



The Sizewell C Project

6.14 Environmental Statement Addendum
Volume 3: Environmental Statement Addendum Appendices
Chapter 2 Main Development Site
Appendix 2.14.A Groundwater and Surface Water

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APPENDIX 2.14.A: WATER MONITORING AND RESPONSE STRATEGY

(UPDATED VOLUME 2, APPENDIX 19F OF THE
ENVIRONMENTAL STATEMENT)

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1. MONITORING AND RESPONSE STRATEGY

1.1 Introduction

1.1.1 As part of the development of the Sizewell C power station there is the potential for changes to occur to the groundwater flow regime at the site and in the surrounding area. In order to establish an understanding of the groundwater and surface water regime at the site, an ongoing adaptive monitoring programme has been in place since 2013. The monitoring network has frequently been reviewed and updated during that time to incorporate new boreholes installed as part of the various Ground Investigations (GIs) undertaken. Monitoring data underpins the groundwater assessment, including the numerical model, and provides confidence to stakeholders that the conceptual understanding of the groundwater and surface water system is well developed.

1.1.2 The environmental impact assessment, particularly in relation to sensitive groundwater dependent ecological receptors, relies on the outputs of predictive numerical modelling scenarios. In order to demonstrate the anticipated change in the water environment used to inform the assessment is in line with that which actually occurs, a specific programme of monitoring is proposed. This strategy sets out the principles of the monitoring, and the mitigation approach should monitoring identify that construction works within the main development site are leading to materially worse environmental effects on groundwater levels or quality at the site or surrounding area.

1.2 Current monitoring network

a) Groundwater

1.2.1 The current monitoring network includes 86 No. borehole locations for monitoring groundwater within the Sizewell C site and surrounding area. Locations are shown on **Figure 19.3** of this volume and listed in **Annex 19F.1**.

1.2.2 Data loggers are installed at 49 No. of the locations, providing a continuous record of groundwater levels across the site, with readings taken at 15-minute intervals. Of these loggers, 17 No. are Conductivity, Temperature and Depth Sensor (CTD) loggers, recording electrical conductivity and temperature as well as groundwater level. Manual water level measurements are taken monthly at all monitoring locations. As well as providing an instantaneous groundwater level record, these manual readings are used to ensure that the logger data is compensated correctly and that the loggers are fully functioning and recording accurate data.

1.2.3 Manual temperature level and conductivity reading profiling is carried out monthly at five crag boreholes (C1D, C2D, C3D, C4D, GW3). These temperature level and conductivity reading profiles provide an indication as to the depth of the saline interface at the site.

1.2.4 Low flow groundwater sampling is undertaken across the site as appropriate to provide a baseline water quality and hydrochemistry dataset and to inform ongoing assessments.

b) Surface water

1.2.5 The Sizewell Marshes Site of Special Scientific Interest (SSSI) contains a series of interconnected drainage ditch systems. In order to provide further understanding of the flows and surface water levels within the SSSI, a programme of velocity and stage monitoring at seven locations is currently implemented. The rationale for the location of the gauges, shown on **Figure 19.3** of this volume, is as follows:

- G5 – upstream location to monitor surface water inflows to the Sizewell Marshes SSSI through the Leiston drain, within the extent of the Aldhurst Farm Habitat Creation Scheme;
- G3 and G4 – control structures (weirs) located to determine the partitioning of flow between Leiston drain (G4) and Sizewell drain (G3) at the upstream end of the Sizewell Marshes SSSI;
- G6a and G7a – downstream locations in the Leiston drain (G6a) and Sizewell drain (G7a);
- G1 – downstream location to monitor total outflow from the Sizewell Marshes SSSI (downstream of the Leiston beck/Sizewell drain confluence) in the Leiston drain; and
- G8 – installed approximately 500m south of Minsmere Sluice in 2015 in order to monitor changes in flow and level in the Leiston drain downstream of G1.

1.2.6 Monitoring locations G1, G5, G6a, G7a and G8 all comprise a bed mounted echo-correlation sensor (Nivus) which records both velocity and stage. The velocity is output to the timeview telemetry system, however as only one parameter can be output using this method, separate impress pressure transmitters were installed to allow for stage data to also be received by telemetry. The telemetry system outputs the data to the timeview website once every 24 hours, allowing for swift, remote view of the telemetered parameters. Additionally, the loggers can be manually downloaded on site for review as required.

1.2.7 During each monthly site visit, vegetation and silt clearance is undertaken to reduce the chance of the velocity sensor becoming blocked. The two batteries that power each Nivus are replaced with recharged ones to ensure that data collection continues with minimal risk of disruption. The batteries are replaced at least once every 6 weeks in order to ensure that there is sufficient charge to power the instruments.

1.2.8 G3 and G4 do not use a Nivus sensor to estimate velocity rates – these instead use a v-notch weir-based system, with separate impress pressure transmitters installed to allow for stage data to be received by telemetry. These sites do not have batteries that require changing and operate from an internal power source. As with the other gauging stations, vegetation and silt clearance is carried out on a monthly basis to maintain the operation of the weir.

c) Weather station

1.2.9 A weather station is currently in place at the site which monitors multiple parameters, including rainfall. The data from the weather station is downloaded as part of the monthly site visit and the batteries replaced every 6 months.

1.3 Future monitoring strategy

a) Introduction

1.3.1 The assessment of potential changes to the water environment shows that the predicted changes are limited in extent, magnitude and duration such that **no significant** environmental impacts should occur. However, it is recognised that reassurance monitoring is required to demonstrate that the predicted change is realised, and not exceeded, as the project progresses.

1.3.2 The monitoring strategy set out in this document relates to the groundwater monitoring arrangements that would be undertaken to understand the effect of the proposed development on the site in comparison to baseline conditions and to validate the effectiveness of the mitigation measures implemented. The precise monitoring arrangements for the Sizewell Marshes SSSI would then be set out within a monitoring plan, developed following consultation with appropriate stakeholders. This monitoring plan could also be used to inform a revised Water Level Management Plan for the SSSI that would be prepared and owned by the Internal Drainage Board (IDB). Sentinel boreholes will be used to identify any potential changes that may extend to the Minsmere Walberswick Heaths and Marshes SSSI.

- 1.3.3 The monitoring plan would be submitted to East Suffolk Council for approval prior to the commencement of works in a defined area of land. The monitoring plan will define the proposed monitoring arrangements, such as water level, flow and water quality, and explain the relationship that these measures would have to monitoring that would be secured through other consents, licences or permitting regimes enacted by regulators and statutory authorities such as the Environment Agency and IDB.
- 1.3.4 Importantly, the monitoring plan would not seek to duplicate monitoring that is already secured and controlled by other consents, licences or permits. Instead, the monitoring plan will provide a single point of reference for East Suffolk Council and other statutory bodies and demonstrate compliance with the monitoring requirements secured by each of the permits and licences.
- 1.3.5 The monitoring plan will initially be based on the continuation of baseline monitoring in terms of frequency, locations, and collection of the same data type. It will be reviewed annually for the first five years, or as required by the addition of new and related permits, and proactively managed through the permitting regime such that additional monitoring points will be incorporated as necessary to ensure adequate coverage is maintained throughout all phases of the proposed development. The timing and frequency of reviews of the monitoring plan is expected to be on an annual basis, but will be agreed as part of the permitting regime.

b) Monitoring approach

- 1.3.6 The aims of the monitoring strategy are as follows:
- to collect appropriate monitoring data to facilitate comparison with the long-term baseline dataset;
 - be adaptive such that as the proposed development evolves, suitable monitoring is in place throughout e.g. installation of additional monitoring infrastructure to validate the performance of the cut-off wall prior to commencement of dewatering;
 - to provide sufficient reassurance monitoring data to allow comparison between actual and predicted water levels;
 - provide sentinel boreholes to test that there is no change extending to other sensitive receptors such as the Minsmere Walberswick Heaths and Marshes SSSI;
 - to facilitate ongoing engagement with Suffolk Wildlife Trust; and

- a framework of 'trigger' and 'action' levels to determine when management actions are required will be agreed with stakeholders. These 'trigger' and 'action' levels will be secured through the formal permitting and licensing regimes. The formal process to be followed in determining levels will depend on the nature of the activity and the appropriate permitting and/or licensing regime with which the activity must comply. These may be captured in an updated Water Level Management Plan for the Sizewell Marshes SSSI, or implemented as a standalone control measure. The monitoring plan will provide the mechanism to assess whether these actions are needed.

1.3.7 In addition to ongoing groundwater and surface water monitoring, there will be continued monitoring of vegetation to establish ecological changes. Should monitoring identify ecological change attributed to hydrological change as led from construction works within the main development site (i.e. materially worse environmental effects on groundwater levels or quality at the site or surrounding area) this would lead to a review of the previously agreed trigger levels and corrective action being taken accordingly.

1.3.8 In addition to ongoing groundwater and surface water monitoring, there will be continued monitoring of vegetation to establish ecological changes. Should ecological monitoring identify that construction works within the main development site are leading to materially worse environmental effects on groundwater levels or quality at the site or surrounding area, a review of the trigger levels and corrective action would be undertaken.

c) **Proposed monitoring principles**

1.3.9 The existing monitoring network is appropriate for the site in its present state and is likely to continue to be so during early stages of construction such as site clearance. However, as construction progresses, and the site moves into subsequent phases, the monitoring requirements will change.

1.3.10 The monitoring plan will be kept as a live document and revised regularly to ensure it remains fit for purpose for the activities being undertaken at the site. The monitoring plan, including any revisions, would be developed following consultation with East Suffolk Council, Suffolk County Council, the Environment Agency, Natural England and Suffolk Wildlife Trust, as appropriate.

1.3.11 Updates to the monitoring plan will be undertaken in line with the following principles:

- the monitoring undertaken should be proportionate to risk;

- the monitoring requirements should be informed by the outcome of assessment;
- the monitoring should take into consideration the extensive baseline monitoring dataset;
- the monitoring should make use of the existing monitoring infrastructure where possible;
- the monitoring will focus on the impact of the proposed development on the Sizewell Marshes SSSI and Minsmere Walberswick Heaths and Marshes SSSI; and
- the monitoring network will be adaptive and dependent on the project phase and the data/assessment requirements. The network will incorporate additional monitoring points introduced during future GIs as appropriate.

d) **Mitigation approach**

- 1.3.12 The Environmental Statement considers the potential significant effects on groundwater by using a source-pathway-receptor model and proposes mitigation that seeks to avoid and reduce any significant effects.
- 1.3.13 The ES defines the mitigation measures that are proposed, with the precise details would be defined in accordance with the parameters set out in this monitoring and response strategy. The details would then be secured through the permitting and licensing regimes prior to relevant activities or works commencing. This strategy also considers the vulnerability of receptors to change, and identifying trigger levels and appropriate responses should a previously unforeseen pathway emerge.
- 1.3.14 An adaptive trigger level approach will be taken, in line with the following principles:
- change from baseline conditions identified;
 - plan to prepare for pre-determined action; and
 - the implementation of mitigation.
- 1.3.15 This would be implemented as a standalone control measure but could be used by the IDB to inform any update to the Water Level Management Plan for Sizewell Marshes SSSI.

- 1.3.16 Trigger levels would be defined, which would relate to the degree of change observed such as change in level or flow, and duration of the change. Each trigger level would involve suitable intervention to avoid or mitigate predicted significant environmental effects on groundwater or the site or surrounding area. For example, this may require altering the management arrangements for existing and proposed water control structures within the Sizewell Marshes SSSI to modify the movement of water through the wetland.
- 1.3.17 The trigger levels would be developed to be cognisant of the sensitivity of the receptor to the potential impact identified. The monitoring plan would include a mitigation toolkit which would identify the type of mitigation that would be put in place if defined trigger levels were reached.
- 1.3.18 Where mitigation measures identified in the mitigation toolkit related to actions of issues that would be secured by other permits and licences, then the monitoring plan would not seek to duplicate these controls.
- 1.3.19 It is envisaged that the principal mitigation options would relate to the new control structure to be installed at the northern end of the realigned Sizewell drain and operational practice within the Sizewell Marshes SSSI. Consequently, this approach is consistent with the existing operational management regime within the system.
- 1.3.20 The entire process would have continued oversight by appropriate technical specialists, in conjunction with key stakeholders, who would provide advice on the trigger levels reached, the levels of intervention and the subsequent mitigation requirements.
- 1.4 **Summary**
- 1.4.1 A comprehensive monitoring network is currently in place at the site, the locations of which are presented on **Figure 19.3** of this volume and listed in **Annex 19F.1**. The network includes 86 No. groundwater monitoring locations, seven surface water monitoring locations and a weather station.
- 1.4.2 The assessment of potential changes to the water environment shows that the predicted changes are limited in extent, magnitude and duration such that no significant environmental impacts should occur. However, it is recognised that reassurance monitoring is required to demonstrate that the predicted change is realised, and not exceeded, as the Sizewell C Project progresses. All of the monitoring requirements will be captured in a monitoring plan which shall be agreed prior to the commencement of works.

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- 1.4.3 The monitoring plan itself will not act as a formal mechanism to secure monitoring requirements, rather it will collate monitoring requirements secured by each of the permits and licences.
 - 1.4.4 The monitoring plan will initially be based on the continuation of the baseline monitoring programme. The plan will be regularly reviewed and proactively managed to ensure that adequate coverage is maintained throughout all phases of the proposed development.
 - 1.4.5 The monitoring will be focused in the areas where the assessment modelling showed potential change to occur, e.g. Sizewell Marshes SSSI, however sentinel boreholes will be incorporated to demonstrate that the change does not extend to other sensitive receptors.
 - 1.4.6 A framework of ‘trigger’ and ‘action’ levels to determine when management actions are required will be set out within the monitoring plan, that would be submitted to East Suffolk Council for approval, following consultation with relevant stakeholders. This would be implemented as a standalone control measure. The monitoring plan will provide the mechanism to assess whether and when these actions are implemented.

FIGURES

Environmental Statement, Volume 2, Figure 19.3 – Sizewell C Monitoring Locations

ANNEX 19F.1 MONITORING LOCATION LIST

Table 1.1: Monitoring location list.

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
P1	-	646986	263819	0.484	1.99	Peat	Manual dip and WL logger download.
P2	-	646855	263748	0.609	1.99	Peat	Manual dip and WL logger download.
P3	-	646478	263761	0.951	1.97	Peat	Manual dip and WL logger download.
P4	-	646935	264023	0.526	1.99	Peat	Manual dip and WL logger download.
P5	-	646724	263987	0.776	1.99	Peat	Manual dip and WL logger download.
P6	-	646525	264105	0.813	1.94	Peat	Manual dip and WL logger download.
P7	-	647029	264188	0.704	1.98	Peat	Manual dip and WL logger download.
P8	-	646809	264246	0.654	1.98	Peat	Manual dip and WL logger download.
P9	-	646665	264287	0.762	1.95	Peat	Manual dip and WL logger download.
P10	-	647323	264466	0.544	1.99	Peat	Manual dip and WL logger download.
P11	-	647189	264376	0.435	1.98	Peat	Manual dip and WL logger download.
P12	-	646923	264427	0.766	1.97	Peat	Manual dip and WL logger download.
P13	-	647426	264795	0.516	1.85	Peat	Manual dip and WL logger download.
P14	-	646742	263648	0.746	1.98	Peat	Manual dip and WL logger download.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
P15	-	646520	263856	0.684	1.97	Peat	Manual dip and WL logger download.
PZ2009_2	MPM2009_7A	647346	264112	1.760	46.80	Crag	Manual dip and WL logger download.
PZ2009_3	MPM2009_4A	647352	264218	1.560	47.95	Crag	Manual dip and WL logger download.
PZ2009_5	DBH2009_5	647305	264094	1.414	21.32	Sand	Manual dip and WL logger download.
PZ2009_6	DBH2009_6	647249	264095	1.513	21.61	Sand	Manual dip and WL logger download.
PZ2009_7	DBH2009_7	647088	264094	1.694	20.90	Sand	Manual dip and CTD logger download.
PZ2009_8	DBH2009_8	647339	264095	1.674	35.82	Sand	Manual dip and WL logger download.
PZ2009_10	DBH2009_10	647411	264095	1.784	35.98	Sand	Manual dip and CTD logger download.
PZ2009_11	DBH2009_11	647560	264095	3.253	20.50	Sand	Manual dip and CTD logger download.
PZ2009_13	DBH2009_13	647330	263969	2.052	20.64	Sand	Manual dip and CTD logger download.
PZ2009_14	DBH2009_14	647330	263846	6.270	20.63	Sand	Manual dip and CTD logger download.
PZ2009_15	CBH2009_5	647191	264181	1.281	40.38	Crag	Manual dip and CTD logger download.
PZ2009_16	CBH2009_7	647059	263872	3.583	56.50	Crag	Manual dip and CTD logger download.
PZ2009_17	DBH2009_15	647156	264674	6.036	21.35	Sand	Manual dip and CTD logger download.
PZ2009_18	GW6D	647289	264397	0.710	14.24	Crag	Manual dip and CTD logger download.
PZ2009_19	GW5	646846	264688	6.996	12.38	Crag	Manual dip and WL logger download.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
PZ2009_20	GW4	646262	264492	7.171	11.66	Crag	Manual dip and CTD logger download.
PZ2009_21	GW19	647074	263591	6.387	10.15	Sand and Gravel.	Manual dip and CTD logger download.
C1 S	-	646559	263657	1.366	6.26	Crag	Manual dip and WL logger download.
C1 D	-	646560	263657	1.297	20.15	Crag	Manual dip, CTD logger download and temperature level and conductivity reading profile.
C2 S	-	646525	264203	1.793	6.21	Crag	Manual dip and WL logger download.
C2 D	-	646527	264204	1.772	19.80	Crag	Manual dip, CTD logger download and temperature level and conductivity reading profile.
C3 S	-	647319	264638	2.801	7.04	Crag	Manual dip and WL logger download.
C3 D	-	647320	264639	2.769	20.83	Crag	Manual dip, CTD logger download and temperature level and conductivity reading profile.
C4 S	-	647002	264442	1.423	6.35	Crag	Manual dip and WL logger download.
C4 D	-	647001	264442	1.421	23.06	Crag	Manual dip, CTD logger download and temperature level and conductivity reading profile.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
GW3	-	645662	264140	10.510	15.15	Crag	Manual dip, CTD logger download and temperature level and conductivity reading profile.
GW6S	-	647288	264395	0.704	5.82	Made ground	Manual dip and WL logger download.
GW7	-	647245	264293	1.894	7.64	Made ground	Manual dip.
GW8	-	647468	264354	7.270	11.06	Made ground	Manual dip.
GW9S	-	647592	264455	3.049	6.73	Gravel	Manual dip.
GW9D	-	647592	264456	3.063	17.83	Crag	Manual dip.
GW10	-	647394	264178	1.763	6.49	Made ground	Manual dip.
GW11S	-	647150	264095	1.480	9.48	Peat	Manual dip.
GW11D	-	647149	264095	1.482	19.35	Crag	Manual dip.
GW11S1	-	647152	264095	1.502	5.56	Made ground.	Manual dip.
GW12	-	647509	264092	8.580	13.85	Made ground (clay) and Crag Sand.	Manual dip.
GW13	-	647575	264085	3.192	7.27	Gravel	Manual dip.
GW15	-	647317	264004	1.578	5.54	Made ground.	Manual dip.
GW16D	-	647439	263800	6.481	10.90	Made ground.	Manual dip.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
GW20	-	647079	262945	2.724	7.90	Crag	Manual dip and WL logger download.
GW21	-	647056	262797	8.734	13.20	Made ground (clay) and Sand.	Manual dip.
GW24S	-	647158	264256	1.523	5.27	Sand	Manual dip and WL logger download.
GW24D	-	647157	264254	1.441	16.16	Crag	Manual dip.
BP12	-	645713	264789	12.010	20.32	Crag	Manual dip.
BP23	-	646544	265007	8.650	12.24	Crag	Manual dip and WL logger download.
BP27	-	645577	265683	11.920	20.48	Crag	Manual dip.
BDG1	-	647324	264544	1.680	15.54	Crag	Manual dip and WL logger download.
C7	-	645315	265287	15.730	20.10	Crag	Manual dip.
BP6	-	645450	265231	16.440	20.56	Crag	Manual dip.
BP7	-	645701	265224	16.410	20.85	Crag	Manual dip.
BP9	-	645542	265361	13.630	20.37	Crag	Manual dip.
BP28	-	645608	265523	10.310	20.05	Crag	Manual dip and WL logger download.
BR15	-	645337	264757	15.250	12.32	Crag	Manual dip.
CPB_BP_11	-	645574	265148	17.370	19.69	Crag	Manual dip and CTD logger download.
CPB_BP_13	-	646009	265384	12.070	20.10	Crag	Manual dip.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
CPB_BP_14	-	646038	265267	13.930	19.36	Crag	Manual dip.
SD_BP_3	-	645574	265405	12.390	45.19	Crag	Manual dip.
SD_BP_5	-	645586	265286	15.470	25.26	Crag	Manual dip.
SD_BP_6	-	645929	265296	14.140	25.38	Crag	Manual dip.
SD_BP_7	-	645326	265151	17.230	23.50	Crag	Manual dip.
SD_BP_8	-	645580	265036	15.660	25.00	Crag	Manual dip.
Piez 1A	-	645457.5	263523.4	1.980	2.37	Peat	Manual dip.
Piez 1B	-	645458.7	263523.9	1.940	2.70	Peat	Manual dip.
Piez 2A	-	645439.7	263551.1	2.120	1.53	Peat	Manual dip.
Piez 2B	-	645440.7	263551.8	2.100	1.01	Peat	Manual dip.
Piez 3A	-	645542.7	263621.8	1.630	3.97	Peat	Manual dip.
Piez 3B	-	645543.5	263622.6	1.650	0.43	Peat	Manual dip.
GR09	-	644733.9	263725.8	14.830	15.30	Sand	Manual dip.
GR11	-	644538.3	263797.9	10.840	11.82	Sand	Manual dip and CTD logger download.
AF6	-	645327.2	263322.1	6.040	11.00	Sand	Manual dip.
BH1	-	645431	263516	2.430	5.00	No BH Log.	Manual dip.

NOT PROTECTIVELY MARKED

Location.	Previous Borehole ID.	Easting.	Northing.	Ground Level (mAOD).	Base of Borehole (mbgl).	Response Zone.	Monitoring Undertaken.
RR7	-	645343.5	264041.9	9.030	-	Sand	Manual dip.