RV *Investigator* Voyage Plan

Voyage #:	**IN2021_V03**
Voyage title:	**Integrated Marine Observing System: monitoring of East Australian Current property transports at 27° S**
Mobilisation:	Hobart, Tuesday, 4th May – Friday, 7th May, 2021
Medical Clearance Period:	Hobart, Wednesday, 5th May – Friday, 7th May, 2021 *(all participants and crew remain on board once tested)*
Depart (receipt of medical results):	Saturday, 0800 Hobart 8th May, 2021 *(Departure date and time will be dictated by return of medical results)*
Arrive:	Brisbane, 0800 Thursday, 3rd June, 2021
Demobilisation:	Brisbane, Friday, 4th June, 2021
Voyage Manager:	John Hooper
Chief Scientist:	Chris Chapman (CS in Training)
Affiliation:	CSIRO
Principal Investigators:	Dr. Bernadette Sloyan (Applicant and Chief Scientist), Dr. Amandine Schaeffer, Prof Iain Suthers
Other Projects	
Project name:	**Dynamics of larval fish diversity for ocean observing off North Stradbroke Island**
Affiliation:	University of NSW

Scientific objectives

The East Australian Current (EAC) is the complex and highly energetic western boundary of the South Pacific Ocean off eastern Australia. It closes the South Pacific subtropical gyre, transporting heat, salt, nutrients, carbon and plankton southward and onto the continental shelf. Off the coast of Brisbane (approximately 27°S) the EAC is dominated by a relatively stable jet that meanders in an east-west direction. The mooring array is located near the existing long-term XBT transect and satellite altimetry ground tracks. The aim of this observing system is to capture the mean and time-varying flow of the EAC.

This EAC mooring array is a component of IMOS. These observations will provide an intensive reference set of measurements of the EAC over a sustained period for improved understanding of the relationship of EAC with the large-scale South Pacific gyre. The mooring array will provide a physical context for the impact of the EAC on upwelling and the coastal marine ecosystems; on cross-shelf flows such as frontal eddies; and on the validation and interpretation of the EAC system in numerous climate and ocean models.

Voyage objectives

This voyage will recover and re-deploy an array of six full-depth current meter and property (temperature, salinity and pressure) moorings from the continental slope to the abyssal waters off Brisbane (27°S). The observing system is designed to capture the mean and time-varying flow of the EAC. In order to resolve interannual and decadal signals we aim to maintain multi-year deployments of the array.

The data from the EAC mooring array and other oceanographic sampling are essential for understanding, at the regional to global scale, the role of boundary current in the climate system, and, at the local scale, simulating cross-shelf flows, upwelling, and frontal eddy formation. These local-scale processes have a fundamental impact on nutrient and phytoplankton concentrations and therefore far-reaching effects on annual fisheries productivity and coastal shark interactions along the eastern seaboard.

We will undertake CTD casts, sampling salinity and $0_{2,}$ and numerous Triaxus and ship ADCP sections across the EAC mooring line and at several locations during the transit from Hobart to the mooring sites. Additionally, we aim to complete two oceanographic surveys: one in the Fraser Island area between 28°S and 26°S; and the other on and over the continental shelf in the vicinity of the North Stradbroke Island National Reference Station. These surveys will include bongo net tows and Triaxus/SADCP sections and will occur in between the mooring operations and at the completion of the mooring operations, as well as opportunistic sampling of jellyfish and salps over the side of the vessel when it is stationary using the extendable “pool scoop”. We aim to sample small scale, ephemeral frontal eddies flowing down from Fraser Island and shelf – continental slope boundary exchanges. These observations will enable us to characterise the spatial and temporal variability of shelf water and plankton around the Stradbroke Island National Reference Station (NRS) mooring, and their connection to the offshore regions. We will also deploy numerous eXpendable Bathymetric Thermographs (XBTs) during the transit from Hobart north.

We will also aim to perform Triaxus and bongo net tows during the northward transit at various locations, with top priority given to a location off the coast of Newcastle NSW (near 32.5°S) to supplement the IMOS mooring and HF radar installation at that location. We will also deploy a number of floats (core Argo and BCG-Argo) during the voyage.

We will collect salinity and oxygen samples for calibration of the CTD salinity and oxygen sensors. Limited dissolved inorganic carbon samples may be collected if we deploy BGC Argo floats).

The following specific objectives will be completed:

1. Moorings recovery and deployment at appropriate locations;
2. Full depth CTD/rosette stations at each mooring recovery location with only salt and O2 water samples;
3. Pre-deployment CTD casts for calibration of Seabird 37 and 39 mooring instruments to a depth of 2000 m;
4. Triaxus and Ship ADCP sections at various locations during the transit from Hobart to the mooring locations, across the mooring line, at the shelf-slope and Fraser Island survey regions;
5. Bongo net tows along the EAC mooring line, and as part of the shelf-slope and Fraser Island survey areas to study the significance of re-circulation features;
6. Bongo nets, CTD and bio-acoustic samplings at various locations during the transit from Hobart to the mooring sites; and surrounding the Stradbroke NRS site including opportunistic sampling of frontal eddies; and
7. Deploy Surface Velocity Program drifters, XBTs and Argo (core and BGC) floats during the voyage, with supporting CTDs in the case of BGC Argo floats.

	EAC_500 (M1)	**EAC_2000 (M2)**	**EAC_3200 (M3)**	**EAC_4200 (M4)**	**EAC_4700 (M5)**	**EAC_4800 (M6)**
Longitude	153.9007 (153° 54.042'E)	153.999 (153° 59.94' E)	154.1366 (154° 8.196' E)	154.2982 (154 ° 17.892' E)	154.6493 (154 ° 38.958 ' E)	155.3053 (155 ° 18.318' E)
Latitude	-27.3293 (27 °19.758' S)	-27.3148 (27 ° 18.888' S)	-27.2846 (27 ° 17.076' S)	-27.2506 (27 ° 15.036' S)	-27.2083 (27 ° 12.498' S)	-27.1054 (27 ° 06.324' S)
Depth	545	1905	3185	4267	4779	4791

Table 1. Location of moorings to be recovered.

	EAC_500 (M1)	**EAC_2000 (M2)**	**EAC_3200 (M3)**	**EAC_4200 (M4)**	**EAC_4700 (M5)**	**EAC_4800 (M6)**
Longitude	153.8993 (153° 53.958'E)	154.0026 (154 ° 0.156' E)	154.1356 (154 ° 8.136' E)	154.2971 (154 ° 17.8260' E)	154.6471 (154 ° 38.826' E)	155.2993 (155 ° 17.958' E)
Latitude	-27.327 (27 ° 19.620' S)	-27.3157 (27 ° 18.942' S)	-27.2853 (27 ° 17.118' S)	27.2498 (27 ° 14.988' S)	-27.2086 (27 ° 12.516' S)	-27.102 (27 ° 6.120' S)
MNF Swath Depth (m) - correction	541	1887	3187-30	4266-10	4777-10	4791-10
Build depth	**541**	**1887**	**3157**	**4256**	**4767**	**4781**

Table 2. Location of moorings to be deployed

	Latitude	**Longitude**
In-shore	-27.33 (27° 19.5' S)	153.9 (153° 54.4' E)
Off-shore	-27.10 (27° 6'S)	155.35 (155°15' E)

Table 3. On-shore and off-shore locations of SADCP/Triaxus sections along the mooring line

	Latitude	**Longitude**
North Stradbroke	-27.34 (27° 20.5' S)	153.56 (153° 33.73' E)

Table 4. Location of North Stradbroke Island IMOS mooring site

	Latitude	**Longitude**
Southwest limit	-28.0 (28° 00'S)	153.54 (153°32.4'E)
Southeast limit	-28.0 (28° 00'S)	154.1 (154° 06'E)
Northeast limit	-27.0 (27° 00'S)	154.1 (153° 54'E)
Northwest limit	-27.0 (27° 00'S)	153.54 (153° 32.4'E)

Table 5. Approximate area of shelf-EAC SADCP/Triaxus/Bongo net survey region

	Latitude	**Longitude**
Southwest limit	-25.30 (25°18'S)	153.5(153° 30'E)
Southeast limit	-25.30 (25°18'S)	155.5 (155° 30'E)
Northeast limit	-24.3 (24° 18'S)	155.5 (155° 30'E)
Northwest limit	-24.3 (24° 18'S)	153.5 (153° 30'E)

Table 6. Approximate area of Fraser Island SADCP/Triaxus/Bongo net survey region

Opportunistic Heritage Site Investigations

The Marine National Facility has been provided three targets of potential heritage significance by Heritage NSW. The targets will be opportunistically passed over depending on the ships route of transit which will be determined by elements of the primary objectives studying the East Australian Current south of 27S. Imaging the heritage sites using MBES will aid in the protection of the sites if features of heritage significance are resolved.

Target	Latitude	Longitude
Target 1a	30° 54.56S	153° 15.3E
Target 1b	30° 54.52S	153° 15.26E
Target 1c	30° 54.54S	153° 15.27E
Target 2a	33° 27.6S	151° 51.6E
Target 2b	33° 27.51S	151° 51.61E
Target 3	36° 35.58S	150° 13.32E

Operational Risk Management

- Mooring deployment and recovery

  The planned operations with moorings have been identified as potentially high risk work and will therefore trigger MNF procedures for potentially high risk operations including toolbox meeting before each operation, operational summary meeting immediately following each operation.

  Moorings will include a rehearsal of high risk activities and we will carry out all moorings operations in alignment with the Moorings Procedure.

- CTD operations

  Support staff and ASP crew involved in the CTD operations have completed risk assessments of this work and will be signing onto deck Job Safety Analysis and Safe Work Instructions, specific for this task.

- Triaxus tows (Tow speed 6-8 knots)

  Due to the level of risk associated with towing the Triaxus (overhead wires under tension), main deck access will be restricted during periods of Triaxus use. As a result, Triaxus operations have been scheduled between 1800 – 0700 on days when the mooring team will not be working on the back deck. Main deck exclusion zones will be demarcated to allow for auxiliary mooring operations (i.e. Cleaning/ maintenance) as required, during Triaxus towing periods.

- Bongo Net Tows (Tow speed 3 knots to 40 m depth, 10 minutes each)

  The MNF's 60 or 70 cm diameter bongo net with the 20 kg net depressor will be deployed over the stern through the ship's A Frame as is current SWI required practice. Sampling will usually be at night (19:00 to 01:00, with 2-3 replicates per site). Winds >25 knots can make deployment difficult and may have to be cancelled for the evening.

- Biological Sampling (Chemical usage)

  Formalin and 95% ethanol will be dispensed in the Preservation room fume hood, with gloves and glasses. Samples will be preserved and double bagged, kept in black drums for ease of shipment. SWI will be utilised for handling.

- Argo float deployments (deployment speed 0-2 knots)

  At the desired location, core Argo floats will be deployed in their cardboard disposable boxes from the fantail and BGC-Argo floats will be deployed using the A-frame, synthetic rope and sea catch release.

- Opportunistic sampling of jellyfish/salps using the extendable “pool scoop”

  Will only be undertaken while the ship is stationary (ie. during mooring operations or CTD casts), when conditions allow (calm seas and weather).
- Opportunistic deployment of XBT using XBT auto launcher system as a trial.
- SVP deployments (deployment speed of up to 12 knots)

  At the desired locations, Surface Velocity Program (SVP) floats will be deployed by hand.

Risk	Activities impacted	Contingency management
Mooring deployment and recovery	MNF procedures for potentially high risk operations including toolbox meeting before each operation, operational summary meeting immediately following each operation. Moorings operations will include a rehearsal of high risk activities and operations will follow approved Moorings Procedure.	Clear and open communication to be maintained during the voyage
Mooring instrument cleaning	Potential risk of stings and cuts from biology growth on instruments	Use gloves and plastic cleaning implements when handling fouled instruments
CTD Operations	Support staff and ASP crew involved in the CTD operations have completed risk assessments of this work, and will be signing onto deck Job Safety Analysis and Safe Work Instructions, specific for this task.	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF personnel
Triaxus Tows	Triaxus operations have been scheduled between 1800 – 0700, on completion of daily moorings operations, in addition, main deck exclusion zones will be marked to allow for auxiliary mooring operations (i.e. Cleaning/ maintenance)	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF/ASP personnel as governed by SWI.

Risk	Activities impacted	Contingency management
	as required, during Triaxus towing periods.	
Bongo Net Tows	Support staff and ASP crew involved in the bongo net operations have completed risk assessments of this work, and will be signing onto deck Job Safety Analysis and Safe Work Instructions, specific for this task.	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF/ASP personnel as governed by SWI.
Chemical spills	One container of formalin will be secured (tied down) in the fume hood, and usually a sheep-drench gun used to dispense 60 mL per 1.2 L jar. Some sorting of preserved samples will occur in the wet lab; waste cubes will be brought to retain 5% formalin waste	Discussion and JSA with MNF safety officers before voyage. Post MSDS forms, and follow UNSW Safe-Sys documentation.
Argo (Core) floats	ASP crew will deploy Argo floats following instructions provided by scientific personnel (Rebbeca Cowley)	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF and ASP personnel
BGC Argo float	ASP crew will deploy BGC Argo floats following instructions provided by scientific personnel (Chris Chapman)	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF and ASP personnel
XBTs	Science crew will deploy XBTs in consultation with MNF and ASP crew.	Clear and open communication to be maintained during the voyage. Science party to adhere to instructions of MNF and ASP personnel.
SVP floats	Science crew will deploy SVP floats in consultation with	Clear and open communication to be maintained during the voyage. Science party to

Risk	Activities impacted	Contingency management
	MNF and ASP crew (Amandine Schaeffer)	adhere to instructions of MNF and ASP personnel.

Media Activities

The MNF will seek to pursue opportunities that arise during the voyage to promote the science, scientists and ship, via conventional and social media channels, in consultation and/or collaboration with the relevant ship user.

Media Plan

Contact: Dr. Thomas Moore (CSIRO) with CSIRO and IMOS media liaisons

Goal

Our goal is to maximise opportunities to promote the science, scientists, and the *RV Investigator* via conventional and social media channels, placing the national investment in these activities in an appropriately favourable light that helps to explain to the public why our work is important.

Media Overview

There are a number of potentially compelling stories around the voyage as well a collection of stakeholders that, together, help deliver the resources, infrastructure, and science leadership that delivers the research impact. The narrative around the IN2021_V03 work is entirely positive, with a low risk of controversy if the facts of the voyage are clearly understood, but we have identified possible snags and suggested ways to prepare to address these issues.

Stakeholders

The IN2021_V03 science communicators will keep the stakeholders aware of media activities, starting with this proposed plan.

- MNF
- IMOS
- CSIRO
- UNSW
- SIMS

Purpose: "This voyage will fill gaps in the puzzle that links ocean physics, to climate, to the marine ecosystems that impact our coastal communities and industries."

Promise: "This voyage will take advantage of the world-class facilities and state-of-the-art technology available on the *RV Investigator*."

Personalities: "This voyage is undertaken by Australia's ocean experts, from a diverse background, and joined by young scientists-in-training who will lead our oceanography in the future."

Positioning: "This voyage is an assembly of Australian science infrastructure and expertise that is uniquely placed as part of our nation's only dedicated blue-water research effort."

Voices

Where possible, individual stories and released content should have two voices – a primary voice from the science leader / expert and a second voice highlighting the resourcing and infrastructure that supports the specific topic (IMOS or MNF). IMOS will provide a line for inclusion in written releases and other content where appropriate.

Stories

There are a number of stories we are developing for this voyage, including:

- The importance of long-term ocean monitoring to fill gaps in ocean knowledge that links physics to climate to ecosystems off eastern Australia. (CSIRO)
- The deployment of robotic floats to explore large-scale changes in the chemistry and biology of marine ecosystems in the Tasman Sea. (CSIRO / UTAS)
- A number of human interest stories focusing on the young, early career research staff and students on the voyage. These stories will have a diversity in STEM aspect to them.
- New methods of looking at fish mortality being explored in this marine bioregion for the first time. (UNSW)

Proposed media activities

Organisation	Activities	Timing	Responsible person
CSIRO	Chief Scientist undertaking interviews with networks to discuss science stories.	Pre-departure	various members of the science party
CSIRO	Voyage content production for blog and social media.	Throughout voyage	TBA
CSIRO	“Evergreen” content production.	Throughout voyage	TBA
CSIRO	Media engagement for print stories.	Opportunisticall y	TBA

Existing leads and interest

Contact with interested parties and potential stakeholders will be initiated closer to departure date.

Data communication requirements

Vessel’s data capacity will support Comms Plan.

Risk planning

The IN2021_V03 area of operations sits over the continental shelf and off south eastern Queensland between the Sunshine and Gold Coasts with their fishing ports, Mooloolaba and Southport. Marine resources management and the intersection of commercial fishing, recreational fishers, and government regulation (informed by science) can be a common source of controversy in coastal communities.

Overall activity plan including details for first 24 hours of voyage

The general plan is a staged recovery and redeployment of the six EAC moorings along the mooring deployment line. We will undertake a CTD station prior to the recovery of a mooring and a few additional stations to support bongo-net operations and to calibrate instruments prior to deployment and post recovery. Therefore, with the bongo net sampling we will undertake at approximately 29 CTD stations on the voyage, sampling only salinity and DO. We will also complete a number of Triaxus and ship ADCP sections along the mooring line, at several locations along the southeast Australian coast during the transit from Hobart to the mooring sites. We aim to complete two physical and biological oceanographic surveys in between mooring operations and towards the end of the voyage, the first off Fraser Island, the second over the continental shelf near the IMOS National Reference Station near North Stradbroke Island. These surveys will include Triaxus/SADCP transects and bongo net tows.

First 24 hours

Steam from Hobart to Storm Bay pilot station, round the Tasman Peninsula and steam directly north towards the first bongo-net site near the Maria Island NRS. After Bongo net tows, we will undertake CTD toolbox and a test CTD cast in water depth greater than 2000m. After the CTD training, science personnel will be trained in water sampling procedures by Hydrochemistry staff. In the case that we deploy BGC Argo floats, the test CTD will be undertaken after the first BGC Argo float is deployed, and will double as a calibration CTD for the BGC Argo float instruments. We will also continue to set up the deck, mooring gear and instruments.

Voyage track example

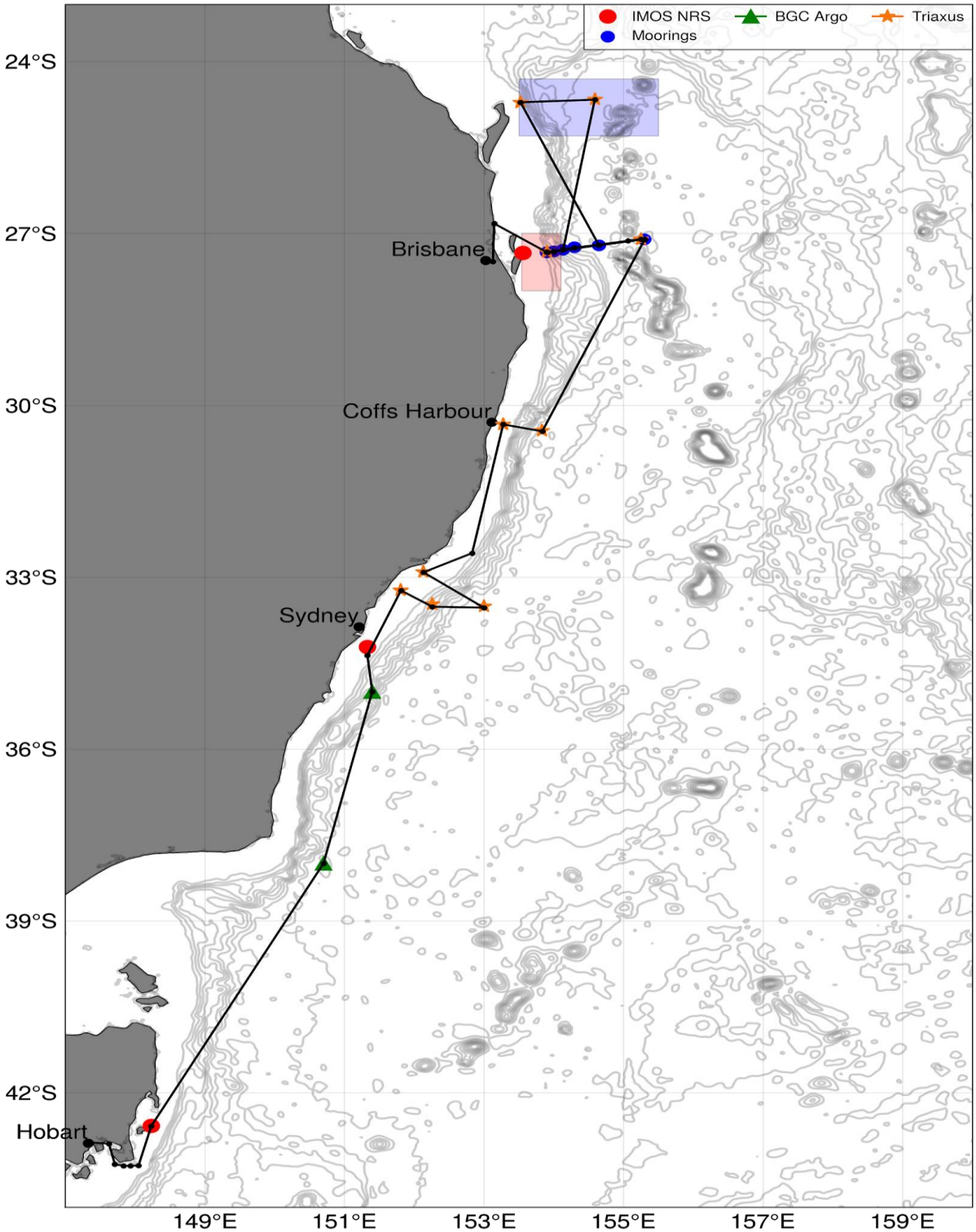

Figure 1: Voyage track including location of moorings, SADCP/Triaxus tows and potential survey locations. Bathymetry is indicated by light grey contour lines (CI: 500m).

Waypoints and stations

List of major operations; mooring operations (recover (_R) and deploy (_D)), full depth CTD stations, ship ADCP/Triaxus line along the mooring line and to the north of the mooring line near Fraser Island. We also aim to complete a shelf-slope survey to the west of the mooring line. The time given

is the time for each operation. Please refer to Table 3 (Time Estimates) for actual planned daily schedule as mooring operations will be conducted between the hours of 0600 and 1700hrs. Transit times are based on a steaming speed of 10 knots, Triaxus/SADCP lines are based on tow speed of 6-8 knots. With the exception of sections undertaken during the transit north, Triaxus/SADCP and SADCP sections will be undertaken between mooring operations, and Triaxus operations will be between 1800-0700 hours to ensure no one is working below the live tow-wire.

Bongo net tows will usually occur after sunset to 0200, and usually start within 1 hour steam from the vessel's location at ~1600. Between 0200-0600 will be either CTD, Triaxus or re-position vessel for morning's mooring activities.

Transit Plan

Opportunistic science is planned for the voyage, consisting of bongo net and Triaxus/SADCP tows; and the deployment of Argo (core and BGC) floats. However, our ability to conduct these operations will depend on a number of factors, including the departure time, forecast weather at the mooring sites; and available personnel.

Two transit plans are presented. Plan 'A' consists of three Triaxus sections along lines selected prior to departure. Plan 'B' consists of a single Triaxus tow along a preselected line, and another Tiaxus tow near an interesting oceanographic feature, such as a turbulent eddy. The various plans are illustrated in Figure 2 below. The decision of which plan to follow will be made on board either shortly before, or shortly after departure from Hobart. In both plans, the same time is allocated, and we have planned to reach the mooring site at the same date and time regardless of which plan is followed.

During transit, it is highly likely that we will deploy 6 core Argo floats, 2 BGC Argo floats and numerous XBTs. Core Argo float deployments are anticipated to take only 15-20 minutes each and XBT deployments can be done during steaming. However, BGC Argo floats are significantly heavier and take more time to deploy than core Argo floats. Additionally, deployment of these floats must be accompanied by supporting CTD casts to 2,250m depth with 24 niskin bottles fired. As such, deployment of each float is expected to take approximately 3 hours each, for a total of 6 hours. The deployment of BGC Argo floats has been built into the voyage plan, noting that the exact position that these floats will be deployed will depend on operational requirements.

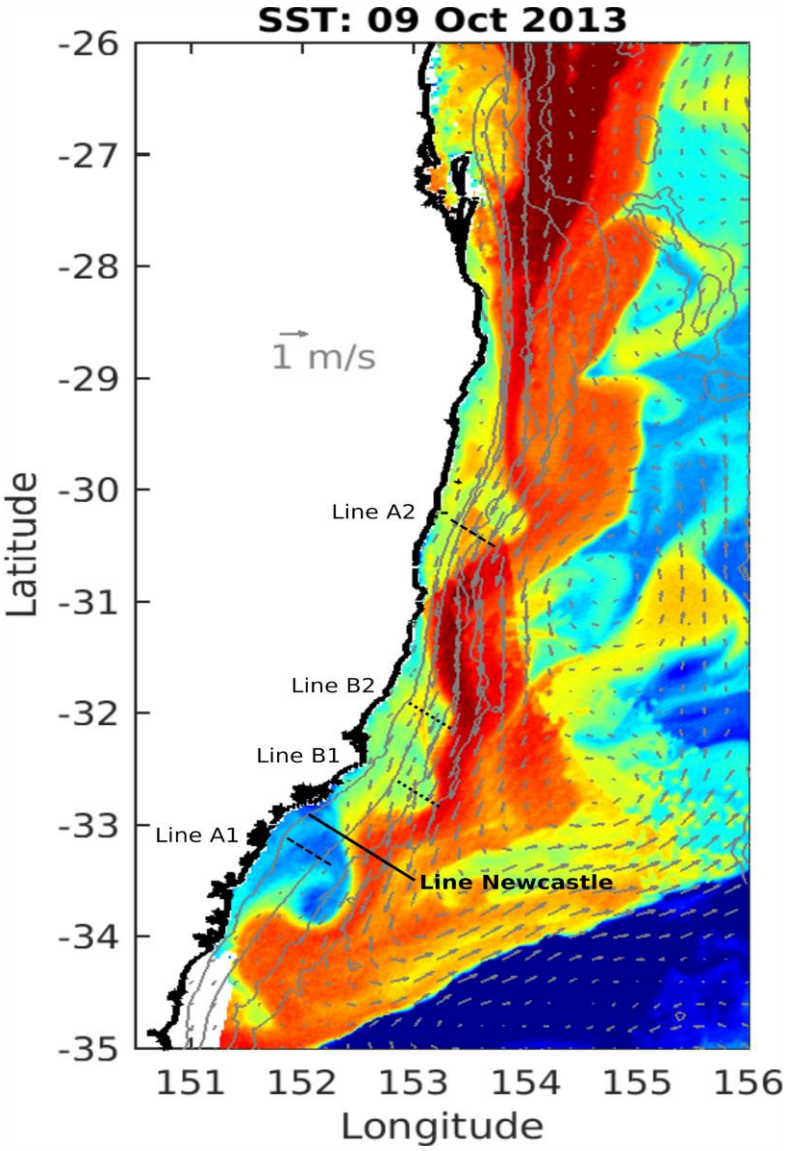

Figure 2: Example of different transit plans to be decided based on prevailing oceanographic conditions. Plan A (by default): line Newcastle (60 NM), line A1 (30 NM under NEWC radar footprint) and line A2 (30 NM under Coffs Harbour radar footprint). Plan B if frontal instabilities / eddies are obvious in the satellite sea surface temperature image (as shown here, from Schaeffer et al, JGR 2017): line Newcastle (60 NM), line B1 (30 NM across a structure) and line B2 (30 NM across a structure).

In the transit plan below, two Triaxus/SADCP tows are flags as being modifiable depending on the oceanographic conditions and which transit plan is followed.

Transit Plan Waypoints

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total time (hrs)
Hobart	42°52.2'S	147°21.0'E	0	0	0	0
Storm Bay	43°3.75'S	147°24.0'E	15	15	3	3
Transit to Backscatter Calibration Line 1 Start	43°11.9'S	147°37.513'E	15	30	1.5	4.5
Backscatter Calibration Line 1	43°14.9'S	147°42.6'E	6	36	1	5.5
Transit to Backscatter Calibration Line 4 Start	43°16.51'S	147°50.1'E	6	42	0.5	6
Backscatter Calibration Line 4 End	43°16.63'S	147°56.08'E	4	46	0.5	6.5
Tasman Island/turn North Point	43°16.20'S	148°03.00'E	5	51	0.5	7
Transit to Maria Island NRS station	42°34.87'S	148°13.968'E	42	93	4.5	11.5
2xBongo Net tows off Maria Island NRS	42°34.87'S	148°13.968'E	0	93	1	12.5
Transit to instrument dip CTD location	42°34.87'S	148°37.0E	10	103	1	13.5
Instrument dip CTD #1	42°34.87'S	148°37.0E	0	103	2	15.5
Transit to BGC Argo deployment location 1	38°00.0'S	150°42'E	300	393	30	42.5
Deploy BGC Argo float 1. Instrument dip CTD #2 @	38°00.0'S	150°42'E	0	393	4	45.5

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total time (hrs)
Deployment location (2,250m depth)						
Transit to BGC Argo deployment location #2	35°00.0'S	151°24.0'E	180	573	18	63.5
Deploy BGC Argo float #2. Instrument dip CTD @ Deployment location (2,250m depth)	35°00.0'S	151°24.0'E	0	573	4	66.5
Transit to Port Hacking NRS	34°22'S	151°19.8'E	46	619	4.5	71
2xBongo Net tows off Port hacking NRS	34°22'S	151°19.8'E	0	619	1	72
PLAN 'A' Transit to beginning of first Triaxus/SADCP line and begin Triaxus/SADPC line	33°14.0'S	151°48.7'E	60	679	6	78
PLAN `B' Sample interesting oceanographic feature (approx 6 hours)				679		78
End Triaxus/SADCP line	33°31'S	152°15.6'E	30	709	6	84

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total time (hrs)
Transit to beginning of 2nd Triaxus/SADCP line (Newcastle)	33°32'S	153°00'E	40	749	4	88
Instrument dip CTD #4	33°32'S	153°00'E	0		3	
Deploy Core Argo Float #1	33°32'S	153°00'E	0			
End Triaxus/SADCP line	32°55'S	152°08'E	60	809	12	100
Plan `A' Transit to beginning of 3rd Triaxus/SADCP line and begin Triaxus/SADPC line	30°20.1'S	153°16.6'E	180	989	18	118
PLAN `B' Sample interesting oceanographic feature (approx 6 hours)				989		118
End Triaxus/SADCP line	30°27.3'S	153°50.2'E	30	1019	6	124
Instrument dip CTD #5	30°27.3'S	153°50.2'E	0		3	

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total time (hrs)
Deploy Core Argo Float #2	30°27.3'S	153°50.2'E				
Transit EAC_4800 (M6_R) recovery site	27°06.324'S	155°18.318'E	205	1224	19	143

Mooring and survey plan

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
CTD @ EAC_4800 (M6_R)	27°06.324'S	155°18.3180'E	0	1224	6	149
Recover EAC_4800 (M6_R)	27°06.324'S	155°18.3180'E	0	1224	10	159
Transit to offshore Triaxus/SADCP line location. Begin Triaxus/SADCP line across mooring line	27°07.850'S	155°04.0000'E	10	1234	1	160
End Triaxus/SADCP line	27°20.000'S	153°55.0000'E	60	1294	12	172
Transit EAC_4200 recovery site (M4_R)	27°15.036'S	154°17.8920'E	30	1324	3	175
CTD @ EAC_4200 (M4_R)	27°15.036'S	154°17.8920'E	0	1324	4	179
Deploy Core Argo Float #3	27°15.036'S	154°17.8920'E	0		0	

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
Transit EAC_4700 recovery site (M5_R)	27°12.498'S	154°38.9580'E	20	1344	2	181
CTD @ EAC_4700 recovery site (M5_R)	27°12.498'S	154°38.9580'E	0	1344	6	187
Begin Transit EAC_4800 deploy site (M6_D)	27°6.1200'S	155°17.9580'E	35	1379	4	191
Deploy EAC_4800 (M6_D)	27°6.1200'S	155°17.9580'E	0	1379	12	203
Transit EAC_4700 recovery site (M5_R)	27°12.498'S	154°38.9580'E	35	1414	2	205
Recovery EAC_4700 (M5_R)	27°12.498'S	154°38.9580'E	0	1414	12	217
Bongo net tows after dusk. Transit to inshore Fraser Island survey region.	24°42.70'S	153°31.50'E	170	1584	18	235
Bongo net tows after dusk. Begin Triaxus/SADCP line	24°42.70'S	153°31.50'E	0	1584	4	239
End Triaxus/SADCP line and recover Triaxus	24°40.0'S	154°35.40'E	35	1619	8	247
Deploy Core Argo Float #4	24°40.0'S	154°35.40'E	0		0	
Transit to EAC_3200 (M3_R)	27°17.076'S	154°08.1960'E	160	1779	18	265

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
recovery site. During transit calibration CTDs of recovered mooring instruments						
CTD @ EAC_3200 (M3_R).	27°17.076'S	154°08.1960'E	0	1779	4	269
Deploy Core Argo Float #5	27°17.076'S	154°08.1960'E	0		0	
Begin Transit to EAC_4700 (M5_D)	27°12.516'S	154°38.8260'E	25	1804	5	274
Deploy EAC_4700 (M5_D)	27°12.516'S	154°38.8260'E	0	1804	12	286
Transit to EAC_4200 (M4_R)	27°15.036'S	154°17.8920'E	20	1824	4	290
Recover EAC_4200 (M4_R)	27°15.036'S	154°17.8920'E	0	1824	8.0	298
Transit to offshore beginning of Triaxus/SADCP line, bongo net tows after dusk.	27°06.10'S	155°15.0000'E	35	1859	4	302
Deploy Core Argo Float #6	27°06.10'S	155°15.0000'E	0		0	
End Triaxus/SADCP line and recover Triaxus.	27°19.51'	153°54.38'E	60	1919	12	314
Transit to EAC_2000 (M2_R) recovery location.	27°18.888'S	153°59.9400'E	10	1929	1	315

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
CTD @ EAC_2000 (M2_R).	27°18.888'S	153°59.9400'E	20	1949	4	319
Transit to EAC_4200 (M4_D) deployment site. During transit calibration CTD of recovered mooring instruments. Bongo net tows after dusk	27°14.99'S	154°17.826'E	35	1984	17	336
Deploy EAC_4200 (M4_D)	27°14.99'S	154°17.8260'E	0	1984	12	348
Transit to EAC_3200 (M3_R) recovery site.	27°17.076'S	154°08.1960'E	20	2004	4	352
Recover EAC_3200 (M3_R)	27°17.076'S	154°08.1960'E	0	2004	10	362
Transit to offshore beginning of Triaxus/SADCP line. Start Triaxus/SADCP line.	27°06.10'S	155°15.0000'E	50	2054	4	366
End SADCP/Triaxus line	27°19.51'	153°54.38'E	60	2114	11	377
Transit to EAC_500 (M1_R) recovery site	27°19.758'S	153°54.0420'E	10	2124	1	378
CTD @ EAC_500 (M1_R)	27°19.758'S	153°54.0420'E	0	2124	3	381

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
Undertake shelf-EAC survey. Actual way points will be determined just prior to the voyage and updated during the voyage based on position of EAC front and eddies in the regions. Calibration CTDs of recovered instruments to be undertaken en route.			200	2324	Approx. 38 hours	419
Transit to EAC_3200 (M3_D) deployment site	27°17.118'S	154°08.1360'E	50	2374	4	423
Deploy EAC_3200 (M3_D)	27°17.118'S	154°08.1360'E	0	2374	8	431
Transit to EAC_2000 (M2_R) recovery site	27°18.888'S	153°59.9400'E	20	2394	2	433
Recover EAC_2000 (M2_R)	27°18.888'S	153°59.9400'E	0	2394	8	441
Transit to EAC_500 (M1_R) recovery site	27°19.758'S	153°54.0420'E	10	2404	1	442
Recover EAC_500 (M1_R)	27°19.758'S	153°54.0420'E	0	2404	5	447
Transit to inshore Triaxus/SADCP site. Bongo nets after dusk. Begin	27°19.51'	153°54.38'E	10	2414	4	451

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
Triaxus/SADCP transect						
Recover Triaxus	27°06.10'S	155°15.0000'E	35	2449	6	457
Transit to EAC_2000 deployment site (M2_D). Calibration CTDs of recovered instruments. Bongo net tows after dusk.	27°18.942'S	154°00.1560'E	60	2509	22	479
Deploy EAC_2000 (M2_D)	27°18.942'S	154°00.1560'E	0	2509	6	485
Transit to EAC_500 deployment site (M1_D)	27°19.62'S	153°53.9580'E	10	2519	1	486
Deploy EAC_500 (M1_D)	27°19.62'S	153°53.9580'E	0	2519	3	489
Transit Transit to EAC_2000 deployment site (M2_D).	27°18.942'S	154°00.1560'E	10	2529	1	490
Transit to EAC_500 deployment site (M1_D)	27°19.62'S	153°53.9580'E	10	2539	1	491
Continue shelf survey. Way points will be determined just prior to the voyage and updated during			100	2639	Approx. 28 hours	519

	Degrees Decimal Minutes Latitude	Degrees Decimal Minutes Latitude	Distance (nm)	Total Distance (nm)	Steaming / CTD/ mooring time (hrs)	Total time (hrs)
the voyage. Calibration CTDs of recovered instruments to be undertaken en route.						
Transit to Pilot station at Caloundra	26°49.728'S	153°08.8800'E	20	2659	2	521
Transit Brisbane	27°29.6'S	153°7.8'E	45	2704	4	525

CTD Configuration

	Please select:
Fundamentals:	
Which CTD rosette to be used for this voyage (24 Niskin bottles or 36):	24
Likely total number of casts:	29 (15 full depth, 15 shallow to support Bongo net tows)
Likely number of salinity samples	273
Likely number of DO samples	246
Likely maximum depth of deepest cast:	5000 m
Lowered ADCP required:	no
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):	yes
• PAR Sensor (Biospherical QCP-2300):	yes
• Transmissometer (Wetlabs C-Star 25cm):	yes
• Fluorometer – Chlorophyll-a (Chelsea Aquatracka III – 430/685nm):	yes
• Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	Yes, if configuration allows, but lower priority than User supplied FLBB sensor
• Nephelometer (Seapoint Turbidity Meter)	yes

• User supplied Wetlabs FLBB 6000m rated sensor (Trull)	yes
Hydrochemistry Analyses:	
• Salinity	yes
• Dissolved Oxygen	yes
• Nutrients: Nitrate	yes
• Nutrients: Phosphate	yes
• Nutrients: Silicate	yes
• Nutrients: Nitrite	yes
• Nutrients: Ammonia (special request after discussion with hydrochemistry)	no

The science party will also undertake carbon sampling from a number of CTD stations. This will include:

1. up to 24 pairs of DIC/Alkalinity samples 12 depths in the top 2000m from 2 casts; 2 L total per depth including rinses;
2. up to 24 pairs of nutrient samples 12 depths in the top 200m;
3. up to 12 pairs of pigment/POM samples 6 depths in top 150m from 2 CTD casts or 3 depths from 4 casts, depending on bottle spacing and biomass profiles; 4-8 L per depth depending on biomass abundance

Time estimates

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

<table>
<tr><th>Date</th><th>Time</th><th>Activity</th></tr>
<tr><td>4-5 May</td><td>0800-1700</td><td>Mobilisation. Transport EAC mooring equipment to dock. The specific working order for the mobilisation day for crane lifts is:
<table>
<tr><th>Task/Equipment</th><th>Weight</th><th>Number of lifts</th><th>Estimated Time (min)</th></tr>
<tr><td>Load Mooring weights x 18</td><td>1.5 T</td><td>18</td><td>120</td></tr>
<tr><td>Load Pallets of SBE37s</td><td>4x425 kg</td><td>1</td><td>60</td></tr>
<tr><td>Land shipping container</td><td>3.5T</td><td>1</td><td>25</td></tr>
<tr><td>Landing open half height container x 2</td><td>4.5T</td><td>2</td><td>60</td></tr>
<tr><td>Load Syntatic floatation sphere with current meters installed x 10</td><td>550 kg</td><td>10</td><td>120</td></tr>
<tr><td>Load Syntatic floatation sphere x 4</td><td>450 kg</td><td>4</td><td>120</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Date</th><th>Time</th><th>Activity</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Load cube rack</td><td>600 kg</td><td>1</td><td>25</td></tr>
<tr><td>Load pallet of releases</td><td>600 kg</td><td>1</td><td>25</td></tr>
<tr><td>Load spoolers x 3</td><td>200 kg</td><td>3</td><td>45</td></tr>
<tr><td>Load Pallet of spools x 3</td><td>350 kg</td><td>3</td><td>45</td></tr>
<tr><td>Load Pallet of Wire/Dynex x2</td><td>3x350kg</td><td>3</td><td>60</td></tr>
<tr><td>Load BGC Argo floats</td><td>32kgx2</td><td>2</td><td>30</td></tr>
<tr><td>Load pallet of core Argo floats</td><td>150kg</td><td>1</td><td>30</td></tr>
<tr><td>Load pallet of XBTs</td><td>150kg</td><td>1</td><td>15</td></tr>
<tr><td>Load pallet misc. science equipment</td><td>200kg</td><td>1</td><td>15</td></tr>
<tr><td></td><td></td><td>Total time (hrs)</td><td>Approx 14 hours</td></tr>
</table>
Full containers will be loaded onto the vessel, as per the deck plan (see figure 2). Syntactic spheres will be loaded onto the deck and moved to storage positions. We will also hand carry on a number of instrument boxes. Instrument will be secured on tables in the dirty wet lab and sheltered science area.
Science crew will unload, store and secure equipment.

Set up back deck and store gear in dirty wet lab. Test all instrument setups.

Test mooring winch is in working order. If required, reorganise back deck. Secure all gear.
</td></tr>
<tr><td>5-7 May</td><td></td><td>Pre voyage medical clearance</td></tr>
<tr><td>08 May (Day 1)</td><td>0800
1100

1400

1500

1800</td><td>Depart Hobart
Pilot disembarks at Storm Bay and begin transit to turn north point at Tasman Island. During Transit, undertake backscatter calibration.
Arrive at Maria Island NRS. Undertake 2x10min Bongo Net tows.

Transit to water deeper than 1000m. Undertake Instrument dip CTD #1

Continue transit north.</td></tr>
</table>

Date	Time	Activity
09 May (Day 2)	2100	Arrive BGC Argo deployment location #1 (38S 150 42). Deploy BCG Argo float #1. Undertake CTD 2 at deployment location (2,250m)
	2400	Continue transit north
10 May (Day 3)	1800	Arrive BGC Argo deployment location #2 (35S 151 24). Deploy BGC Argo float #2. undertake CTD 3 at deployment location (2,250m)
	2100	Continue transit north
11 May (Day 4)	0100	Arrive at Port Hacking NRS. Undertake 2x10min Bongo Net Tows.
	0200	Continue transit north
	0900	Arrive at first inshore Triaxus/SADCP location near Newcastle. Begin 5-hour Triaxus/SADCP tow across the shelf.
	1400	Recover Triaxus.
	1500	Begin transit to next Triaxus/SADCP location
	1900	Arrive 2nd inshore Triaxus/SADCP location near Newcastle. Undertake Instrument dip CTD
	2200	Deploy Core Argo Float #1
	2200	Begin 8-hour Triaxus tow across the shelf.
12 May (Day 5)	0600	Recover Triaxus. Continue transit to 3rd Traixus/SADCP location near Coffs Harbour.
	2300	Arrive Coffs Harbour Triaxus/SADCP. 2x10min Bongo net tows
	2400	Begin 5-hour Triaxus/SADCP tow across the shelf.
13 May (Day 6)	0600	Recover Triaxus. Conduct Instrument dip CTD 3.
	0900	Deploy core Argo float #2
	0900	Continue transit north to EAC_4800 (M6_D) recovery site.
14 May (Day 7)	0200	Arrive at EAC_4800 (M6_R) recovery site and begin CTD 4 at mooring site.

Date	Time	Activity
	0700	Complete CTD and hold mooring toolbox in preparation for mooring recovery.
	0800	Begin mooring recovery operation (M6_R)
	1600	Complete mooring recovery operations. Clean back deck and instruments. Begin transit to offshore Triaxus/SADCP station. 3x10 minute Bongo net tows after dusk
	2000	Begin Triaxus/SADCP transect across mooring line. Begin transit to EAC_4700 (M5_R) recovery site.
	2000-2400	Conduct bongo net toolbox during steam to EAC_4700 (M5_R) Arrive EAC_4700 (M5_R) recovery site.
	2400	Undertake 3 bongo net tows 10 minutes each at completion of CTD. Then 1 h steam and CTD; followed by 3 bongo net tows. Steam to EAC_4700 (M5_R) site
		Begin CTD 2 at EAC_4700 (M5_R). Begin transit to EAC_4200 (M4_R) recovery site.
15 May (Day 8)	0600	Recover Triaxus. Begin transit to EAC_4700 (M5_R) recovery site.
	1200	Arrive EAC_4200 (M4_R). Begin CTD 2 at EAC_4200 (M4_R) recovery site.
	1600	Complete CTD 2 at EAC_4700 (M4_R) recovery site. Begin transit to EAC_4700 (M5_R) recovery site.
	1900-2400	Arrive EAC_4700 (M5_R). Begin CTD 3 at EAC_4700 (M5_R) recovery site. Deploy Core Argo float #3 after CTD.
		During the day the mooring and deck crew will spool-off the recovered EAC_4800 mooring lines and spool-on the EAC_4800 deployment line. They will clean and prepare the deck for the next mooring operation. The science team will begin to download data and clean instruments. Recovered cleaned instruments will be packed and stored.
16 May (Day 9)	0000	Complete CTD at EAC_4700 (M5_R). Begin transit to EAC_4800 (M6_D) deployment site
	0400	

Date	Time	Activity
		Arrive EAC_4800 (M6_D) deployment site. Assess weather conditions and prepare ship for mooring deployment operations.
	0630	Mooring toolbox meeting
	0730	Begin to Deploy EAC_4800 (M6_D)
	1800	Complete mooring deployment operation. Triangulate mooring position.
	2000	Undertake 3 bongo net tows 10 minutes each.
	2400	Begin transit to EAC_4700 (M5_R) site.
17 May (Day 10)	0400	Arrive EAC_4700 (M5_R) site. Assess weather conditions and prepare ship for mooring recovery operations.
	0630	Mooring recovery toolbox meeting
	0730	Begin recovery of EAC_4700 (M5_R)
		Complete recovery of EAC_4700 (M5_R).
	1800	3x10 min bongo net tows.
	2200	Begin transit to inshore Fraser Island survey region.
18 May (Day 11)	1400	Arrive Sandy Cape, Fraser island (24°39.5S,153°27.2E). Begin 3x15 minute Bongo net tows after dusk.
	1800	Deploy Core Argo Float #4
	2000-2200	Deploy Triaxus and begin Triaxus/SADCP line to offshore location (24°26.5S,154°25.8E).
		During the day the mooring and deck crew will spool-off the recovered EAC_4700 mooring lines and spool-on the EAC_4700 deployment line. They will clean and prepare deck for next mooring operation. The science team will begin to download data and clean instruments. Recovered cleaned instruments will be packed and stored.
19 May (Day 12)	0500	Recover Triaxus. Begin transit to EAC_3200 (MR_3) recovery site. During transit perform calibration CTD (CTD 6) of EAC_4800 recovered SBE 37 and 39 instruments

Date	Time	Activity
	2200-2400	Arrive EAC_3200 (M3_R) recovery site. Begin pre-recovery CTD (CTD 7). Deploy Core Argo float #4 after CTD. During the day the mooring and deck crew will continue to spool-off the recovered EAC_4700 mooring lines and spool-on the EAC_4700 deployment line, clean deck and prepare to next mooring operation. Recovered cleaned instruments will be packed and stored.
20 May (Day 13)	0100 0400 0630 0730 1600 - 2200 2200	Complete CTD 7. Begin transit to EAC_4700 (M5_D) deployment location Arrive EAC_4700 (M5_D) deployment location. Assess weather and current conditions and plan vessel setup for mooring operations. Deploy core Argo float #6 Mooring deployment toolbox meeting Begin deployment of EAC_4700 (M5_D) Complete mooring deployment operation. Triangulate mooring position. 3x10 minute bongo net tows upon completion of mooring position triangulation. Transit to EAC_4200 (M4_R) recovery site
21 May (Day 14)	0400 0630 0730 1600 1900 2100-2400	Arrive EAC_4200 (M4_R) recovery site. Assess weather conditions Mooring toolbox meeting Recovery EAC_4200 (M4_R) Complete recovery of mooring Transit to the inshore edge of the Triaxus/SADCP section. Bongo net sampling after dusk. Deploy Triaxus at offshore edge and begin tow to offshore edge.
22 May (Day 15)	0900 1600	Complete Triaxus section. Recover triaxus. Begin transit to EAC_2000 (M2_R) site. Calibration CTD of EAC_4200 recovered SBE 37 and 39 instruments during transit. Arrive EAC_2000 (M2_R) site. Begin prerecovery CTD (CTD 9).

Date	Time	Activity
	1800	Transit to shelf. Bongo net tows after dusk. During the day the mooring and deck crew will spool-off the recovered EAC_4200 mooring lines and spool-on the EAC_3200 deployment line, clean deck and prepare form next mooring operation. Recovered cleaned instruments will be packed and stored. Science team will download data from recovered instruments.
23 May (Day 16)	0400 0630 0730 1600 1800 - 2400	Arrive EAC_4200 (M4_D) deployment site. Assess weather conditions and position the ship. Mooring deployment toolbox meeting Begin deployment of EAC_4200 (M4_D) Complete mooring deployment operation. Triangulate mooring position. Move to EAC_3200 (M3_R) recovery location. Bongo nets and CTD overnight
24 May (Day 17)	0400 0630 0730 1600 2200-2400	Arrive EAC_3200 (EAC3_R) recovery location. Assess weather and current conditions and plan vessel setup for mooring operations. Mooring recovery toolbox Begin recovery of mooring Complete mooring recovery. Transit to offshore edge Triaxus/SADCP line. Bongo nets after dusk Begin Triaxus tow
25 May (Day 18)	0700 0900 1100 1200	End triaxus/SADCP line. Begin transit to EAC_2000 (M2_R) site. Begin pre-recovery CTD at EAC_500 recovery site (M1_R) Complete pre-recovery CTD at EAC_500 recovery site (M1_R) Begin shelf survey. SADCP sections and/or CTDs along the shelf front or shelf eddy. Calibration of CTD EAC_3200 recovered SBE 37 and 39 instruments.

Date	Time	Activity
	1900-2400	Bongo net tows after dusk. During the day the mooring and deck crew will spool-off the recovered EAC_3200 mooring lines and spool-on the EAC_3200 deployment line. They will clean and prepare deck for next mooring operation. The science team will begin to download data and clean instruments. Recovered cleaned instruments will be packed and stored.
26 May (Day 19)	0600 1900	Continue shelf survey. SADCP and CTDs along the shelf. Bongo net tows after dusk During the day the mooring and deck crew will continue spooling on/off work, as well as packing containers and arranging the deck in preparation for demobilisation. Recovered cleaned instruments will be packed and stored.
27 May (Day 20)	0400 0630 0700 1600-2400	Arrive EAC_3200 (M3_D) deployment location. Assess weather and current conditions and plan vessel setup for mooring operations. Mooring deployment toolbox meeting Begin deployment of EAC_3200 (M3_D) Complete mooring deployment operation. Triangulate mooring position. Transit to EAC_2000 (EAC2_R) location.
May 28 (Day 21)	0400 0600 0700 1300 1400 1800	Arrive EAC_2000 (EAC2_R) recovery location. Assess weather and current conditions and plan vessel setup for mooring operations. Mooring recovery toolbox Begin recovery of mooring Complete mooring recovery operation. Move to EAC_500 (EAC1_R) recovery location. Begin recovery of EAC_500 (EAC1_R) Complete mooring recovery. Transit to in-shore end of Triaxus/SADCP along mooring line Deploy triaxus and begin triaxus/SADCP line along the EAC mooring line

Date	Time	Activity
	1830-2400	
29 May (Day 22)	0600	Recover Triaxus.
	1000	Calibration of CTD EAC_2000 and EAC_500 recovered SBE 37 and 39 instruments.
	1200	Continue self-survey with SADCP and CTDs.
	1900	Bongo net tows after dusk.
30 May (Day 23)	0400	Arrive EAC_2000 (MR2_D) deployment location. Assess weather and current conditions and plan vessel setup for mooring operations.
	0630	Mooring deployment toolbox Begin deployment of mooring
	0730	
	1200	Complete mooring deployment operation. Begin transit to EAC_500 (M1_D) deployment location. Mooring deployment toolbox during transit.
	1300	Arrive EAC_500 (M1_D) deployment location. Assess weather and current conditions and plan vessel setup for mooring operations.
	1330	Begin deployment of mooring
	1700	Complete mooring deployment operation. Begin transit to EAC_2000 (M2_D) site. Triangulate mooring position. Transit to EAC_2000 (EAC2_R) location.
	1800-2100	Triangulate mooring position. Begin transit to EAC_500 (M1_D) deployment location.
	2200-2400	Arrive EAC_500 (M1_D) deployment site. Triangulate mooring position.
	2400	Bongo net tows

Date	Time	Activity
31 May-June 2 (Days 24-26)	0800	Continue shelf survey. SADCP/CTDs along shelf. During the day the mooring and deck crew will pack mooring containers and prepare mooring equipment for demobilisation.
June 03 (Day 27)	0200 0800 0900-1700	Arrive pilot station, pick up pilot, begin transit to Brisbane Arrive Brisbane Begin demobilisation. Complete packing of gear, and begin off-loading
June 04 (Day 28)	0600	Continue demobilisation. Off-load containers from vessel to trucks. Hand carry gear off ship. Transport containers to the storage yard.

Deployment of BGC-Argo floats require a CTD cast in water greater than 2000 m. The exact deployment location will be determined during the voyage based on position of the EAC. Prior to the start of a CTD station we will notify the MNF and ASP of the intention to deploy a float.

*** The autonomous XBT system, developed by CSIRO, will be tested during a transit between mooring operations.

Piggy-back projects

Argo Australia

Core Argo Floats Dr Beatriz Pena-Molino (CSIRO)

The international Argo program is the largest coordinated effort to monitor the subsurface oceans (http://www.argo.ucsd.edu/About_Argo.html). Argo is a highly regarded, international program that measures the changing ocean temperature (heat content) and salinity with profiling floats distributed throughout the ocean. Since its inception Australia has been one of the leading partners in the program, deploying and maintaining about 10% of the global array.

Argo Australia is a joint project between CSIRO's Oceans and Atmosphere, the Bureau of Meteorology, the Australian Antarctic Program Partnership (AAPP), Australia's Integrated Marine Observing System (IMOS) and the Royal Australian Navy. CSIRO manages procurement, deployment and data processing and distribution of all Australian floats in collaboration with our domestic and international partners.

We will deploy 3-6 Argo floats during this voyage in waters with a depth greater than 2000m. These floats will be deployed during transit, in between mooring operations, and during the Fraser Island oceanographic survey.

BGC-Argo Floats Dr. Peter Strutton (UTAS)

Biogeochemical-Argo is the extension of the Argo array of profiling floats to include floats that are equipped with biogeochemical sensors for pH, oxygen, nitrate, chlorophyll, suspended particles, and downwelling irradiance. Newly developed sensors now allow profiling floats to also observe biogeochemical properties with sufficient accuracy for climate studies. This extension of Argo will enable an observing system that can determine the seasonal to decadal-scale variability in biological productivity, the supply of essential plant nutrients from deepwaters to the sunlit surface layer, ocean acidification, hypoxia, and ocean uptake of CO2. Biogeochemical-Argo will drive a transformative shift in our ability to observe and predict the effects of climate change on ocean metabolism, carbon uptake, and living marine resource management.

The Australian contribution to global Biogeochemical-Argo is coordinated through the Australia-India Strategic Research Fund (AISRF) Indian Ocean Bio-Argo project and the IMOS Argo-Australia facility.

We will use this voyage to deploy 2 floats in the Tasman Sea during the transit north, with supporting CTD casts to 2,250m depth.

EXpendable Bathythermographs (XBTs) - Rebecca Cowley

XBTs are a small probe dropped over the side of a vessel to measure a profile of temperature as a function time (which is later converted to a profile of temperature as a function of depth). XBTs can be deployed rapidly with minimal equipment and can be deployed from a moving vessel. XBTs form an integral part of the Global Temperature and Salinity Profile (GTSP) program.

During this voyage we will deploy XBTs during the transit from Hobart to the mooring sites. XBTs will be deployed at regular intervals (approximately every 10 nautical miles, or once per hour during steaming at 10 knots). We will not deploy XBTs in marine protected zones. In addition, the autonomous XBT system, developed by CSIRO, will be tested during transit.

Permits

DoE & AFMA permits for biological sampling:

1. DoE permit #: AU-COM2021-505-Suthers, Access to Biological Resources in a Commonwealth Area for Non-Commercial Purposes
2. AFMA permit #: 1004298 Scientific Permit
3. NSW DPI Scientific Collection permit # :P18/0012-1.0

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			
Air Chemistry Lab			
Preservation Lab	x		
Constant Temperature Lab	x		setpoint temperature at coastal SST
Underway Seawater Analysis Laboratory			
GP Wet Lab (Dirty)	x		
GP Wet Lab (Clean)	x		
GP Dry Lab (Clean)	x		
Sheltered Science Area	x		
Observation deck 07 level			
Walk in Freezer			
Blast Freezer			
Ultra-Low Temperature Freezer (-80^{0}C) X2			
Walk in Cool Room	x		
Saltwater ice machine	x		

(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)			Cannot be overstacked
Trace metal rosette and bottles			10-foot container
Modular Hazchem Locker			
Deck incubators			
Stabilised Platform Container			
Clothing container			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		
Lowered ADCP			
Sonardyne USBL System			
Milli-Q System	X		
Laboratory Incubators			
Heavy Duty Electronic Balance (80kg)			
Medium Duty Electronic Balance (15kg/5g resolution)			
Light Duty Electronic Balance (3kg/1g resolution)			
Surface Net (mouth area 1m^2)			500-micron, mesh please

Bongo Net (instrumented with depth and temperature) ring diameter 485mm 0.018m^2	X		500-micron mesh only
Smith Mac grab			
Dissecting Microscopes (x4)	x		number required: all 4

(iv) Specialised laboratory and sampling equipment

Name	Essential	Desirable	Notes/Comments *(These items may require additional MNF support staff)*
TRIAXUS – Underway Profiling CTD	X		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 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.
Desired towing profile:	0-300 m or deeper		0-300 m at 6-8 knots
Additional instrumentation: (Please supply, make and model and datasheets. Also, a contact person for discussion on integration.			
Continuous Plankton Recorder (CPR)			
Deep towed camera			
Piston Coring System			
Gravity Coring System			
Multi Corer			

Kasten Corer			
XBT System			2 per day provided
Trace Metal Rosette and bottles			
Sherman epibenthic sled			
Trace- metal in-situ pumps (x6)			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)			Please specify 335-micron, 500 microns, or 1,000-micron mesh – Not needed
Rock saw			Requires trained science personnel
Portable pot hauler			
Beam Trawl			
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
MIDOC (multiple opening/closing codend system for pelagic trawl)			
Stern Ramp (please select exposed *OR* installed)	**Ramp Exposed**	**Deck covers installed**	
		x	
Trawl monitoring instrumentation (ITI) (2,000m depth limit)			
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		
150kHz ADCP	x		
Multi Beam echo sounder EM122 12kHz (100m to full ocean depth)	x		
Multi Beam echo sounder EM710 70-100kHz (0-1000m approx.)			
Sub-Bottom Profiler SBP120			
Scientific Echo Sounders EK60 (6 bands, 18kHz-333kHz)	x		Turned on when working near the North Stradbroke Island NRS. Turned off when making ship ADCP/Triaxus sections and survey and during mooring work
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)			
Scanning Mobility Particle Sizer (SMPS)			
Radon detector			
Ozone detector			
Condensation Particle Counter (CPC)			
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			

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.			

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 Voyage Operations Manager as required. Additional staff may be required for these activities.
D & N Francis winch			13mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			
EM2040			Shallow water multibeam echosounder system

Appendix B

User Suppled Equipment

Owner	Item Name	Weight	Dimensions	Location on Vessel
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Jamie Derrick	Mooring Weights	1500kg	1.5m x 1.5m x 1.5m	aft main deck
Darren Moore	73x SBE 37s	150kg	1m x 1m x 2.5m	general purpose wet lab - dirty (main)
Darren Moore	35x SBE 39s	100kg	1m x 1m x 2.5m	general purpose wet lab - dirty (main)
Jamie Derrick	2 Open Half Height Container with 266 Glass floats			aft main deck
Darren Moore	8 X Starmon Mini			general purpose wet lab - dirty (main)
Darren Moore	12 Iridium Beacons			general purpose wet lab - dirty (main)
Darren Moore	6 Strobe light			general purpose wet lab - dirty (main)
Darren Moore	12 Edgetech mooring releases			sheltered lab
Darren Moore	28x Nortec Aquadopp	500kg		general purpose wet lab - dirty (main)
Darren Moore/Jamie Derrick	10 ADCP 75 kH			in syntatic floats/ in frame on aft deck
Darren Moore/Jamie Derrick	4 ADCP 150 kHz			in syntatic floats/ in frame on aft deck

Owner	Item Name	Weight	Dimensions	Location on Vessel
Darren Moore/Jamie Derrick	3 ADCP 300 kHs			in frames/ on back deck and in dirty wet lab
Jamie Derrick/Darren Moore	10 Syntatic Floatation Sphere With current Meters Installed			aft main deck
Jamie Derrick	4 Syntatic Floatation Sphere			aft main deck
Jamie Derrick/Darren Moore	7 ADCP frames/with ADCPs install			aft main deck
Bernadette Sloyan	5x Boxes of Science Party Gear	200kg		clean lab/science area
Jamie Derrick	Mooring Winch			aft main deck
Jamie Derrick	Mooring consumable rack unit			Sheltered lab
Jamie Derrick	20 Spools of wire and dynex			main deck
James Derrick	1 Pallet truck			min deck
Tom Trull/Chris Chapman	Wetlabs FLBB Sensor	<1kg		mounted on CTD, To be mounted facing into open ocean, e.g. as previously mounted on INV2019_v02
Bec Cowley	6 Core Argo floats			general purpose wet lab - dirty (main)
Chris Chapman	2 BGC Argo			general purpose wet lab - dirty (main)
Amandine Schaeffer	2 SVP floats	carry on - no hazmats		general purpose wet lab - dirty (main)
Iain Suthers	2 microscopes			clean wet lab
Iain Suthers	8 x 50L Nally bins containing jars and drum for sample storage			Securely stowed in dirty wet lab under and on benches using user supplied materials

Appendix C

Hazardous Materials Manifest

Responsible Person	Hazardous Material Name	Hazardous Material UN Number	Poison Schedule Number	Permit held for Hazardous Material	State or Territory in which Permit is held	Class	Conc.	Quantity: Total	Quantity: Units	Container Size	Location of Use	Location of Storage
Iain Suthers	Ethanol	1170				Class 3 - Flammable Liquid	95%	20	L	20L	Preservation Laboratory	
Iain Suthers	Formaldehyde	2209	S6			Class 8 - Corrosives	37%	20	L	20L	Preservation Laboratory	
Chris Chapman	mercuric chloride saturated aqueous solut	1624	S7	Yes	Tas	Class 6 - Toxic	100%	100	mL	50mL plastic	Underway Seawater Laboratory	GP Wet Laboratory - Clean
Chris Chapman	Argo floats: lithium batteries contained in equipment or packed with equipment	3091				Class 8 - Corrosives		6 to 8	units	Internal to floats	Sheltered Science Area & Deck Workshop	GP Wet Laboratory - Dirty
Chris Chapman	TBTO anti-foul device	see SDS				Other - specify in notes	53%	12	units	Internal to floats	Sheltered Science Area & Deck Workshop	GP Wet Laboratory - Dirty
Darren Moore	isopropyl alcohol	1219				Class 3 - Flammable Liquid	70%	1	L	1L	GP Wet Laboratory - Dirty	GP Wet Laboratory - Dirty
Darren Moore	Various and numerous lithium batteries	3090/3091				Class 8 - Corrosives		950	AA	5L Plastic	GP Wet Laboratory - Dirty	GP Wet Laboratory - Dirty

Responsible Person	Hazardous Material Name	Hazardous Material UN Number	Poison Schedule Number	Permit held for Hazardous Material	State or Territory in which Permit is held	Class	Conc.	Quantity: Total	Quantity: Units	Container Size	Location of Use	Location of Storage
Darren Moore	Octyl Phenol Ethoxylate	4425	N/A			Class 6 - Toxic		1	L	1L	GP Wet Laboratory - Dirty	GP Wet Laboratory - Dirty
Darren Moore	TBT anti-foul device							146	pairs	internal to CTD	GP Wet Laboratory - Dirty	GP Wet Laboratory - Dirty