

## RV Investigator Voyage Plan

VOYAGE #: IN2022_T01			
Version Number:	FINAL		
Voyage title:	Transit: Cairns to Darwin 2022		
Mobilisation/Port Period:	Cairns, Thursday 8 <sup>th</sup> – 10 <sup>th</sup> September, 2022		
Pre-medical clearance period	Cairns, Friday, 9 – 10 <sup>th</sup> September, 2022		
Depart:	Cairns, 0800 Sunday, 11 September, 2022		
Return:	Darwin, 1000 Sunday, 18 September, 2022		
Demob / Port Period (IN2022_P07):	Darwin, 1000 Sunday, 18 – 24 September, 2022		
Voyage Delivery Coordinator:	David Flynn	Contact details:	<a href="mailto:David.Flynn@csiro.au">David.Flynn@csiro.au</a>
Voyage Manager:	Hugh Barker	Contact details:	<a href="mailto:Hugh.Barker@csiro.au">Hugh.Barker@csiro.au</a>
Chief Scientist:	N/A		
Affiliation:	N/A	Contact details:	N/A
Principal Investigators:	Dr. Rob Beaman		
Project name:	Project 3D-GBR		
Affiliation:	James Cook University	Contact details:	<a href="mailto:robin.beaman@jcu.edu.au">robin.beaman@jcu.edu.au</a>

## Scientific / Voyage objectives

The primary objective of voyage IN2022\_T01 is movement of RV Investigator from Cairns to Darwin in preparation for IN2022\_V08. Underway training, repairs, maintenance and science operations will occur whilst en route without impacting the voyage departure and arrival times.

## Piggyback projects

### **Project 3D-GBR & underway scientific mapping.**

The GSM team and Dr. Robin Beaman (James Cook University) have optimised the voyage track between Cairns and Torres Strait to include areas of high national priority for seabed mapping. The new mapping data will feed into Project 3D-GBR to build a comprehensive 3D depth model for the Great Barrier Reef and Coral Sea.

The following track timings and waypoints have been calculated and provided to the ship/VM for use onboard based on available time/weather. Dr Beaman's and the GSM team's preferred tracks are in priority order Tracks #4, #3, #2, #1.

Direct Route: 6.26 Days

**Track #4: 6.51 Days (preferred and selected, as edge maps previous RV Falkor multibeam data)**

Track #3: 6.38 Days

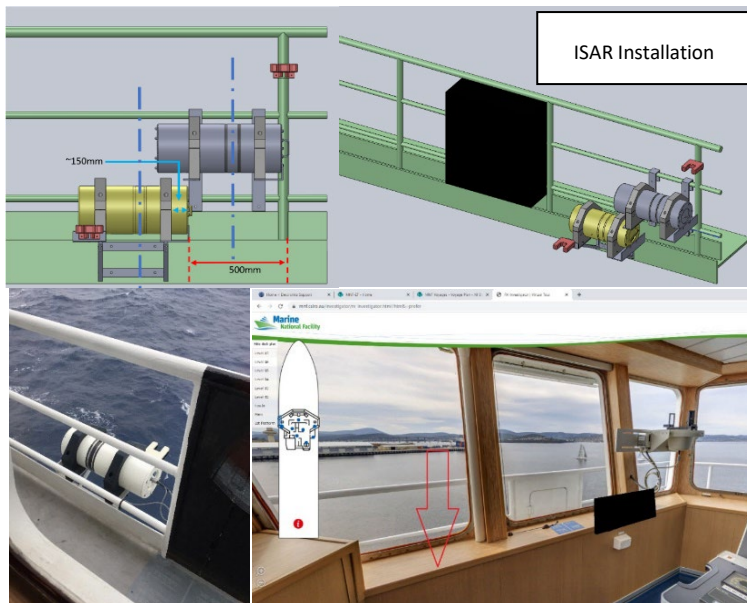
Track #2: 6.33 Days

Track #1: 6.30 Days

Track #4 is preferred because it aims to edge map the RV Falkor's existing multibeam data along this far northern GBR continental slope to continue building the mapping data coverage to seaward. In this way, we can extend the mapping coverage to understand better the topographic relief of the GBR margin where deep water currents interact with the canyons and slope along here. It is very important to continue this systematic mapping, and in turn, this IN2022\_T01 transit will provide the new data for a future mapping transit by Investigator.

### **1x ARGO BioGeoChemical (BGC) float deployment**

A BGC ARGO float is planned for deployment at the same time and location as the 2nd planned CTD training station (see waypoints below), with Hydrochemistry and SIT/DAP support. A calibration CTD will be used before deploying the unit in minimum 2250 m depth. The CTD setup includes 13 DIC/Alkalinity pairs, with each pair to be accompanied by a salinity and oxygen sample.



## Sea Surface Temperature Radiometer Comparisons/Calibrations

A 2nd Sea Surface Temperature Radiometer (ISAR) is installed on port bridge wing for comparison to the existing 1st ISAR unit. This comparison project was completed for IN2021\_E01 in temperate waters, with the intention here to compare readings in tropical waters. This requires running cable and conduit into the bridge during the port period IN2022\_P06, led by Nicole Morgan from SIT.

## Training opportunities

Hydro	–	N/A
DAP	–	2x trainees. in situ personnel training onboard + replacement of servers onboard.
SIT	–	N/A
GSM	–	N/A
Field Ops	–	N/A

## Voyage Risk Assessment (VRA)

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

## Media activities

N/A

## Activity plan for first 24-48 hours of voyage

Day	Date	Time	Activity
Friday	9 Sept	~1000	All board RVI
Friday	9 Sept	1030	Seagoing Inductions @ Aft Lounge
Friday	9 Sept	1400	Muster drill @ 02 Deck
Friday	9 Sept	1600	Voyage Management Team Meeting @ Bridge
Saturday	10 Sept	1000	VM Briefing with Support Staff / Outreach members
Sunday	11 Sept	~0800	Set sail with Pilot onboard
Sunday	11 Sept	1100	Depart Cairns Harbour
Sunday	11 Sept	1200	Transit Trinity Opening to Queensland Trough 1
Sunday	11 Sept	2300	Mapping underway and arrive Queensland Trough 2

## Voyage track

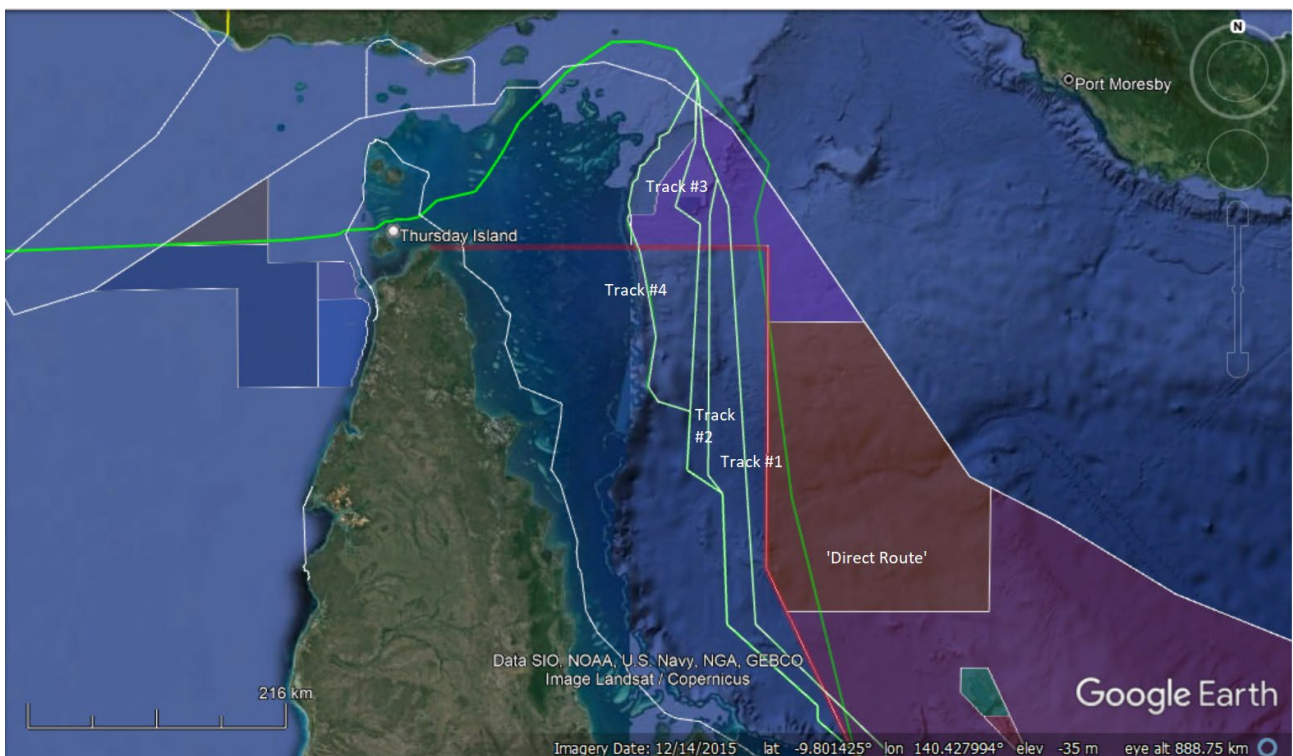
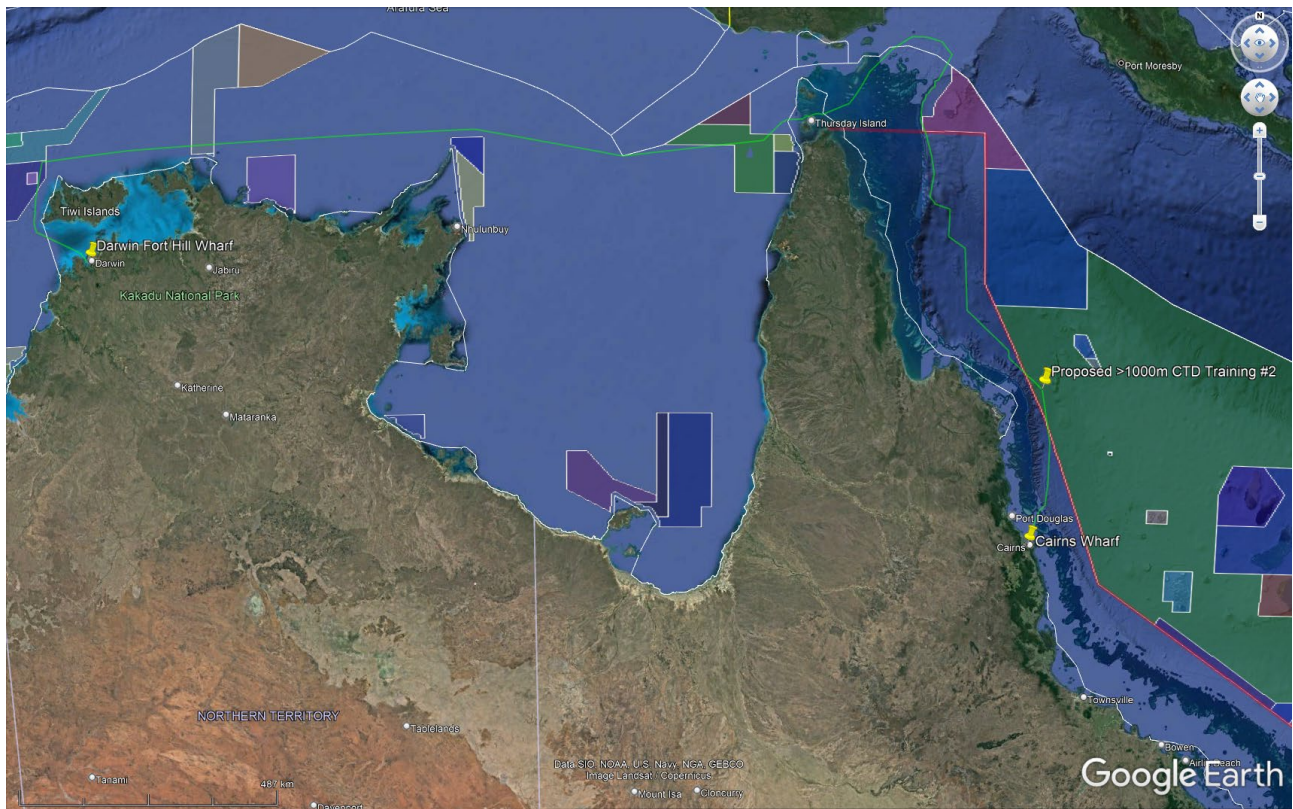


Figure 1. Planned voyage track line (green) showing Australia's EEZ (white) and Australian marine parks.  
(BOTTOM) Alternate voyage tracks for mapping between Cairns and the Torres Strait.



## Waypoints and stations

SITE / WAYPOINT	LATITUDE DD	LONGITUDE DD	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
Port Cairns WP4 Cairns Pilot	-16.94089	145.78188	0	0	0.0	0
WP3 Cairns Pilot	-16.93441	145.78042	0	0	0.1	0
WP2 Cairns Pilot	-16.90942	145.78642	2	2	0.3	0
WP1 Cairns Pilot	-16.77280	145.86585	9	11	1.9	2
Pixie Rf	-16.57401	145.88749	12	23	2.4	5
Norman Rf	-16.39871	145.96113	11	35	2.3	7
Linden Bank	-16.32023	146.05091	7	42	1.4	8
1 QLD Trough	-15.98980	146.08620	20	62	2.0	10
2 QLD Trough	-15.36590	146.09620	37	99	3.7	14
3 QLD Trough + CTD @2500m + BGC Argo	-14.56020	145.94780	49	148	4.9	19
1 Bligh Trough	-14.10100	145.39770	42	190	4.2	23
2 Bligh Trough	-13.99250	145.39380	7	197	0.7	24
3 Bligh Trough	-13.40430	144.71620	53	250	5.3	29
4 Bligh Trough	-12.46280	144.67680	57	307	5.7	35
5 Bligh Trough	-12.29550	144.41530	18	325	1.8	37
6 Bligh Trough	-11.87530	144.43660	25	350	2.5	39
1 far northern GBR	-11.80630	144.20230	14	365	1.4	41
Possible Argo Recovery	-11.90300	143.87700	20	385	2.0	43
2 far northern GBR	-11.69890	144.12070	19	403	1.9	45
3 far northern GBR	-11.34470	144.18440	22	425	2.2	47
4 far northern GBR	-11.06780	144.14420	17	442	1.7	48
5 far northern GBR	-10.74230	144.06360	20	462	2.0	50
6 far northern GBR	-10.57171	143.99003	11	473	1.1	51
7 far northern GBR	-10.49819	143.97219	5	478	0.5	52
8 far northern GBR	-10.45660	143.99389	3	480	0.3	52
9 far northern GBR	-10.39763	143.98217	4	484	0.4	53
10 far northern GBR	-10.23335	144.01288	10	494	1.0	54
11 far northern GBR	-10.20694	144.04429	2	496	0.2	54
12 far northern GBR	-10.11486	144.06784	6	502	0.6	54

SITE / WAYPOINT	LATITUDE DD	LONGITUDE DD	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
13 far northern GBR	-10.09915	144.09854	2	504	0.2	55
14 far northern GBR	-10.01278	144.16207	6	511	0.6	55
15 far northern GBR	-9.98922	144.20347	3	513	0.3	56
16 far northern GBR	-9.90427	144.20490	5	518	0.5	56
1 Gulf of Papua	-9.87617	144.26830	4	523	0.4	56
2 Gulf of Papua	-9.47582	144.48242	27	550	2.7	59
Arr GNEC	-9.27410	144.32405	15	565	1.5	61
1 Bramble Cay	-9.21367	144.07928	15	580	1.5	62
2 Bramble Cay	-9.21767	143.85650	13	593	1.3	63
3 Bramble Cay	-9.44035	143.52298	24	617	2.4	66
PBG Dalrymple Is	-9.56670	143.40830	10	627	1.0	67
Arden	-9.80000	143.18000	19	647	1.9	69
Dove	-10.01330	143.06330	15	661	1.5	70
Bet	-10.18670	142.95000	12	674	1.2	72
Kircaldie	-10.30000	142.86120	9	682	0.9	72
Twin	-10.48050	142.45070	27	709	2.7	75
Marina	-10.46970	142.37800	4	713	0.4	75
Alert (NW)	-10.47280	142.34220	2	715	0.2	76
Nardana	-10.50880	142.25120	6	721	0.6	76
Hammond	-10.51050	142.20230	3	724	0.3	77
Mecca	-10.53550	142.16670	3	727	0.3	77
Harrison (N)	-10.56150	142.13470	2	729	0.2	77
Goods (N) Goods Is	-10.56430	142.07380	4	733	0.4	77
Booby	-10.57167	141.91133	10	742	1.0	78
Gannet	-10.58217	141.88383	2	744	0.2	79
Gannet Buoy	-10.59283	141.87533	1	745	0.1	79
Booby Is. PBG	-10.60500	141.83000	3	748	0.3	79
1 Arafura Sea	-10.90000	141.53333	25	772	2.5	81
2 Arafura Sea	-11.15000	139.38333	128	900	12.8	94
3 Arafura Sea	-10.70900	137.10817	137	1037	13.7	108
4 Arafura Sea	-10.78100	131.52667	329	1366	32.9	141
5 Arafura Sea	-10.84903	130.03047	88	1454	8.8	150

SITE / WAYPOINT	LATITUDE DD	LONGITUDE DD	DISTANCE (NM)	TOTAL DISTANCE (NM)	STEAMING TIME (HRS)	TOTAL STEAM (HRS)
6 Arafura Sea	-11.39880	129.92520	34	1488	3.4	153
7 Arafura Sea	-11.81950	129.89230	25	1513	2.5	155
8 Arafura Sea	-11.95800	129.93470	9	1522	0.9	156
Darwin Approaches	-12.32960	130.69263	50	1572	5.0	161
Middle Passage	-12.34388	130.71204	1	1573	0.1	161
PBG Darwin	-12.40822	130.76660	5	1578	0.5	162
Channel Rk	-12.42401	130.77599	1	1579	0.1	162
Berrell Shoal	-12.47228	130.81436	4	1583	0.4	162
Fort Point	-12.47711	130.84231	2	1585	0.2	163
Berth Darwin	-12.47227	130.84620	0	1585	0.0	163

## CTD configuration

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

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

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

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

	PLEASE SELECT:
<b>Fundamentals:</b>	
Which CTD rosette to be used for this voyage (24 or 36 Niskin bottles):	36
Likely total number of casts:	1
Likely maximum depth of deepest cast:	2500m
Lowered ADCP required:	
<b>Instrumentation (maximum 6 auxiliary channels in addition to 2x DO):</b>	
2x pumped Temperature, Conductivity, Dissolved Oxygen circuits:	(Standard)
Altimeter (required if operating anywhere near the sea floor):	
PAR Sensor (Biospherical QCP-2300):	
Transmissometer (Wetlabs C-Star 25cm):	



	PLEASE SELECT:
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)	
<b>Hydrochemistry Analyses:</b>	
Salinity	
Dissolved Oxygen	
Nutrients: Nitrate	
Nutrients: Phosphate	
Nutrients: Silicate	
Nutrients: Nitrite	
Nutrients: Ammonia	

## Time estimates

The following time estimates are based on a steaming speed of 10 knots. Please see the attached file for further detail on planned activities, their durations and transit times.

Note #1: MNF Hydrochemistry test CTD to 1000m has been removed from Time Estimates for this voyage only, based on assessment from Hydrochemistry team.



IN2022\_T01-Waypoints-Activity-Schedule

## Permits

GBRMPA permit **G19/41954.1** with accompanying **Sampling & Analysis Plan** which was approved on 16/8/2022.

There are also two Commonwealth marine park 'network' zones this voyage track will traverse between Cairns and Darwin using underway science equipment: The Coral Sea and North.

- For the Coral Sea marine park network we have the MNF Parks Australia blanket (Coral Sea) permit **PA2020-00041-5**.
- For the North marine park network, we have the MNF Parks Australia blanket (North) permit **PA2020-00041-4**.
- A further marine park permit is provided specifically for the launch of a BGC-Argo Float within the Coral Sea Marine Park **PA2020-00051-4**.

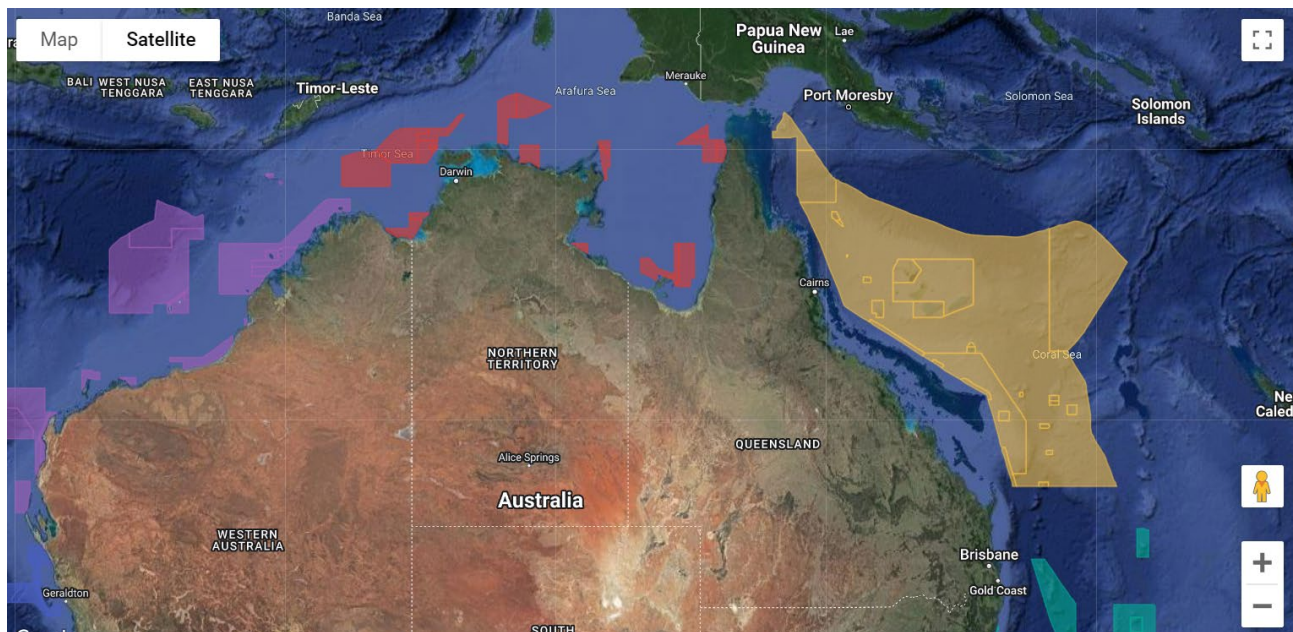


Figure 2. A map showing two marine park 'network' zones this voyage track will traverse using underway science equipment: The Coral Sea (Yellow) and North (Red).

## List of additional figures and documents

- Appendix A MNF Equipment
- Appendix B User Supplied Equipment
- Appendix C Hazardous Materials Manifest
- Document A
- Document B
- Figure 1
- Figure 2

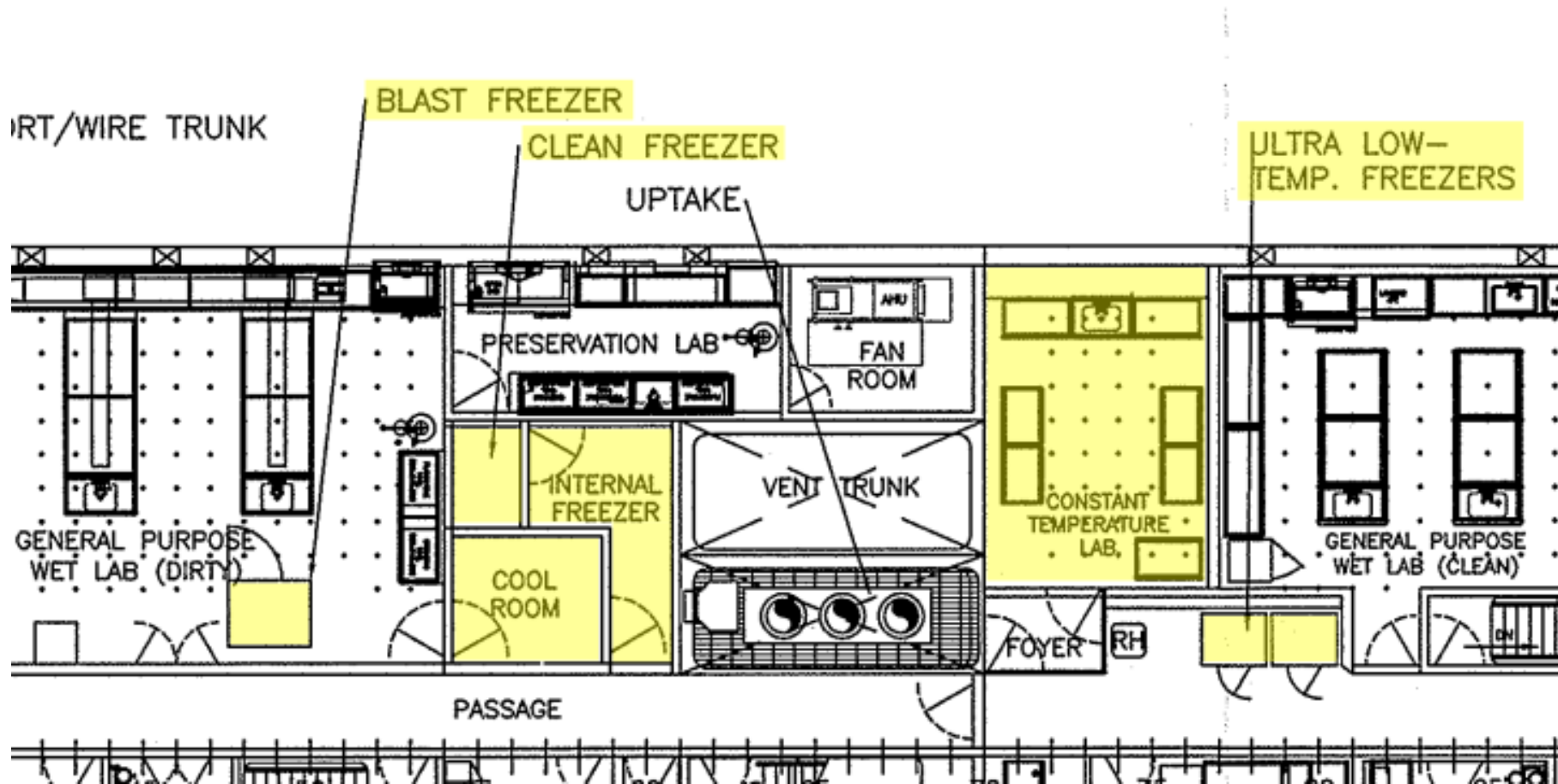
# Appendix A

## 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		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
Air Chemistry Lab		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
Preservation Lab		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
Constant Temperature Lab (Min temp: 2°C / Max temp 35°C)		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> <li>Please indicate the required setpoint temperature</li> </ul>
Underway Seawater Analysis Laboratory		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
GP Wet Lab (Dirty)		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
GP Wet Lab (Clean)		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
GP Dry Lab (Clean)		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this lab</li> </ul>
Sheltered Science Area		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this area</li> </ul>
Observation Deck 07 Level		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this area</li> </ul>
Internal Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C) Volume: >20m <sup>3</sup>		<ul style="list-style-type: none"> <li>Please indicate the intended activity in this area</li> <li>Please indicate the required setpoint temperature</li> </ul>

STANDARD LABORATORIES AND FACILITIES		
NAME	REQUIRED	NOTES/COMMENTS
Clean Freezer (Dirty Wet lab) (Min temp -25°C / Max temp 0°C)  Volume: >2.5m <sup>3</sup>  Co-located within the Internal freezer and separated by a door		<ul style="list-style-type: none"> <li>• Please indicate the intended activity in this area</li> <li>• Please indicate the required setpoint temperature</li> </ul>
Blast Freezer (Dirty Wet lab) (Min temp -30°C / Max temp 0°C)  Internal volume >1.5m <sup>3</sup>  Capable of reducing the temperature of 150kg of water from +20C to -30C in one hour.		<ul style="list-style-type: none"> <li>• Please indicate the intended activity in this area</li> <li>• Please indicate the required setpoint temperature</li> </ul>
Cool Room (Dirty Wet lab) (Min temp 0°C / Max temp 10°C)		<ul style="list-style-type: none"> <li>• Please indicate the intended activity in this area</li> <li>• Please indicate the required setpoint temperature</li> </ul>
Ultra-Low Temperature Freezers x2 (Main Deck) Min temp -80°C / Max temp -80°C		<ul style="list-style-type: none"> <li>• Please indicate the intended activity in this area</li> </ul>
YODA Freezers (x2) (Clean Dry lab) (Min temp -20°C / Max temp 10°C)		<ul style="list-style-type: none"> <li>• Please specify if both or only one are needed</li> <li>• Please indicate the intended activity in this area</li> <li>• Please indicate the required setpoint temperature</li> </ul>



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)			<ul style="list-style-type: none"> <li>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).</li> </ul>

MOBILE LABORATORY AND FACILITIES (MAY REQUIRE ADDITIONAL SUPPORT)			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Trace Metal Seawater Analysis Laboratory (TM2-white - 20ft)			<ul style="list-style-type: none"> <li>Used for wet sampling of trace metal clean Niskins and is stored on the main deck (if possible).</li> <li>Cannot be overstacked</li> </ul>
Trace Metal Rosette and Niskin Storage Container			10-foot container
Modular Hazchem Locker			
Stabilised Platform Container			Please indicate what instruments are to be installed in the container Cannot be overstacked
Clothing Container			The use of this container will be identified by MNF

STANDARD SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
CTD - Seabird 911 with 36 Bottle Rosette			
CTD - Seabird 911 with 24 Bottle Rosette			
Lowered ADCP			
Continuous Plankton Recorder (CPR)			<p><i>*note: Use of this item must be flagged with the relevant CSIRO Oceans &amp; 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.</i></p>



SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
TRIAXUS – Underway Profiling CTD			<p>Triaxus is a pilotable towed vehicle capable of carrying a variety of instrumentation. Constant depth towing or undulating profiles (e.g. cyclic depth pattern from 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.</p> <p>Triaxus is normally configured with the following sensors as a minimum:</p> <ul style="list-style-type: none"> <li>• Dual temperature, conductivity and dissolved oxygen (SBE9plus and dual pumped temperature/conductivity/dissolved oxygen circuits)</li> <li>• PAR</li> <li>• Chlorophyll-A, CDROM, optical backscatter (Eco-triplet)</li> <li>• Plankton counter (Laser Optical Plankton Counter)</li> <li>• Transmissometer</li> </ul> <p>Contact MNF for further details on other instrumentation and capability.</p>
Desired towing profile:			
Additional instrumentation: (please supply, make and model and datasheets and a contact person for discussion on integration)			
Piston Coring System			
Gravity Coring System			
Multi Corer			

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
Kasten Corer			
Smith Mac Grab			
Rock Dredges			
Rock Saw			Requires trained science personnel
Seaspy Magnetometer			
Portable Pot Hauler			
Equipment to measure seawater sound velocity/CTD:			
XBT System	X		2 per day provided, but none to be deployed within GBR Marine Park
Valeport Rapid SV	X		Essential for multibeam sound speed profiles without XBTs inside GBR Marine Park
Valeport Rapid CTD	X		Essential for multibeam sound speed profiles without XBTs inside GBR Marine Park
Valeport SVX2	X		Essential for multibeam sound speed profiles without XBTs inside GBR Marine Park
Trace Metal Rosette and Bottles			
Trace Metal In-situ Pumps (x6)			<ul style="list-style-type: none"> <li>See non-MNF owned section below for additional 2 units.</li> <li>Science team to organise and pay for battery packs for this system (+ spare).</li> <li>They can be sourced through a supplier such as 'Batteryworld Hobart' (Graham Cowie, 03 6272 3900) who has made these previously.</li> <li>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.</li> </ul>

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
Deep Towed Camera			
Drop Camera			
Sherman Epibenthic Sled			Stern ramp must be removed to operate this system.
Brenke Sled			
Hydro-Bios MultiNet (Mammoth) (1m x 1m) <i>(has replaced the EZ net)</i>			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.			8m <sup>2</sup> 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.			16m <sup>2</sup> mouth area Tow speed ≤2 knots

SPECIALISED SAMPLING EQUIPMENT			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS (THESE ITEMS MAY REQUIRE ADDITIONAL MNF SUPPORT STAFF)
Trawl Monitoring Instrumentation (ITI) (2,000m depth limit)			MNF to identify this need, dependent on pelagic or demersal trawling requirement
Stern ramp		INSTALLED	Remaining in place following V07 unless required out by ASP

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			

SCIENTIFIC / SAMPLE ANALYSIS SYSTEMS				
MICROSCOPES:				NOTES/COMMENTS
Olympus /CH	Compound			
Leica / MTU282	Camera tube			
Adapters for tube / Nikon	Pentax			
Ring Light *2 / MEB121	LED			
Heavy Duty Electronic Balance (80kg)				
Medium Duty Electronic Balance (15kg/5g resolution)				
Light Duty Electronic Balance (3kg/1g resolution)				

## Underway systems

ACOUSTIC UNDERWAY SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
75kHz ADCP			
150kHz ADCP			
Multi Beam Echo Sounder EM122 12kHz (100m to full ocean depth)	X		Essential to complete multibeam mapping project outcomes
Multi Beam Echo Sounder EM710 70-100kHz (0-1000m approx.)	X		Essential to complete multibeam mapping project outcomes
Sub-Bottom Profiler SBP120		X	Data exported as SEG-Y files with instantaneous corrections applied
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

ACOUSTIC UNDERWAY SYSTEMS			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Scientific Narrowband/Broadband Echo Sounders EK80 (6 bands, 18kHz-333kHz)	X		EK80s will be used in narrowband mode unless otherwise requested Quantitative measurements from scientific echosounders requires sphere calibration in the watermass of sampling
Multibeam Scientific Echo Sounder ME70 (70-100 kHz)			
Omnidirectional Echo Sounder SH90			<i>This system is unavailable until 2023 (date TBD)</i>
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 <sub>2</sub> /CH <sub>4</sub> /H <sub>2</sub> O)			
Aerodyne Spectrometer (analysis of N <sub>2</sub> O/CO/H <sub>2</sub> O)			
Cloud Condensation Nuclei (CCN)			
Polarimetric Weather Radar			



UNDERWAY SEAWATER SYSTEMS AND INSTRUMENTATION			
NAME	ESSENTIAL	DESIRABLE	NOTES/COMMENTS
Thermosalinograph			
Fluorometer			
Optode			
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)			
EM2040			Shallow water multibeam echosounder system