



Centre for Environment  
Fisheries & Aquaculture  
Science



## **RESEARCH VESSEL PROGRAMME**

**RV CEFAS ENDEAVOUR  
Survey: C END 02 – 2023**

**STAFF:**

Name	Role	Name	Role
E. E. Manuel Nicolaus	SIC	Naomi Greenwood	Water Sampling
Izzy Lake	2IC	Matt Brown	Deck support
Axayacatl Molina-Ramirez	Deck lead	Peter Hamstead	Water Sampling
Tom Hull	Deck support/ data manager	Celia Marlowe	Shadowing all
Elise Brabben	Water Sampling; Chemical lead	Rosalyn Putland	Noiselanders, Water Sampling
Freya Mickleburgh	Water Sampling	Camille Visinand	Shadowing all

**DURATION:**

30<sup>th</sup> January to 5<sup>th</sup> February 2023.

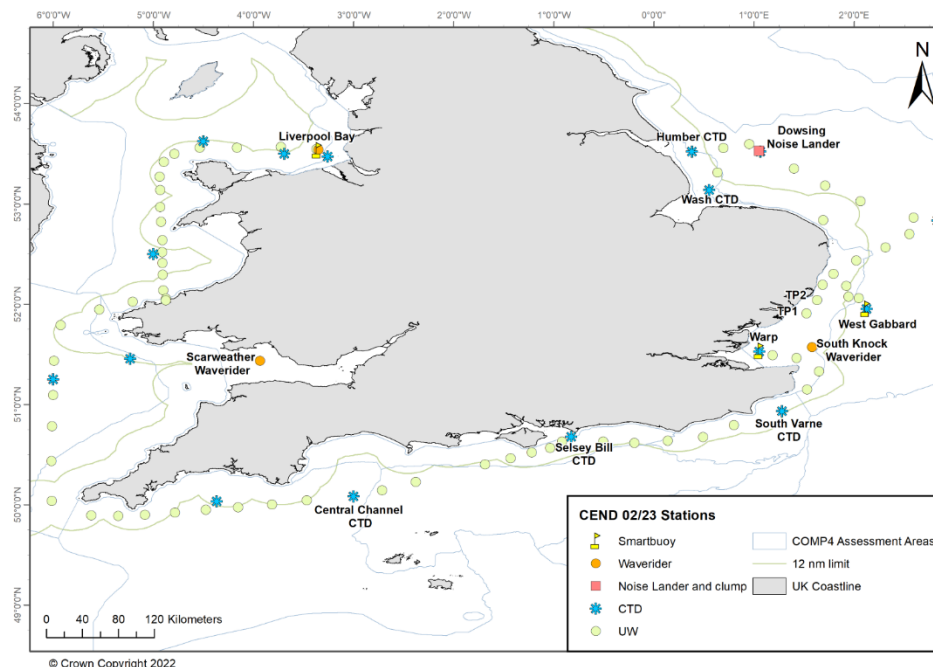
29<sup>th</sup> January: boarding in Liverpool from 16:00.

30<sup>th</sup> January: Drill at 15:00, induction at 16:00; Pilot at 19:00 sailing from Liverpool

5<sup>th</sup> February: 20:30 Pilot; docking in Lowestoft

6<sup>th</sup> February: disembark and demob

**LOCATION: England and Wales**





Station #	Latitude	Longitude	Sample Type
1	53.54325	-3.36459	Liverpool Zooplankton
2	53.5451	-3.37073	UW
3	53.54	-3.35	Liverpool Bay Waverider
4	53.53343	-3.36379	Liverpool SmartBuoy
5	53.56742	-3.72582	UW
6	53.55751	-4.16591	UW
7	53.5587	-4.53769	UW
8	53.49799	-4.79023	UW
9	53.41708	-4.89486	UW
10	53.26852	-4.93841	UW
11	53.13733	-4.93122	UW
12	52.96791	-4.93013	UW
13	52.82063	-4.92454	UW
14	52.6352	-4.91014	UW
15	52.51635	-4.912	UW
16	52.40766	-4.90873	UW
17	52.2919	-4.90717	UW
18	52.13737	-4.90078	UW
19	52.05318	-4.87202	UW
20	52.03602	-4.87692	UW
21	52.02371	-5.20645	UW
22	51.94461	-5.53847	UW
23	51.78872	-5.92609	UW
24	51.43364	-5.9925	UW
25	51.09275	-6.00153	UW
26	50.7797	-6.01235	UW
27	50.43453	-6.01896	UW
28	50.0351	-6.01609	UW
29	49.89307	-5.62098	UW
30	49.88732	-5.35181	UW
31	49.89659	-5.08445	UW
32	49.92109	-4.78469	UW
33	49.94707	-4.47515	UW
34	49.97233	-4.15435	UW
35	49.99961	-3.81601	UW
36	50.04217	-3.46776	UW
37	50.14256	-2.71535	UW
38	50.22457	-2.37816	UW
39	50.39939	-1.68804	UW
40	50.46044	-1.43163	UW
41	50.51861	-1.22027	UW
42	50.56524	-1.03719	UW
43	50.62912	-0.91884	UW
44	50.62687	-0.50766	UW
45	50.61327	-0.19653	UW
46	50.63537	0.138141	UW
47	50.67338	0.492134	UW
48	50.79123	0.799564	UW
49	51.14635	1.529421	UW
50	51.3285	1.649486	UW

51	51.46108	1.422894	UW
52	51.48806	1.18523	UW
53	51.52705	1.041961	Warp Zooplankton
54	51.5283	1.052731	Warp CTD
55	51.53313	1.049381	Warp SmartBuoy
56	51.533	1.046	Warp Noise Lander
57	51.5334	1.0457	Warp Noise Lander Clump
58	52.03867	1.629706	UW
59	52.07339	1.943381	UW
60	51.95506	2.122525	Zooplankton
61	51.95345	2.124375	West Gabbard CTD
62	51.95228	2.111674	West Gabbard SmartBuoy
63	52.05983	2.046956	UW
64	52.1795	1.92197	UW
65	52.30035	1.794622	UW
66	52.43231	2.021222	UW
67	52.56397	2.312263	UW
68	52.69809	2.553178	UW
69	52.86279	2.593453	UW
70	53.02614	2.062385	UW
71	53.18053	1.710809	UW
72	53.34934	1.400211	UW
73	53.52353	1.063249	Dowsing CTD
74	53.52943	1.052139	Dowsing Noise Lander
75	53.52887	1.050488	Dowsing Noise Lander clump
76	53.59508	0.952343	UW
77	53.55581	0.692865	UW
78	53.52331	0.380722	Humber CTD
79	53.31215	0.635571	UW
80	53.13973	0.552509	Wash CTD
81	52.83575	1.692035	UW
82	51.4333	-3.933	Scarweather Waverider
90	52.5	-5	665wa Off Cardigan Bay
91	51.25	-6	605wa Celtic Deep*
93	51.907	1.523	TP1 UW
94	52.193	1.685	TP2 UW

SB- Smartbuoy; WR-Waverider, UW-underway; WG- West Gabbard;

\* Low priority station

**AIMS:**

1. Service Noise Landers at Dowsing and Warp (GIA06H) 2 days
2. Service SmartBuoys at Liverpool Bay, West Gabbard and Warp (GIA03D) 2 days
3. Continuous flow and CTD Rosette water sampling as required on various transects
4. Collection of zooplankton sample at Liverpool Bay, West Gabbard, Warp and East of Warp
5. Exchanging Waverider at Liverpool Bay and Scarweather. Grapple for clump at South Knock WR site during low tide (C6029A) 2.5 days

## **NARRATIVE:**

### **Day 1. 30<sup>th</sup> – 31<sup>st</sup>**

Scientists joined the vessel on the 30<sup>th</sup> of January and a drill was carried out at 15:00, followed by induction at 16:00 and a pre-survey brief with all crew members. The pilot was booked to leave at 21:00 and we were on our way to start sampling just before midnight.

Collection of surface seawater samples began at 22:40 from the underway flowthrough system and will be analysed in the lab for salinity, chlorophyll, Suspended Particulate Matter (SPM), salinity, Coloured Dissolved Organic Matter (CDOM) and nutrient (phosphate, nitrate, nitrite, silicate and ammonia) concentrations.

We reached Liverpool Bay SmartBuoy station at 05:00 on 31<sup>st</sup> January and started operations with a zooplankton ringnet dip (0.5 m, 200µm mesh). This was followed by a pre-deployment water dip at 05:50 with the ESM2 profiler and 10 L niskin bottle which collects surface and bottom seawater from the water column to analyse for dissolved oxygen (3 x samples collected from surface, 3 x bottom); nutrients (1 x surface, 1 x bottom); chlorophyll (3 x surface); suspended particulate matter (SPM) (1 x surface, 1 x bottom); salinity (1 x surface, 1 x bottom); Coloured Dissolved Organic Matter (CDOM) (1 x surface, 1 x bottom); and phytoplankton (1 x surface). These samples can stand alone to contribute to eutrophication assessment but can also be used to calibrate sensors on the SmartBuoy and Ferrybox, increasing the valid spatial coverage of relevant assessment parameters autonomously measured throughout the survey.



1. ESM2 profiler and niskin bottle on the deck



The SiC usually goes up to the bridge between 6:40 and 7:00 to catch up with the Chief mate to discuss any issues that may have occurred over the night. Additionally, at 08:00 the SiC catches up with the Master and Navigation Officer to discuss the planned route and operations. As the plan was to be in position to collect the Liverpool SmartBuoy the SiC asked the bridge team to start operations for the recovery at 06:45. It then became apparent, that the vessel had issues with the stern thruster at 06:45 and the scientific crew went into downtime from 07:15 when it was determined that we could not recover or deploy the SmartBuoy or Waverider.

At 11:50 the SiC asked if we could deploy any gear and not recover with the issues we were experiencing, but this was not possible. At 12:00 it was decided to leave Liverpool Bay to make up lost time and steam the 250nm through the relevant assessment areas and collecting underway water samples to Scarweather Waverider to be able to carry out other survey aims. The coastguard visited us at 16:00 for routine practice of a helicopter rescue, and during downtime the scientists played card games including Bohnanza. Hourly underway water samples were collected until the next water sampling station for an ESM2 profiler dip in Cardigan Bay.



## 2. Coastguard visit

### **Day 2. 1<sup>st</sup> Feb**

Cardigan Bay CTD dip was carried out at 00:15 and we continued the overnight hourly underway water samples to Scarweather Waverider. The weather was not ideal for recovery and deployment at 13:00. Therefore, we took the ESM2 profiler water samples from the surface and bottom first and deployed the Secchi disk and measured water turbidity and the colour of the water surface for our seawater assessments. Once completed, we approached the Waverider now at slack tide at 15:00 and attempted recovery. The thrusters were acting at full capacity but were not strong enough for optimum recovery and therefore it took longer to get into and hold position. At 15:10

the recovery started, and the Waverider was recovered at 15:23 (51.4334, -3.9329). Clump was recovered at 15:39 (51.4334, -3.9339). Clump and Waverider deployed at 16:07 (51.4334, -3.9343).



### 3. Waverider recovery

Throughout the recovery and deployment there was difficulty due to the Tower waypoint recording system. The computer only works in one room with no windows therefore the SiC had to be on the phone to a scientist downstairs whilst recovery was ongoing to relay messages. Usually, the computer works on the bridge to allow for visibility of recovery on back deck and fixing the GPS waypoint. This is no longer possible. What was a one-person job is now a three-person job. After the new Waverider was deployed, we started our 470 nm (40 hours) steam from Scarweather through the English Channel.

### Day 3. 2<sup>nd</sup> Feb

Hourly underway water samples collecting surface seawater continued throughout the night and early morning until our steam through channel paused at 08:45 off Plymouth Sound to deploy the Secchi disk and take a corresponding water sample. At 09:00 the onshore team helped to fix the issues with Tower, and we can now fix GPS waypoints from both the dry lab and bridge. The team prepped the side scan sonar and buoy gear ready for the next few days of survey aims at Warp and Dowsing. During daytime hours, it sometimes feels like routine ship maintenance is prioritised to utilise available



time, instead of supporting the scientific crews aims, maybe this means there is not enough time to do these types of maintenance at other times.

In the afternoon, we continued until around 16:00 for another Secchi disk dip, followed by a steam straight to Warp overnight, again collecting hourly underway surface seawater samples.

#### **Day 4. 3<sup>rd</sup> Feb**

We arrived at Warp at around 07:00 and proceeded with a zooplankton ring net haul at 07:45, followed by a pre-deployment CTD ESM2 profiler dip at both the bottom and surface at 08:10. We began getting into position for the SmartBuoy and Noise Lander exchange at 08:30. The Warp SmartBuoy was recovered at 08:50 (51.5331, 1.0493), the Noise Lander clump at 09:19 (51.5334, 1.0457), and Noise Lander at 09:34 (51.533, 1.046).



4. Warp SmartBuoy Recovery



Following recovery, the ship got back into position and the Noise Lander clump was deployed at 10:14 (51.5327, 1.0458) and Noise Lander at 10:22 (51.5332, 1.0453). It was the time to deploy the momentous 150<sup>th</sup> Warp SmartBuoy, a few of the scientists were ready to take pictures of the safe deployment of the Buoy. It was deployed at 10:48 (51.5331, 1.0493).



#### 5. 150<sup>th</sup> Warp SmartBuoy Deployment.

Once the Warp SmartBuoy was deployed, a post-deployment CTD (surface and bottom) occurred at 11:00, and the Secchi disk dip happened at 11:15. Following this, we debated if we could make it to West Gabbard SmartBuoy station in time. After consulting the bridge crew, weather, sunset times, and forecast wave height, it was decided to steam as quickly as possible to West Gabbard to utilise the good weather, low wave height and last of the daylight. At West Gabbard it was noticed that the SmartBuoy had dragged into a new position and was no longer at 51.951, 2.1115. Once the pre-CTD was completed at 15:25, the SmartBuoy exchange began, and we started to get into position at 15:55. Stern thrusters were not responding initially but were swiftly fixed.

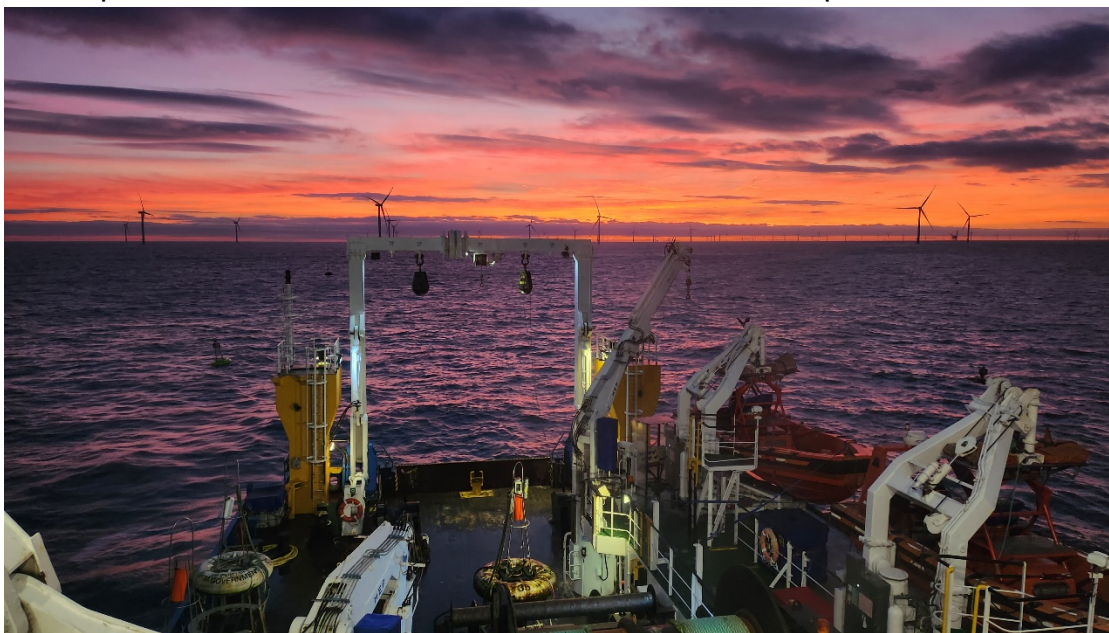


The West Gabbard SmartBuoy was recovered at 16:11 (51.9613, 2.1172) and checked for damage.



#### 6. West Gabbard SmartBuoy Recovery

It was noted that the mid-tether had been damaged but no reason was determined. The cage metal was bent. The clump chain was entangled, and so a lot of care was taken to recover it. The clump was recovered at 16:26 (51.9615, 2.1176). The total weight put on was increased to prevent more dragging of the new SmartBuoy and it was deployed at 17:00. A post-deployment CTD dip was deployed at 17:45 with the ESM2 profiler to collect bottom and surface seawater samples.



#### 7. Sunset at West Gabbard



Once operations were completed, we steamed straight to Dowsing, collecting hourly underway surface seawater samples.

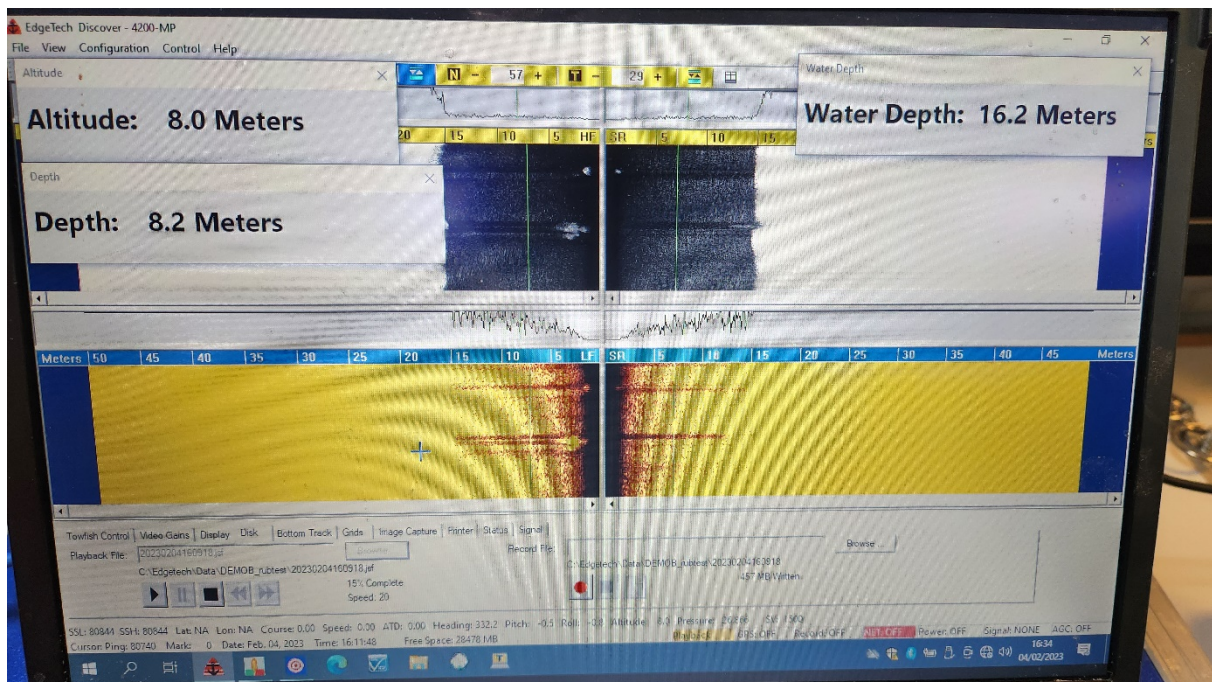
### **Day 5. 4<sup>th</sup>**

The ship arrived at Dowsing at 06:00 and two CTD dips were carried out to collect the surface and bottom seawater samples using the ESM2 profiler and niskin bottle at 06:03. After breakfast the Noise Lander recovery operations began. At 08:45 the Noise Lander clump was recovered (53.5291, 1.0512), and the Noise Lander recovered at 09:01 (53.5260, 1.0523). The sea state was very calm and little to no wind made for a nice recovery.

We then had the opportunity to search for two lost Noise landers from 2021 and 2022 deployments. The acoustic release on the landers did not work as expected owing to battery duration, and so we decided to use the multi-beam. Scientists spent 2 hours trying to operate the multibeam from the MIST lab. When scientists tried to connect with the multibeam there were problems connecting between the hardware and the ships network. It was identified that the power unit of the multibeam unit needs to be replaced, therefore the system could not be used for searching for the landers. After lunch, the team used the side-scan sonar to search the seabed for the landers.



8. Side-scan sonar deployment



## 9. Example of live feed from the side-scan

Not having tower/echo sounder/transas screens together increased difficulty for running the side-scan sonar lines accurately. A bad internet connection also caused issues with not being able to easily contact the shore throughout when advice was needed. In total, three lines were run with the side scan, followed by two grapple lines, but ultimately the landers were not found and therefore not recovered.

We then steamed to the Humber CTD station, collecting surface water samples from the Ferrybox until we arrived at 21:00 to deploy the ESM2 for bottom and surface seawater samples. Hourly underway surface seawater samples continued after this until we reached the next planned stations in the Wash.

## Day 6. 5<sup>th</sup> February

The first of the two Wash stations was sampled at 00:49 with surface and bottom ESM2 deployments collecting seawater, followed by dips at the Inner Wash CTD station at 01:45. Hourly underway surface seawater samples continued until stopping just off of Norfolk at around 05:40. We started water sampling again in daylight at 08:00 for surface seawater samples via the underway flowthrough system and Secchi disk deployments and continued our steam south to TP1 and TP2. At TP1 and TP2, ESM2 profiler dips to collect seawater were taken (3 x samples collected from surface, 3 x bottom); nutrients (1 x surface, 1 x bottom); chlorophyll (3 x surface); suspended particulate matter (SPM) (1 x surface, 1 x bottom); salinity (1 x surface, 1 x bottom); and Coloured Dissolved Organic Matter (CDOM) (1 x surface, 1 x bottom). The scientists tidied up and packed everything away to make for a quick demob the next day. We met the pilot at 20:00 to take us into Lowestoft and we docked at 21:00.





10. CEND 02/23 Scientific crew

**Day 7. 6<sup>th</sup> February**

Scientific staff tidied their work areas around the ship and assisted in demobbing of part of the gear, with the rest to be demobbed on the 7<sup>th</sup>. Staff left the vessel by 11am.

## RESULTS: In relation to the above-mentioned Aims:

1. Service Noise Landers at Dowsing and Warp (GIA06H) – did not recover 2021 and 2022 deployments at Dowsing
2. Service SmartBuoys at West Gabbard and Warp (GIA03D)
3. Continuous flow and CTD Rosette water sampling as required on various transects
4. Collection of zooplankton sample at West Gabbard, Warp and East of Warp
5. Exchanging Waverider at Scarweather.

The detailed breakdown of equipment deployed, and samples collected for analysis can be found in Table 1.

Table 1. Summary of sample collections including deployments and recoveries of gear. (UW = underway water sample, ESM2 = CTD profiler)

STN #	Date	Time	Latitude	Longitude	Gear Code	Analytic
2	30/01/2023	22:41	53.51479	-3.103619	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
3	31/01/2023	00:11	53.50897	-3.260428	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
4	31/01/2023	01:39	53.45327	-3.207976	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
5	31/01/2023	02:23	53.45346	-3.330037	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
6	31/01/2023	03:57	53.56169	-3.403897	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
7	31/01/2023	05:33	53.54193	-3.36771	Zooplankton	Plankton
8	31/01/2023	05:52	53.54278	-3.353631	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
8	31/01/2023	06:04	53.54469	-3.344021	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
9	31/01/2023	12:29	53.55016	-3.523848	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
10	31/01/2023	13:30	53.55258	-3.731606	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
11	31/01/2023	14:30	53.55604	-3.921644	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
12	31/01/2023	15:30	53.55783	-4.126067	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
13	31/01/2023	16:30	53.55949	-4.366176	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1



14	31/01/2023	18:30	53.54354	-4.700479	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
15	31/01/2023	19:30	53.40818	-4.891255	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
16	31/01/2023	20:30	53.20672	-4.933515	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
17	31/01/2023	21:30	52.99082	-4.956522	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
18	31/01/2023	22:30	52.76852	-4.970705	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
19	01/02/2023	00:16	52.49777	-4.995406	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
19	01/02/2023	00:32	52.49553	-4.986769	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
20	01/02/2023	01:30	52.38776	-5.158519	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
21	01/02/2023	02:30	52.2432	-5.354532	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
22	01/02/2023	03:30	52.11635	-5.529459	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
23	01/02/2023	04:34	51.99857	-5.691881	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
24	01/02/2023	05:37	51.87882	-5.855629	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
25	01/02/2023	06:27	51.74949	-5.937079	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
26	01/02/2023	07:31	51.61015	-5.80778	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
27	01/02/2023	08:28	51.52178	-5.50464	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
28	01/02/2023	09:28	51.44019	-5.178903	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
29	01/02/2023	10:32	51.43709	-4.797269	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
30	01/02/2023	11:24	51.43321	-4.479244	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
31	01/02/2023	13:28	51.43274	-3.924679	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
31	01/02/2023	13:52	51.43387	-3.900765	ESM2 + Secchi	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
32	01/02/2023	15:22	51.43342	-3.932906	Waverider Recovery	



33	01/02/2023	15:39	51.43347	-3.933904	Waverider Clump	
34	01/02/2023	16:06	51.43346	-3.934341	Waverider Deployment	
35	01/02/2023	17:30	51.27203	-4.209845	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
36	01/02/2023	18:30	51.14471	-4.455924	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
37	01/02/2023	19:30	51.02182	-4.697179	UW	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
38	01/02/2023	20:30	50.90183	-4.923326	UW + Secchi	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1
39	01/02/2023	21:30	50.78704	-5.146865	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
40	01/02/2023	23:00	50.61546	-5.471437	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
41	02/02/2023	00:29	50.45627	-5.785696	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
42	02/02/2023	01:30	50.32977	-6.006545	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
43	02/02/2023	02:31	50.12836	-6.010923	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
44	02/02/2023	03:30	49.92604	-6.011725	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
45	02/02/2023	04:30	49.88404	-5.70021	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
46	02/02/2023	05:31	49.89014	-5.357531	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
47	02/02/2023	06:30	49.91332	-5.03377	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
48	02/02/2023	07:31	49.94959	-4.706523	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
49	02/02/2023	08:49	50.03302	-4.369875	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
50	02/02/2023	08:51	50.03292	-4.369375	Secchi Disk	Water Turbidity
51	02/02/2023	09:59	50.05927	-4.036511	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
52	02/02/2023	11:00	50.08089	-3.716073	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
53	02/02/2023	12:00	50.12497	-3.416914	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
54	02/02/2023	13:00	50.18049	-3.110622	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
55	02/02/2023	14:00	50.20925	-2.789195	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
56	02/02/2023	15:00	50.26888	-2.466111	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
57	02/02/2023	16:00	50.31324	-2.160769	UW + Secchi	Salinity x1; Nutrients x1; SPM x1 Chlorophyll x1; CDOM x1





58	02/02/2023	16:55	50.35438	-1.863997	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
59	02/02/2023	18:00	50.41187	-1.445609	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
60	02/02/2023	19:00	50.46714	-1.049418	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
61	02/02/2023	20:00	50.51847	-0.674867	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
62	02/02/2023	21:00	50.56685	-0.309692	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
63	02/02/2023	22:00	50.61409	0.037399	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
64	02/02/2023	23:00	50.65383	0.33378	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
65	02/02/2023	23:59	50.71644	0.602016	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
66	03/02/2023	00:58	50.8331	0.871053	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
68	03/02/2023	02:00	50.96219	1.152581	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
69	03/02/2023	03:00	51.08633	1.406491	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
70	03/02/2023	04:00	51.22492	1.636401	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
71	03/02/2023	05:00	51.40899	1.521108	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
72	03/02/2023	06:01	51.48627	1.236192	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
73	03/02/2023	07:42	51.52869	1.043896	Zooplankton	Plankton
74	03/02/2023	07:54	51.52891	1.041376	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
75	03/02/2023	08:06	51.52911	1.038748	ESM2 + Secchi	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
76	03/02/2023	08:49	51.53299	1.048533	SmartBuoy Recovery	
77	03/02/2023	08:55	51.53302	1.048594	SmartBuoy Clump Recovery	
78	03/02/2023	09:18	51.5333	1.04522	Noise Lander Clump Recovery	
79	03/02/2023	09:34	51.53279	1.045857	Noise Lander Recovery	
80	03/02/2023	10:14	51.53277	1.045888	Noise Lander Clump Deployment	



81	03/02/2023	10:22	51.5332	1.045326	Noise Lander Deployment	
82	03/02/2023	10:48	51.53314	1.049378	SmartBuoy Deployment	
83	03/02/2023	10:59	51.53338	1.051922	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
84	03/02/2023	11:12	51.53457	1.05518	ESM2 + Secchi	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
85	03/02/2023	11:16	51.53503	1.056396	Secchi Disk	Water Turbidity
86	03/02/2023	12:30	51.6973	1.356655	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
87	03/02/2023	13:30	51.82844	1.660016	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
88	03/02/2023	14:30	51.84342	2.005785	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
89	03/02/2023	15:24	51.95969	2.131038	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
89	03/02/2023	15:40	51.95969	2.131038	ESM2 + Secchi	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
90	03/02/2023	16:11	51.9613	2.117218	SmartBuoy Recovery	
92	03/02/2023	16:26	51.96155	2.117679	SmartBuoy Clump Recovery	
91	03/02/2023	17:00	51.95215	2.111434	SmartBuoy Deployment	
92	03/02/2023	17:03	51.95228	2.111698	Zooplankton	Plankton
93	03/02/2023	17:43	51.95187	2.118968	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
93	03/02/2023	17:59	51.95187	2.118968	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
95	03/02/2023	20:00	52.11011	2.106258	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
96	03/02/2023	21:00	52.29085	2.039059	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
97	03/02/2023	22:00	52.485	2.007547	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
98	03/02/2023	23:00	52.69276	1.927734	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1

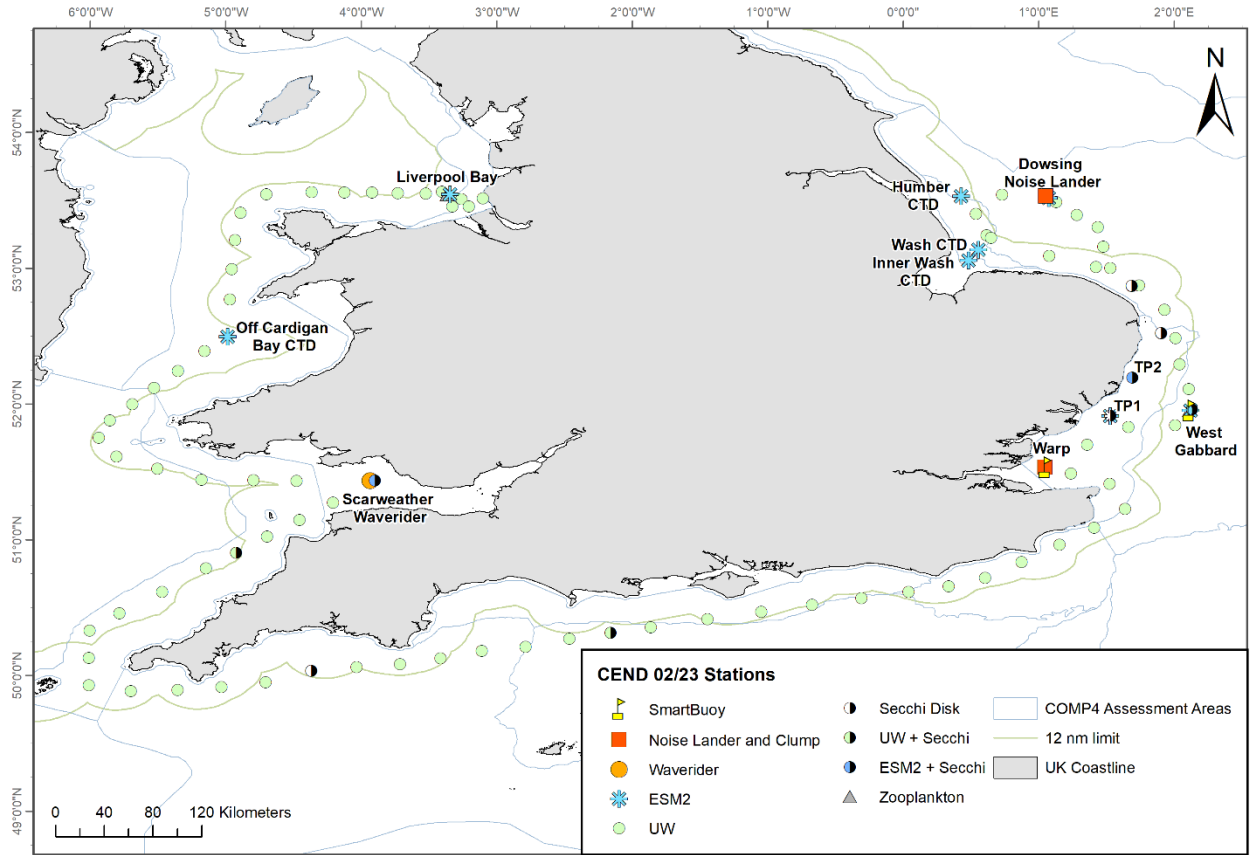


99	04/02/2023	00:00	52.87181	1.738678	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
100	04/02/2023	01:00	53.00109	1.526901	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
101	04/02/2023	02:00	53.15713	1.476206	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
102	04/02/2023	03:03	53.30129	1.43568	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
103	04/02/2023	04:00	53.39047	1.279161	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
104	04/02/2023	05:00	53.48733	1.128757	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
105	04/02/2023	06:03	53.52105	1.06709	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
106	04/02/2023	06:16	53.51584	1.072101	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
106	04/02/2023	08:44	53.52909	1.051188	Noise Lander Clump Recovery	
107	04/02/2023	09:01	53.52952	1.052303	Noise Lander Recovery	
108	04/02/2023	09:15	53.52954	1.052332	Secchi Disk	Water turbidity; CDOM x1
109	04/02/2023	14:25	53.53749	1.042911	Side-scan	
109	04/02/2023	14:46	53.51937	1.058877	Side-scan	
110	04/02/2023	14:46	53.51986	1.058377	Side-scan	
110	04/02/2023	15:13	53.54431	1.033955	Side-scan	
112	04/02/2023	19:36	53.540297	0.729130	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
113	04/02/2023	21:03	53.524467	0.406400	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
113	04/02/2023	21:35	53.529583	0.425900	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
114	04/02/2023	22:46	53.400467	0.535217	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
116	04/02/2023	23:52	53.24272	0.613917	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
117	05/02/2023	00:49	53.13837	0.550533	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
117	05/02/2023	01:01	53.13544	0.553238	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1



118	05/02/2023	01:47	53.06152	0.481781	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
118	05/02/2023	01:56	53.05782	0.482291	ESM2	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
119	05/02/2023	03:21	53.22337	0.646234	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
120	05/02/2023	04:50	53.09032	1.076997	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
121	05/02/2023	05:56	53.00785	1.422613	UW	Salinity x1; Nutrients x1; Chlorophyll x1; SPM x1
122	05/02/2023	08:03	52.86876	1.683765	Secchi Disk	Water Turbidity
123	05/02/2023	08:06	52.86697	1.685302	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
124	05/02/2023	10:00	52.5212	1.902652	Secchi Disk	Water Turbidity
125	05/02/2023	10:03	52.51933	1.902533	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
126	05/02/2023	12:18	52.19434	1.689969	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
126	05/02/2023	12:19	52.19434	1.689969	ESM2 + Secchi Disk	Surface: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1; CDOM x1
127	05/02/2023	14:33	51.90932	1.525894	UW	Salinity x1; Nutrients x1; SPM x1; Chlorophyll x1; CDOM x1
128	05/02/2023	14:36	51.91004	1.526797	ESM2	Bottom: Dissolved oxygen (3x bottom); Salinity x1; Nutrients x1; Chlorophyll x3; SPM x1
129	05/02/2023	14:43	51.91228	1.527899	Secchi Disk	Water Turbidity





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Second Scientist in Charge: Izzy Lake

Date: 08/02/2023

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