

FIVE ESTUARIES OFFSHORE WIND FARM

10.65 OUTLINE GROUNDWATER MONITORING PLAN

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DEFINITION OF ACRONYMS

Term	Definition
GWRA	Groundwater Risk Assessment
ECC	Export cable corridor
OnSS	Onshore Substation
GWMP	Groundwater Monitoring and Mitigation Plan
PWS	Private Water Supplies
DCO	Designated Consent Order
BGL	Below Ground Level
m	Metres
DWS	UK Drinking Water Standards
CoCP	Code of Construction Practice

1. BACKGROUND

- 1.1.1 Based on the findings of the Groundwater Risk Assessment (GWRA) for the Five Estuaries Onshore Export Cable Corridor (ECC) and Onshore Substation (OnSS) a Groundwater Monitoring and Mitigation Plan (GWMP) is required to ensure that there are no adverse impacts from the construction phase on water supplies.
- 1.1.2 The GWRA has identified two Private Water Supplies (PWS) and one licenced abstraction which could potentially be impacted by the dewatering associated with the construction works during which regular monitoring will be required to ensure that there is no adverse impact on the supplies. A further five PWSs have also been recorded remote from dewatering activity but within close proximity to other construction activity which could impact water quality for which confirmatory monitoring is proposed to ensure that there is no adverse impact on the water quality.
- 1.1.3 This outline GWMP will be confirmed following finalised design of the works, construction techniques and confirmation of need from the water users. The final GWMP, produced in accordance with this outline, will be submitted for approval to the relevant authorities and secured through a Designated Consent Order (DCO) requirement.

2. MONITORING AND SAMPLING PLAN

- 2.1.1 The proposed outline monitoring plan is based on the water quality testing requirements for private water supplies as outlined within 'The Private Water Supplies (England) Regulations, 2016) and will be completed throughout the proposed construction phase of development.
- 2.1.2 Two monitoring suites are proposed;
 - (a) All supplies within 100m of possible dewatering activity will monitor all parameters outlined in Part I and Part II of Schedule 1 of the regulations and will undertake frequent water level monitoring; and
 - (b) All supplies between in excess of 100m from possible dewatering but in close proximity to construction activity which could impact water quality will monitor a reduced suite of indicator determinands, as outlined by Part II of Schedule 1 of the regulations

2.2 MONITORING LOCATIONS

2.2.1 Monitoring will be completed from the PWS and licenced abstraction locations outlined in Table 2-1, unless agreed with the landowner that monitoring is not required, for example if the abstractions are no longer in use. Locations are presented on Figure 1.

TABLE 2-1: PROPOSED GROUNDWATER MONITORING LOCATIONS

Location ID	Location Name	National Grid Reference (NGR)	Distance from Potential Dewatering
PWS008	Normans Farm	TM 08463 28479	<100m
PWS001	Paynes Cottage	TM 10147 27445	
A10	Dairy House Farm	TM 20981 18927	
PWS002	Little Bromley Hall	TM 09153 27904	100 – 250m
PWS004	Little Bromley Hall	TM 09086 27931	
PWS011	Oakwood	TM 10633 27067	
PWS013	Craigus	TM 10913 26945	
PWS014	Orchard Cottage	TM 10695 27054	

2.3 DURATION OF MONITORING

2.3.1 Monitoring would be undertaken during the construction phase, the exact timing of which will be determined by any on-site activities. Monitoring would commence a minimum of 1 month prior to any works within a 250m radius of the water supply and would continue for a period of up to 3 months following cessation of works. The frequency of monitoring is based on the sensitivity of the water supply and is presented in Section 2.5.

2.4 METHODOLOGY AND PROCEDURE

2.4.1 The requirement for monitoring will be agreed with the landowner prior to the commencement of the construction phase of development. Where it is agreed that there is no requirement for the groundwater supply during the construction phase (i.e. due to the availability of alternate supply or lack of need) then there will be no requirement for the extended monitoring suite and only pre-commencement and post-development confirmatory monitoring will be required.

LEVEL MONITORING

- 2.4.2 Continuous monitoring of water levels has been proposed for the three supplies located within 100m of the cable route whilst any dewatering is being undertaken within the trenches, unless agreed otherwise with the land-owner. Monitoring should be completed using automated water level loggers and include barometric compensation. The monitoring frequence should be suitable to allow for recording of daily changes in water level.
- 2.4.3 Routine monitoring is also proposed for locations in excess of 100m of the cable route and during periods where no dewatering is being undertaken. Routine monitoring should be undertaken using a calibrated dip meter and the dip to water from both the top of well and ground level recorded in addition to the dip to base.

SAMPLE COLLECTION

- 2.4.4 The choice of sampling technique utilised will be at the discretion of the contractor used and the nature of the water supply. The water supply should be taken prior to any local treatment (i.e. from the well rather than the tap). Where the well has not been in regular use samples should be taken following either of the approaches below:
 - (a) pumping: boreholes are purged prior to sampling using either a submersible or surface mounted pump. Three (3) well volumes should be purged where possible to remove stagnant water from the borehole and allow fresh water to be sampled; or
 - (b) bailing: the same approach should be used when using a bailer for sampling with three well volume purged using the bailer prior to sampling to allow fresh water to be sampled;

SAMPLE PREPARATION. PRESERVATION AND TRANSPORT

- 2.4.5 In accordance with best practice filtration should take place in the field for dissolved heavy metals using a 0.45µm in-line filter, in order to prevent precipitation of metal species. Typically filtered water is placed in a 150ml plastic bottle containing nitric acid (to be confirmed with the chosen laboratory).
- 2.4.6 Samples should be filled to the top of the bottle neck until a meniscus forms. This ensures that all air has been excluded from the samples, which helps to prevent oxidation of the sample. It can also prevent removal of other dissolved gases from solution.
- 2.4.7 Samples should be delivered to the selected accredited laboratory with the relevant chain of custody form completed within 24 hours of sampling.

TESTING

2.4.8 Testing should be completed by an ISO/17025 accredited laboratory.

2.5 PROPOSED MONITORING SCHEDULE

2.5.1 The proposed monitoring schedule is outlined in Table 2.1 for supplies located within 100m of potential dewatering activity and in Table 2.2 for supplies located at risk from water quality impacts, as noted above the requirement for monitoring will be agreed with the supply owner prior to commencement of works and locations only monitored if the PWS is in use during the construction phase.

TABLE 2-2: GROUNDWATER MONITORING SCHEDULE – WATER SUPPLIES WITHIN 100M OF POTENTIAL DEWATERING

Location ID	Frequency	Monitoring Parameter	Notes	
PWS001 PWS008	Continuous – during periods of dewatering only	Groundwater Level (mBGL)	To commence 1 week prior to commencement of	
A10	Weekly	Field Measurements	dewatering until 1 week following cessation	
		pH, oxidation redox potential, dissolved oxygen, electrical conductivity, total dissolved solids, turbidity		
	Monthly	Field Measurements	To commence 1	
		pH, oxidation redox potential, dissolved oxygen, electrical conductivity, total dissolved solids, turbidity	month prior to commencement of any works within 100m radius of well until 3 months following cessation of	
		<u>Lab Measurements</u>	working	
		Groundwater Level, Coliforms, E.Coli, colony counts, Enterococci		
		Ammonium, Chloride, electrical conductivity, pH, Sulphate, Total Organic Carbon, Turbidity		
		Arclylamide, antimony, arsenic, benzene, benzo(a)pyrene, boron, bromate, cadmium,chromium VI Copper, cyanide, 1,2 dichloroethane, epichlorohydrin, fluoride, lead, mercury, nickel, nitrate, nitrite, Polycyclic aromatic hydrocarbons, selenium		
		Aluminium, iron, manganese, sodium, tetrachloromethane		

TABLE 2-3: GROUNDWATER MONITORING SCHEDULE: WATER SUPPLIES AT RISK FROM WATER QUALITY IMPACTS

Location ID	Frequency	Monitoring Parameter	Notes
PWS002 PWS004	Monthly	Groundwater Levels (mBGL), base of well	To commence 1 month prior to commencement of
PWS011		Field Measurements	
PWS013		pH, oxidation redox potential,	any works within 250m radius of well
PWS014		dissolved oxygen, electrical conductivity, total dissolved solids, turbidity	until 3 months following cessation of working
		Lab Measurements	_
		Ammonium, Chloride, electrical conductivity, pH, Sulphate, Total Organic Carbon, Turbidity	

2.6 RECORD KEEPING AND REPORTING

MONITORING AND SAMPLING RECORDS

- 2.6.1 During each monitoring event, the sampling personnel should record the following information:
 - > date of sampling;
 - > on-site weather condition;
 - > name of sampling personnel;
 - > sampling equipment, serial number and method;
 - > time at which water level was recorded and at which sample was taken;
 - volume of water purged from the groundwater monitoring well prior to sampling (if purging undertaken);
 - > response to pumping (pump rate, drawdown at end of pumping);
 - > observations including water colour, turbidity, odour;
 - > observations of damage to installations.

MONITORING DATABASE

2.6.2 The data collected from each monitoring visit should be inputted into a suitable, user-friendly database, for example Microsoft Excel.

QUALITY ASSURANCE AND QUALITY CONTROL

- 2.6.3 Monitoring and sampling should be undertaken in accordance with the proposed monitoring procedures by suitably trained personnel.
- 2.6.4 Monitoring instruments and equipment should be serviced and maintained in accordance with the manufacturers' recommendations. Calibration records should be kept and filed accordingly.
- 2.6.5 A suitably accredited laboratory should carry out analysis of groundwater samples.

2.7 MITIGATION PLANNING

WATER QUALITY

- 2.7.1 To ensure that there is no adverse impact on the water supplies the water quality data should be reviewed following each monitoring round and assessed against baseline data and relevant UK Drinking Water Standards (DWS), as outlined in 'The Water Supply (Water Quality) Regulations 2016'.
- 2.7.2 In the event of an exceedance of DWS the following measures would be undertaken:
 - > Request a re-test of the sample from the lab to ensure the results is correct;
 - Review the latest monitoring against the baseline water quality data collected prior to commencement of working to determine if the exceedance is consistent with baseline data;
 - > If the monitoring indicates a deterioration in water quality since baseline monitoring temporarily increased to weekly to allow for further review;
 - > Provide a provision for temporary alternate supply; and
 - Meanwhile complete assessment of potential on-site sources of impact to water quality and outline appropriate mitigation (if needed).

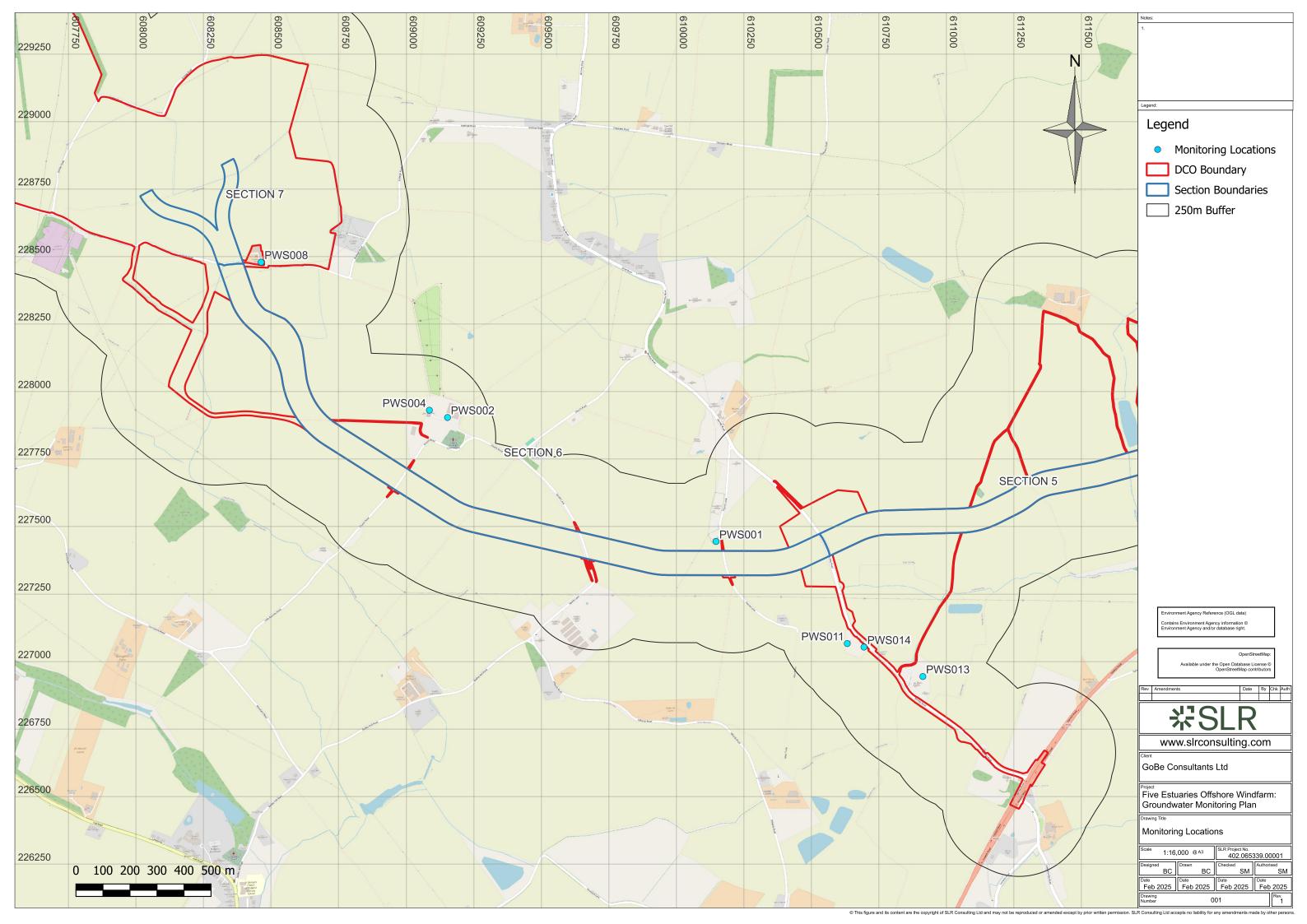
WATER LEVELS

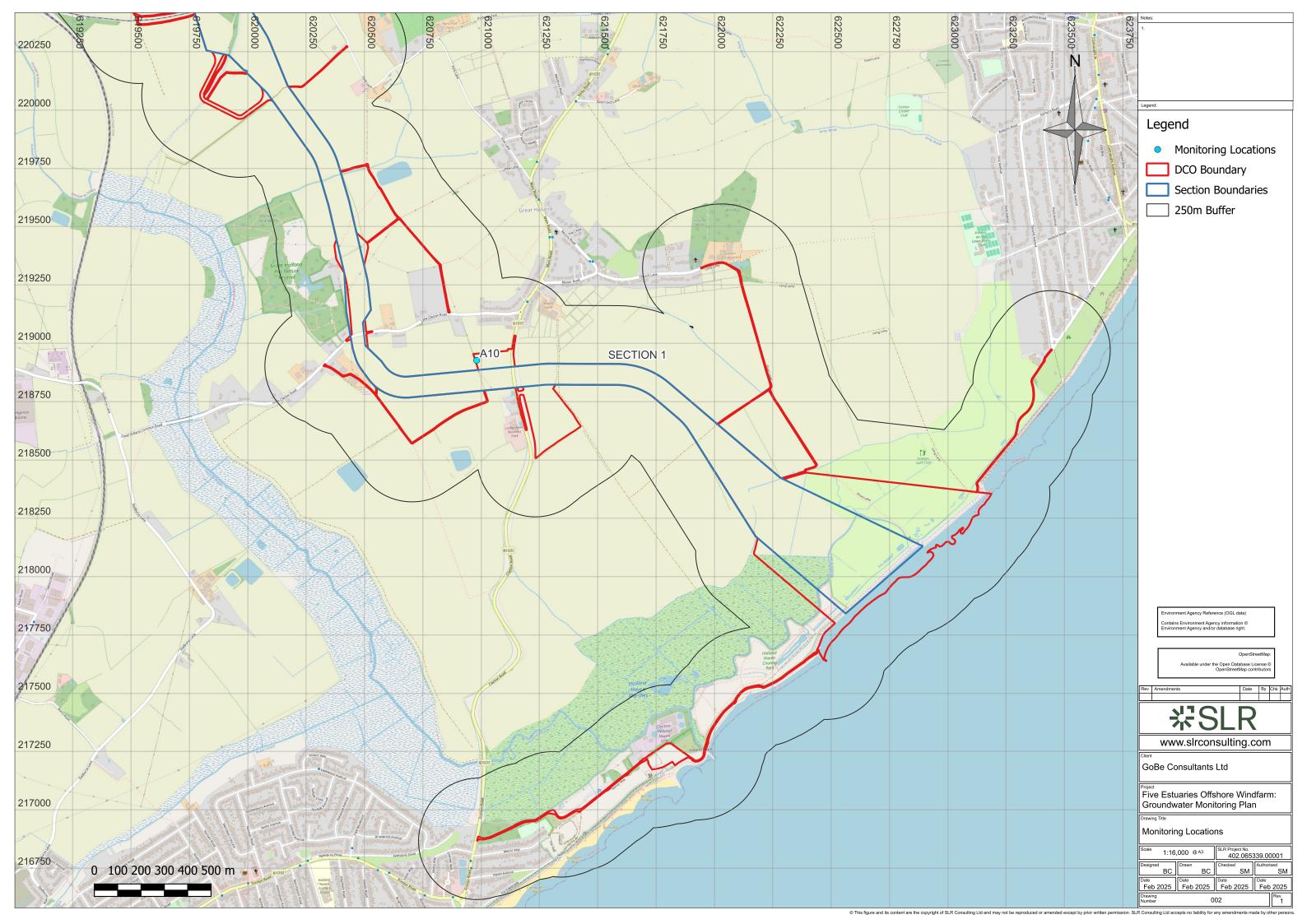
- 2.7.3 It is not proposed to stipulate trigger levels for level monitoring as it is noted that natural seasonal variation will potentially result in water levels dropping below the base of proposed excavations and could result in shallow wells running dry.
- 2.7.4 However, in the event of a landowner reporting a lack of supply the following measures should be undertaken:
 - > Temporarily cease dewatering to review monitoring data;
 - Review level monitoring and logger data to assess whether there has been a notable change in water levels since commencement of dewatering;
 - > If the review indicates a likely source then dewatering to be ceased until appropriate mitigation can be put into place; and
 - > If the monitoring indicates natural seasonal trends or alternate course for loss of supply then dewatering to recommence.
- 2.7.5 Any concerns raised from supply owners will be communicated through the community liaison officer, as outlined within the Code of Construction Practice (CoCP).

3. MITIGATION

- 3.1.1 In the unlikely event of an adverse impact on water quality appropriate mitigation will be put into place to provide either a temporary or permanent replacement to supply.
- 3.1.2 If a longer term impact were to occur, this would potentially include the drilling of a replacement well away from the current location to remove any impact on water quality or availability of supply.
- 3.1.3 If the impact is assessed as short duration due to dewatering then a temporary water supply (such as tankering/water bowser) could potentially be provided, to be agreed with the PWS owner.

FIGURE 1 MONITORING LOCATIONS







PHONE EMAIL WEBSITE ADDRESS

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