Appendix 1

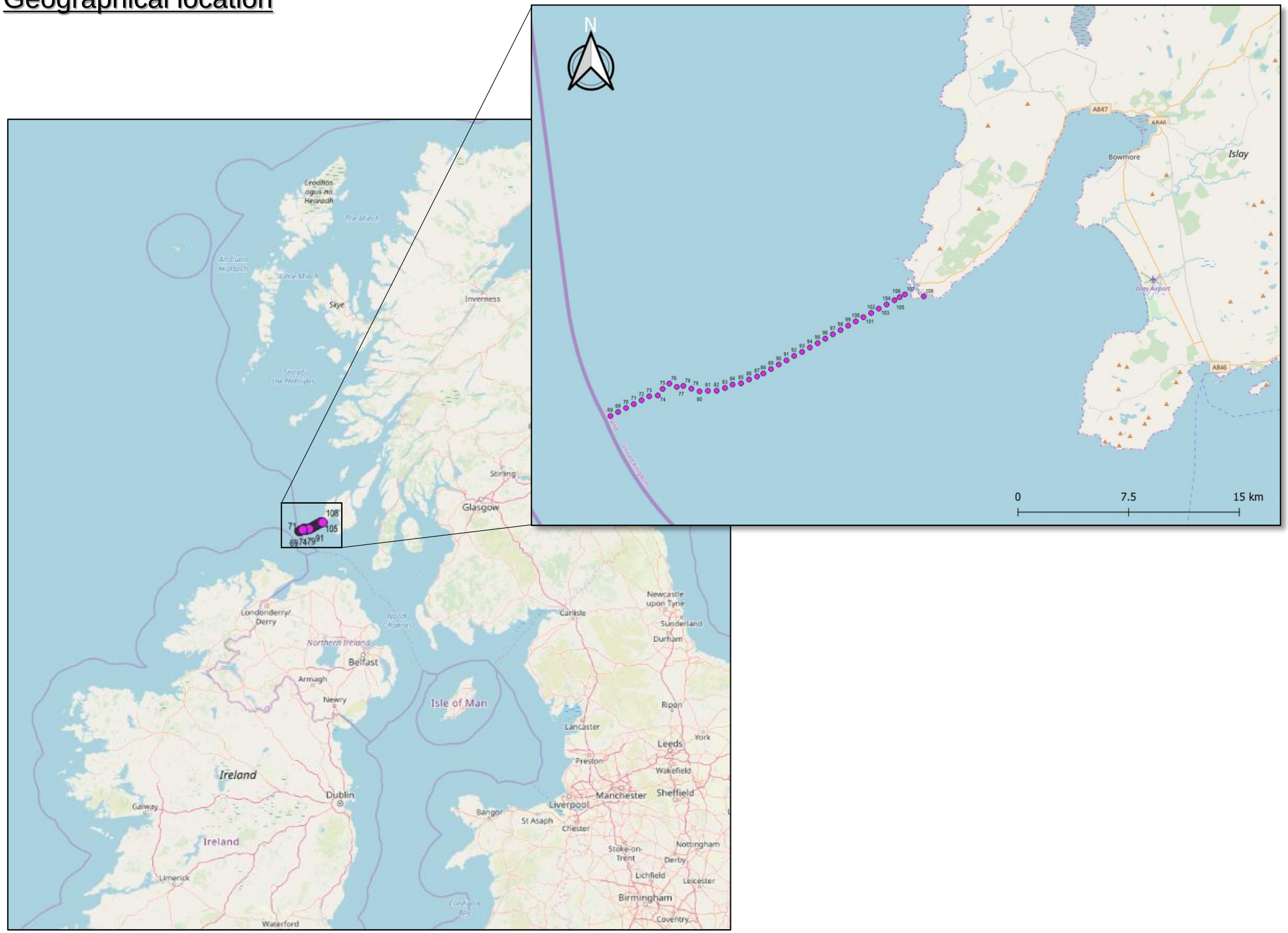
Acoustic Listening stations coordinates

id	Lat	Lon
68	55°36'2.28"N	6°50'22.89"W
69	55°36'10.94"N	6°49'53.25"W
70	55°36'19.74"N	6°49'22.80"W
71	55°36'28.12"N	6°48'52.85"W
72	55°36'36.57"N	6°48'22.74"W
73	55°36'45.09"N	6°47'53.22"W
74	55°36'47.13"N	6°47'20.10"W
75	55°37'1.31"N	6°47'1.33"W
76	55°37'13.01"N	6°46'35.35"W
77	55°37'5.55"N	6°46'6.56"W
78	55°37'7.83"N	6°45'41.43"W
79	55°37'1.86"N	6°45'10.35"W
80	55°36'55.97"N	6°44'38.59"W
81	55°36'57.05"N	6°44'6.42"W
82	55°36'57.32"N	6°43'32.75"W
83	55°37'3.28"N	6°43'0.66"W
84	55°37'10.81"N	6°42'31.28"W
85	55°37'13.50"N	6°41'58.31"W
86	55°37'21.86"N	6°41'27.57"W
87	55°37'28.30"N	6°40'56.39"W
88	55°37'34.95"N	6°40'32.41"W
89	55°37'44.61"N	6°40'2.86"W
90	55°37'54.46"N	6°39'32.84"W

id	Lat	Lon
91	55°38'3.65"N	6°39'2.94"W
92	55°38'13.14"N	6°38'33.26"W
93	55°38'21.95"N	6°38'2.71"W
94	55°38'31.58"N	6°37'32.60"W
95	55°38'41.02"N	6°37'2.57"W
96	55°38'50.82"N	6°36'33.23"W
97	55°39'0.41"N	6°36'3.87"W
98	55°39'9.50"N	6°35'34.11"W
99	55°39'19.16"N	6°35'4.67"W
100	55°39'28.34"N	6°34'35.28"W
101	55°39'37.51"N	6°34'5.72"W
102	55°39'46.70"N	6°33'35.87"W
103	55°39'56.30"N	6°33'6.32"W
104	55°40'5.36"N	6°32'36.20"W
105	55°40'14.64"N	6°32'5.69"W
106	55°40'21.29"N	6°31'45.74"W
107	55°40'27.32"N	6°31'25.44"W
108	55°40'23.01"N	6°30'12.63"W

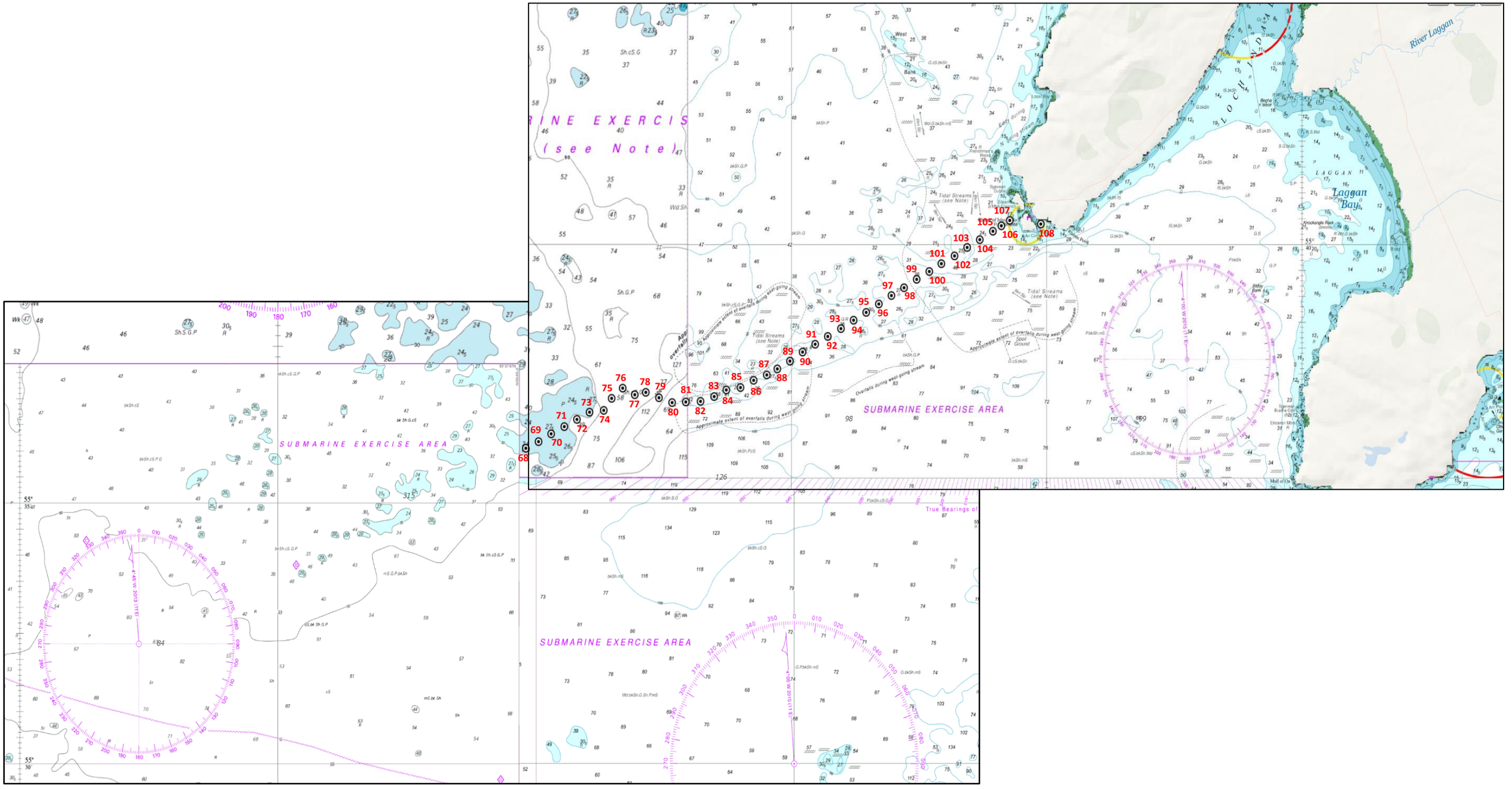
Appendix 1

Geographical location



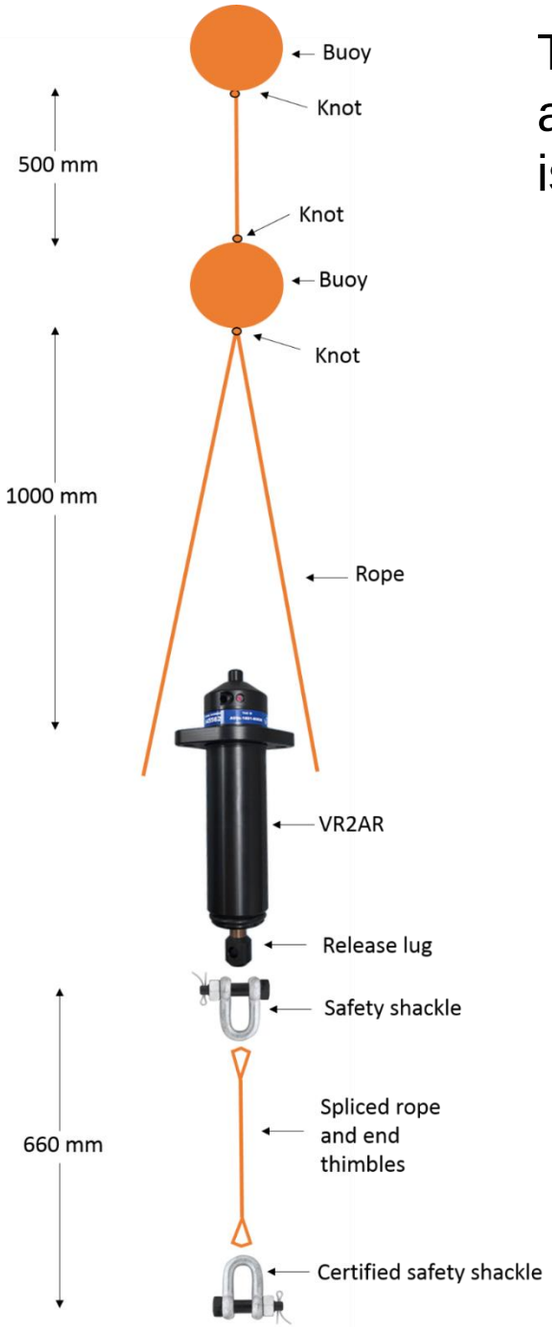
Appendix 1

Admiralty map



Appendix 2

All parts of the mooring and floatation system

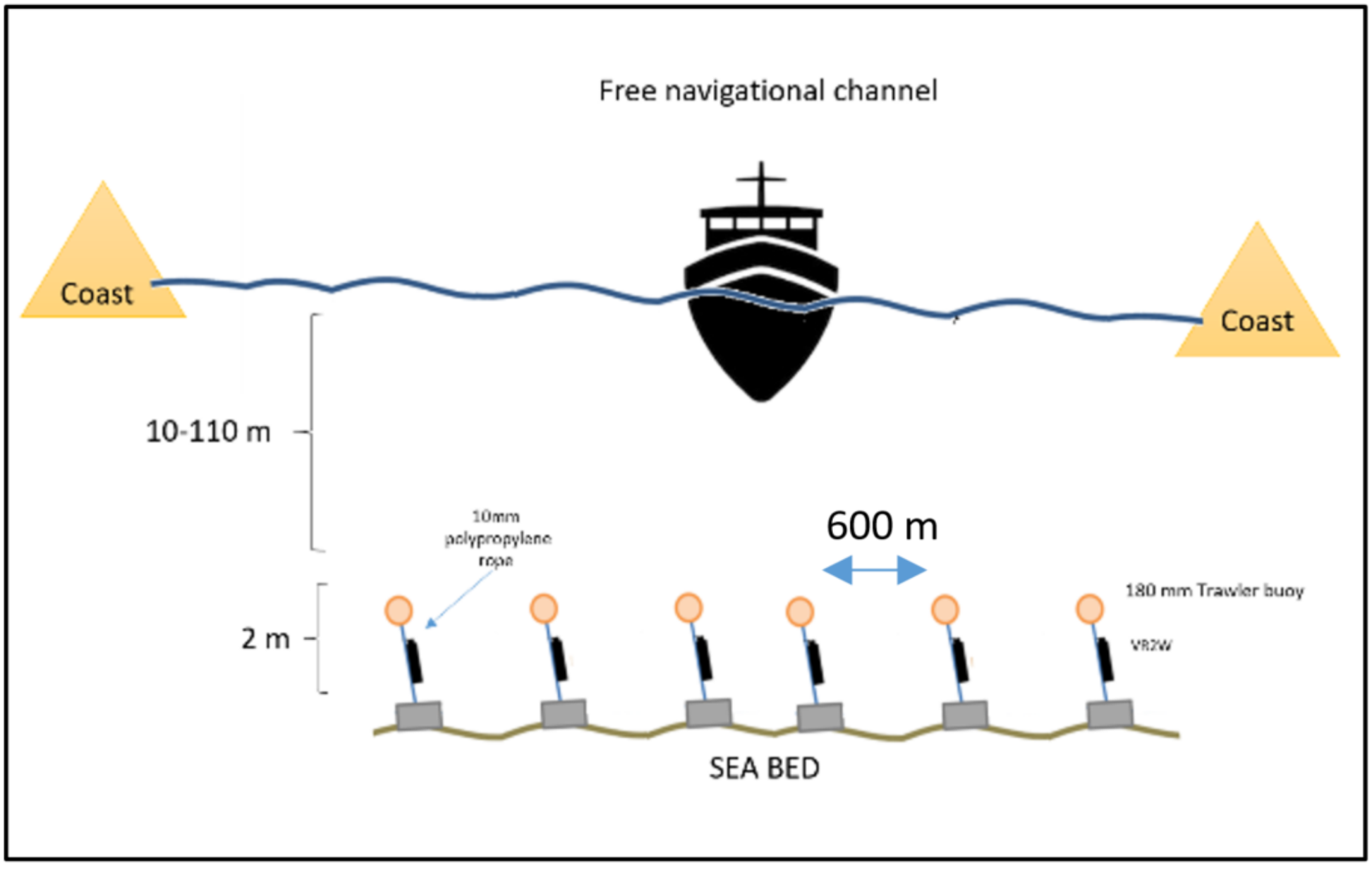


The floatation system in operation after acoustic release mechanism is activated

The floatation system at surface awaiting recovery
by grappling hook or gaff between the two buoys to insure the VR2AR unit is not damaged by the hook

Appendix 3

Configuration of the array on the sea bed



Appendix 4

Forces involved in the displacement of acoustic receivers under the water

The deployment of acoustic arrays requires the calculation of forces involved in the displacement of mooring, floats and receivers under the water .
Modelling carried out by the SeaMonitor project suggest that mooring weights >70Kg will enable the deployment of receivers in the majority of the areas to be covered by the project

Generic forces

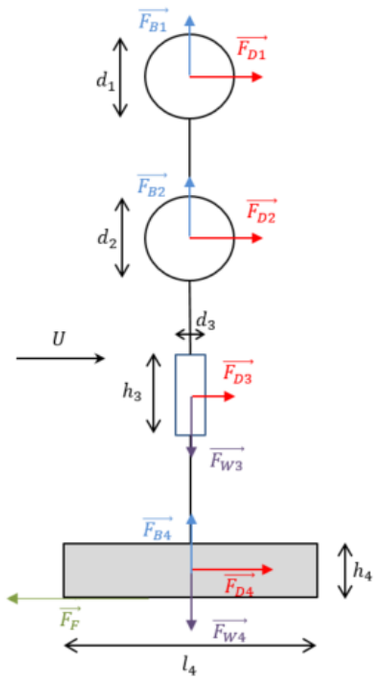
Drag forces $F_D = \frac{1}{2}\rho_w C_D A\, U^2$

Weight $F_W = m\, g$

Buoyancy $F_B = \rho_w V g$

Frction force $F_F = \mu(F_W - F_B)$

Equilibrium (Newton's 1st law) $F_D = F_F$



Specific forces:

Drag forces:

$$F_{D1} = \frac{1}{2}\rho_w C_{D1}\, \pi \frac{d_1^2}{4}\, U^2$$

$$F_{D2} = \frac{1}{2}\rho_w C_{D2}\, \pi \frac{d_2^2}{4}\, U^2$$

$$F_{D3} = \frac{1}{2}\rho_w C_{D3}\, h_3 d_3\, U^2$$

$$F_{D4}{}^{(1)} = \frac{1}{2}\rho_w C_{D4}{}^{(1)}\, h_4^2\, U^2 \qquad F_{D4}{}^{(2)} = \frac{1}{2}\rho_w C_{D4}{}^{(2)}\, h_4 l_4\, U^2$$

Weight:

$$F_{W3} = m_3 g$$

$$F_{W4} = m_4 g$$

Buoyancy:

$$F_{B1} = \rho_w \frac{\pi d_1^3}{6}\, g = m_1 g$$

$$F_{B2} = \rho_w \frac{\pi d_2^3}{6}\, g = m_2 g$$

$$F_{B4} = \rho_w\, h_4^2\, l_4\, g$$

Equilibrium $\sum_{i=1}^{4} F_{Di} = \mu \sum_{i=1}^{4} (F_{Wi} - F_{Bi})$

$$\Rightarrow U^{(1)} = \sqrt{\frac{2\,\mu\, g\left(m_3 + m_4 - (m_1 + m_2 + \rho_w h_4^2 l_4)\right)}{\rho_w \left(C_{D1}\frac{\pi d_1^2}{4} + C_{D2}\frac{\pi d_2^2}{4} + C_{D3} h_3 d_3 + C_{D4}{}^{(1)} h_4^2\right)}}$$

Current flows in the direction of the long side of the anchor

$$U^{(2)} = \sqrt{\frac{2\,\mu\, g\left(m_3 + m_4 - (m_1 + m_2 + \rho_w h_4^2 l_4)\right)}{\rho_w \left(C_{D1}\frac{\pi d_1^2}{4} + C_{D2}\frac{\pi d_2^2}{4} + C_{D3} h_3 d_3 + C_{D4}{}^{(2)} h_4 l_4\right)}}$$

Current flows in the direction perpendicular to the long side of the anchor

$$\Rightarrow m_4{}^{(1)} = \frac{\rho_w U^2 \left(C_{D1}\frac{\pi d_1^2}{4} + C_{D2}\frac{\pi d_2^2}{4} + C_{D3} h_3 d_3 + C_{D4}{}^{(1)} h_4^2\right)}{2\,\mu\, g} + (m_1 + m_2 + \rho_w h_4^2 l_4 - m_3)$$

$$m_4{}^{(2)} = \frac{\rho_w U^2 \left(C_{D1}\frac{\pi d_1^2}{4} + C_{D2}\frac{\pi d_2^2}{4} + C_{D3} h_3 d_3 + C_{D4}{}^{(2)} h_4 l_4\right)}{2\,\mu\, g} + (m_1 + m_2 + \rho_w h_4^2 l_4 - m_3)$$

Input parameters

Steel block anchor

Long side (m)	0.825
Short sides (m)	0.15
Mass (kg)	36.3
Friction coefficient	0.4
Drag coefficient 1	1.05
Drag coefficient 2	2.05

Receiver unit

Length (m)	0.308
Diameter (m)	0.073
Mass in water (kg)	0.05
Drag coefficient	0.42
Height from anchor (m)	0.6

Buoy 1

Diameter (m)	0.28
Mass of lift (kg)	8.4
Drag coefficient	0.38
Height from hydrophone (m)	1

Buoy 2

Diameter (m)	0.28
Mass of lift (kg)	8.4
Drag coefficient	0.38
Height from buoy 1 (m)	1.34

Environment:

Water density (kg/m^3)	1025
Water depth (m)	50
Water velocity (m/s)	1

Output parameters

Pressure (bar)	5.03
Anchor volume (m^3)	0.0186
Anchor weight (N)	169.45
Total weight (N)	5.13
Friction force (N)	2.05

Cross sectional areas

Anchor 1 (m^2)	0.0225
Anchor 2 (m^2)	0.1238
Hydrophone (m^2)	0.0225
Buoy 1 (m^2)	0.0616
Buoy 2 (m^2)	0.0616

U_{max} (m/s) (1)	
U_{max} (m/s) (2)	
m_{anchor} (kg) (1)	**46.21**
m_{anchor} (kg) (2)	**76.26**