

RV Investigator Voyage Plan

Voyage #:	IN2020_V09		
PROJECT # 1			
Voyage title:	SOTS: Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania		
Mobilisation:	Hobart, Friday, 21 to Saturday, 22 August 2020		
Medical testing:	Hobart, Monday, 24 to Tuesday, 25 August 2020		
Depart:	Hobart, Wednesday, 26 or Thursday, 27 August 2020		
Return:	Hobart, Friday, 25 September 2020		
Demobilisation:	Hobart, Friday, 25 September 2020		
Voyage Manager:	Linda Gaskell	Contact:	linda.gaskell@csiro.au
Deputy Voyage Manager:	Lisa Woodward	Contact:	linda.gaskell@csiro.au
Chief Scientist:	Elizabeth Shadwick		
Affiliation:	CSIRO	Contact:	Elizabeth.Shadwick@csiro.au
Alternative Chief Scientist:	Tom Trull		
Affiliation:	CSIRO	Contact:	tom.trull@csiro.au
PROJECT # 2			
Principal Investigator:	Steve Rintoul		
Project name:	Recovery of moorings deployed on IN2018_V05 to investigate Antarctic Circumpolar Current dynamics	Contact:	Steve.Rintoul@csiro.au
Affiliation:	CSIRO		

Scientific objectives

Shadwick: Southern Ocean Time Series

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. SOTS 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.

The primary objectives are; recovery of SOFS 8, deployment of SOFS 9, deployment of SAZ 22 and recovery of SAZ 21. 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.

Voyage objectives (SOTS)

1. Deploy SOFS-9 meteorology/biogeochemistry mooring
2. CTD cast/ship observations next to the SOFS-9 mooring/spool/rest
3. Deploy SAZ-22 sediment trap mooring
4. Recover SAZ-21 sediment trap mooring
5. Recover SOFS-8 meteorology/biogeochemistry mooring
6. Conduct aerosol and rain sampling (Chief Scientist)
7. Tow CPR to SOTS site (Chief Scientist)
8. XBT deployments (Chief Scientist):
 - a. 1 x XBT every 1 hour for 55° to 49°S; and
 - b. 1 x XBT every 2 hours from 49°S to 200m contour

The above differs from the priority ranking, because it is designed to be the most efficient to achieve all the goals. In particular, deploying SOFS-9 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.

Scientific objectives

Rintoul: Recovery of moorings deployed on IN2018_V05 to investigate Antarctic Circumpolar Current dynamics

Improve understanding of how Southern Ocean currents respond to changes in wind.

Voyage objectives (Rintoul)

1. Recover an oceanographic mooring deployed during IN2018_V05 at 56°S, 151°E (see Attachment 3).
2. Collect a full-depth CTD station at the mooring site.
3. Deploy three EM-APEX floats.

ACC mooring recovery

The highest priority activity on the voyage is the mooring recovery. The plan for the mooring recovery is:

- Arrive on site before dawn and triangulate the mooring to confirm location (~2 hrs). It will be critical to ensure the vessel is positioned well to sight the mooring on release.
- A Bridge toolbox will be held, then at first light, we will release and grapple the mooring on the surface (~1-2 hrs).
- The mooring will be recovered on deck and all instrumentation removed (~5-8 hrs) - this can vary greatly depending on how well the mooring comes up (how many wuzzles need to be sorted out).
- Conduct deck clean-up (~1 hr).
- Later work – spool off wire/Dynex from moorings winch and onto drums.

Because multiple unknowns are involved (how long to spot the mooring, how long it will take to grapple the mooring – if it is missed on the first pass the ship needs to reposition, and how many tangles [or 'wuzzles'] are in the mooring which need to be sorted out before winding on the winch), a full day needs to be allocated to the recovery.

Because we should not be planning to carry out mooring operations in the dark, the very latest we should be triggering the releases would be 1200.

Two CSIRO mooring technicians will carry out the mooring recovery operation. A SIT technician will help with the instrumentation.

No permits are required for the Rintoul mooring recovery.

EM-APEX float deployments

EM-APEX float deployments are done in a similar manner to regular Argo floats. Deployment position, time, and any notes about the deployment (sea state, winds, accidents, etc) should be recorded. The steps for deployment are as follows:

- Remove CTD plugs
- Two people carry one float to leeward aft quarter
- Attach deployment rope with quick release hook
- One person lifts top end of float with rope, second person lift the bottom end.
- Lift clear of the ship's hull and lower the bottom end until float is suspended by the rope.

- Lower float into the water.
- Release the rope and watch float drift away.
- Repeat for remaining two floats.

Marine National Facility

Ocean Bottom Seismometer (OBS)

Test deployment and retrieval methodology of OBS via the CTD wire and the coring boom in preparation for IN2020_V06. The method involves:

- Routing the spare CTD wire through the corer boom
- Attaching a dual acoustic release (loaned from the Moorings Team), USBL and below this, a dummy payload
- Lift the payload over the bulwark and lower it to ~500 m depth
- Trigger acoustic release to release payload
- Retrieve CTD wire

Time and support requirements (during voyage) equates to ~2 hr prep + ~2 hr per test with SIT support staff responsible for preparation, crew handle deployment (SWI provided).

ARGO floats

The MNF has agreed to deploy 3 x ARGO floats at predetermined waypoints.

Operational Risk Management

SOTS:

The mooring deployment and recovery operations are high risk, management includes:

- Detailed procedures reviewed with the crew and science team before and during the voyage
- Job hazard analysis and toolbox meetings
- Restriction of trawl deck working areas to essential participants
- Mooring operations limited to daylight for high risk activities
- A designated safety observer

The overall mooring protocols are in the ship's Safety Management System (SMS). Detailed mooring procedures are available separately for each operation.

Our operational priorities for the voyage are:

1. Recover SOFS-8
2. Deploy SOFS-9
3. Recover Rintoul ACC mooring
4. Deploy SAZ-22
5. Recover SAZ-21

We plan to proceed with operations 1,2, 4, and 5 at the SOTS site, then go south for the ACC recovery. However, should significant weather delays (i.e. beyond our 2 planned weather days) prevent us from completing all or part of the SAZ turnaround (operations 4 and/or 5), we would not wait at the SOTS site, but depart to recover the ACC mooring.

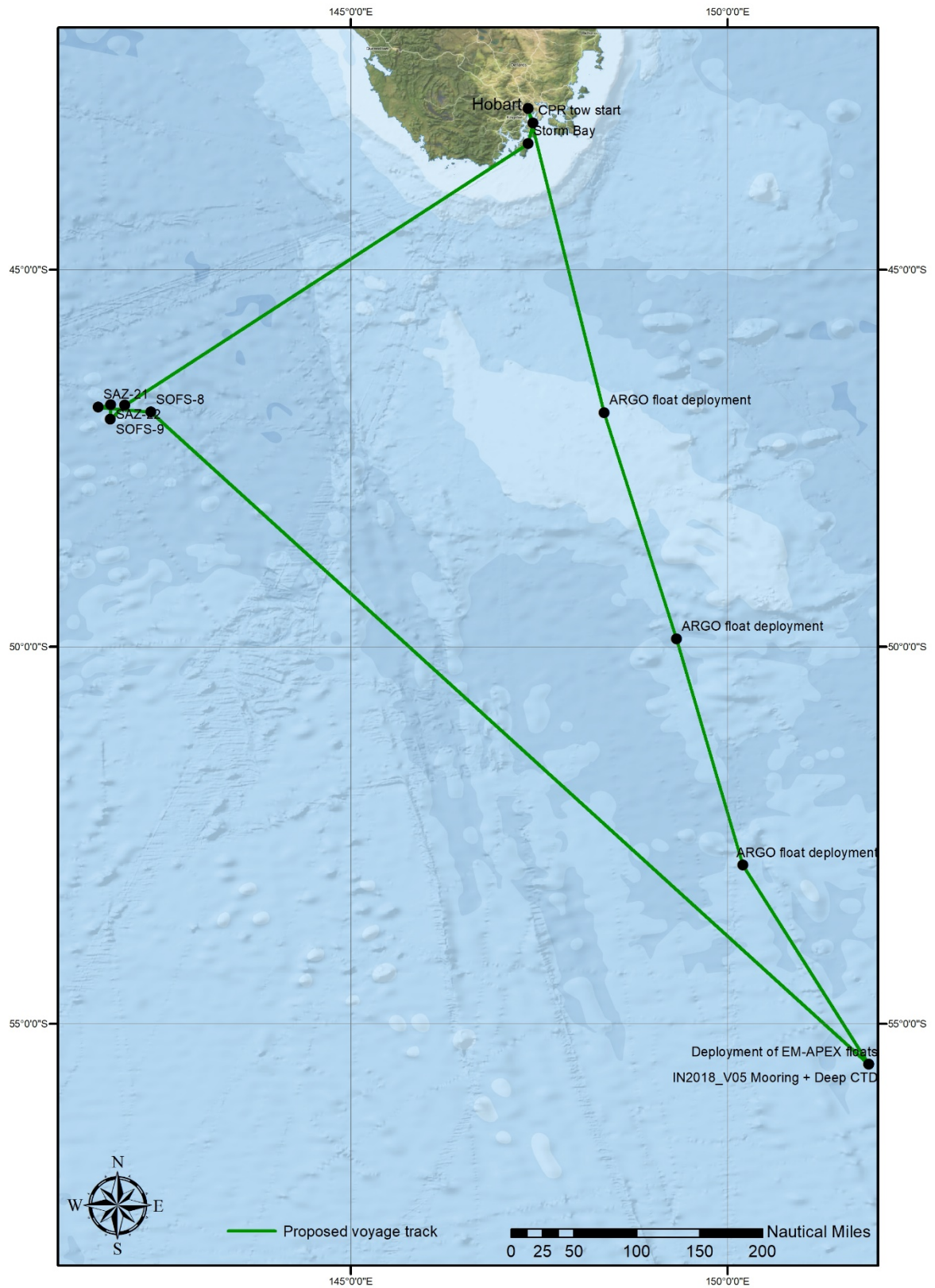
Rintoul:

No potentially high-risk work has been identified outside standard operations.

Activity plan including details for first part of voyage

Date	Month	Activity	# hrs
Fri 21-Sat 22	Aug	<ul style="list-style-type: none"> Mobilise 	24-48 hours
Mon 24	Aug	<ul style="list-style-type: none"> MSS team to spool the SOFS-9 wire 	6 hrs
Tue 25	Aug	<ul style="list-style-type: none"> 08:00 - Whilst alongside, test: mooring anchor dual lift 	1.5 hrs
		<ul style="list-style-type: none"> 09:30 - Hold mooring procedures familiarisation meeting with science party, Voyage Manager, Master, Mates and crew 	1 hr
		<ul style="list-style-type: none"> 16:30: Muster drill for all science party 	0.5 hr
Wed 26	Aug	<ul style="list-style-type: none"> 10:00-12:00: Depart Hobart 	4-8 hrs
		<ul style="list-style-type: none"> Drop keels: Port keel at first stop (flush with gondola, 1.1m projection) and starboard keel at flush with hull. 	
Thu 27-Fri 28	Aug	<ul style="list-style-type: none"> CTD cast in 1000m water: <ul style="list-style-type: none"> 1000m-500m: fire 12 bottles (Hydrochemistry) 500m-0m: fire 12 bottles @ 6 depths (~10') to calibrate sensors 	2-3 hrs
		<ul style="list-style-type: none"> Transit to the SOTS site towing CPR 	34 hrs
		<ul style="list-style-type: none"> <i>Fri 28/8: SOFS-9 pre-deployment meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew</i> 	0.5 hrs

Voyage track example



Waypoints and stations

Time estimates are at 11 knots								
Location	Degrees, Decimals, Minutes (DDM) Latitude	Degrees, Decimals, Minutes (DDM) Longitude	Decimal Latitude	Decimal Longitude	Distance (nm)	Total Distance (nm)	Steaming time (hrs)	Total Steam (hrs)
Hobart	42°52.2'S	147°21'E	42.87	147.35				
CPR tow start (Iron Pot)	43°3.51'S	147°25.044'E	43.0585	147.4174				
Storm Bay	43°19.8'S	147°21'E	43.33	147.35				
CTD cast (1000m depth required)	TBD on board	TBD on board						
SOTS (nominal)	46°48'S	142°0'E	46.80	142.0				
CPR tow finish (SOTS site)	46°48'S	142°0'E	46.80	142.0				
SOFS-9 (deployment) target (4200m)	46°59.184'S	141°48.6'E	46.9864	141.81				
SAZ-22 (deployment) target (4550m)	46°47.622'S	141°48.96'E	46.7937	141.8160				
SAZ-21 (recovery) anchor triangulation (4556m)	46°49.5552'S	141°38.889'E	46.82592	141.64815				
SOFS-8 (recovery) anchor triangulation (4341m)	46°53.601'S	142°20.6784'E	46.89335	142.34464				
IN2018_V05 Mooring + Deep CTD	55°32.544'S	150°52.332'E	55.5424	150.8722				
Deployment of 3 x EM-APEX floats (<i>care to be taken with moorings line location</i>)	55°32.544'S	150°52.332'E	55.5424	150.8722				
ARGO float deployment (1094)	52°54.00'S	150°06'E	52.9	150.2				
ARGO float deployment (8828)	49°36.00'S	149°18.2'E	49.9	149.32				
ARGO float deployment (1082)	46°54.00'S	148°24'E	46.9	148.36				
OBS deployment methodology	43°45.00'S	147°48'E	TBD	TBD				
Hobart	42°52.2'S	147°21'E	42.87	147.35				

CTD Configuration (SOTS)

	Please select:
Fundamentals:	
• Which CTD rosette to be used for this voyage (24 Niskin bottles or 36):	24
• Likely total number of casts:	3
• Likely maximum depth of deepest cast:	2250
• Lowered ADCP required:	
Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):	
• 2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	(Standard)
• Altimeter (required if operating anywhere near the sea floor):	X
• PAR Sensor (Biospherical QCP-2300):	X
• Transmissometer (Wetlabs C-Star 25cm):	X
• Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	
• Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	
• Nephelometer (Seapoint Turbidity Meter)	
Hydrochemistry Analyses:	
• Salinity	X
• Dissolved Oxygen	X
• Nutrients: Nitrate	X
• Nutrients: Phosphate	X
• Nutrients: Silicate	X
• Nutrients: Nitrite	
• Nutrients: Ammonia (special request after discussion with hydrochemistry)	

SOTS:

- We plan to collect 24 x dissolved inorganic carbon, alkalinity, pigments, and POC samples from the 2 deep casts (2250 m); water will also be collected for hydrochemistry analyses back on shore.
- 3rd CTD will be undertaken cast to post-calibrate sensors recovered from SOFS-8 (this exercise is an important quality control measure). The time required can be shortened (2-3 hrs) if needed with fewer bottle samples collected, but this activity is a high priority, and can be done at any time prior to or during the return transit.

Aerosol sampling:

- ASP to provide advance notice of incineration events and a final record of incineration events for the voyage to both the aerosols and atmospheric teams.
- Access to aerosol sampling lab.

Time estimates

The following time estimates are based on a steaming speed of 11 knots.

Any additional time on site to deploy/recover the moorings due to weather conditions can be discussed between the management team on board.

On board Management Team meeting time TBD.

Date	Month	Activity	# hrs
Fri 21-Sat 22	Aug	• Mobilise	24-48 hours
Mon 24	Aug	• MSS team to spool the SOFS-9 wire	6 hrs
Tue 25	Aug	• 08:00 - Whilst alongside, test: mooring anchor dual lift	1.5 hrs
		• 09:30 - Hold mooring procedures familiarisation meeting with science party, Voyage Manager, Master, Mates and crew	1 hr
		• 16:30: Muster drill for all science party	0.5 hr
Wed 26	Aug	• 10:00-12:00: Depart Hobart	4-8 hrs
		• Drop keels: Port keel at first stop (flush with gondola, 1.1m projection) and starboard keel at flush with hull.	
Thu 27-Fri 28	Aug	• CTD cast in 1000m water: <ul style="list-style-type: none"> ○ 1000m-500m: fire 12 bottles (Hydrochemistry) ○ 500m-0m: fire 12 bottles @ 6 depths (~10') to calibrate sensors 	2-3 hrs
		• Transit to the SOTS site towing CPR	34 hrs
		• <i>Fri 28/8: SOFS-9 pre-deployment meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew</i>	0.5 hrs
Sat 29	Aug	• 02:00 (approx): Arrive SOTS site	
		• 02:00-04:00: Ship drift assessment at SOFS-9 site	4 hrs
		• 04:00–06:00 Reposition ship to SOFS-9 deployment start (~18 miles down-weather; to be refined from ship drift assessment)	2 hrs
		• 06:45: GO/NO GO meeting (Master, Bosun, CS, ACS, VM, Managing Engineer)	
		• 06:50: Toolbox in the Dirty Wet Lab, via online or back deck if weather permits, for SOFS-9 mooring deployment	0.5 hrs
		• 06:00–20:00 Deploy SOFS-9 mooring	14 hrs
		• 20:00–00:00 Triangulate SOFS-9 anchor	4 hrs

Date	Month	Activity	# hrs
Sun 30	Aug	• 08:00–12:00 CTD cast to 2250m (<i>salinity, oxygen and nutrient samples required</i>)	4 hrs
		• 10:00–16:00 spool on SAZ-22 collect ship sensor observations close to SOFS-9	6 hrs
		• 17:00 Transit to SAZ-22 deployment start (9 miles down-weather from target)	2 hrs
		• <i>SAZ-22 pre-deployment meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew</i>	0.5 hrs
Mon 31	Aug	• 06:45: GO/NO GO meeting (Master, Bosun, CS, ACS, VM, Managing Engineer)	
		• 06:50: Toolbox in the Dirty Wet Lab, via online or back deck if weather permits, for SAZ-22 mooring deployment	0.5 hrs
		• 06:00–15:00 Deploy SAZ-22 mooring	9 hrs
		• 15:00-19:00 Triangulate SAZ-22 anchor location	4 hrs
		• 19:00-23:00 CTD cast to 2250 m (<i>salinity, oxygen and nutrient samples required</i>)	4 hrs
		• 23:00 Transit to SAZ-21 recovery site (1 mile down-weather from anchor location)	2 hrs
		• <i>SAZ-21 pre-recovery meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew</i>	0.5 hrs
Tue 1	Sep	• 06:45: GO/NO GO meeting (Master, Bosun, CS, ACS, VM, Managing Engineer)	
		• 06:50 Toolbox in the Dirty Wet Lab, via online or back deck if weather permits, for SAZ-21 mooring recovery	0.5 hrs
		• 06:00-18:00 Recover SAZ-21 mooring	12 hrs
		• 19:00: Begin Transit to SOFS-8 recovery site (1 mile down-weather from anchor location)	2 hrs
		• Spool off SAZ-21 wire	4 hrs
		• <i>SOFS-8 pre-recovery meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew (this may be held on Wednesday, 2/9)</i>	0.5 hrs
Wed 2	Sep	• <i>Possible weather/fatigue management day</i>	
		• <i>SOFS-8 pre-recovery meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew (if not held on Tuesday, 1/9)</i>	0.5 hrs
Thur 3-Sat 4	Sep	• 06:45: GO/NO GO meeting (Master, Bosun, CS, ACS, VM, Managing Engineer)	
		• 06:50 Toolbox in the Dirty Wet Lab, via online or back deck if weather permits, for SOFS-8 mooring recovery	0.5 hrs
		• 06:00 – 20:00 Recovery SOFS-8	14 hrs
		• 20:00: Begin transit to Rintoul mooring site (clear deck, and spool off SOFS-8 wire while underway)	62 hrs

Date	Month	Activity	# hrs
Sun 5	Sep	<ul style="list-style-type: none"> • Arrive Rintoul mooring site 	
		<ul style="list-style-type: none"> • CTD cast for mooring calibration (<i>salinity, oxygen and nutrient samples required</i>). • The SOTS program would use this 3rd CTD cast to post-calibrate sensors recovered from SOFS-8 (this exercise is an important quality control measure). The time required can be shortened (2-3 hrs) if needed with fewer bottle samples collected, but this activity is a high priority, and can be done at any time prior to or during the return transit. 	4 hrs
		<ul style="list-style-type: none"> • <i>ACC pre-recovery meeting (time TBD) with science party, Voyage Manager, Master, Mates and crew</i> 	0.5 hrs
Mon 6-Wed 8	Sep	<ul style="list-style-type: none"> • 08:00: Arrive mooring retrieval site 	
		<ul style="list-style-type: none"> • 08:15: GO/NO GO meeting 	
		<ul style="list-style-type: none"> • 08:20: Toolbox in the Dirty Wet Lab, via online or back deck if weather permits, for ACC mooring retrieval. 	0.5 hrs
		<ul style="list-style-type: none"> • 08:45-20:15: Recover Rintoul oceanographic mooring: contact and activate mooring release; spot mooring at the surface; grapple the mooring; bring the mooring aboard. Best to arrive at mooring site before daybreak to listen for acoustic release and be prepared to activate the release at daybreak, so as to allow maximum daylight hours for locating and recovering the mooring. <p><i>Note: the very latest the releases should be triggered is 1200.</i></p>	12 hrs
		<ul style="list-style-type: none"> • 13:00-14:30: Deployment of EM-APEX floats (x3) at mooring site (opportunistically - as per waypoints provided) 	1.5 hrs
		<ul style="list-style-type: none"> • Deployment of ARGO floats (x3) as per waypoints provided 	2 hrs
		<ul style="list-style-type: none"> • 20:30: Depart Rintoul mooring site and transit to Hobart 	55 hrs
		<ul style="list-style-type: none"> • OBS deployment testing (opportunistic MNF activity - multiple deployments TBD. May be undertaken earlier in the voyage). 	2 hrs per deployment/retrieval
		<ul style="list-style-type: none"> • XBT deployments on transit to Hobart (<i>Chief Scientist</i>) 	
Thu 9	Sep	<ul style="list-style-type: none"> • 04:00 (approx): Arrive Hobart and demobilisation 	
Fri 10	Sep	<ul style="list-style-type: none"> • Continue demobilisation 	1 day

Note: 2 x approved contingency days are to be added to the total number of days above. Additional contingency days allocated to the voyage are to be discussed on board by the Senior Management Team, if and when required.

Permits

The Tasman Fracture Zone forms part of the south-east marine park network and is covered by the MNF's Parks Australia permit. This permit covers the use of the ship's underway systems and CPR.

- Collection of seawater and sediment trap samples for return to Hobart under ACE CRC Quarantine permit Department of Agriculture and Water Resources 0003181884.
- Towing of the CPR and operation of underway ship scientific seawater supply through the Tasman Fracture Zone Commonwealth Marine Reserve Permit issued by the Director of National Parks to the MNF #PA2018_00005-1.
- PA2020-00051-1 Southeast Network for ARGO float deployments.
- Mooring locations and buoy marking details will be provided to AMSA for notice to mariners.

Signature

Your name	Elizabeth Shadwick
Title	Chief Scientist
Signature	
Date:	21 August 2020

List of additional figures and documents

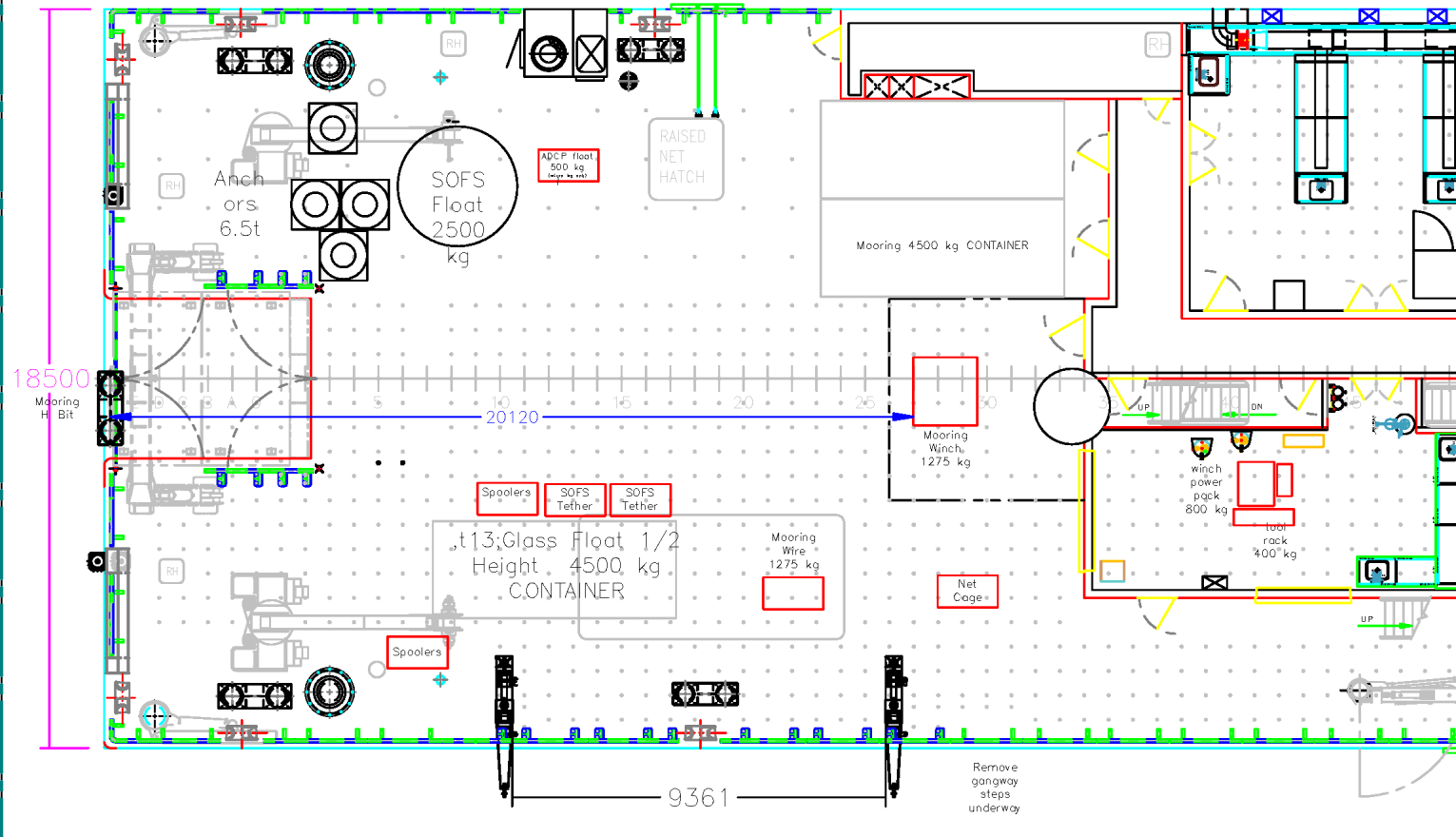
Attachment 1: Deck plan

Attachment 2: SOTS (SOFS and SAZ) mooring diagrams

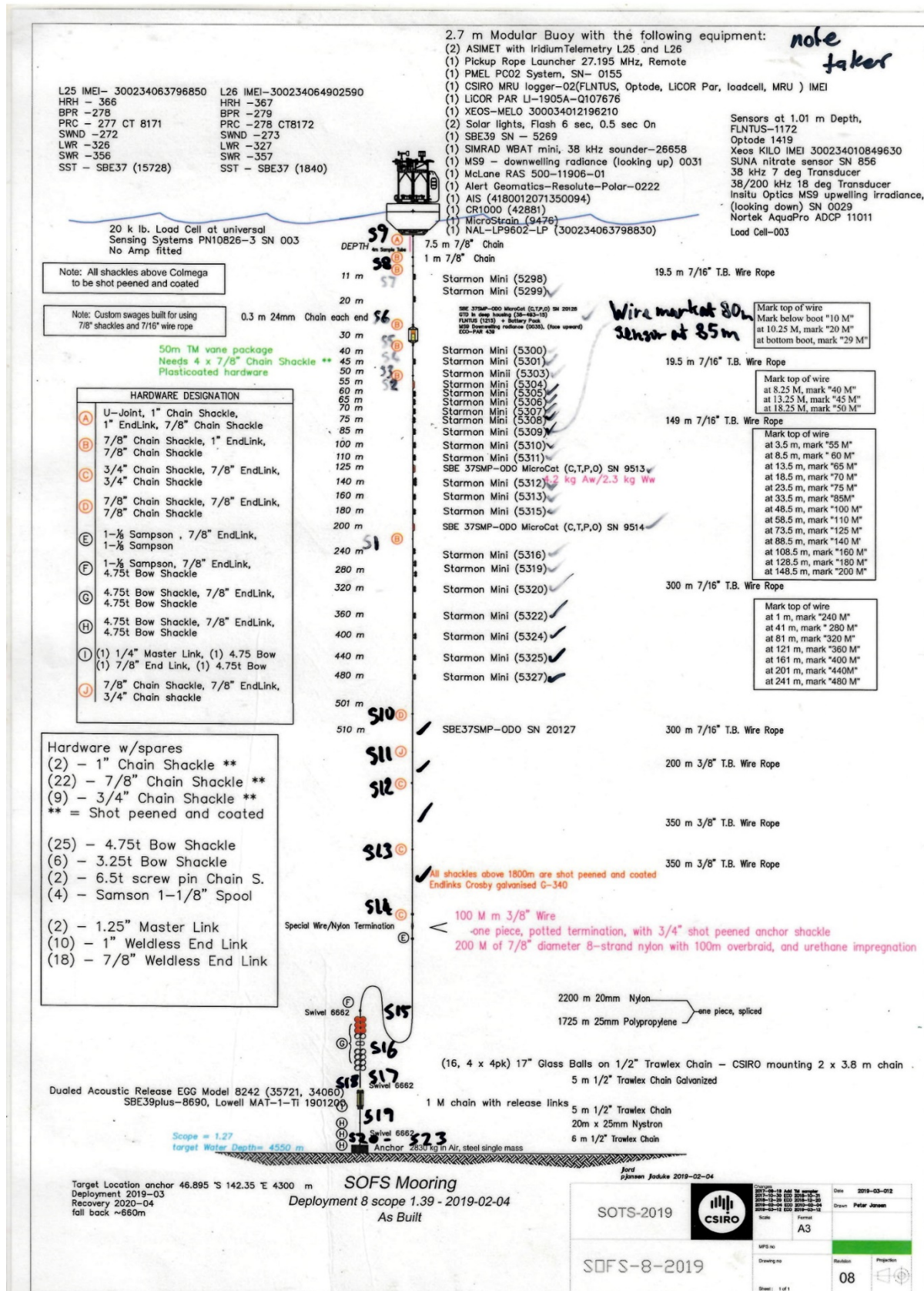
Attachment 3: Oceanic mooring diagram

Attachment 1

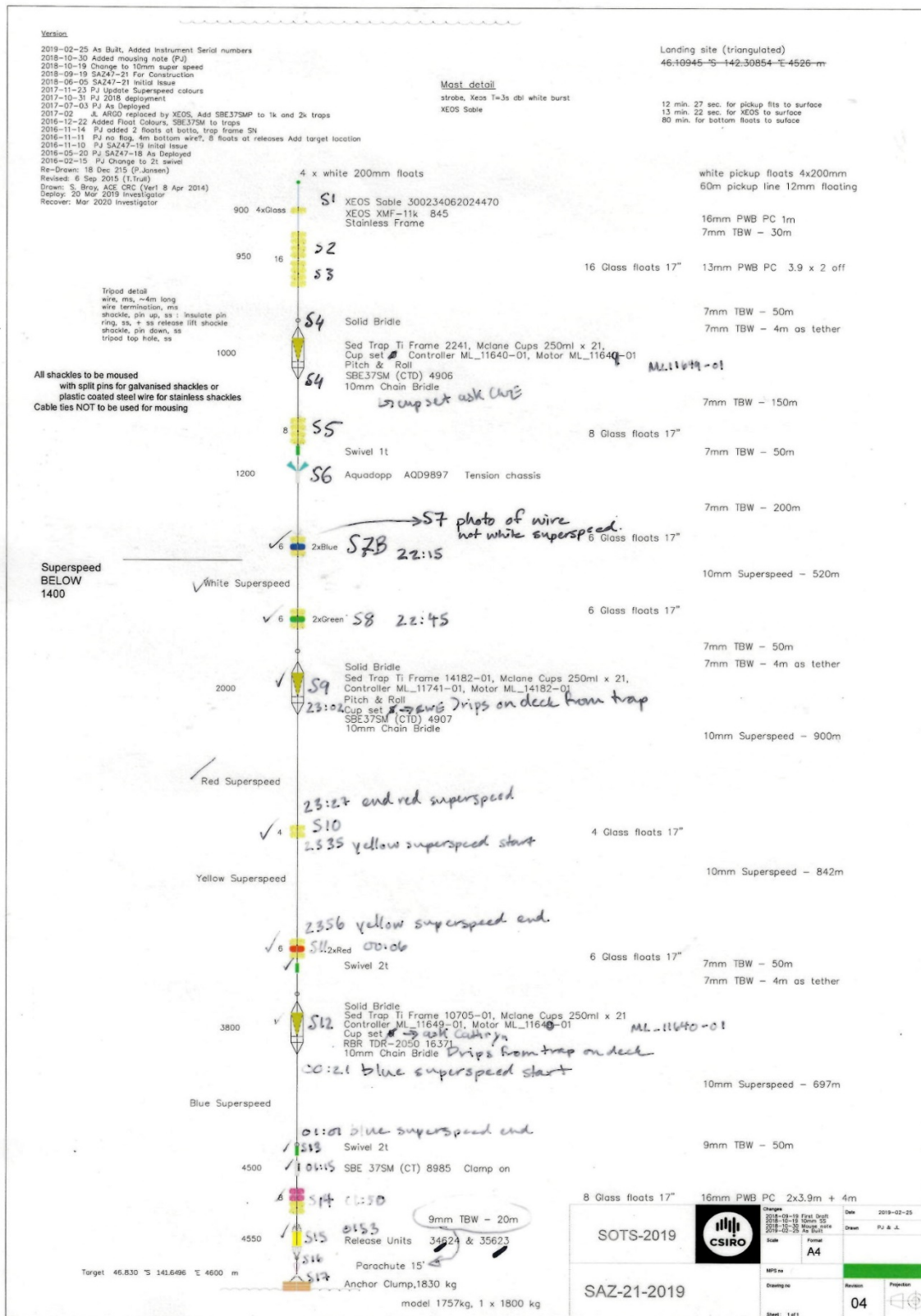
SOTS Deck Plan



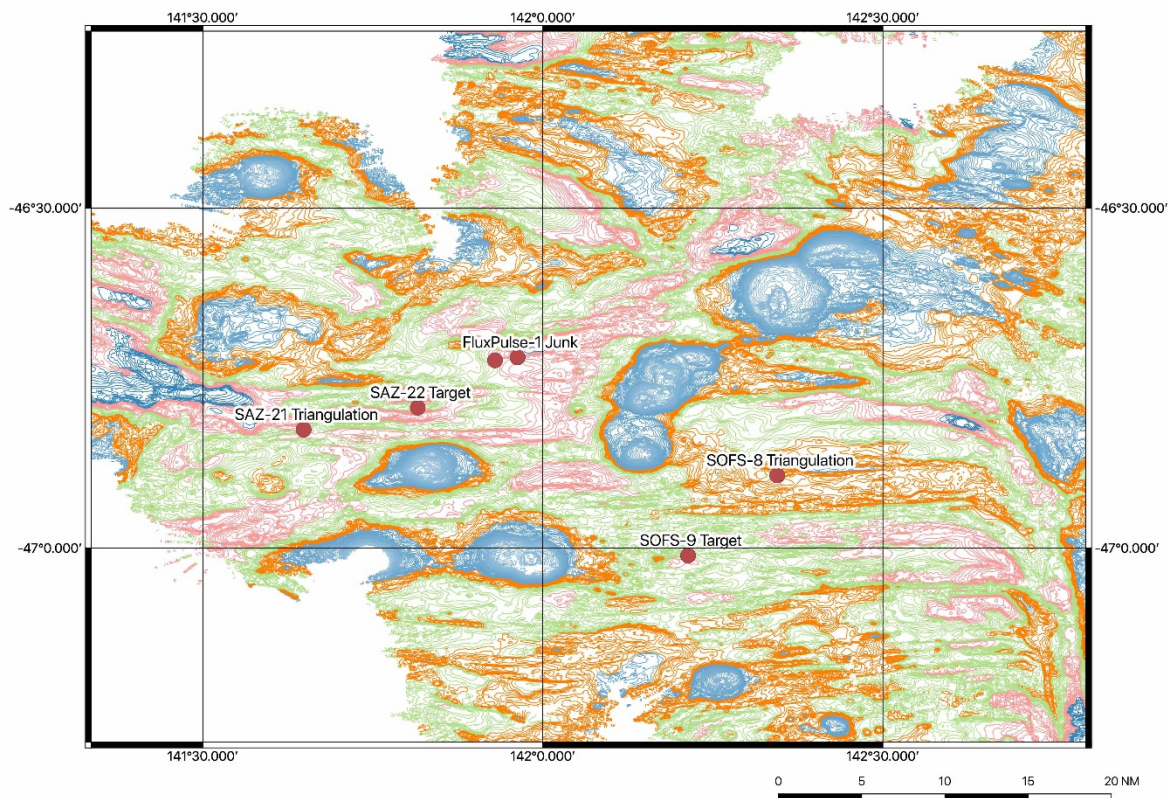
Attachment 2



Mooring diagram: SOFS-8 as deployed in March 2019



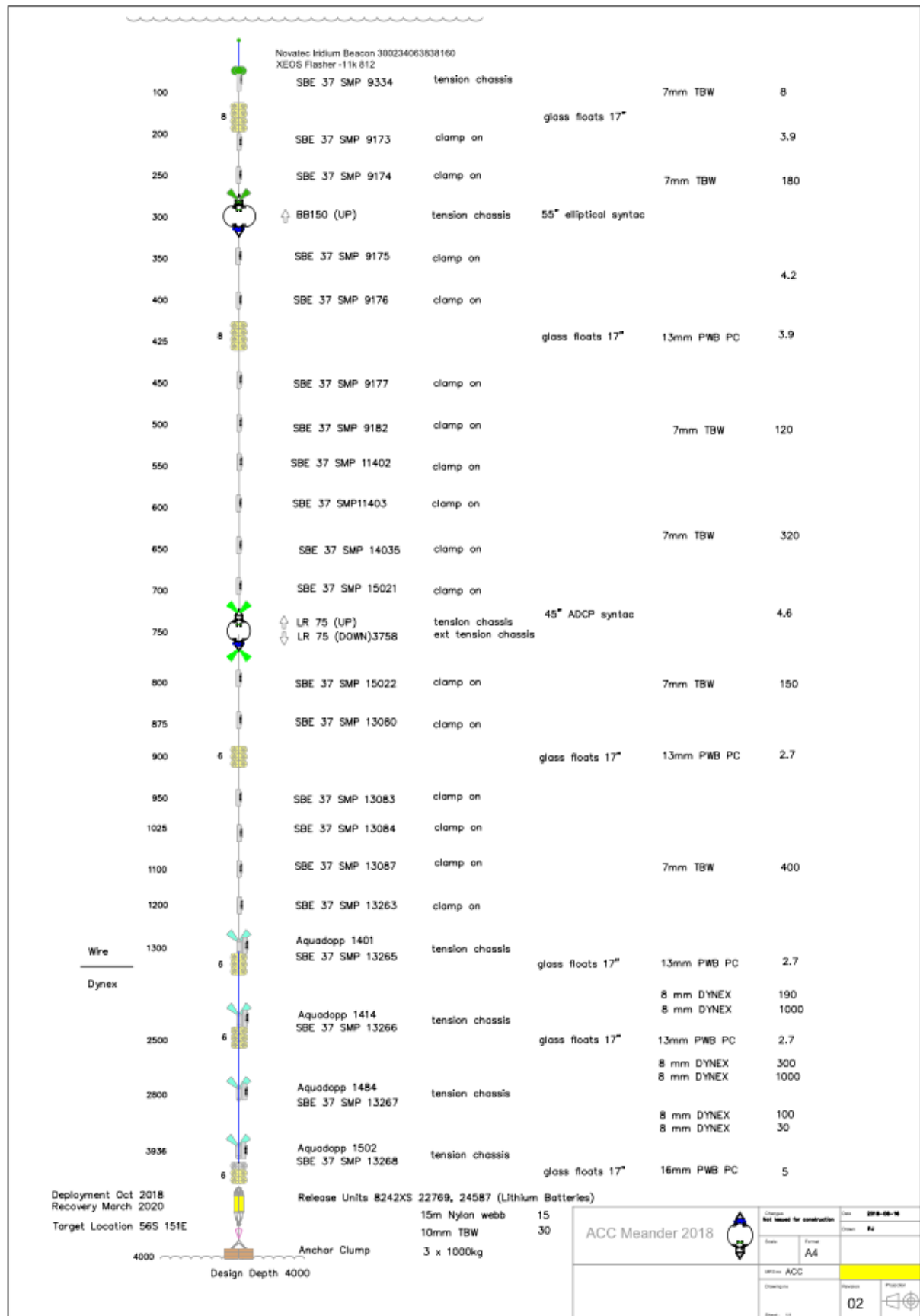
Mooring diagram: SAZ-21 as deployed in March 2019



Map of SOTS mooring locations

- Mooring Deployment Procedures (available separately)
- CTD Water Sampling Collection and Labelling Plan (available separately)

Attachment 3



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.

(i) Standard laboratories and facilities

Name	Essential	Desirable	Notes/Comments
Aerosol Sampling Lab	X		
Air Chemistry Lab	X		
Preservation Lab	X		
Constant Temperature Lab	X		<ul style="list-style-type: none"> Please indicate the required setpoint temperature
Underway Seawater Analysis Laboratory	X		
GP Wet Lab (Dirty)	X		
GP Wet Lab (Clean)	X		
GP Dry Lab (Clean)	X		<ul style="list-style-type: none"> Require use of laminar flow bench in this lab.
Sheltered Science Area	X		
Observation deck 07 level			
Walk in Freezer	X		
Blast Freezer	X		
Ultra-Low Temperature Freezer (-80°C) X2	X		
Walk in Cool Room	X		
Salt water ice machine			

(ii) Specialised laboratory and facilities (may require additional support)

Name	Essential	Desirable	Notes/Comments
Modular Radiation Laboratory			
Modular Trace Metal Laboratory (TM1-blue)			
Modular Trace Metal Laboratory (TM2-white)			<ul style="list-style-type: none"> Cannot be overstacked
Trace metal rosette and bottles			<ul style="list-style-type: none"> 10 foot container
Modular Hazchem Locker			
Deck incubators			
Stabilised Platform Container			
Clothing container			<ul style="list-style-type: none"> The use of this container will be identified by MNF

(iii) Standard laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments
CTD - Seabird 911 with 36 Bottle Rosette			
CTD - Seabird 911 with 24 Bottle Rosette	X		<ul style="list-style-type: none"> With PAR, Transmissometer & user supplied FLBB
Lowered ADCP	X		
Sonardyne USBL System	X		
Milli-Q System	X		
Laboratory Incubators	X		
Heavy Duty Electronic Balance (80kg)			
Medium Duty Electronic Balance (15kg/5g resolution)	X		
Light Duty Electronic Balance (3kg/1g resolution)	X		
Surface Net (mouth area 1m ²)			<ul style="list-style-type: none"> Please specify 335 micron, 500 micron, or 1,000 micron mesh
Bongo Net (not instrumented) ring diameter 485mm 0.018m ²			<ul style="list-style-type: none"> 500 micron mesh only
Smith Mac grab			

(iii) Standard laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments
Dissecting Microscopes			
Microscopes:			<ul style="list-style-type: none"> Refer to the “MNF microscopes procedure” for more information
<i>Brand / model</i>	<i>Type</i>		
• Leica / M80	Dissecting		
• Leica / M80	Dissecting		
• Leica /MZ6	Dissecting		
• Olympus / CH	Compound		
• Olympus /CH	Compound		
• Leica / MTU282	Camera tube		
• Adapters for tube / Nikon	Pentax		
• Ring Light *2 / MEB121	LED		

(iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments <i>(These items may require additional MNF support staff)</i>
TRIAXUS – Underway Profiling CTD			<p>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 10m 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</p> <p>Usual instrumentation: SBE9plus (pressure sensor and communication hub) and dual pumped temperature/conductivity/dissolved oxygen circuits. Usual auxiliary instrumentation includes an ECO-Triplet (Chl, CDOM, backscatter), transmissometer, PAR sensor, and Laser Optical Plankton Counter.</p>

(iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments (These items may require additional MNF support staff)
Desired towing profile:			
Additional instrumentation: (Please supply, make and model and datasheets. Also a contact person for discussion on integration.			
Continuous Plankton Recorder (CPR)	X		
Deep towed camera			
Piston Coring System			
Gravity Coring System			
Multi Corer			
Kasten Corer			
XBT System			<ul style="list-style-type: none"> 2 per day provided
Trace Metal Rosette and bottles			
Sherman epibenthic sled			
Brenke Sled			
Rapid Cast SVP			
Magnetometer			
Drop Camera			
Trace- metal in-situ pumps (x6)			<ul style="list-style-type: none"> MNF supplied laptop is required communication with the pumps. See non-MNF owned section below for additional 2 units
Rock Dredges			
EZ Net (maximum of 10 nets for depth stratified sampling. Mouth area of 1m ²)			<ul style="list-style-type: none"> Please specify 335 micron, 500 micron, or 1,000 micron mesh
Rock saw			<ul style="list-style-type: none"> Requires trained science personnel
Portable pot hauler			

(iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments (These items may require additional MNF support staff)
Beam Trawl			
Pelagic trawl system (net, doors)			<ul style="list-style-type: none"> Contact MNF to discuss net and mesh dimensions
Demersal trawl system (net, doors)			<ul style="list-style-type: none"> Contact MNF to discuss net and mesh dimensions
MIDOC (multiple opening/closing codend system for pelagic trawl)			
Stern Ramp (please select exposed <i>OR</i> installed)	Ramp Exposed	Deck covers installed	<ul style="list-style-type: none"> Stern-ramp cover (“dance-floor”) without overhanging lip on aft surface installed with gap protectors and mounts for user-supplied bullhorn fairlead.
		X	
Trawl monitoring instrumentation (ITI) (2,000m depth limit)			<ul style="list-style-type: none"> Trawl net monitoring system for depth and wire out monitoring
A-frame utility winches.			<ul style="list-style-type: none"> Tagging line cleat attachment points fitted.
Net drum winch			<ul style="list-style-type: none"> Install <i>Investigator</i> net drum winch on Mezzanine with spooler-rail installed aft of it, as the best location as discussed with MNF and ASP for this voyage
Hull mounted 12 kHz Transducer			<ul style="list-style-type: none"> Working hull mounted 12 kHz transducer for use with acoustic release deck unit
Meteorological Instrumentation	X		<ul style="list-style-type: none"> Working and logging meteorological instruments including ISAR SST radiometer
Drop Keel	X		<ul style="list-style-type: none"> Working drop keel for bioacoustics, thermosalinograph and ADCP data gathering deployed to >4 m.
Radiosonde Receiver System			

(v) 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			
Seismic acquisition system			

(vi) Underway systems

Acoustic Underway Systems

Name	Essential	Desirable	Notes/Comments
75kHz ADCP	X		<ul style="list-style-type: none"> Working and logging underway ADCP, with real-time display
150kHz ADCP			
Multi Beam echo sounder EM122 12kHz (100m to full ocean depth)	X		<ul style="list-style-type: none"> Operating remotely by GSM. Monitored on board by DAP.
Multi Beam echo sounder EM710 70-100kHz (0-1000m approx.)			<ul style="list-style-type: none"> Multibeam/Multifrequency bio-acoustic system, with MNF supplied electronics, computing, and operational support
Sub-Bottom Profiler SBP120			
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	X		<ul style="list-style-type: none"> One setting to 1500m; to be monitored on board by DAP and on shore by GSM.
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			
Gravity Meter			

Atmospheric Underway Sensors

Name	Essential	Desirable	Notes/Comments
Nephelometer			
Multi Angle Absorption Photometer (MAAP)	X		
Scanning Mobility Particle Sizer (SMPS)	X		
Radon detector	X		
Ozone detector			
Condensation Particle Counter (CPC)			
Picarro spectrometer (analysis of CO ₂ /CH ₄ /H ₂ O)			
Aerodyne spectrometer (analysis of N ₂ O/CO/H ₂ O)	X		
Cloud Condensation Nuclei (CCN)	X		
Polarimetric Weather Radar			

Underway Seawater Systems and Instrumentation

Name	Essential	Desirable	Notes/Comments
Thermosalinograph	X		<ul style="list-style-type: none"> Working and logging underway thermosalinograph and fluorometer and real-time display
Fluorometer	X		<ul style="list-style-type: none"> Working and logging underway thermosalinograph and fluorometer and real-time display
Optode	X		
pCO ₂	X		

Seawater systems

Name	Essential	Desirable	Notes/Comments
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			

Seawater systems

Name	Essential	Desirable	Notes/Comments
Raw seawater available on deck and in laboratories.			

Non MNF Owned Equipment which may be accessed

Name	Essential	Desirable	<p>Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with Voyage Operations Manager as required.</p> <p>Additional staff may be required for these activities.</p>
D & N Francis winch			<ul style="list-style-type: none"> 13mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			<ul style="list-style-type: none"> Shallow water multibeam echosounder system

Possible increased data requirements for ABC media has been communicated with DAP.

Appendix B

User Supplied Equipment

Item Name	Weight	Dimensions	Location on Vessel
Bullhorn mooring fairlead	100 kg	1m	Main deck
Mooring winch	1.5 tonne	2x1x1.5 m	Main deck / Sheltered Science Area
Half height open top moorings container	5 tonnes	20ft	Main deck
SOFS float and recovery cradle	2.5 tonnes	3x3 m	Main deck
Mooring anchor stacks	8 tonnes	3x1 m	Main deck
Full height container for storing and working on sediment traps	4.5 tonnes	20ft	Main deck
6 cage pallets of mooring equipment	500kg per cage	1 x 2 m each	Main deck
Hand held and deck mounted pneumatic line throwers (grappling gun)	50 kg	0.5 m	Sheltered Science Area
Video cameras	0.5kg	0.1 m2	Main deck
Acoustic release deck unit	5kg	0.5 m2	Operations Room
Pigment filtration system and FIRE	25 kg	1 m2	Underway Seawater Lab
FLBB sensor	10 kg	1 m2	CTD room
POC particle filtration system	5 kg	1 m bench space	Clean Dry lab
Aerosol sampling	20 kg	1 m2	Aerosol lab
Precipitation (Rain) Sampler	10 kg	1 m3	to be installed on 05 level outside of bridge equipment room (no power required)
Hydraulic High Pressure Unit (HPU)	850kg	approx 120W x 100D x 140H (cm)	Sheltered workshop
2 x Air Spoolers	300kg	approx 120W x 120D x 100H (cm)	Main deck secured to half height
Tool Rack	500kg	approx 150W x 80D x 200H (cm)	Sheltered workshop secured to HPU
3 x EM-APEX floats	30kg each		Dirty Wet lab sorting table
3 x ARGO floats	28kg each		Dirty Wet lab sorting table