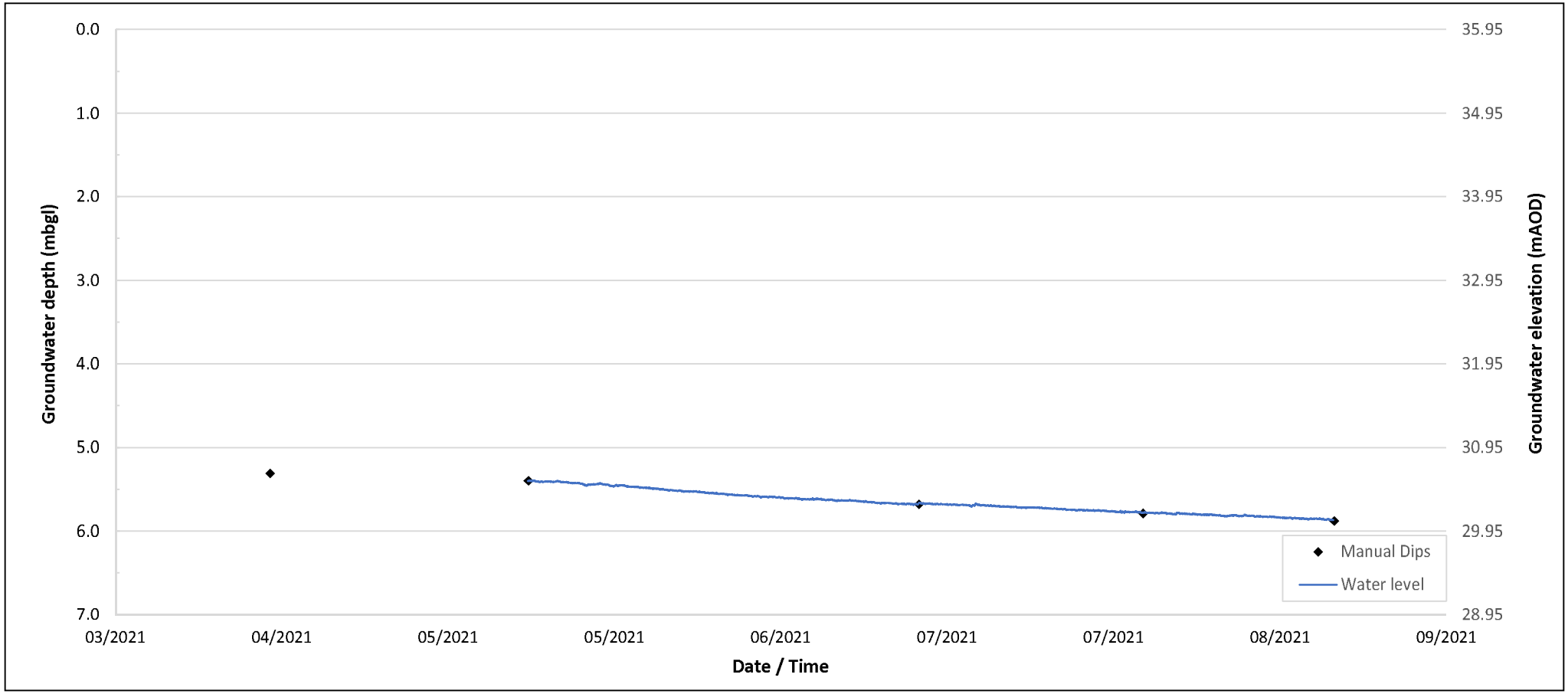
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3007**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AZ410**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**587043.5**	NORTHING (m):	**218300.5**	ELEVATION (mAOD):	**35.95**
NOMINAL INSTALLATION DEPTH:	**5.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**7.00mbgl**	TOP OF RESPONSE ZONE:	**5.00mbgl**		
CALIBRATION DIP:	**5.40mbgl on 13/05/2021 15:17**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

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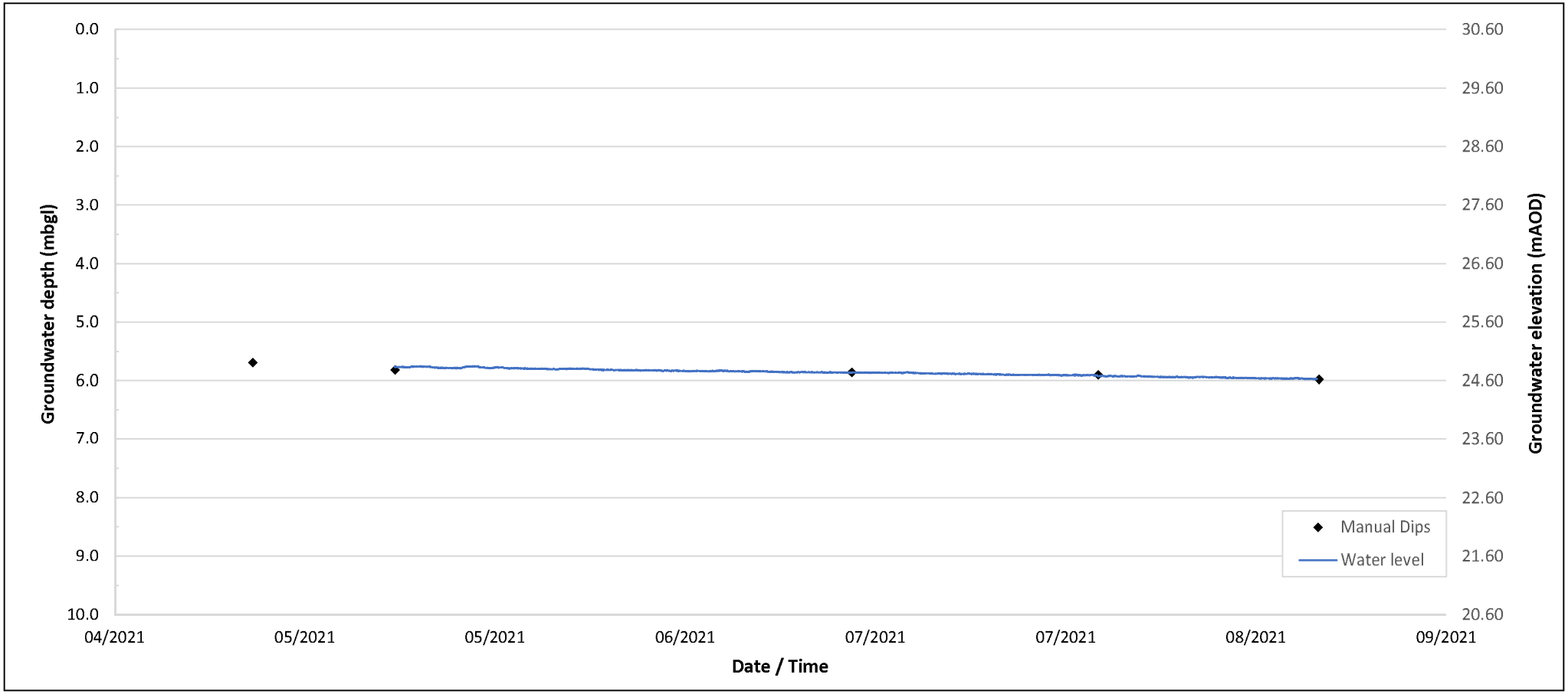
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3008**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ610**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**587116.0**	NORTHING (m):	**218486.0**	ELEVATION (mAOD):	**30.60**
NOMINAL INSTALLATION DEPTH:	**8.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**6.00mbgl**		
CALIBRATION DIP:	**5.86mbgl on 30/06/2021 12:26**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.30mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

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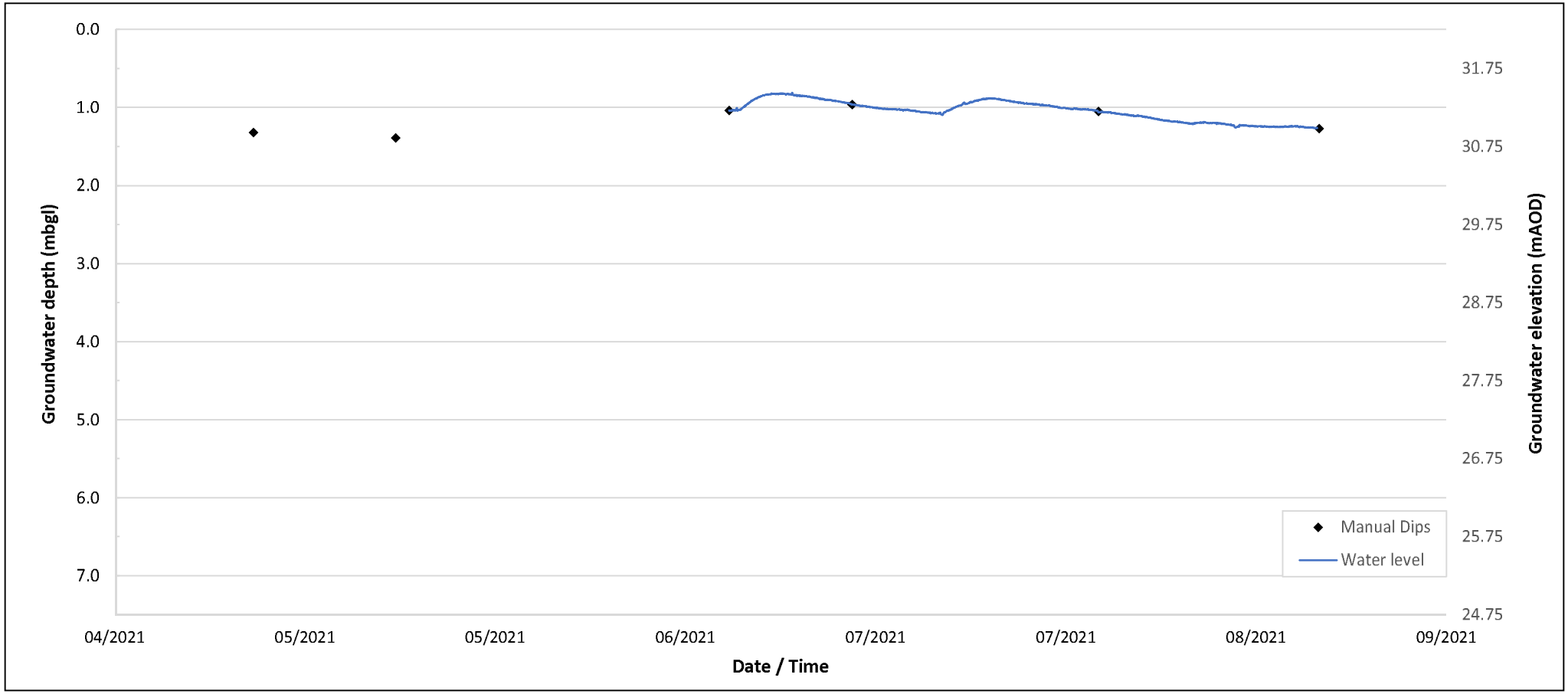
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3009**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD767**	INSTALLATION DATE:	**17/06/2021**	EASTING (m):	**587155.0**	NORTHING (m):	**218664.5**	ELEVATION (mAOD):	**32.25**
NOMINAL INSTALLATION DEPTH:	**7.15mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**7.50mbgl**	TOP OF RESPONSE ZONE:	**5.50mbgl**		
CALIBRATION DIP:	**0.96mbgl on 30/06/2021 12:13**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**7.50mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

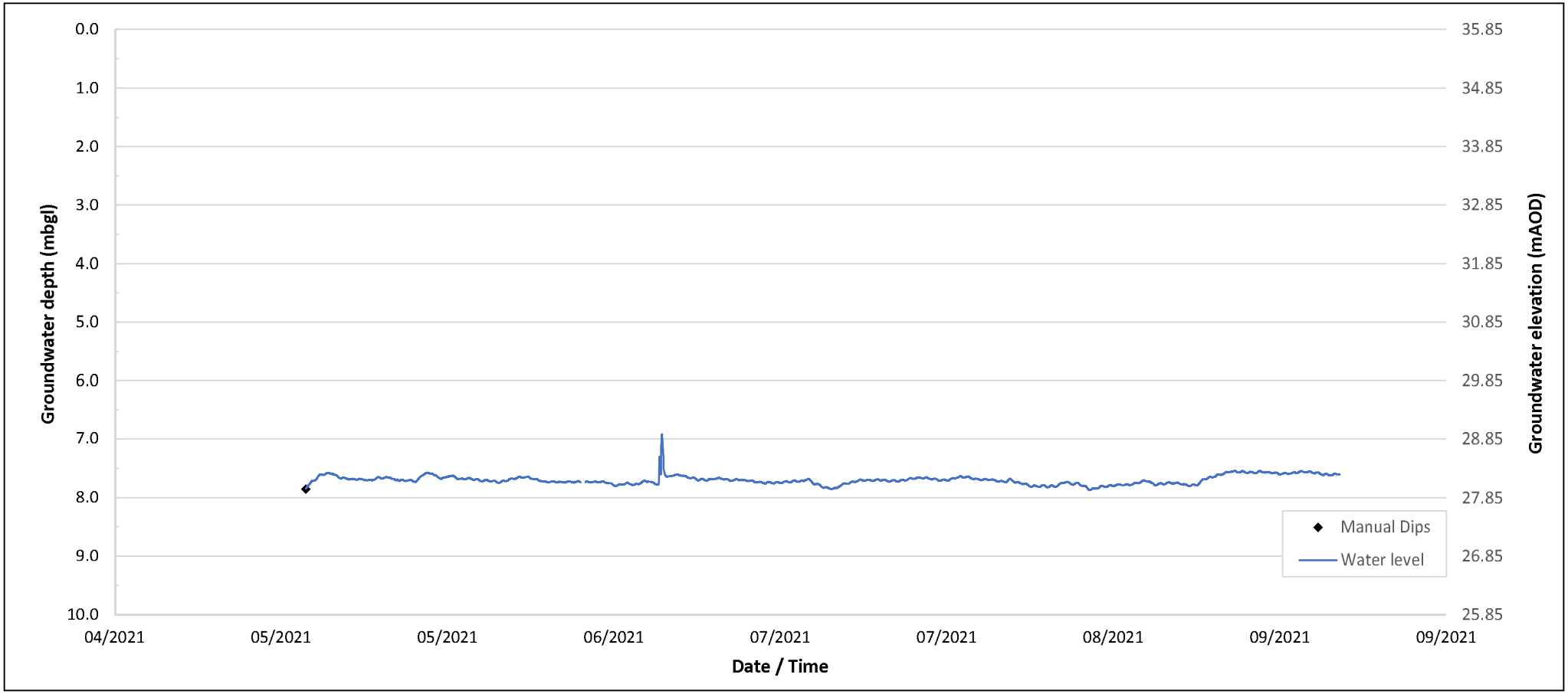
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3011**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40772906/DD741** INSTALLATION DATE: **06/05/2021**

NOMINAL INSTALLATION DEPTH: **9.00mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **7.85mbgl on 06/05/2021 23:01**

WELL DETAILS

EASTING (m): **587336.5** NORTHING (m): **218644.5** ELEVATION (mAOD): **35.85**

WELL DEPTH: **10.00mbgl** TOP OF RESPONSE ZONE: **3.00mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **10.45mbgl**

REMARKS

Groundwater sample taken at 08/06/2021 23:50; data removed 09/06/2021 00:00-12:00 due to affected water depths.

CONTRACT **36104**

CHECKED **DM**

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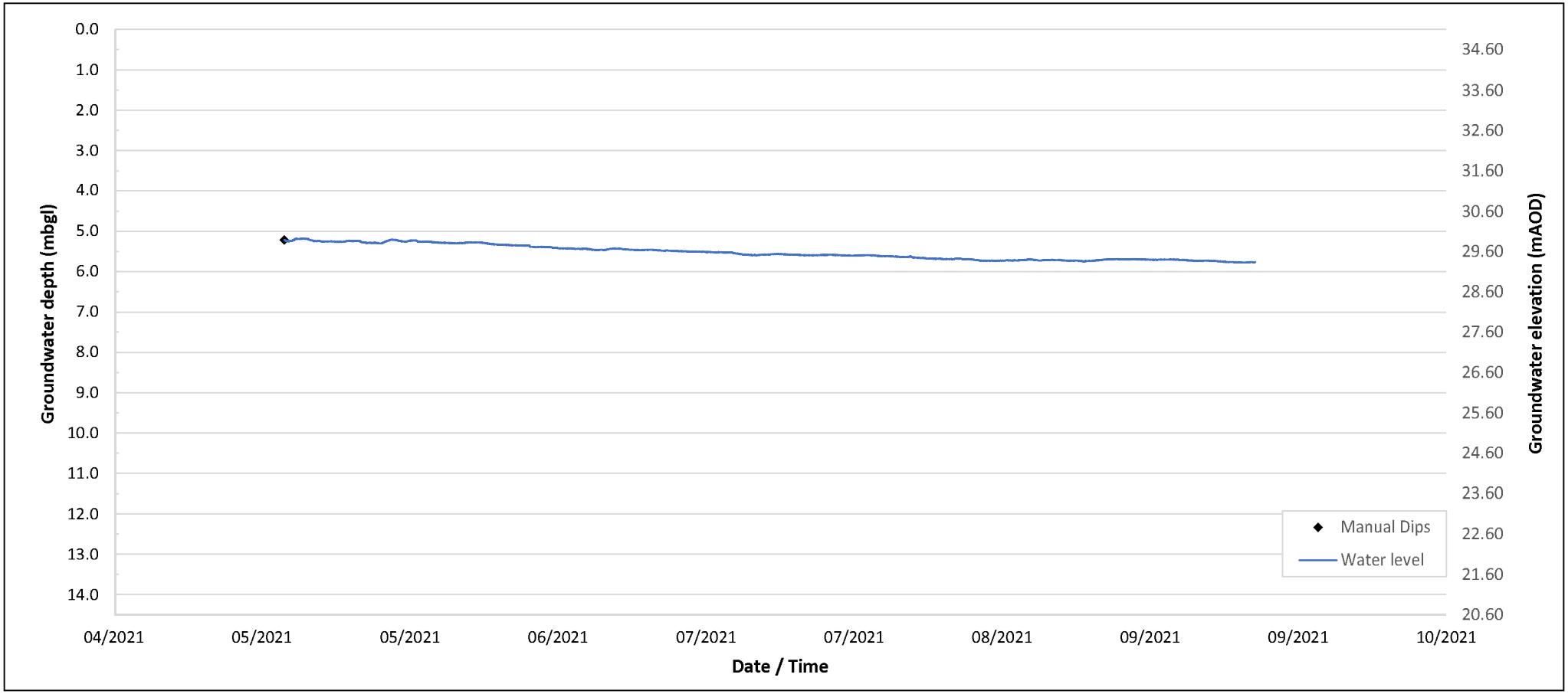
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3012**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40772950/DE082** INSTALLATION DATE: **06/05/2021**

NOMINAL INSTALLATION DEPTH: **10.35mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **5.21mbgl on 06/05/2021 22:05**

WELL DETAILS

EASTING (m): **587460.0** NORTHING (m): **218765.0** ELEVATION (mAOD): **35.10**

WELL DEPTH: **14.50mbgl** TOP OF RESPONSE ZONE: **5.50mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **14.95mbgl**

REMARKS

CONTRACT	CHECKED
36104	**DM**

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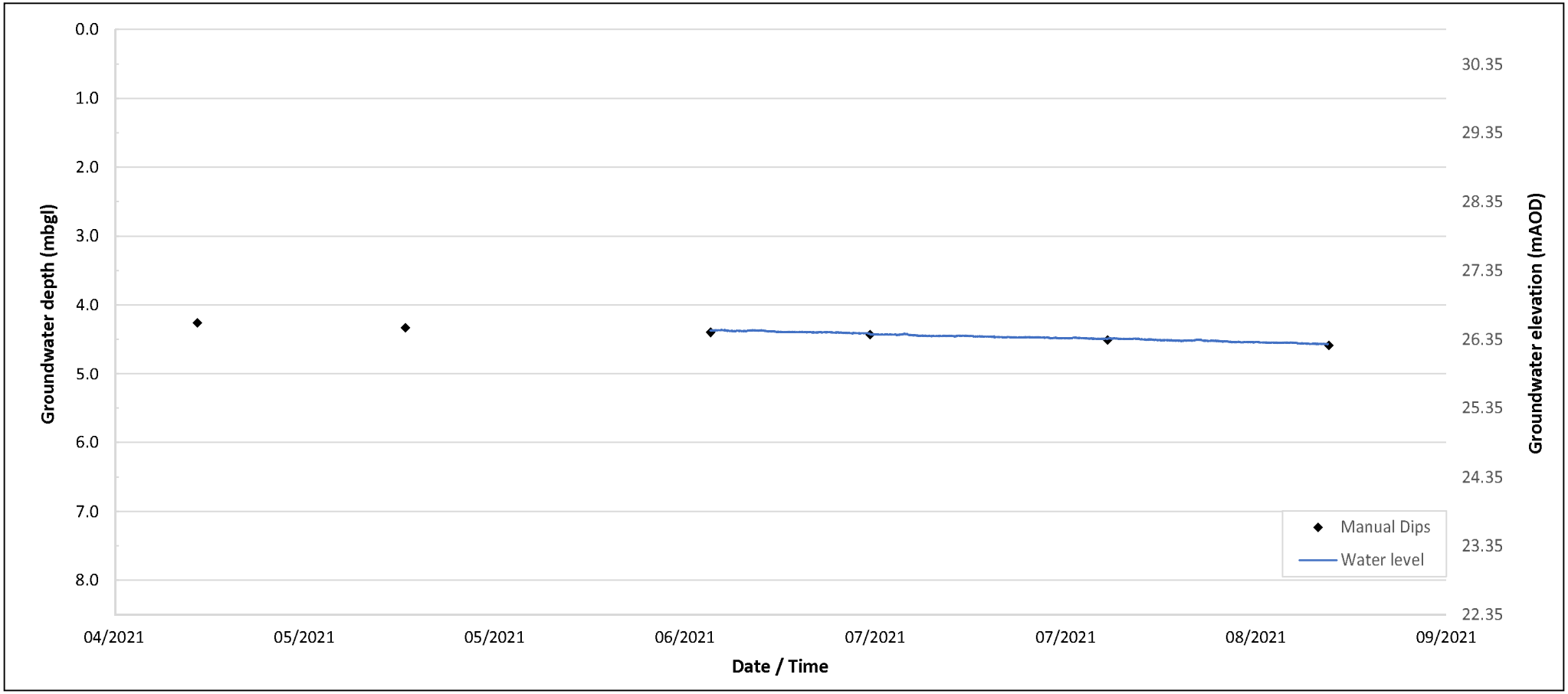
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3015**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD740**	INSTALLATION DATE:	**15/06/2021**	EASTING (m):	**587551.0**	NORTHING (m):	**219436.0**	ELEVATION (mAOD):	**30.85**
NOMINAL INSTALLATION DEPTH:	**8.39mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**8.50mbgl**	TOP OF RESPONSE ZONE:	**2.50mbgl**		
CALIBRATION DIP:	**4.43mbgl on 02/07/2021 10:31**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**8.50mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

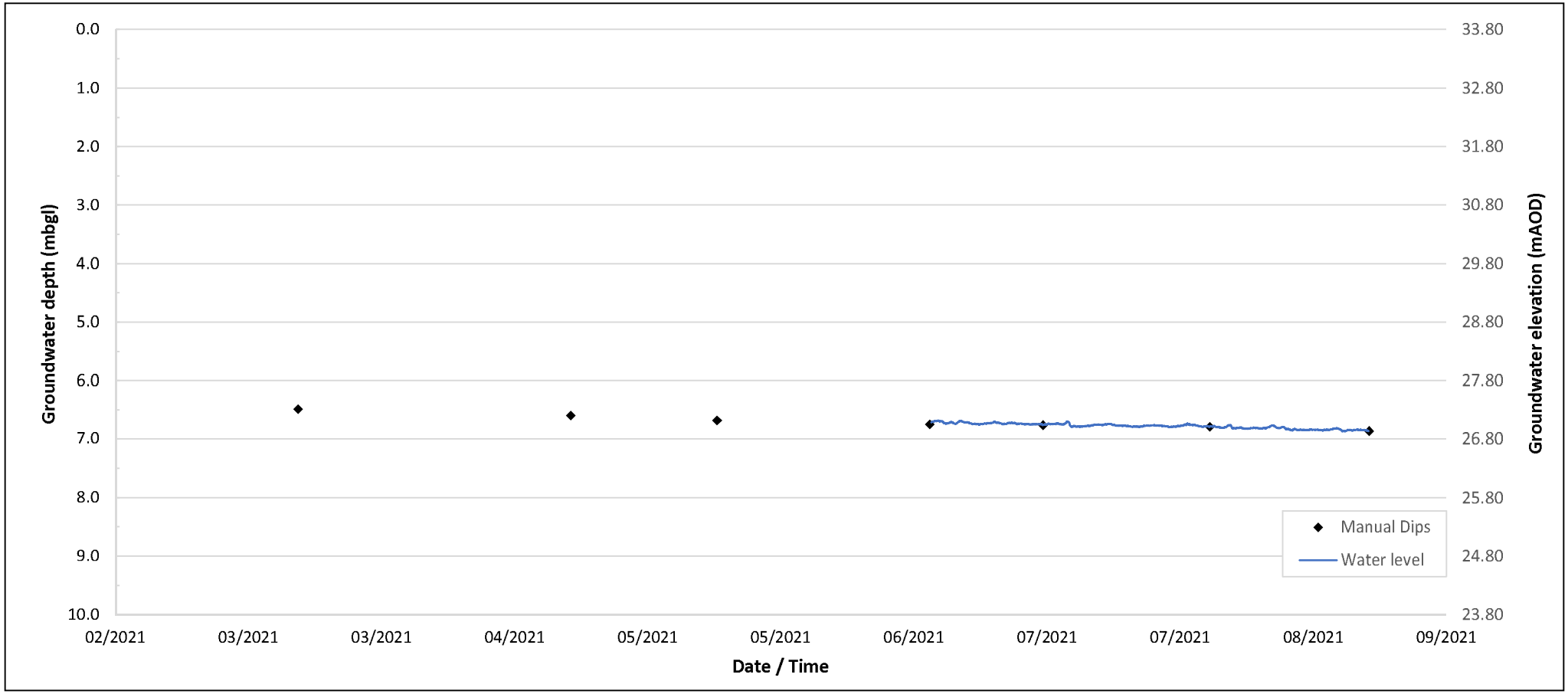
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3025**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**DG830**	INSTALLATION DATE:	**15/06/2021**	EASTING (m):	**587938.5**	NORTHING (m):	**220406.5**	ELEVATION (mAOD):	**33.80**
NOMINAL INSTALLATION DEPTH:	**9.93mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**6.50mbgl**		
CALIBRATION DIP:	**6.76mbgl on 02/07/2021 09:43**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

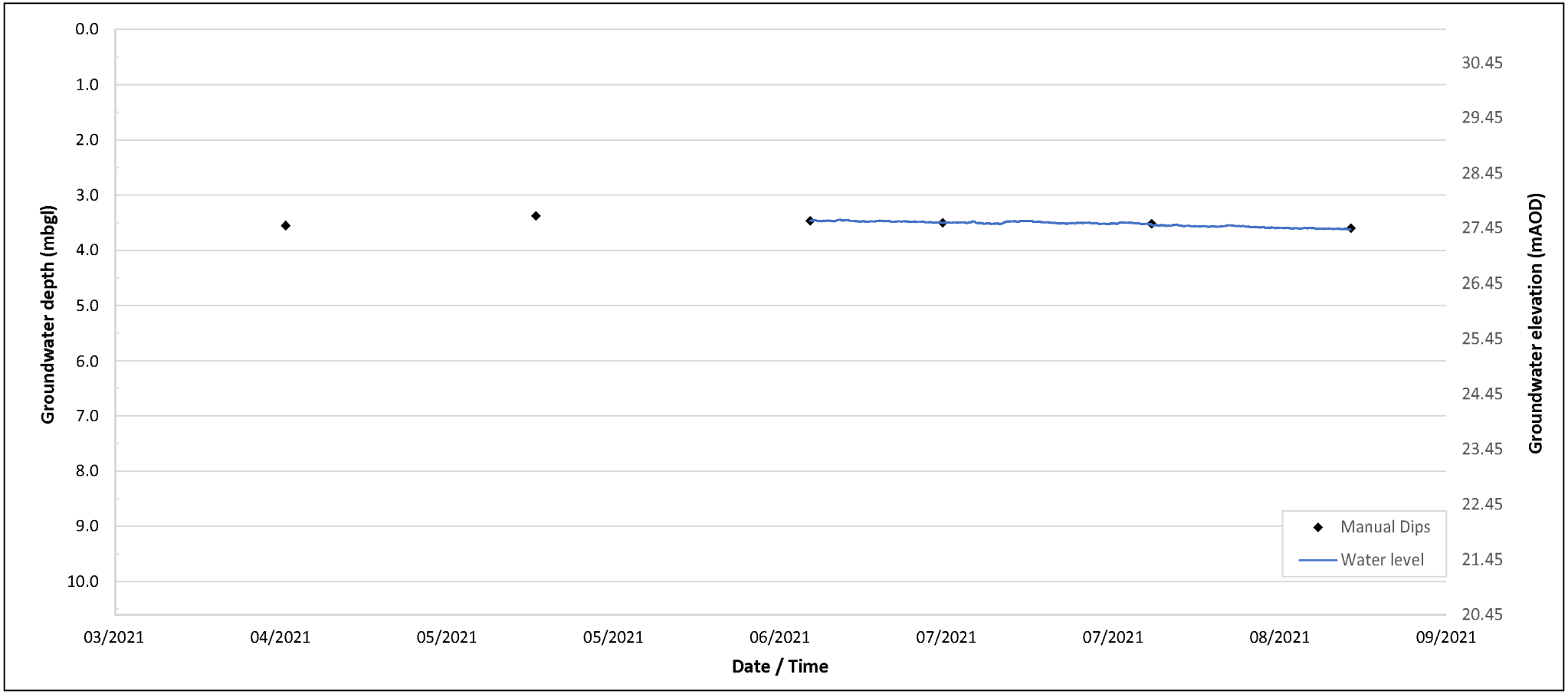
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3027**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD764**	INSTALLATION DATE:	**16/06/2021**	EASTING (m):	**588348.0**	NORTHING (m):	**220368.5**	ELEVATION (mAOD):	**31.05**
NOMINAL INSTALLATION DEPTH:	**9.97mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.60mbgl**	TOP OF RESPONSE ZONE:	**2.10mbgl**		
CALIBRATION DIP:	**3.50mbgl on 02/07/2021 11:57**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.60mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

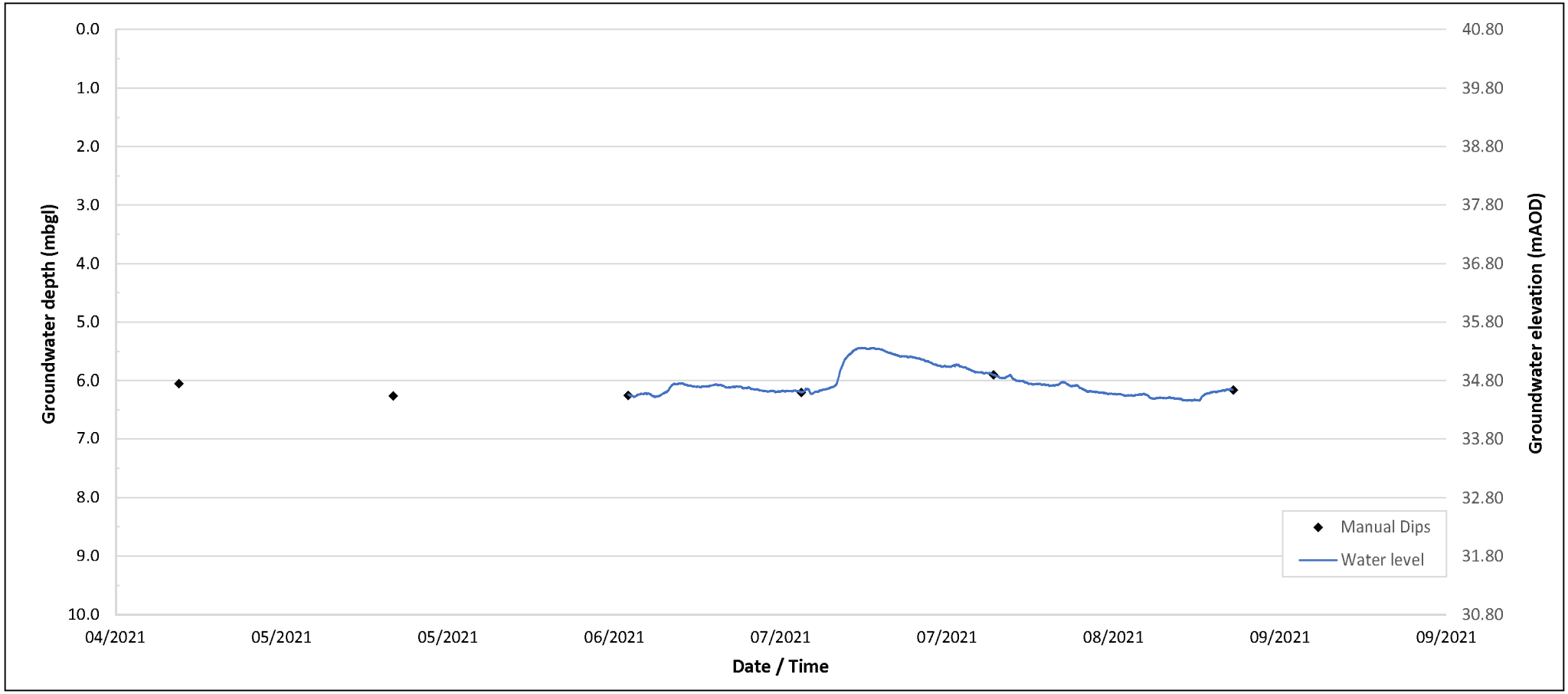
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3031**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD734**	INSTALLATION DATE:	**14/06/2021**	EASTING (m):	**588993.0**	NORTHING (m):	**221011.5**	ELEVATION (mAOD):	**40.80**
NOMINAL INSTALLATION DEPTH:	**9.32mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**8.00mbgl**		
CALIBRATION DIP:	**6.20mbgl on 05/07/2021 12:17**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

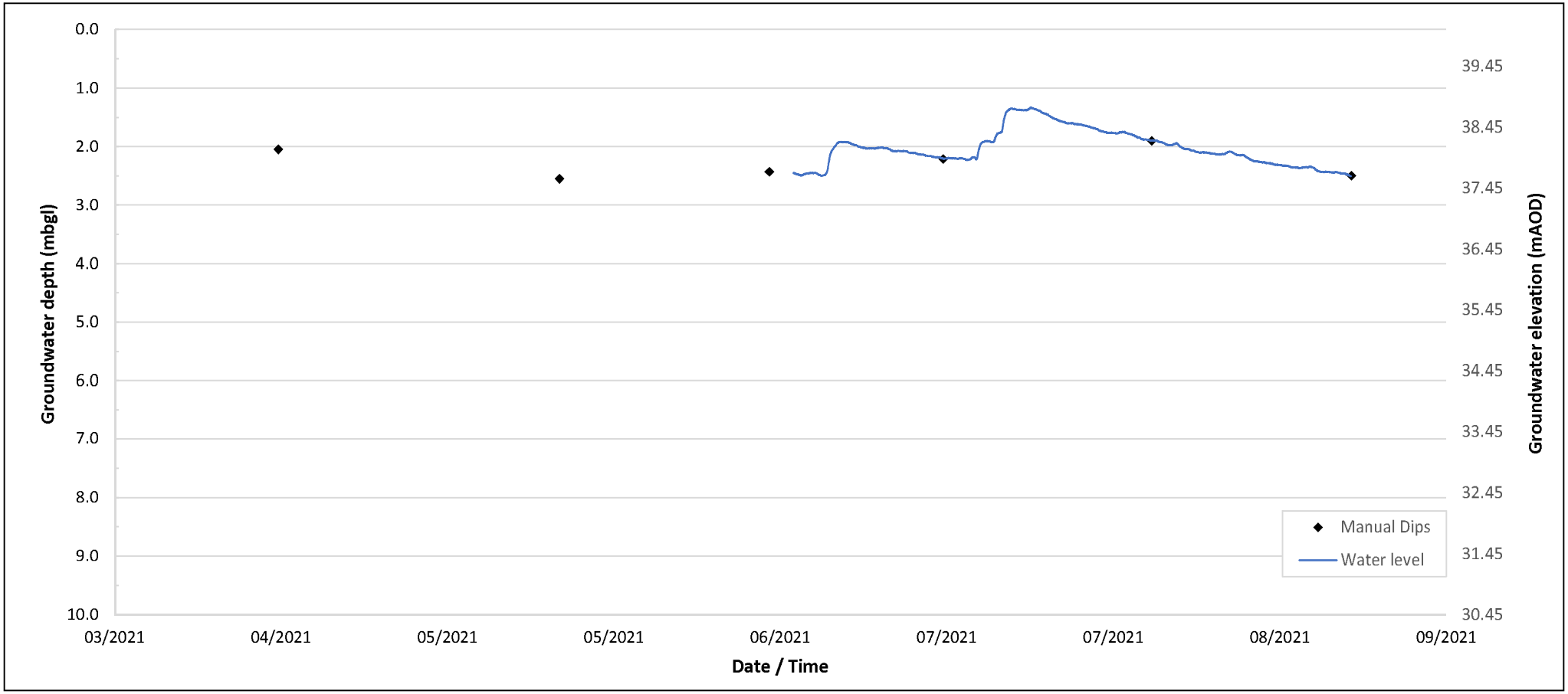
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3032**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD711**	INSTALLATION DATE:	**11/06/2021**
NOMINAL INSTALLATION DEPTH:	**8.58mbgl**	RECORDING FREQUENCY	**1 hour**
CALIBRATION DIP:	**2.21mbgl on 02/07/2021 13:28**		

WELL DETAILS

EASTING (m):	**589438.5**	NORTHING (m):	**221398.0**	ELEVATION (mAOD):	**40.05**
WELL DEPTH:	**9.60mbgl**	TOP OF RESPONSE ZONE:	**1.50mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

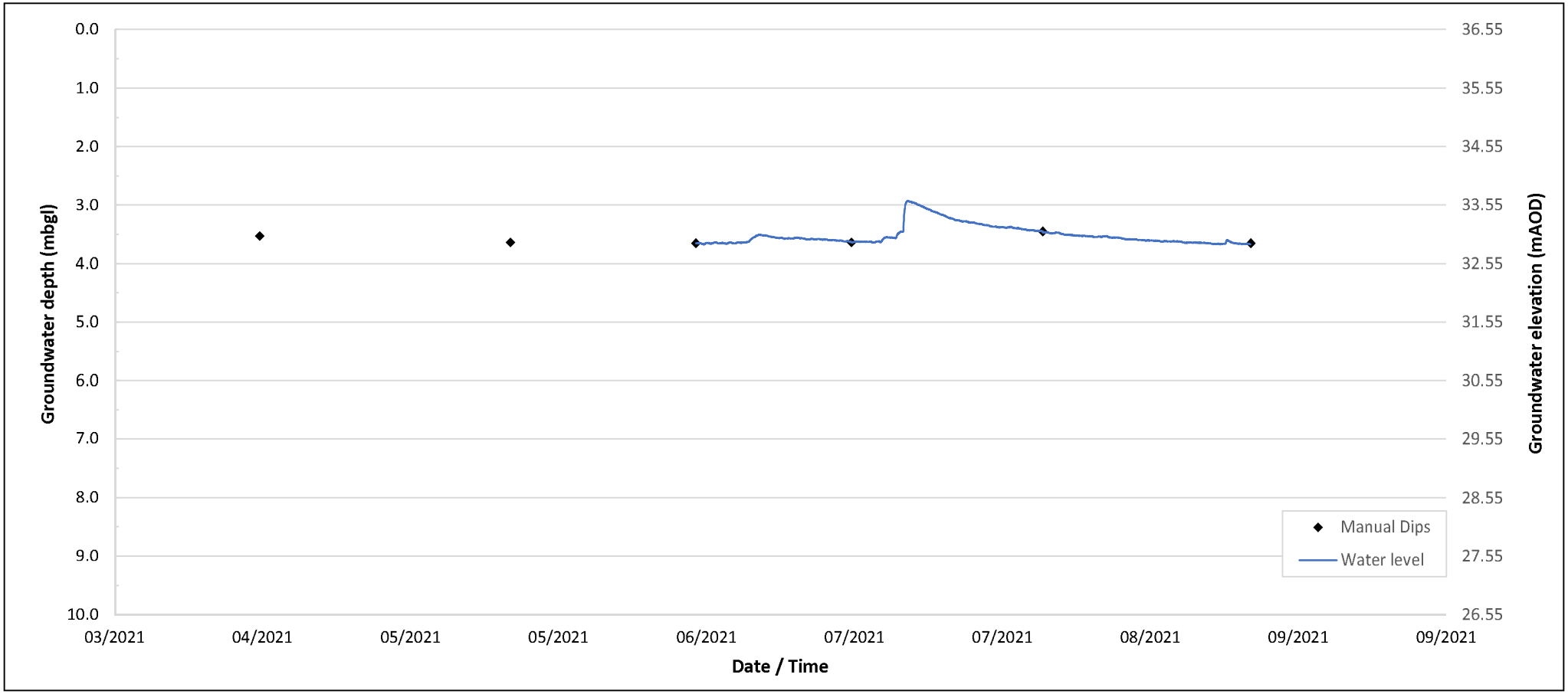
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3036**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD816**	INSTALLATION DATE:	**11/06/2021**	EASTING (m):	**590005.0**	NORTHING (m):	**221950.5**	ELEVATION (mAOD):	**36.55**
NOMINAL INSTALLATION DEPTH:	**9.56mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**5.50mbgl**		
CALIBRATION DIP:	**3.64mbgl on 02/07/2021 15:15**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

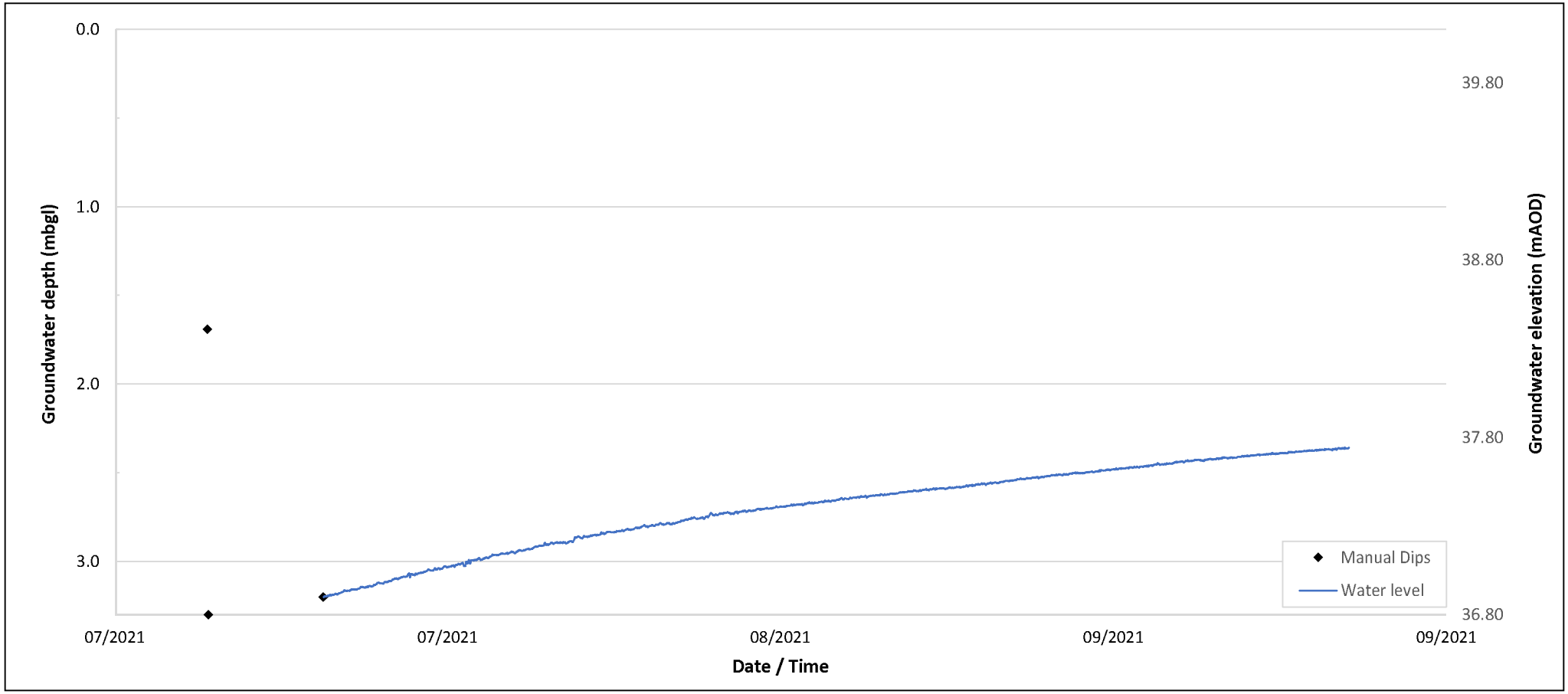
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3039**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**40798719/CD741**	INSTALLATION DATE:	**08/07/2021**				
NOMINAL INSTALLATION DEPTH:	**3.20mbgl**	RECORDING FREQUENCY	**1 hour**				
CALIBRATION DIP:	**See below.**						

WELL DETAILS

EASTING (m):	**590840.0**	NORTHING (m):	**222412.0**	ELEVATION (mAOD):	**40.10**
WELL DEPTH:	**3.30mbgl**	TOP OF RESPONSE ZONE:	**1.30mbgl**		
WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**3.30mbgl**		

REMARKS

Initial dip on 08/07/2021 taken at 12:54 was prior to development of monitoring well, post-development dip of 'Dry' (3.30m) taken at 14:18. Diver reading on 15/07/2021 12:00 determined as the point at which the water level has risen to the diver installation depth and therefore used to calibrate data.

CONTRACT	CHECKED
36104	**DM**

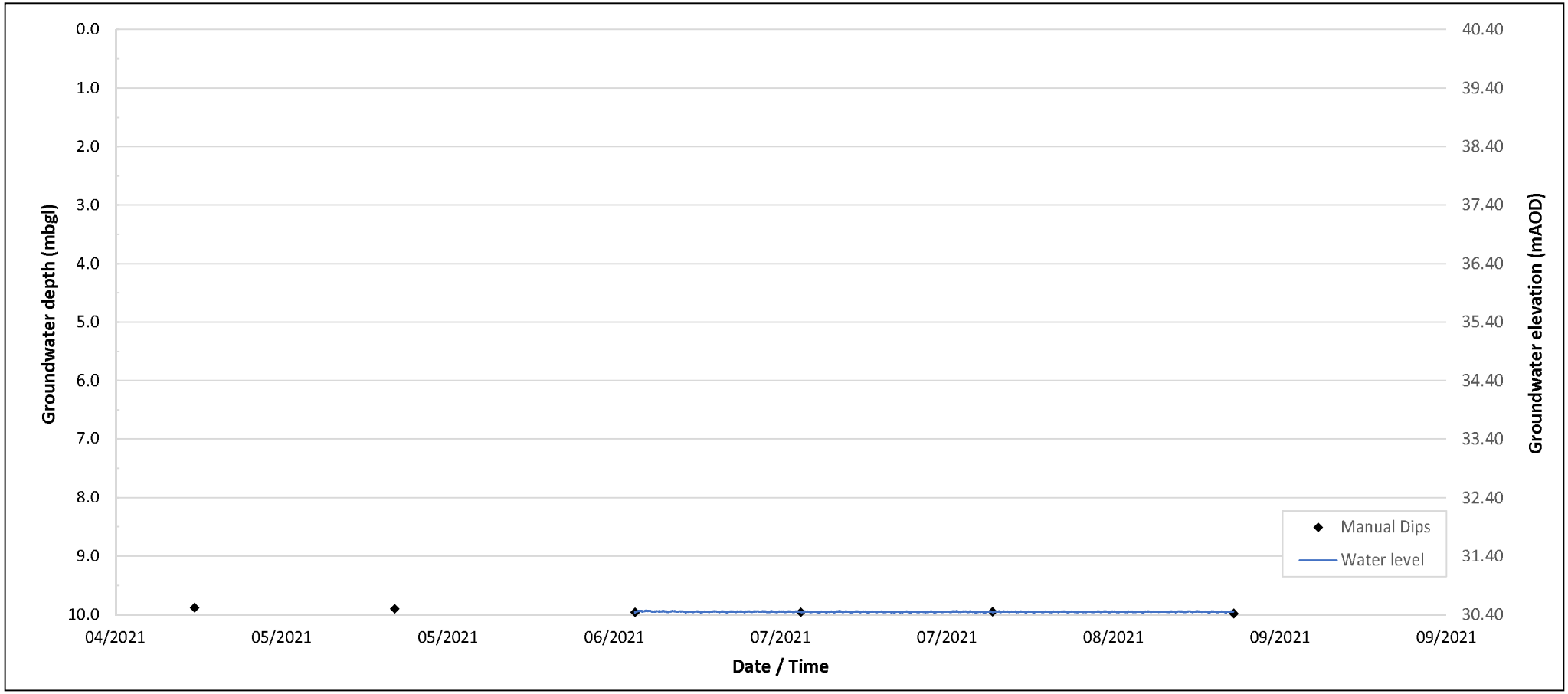
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3043**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **CD746** INSTALLATION DATE: **15/06/2021**

NOMINAL INSTALLATION DEPTH: **10.00mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **9.96mbgl on 05/07/2021 10:38**

WELL DETAILS

EASTING (m): **591257.0** NORTHING (m): **223288.5** ELEVATION (mAOD): **40.40**

WELL DEPTH: **10.00mbgl** TOP OF RESPONSE ZONE: **5.00mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **10.00mbgl**

REMARKS

CONTRACT	CHECKED
36104	**DM**

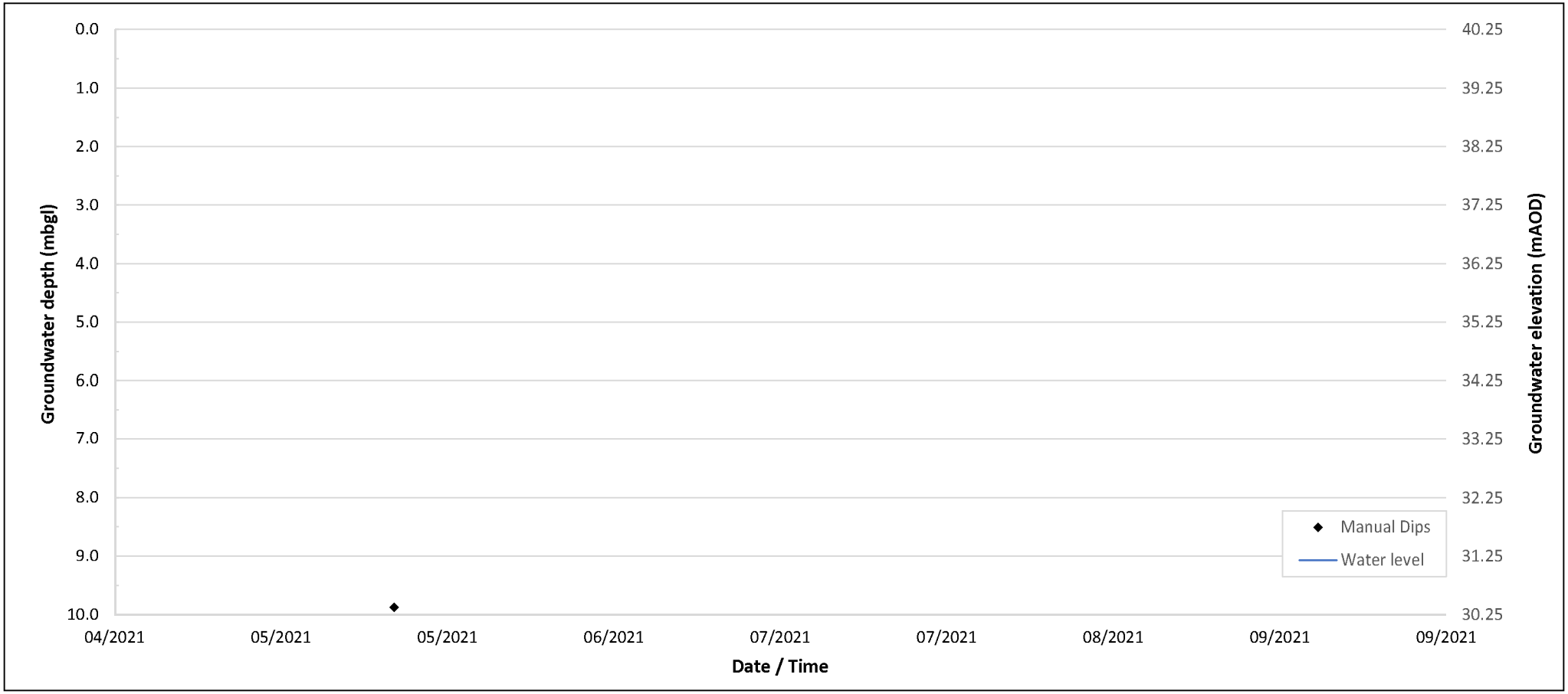
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3046**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD749**	INSTALLATION DATE:	**14/06/2021**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**9.80mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**591459.0**	NORTHING (m):	**223486.0**	ELEVATION (mAOD):	**40.25**
CALIBRATION DIP:	**See below.**			WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**6.00mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.00mbgl**		

REMARKS

Well recorded as dry during monitoring visits on 23/04/2021, 17/05/2021, 14/06/2021, 05/07/2021, 28/07/2021 and 26/08/2021.

CONTRACT	CHECKED
36104	**DM**

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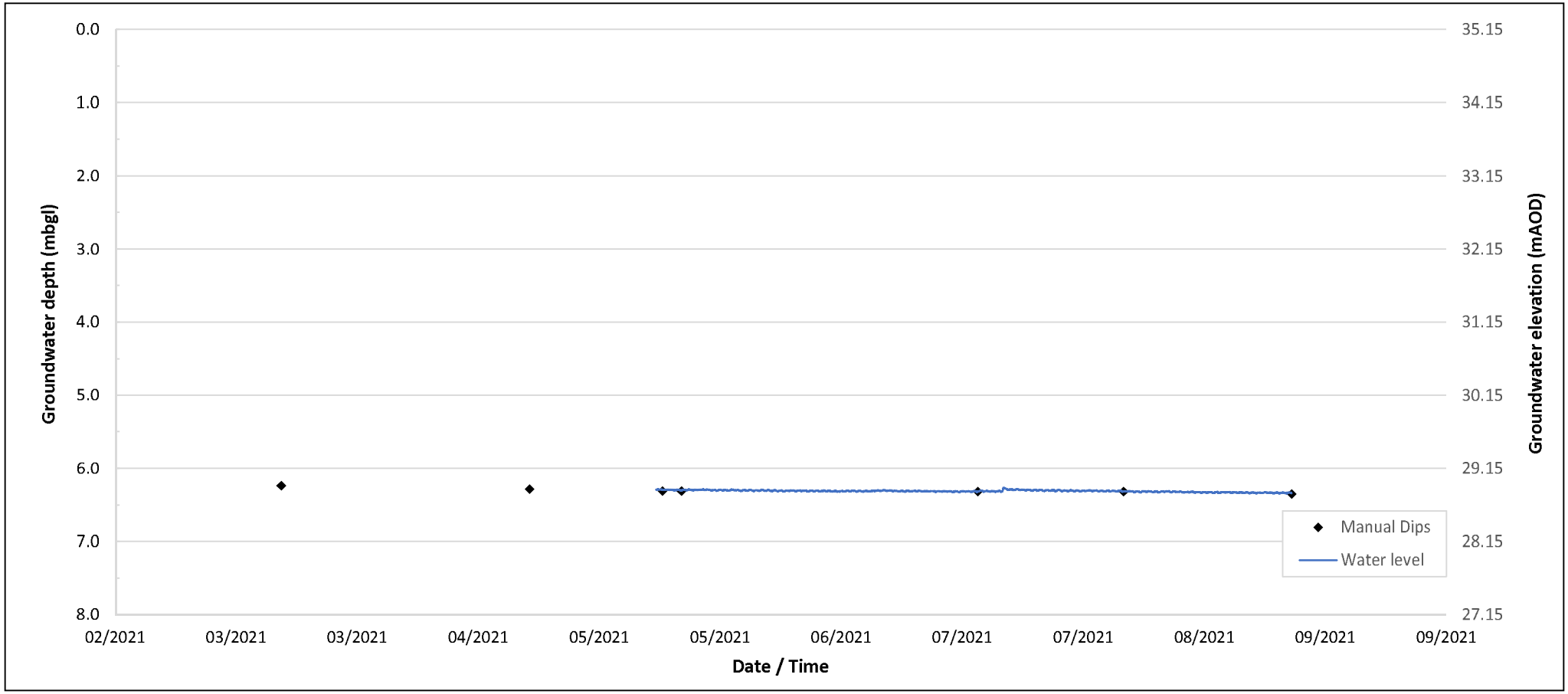
WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3049A**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**BZ612**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**592218.5**	NORTHING (m):	**224039.0**	ELEVATION (mAOD):	**35.15**
NOMINAL INSTALLATION DEPTH:	**7.30mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**8.00mbgl**	TOP OF RESPONSE ZONE:	**4.00mbgl**		
CALIBRATION DIP:	**6.32mbgl on 05/07/2021 14:12**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**8.00mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

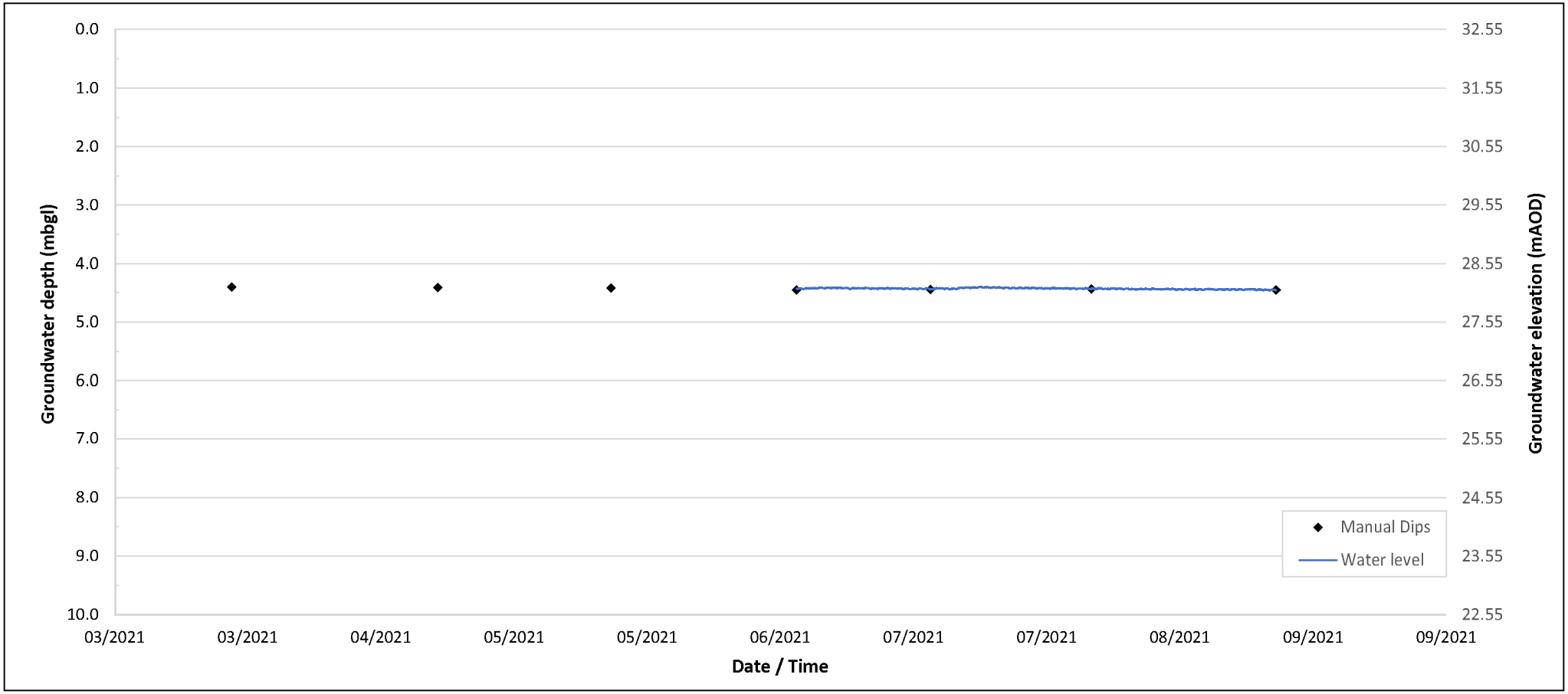
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3051**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD765**	INSTALLATION DATE:	**15/06/2021**	EASTING (m):	**592331.0**	NORTHING (m):	**224108.5**	ELEVATION (mAOD):	**32.55**
NOMINAL INSTALLATION DEPTH:	**9.27mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**2.00mbgl**		
CALIBRATION DIP:	**4.44mbgl on 05/07/2021 13:38**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.15mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

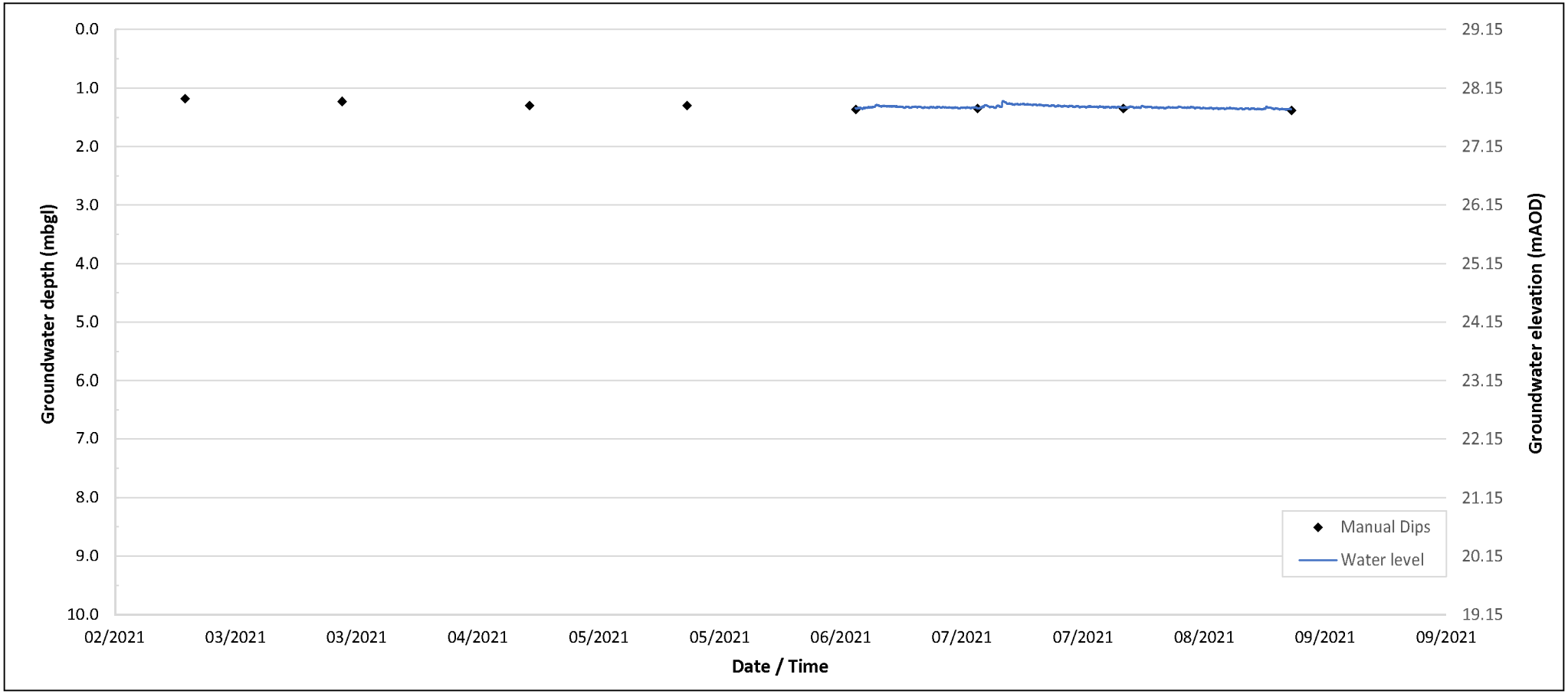
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3053**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD782**	INSTALLATION DATE:	**15/06/2021**	**WELL DETAILS**					
NOMINAL INSTALLATION DEPTH:	**9.24mbgl**	RECORDING FREQUENCY	**1 hour**	EASTING (m):	**592491.0**	NORTHING (m):	**224197.0**	ELEVATION (mAOD):	**29.15**
CALIBRATION DIP:	**1.35mbgl on 05/07/2021 13:48**			WELL DEPTH:	**10.00mbgl**	TOP OF RESPONSE ZONE:	**2.00mbgl**		
				WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**10.45mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

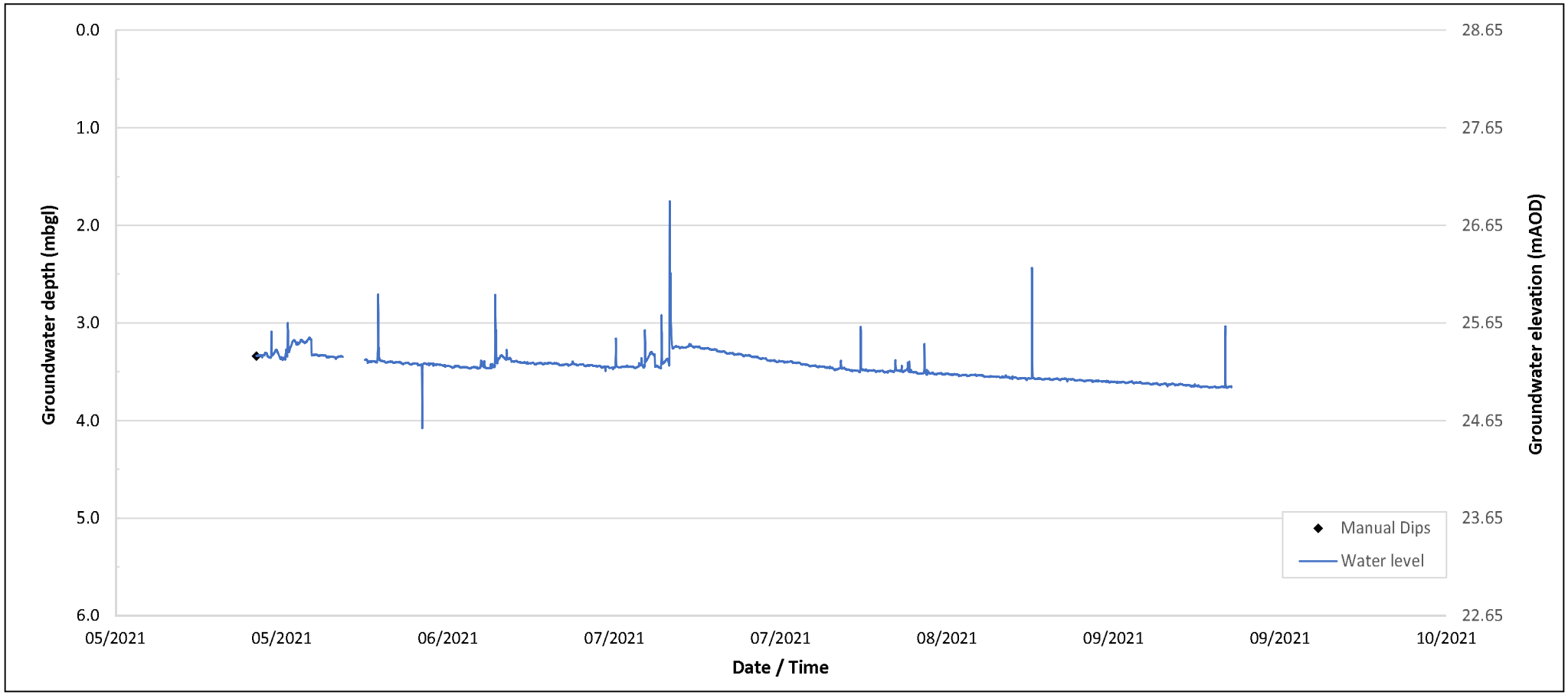
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **BH3054**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.: **40772905/DD081** INSTALLATION DATE: **20/05/2021**

NOMINAL INSTALLATION DEPTH: **5.20mbgl** RECORDING FREQUENCY **1 hour**

CALIBRATION DIP: **3.34mbgl on 20/05/2021 21:53**

WELL DETAILS

EASTING (m): **592693.0** NORTHING (m): **224311.5** ELEVATION (mAOD): **28.65**

WELL DEPTH: **6.00mbgl** TOP OF RESPONSE ZONE: **1.40mbgl**

WELL DATUM: **0.00mbgl** BASE OF RESPONSE ZONE: **6.00mbgl**

REMARKS

No data collected between 31/05/2021 08:00 and 03/06/2021 00:00. Peaks in data attributed to heavy rainfall.

CONTRACT	CHECKED
36104	**DM**

Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3405**

DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**AE760**	INSTALLATION DATE:	**13/05/2021**	EASTING (m):	**587062.5**	NORTHING (m):	**218533.0**	ELEVATION (mAOD):	**29.85**
NOMINAL INSTALLATION DEPTH:	**4.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**0.80mbgl**		
CALIBRATION DIP:	**2.61mbgl on 13/05/2021 11:08**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.45mbgl**		

REMARKS

Monitoring well developed (pumped dry) on 26/05/2021, minimum level recorded by the diver reflects diver installation depth.

CONTRACT	CHECKED
36104	**DM**

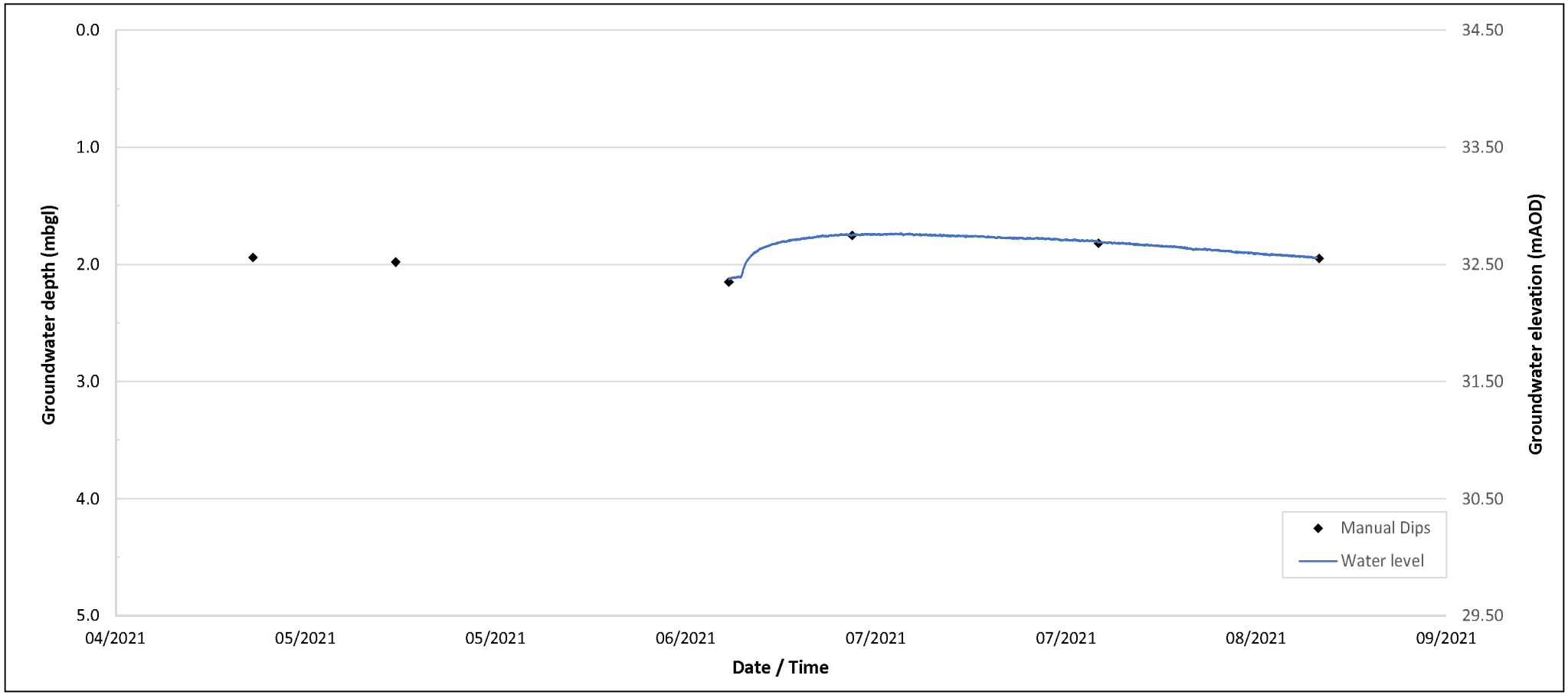
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3406**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD763**	INSTALLATION DATE:	**17/06/2021**	EASTING (m):	**587326.5**	NORTHING (m):	**218686.5**	ELEVATION (mAOD):	**34.50**
NOMINAL INSTALLATION DEPTH:	**4.59mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**0.80mbgl**		
CALIBRATION DIP:	**1.75mbgl on 30/06/2021 12:05**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.45mbgl**		

REMARKS

CONTRACT	CHECKED
36104	**DM**

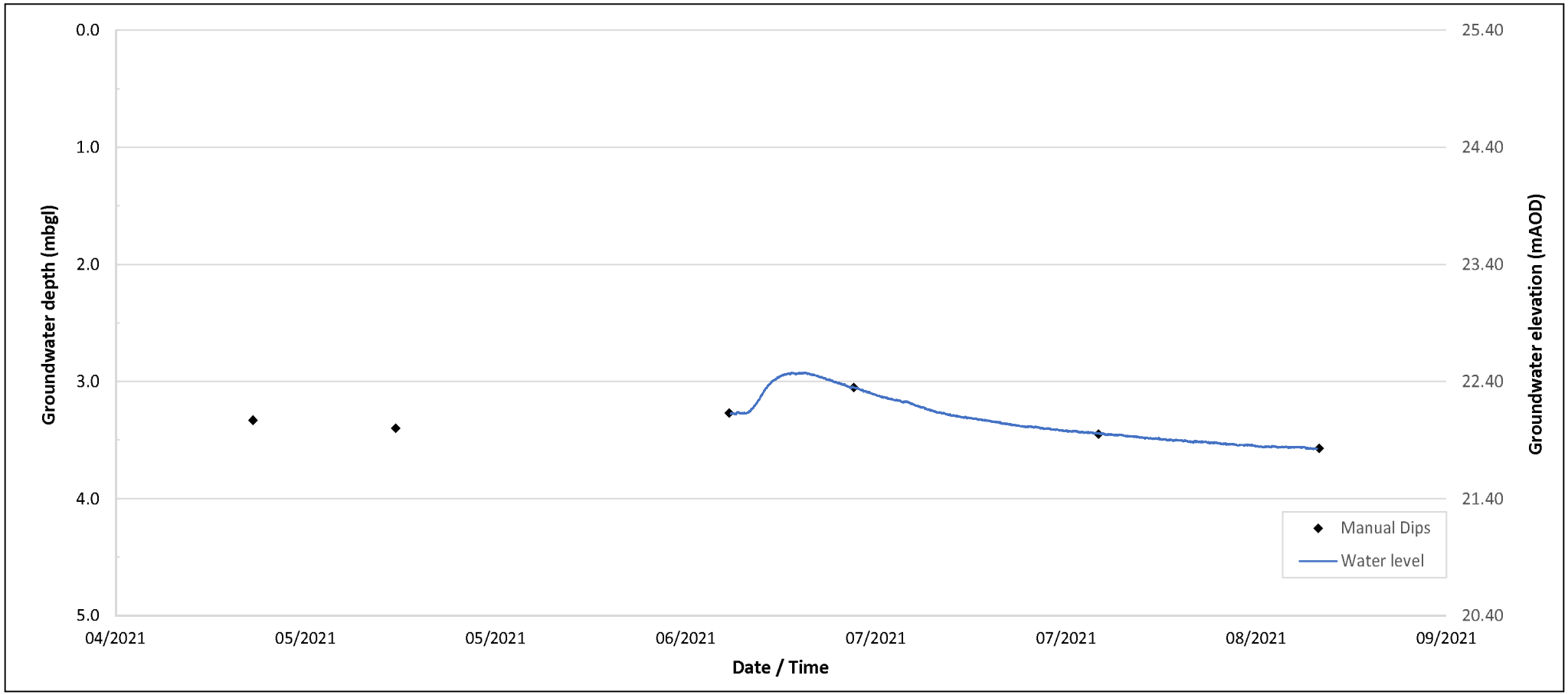
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3408**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**DG840**	INSTALLATION DATE:	**17/06/2021**	EASTING (m):	**587240.0**	NORTHING (m):	**218833.0**
NOMINAL INSTALLATION DEPTH:	**4.29mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**0.80mbgl**
CALIBRATION DIP:	**3.05mbgl on 30/06/2021 16:40**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.45mbgl**

			ELEVATION (mAOD): **25.40**

REMARKS

CONTRACT	CHECKED
36104	**DM**

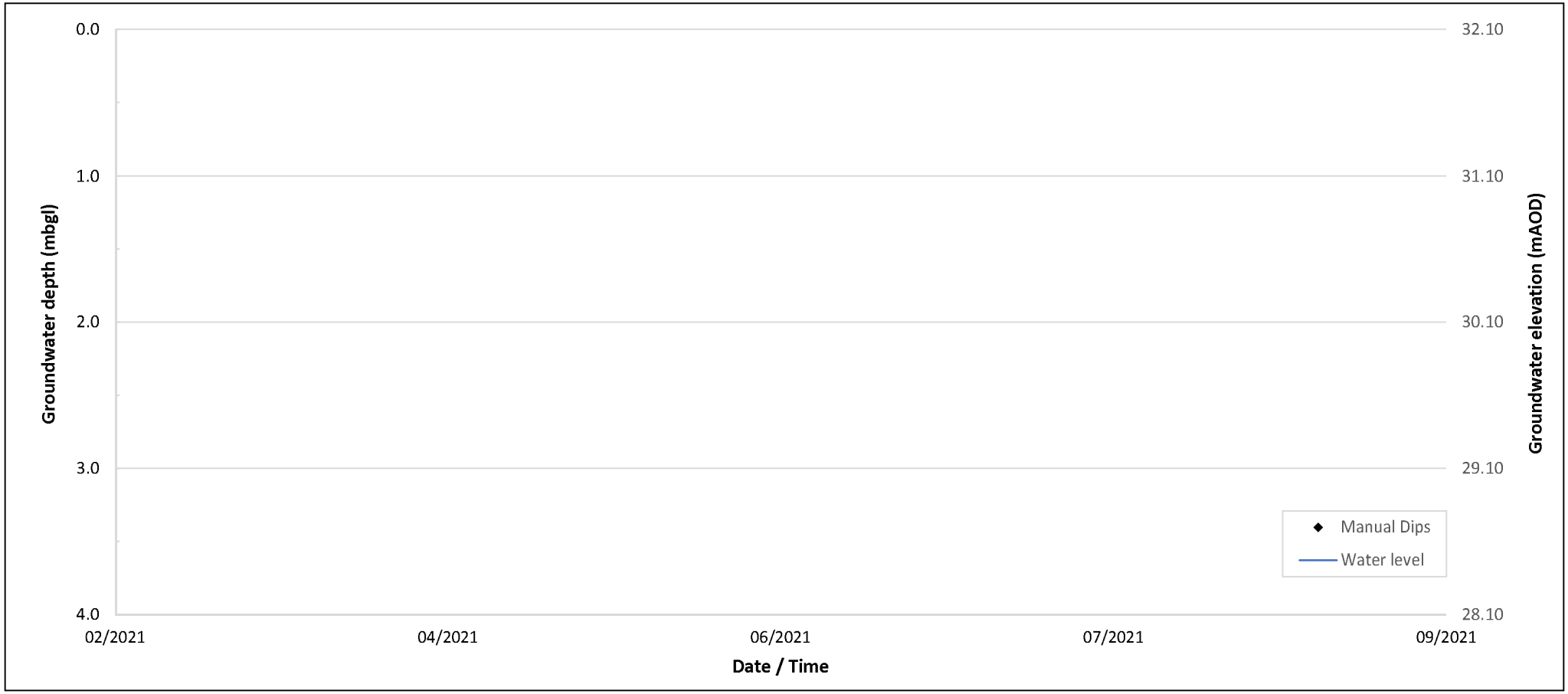
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3418**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD726**	INSTALLATION DATE:	**15/06/2021**	EASTING (m):	**588416.5**	NORTHING (m):	**220620.5**
NOMINAL INSTALLATION DEPTH:	**4.00mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**4.00mbgl**	TOP OF RESPONSE ZONE:	**1.00mbgl**
CALIBRATION DIP:	**See below.**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**4.00mbgl**

WELL DETAILS ELEVATION (mAOD): **32.10**

REMARKS

Well recorded as dry during monitoring visits on 14/04/2021, 14/05/2021, 15/06/2021, 02/07/2021, 27/07/2021 and 20/08/2021.

CONTRACT	CHECKED
36104	**DM**

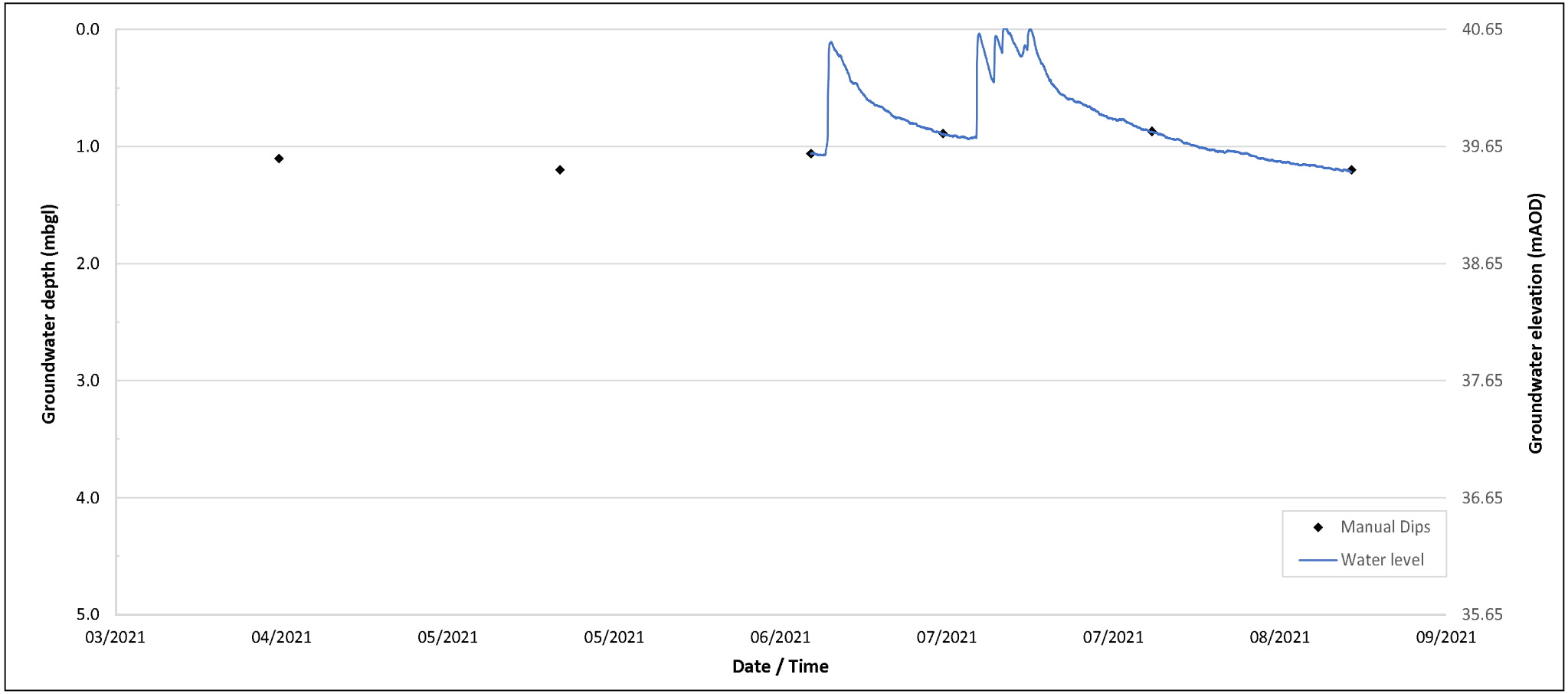
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3425**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD752**	INSTALLATION DATE:	**16/06/2021**	EASTING (m):	**589343.5**	NORTHING (m):	**221468.0**	ELEVATION (mAOD):	**40.65**
NOMINAL INSTALLATION DEPTH:	**4.26mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**1.00mbgl**		
CALIBRATION DIP:	**0.89mbgl on 02/07/2021 12:50**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.45mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

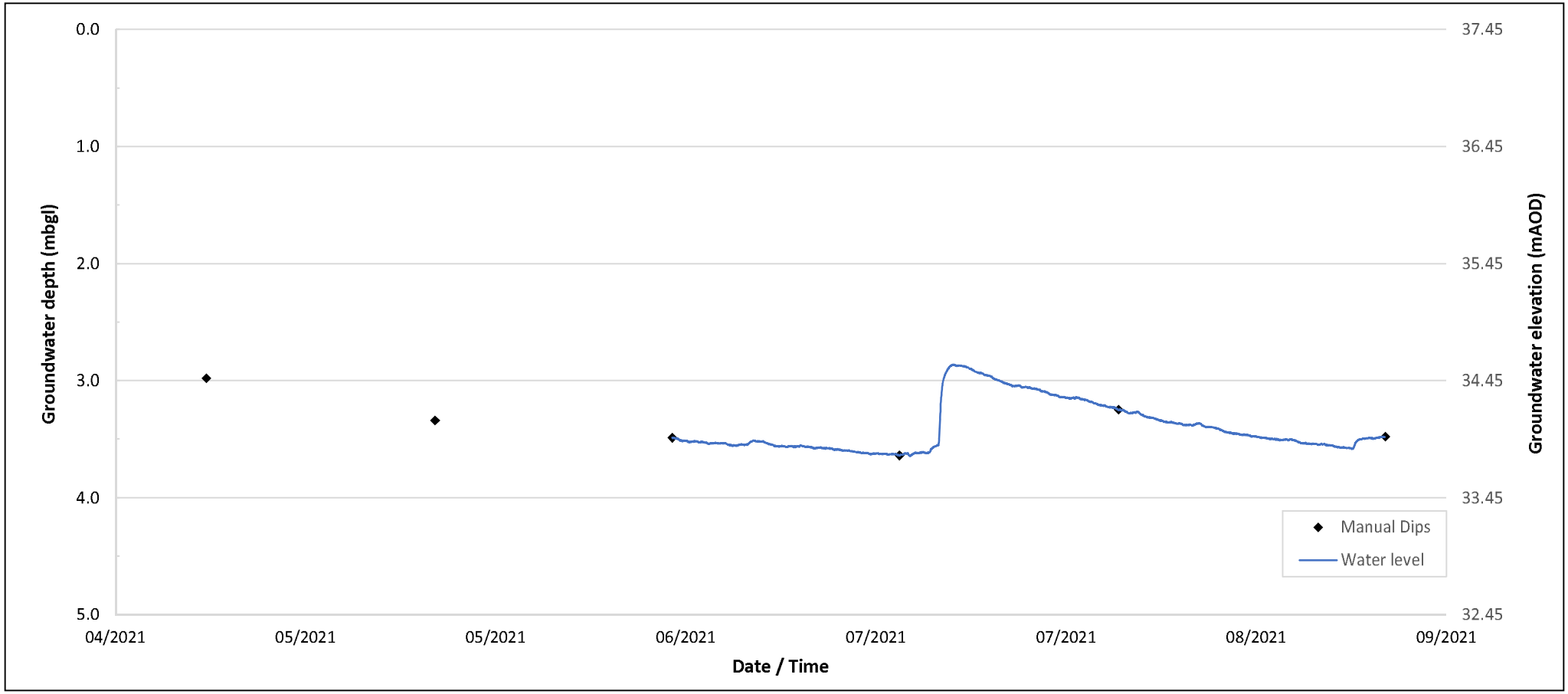
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3428**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**CD753**	INSTALLATION DATE:	**11/06/2021**	EASTING (m):	**590415.5**	NORTHING (m):	**222112.5**	ELEVATION (mAOD):	**37.45**
NOMINAL INSTALLATION DEPTH:	**4.84mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**4.00mbgl**		
CALIBRATION DIP:	**3.64mbgl on 05/07/2021 12:04**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.00mbgl**		

WELL DETAILS

REMARKS

CONTRACT	CHECKED
36104	**DM**

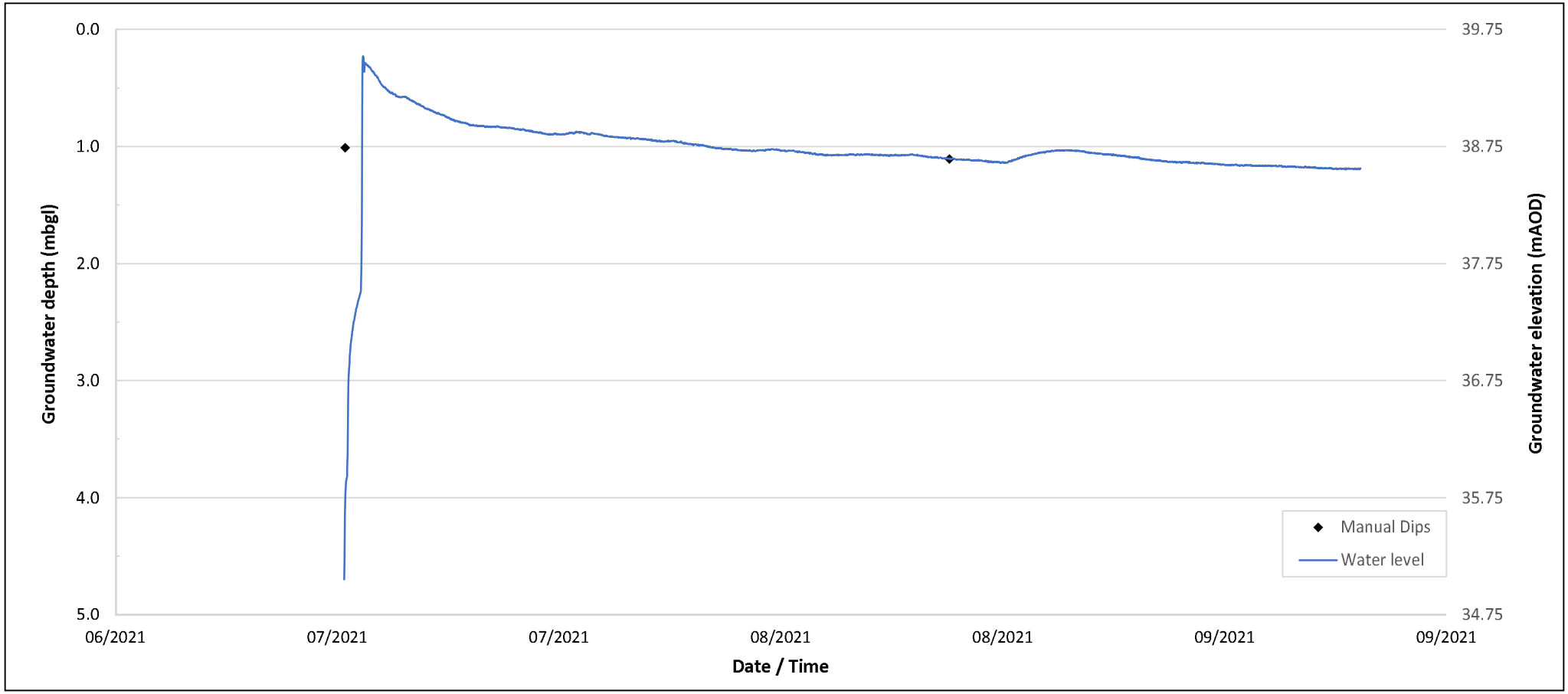
Geotechnical Engineering Limited

WATER LEVELS

CLIENT COSTAIN

SITE A12 CHELMSFORD TO A120 - PHASE 3 JUNCTION 23 TO 25 PRELIMINARY GI

BOREHOLE **WS3431**



DATALOGGER INSTALLATION DETAILS

DATALOGGER SERIAL NO.:	**40798750/CD654**	INSTALLATION DATE:	**08/07/2021**	EASTING (m):	**590895.5**	NORTHING (m):	**222338.5**
NOMINAL INSTALLATION DEPTH:	**4.70mbgl**	RECORDING FREQUENCY	**1 hour**	WELL DEPTH:	**5.00mbgl**	TOP OF RESPONSE ZONE:	**1.00mbgl**
CALIBRATION DIP:	**1.105mbgl - 18/08/2021 10:05**			WELL DATUM:	**0.00mbgl**	BASE OF RESPONSE ZONE:	**5.45mbgl**

WELL DETAILS

ELEVATION (mAOD): **39.75**

REMARKS

Limited permission to access position. Initial dip was taken prior to purging well dry before diver installation.

CONTRACT	CHECKED
36104	**DM**