CORNWALL HIGHWAYS
A SERVICE OF CORNWALL COUNCIL

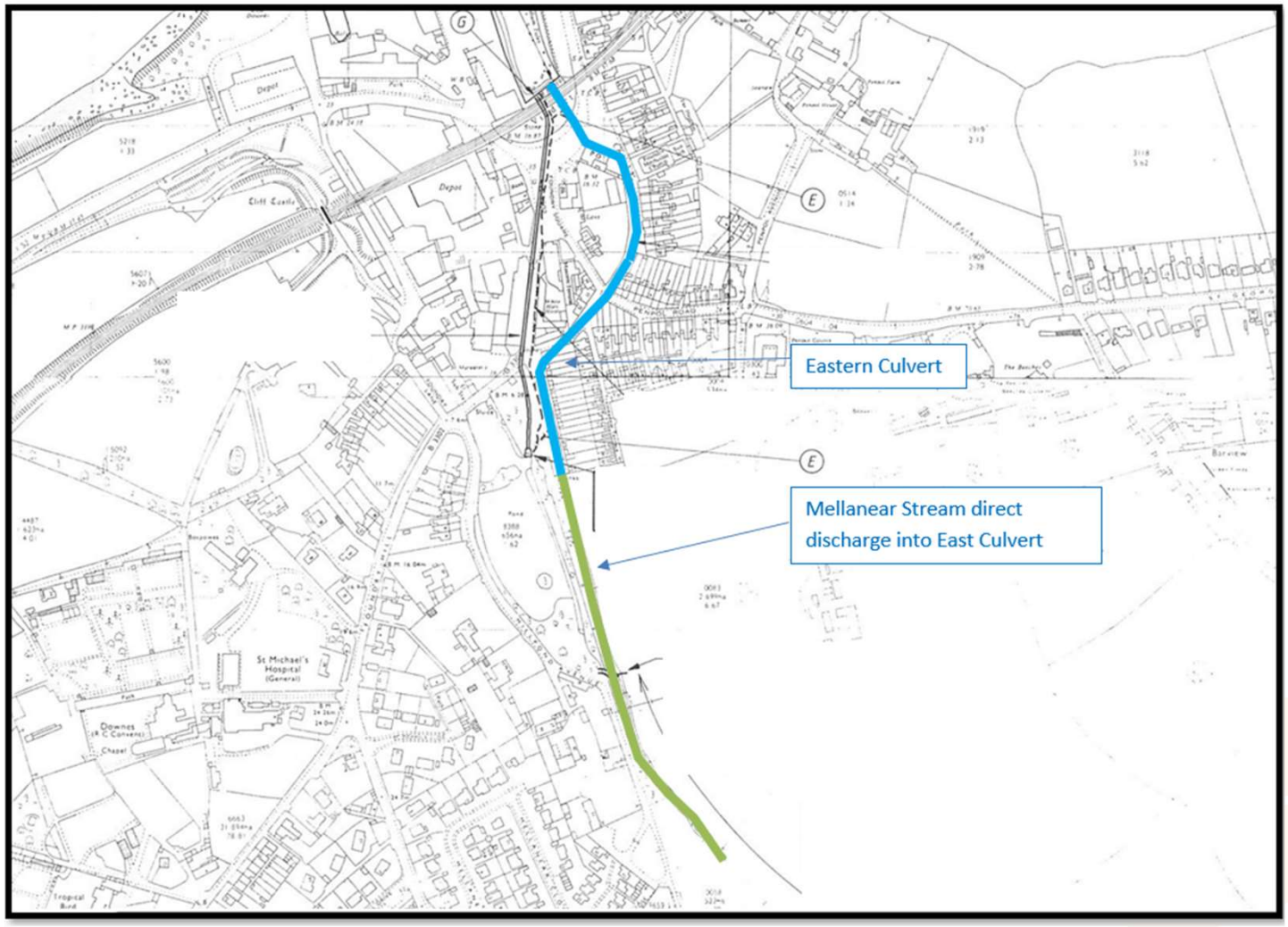
East Culvert
Penpol Road, Hayle

Andy Hoskin

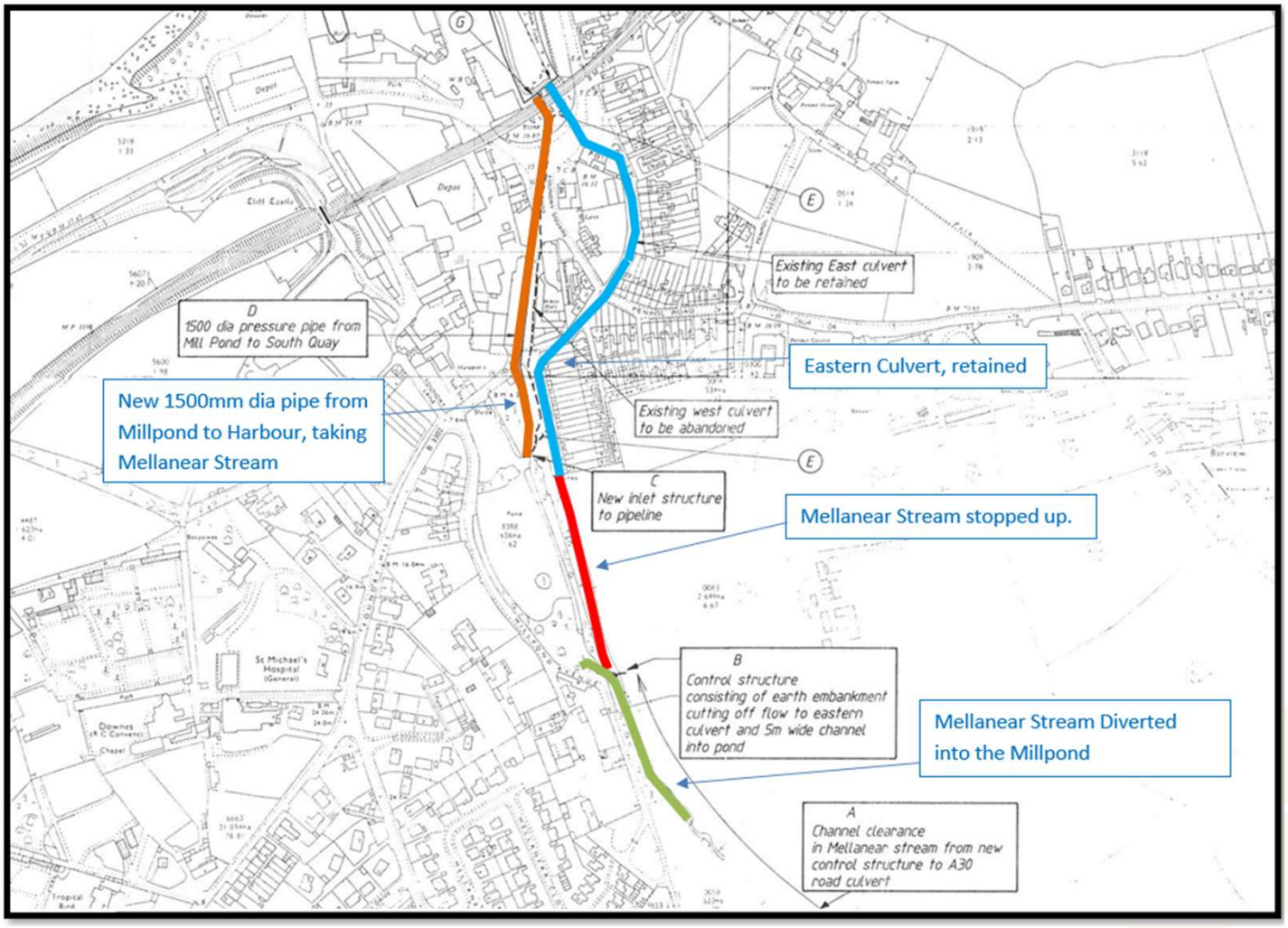
Highway Manager

enquiries@cornwallhighways.co.uk

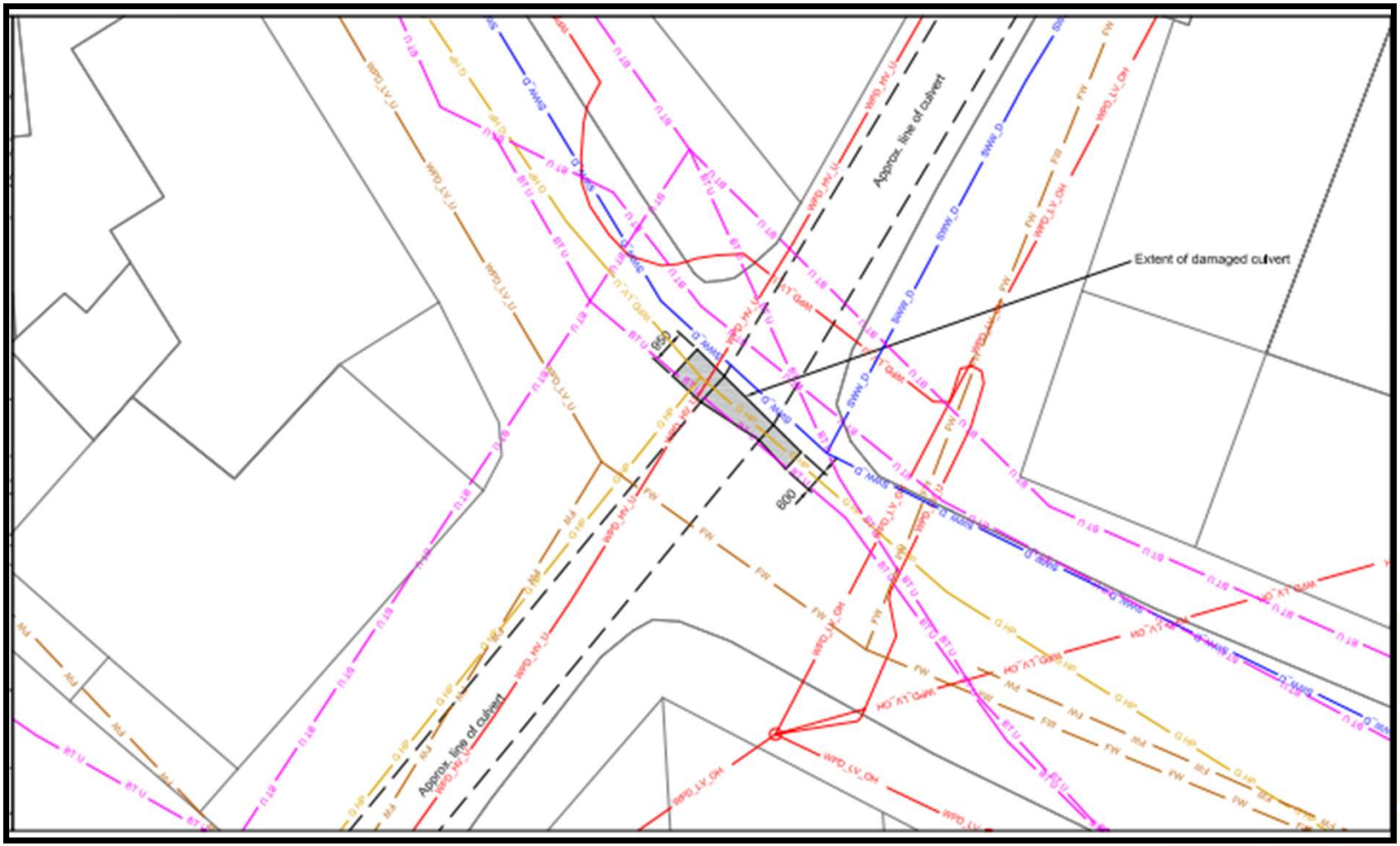
Historic layout pre 1990



Current layout post 1990

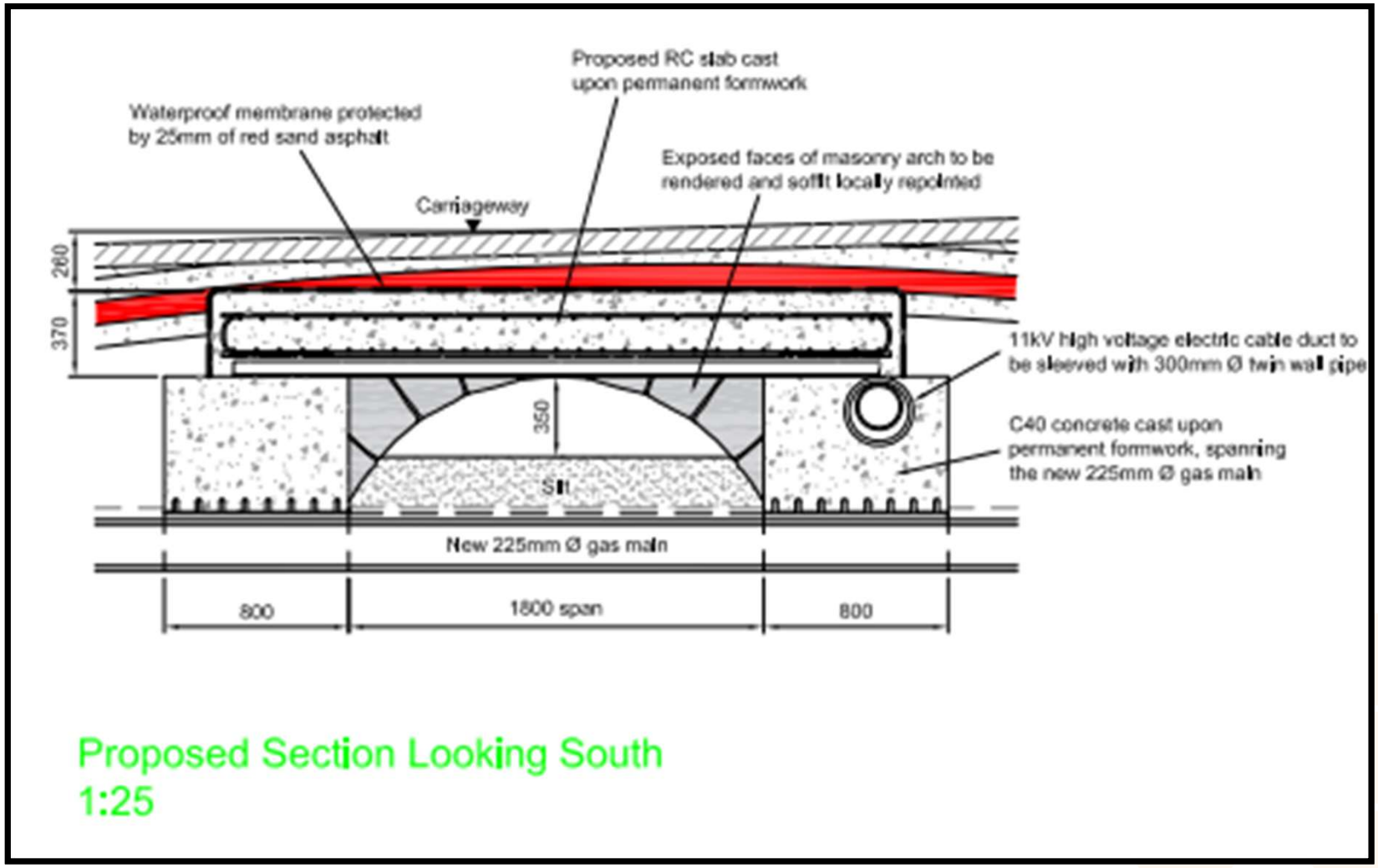


Utility Apparatus in the area



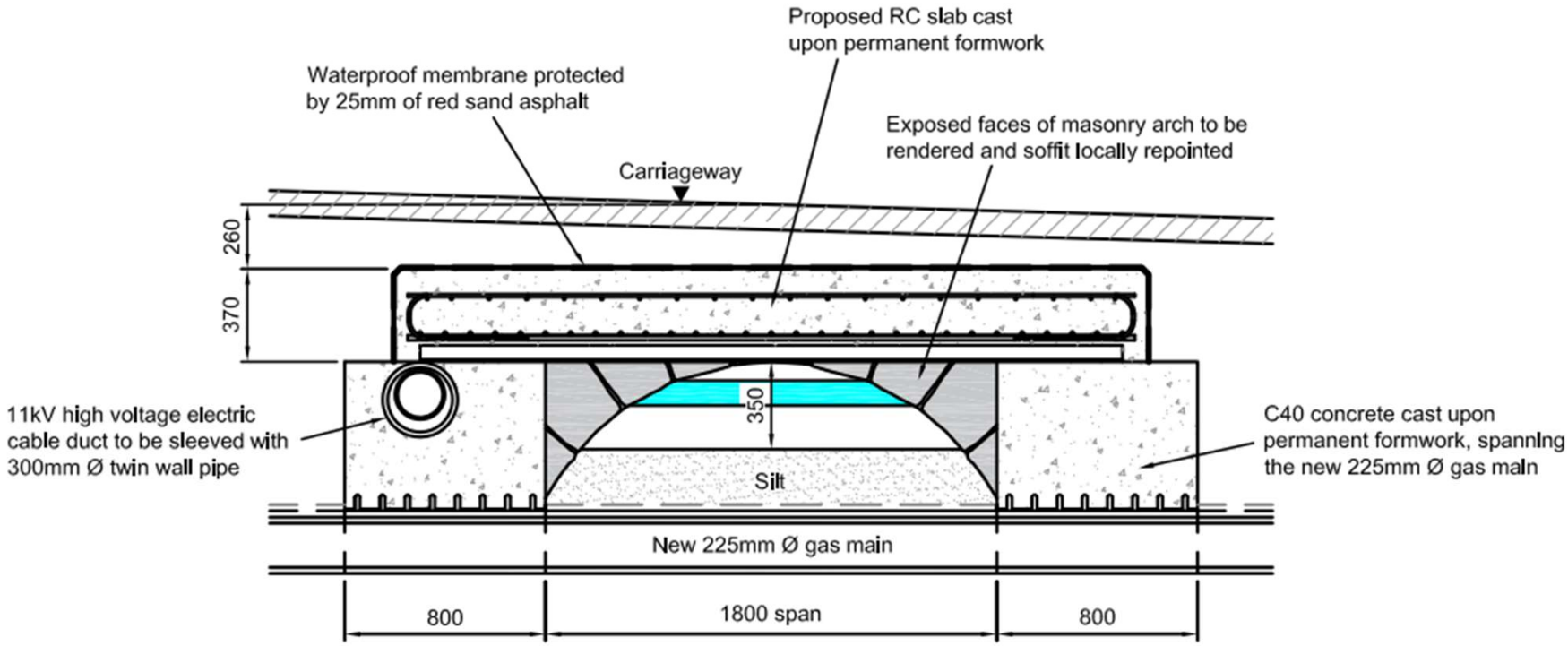
enquiries@cornwallhighways.co.uk

Repaired Section South



enquiries@cornwallhighways.co.uk

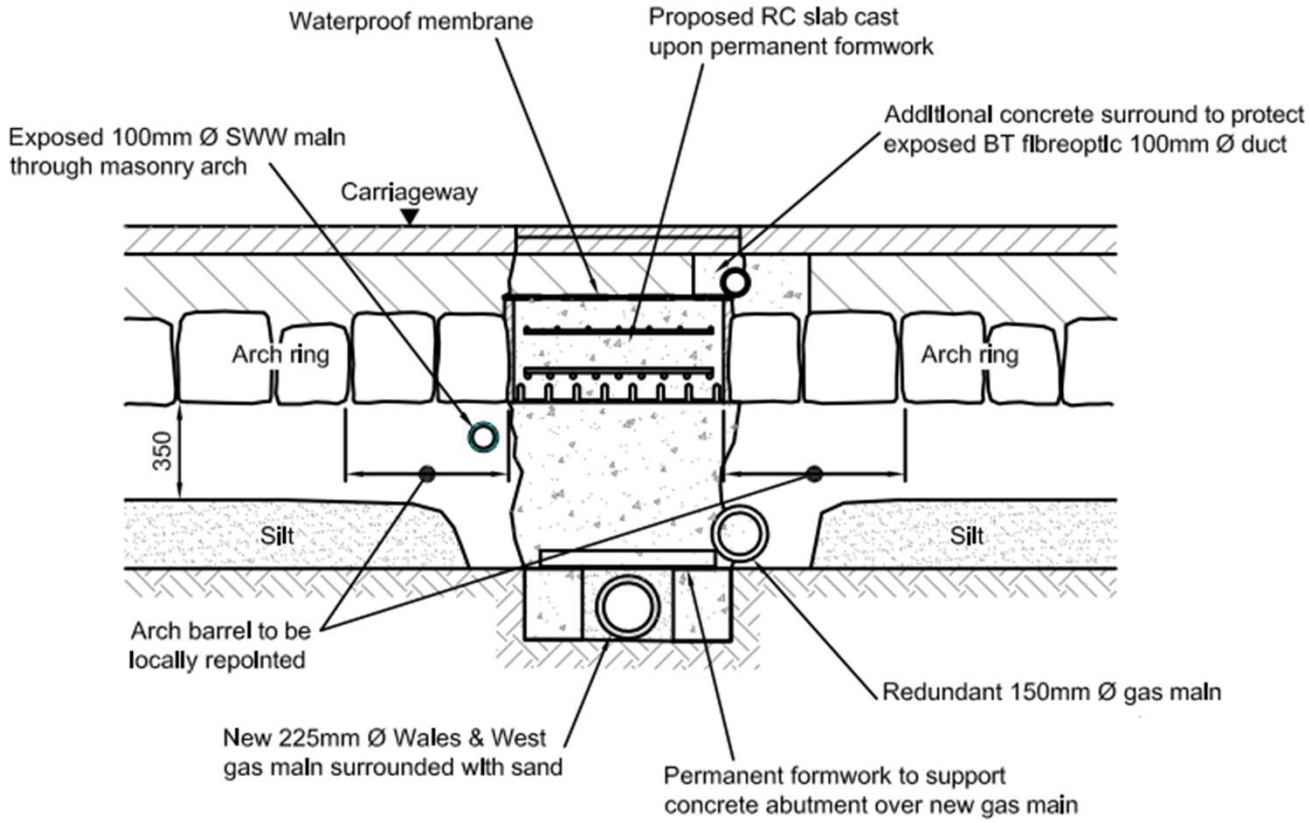
Repaired Section North



Proposed Section Looking North
1:25

enquiries@cornwallhighways.co.uk

Repaired Cross Section



Proposed Cross Section
1:25

enquiries@cornwallhighways.co.uk

Repair to damaged section

enquiries@cornwallhighways.co.uk

CORNWALL HIGHWAYS
A SERVICE OF CORNWALL COUNCIL

East Culvert
Penpol Road, Hayle

Andy Hoskin

Highway Manager

enquiries@cornwallhighways.co.uk

PLANETARY

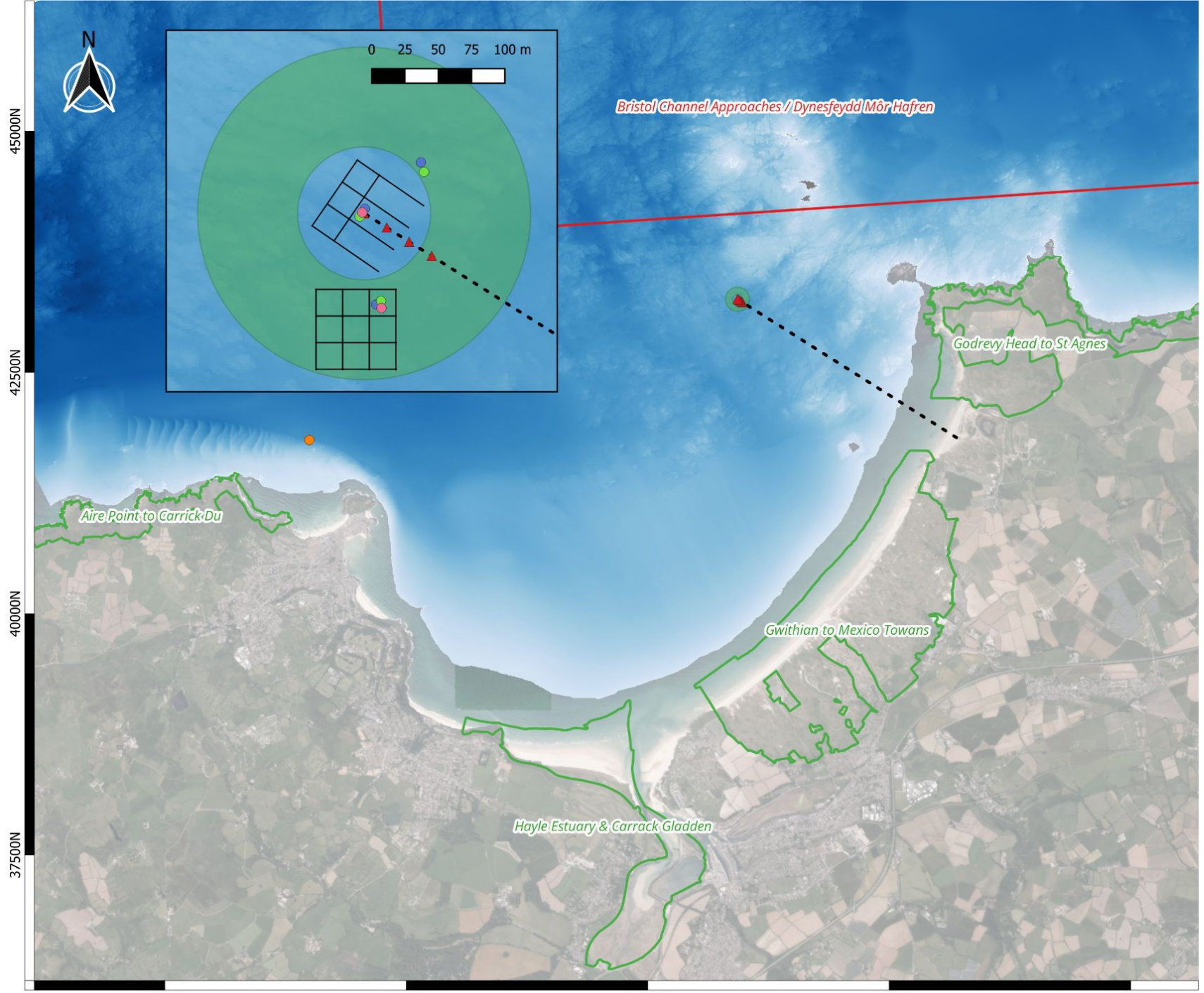
Hayle Town Council
Konsel an dre Heyl

Ocean Alkalinity Enhancement Update

May 2023 Baseline Survey Results and November Halifax Status

Peter Chargin

November 16th, 2023



Map Title

Hayle 2.0: Monitoring and Outfall

Project

Hayle 2.0 OAE Trial

Key

- Diffusers
- Pipeline
- Mid-field mixing zone
- Biota Sampling
- Water Quality + Plankton
- Sediment
- Control
- Ecological Dive Survey

Depth (m)

1.135

-32.098

Source Information

Planetary Technologies Inc 2022
Bing Maps Base Layer

Location Map

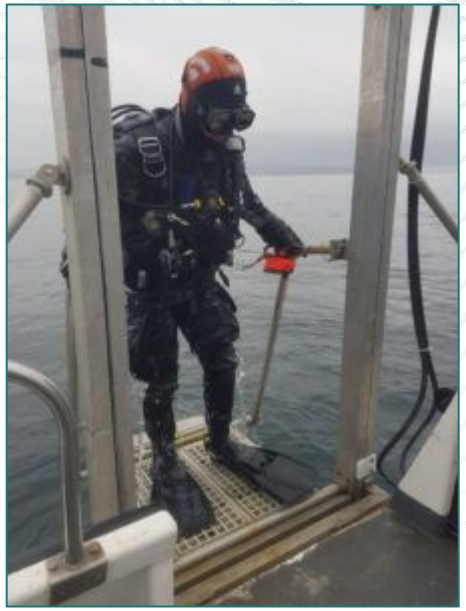
Scale

0 750 1,500 m

Coordinate System

EPSG:27700:
British National Grid

PLANETARY



What we measured...

Water

- Water samples for elemental analysis (primarily trace metals);
- Profiles to measure temperature, conductivity, pH, salinity, dissolved oxygen and turbidity (water clarity).

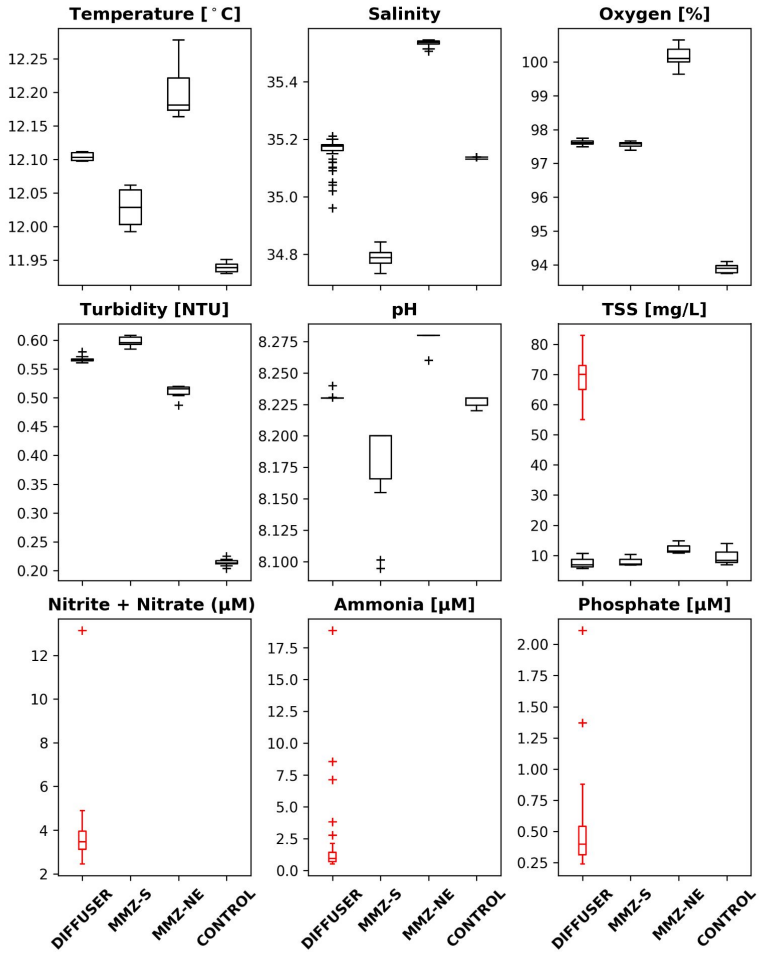
Sediment

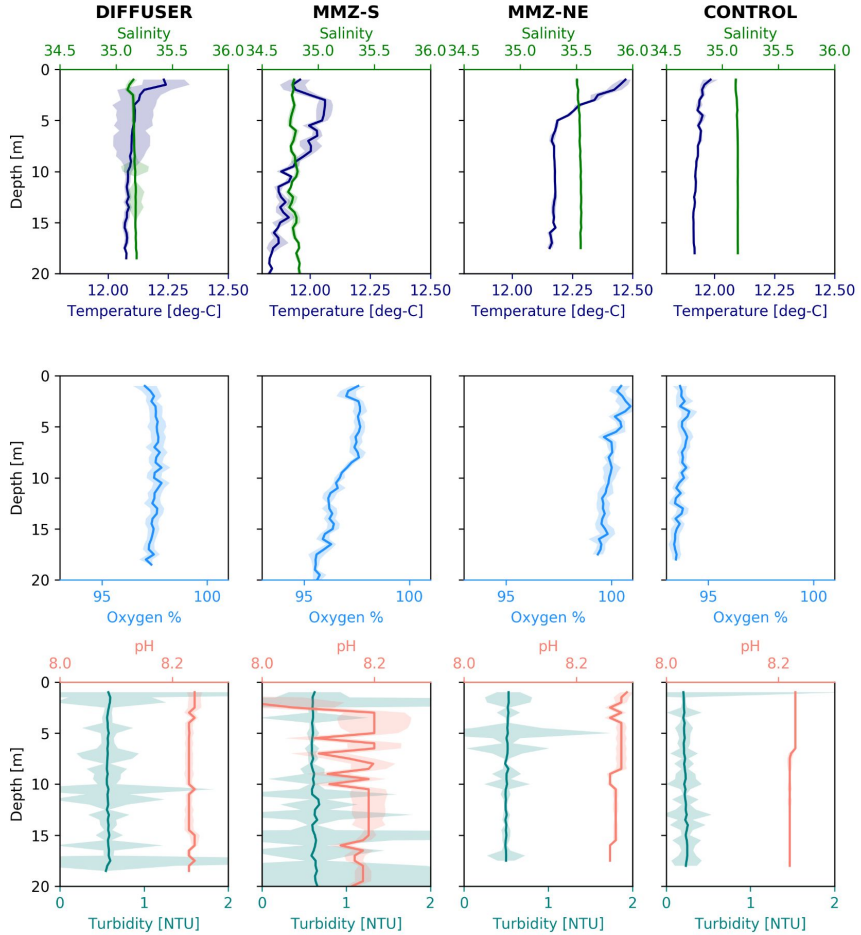
- Elemental analysis at each of the four locations

Biology

- Ecological Survey
- Phytoplankton and zooplankton
- Tissue analysis of invertebrates for elemental analysis (primarily trace metals)

Nutrient & Water Column Profiles





Parameter	Unit	Detection Limit	Lab Result												Reference Standards & Data		
			Diff			MMZ-S			MMZ-NE			CTRL			UK EQS		EA Sampling: 2002-04 Range
			A	B	C	A	B	C	A	B	C	A	B	C	AA	MAC	
Aluminum	µg/L	0.7	2.42	1.81	4.33	2.34	1.47	1.54	1.03	0.718	1.25	1.12	1.65	1.71	–	–	–
Arsenic	µg/L	0.05	1.9	1.82	1.67	1.81	1.7	1.64	1.49	1.64	1.77	2.02	2.27	1.49	25	–	1.2 – 1.8
Boron	µg/L	10	4380	4490	4380	4390	4340	4320	4420	4340	4370	4380	4370	4320	7000	–	–
Cadmium	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	–	–	<0.25
Calcium	mg/L	0.1	381	406	387	376	387	379	383	364	373	379	382	378	–	–	–
Chromium	µg/L	0.1	0.196	0.155	0.158	<0.1	0.167	0.179	0.224	0.259	0.156	0.296	0.146	0.172	0.6	32	<0.5 – 5.1
Cobalt	µg/L	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	3	–	–
Copper	µg/L	0.5	0.613	<0.5	0.513	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.565	<0.5	<0.5	3.76	–	<0.5 – 1.1
Iron	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.011	<0.004	<0.004	1	–	–
Lead	µg/L	0.3	<0.3	<0.3	0.389	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.326	<0.3	0.341	1.3	–	<2.5 – 2.5
Magnesium	mg/L	0.09	1260	1350	1290	1250	1280	1260	1260	1210	1250	1270	1270	1260	–	–	–
Manganese	µg/L	0.1	0.744	0.537	0.334	0.807	1.04	0.557	0.667	0.795	0.497	0.671	0.776	0.744	–	–	–
Mercury	µg/L	0.002	0.082	0.0694	0.0792	0.0532	0.0599	0.0617	0.066	0.0748	0.0684	0.072	0.0694	0.071	–	0.07	<0.01 – 0.01
Nickel	µg/L	0.5	<0.5	0.638	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	8.6	34	<3
Silver	µg/L	0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	1	–
Tin	µg/L	0.05	4.75	1.9	4.06	1.12	0.624	1.82	<0.5	<0.5	<0.5	3.54	6.26	14	10	–	–
Vanadium	µg/L	0.005	1.69	1.67	1.58	1.7	1.59	1.51	1.65	1.63	1.71	1.69	1.74	1.62	100	–	–
Zinc	µg/L	2	2.9	2.6	3.13	2.2	<2	2.92	3.38	<2	<2	2.5	2.32	<2	7.9	–	<4 – 7

Above Threshold

Detected values

Elemental Analysis (trace metals)

Sediment example

Seawater example

Biology: Benthic Ecological Survey

	A	B	C	D	E	F	G	H
1	SPECIES ID	SCIENTIFIC NAME	KINGDOM	PHYLUM	CLASS	ORDER	FAMILY	GENUS
2	STI.1	Actinothoe sphyrodeta	Animalia	Cnidaria	Anthozoa	Actiniaria	Sagartiidae	Actinothoe
3	STI.2	Alcyonidium diaphanum	Animalia	Bryozoa	Gymnolaemata	Ctenostomatida	Alcyonidiidae	Alcyonidium
4	STI.3	Alcyonium digitatum	Animalia	Cnidaria	Anthozoa	Malacalcyonacea	Alcyoniidae	Alcyonium
5	STI.4	Antedon bifida	Animalia	Echinodermata	Crinoidea	Comatulida	Antedonidae	Antedon
6	STI.5	Aplidium elegans	Animalia	Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Aplidium
7	STI.6	Aplidium punctum	Animalia	Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Aplidium
8	STI.7	Ascidia mentula	Animalia	Chordata	Ascidiacea	Phlebobranchia	Ascidiidae	Ascidia
9	STI.8	Ascidiella aspersa	Animalia	Chordata	Ascidiacea	Phlebobranchia	Ascidiidae	Ascidiella
10	STI.9	Aslia lefevrei	Animalia	Echinodermata	Holothuroidea	Dendrochirotida	Cucumariidae	Aslia
11	STI.10	Asterias rubens	Animalia	Echinodermata	Asteroidea	Forcipulatida	Asteriidae	Asterias

135	STI.134	Sycon ciliatum	Animalia	Porifera	Calcarea	Leucosolenida	Syconidae	Sycon
136	STI.135	Symphodus melops	Animalia	Chordata	Teleostei	Eupercaria incertae sedis	Labridae	Symphodus
137	STI.136	Synoicum incrustatum	Animalia	Chordata	Ascidiacea	Aplousobranchia	Polyclinidae	Synoicum
138	STI.137	Taurulus bubalis	Animalia	Chordata	Teleostei	Perciformes	Cottidae	Taurulus
139	STI.138	Tethya citrina	Animalia	Porifera	Demospongiae	Tethyida	Tethyidae	Tethya
140	STI.139	Thorogobius ephippiatus	Animalia	Chordata	Teleostei	Gobiiformes	Gobiidae	Thorogobius
141	STI.140	Thyone	Animalia	Echinodermata	Holothuroidea	Dendrochirotida	Phyllophoridae	Thyone
142	STI.141	Tricolia pullus	Animalia	Mollusca	Gastropoda	Trochida	Phasianellidae	Tricolia
143	STI.142	Trivia arctica	Animalia	Mollusca	Gastropoda	Littorinimorpha	Triviidae	Trivia
144	STI.143	Trivia monacha	Animalia	Mollusca	Gastropoda	Littorinimorpha	Triviidae	Trivia
145	STI.144	Tubularia indivisa	Animalia	Cnidaria	Hydrozoa	Anthoathecata	Tubulariidae	Tubularia
146	STI.145	Ulva lactuca	Plantae	Chlorophyta	Ulvophyceae	Ulvales	Ulvaceae	Ulva
147	STI.146	Urticina felina	Animalia	Cnidaria	Anthozoa	Actiniaria	Actiniidae	Urticina
148								

Benthic Species

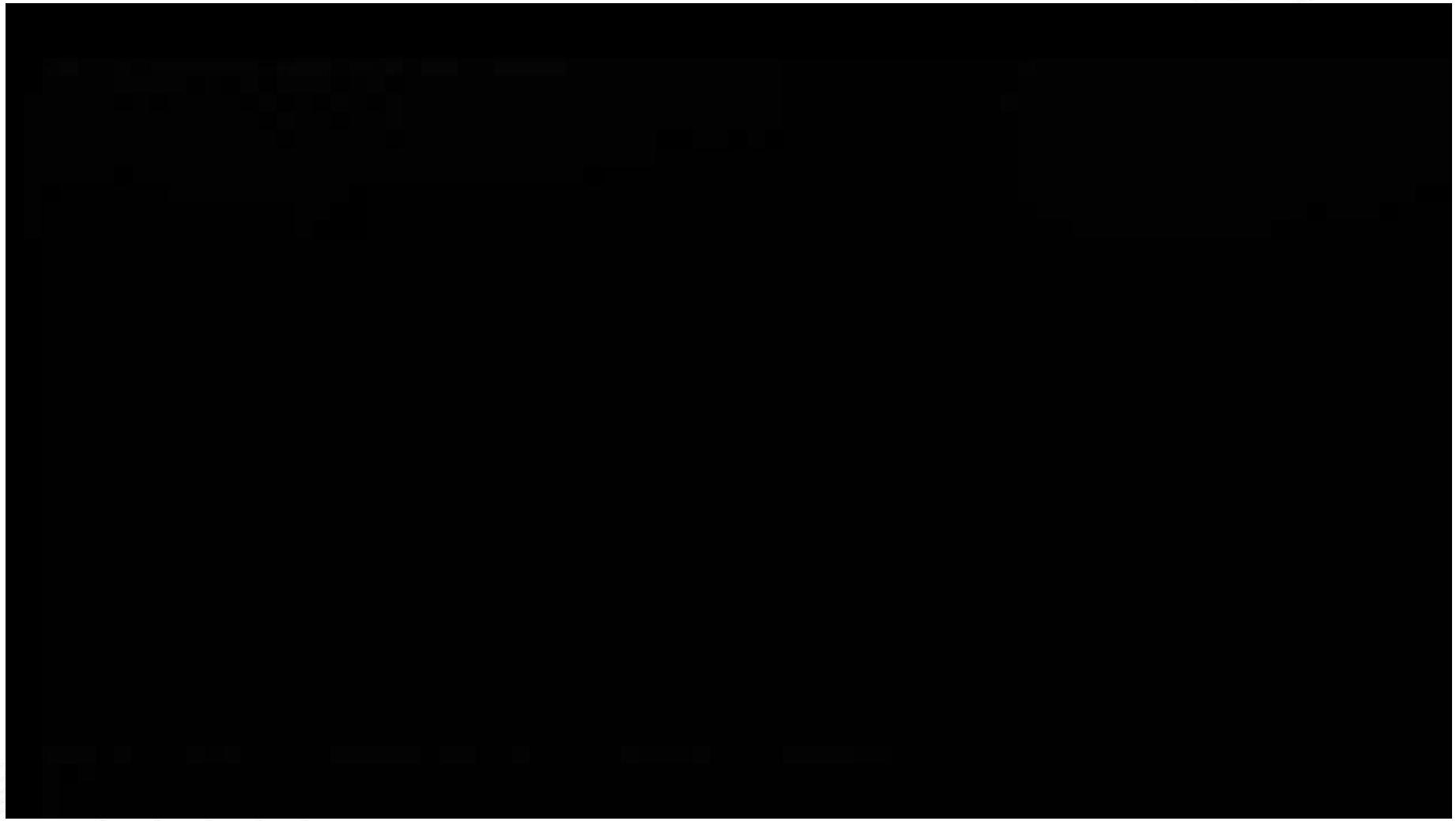
- Analysis of video taken during dive survey resulted in the identification of 146 species between 3 survey sites.

PLANETARY

Biology: Tissue Testing

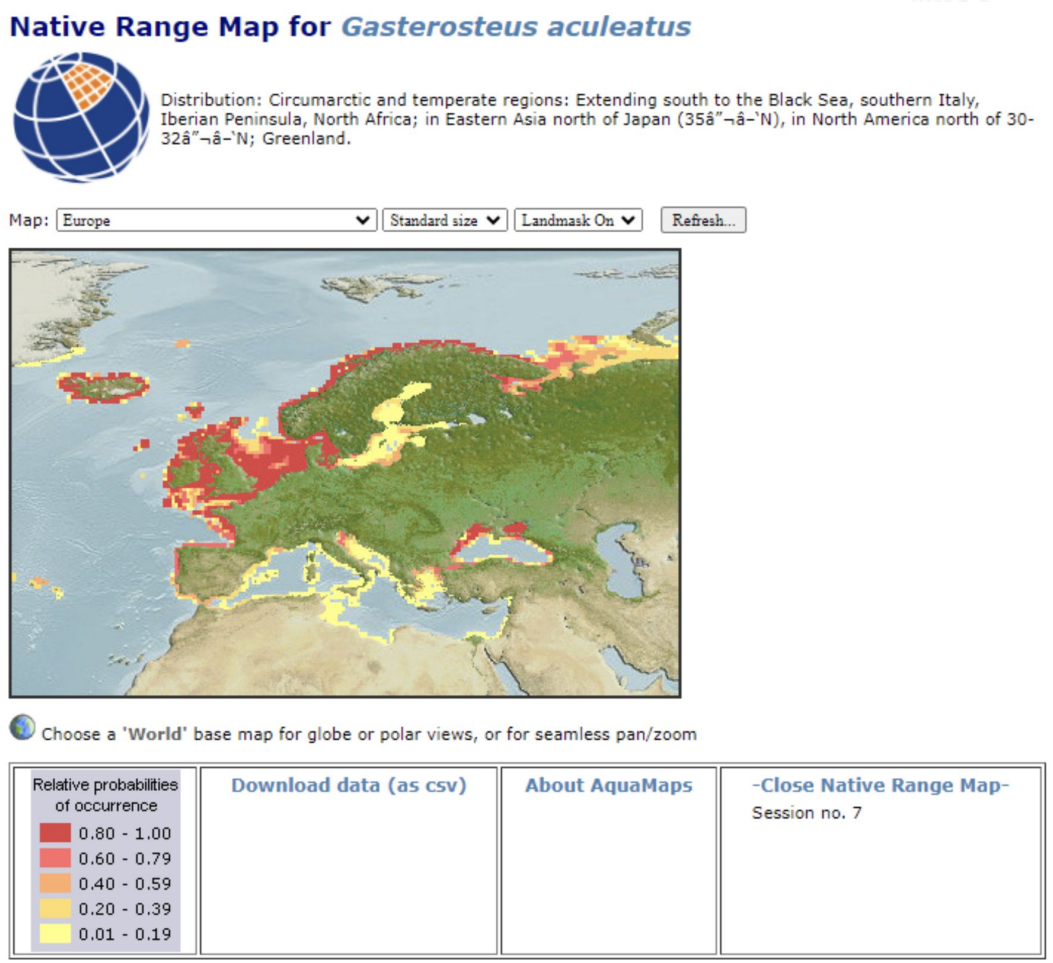
Sub-Matrix: BIOTA	Client sample ID	Fauna Diffuser Crab					
	Laboratory sample ID	LE2307155-001					
	Client sampling date / time	2023-05-07					
Parameter	Result	MU	Unit	LOR	Package	Method	Issuer
Sample Preparation							
Digestion	Yes	----	-	-	F-15HF-sol2	B-PF51HF-MW	LE
Total Metals/Major Cations							
Aluminum	7.94	± 1.42	mg/kg	2.00	F-15HF-sol2	B-SFMS-51	LE
Arsenic	19.9	± 2.5	mg/kg	0.0200	F-15HF-sol2	B-SFMS-51	LE
Boron	<2	----	mg/kg	2.00	F-15HF-sol2	B-SFMS-51	LE
Cadmium	<0.005	----	mg/kg	0.00500	F-15HF-sol2	B-SFMS-51	LE
Calcium	777	± 105	mg/kg	30.0	F-15HF-sol2	B-SFMS-51	LE
Chromium	3.96	± 1.03	mg/kg	0.0500	F-15HF-sol2	B-SFMS-51	LE
Cobalt	0.119	± 0.017	mg/kg	0.0200	F-15HF-sol2	B-SFMS-51	LE
Copper	8.03	± 1.12	mg/kg	0.200	F-15HF-sol2	B-SFMS-51	LE
Iron	20.4	± 3.0	mg/kg	2.00	F-15HF-sol2	B-SFMS-51	LE
Lead	<0.03	----	mg/kg	0.0300	F-15HF-sol2	B-SFMS-51	LE
Magnesium	743	± 102	mg/kg	20.0	F-15HF-sol2	B-SFMS-51	LE
Manganese	0.451	± 0.062	mg/kg	0.200	F-15HF-sol2	B-SFMS-51	LE
Mercury	0.0365	± 0.0046	mg/kg	0.0200	F-15HF-sol2	B-SFMS-51	LE
Nickel	2.08	± 0.41	mg/kg	0.0500	F-15HF-sol2	B-SFMS-51	LE
Silver	0.150	± 0.026	mg/kg	0.00300	F-15HF-sol2	B-SFMS-51	LE
Tin	<0.05	----	mg/kg	0.0500	F-15HF-sol2	B-SFMS-51	LE
Vanadium	0.0462	± 0.0063	mg/kg	0.0200	F-15HF-sol2	B-SFMS-51	LE
Zinc	60.7	± 8.3	mg/kg	0.500	F-15HF-sol2	B-SFMS-51	LE

DIVE SURVEY



Biology: Toxicology Testing

- **Perform certified lab-based testing of small native fish**
- **Conduct LC50 testing of stickleback (Gasterosteus aculeatus) with Planetary's MH**
- **Test at multiple concentrations: .63 g/l, 1.25 g/l, 2.5 g/l, 5 g/l, 10g/l**
- **Concentration proposed for Hayle trial: <1g/l**



Biology: Toxicology Testing Results

Planetary's magnesium hydroxide is non-toxic to stickleback at 10 g/l

- **Concentration proposed for Hayle trial: <1g/l**

GENERAL REPORT
AQUATIC TOXICITY TESTING OF BRUCITE

Submitted By:

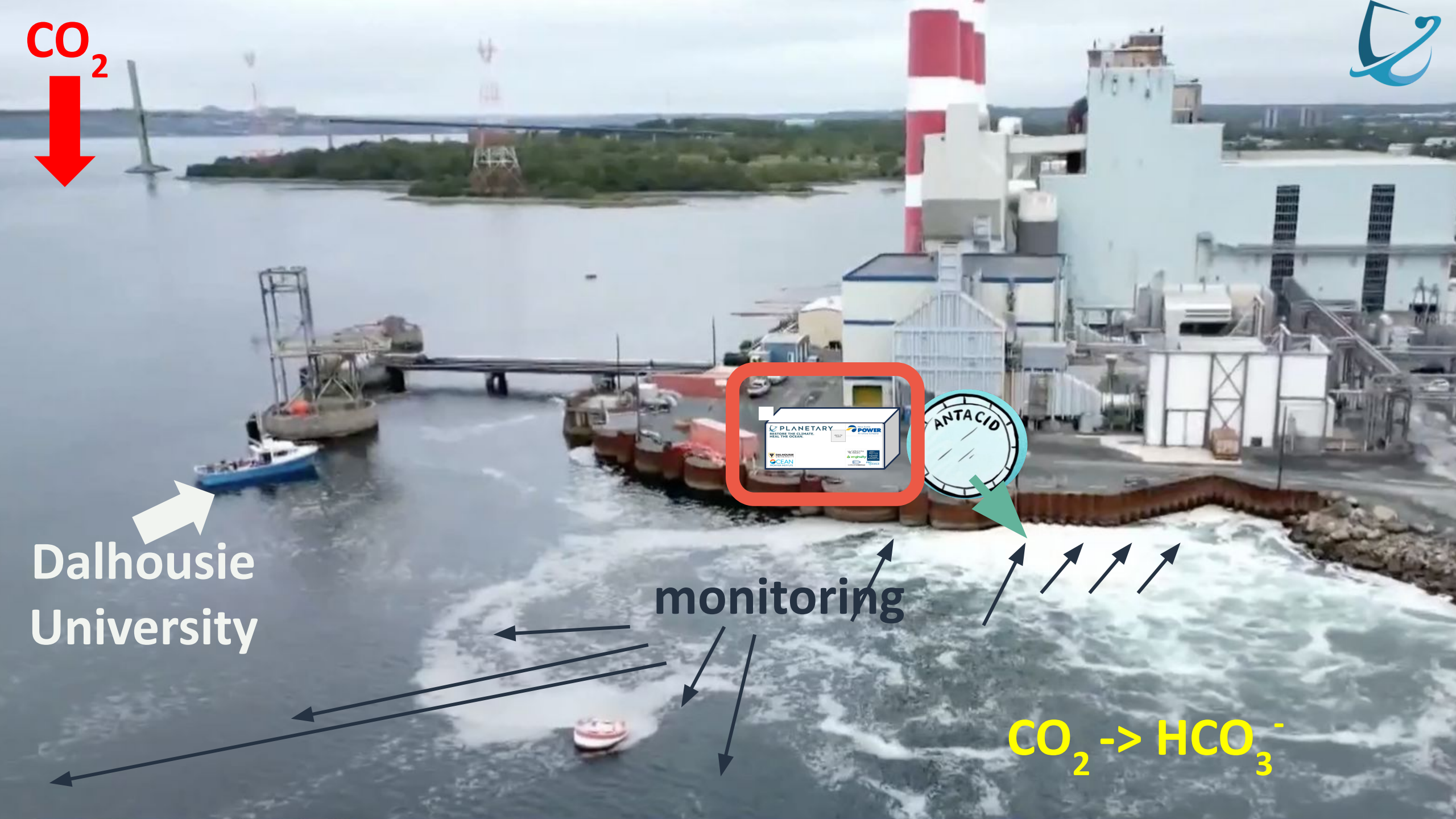
HITS
Aquatic Toxicity Testing

Observation Period	LC50 (g/L)	95% confidence limits (g/L)
96 hours	>10.0	N/A

Table 1 – Brucite Toxicity Results (September 2023).

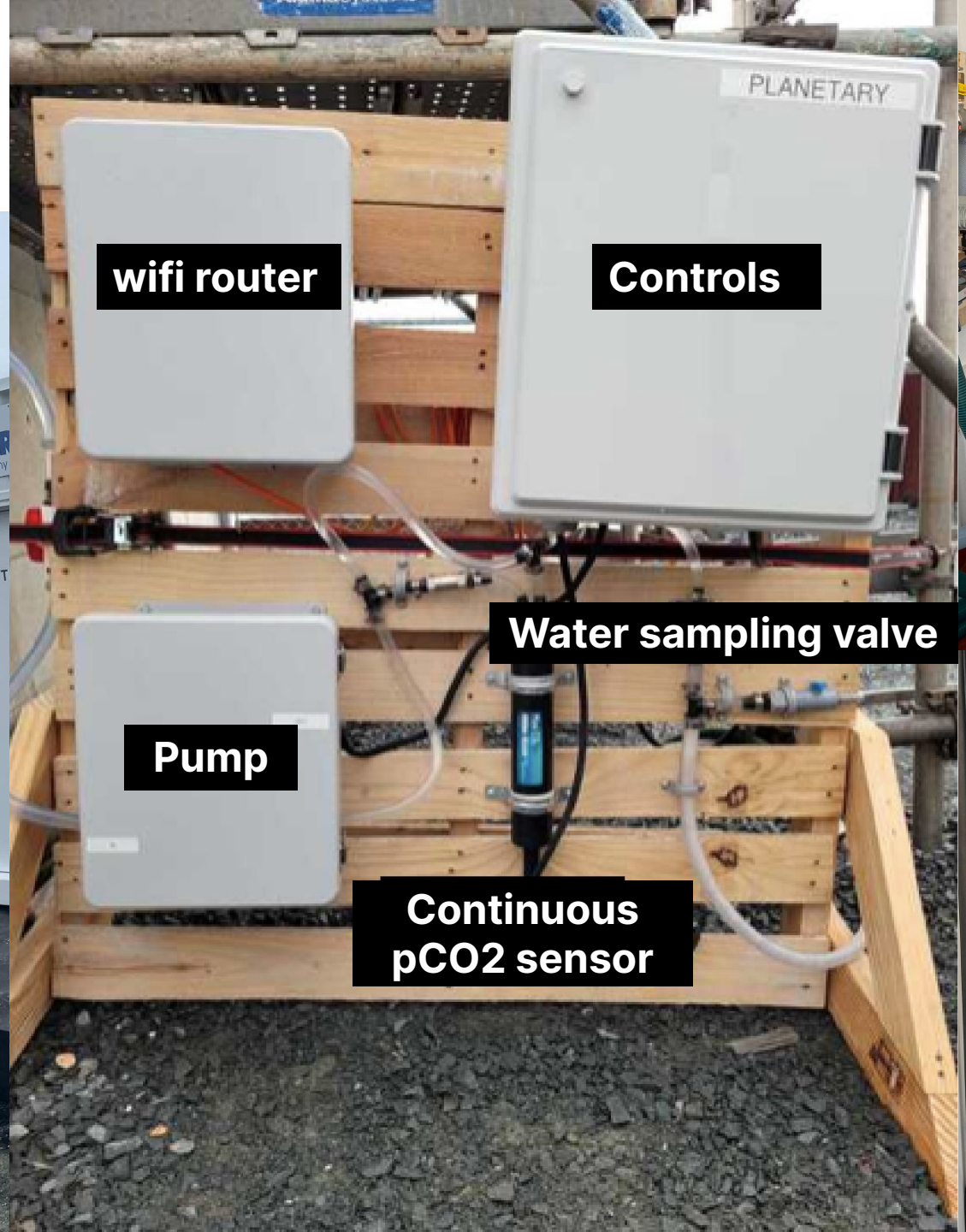
Based on the results of the above testing, the acutely toxic concentration of the chemical Brucite to Threespine stickleback falls above 10 g/L (or 10,000 mg/L).

Update on Halifax Project


CO_2
PLANETARY
RESTORE THE CLIMATE.
HEAL THE OCEAN.
POWER
ANTACID
Dalhousie
University
monitoring
CO_2 -> HCO_3^-

Site Automation and Monitoring Syster


Nova Scotia
POWER
An Emera Company
GESU 802454-9

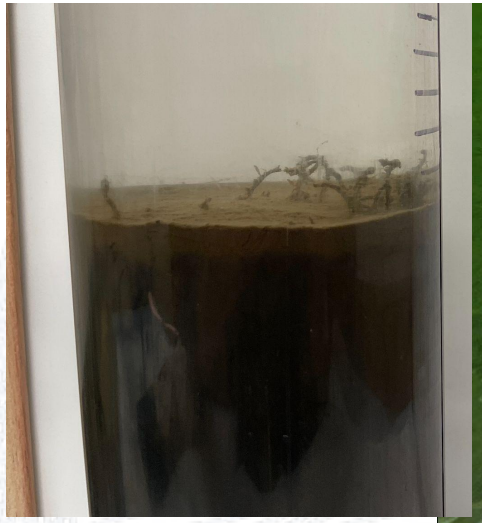

PLANETARY
wifi router
Controls
Water sampling valve
Pump
Continuous
pCO2 sensor

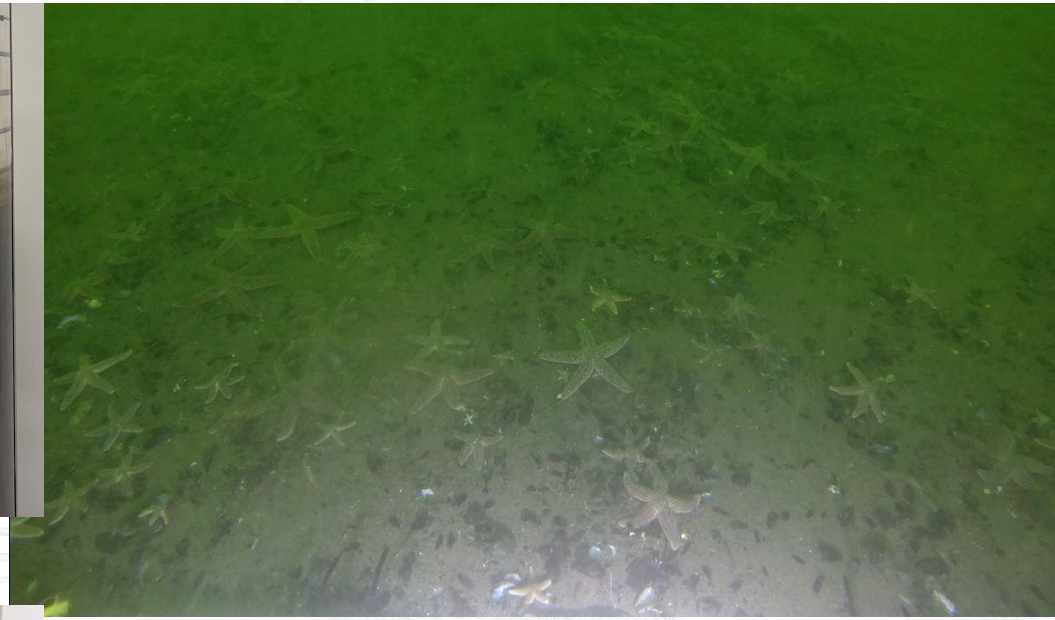

ProMine

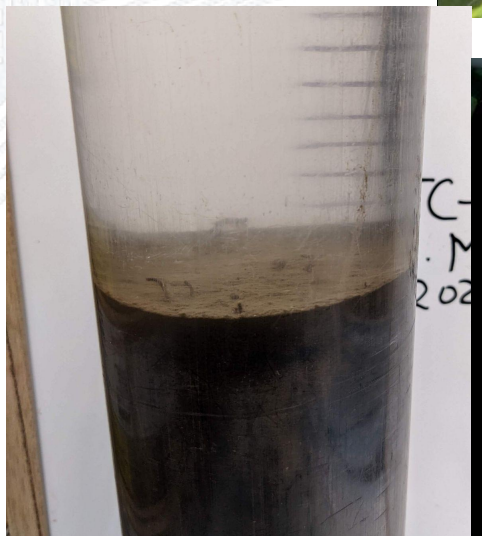

RIGHT TO KNOW
SAFETY
DATA
SHEET

Sediment Monitoring

In addition to water monitoring







Results

Too early for most scientific results to be determined

- **Trial to be completed by November 30**
- **Weekly additions for up to 12 hours per day so far**
- **All limits respected (tests conducted and verified by local lab and enforcement agency)**
- **Maximum rate of addition: approximately 11k tonnes per year gross removals**
- **Target for net removal this year: approximately 100 tonnes**
- **No issues identified so far**

PLANETARY

Thank you!