RV *Investigator* Voyage Plan

VOYAGE #:	IN2024_V02
Version Number:	FINAL
Voyage title:	**SOTS:** Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania
Mobilisation:	Hobart, Wednesday, 27 March to Saturday, 30 March 2024
Pre-voyage PCR test & onboarding	Hobart, 0830 - 0930 Saturday, 30 March 2024
Depart:	Hobart, 0800 Sunday, 31 March 2024
Return:	Hobart, 0800 Sunday, 21 April 2024
Demobilisation:	Hobart, Monday, 22 April 2023
Voyage Delivery Coordinator:	David Flynn
Voyage Manager:	Max McGuire
Chief Scientist:	Elizabeth H. Shadwick
Affiliation:	CSIRO

Scientific objectives

Principal Investigator: Dr. Elizabeth Shadwick – CSIRO Env and AAPP

The Southern Ocean has a predominant role in the movement of heat and carbon dioxide into the ocean interior moderating Earth's average surface climate. The IMOS SOTS sub-facility uses a set of two automated moorings to measure these processes under extreme conditions, where they are most intense and have been least studied. The atmosphere-ocean exchanges occur on many timescales, from daily insolation cycles to ocean basin decadal oscillations and thus high frequency observations sustained over many years are required. The current context of anthropogenic forcing of rapid climate change adds urgency to the work.

Voyage objectives

The primary objective is to first deploy a new set of SOTS moorings (SOFS-13 and SAZ-26) and then recover the existing SOTS moorings (SOFS-12, SOFS-11-SWAP and SAZ-25). Each of the SOTS moorings delivers to specific aspects of the atmosphere-ocean exchanges:

- the SAZ sediment trap mooring collects samples to quantify the transfer of carbon and other nutrients to the ocean interior by sinking particles and investigate their ecological controls.
- the Southern Ocean Flux Station (SOFS) mooring measures meteorological and ocean properties important to air-sea exchanges, ocean stratification, waves, currents and biological productivity and ecosystem structure. Water samples are collected for more detailed nutrient and plankton investigations after recovery.

Ancillary work will obtain supporting information on atmospheric and oceanographic conditions using CTD casts, and underway measurements.

1. Deploy SOFS-13 meteorology/biogeochemistry mooring
2. Deploy SAZ-26 sediment trap mooring
3. Recover SOFS-12 meteorology/biogeochemistry mooring
4. Recover SOFS-11-SWAP mooring
5. Recover SAZ-25 sediment trap mooring
6. CTD sampling (3 cast to 4550m, 2 to 600m) at the SOTS site, including collecting samples for nutrients, oxygen, dissolved inorganic carbon, alkalinity, and particulate matter analyses
7. Ship meteorological observations at SOFS buoys for comparisons
8. Recovery of CalTech and CSIRO gliders on return transit if required and in range (noting that this may require a route to Hobart further west than the track shown on the map below)
9. Deployment of two Argo Floats
10. Carry out underway air and water sampling and sensor measurements, including bio-optics and bio-acoustics

Voyage Priorities (SOTS)

Note: The objectives list above are NOT the priority ranking, because the list is designed for efficiency, using past voyage experience, to achieve all goals. In particular, deploying SOFS-13 as the first operation frees up deck space and increases efficiency. This sequence also optimises fatigue management (long day, spooling/rest day, short day, short day, long day), but is subject to change based on the weather conditions and other factors including the fatigue of the team.

The overall priority is successful SOTS moorings deployment, recovery, and collection of calibration/validation samples (SOTS objectives 1 – 7), followed by objectives 8 to 10. After these, the supplementary and piggyback project operations are prioritised lower, however careful consideration has been applied during planning and will be applied during voyage management at sea, in order to optimise timing of operations for maximum outcomes across all projects.

Voyage Risk Assessment (VRA)

The MNF, in consultation with the science party and other relevant stakeholders, will develop a comprehensive Voyage Specific Risk Assessment (VSRA) to ensure voyage risks are identified and appropriately controlled.

The MNF will arrange a meeting to undertake this risk assessment process.

This voyage has undergone a comprehensive risk assessment process.

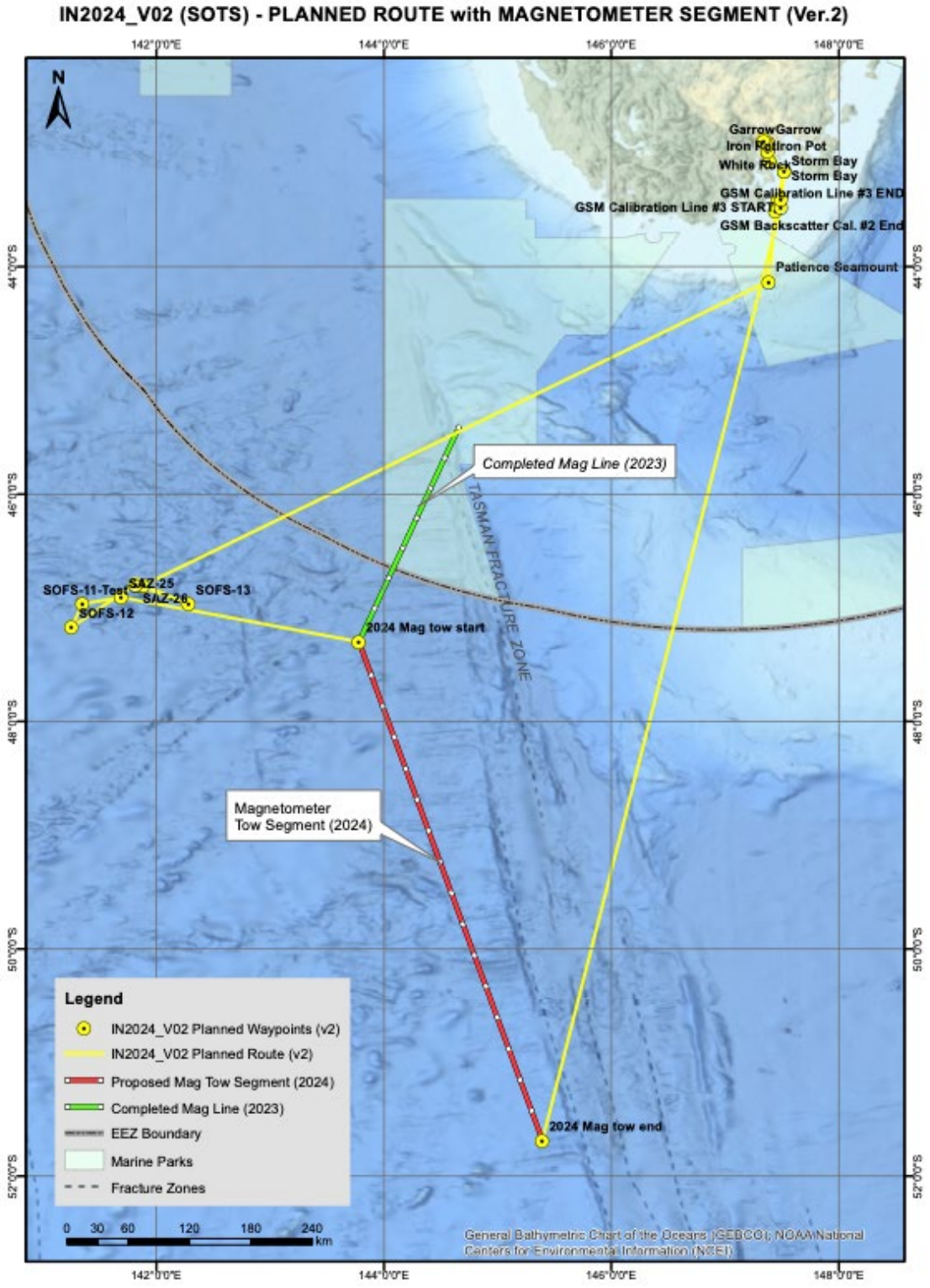
Media Activities

ORGANISATION	ACTIVITIES	TIMING	RESPONSIBLE PERSON
CSIRO	Media engagement	Opportunistically	Thea Williams

Activity plan for first 24-48 hours of voyage

Please provide a plan for the activities for the first 24 hours at sea. This may be weather dependent and if so, please indicate an alternative. This plan will allow the vessel crew to ready gear and personnel for the activities.

Day	Date	Time	Activity
Sat	30 Mar	0830	PCR test pre-boarding, remainder of day completing seagoing inductions, muster drill, voyage management team meeting and general voyage preparations
Sun	31 Mar	0800	Depart PW04
Sun	31 Mar	1000	In Adventure or Storm Bay, toolbox talk planning & testing: Moorings (Test fire/training Pneumatic Line Thrower), SOFS anchor lift
Sun	31 Mar	1300	Begin transit to the SOTS site via detour to Patience Seamount (147.38466, -44.1243)
Sun	31 Mar	1600	Perform Test CTD as soon as seawater is 1000m deep


IN2024_V02 (SOTS) - PLANNED ROUTE with MAGNETOMETER SEGMENT (Ver.2)
142°0'0"E
144°0'0"E
146°0'0"E
148°0'0"E
N
Garrow
Garrow
Iron Pot
Iron Pot
White Rock
Storm Bay
Storm Bay
GSM Calibration Line #3 END
GSM Calibration Line #3 START
GSM Backscatter Cal. #2 End
Patience Seamount
Completed Mag Line (2023)
TASMAN FRACTURE ZONE
SOFS-11-Test
SAZ-25
SAZ-26
SOFS-13
SOFS-12
2024 Mag tow start
Magnetometer
Tow Segment (2024)
2024 Mag tow end
Legend
IN2024_V02 Planned Waypoints (v2)
IN2024_V02 Planned Route (v2)
Proposed Mag Tow Segment (2024)
Completed Mag Line (2023)
EEZ Boundary
Marine Parks
Fracture Zones
0 30 60 120 180 240
km
General Bathymetric Chart of the Oceans (GEBCO); NOAA/National Centers for Environmental Information (NCEI)

Waypoints and stations

SITE	DEGREES DECIMAL MINUTES LATITUDE	DEGREES DECIMAL MINUTES LONGITUDE	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
Hobart PW4 (CSIRO, TAS)	42° 53.170' S	147° 20.320' E	0.0	0	0.0	0
Sullivans Cove	42° 53.026' S	147° 20.356' E	0.1	0.1	0.0	0.0
Battery Pt	42° 53.027' S	147° 20.701' E	0.3	0.4	0.1	0.1
Garrow	42° 54.872' S	147° 22.972' E	2.5	2.9	0.5	0.6
Hobart PBG	42° 55.411' S	147° 22.972' E	0.5	3.4	0.1	0.7
White Rock	42° 58.582' S	147° 22.499' E	3.2	6.6	0.3	1.0
Iron Pot	43° 03.687' S	147° 23.440' E	5.2	11.8	0.5	1.5
Storm Bay	43° 09.149' S	147° 31.376' E	8.0	19.7	0.8	2.3
GSM Backscatter Cal. #2 Start	43° 24.478' S	147° 27.939' E	15.5	35.3	1.6	3.9
GSM Backscatter Cal. #2 End	43° 30.632' S	147° 26.618' E	6.2	41.5	0.8	4.6
Patience Seamount	44° 07.458' S	147° 23.080' E	36.9	78.5	3.7	8.3
SOTS (nominal)	46° 48.200' S	141° 53.040' E	281.9	360.3	28.2	36.5
SOFS-13 (deployment) target	46° 57.990' S	142° 17.058' E	19.1	379.5	1.9	38.4
SAZ-26 (deployment) target	46° 47.622' S	141° 48.960' E	21.8	401.3	2.2	40.6
SOFS-12 (recovery) anchor	47° 10.171' S	141° 15.369' E	32.2	433.5	3.2	43.8
SOFS-11-SWAP (recovery) anchor	46° 57.896' S	141° 21.070' E	12.9	446.4	1.3	45.1
SAZ-25 (recovery) anchor	46° 54.529' S	141° 41.539' E	14.4	460.8	1.4	46.6
2024 Mag tow start	47° 17.913' S	143° 46.983' E	88.6	549.3	8.9	55.4
2024 Mag tow end	51° 40.999' S	145° 23.647' E	270.6	820.0	27.1	82.5
GSM Calibration Line #3 END	43° 28.370' S	147° 29.713' E	736.3	1859.0	73.6	156.1
GSM Calibration Line #3 START	43° 23.824' S	147° 29.656' E	4.5	1863.6	0.6	156.7
Storm Bay	43° 09.149' S	147° 31.376' E	14.7	1878.3	1.5	158.2

CTD Configuration

Note #1: On every departure a test CTD is to be undertaken, ideally 24 hours prior to the first planned CTD cast. This requirement is a single cast to a minimum of 1000m, firing half the bottles at the maximum depth of the cast, followed by firing of the remaining bottles near the chlorophyll maximum (requiring one stop on the retrieval). This test CTD is essential to the MNF Hydrochemistry team and supports the training of samplers, testing of Niskin bottles, collection of a tracking standard for the voyage, and ongoing quality and uncertainty calculations. Please allow for this cast in your voyage's Time Estimates (approximately 1 hour).

The MNF CTD is a Seabird 911 system with a variety of auxiliary sensors, installed on either a 24 or 36 bottle Niskin frame.

The science party may be required to assist with sampling the Niskin bottles, preparing the bottles for deployment and for setting up and logging each deployment of the CTD. Training will be given by the MNF DAP and hydrochemistry teams on board.

Plan for the following maximum rate of analyses based on 2 Hydrochemists:

- 48 nutrients, 48 dissolved oxygen, 48 salinity analyses per 24 hours; OR
- 72 nutrient, 36 dissolved oxygen, 36 salinity analyses per 24 hours; OR
- 160 nutrient analyses (only) per 24 hours.

	PLEASE SELECT:
Fundamentals	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	36
Likely total number of casts:	14
Likely maximum depth of deepest cast:	4550 m
Standard CTD Configuration - Instrumentation (maximum 6 auxiliary channels plus 2 x DO) 6000m	
1 x SBE9+ (CTD) 2 x SBE3P Temperature Sensors 2 x SBE4C Conductivity Sensors 2 x SBE5T pumps	Yes
2 x SBE43 Dissolved Oxygen Sensors	Yes
1 x Tritech PA200/500 Altimeter	Yes
1 x Biospherical QCP2300HP PAR Sensor	Yes
1 x Wetlabs C-Star 25cm Transmissometer	Yes
1 x Wetlabs ECO FLCDRTD Fluorometer – CDOM (370/460nm)	No
1 x Wetlabs ECO FLBBRTD Fluorometer – Chlorophyll-a & Backscatter (2 x channels - 470/695nm)	Yes
Alternative Instruments (Instruments highlighted in grey can be substituted from standard configuration)	
Seapoint Turbidity Meter – Nephelometer	

	PLEASE SELECT:
Chelsea Aquatracka III (430/685nm) Fluorometer – Chlorophyll-a	
Seabird SUNA – Ultraviolet Nitrate Analyzer (**Serial Connection - 2000m**)	
Standard LADCP Configuration – Instrumentation: 6000m	
1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 150 kHz LADCP (Master - Down) 1 x 48V Deep Sea Battery	No
Alternative LADCP Configuration - Instrumentation: 6000m	
1 x Teledyne 300 kHz LADCP (Slave - Up) 1 x Teledyne 300 kHz LADCP (Master - Down) 1 x 48V Deep Sea Battery	No
Hydrochemistry Analyses	
Salinity	Yes
Dissolved Oxygen	Yes
Nutrients: Nitrate	Yes
Nutrients: Phosphate	Yes
Nutrients: Silicate	Yes
Nutrients: Nitrite	No
Nutrients: Ammonia	No

For the 2 shallow CTD casts at the SOTS site, we will fit our SBE CTD sensors to the rosette frame; we will supply instrument mounts, and assist SIT with the removal of Niskin bottles to accommodate the sensors.

Time estimates

The following time estimates are based on a steaming speed of 10 knots.

DATE	TIME	ACTIVITY
Sun 31	Mar	0800 – Depart PW04 (dependant on medical clearance results) 0830 – Muster drill for all science party (if not already complete alongside) 1000 – In Adventure or Storm Bay, test the following: mooring anchor dual lift, CTD, … 1230 – 1300 Outbound: Calibrate backscatter of EM710 on GSM Line #2 @8kts 1300 – Begin transit to SOTS (via Patience Seamount, 147.38466, -44.1243)
Mon 01	Apr	Transit to SOTS (upon completion of acoustic survey and deep-camera tow) and underway sensor observations. Perform Test CTD in water 1000m deep

DATE	TIME	ACTIVITY
		Hold Mooring Procedures Familiarization Meeting with Science Party, Master, Mates and Crew
Tue 02	Apr	midday: Arrive SOTS site (dependant on weather conditions) Deploy Argo Float #1 (nominally 47S, 142E) 1400-1800: SOTS CTD cast to 600m (pre-deployment calibration of SOFS-13 sensors) 1630-1700: SOFS-13 Deployment Meeting 1800-2400: Ship drift assessment at SOFS-13 site
Wed 03	Apr	0400-0600 Reposition ship to SOFS-13 deployment start (~19 miles down-weather) 0645 SOTS: Toolbox on Bridge for SOFS-13 mooring deployment 0600-2000 SOTS: Deploy SOFS-13 mooring 2000-2400 SOTS: Triangulate SOFS-13 anchor, collect ship sensor observations close to SOFS-13
Thu 04	Apr	0100 – 0600 – Microplastics Net tow and CTD cast #1 Rest/Spooling Day: Collect ship sensor observations close to SOFS-12 0800-1200: CTD Cast to 4550m (pre-deployment calibration of SAZ-26 sensors, SOTS sampling #, UTS sampling #1) 1000-1500: Spool on SAZ-26 2200-2400: Microplastics net tow and CTD cast #2
Fri 05	Apr	0000 – 0300: continue microplastics net tow and CTD cast #2 0400-0600 SOTS: Transit to SAZ-26 deployment start (15 miles down-weather from target) 0645 SOTS: Toolbox on Bridge for SAZ-26 mooring deployment 0600-1500 SOTS: Deploy SAZ-26 mooring 1500-1800 SOTS: Triangulate SAZ-26 anchor location 2000-2400: Microplastics net tow and CTD cast #3
Sat 06	Apr	0400-0600 Transit to SAZ-25 recovery site (1 mile down-weather from anchor location) 0645 Toolbox on Bridge for SAZ-25 mooring recovery 0600-1800 Recover SAZ-25 mooring 2000-2400: Microplastics net tow and CTD cast #4
Sun 07	Apr	0600-0800 SOTS: Transit to SOFS-12 site – ship mooring comparison and inspection of the SOFS-12 float 0800-1800 SOTS: Spool off SAZ-25 mooring – deck ops only 1000-1200 SOTS: Ship-buoy met comparison at SOFS-12

DATE	TIME	ACTIVITY
		1200-1600 SOTS: CTD cast to 4000m (SOTS sampling #2, UTS sampling #2) 1600-2200 SOTS: Ship-buoy met comparison at SOFS-12 2200-2400 – begin microplastics net tow and CTD cast #5
Mon 08	Apr	0000-0300 – continue microplastics net tow and CTD cast #5 0400-0600 SOTS: Transit to SOFS-12 recovery site (1 mile down-weather from surface float location) 0645 SOTS: Toolbox on Bridge for SOFS-12 mooring recovery 0600-2000: Recover SOFS-12
Tue 09	Apr	0000 – 0600: Microplastics net tow and CTD #6 Spooling/Rest Day: Collect ship sensor observations close to SOFS-13 1000-1200: CTD cast to 600 m (post-recovery calibration of SOFS-12 and SAZ-25 sensors) 1400-1800: Deep CTD cast (UTS sampling #3) 2300 – 2400: begin microplastics net tow and CTD cast #7
Wed 10	Apr	0000-0300 – continue microplastics net tow and CTD cast #7 0400-0600 SOTS: Transit to SOFS-11-Test recovery site (1 mile down-weather from surface float location) 0645 SOTS: Toolbox on Bridge for SOFS-11-Test mooring recovery 0600-2000: Recover SOFS-11 2000: Begin transit to magnetometer tow line (clear deck, and spool off SOFS-11-Test wire while underway)
Thu 11/Fri 12	Apr	Magnetometer tow, Argo Float #2 deployment (nominally 144.5E, 52S)
Sat 13	Apr	2000 – 0600: Microplastics net tow and CTD cast #8 (UTS sampling #4) - upon completion of magnetometer tow
Sun 14	Apr	0800-1800: recover CSIRO and CalTech Gliders on return transit if required and within range
Mon 15	Apr	Bad weather allowance
Tue 16	Apr	Bad weather allowance
Wed 17	Apr	Bad weather allowance
Thu 18	Apr	Bad weather allowance
Fri 19	Apr	Begin transit to Hobart
Sat20	Apr	Time permitting conduct microplastics net tow and CTD in shelf waters. Transit - Inbound: Calibrate backscatter of EM710 on GSM Line #3 @8kts

DATE	TIME	ACTIVITY
Sun 21	Apr	0800 - Arrive Hobart, Demobilisation

Supplementary projects

1. Principal Investigator: Elise Tuuri.

Microplastics in the food chain: impact on planktonic organisms and understanding microplastic distributions. Ship Time: At night negotiated with CS.

Proposed work: Along the existing voyage track using available operational time at night, ideally on continental shelf, conduct paired CTD and Hydrobios horizontal net tows for microplastics sampling.

Each CTD requires 3 x 12 L Niskin bottles fired at each of: 20m from bottom, Deep Chlorophyll Max (DCM; if identified, alternatively an average value will be used from the DCM recorded at stations on board IN2024_T01) and Sub-Surface, (9 x 12 L bottles total). Each Hydrobios deployment, fitted with 335-micron nets, requires 2 nets activated at the same 3 depths: 20m from bottom (or max depth of HB net if seafloor is > 500 m deep), at DCM and Sub-Surface. Required sampling for each site and approximations of time below:

Sampling Method	**Sampling Depths**	**Sample Type**	**Sampling time (approx)**
CTD Deployment to bottom and determination of DCM			Depth Dependant
Niskin	20 m above max depth	3 x bottles	
Niskin	DCM	3 x bottles	
Niskin	Sub-surface	3 x bottles	
CTD/Niskin			**~ 1 hour**
HB Net deployment to max depth			Depth Dependant
Net #1	20 m above max depth	Microplastics	10 min @ ~ 2 knots
Net #2	20 m above max depth	Zooplankton	10 min @ ~ 2 knots
Transition net #3			Depth Dependant
Net #4	DCM	Microplastics	10 min @ ~ 2 knots
Net #5	DCM	Zooplankton	10 min @ ~ 2 knots
Transition net #6			< 5 min

Net #7	Sub-surface	Microplastics	10 min @ ~ 2 knots
Net #8	Sub-surface	Zooplankton	10 min @ ~ 2 knots
Retrieval net #6			< 5 min
HydroBios Nets			**~ 2.5 hours**
TOTAL			**~4 hours**

Therefore, the water budget from the shallow CTD casts for the microplastics project are as follows:

- 3 x 12 L Niskin bottles from ~ 20m from bottom
- 3 x 12 L Niskin bottles from Deep Chlorophyll Max
- 3 x 12 L Niskin bottles from Sub-surface
    - Desirable: salinity and DO

Niskin bottle samples will be transferred to the lab in 10 L Nalgene bottles and vacuum filtered onto 0.45 um membranes. These will be stored at room temperature until analysis back in the laboratory at Flinders University. Cod ends/contents from each net (#2, #5 and #8, one from each sampling depth) will be preserved in 70% ethanol within 15 minutes of the end of the tow to study zooplankton community compositions at each site. Cod ends/contents from each other net (#1, #4 and #7) will be placed in the laminar flow and subsequently transferred into containers with filtered sea water for chemical digestion at Flinders University. Filtrate from HB net samples (< 20 um) will be collected and provided to Katherina Petrou (UTS). Preserved zooplankton community samples will be made available to Nia Riengchan (UTAS). Controls will also be collected where possible, such as samples of fibres from the clothes of the crew handling the CTD and net deployments, fibres from the HB net, paint flake samples from the frame of the net and the vessel, water samples processed through the Niskin bottles and atmospheric microplastics in the laboratory.

Throughout the voyage and particularly at the sampling sites, we will be assessing and analysing the physical process present at the time of and around sampling. The team will be utilising the 75 kHz and 150 kHz ADCP and visual clues (i.e. floating detritus), to identify surface signatures of convergence zones (Langmuir Cells or Lagrangian Coherent Structures).

Equipment requested from the MNF: CTD with Niskin Bottle Rosette, Hydro-Bios net with either 100 um or 335 um net; Bongo nets as contingency; 2 x dissecting microscope; Laminar flow hood; Fume Hood; Milli-Q water; access to chemical storage.

2. Principal Investigator: Katherina Petrou/ Daniel Neilson.

Adding the Sub-Antarctic to an oceanic latitudinal study of diatom silica production rates

Proposed Work:

The time required to complete each silicification incubation study is around 36-48 hours. Ideally, we will obtain water from a CTD cast every few days for a series of incubations. While the ship needs to be stationary during CTD deployment and recovery, apart from this activity no additional stations or stops are required. No deviations from the current cruise plans are requested.

We would like 40L from 5 depths (surface down to 200m), including surface and chlorophyll maximum from each CTD, (40L from each depth). Phytoplankton fraction of multi-net samples with Elise. Other than that, all other protocols and processes will be done on board in the lab, independent of the ship operations.

Link CTD hydrochem, POC, HPLC and taxonomy from SOTS sites for our samples.

All other requests: cold lab and dry lab space, fridge and freezer storage have been listed in the application.

Water Budget from CTD casts:

- 40L per depth, 5 depths each cast requested
- Multi-net samples to be shared with microplastics project where possible
- Water 40L from multiple depths (surface – 200m) from some regionally different microplastics CTD casts.

Piggyback projects

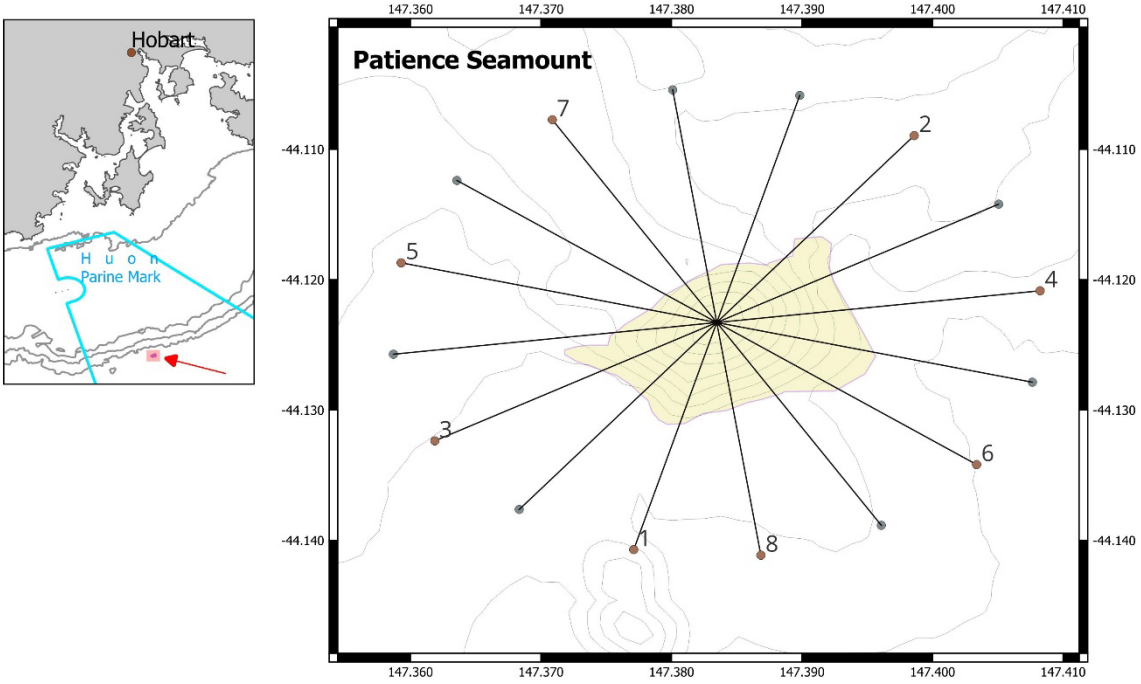
1. Principal Investigator: Ben Scoulding.

Acoustic survey of basket eel on Patience seamount in Huon AMP and ecological and carbon sequestration role of zooplankton in the Southern Ocean. Ship Time: negotiated with CS.

Proposed Work:

We seek to carry a planned camera and acoustic survey of Patience Seamount within the 'Huon' Marine Park (Huon MP) south of Tasmania, lead remotely by scientists not onboard. The Huon MP has been identified as the only known location of a spawning aggregation of the basketwork eel, Diastobranchus capensis – a globally distributed and ecologically important deep-sea species. In the austral autumn, the spawning aggregation is large and likely the regional-scale spatial anchor for the species. As such it represents a key natural value in Australia – one with a hypothesised trajectory of 'improving status' following decades long impact from bottom trawling before the Huon MP was established. The spatial concentration of eels in the aggregation (~2-3 km2) and their high acoustic reflectivity are highly attractive characteristics that will enable the aggregation to be measured quantitatively with a hydroacoustic sensor (echosounder) and with very little further extractive sampling. As stated by Williams et al., (2021) "Monitoring the aggregation's status, and validating seasonal spawning, provide important opportunities to examine conservation-led recovery in the deep sea as part of Australia's new national strategy of Monitoring, Evaluation, Reporting, and Improvement (MERI) for conservation values within marine parks.".

Transect	Start_lon	Start_lat	End_lon	End_lat
1	147.3898	-44.1059	147.3771	-44.1407
2	147.3683	-44.1376	147.3986	-44.1089
3	147.405	-44.1142	147.3619	-44.1324
4	147.3587	-44.1257	147.4082	-44.1208
5	147.4076	-44.1279	147.3593	-44.1187
6	147.3636	-44.1124	147.4034	-44.1342
7	147.3961	-44.1388	147.3709	-44.1077
8	147.3801	-44.1054	147.3868	-44.1411



2. Principal Investigator: Philippe Vandenbossche.

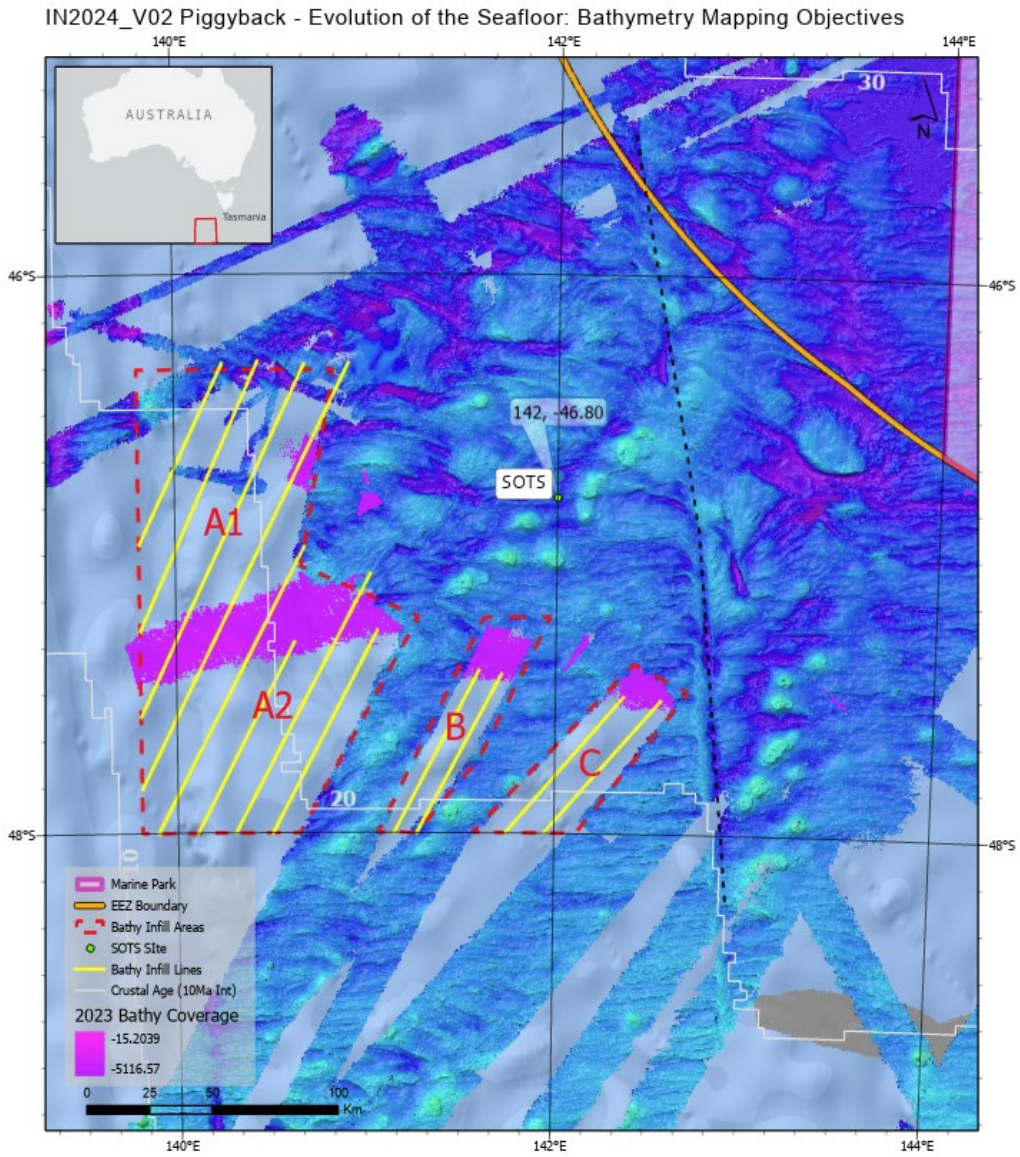
Evolution of the Seafloor of the Australian-Antarctic Southern Ocean.

There are two primary objectives that will augment existing data in support of this research:

1. Acquire towed magnetometer data between SOTS and ~-51.4°S (illustrated on the planned voyage route map), to cover an anticipated seafloor age range of ~24 Ma to 10 Ma. No physical rock dating is known to exist in the study area and therefore magnetic data will provide valuable indicative ages of the seafloor crust across the region. This 2024 magnetometer transect is planned to be a continuation of the previously acquired data in 2023 and is estimated to extend ~271 nautical miles in a SSE direction from the previous line.
2. Acquire multibeam bathymetry data in areas previously unmapped. Areas to primarily target lie to the west and south of the SOTS site as illustrated by areas A1, A2, B & C on the map below. This will extend the seafloor mapping coverage in the region, thereby providing valuable new bathymetry data that will be used to analyse the seafloor morphology and tectonic fabric (and contribute to the International Seabed 2030 initiative).

Fit with voyage plan

While the magnetometer towing is expected to form part of the transit there is expected to be a course deviation to achieve this (see planned voyage track above). The priority magnetometer survey line (Magnetometer Line 2024_01) is estimated to add a transit deviation from the proposed track of 75 Km (or 40 NM), thus adding ~4 hours (at 10 knots) or ~6 hours with deployment and recovery. Multibeam mapping is divided into areas and can be targeted for periods when time allows.



Map illustrating the bathymetry mapping objectives (areas A1, A2, B & C)

Permits

This voyage may or expects to traverse through the following Marine Parks:

- Tasman Fracture Marine Park
- Huon Marine Park

No operations are planned, except for approved underway science deployments/systems as per the following permits. An assessment of unplanned deployments (e.g. XBTs) is to be carried out onboard before commencing any operations.

- Southwest Marine Parks: PA2020-00041-2 (variation PA2020-00041-8)
- Southeast Marine Parks: PA2020-00041-1 (variation PA2020-00041-7)

Both permits preclude echosounders or other activities that may take, keep, move or interfere with a cetacean. Must act consistently with Part 8 of EPBC Regs 2000 for cetacean and whale watching approach distances and precautionary zones. Must not travel greater than 10 knots when cetaceans are likely to be present.

Other

- AAPP permit for import of samples – Permit 0008136576
- UTS permit for import of samples – Permit 0007469503
- Flinders permit for import of samples – Permit 0008750106

Signature

Your name	Dr. Elizabeth Shadwick
Title	Chief Scientist
Signature	
Date:	20 March 2024

List of additional figures and documents

a. Appendix A MNF Equipment
b. Appendix B User Supplied Equipment
c. Appendix C Hazardous Materials Manifest
d. Mooring Locations
e. Mooring Diagram – SOFS-13
f. Mooring Diagram – SAZ-26
g. Deck Plan

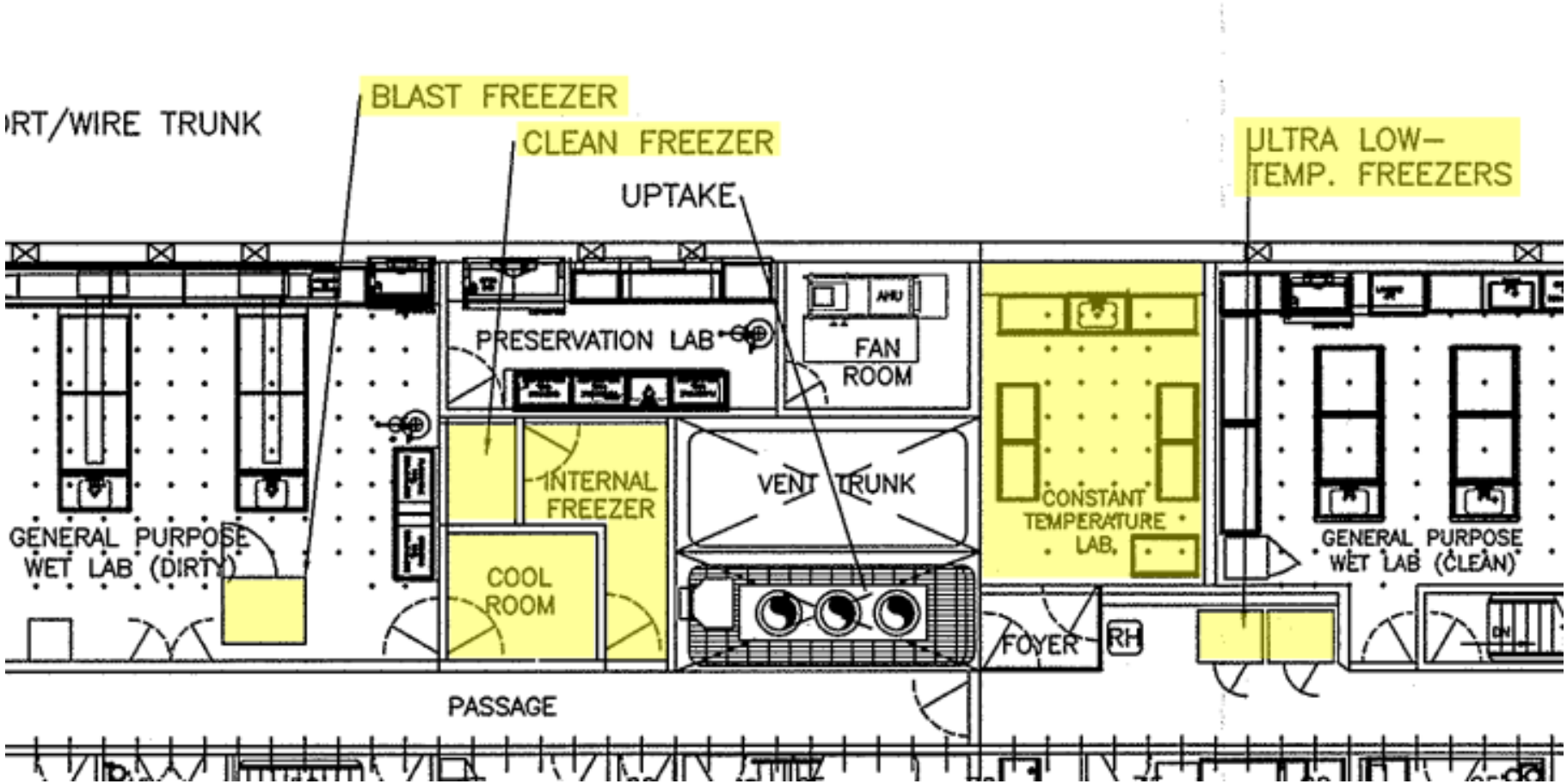
Appendix A

Scientific equipment and facilities provided by the Marine National Facility

Some equipment items on the list may not be available at the time of sailing. Applicants will be notified directly of any changes. Indicate what equipment and facilities you require from the Marine National Facility by placing an **X** in the relevant box.

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Aerosol Sampling Lab		• Please indicate the intended activity in this lab
Air Chemistry Lab		• Please indicate the intended activity in this lab
Preservation Lab	X	• Please indicate the intended activity in this lab
Constant Temperature Lab (Min temp: ~4°C / Max temp ~35°C)	x	• UTS piggy-back to do incubations • Setpoint temperature TBC
Underway Seawater Analysis Laboratory		• Please indicate the intended activity in this lab
GP Wet Lab (Dirty)	x	• Storage of mooring gear, staging area for mooring operations • Transferal of zooplankton HB net samples to storage containers
GP Wet Lab (Clean)	X	• Use of laminar flow for vacuum pumping niskin bottle samples to filter paper. • Use of laminar flow to transfer microplastic HB net samples to containers
GP Dry Lab (Clean)	x	• POC and HPLC sample filtration, collection of sediment trap processing water
Sheltered Science Area		• Please indicate the intended activity in this area
Observation Deck 07 Level		• Please indicate the intended activity in this area
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature

STANDARD LABORATORIES AND FACILITIES		
NAME	**REQUIRED**	**NOTES/COMMENTS**
Clean Freezer (Dirty Wet lab) (Min temp -25^{o}C / Max temp 0^{o}C) Volume: >2.5m^{3} Co-located within the Internal freezer and separated by a door	X	• UTS will need access to fridge and freezer space for storing samples. Please indicate the required setpoint temperature
Blast Freezer (Dirty Wet lab) (Min temp -30^{o}C / Max temp 0^{o}C) Internal volume >1.5m^{3} Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.	X	• UTS may need this to flash freeze samples. • Please indicate the required setpoint temperature
Cool Room (Dirty Wet lab) (Min temp 0^{o}C / Max temp 10^{o}C)	x	• Storage of sediment trap processing water • Setpoint temperature 4^{o}C
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80^{o}C / Max temp -80^{o}C)	x	• Storage of HPLC and eDNA samples
YODA Freezers (x2) (Clean Dry lab) (Min temp -20^{o}C / Max temp 10^{o}C)		• Please specify if both or only one are needed • Please indicate the intended activity in this area • Please indicate the required setpoint temperature



MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Modular Isotope Laboratory			If nominated, additional processes to be completed.

MOBILE LABORATORY AND FACILITIES *(MAY REQUIRE ADDITIONAL SUPPORT)*			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace Metal Niskin Sampling Container (TM1-blue - 20ft)			• Used for the determination of trace metal concentrations. It is a clean laboratory containing laminar flow cabinets and is stored on the main deck (if possible).
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			• Used for wet sampling of trace metal clean Niskins and is stored on the main deck (if possible). • Cannot be overstacked
Trace Metal Rosette and Niskin Storage Container			10-foot container
Modular Hazchem Locker			
Stabilised Platform Container			Please indicate what instruments are to be installed in the container. Cannot be overstacked
Clothing Container			The use of this container will be identified by MNF

STANDARD SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Continuous Plankton Recorder (CPR)			*note: Use of this item must be flagged with the relevant CSIRO Oceans & Atmosphere team responsible for CPR cassette preparation and sample processing. Please discuss your planned CPR use with your VDC, who will assist in liaising with the CPR team.

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
TRIAXUS – Underway Profiling CTD			Triaxus is a pilotable towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles (e.g. cyclic depth pattern from the surface to 200m) are possible. Towing speed depends on the tow profile, instrumentation payload and prevailing conditions. Typically, undulations from the surface to 200m are possible at 8knt, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m to a distance of approximately 1.5km from the ship. Triaxus is normally configured with the following sensors as a minimum: • Dual temperature, conductivity and dissolved oxygen (SBE9plus and dual pumped temperature/conductivity/dissolved oxygen circuits) • PAR • Chlorophyll-A, CDROM, optical backscatter (Eco-triplet – 2000m Max) • Plankton counter (Laser Optical Plankton Counter) • Transmissometer Contact MNF for further details on other instrumentation and capability.
Desired towing profile:			
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			
Piston Coring System			
Gravity Coring System			
Multi Corer			

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Kasten Corer			
Smith Mac Grab			
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer	X		
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:			
XBT System		X	2 per day provided
Valeport Rapid SV			
Valeport Rapid CTD			
Valeport SVX2		X	If space allows on the CTD frame
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			• See non-MNF owned section below for additional 2 units. • Science team to organise and pay for battery packs for this system (+ spare). • They can be sourced through a supplier such as 'Batteryworld Hobart' (Graham Cowie, 03 6272 3900) who has made these previously. • The science teams need to calculate how long they will be deployed and bring enough batteries to cover their deployment times. They are rated to 30 Amp hours, which equals to 36,000 litres of sea water being filtered.

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Deep Towed Camera	X		
Drop Camera			
Sherman Epibenthic Sled			Stern ramp must be removed to operate this system.
Brenke Sled			
Hydro-Bios MultiNet (Mammoth) (1m x 1m) *(has replaced the EZ net)*	X		Please specify 100-micron, 335-micron, or 500-micron mesh Can be used in a vertical or horizontal operations. **Horizontal tows. Both 100 (contingency) and 335-micron (essential) net meshes requested onboard.**
Surface Net (1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Bongo Net	X		750mm frame, 500-micron mesh net and 335-micron cod end (contingency for microplastics supplementary).
Beam Trawl			
MIDOC			Multiple opening/closing net system with cod ends- suitable for pelagic trawls
Pelagic Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
Demersal Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
RMT-8 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			8m2 mouth area Tow speed ≤2 knots
RMT-16 (Rectangular Midwater Trawl)			16m2 mouth area

SPECIALISED SAMPLING EQUIPMENT			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)**
Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			Tow speed ≤2 knots
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			MNF to identify this need, dependent on pelagic or demersal trawling requirement
Stern ramp	**EXPOSED**	**INSTALLED**	MNF to identify this requirement

RESEARCH SUPPORT INFRASTRUCTURE			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Saltwater Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			Temperature controlled deck incubators
Milli-Q System	x		
Sonardyne USBL System			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				**NOTES/COMMENTS**
BRAND / MODEL	**TYPE**	**ESSENTIAL**	**DESIRABLE**	Refer to the "MNF microscopes procedure" for more information
Leica / M80	Dissecting	X		To facilitate the sharing of zooplankton community samples from HB net with UTAS PhD student

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				**NOTES/COMMENTS**
Leica / M80	Dissecting			
Leica /MZ6	Dissecting	X		To facilitate Pimnara (Nia) Riengchan's PhD work
Olympus / CH	Compound	X		To facilitate the sharing of zooplankton community samples from HB net with UTAS PhD student
Olympus /CH	Compound			
Leica / MTU282	Camera tube			
Adapters for tube / Nikon	Pentax			
Ring Light *2 / MEB121	LED		X	Requested if there is not a light associated to dissecting or compound microscope
Heavy Duty Electronic Balance (80kg)				
Medium Duty Electronic Balance (15kg/5g resolution)				
Light Duty Electronic Balance (3kg/1g resolution)				

Underway systems

ACOUSTIC UNDERWAY SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
75kHz ADCP	x		To collect data from the water profile at microplastics stations
150kHz ADCP	x		To collect data from the water profile at microplastics stations
Multi Beam Echo Sounder EM122 12kHz (100m to full ocean depth)	x		

ACOUSTIC UNDERWAY SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)	x		
Sub-Bottom Profiler SBP120	x		
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)	x		EK60s will be onboard for use as a backup for EK80s and set in narrowband mode Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)	x		EK80s will be used in narrowband mode unless otherwise requested Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter		x	

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Nephelometer			
Multi Angle Absorption Photometer (MAAP)			
Scanning Mobility Particle Sizer (SMPS)			
Radon Detector			
Ozone Detector			
Condensation Particle Counter (CPC)			

ATMOSPHERIC UNDERWAY SENSORS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Picarro Spectrometer (analysis of CO_2/CH_4/H_2O)			
Aerodyne Spectrometer (analysis of N_2O/CO/H_2O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			
Filter Aerosol Sampling units (FAS) x 3			Used for collecting physical aerosol samples on filters. FAS includes pumps, filter holders, flow controllers, totalizer, Very Sharp Cut Cyclone (VSCC) PM1 and PM2.5. • User to specify how many units are required (maximum 3 supplied by MNF). • User to provide own filters. • User to outline sampling requirements with MNF Seagoing Instrumentation Team (SIT) i.e. ship exhaust sample avoidance etc.

UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Thermosalinograph	x		
Fluorometer	x		
Optode	x		
pCO2	x		

SEAWATER SYSTEMS			
NAME	**ESSENTIAL**	**DESIRABLE**	**NOTES/COMMENTS**
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories	x		
Raw seawater available on deck and in laboratories	x		

EQUIPMENT AND SAMPLING GEAR REQUIRING EXTERNAL SUPPORT (MAY REQUIRE ADDITIONAL SUPPORT FROM APPLICANTS)			
NAME	**ESSENTIAL**	**DESIRABLE**	**PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
Seismic Compressors			• Additional crew and seismic acquisition personnel will be required to be onboard to support this system. Number of personnel TBD by the MNF. • The science party is to provide an onboard seismic data processing resource.
Seismic Acquisition System			• Additional crew and seismic acquisition personnel will be required to be onboard to support this system. Number of personnel TBD by the MNF. • The science party is to provide an onboard seismic data processing resource.

NON-MNF OWNED EQUIPMENT WHICH MAY BE ACCESSED			
NAME	**ESSENTIAL**	**DESIRABLE**	**PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
D & N Francis winch			15mm electro-optical cable
Box Corer			

NON-MNF OWNED EQUIPMENT WHICH MAY BE ACCESSED			
NAME	**ESSENTIAL**	**DESIRABLE**	**PLEASE GIVE THIS CAREFUL CONSIDERATION, AS THERE IS NO GUARANTEE THAT THESE RESOURCES WILL BE AVAILABLE UNLESS SPECIFICALLY REQUESTED. LIAISE WITH YOUR VOYAGE OPERATIONS MANAGER AS REQUIRED. ADDITIONAL STAFF MAY BE REQUIRED FOR THESE ACTIVITIES.**
UTAS In-Situ Pumps (x2)			
EM2040			Shallow water multibeam echosounder system

Special Requests – MNF Scientific Equipment and Facilities

- Describe any special requirements here.
- Do you have video conferencing / data communication requirements?

Appendix B

User Supplied Equipment

The table below will include information provided by the Chief Scientist / Principal Investigators in the '*Equipment Manifest-user supplied voyage specific'* document. The Chief Scientist will co-ordinate the completion of this Manifest with all PIs and forward the completed document to the Voyage Operations Manager.

NOTE: User supplied equipment will remain the responsibility of the science party throughout the voyage. The MNF technicians and ship's crew endeavour to assist wherever possible, however the MNF take no responsibility for the pre-deployment checks or repairs and maintenance of this equipment

This information will also be used for the mobilisation list and deck plan for the voyage.

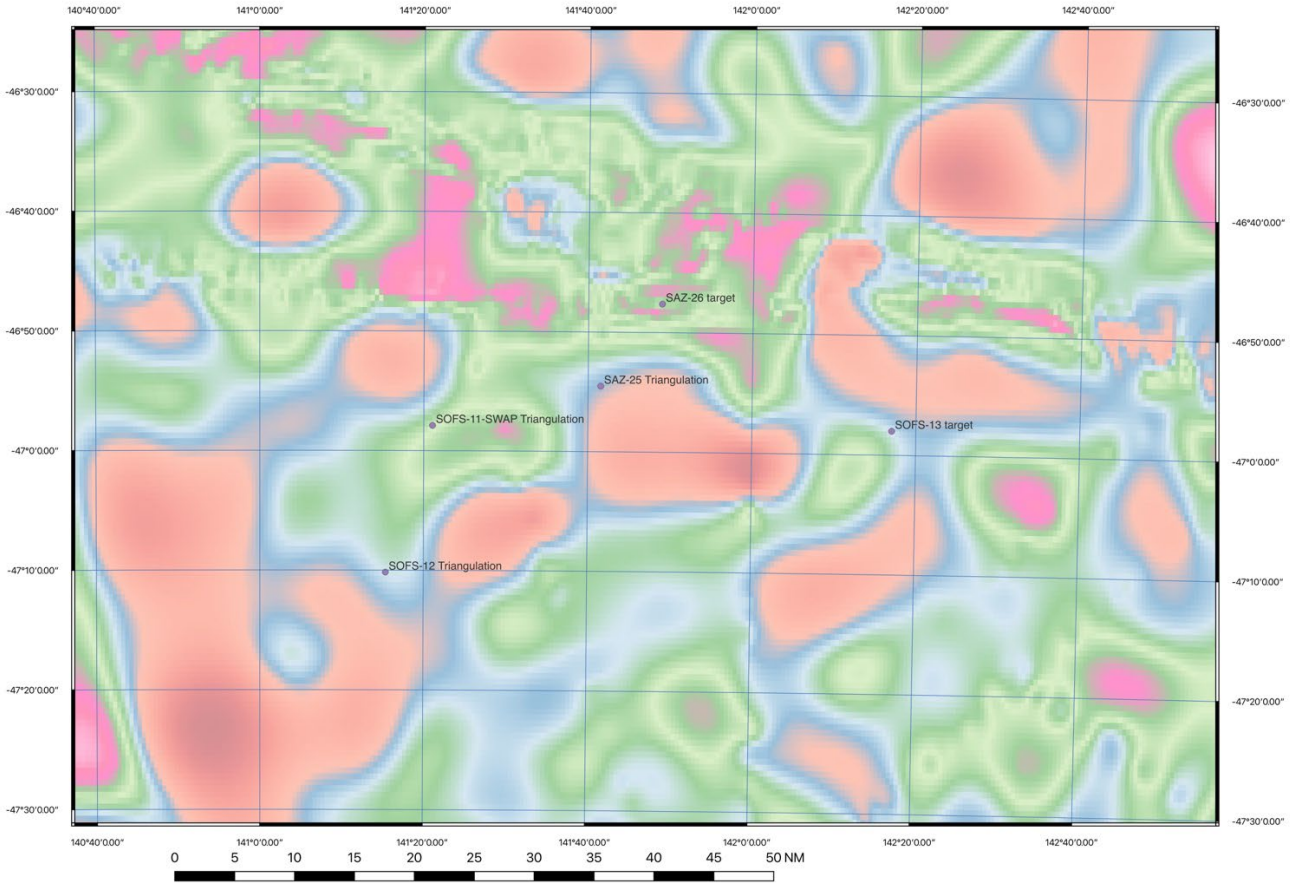
Owner	Item name	Weight	Dimensions	Location on Vessel
MNF use only				

Appendix C

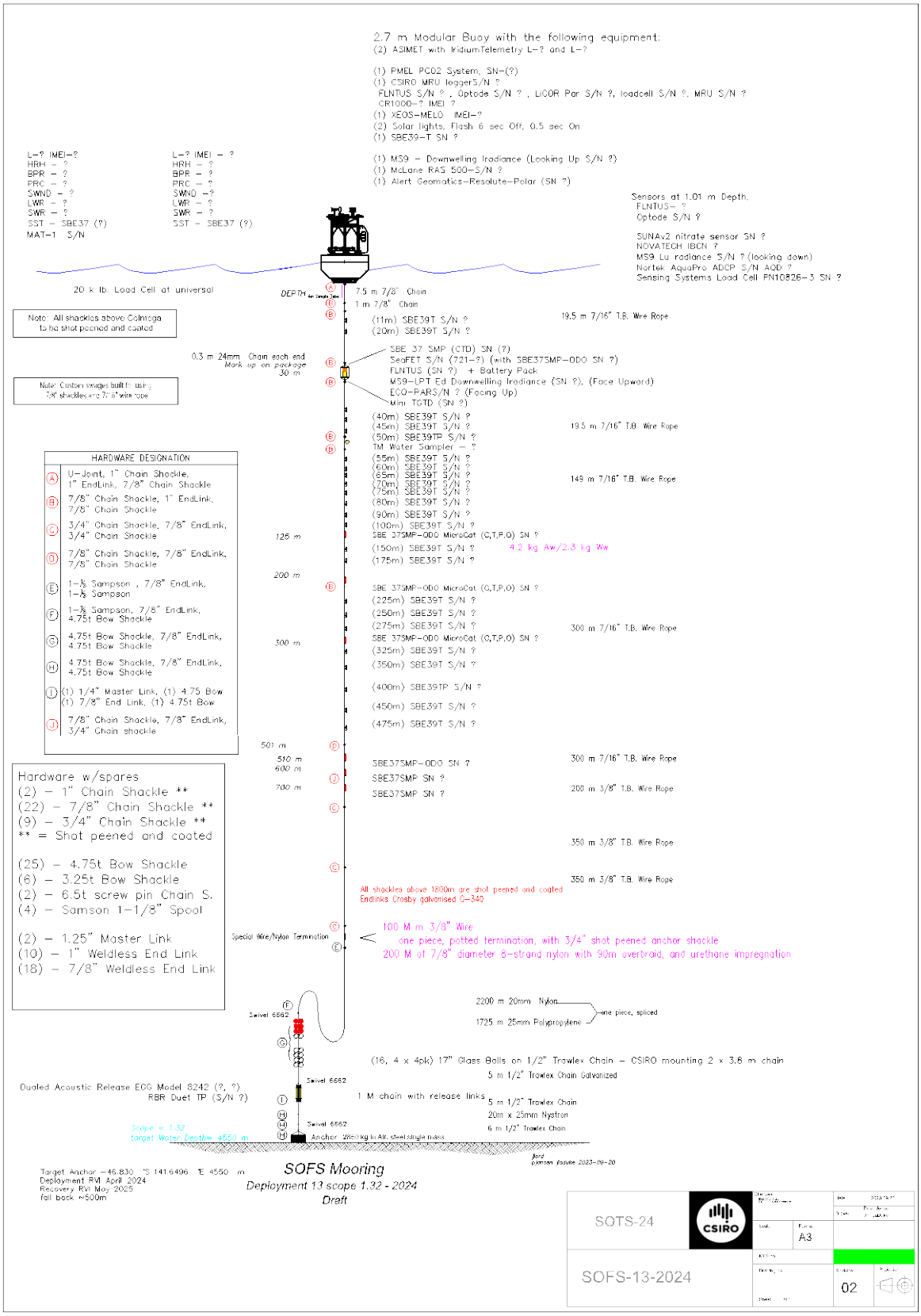
Hazardous Materials Manifest

MNF to include here once finalised.

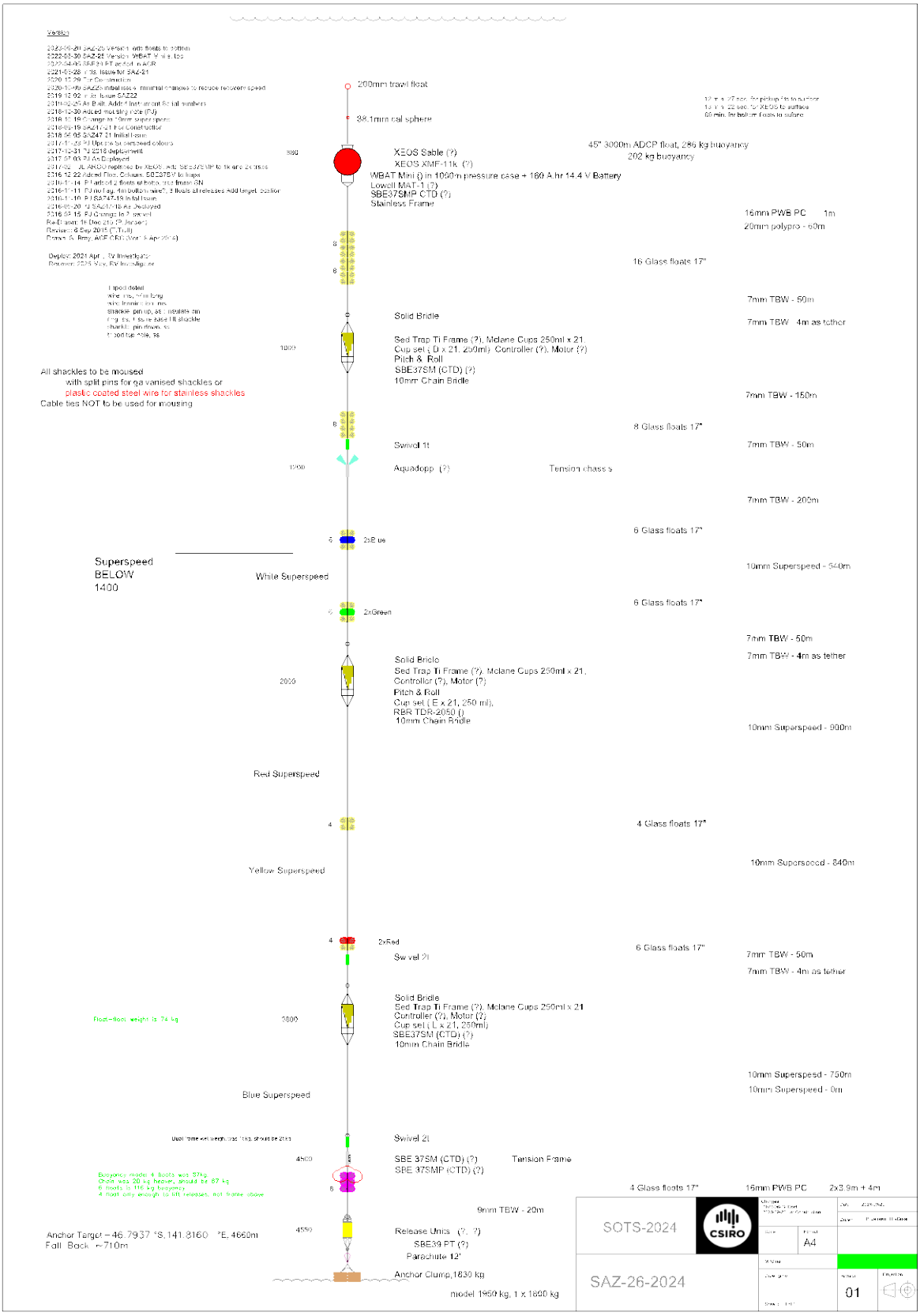
Mooring Locations (SOTS)



Mooring Diagram – SOFS-13



Mooring Diagram – SAZ-26



IN2024_V02 Deck Plan