RV *Investigator* Voyage Plan

Voyage #:	IN2022_V06		
Voyage title:	Integrated Marine Observing System: monitoring of East Australian Current property transports at 27° S		
Mobilisation:	Wagners Wharf, Pinkenba (Brisbane) Friday, 8 July 2022		
Quarantine and Pre-medical clearance period:	Brisbane, Monday, 4 to Monday, 11 July 2022 (inclusive)		
Continuation of mobilisation and pre-departure medical clearance period:	Tuesday, 12 to Wednesday, 13 July 2022 (inclusive)		
Depart:	Wagners Wharf, Pinkenba (Brisbane) Thursday, 14 July 2022		
Return:	Wagners Wharf, Pinkenba (Brisbane) 08:00 Saturday, 30 July 2022		
Demobilisation:	Wagners Wharf, Pinkenba (Brisbane) Saturday, 30 July 2022		
Voyage Delivery Coordinator:	Linda Gaskell	**Contact details:**	linda.gaskell@csiro.au
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Affiliation:	CSIRO	**Contact details:**	chris.chapman@csiro.au
Principal Investigators:	Amandine Schaeffer (UNSW)		
Project name:	Integrated Marine Observing System: monitoring of East Australian Current property transports at 27° S		
Affiliation:	UNSW	**Contact details:**	a.schaeffer@unsw.edu.au

Scientific objectives

The East Australian Current (EAC) is a complex and highly energetic western boundary system of the South Pacific Ocean off eastern Australia. It closes the South Pacific subtropical gyre, transporting heat, salt and plankton southward and onto the continental shelf. Off Brisbane (27°S) the EAC is north of the high eddy variability region, approaches its maximum strength and is relatively uniform and coherent. 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 basin-scale South Pacific gyre. The mooring array will provide a physical context for the impact of the EAC on upwelling and 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 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.

We will undertake biological and oceanographic sampling, using CTDs, Triaxus tows, SADCP, to characterise the shelf waters off the Stradbroke NRS, and to sample dynamic, ephemeral frontal eddies flowing down from Fraser Island and shelf – boundary exchanges. These observations will enable us to discover the spatial and temporal variability of shelf water and plankton around the Stradbroke Island National Reference Station (NRS) mooring (Canyon monitoring).

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/0_2 and nutrient samples, numerous Triaxus and ship ADCP sections across the EAC mooring line and across the shelf-EAC. These surveys will includeTriaxus/SADCP lines in the area between 28°S and 26°S. These operations will occur in between the mooring operations and at the completion of the mooring operations. We will deploy 2 Standard Argo floats during the voyage.

Should time allow, we will conduct hydrographic survey of a “superproductive” Richcmond submarine canyon between the Gold Coast and Byron Bay. Will will undertake a long sub-bottom profiler section in this region in order to identify future coring sites for paleoclimate studies.

We will use the 36-bottle rosette with the lowered ADCPs (150 kHz and 300 kHz) attached. We will collect salinity and oxygen samples for calibration of the CTD salinity and oxygen sensors, as well as for calibration and quality control of recovered mooring instruments. We will also collect nutrient (silicate, phosphate and nitrate) and carbon samples. Although we use the 36 bottle rosette, only 18 niskin bottles will be required. Removing one in two bottles will enable us to fix brackets for the post-recovery “dips’ of recovered instruments (as in previous mooring voyage IN2021_V03).

The following specific objectives will be completed:

1. Recover moorings at appropriate locations;
2. CTD/rosette stations at each mooring location, with LADCP;
3. Calibration CTD cast of recovered Seabird 37 and 39 instruments;
4. Triaxus and Ship ADCP sections along the mooring line and across the EAC;
5. SADCP/Triaxus across the shelf, slope and into the EAC frontal region;
6. CTD and bio-acoustic sampling surrounding the Stradbroke NRS site including opportunistic sampling of frontal eddies;
7. Deploy 2 Standard Argo floats during the voyage;
8. Conduct a detailed CTD sampling;
9. Opportunistic deployment of XBTs.

	EAC_500 (M1)	EAC_2000 (M2)	EAC_3200 (M3)	EAC_4200 (M4)	EAC_4700 (M5)	EAC_4800 (M6)
Longitude	153.90 (153° 53.54'E)	154.002 (154° 0.1362' E)	154.134 (154o 8.0862' E)	154.286 (154° 17.183' E)	154.639 (154° 38.336' E)	155.30230 (155°18.13'E)
Latitude	-27.3256 (27° 19.53' S)	-27.3160 (27° 18.76'S)	-27.281 (27° 16.86'S)	-27.244 (27° 14.69' S)	-27.202 (27° 12.09' S)	-27.1026 (27° 6.15'S)
Depth	540	1908	3161	4292-10	4779	4790

Table 1. Location of moorings to be recovered.

	Latitude	Longitude
In-shore	-27.33 (27° 19.8' S)	153.8 (153° 48' E)
Off-shore	-27.10 (27° 6'S)	155.35 (155° 21' E)

Table 3. On-shore and off-shore locations of SADCP/Triaxus line 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° 0'S)	153.75 (153° 45'E)
Southeast limit	-27.9 (27° 54'S)	154.25 (154° 15'E)
Northeast limit	-27.0 (27° 0'S)	154.75 (154° 15'E)
Northwest limit	-27.0 (27° 0'S)	153.50 (153° 30'E)

Table 5. Approximate area of -EAC SADCP/Triaxus survey

	Latitude	Longitude
Southwest limit	28° 16.43' S	153° 59.62' E
Southeast limit	28° 53.14' S	154° 32.01' E
Northeast limit	28° 17.06' S	153° 49.09' E
Northwest limit	28° 16.43' S	153° 47.21' E

Table 6. Approximate area of –Richmond Canyon survey region

Voyage Specific Risk Assessment

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

Activity plan for first 24-48 hours of voyage

The general plan is a staged recovery of the six EAC moorings along the mooring deployment line. We will undertake a CTD station prior to the recovery of each mooring. We will undertake at approximately 35-40 CTD stations on the voyage. We will also complete a number of Triaxus and ship ADCP sections along the mooring line during the voyage and complete a closed box survey once mooring operations have been completed.

First 24 hours

Steam from Wagners Wharf, Pinkenba (Brisbane), to pilot station and then steam directly to the location of the first mooring operation, EAC_4800 recovery site (M6_R). During the transit to the mooring recovery site we will undertake a rehearsal of mooring operations (for example syntactic sphere movements and lifts), 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 precdures by Hydrochemistry staff. We will also continue to setup the deck, mooring gear and instruments. We will undertake a CTD station at the location of EAC_4800 recover site (M6_R) prior to beginning our first mooring recovery operation.

Voyage track example

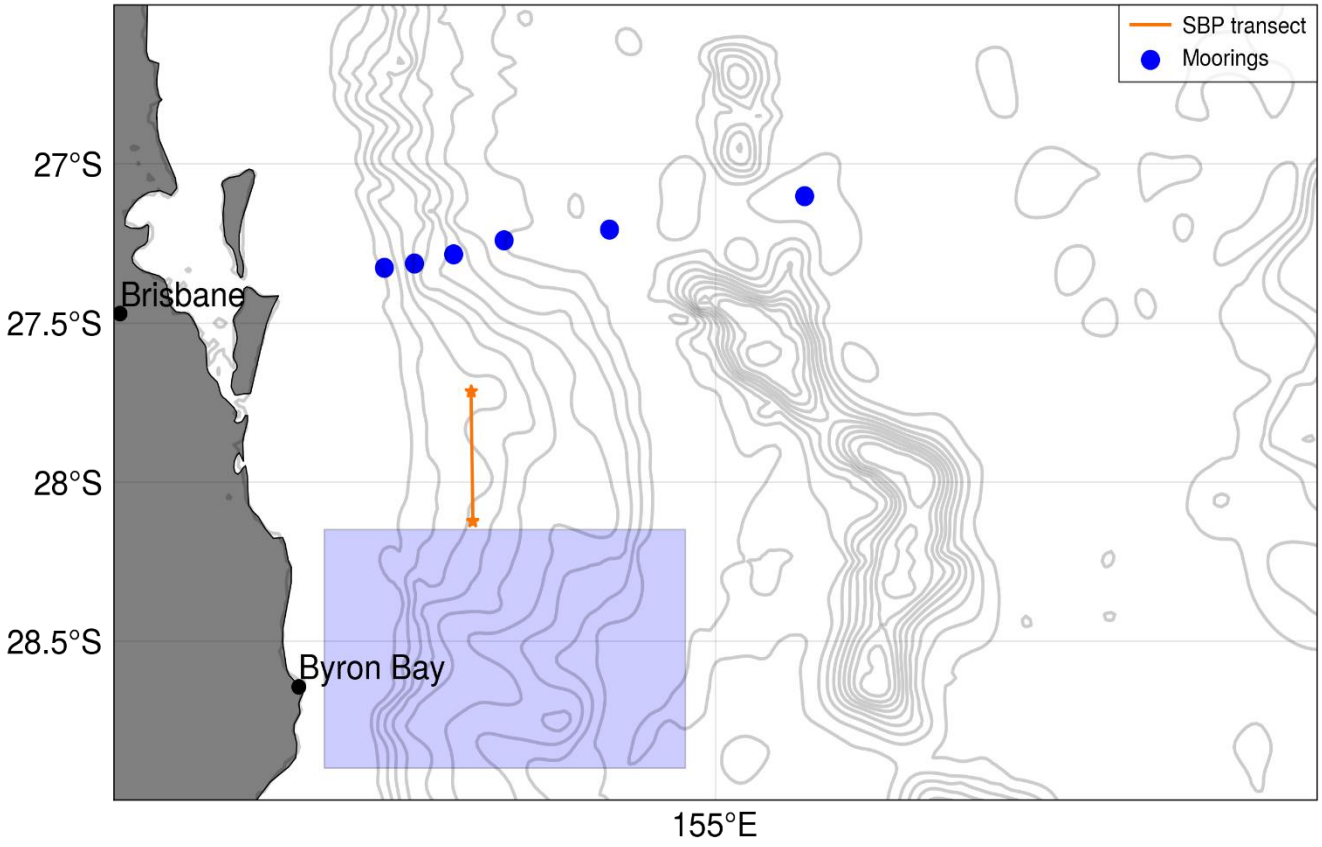

Figure 1: Voyage track including location of moorings. Blue region indicates the location of the Richmond Canyon region. Orange line indicates the sub-bottom profiler transect.

Waypoints and stations

List of major operations; mooring operations (recovery), full depth CTD stations, ship ADCP/Triaxus line, and shelf-slope survey. 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. Triaxus/SADCP and SADCP sections will be undertaken between mooring operations, and Triaxus operations will be between 1800-0600 hours to ensure no one is working below the live tow-wire.

Plan for science between mooring operations

We have planned for two primary scientific activities between mooring operations. **These activities will only be performed if time allows and are of secondary priority to the mooring operations.**

The first activity will be a set closely spaced Triaxus tows across the EAC to perform a detailed investigation of the dynamics of the EAC as it evolves in space and time. 4-5 Triaxus tows across, each of approximately 25nm length, with between 3-5miles between tows (see Fig. 2). This activity will occur overnight during the in between mooring operations. The Triaxus tows will be undertaken in the vicinity of the mooring array (with sufficient clearance from the moorings themselves) to reduce transit times to a minimum.

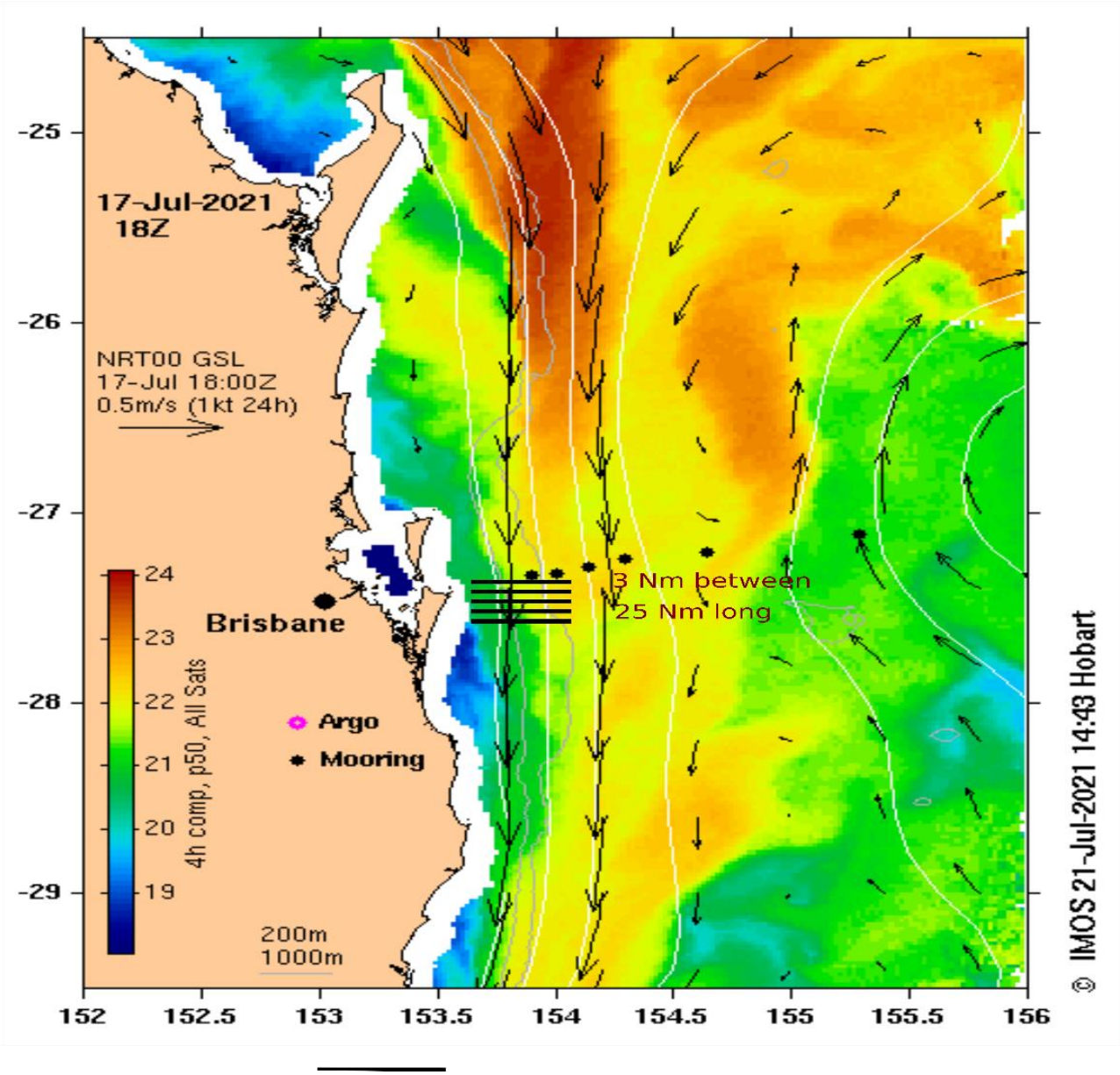

Figure 2: Proposed Triaxus tows

The second activity will occur either at the conclusion of mooring operations, or in-between mooring operations or during day-time “deck days” required by the mooring team to remove mooring equipment from the winch and store correctly. This activity will be a CTD/LADCP survey of the nearby Richmond submarine canyon, that has been identified as harboring significant potential for cross-shelf exchange of water. These canyons will be the focus of an approved upcoming voyage in 2024, and this preliminary canyon survey will provide data to inform the planning of that voyage.

An example sampling plan for this activity is shown in Fig. 3 below.

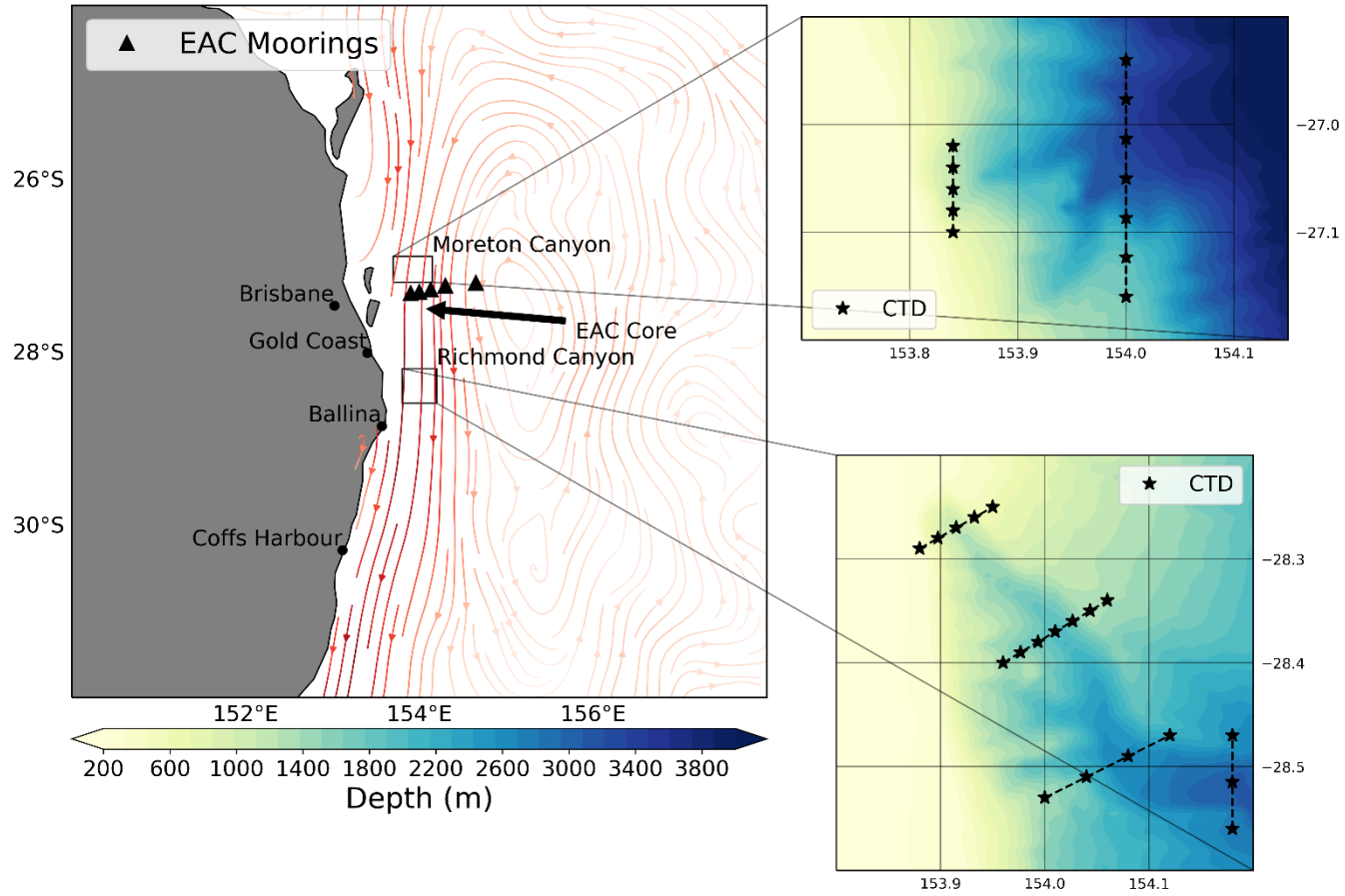

Figure 3: Proposed CTD/LADCP sampling plan

Site	DDM Latitude	DDM Longitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total Steam (hrs)
Brisbane	27°29.6'S	153°7.8'E	0	0	0	0
Coloundra Pilot Station	26°49.728'S	153°08.88'E	45.0	45	6	6
MNF Test CTD @ 1,000m	25°25.1'S	153°50.12'E	40	85	4	10
Transit to EAC_4800 recovery site (M6_R)	27°6.15'S	155°18.13'E	75	160	8	18
CTD @ EAC_4800 (M6_R)	27°6.15'S	155°18.13'E	0	160	4	22
Recover EAC_4800 (M6_R)	27°6.15'S	155°18.13'E	0	160	8	30
Transit EAC_4700 recovery site (M5_R)	27°12.09' S	154° 38.336' E	35		4	34
CTD @ EAC_4700 (M5_R)	27°12.09' S	154° 38.336' E	0		4	38
Transit EAC_4200 recovery site (M4_R)	27° 14.69' S	154° 17.183' E	19		2	40
CTD @ EAC_4200 recovery site (M4_R)	27° 14.69' S	154° 17.183' E	0		3	43
Transit EAC_3200 recovery site (M3_R)	27°16.86'S	154° 8.0862' E	8		1	45

Site	DDM Latitude	DDM Longitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total Steam (hrs)
CTD @ EAC_3200 recovery site (M3_R)	27°16.86'S	154° 8.0862' E	0		3	
Transit EAC_2000 recovery site (M2_R)	27°18.76'S	154° 0.1362' E	7		1	
CTD @ EAC_2000 recovery site (M2_R)	27°18.76'S	154° 0.1362' E	0		2	
Transit EAC_500 recovery site (M1_R)	27 ° 19.53' S	153° 53.54'E	5		0.5	
CTD @ EAC_500 recovery site (M1_R)	27 ° 19.53' S	153° 53.54'E			1	
Transit EAC_4700 recovery site (M5_R)	27 °12.09' S	154° 38.336' E	41		4	
Recovery EAC_4700 (M5_R)	27 °12.09' S	154° 38.336' E	0		11.0	53
Transit to offshore beginning of Triaxus/SADCP line (#1) and begin SACP line	27°07.850'S	155°10.0'E	30		3.0	56
End Triaxus/SADCP line (#1)	27°20.000'S	153°55.0'E	60		12	68
Transit EAC_4200 recovery site (M4_R)	27 ° 14.69' S	154° 17.183' E	25		3	
Dip CTDs #1 and #2	27 ° 14.69' S	154° 17.183' E	0		6	
Recovery EAC_4200 (M4_R)	27 ° 14.69' S	154° 17.183' E	0		11	
Transit to EAC Triaxus survey CTD location #1. Begin Triaxus/ADCP line (#2)	TBA				2	
End Triaxus/SADCP line (#2)	TBA				9	
Transit to EAC Triaxus survey CTD location #2. Begin Triaxus/ADCP line (#3)	TBA				12	
End Triaxus/SADCP line (#3)	TBA				12	
Dip CTD #3	TBA				4	
Transit to EAC Triaxus survey CTD location #3. Begin Triaxus/ADCP line (#4)	TBA				0	
End Triaxus/SADCP line (#4)	TBA				10	
Transit EAC_3200 recovery site (M3_R)	27°16.86'S	154° 8.0862' E	30		3	
Recovery EAC_3200 (M3_R)	27°16.86'S	154° 8.0862' E	0		8	

Site	DDM Latitude	DDM Longitude	Distance (nm)	Total Distance (nm)	Steaming/ CTD/ mooring time (hrs)	Total Steam (hrs)
Dip CTD #4	TBA				4	
Transit EAC_2000 recovery site (M2_R)	27°18.76'S	154° 0.1362' E				
Recovery EAC_2000 (M2_R)	27°18.76'S	154° 0.1362' E			4	
Transit EAC_500 recovery site (M1_R)	27 ° 19.53' S	153° 53.54'E			1	
Recovery EAC_500 (M1_R)	27 ° 19.53' S	153° 53.54'E			3	
Transit start "bulge" SBP line. Commence line	27 ° 30.' S	154° 03.4	13		2	
End "bulge" SBP line	28° 22.07' S	153° 4.06'E	50		5	

CTD Configuration (delete this section if not intended to be used)

	Please select:
Fundamentals:	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	36
Likely total number of casts:	35-40
Likely maximum depth of deepest cast:	4800
Lowered ADCP required:	Yes
Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):	
2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	Yes
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):	
Fluorometer – CDOM (Wetlabs FLCDOM – 370/460nm)	
Nephelometer (Seapoint Turbidity Meter)	
ECO-Triplet (Chlorophyll-a, CDOM & backscatter – maximum depth 2000m)	Yes
Hydrochemistry Analyses:	
Salinity	Yes
Dissolved Oxygen	Yes
Nutrients: Nitrate	Yes
Nutrients: Phosphate	Yes

	Please select:
Nutrients: Silicate	Yes
Nutrients: Nitrite	Yes
Nutrients: Ammonia	Yes

Time estimates

<table>
<tr><th>Date</th><th>Time</th><th>Activity</th></tr>
<tr><td colspan="3">ONSHORE</td></tr>
<tr><td>Mobilisation
(Fri 8 July)</td><td>0800-1700</td><td>Transport EAC mooring equipment for shipyard. 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>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>Land shipping container</td><td>2.4T</td><td>1</td><td>25</td></tr>
<tr><td>Load cube rack</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></td><td></td><td>Total time (hrs)</td><td>Approx. 8 hours</td></tr>
</table>
Full containers will be loaded onto the vessel. 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.</td></tr>
<tr><td>Quarantine (Mon 4 – Mon 11 July)</td><td></td><td>Onshore quarantine period</td></tr>
<tr><td>Pre-departure medical clearance
(Tue 12 - Wed 13 July)</td><td></td><td>Board RVI and undertake pre-departure medical clearance</td></tr>
</table>

Date	Time	Activity	
AT SEA			
Day 1 (Thu 14 July)	0800 1400	Depart Brisbane Offload pilot at Coloundra and begin transit EAC_4800 (M6_R).	
	1600	During transit undertake a rehearsal of mooring operations and test CTD (water depth >2000 m) and deck rehearsal	
Day 2 (Fri 15 July)	0200	Arrive at EAC_4800 (M6_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry) at mooring site *(salts samples only on CTD instrument dips)*	
	0700	Complete CTD station and hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	0730	Begin mooring recovery operation (M6_R)	~8.5 hrs
	1600	Complete mooring recovery operations. Clean back deck and instruments. Begin transit to EAC_4700 (M5_R) recovery site	
	2000	Arrive at EAC_4700 (M5_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry) at mooring site	
Day 3 (Sat 16 July)	0300	Complete CTD station. Transit to EAC_4200 (M4_R)	
	0500	Arrive at EAC_4200 (M4_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry)at mooring site	
	0900	Complete CTD station. Work on beck deck to remove recovered moorings and prepare for next recovery. Begin transit to EAC_3200 recovery (M3_R) site	
	1000	Arrive EAC_3200 (M3_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry) at mooring site	
	1400	Complete CTD station. Begin transit to EAC_2000 (M2_R) recovery site	
	1500	Arrive EAC_2000 (M2_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry) at mooring site	
	1800	Complete CTD station. Begin transit to EAC_500 (M1_R) recovery site	
	1900	Arrive EAC_500 (M1_R) recovery site and begin pre-recovery CTD to full depth (~10-15m off bottom depending on bathymetry) at mooring site	
	2000	Complete CTD station. Begin transit to EAC_4700 (M5_R) recovery site	

Date	Time	Activity	
Day 4 (Sun 17 July)	0300	Arrive EAC_4700 (M5_R) recovery site. Assess conditions for recovery	
	0700	Hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	0730	Begin mooring recovery operation EAC_4700 (M5_R)	~8.5 hrs
	1600	Complete mooring recovery operations. Clean back deck and instruments. Begin transit to offshore Triaxus location.	
	2000	Deploy Triaxus (to ~350 depth) and begin tow to inshore edge	
Day 5 (Mon 18 July)	0600	Recover Triaxus. Begin transit to offshore. Work on back deck to remove recovered moorings and prepare for next recovery	
	1000	In water >2000m instrument dip CTD #1 and #2	
	1300	Complete CTD. Begin transit to EAC_4200 (M4_R)	
	1700	Arrive EAC_4200 (M4_R) recovery site. Assess conditions for recovery	
Day 6 (Tues 19 July)	0700	Hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	0730	Begin mooring recovery operation EAC_4200 (M4_R)	~8.5 hrs
	1600	Complete mooring recovery operations. Clean back deck and instruments. Begin transit to EAC Triaxus survey location	
	2200	Deploy Triaxus (#1) (to ~350 depth) for part 1 of EAC Triaxus survey *(nutrients required)*	
Day 7 (Wed 20 July)	0700	Recover Triaxus (#1). Work on back deck to remove recovered moorings and prepare for next recovery	
	1300	Complete CTD. Transit to part 2 of EAC Triaxus survey	
	2000	Deploy Triaxus (#2) (to ~350 depth) for part 2 of EAC Triaxus survey	
Day 8 (Thur 21 July)	0600	Recover Triaxus (#2). Work on back deck to remove recovered moorings and prepare for next recovery	
	1000	In water > 2000m deep, instrument dip CTD #3	
	1300	Complete CTD. Transit to part 3 of EAC Triaxus survey	
	1800	Deploy Triaxus (#3) (to ~350 depth) for part 3 of EAC Triaxus survey	

Date	Time	Activity	
Day 9 (Fri 22 July)	0300	Recover Triaxus (#3). Transit to EAC_3200 (M3_R) recovery site	
	0500	Arrive EAC_3200 (M4_R) recovery site. Assess conditions for recovery	
	0700	Hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	0730	Begin mooring recovery operation EAC_3200 (M3_R)	~8.5 hrs
	1600	Complete mooring recovery operations. Clean back deck and instruments	
	2100	Deploy Triaxus (#4) (to ~350 depth) for part 4 of EAC Triaxus survey	
Day 10 (Sat 23 July)	0700	Recover Triaxus (#4). Work on back deck to remove recovered moorings and prepare for next recovery. Begin transit to EAC_2000R (M2_R) recovery site	
Day 11 (Sun 24 July)	0500	Arrive EAC_2000 (M2_R) site, assess conditions for recovery	
	0700	Hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	0730	Begin mooring recovery operation EAC_2000 (M2_R)	~4.5 hrs
	1200	Complete mooring recovery operation EAC_2000 (M2_R). Begin Transit to EAC_500 (M1_R)	
	1300	Hold the mooring toolbox in preparation for mooring recovery. GO/NO GO	
	1400	Begin mooring recovery operation EAC_500 (M1_R)	~2 hrs
	1600	Complete mooring recovery operations EAC_500 (M1_R). Begin transit to start of “Bulge” SBP line	
	1800	Arrive start of the “bulge” SBP line. Begin SBP line	
	2400	Finish “bulge” SBP line. Transit to Richmond Canyon survey region	
	0200	Begin Richmond Canyon CTD/LADCP *(Richmond Canyon CTD depths range from 400m-4,000m)*	
Day 12 (Mon 25 July)	0700	Continue Richmond Canyon CTD/LADCP survey During the day the mooring and deck crew will pack mooring containers and prepare mooring equipment for demobilisation	
Day 13 (Tue 26 July)	0700	Continue Richmond Canyon CTD/LADCP survey	
Day 14 (Wed 27 July)	0700	Continue Richmond Canyon CTD/ LADCP survey	

Date	Time	Activity	
Day 15 (Thur 28 July)	0700	Continue Richmond Canyon CTD/ LADCP survey	
Day 16 (Fri 29 July)	2000	Complete Richmond Canyon CTD/ LADCP survey. Begin transit to pilot station	
Day 17 (Sat 30 July)	0200	Arrive pilot station Coloundra, pick up pilot, begin transit to Brisbane	
	0800	Arrive Brisbane	
	0900	Begin demobilisation. Complete packing of gear, and begin off-loading	

Piggyback projects

Sub-bottom profiling of the South-East Queensland Bulge - Dr. Helen Bostock, University of Queensland)

In this project, we will collect a series of Sub-bottom Profiles (SBP) over the south-east Queensland "bulge" area to identify possible future coring spots. The SBP mapping of the area would aim to clearly identify regions for future coring, with an aim to target a region with deep sediment layers.

Argo Australia Core Argo Floats - Dr Peter Oke (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 2 Standard Argo floats during this voyage in waters with a depth greater than 2000m. These floats will be deployed after CTD operations with the vessel steaming at 1-2 kts.

Permits

All planned voyage objectives fall within the activities covered by permits already held by the MNF. No activities are planned within Marine Protected Areas.

List of additional figures and documents

Appendix A MNF Equipment

Appendix B User Supplied Equipment

Appendix A - Scientific equipment and facilities provided by the Marine National Facility

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

Standard laboratories and facilities		
Name	**Required**	**Notes/Comments**
Aerosol Sampling Lab		• Please indicate the intended activity in this lab
Air Chemistry Lab		• Please indicate the intended activity in this lab
Preservation Lab		• Please indicate the intended activity in this lab
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)		• Please indicate the intended activity in this lab • Please indicate the required setpoint temperature
Underway Seawater Analysis Laboratory	X	• Please indicate the intended activity in this lab
GP Wet Lab (Dirty)	X	• Please indicate the intended activity in this lab
GP Wet Lab (Clean)		• Please indicate the intended activity in this lab
Sheltered Science Area	X	• Please indicate the intended activity in this area
Observation Deck 07 Level		• Please indicate the intended activity in this area
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m^3		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Clean Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >2.5m^3		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature

Standard laboratories and facilities		
Name	**Required**	**Notes/Comments**
Co-located within the Internal freezer and separated by a door		
Blast Freezer (Dirty Wet lab) (Min temp -30°C / Max temp 0°C) Internal volume >1.5m^3 Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Cool Room (Dirty Wet lab) (Min temp 0°C / Max temp 10°C)		• Please indicate the intended activity in this area • Please indicate the required setpoint temperature
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80°C / Max temp -80°C)		• Please indicate the intended activity in this area
YODA Freezers (x2) (Clean Dry lab) (Min temp -20°C / Max temp 10°C)		• Please specify if both or only one are needed • Please indicate the intended activity in this area • Please indicate the required setpoint temperature

Mobile laboratory and facilities *(may require additional support)*			
Name	**Essential**	**Desirable**	**Notes/Comments**
Modular Isotope Laboratory			If nominated, additional processes to be completed.
Trace Metal Niskin Sampling Container (TM1-blue - 20ft)			• Used for the determination of trace metal concentrations. It is a clean laboratory containing laminar flow cabinets and is stored on the main deck (if possible).
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			• Used for wet sampling of trace metal clean Niskins and is stored on the main deck (if possible). • Cannot be overstacked
Trace Metal Rosette and Niskin Storage Container			10-foot container
Modular Hazchem Locker			
Stabilised Platform Container			Please indicate what instruments are to be installed in the container Cannot be overstacked
Clothing Container	N/A	N/A	The use of this container will be identified by MNF

Standard sampling equipment			
Name	**Essential**	**Desirable**	**Notes/Comments**
CTD - Seabird 911 with 36 Bottle Rosette	X		
CTD - Seabird 911 with 24 Bottle Rosette			
Lowered ADCP	X		
Continuous Plankton Recorder (CPR)			*note: Use of this item must be flagged with the relevant CSIRO Oceans & Atmosphere team responsible for CPR cassette preparation and sample processing. Please discuss your planned CPR use with your VOM, who will assist in liaising with the CPR team.

Specialised sampling equipment			
Name	**Essential**	**Desirable**	**Notes/Comments** **(these items may require additional MNF support staff)**
TRIAXUS – Underway Profiling CTD	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 the surface to 200m) are possible. Towing speed depends on the tow profile, instrumentation payload and prevailing conditions. Typically, undulations from the surface to 200m are possible at 8knt, with slower speeds for deeper profiles and faster for constant-depth towing. Maximum achievable depth typically 300m to a distance of approximately 1.5km from the ship. Triaxus is normally configured with the following sensors as a minimum: • Dual temperature, conductivity and dissolved oxygen (SBE9plus and dual pumped temperature/conductivity/dissolved oxygen circuits) • PAR • Chlorophyll-A, CDROM, optical backscatter (Eco-triplet) • Plankton counter (Laser Optical Plankton Counter) • Transmissometer Contact MNF for further details on other instrumentation and capability.
Desired towing profile:	0-300 m or deeper		0-350m at 6-8 knots
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			
Piston Coring System			
Gravity Coring System			
Multi Corer			
Kasten Corer			

Specialised sampling equipment			
Name	**Essential**	**Desirable**	**Notes/Comments (these items may require additional MNF support staff)**
Smith Mac Grab			
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer			
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:			
XBT System		X	2 per day provided
Valeport Rapid SV			
Valeport Rapid CTD		X	
Valeport SVX2			
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			• See non-MNF owned section below for additional 2 units. • Science team to organise and pay for battery packs for this system (+ spare). • They can be sourced through a supplier such as 'Batteryworld Hobart' (Graham Cowie, 03 6272 3900) who has made these previously. • The science teams need to calculate how long they will be deployed and bring enough batteries to cover their deployment times. They are rated to 30 Amp hours, which equals to 36,000 litres of sea water being filtered.
Deep Towed Camera			

Specialised sampling equipment			
Name	**Essential**	**Desirable**	**Notes/Comments (these items may require additional MNF support staff)**
Drop Camera			
Sherman Epibenthic Sled			Stern ramp must be removed to operate this system.
Brenke Sled			
Hydro-Bios MultiNet (Mammoth) (1m x 1m) (has replaced the EZ net)			Please specify 100-micron, 335-micron, or 500-micron mesh Can be used in a vertical or horizontal operations
Surface Net (1m x 1m)			Please specify 335-micron, 500-micron, or 1,000-micron mesh
Bongo Net 485mm diameter			500 micron mesh only
Beam Trawl			
MIDOC			Multiple opening/closing net system with cod ends- suitable for pelagic trawls
Pelagic Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
Demersal Trawl System (net, doors)			Contact MNF to discuss net and mesh dimensions
RMT-8 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			8m2 mouth area Tow speed ≤2 knots
RMT-16 (Rectangular Midwater Trawl) Utilises a single warp so can be deployed on the general-purpose towing wire in self-contained mode. Must be deployed with stern ramp covered.			16m2 mouth area Tow speed ≤2 knots
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			MNF to identify this need, dependent on pelagic or demersal trawling requirement
Stern ramp		**Installed**	

Research support infrastructure			
Name	**Essential**	**Desirable**	**Notes/Comments**
Salt Water Ice Machine (Dirty Wet lab)			
Radiosonde Receiver System			
Laboratory Incubators (Clean Dry lab)			
Deck Incubators			Temperature controlled deck incubators
Milli-Q System			
Sonardyne USBL System			

Scientific / sample analysis systems				
Microscopes:				**Notes/Comments**
BRAND / MODEL	**TYPE**	**Essential**	**Desirable**	Refer to the “MNF microscopes procedure” for more information
Leica / M80	Dissecting			
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			
Heavy Duty Electronic Balance (80kg)				

Scientific / sample analysis systems			
Microscopes:			**Notes/Comments**
Medium Duty Electronic Balance (15kg/5g resolution)			
Light Duty Electronic Balance (3kg/1g resolution)			

Underway systems

Acoustic Underway Systems			
Name	**Essential**	**Desirable**	**Notes/Comments**
75kHz ADCP	X		
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	X		
Scientific Narrowband Echo Sounders EK60 (6 bands, 18kHz-333kHz)			EK60s will be onboard for use as a backup for EK80s and set in narrowband mode Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)			EK80s will be used in narrowband mode unless otherwise requested Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			

Acoustic Underway Systems			
Name	**Essential**	**Desirable**	**Notes/Comments**
Omnidirectional Echo Sounder SH90			This system is unavailable until 2023 (date TBD)
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			
Fluorometer			
Optode			

Underway Seawater Systems and Instrumentation			
Name	**Essential**	**Desirable**	**Notes/Comments**
pCO2			

Seawater systems			
Name	**Essential**	**Desirable**	**Notes/Comments**
Trace metal clean seawater supply			
Scientific clean seawater supplied to laboratories			
Raw seawater available on deck and in laboratories			

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			

Non-MNF owned equipment which may be accessed			
Name	**Essential**	**Desirable**	**Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with your Voyage Operations Manager as required. Additional staff may be required for these activities.**
D & N Francis winch			15mm electro-optical cable
Box Corer			
UTAS In-Situ Pumps (x2)			

Non-MNF owned equipment which may be accessed			
Name	**Essential**	**Desirable**	**Please give this careful consideration, as there is no guarantee that these resources will be available unless specifically requested. Liaise with your Voyage Operations Manager as required. Additional staff may be required for these activities.**
EM2040			Shallow water multibeam echosounder system

Appendix B - User Supplied Equipment

Item Name	Weight	Dimensions	Location on Vessel
73x SBE 37s	150kg	1m x 1m x 2.5m	general purpose wet lab - dirty (main)
35x SBE 39s	100kg	1m x 1m x 2.5m	general purpose wet lab - dirty (main)
8 X Starmon Mini			general purpose wet lab - dirty (main)
12 Iridium Beacons			general purpose wet lab - dirty (main)
6 Strobe light			general purpose wet lab - dirty (main)
12 Edgetech mooring releases			sheltered lab
266 Glass floats			in half heigh container and some secured on main deck
28x Nortec Aquadopp	500kg		general purpose wet lab - dirty (main)
10 ADCP 75 kH			in syntatic floats/ in frame on back deck
4 ADCP 150 kHz			in syntatic floats/ in frame on back deck
3 ADCP 300 kHs			in frames/ on back deck and in dirty wet lab
10 Syntatic Floatation Sphere With current Meters Installed			aft main deck
4 Syntatic Floatation Sphere			aft main deck
7 ADCP frames/with ADCPs install			aft main deck
20 Spools of wire and dynex to be recovered			main deck
Open Half Height Container			aft main deck
2 Open Half Height Container			aft main deck
5x Boxes of Science Party Gear	200kg		clean lab/science area
Mooring Winch			aft main deck
Mooring consumable rack unit			Sheltered lab
1 Pallet truck			min deck
2 Standard Argo floats			general purpose wet lab - dirty (main)