

**2012/13 Annual Business Plan  
Integrated Marine Observing System**

**Education Investment Fund  
Super Science Initiative – Marine and Climate**

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## 1. Executive Summary

IMOS will continue to progress strongly during 2012-13, the sixth full year of operation. IMOS has been designed and implemented as a sustained, in-situ marine observing system, with a focus on providing continuous data streams of critical information about ocean processes that operate on long time scales. Therefore each year of operation is building on previous years.

For each of the ten, platform-based Facilities, significant achievements in 2012-13 are expected to be as follows:

1. **Argo** – Continued in-situ monitoring of the seasonal, broad scale structure of the global ocean down to 2,000 meters, in collaboration with national and international partners.
2. **Ships of Opportunity** – Continued, cost effective monitoring of physical, chemical and biological parameters from both commercial vessels and research vessels.
3. **Deepwater Moorings** – Continued recovery and redeployment of instrumentation and delivery of data from the Southern Ocean Flux Station, Southern Ocean Time Series, Antarctic Coast (Polynya) Array, Indonesian Throughflow Array, and East Australian Current (EAC) Array. 2012-13 is the first year in which we'll have all deepwater moorings deployed, and be in a position to begin exploiting the data streams.

(N.B. Strengthened collaboration with New Zealand will be a feature in the Argo, Ship of Opportunity, and Deepwater Mooring Facilities, as well as eMII, building on a successful Australia-NZ symposium conducted in December 2011.)

4. **Ocean Gliders** – Continued deployment, recovery and streaming of data from the full fleet of coastal and deep ocean gliders. Glider transects to the Southern Ocean Time Series site will be been paused during 2012-13, in part due to excessive bio-fouling and concerns about integrity of bio-optical data. Data streams collected to date will be analysed and anti-fouling options investigated before any further transects are undertaken
5. **Autonomous Underwater Vehicle** – Repeat surveys at reference sites in WA (at Ningaloo, Rottneest Island, Jurien Bay and the Abrolhos Islands), Tasmania, NSW, and SE Queensland. New reference sites will be established at the Solitary Islands (funded in part through NERP co-investment) and in the Southern GBR.
6. **National Moorings Network** – All nine National Reference Stations deployed and delivering real-time and/or delayed-mode data. Shelf mooring arrays in NSW, Queensland (GBR and SEQ), NT (Bonaparte Gulf), north west WA (Kimberley and Pilbara), south west WA, and SA all fully operational and delivering data. Passive Acoustic Observatories maintained in WA, SA/Victoria and NSW. The Ocean Acidification mooring network maintained at Yongala (GBR), Maria Island (Tasmania), and Kangaroo Island (SA).
7. **Ocean Radar** – Continued delivery of near real-time and quality controlled data and products from all six sites, in Queensland (GBR), WA (two), SA (two) and NSW. Use of data streams from the long-delayed Coffs Harbour site in NSW will be a particular highlight.
8. **Animal Tagging and Monitoring** – Acoustic curtains maintained in WA, SA, NSW and Queensland (GBR), including internationally-funded Ocean Tracking Network arrays off south west Western Australia and east coast Tasmania. Satellite tagging programs to continue streaming data from the Southern Ocean and Great Australian Bight.
9. **Wireless Sensor Networks** – Continued deployment of networks and streaming of data from Heron Island, Orpheus Island/Davies Reef, and Lizard Island.
10. **Satellite Remote Sensing** – Continued delivery of agreed data and products for remotely sensed sea surface temperature (SST), ocean surface topography (altimetry), and ocean colour. Continued delivery of daily maps of ocean surface currents and temperature through the

*OceanCurrent* website, with regular news items on phenomena of interest.

Availability, discoverability and inter-operability of data through the IMOS Ocean Portal will continue to be the focus of the electronic Marine Information Infrastructure (eMII) Facility. Substantial improvements are being made to the utility of the information infrastructure so as to better enable uptake and use by the research community. Using additional resources provided to IMOS, eMII will also continue to facilitate development of a broader Australian Ocean Data Network (AODN) serving all marine and ocean-climate data relevant to the Australian research community.

It is pleasing to see strengthening collaboration between IMOS and all elements of the national e-Research infrastructure (ANDS, RDSI, Nectar and NCI) becoming evident in a number of Facilities, highlighting the advantages of Australia's national, collaborative approach to research infrastructure development.

Uptake and use of IMOS data will continue to be a major focus in 2012-13, led by the IMOS Nodes and supported by the IMOS Office and all Facilities. We now have the ability to measure uptake and use through the IMOS Publications and Projects Database, enabling us to target effort into areas where this is not yet as strong as it could be. In addition to underpinning a large number of PhD's, post doctoral fellowships and projects funded through the Australian Research Council, all of which are adding to the peer reviewed literature, IMOS is now recognised as a provider of ocean observations to major Australian Government research programs in Climate Change and Marine Environment. Strengthening delivery to research programs in other portfolios such as Fisheries, Resources, and Infrastructure will be a focus in the coming year.

IMOS is also becoming recognised as a provider of ocean observations to major research programs in most States and Territories. Beginning to exploit the impressive array of equipment now deployed in North West Australia, with significant co-investment from the Western Australian State Government, is expected to be a particular highlight in 2012-13. Further expansion around North West Cape (WA), Darwin Harbour, and on the Great Barrier Reef is currently being negotiated with a range of industry, government and institutional partners, reflecting strong economic, social and environmental drivers for better marine science and ocean information.

No material variations are expected from the approved EIF Project Plan.

Key risks include those routinely associated with deployment and retrieval of observing infrastructure in a vast, deep, dynamic marine environment. These are considered in the body of the plan. Specific risks and mitigants for 2012-13 include:

- Loss of equipment in the harsh, remote Southern Ocean. **MITIGANT** - Risk will be managed by partnering with the most experienced Operators, staging implementation, carefully reviewing successes and failures, and insuring against material loss (where appropriate).
- Loss of equipment due to cyclone activity in the tropical North. **MITIGANT** – As above.
- Increasing reliance on the Marine National Facility to support deepwater moorings when the MNF is transitioning from *RV Southern Surveyor* to *RV Investigator*. **MITIGANT** – The IMOS Office and Advisory Board to maintain close liaison with CSIRO and the MNF Steering Committee.

By far the greatest risk now facing IMOS is that of funding discontinuity beyond 30<sup>th</sup> June 2013. Australia has created and developed an impressive national capability in integrated marine

observing and data management that is being recognised as world-leading. It manifests in platforms and sensors, information systems, and data streams, but also in a new generation of marine technicians, software engineers and data scientists applying their intellect in the context of a national ocean observing enterprise. Ongoing investment by the Australian Government is required if we are to extract full value from the research infrastructure created, and which is now being further developed in near real time.

## 2. Status of the Project

2011-12 was the first year in which all IMOS Facilities were funded under the EIF program. For many of the facilities the focus was on the ensuring that the data streams commenced under NCRIS were continued and quality controlled data made available through the Ocean Portal. The following new deployments were done in 2011-12:

- Argo – caught up with the backlog which arose due to prior year communication problems, and deployed the new floats as planned
- Ships of Opportunity – new equipment purchases and some new routes established
- Deepwater Moorings – East Australian Current deep array is being built for a June 2013 deployment.
- Ocean Gliders – new Slocum gliders purchased for the Kimberley and Pilbara transects funded by the WA Government, and for the new Tasmanian transects funded under EIF.
- Autonomous Underwater Vehicle – planned upgrade is in progress
- National Moorings Network – new shelf arrays built for Kimberley and Pilbara from the WA Government funds, and from EIF funding for the shelf SEQ array and the Kangaroo Island acidification mooring
- Ocean Radar – funded under NCRIS the Coffs Harbour array was deployed in March 2012
- Animal Tagging and Monitoring – new arrays at Scott Reef and Rowley Shoals funded by the WA Government, and off the east coast of Tasmania funded by the Ocean Tracking Network, Canada. Satellite tagging of marine animals continued in the Great Australian Bight and Southern Ocean
- Wireless Sensor Networks – no ‘new’ equipment, however to reinstate damage caused during Cyclone Yasi in early 2011 some of the infrastructure was re-built.
- eMII – continued developments of the Ocean Portal (both IMOS and AODN) and commencement of the *OceanCurrent* site.
- Satellite Remote Sensing – reinstatement of the Lucinda Jetty ocean colour mooring expected by June 2012 (following Cyclone Yasi damage in early 2011); plus upgrade to AODAAC.

## 3. Project Infrastructure

By 30<sup>th</sup> June 2012, the bulk of the IMOS infrastructure will be deployed, and capital costs will mainly be directed to regular maintenance required to ensure continuity of the IMOS datastreams. The significant purchases to be made during the 2012-13 year are as follows:

- Argo – purchase and deployment of 30 floats from IMOS funds, plus 18 from co-investments
- Ships of Opportunity – co-investment of XBTs and equipment for the Townsville ground-station

- Deepwater Moorings – from IMOS funds purchase instrumentation for the Polynya and ITF deep arrays, and replacement moorings for the SOFS and SOTS sites (to enable continuous data) and also co-investment from NOAA and CSIRO for the deep arrays
- Ocean Gliders – use of self-insurance funds to replace a sea-glider lost in late 2011
- National Moorings Network - new passive acoustic observatories in Pilbara and Kimberly from WA Government co-investment, plus from IMOS funds instrumentation for all moorings to ensure continuous data streams
- Animal Tagging and Monitoring – new satellite tags for the Great Australian Bight and Southern Ocean programs, and instrumentation for the receiver sites to ensure continuous data streams
- All other facilities – instrumentation as required to ensure continuous data streams

Please refer to Part C of the Facility Plans in **Attachment A** for the details of datastreams to be commissioned and activities to position researchers and others to utilise the infrastructure

#### 4. Management and Implementation

There are no significant changes to the management and implementation arrangements documented in the Final IMOS EIF Project Plan.

The Chair of the Advisory Board Dr Trevor Powell resigned on 30 June 2011, and Dr Ian Poiner accepted that role from September 2011. Since the last Plan was submitted, new Board members Dr Bruce Mapstone, Prof Lee Astheimer and Cmdr Robyn Phillips commenced; and Dr John Gould and Dr Andreas Schiller resigned from the Board. The following continued as Members of the Advisory Board – Dr Nick D’Adamo, Mr John Gunn, Prof Jason Middleton, Dr Peter Rogers, Dr Neville Smith, Prof Rob Lewis; ex-officio Prof Paddy Nixon and Mr Tim Moltmann; secretary Mrs Jo Neilson.

#### 5. Milestones

The EIF Milestones for 2012-13 are listed in **Attachment B**. At the end of that attachment is a table recording the new milestones agreed for the co-investment provided by the WA Government. Otherwise, there are no major changes to the Milestones agreed in the Final IMOS EIF Project Plan, as updated to DIISRTE via the quarterly Milestone reports.

#### 6. Project Resources

Budget – please refer to **Attachment D**. There are no significant changes which impact on the ability of IMOS to deliver against the agreed plan. The net increase between the budget provided in the previous Business Plan of \$113M, and that provided in attachment D of \$117M is \$4M. The key drivers of this change are:

- \$2M from the WA Government for 2013/14, plus co-investment of \$.8M from AIMS, which previously had not been included.
- \$.7M estimated future interest earnings.
- \$.5M various other changes.

Staffing – Under each of the Facilities staffing is required for planning, provisioning and commissioning of the infrastructure. The indicative level of staffing resources for 2012-13 is as follows:

Facility	EIF funds	Co-invest	Total
Argo	4.60	1.35	5.95
SOOP	9.70	1.40	11.10
ABOS	6.50	1.60	8.10
ANFOG	5.00	1.20	6.20
AUV	2.00	3.25	5.25
ANMN	24.32	8.07	32.39
ACORN	4.00	0.75	4.75
AATAMS	2.00		2.00
FAIMMS	1.50	1.50	3.00
eMII	18.00		18.00
SRS	5.38	0.35	5.73
Office	6.00		6.00
<b>Total</b>	<b>89.00</b>	<b>19.47</b>	<b>108.47</b>

## 7. Confidential Material

Matters of a confidential nature have been addressed directly with DIISRTE and do not form part of this Plan.

## Attachment A.1

Facility: **Argo Australia**  
Leader: Susan Wijffels and Ann Thresher, CSIRO  
Contact: Phone: 03 6232 5450; email: susan.wijffels@csiro.au; ann.thresher@csiro.au

### A Executive Summary

#### A.1 **Expected progress with the Facility in the 2012-13 year**

The facility expects to deploy a further 50 floats, targeting thinning parts of the array, particularly in the South Pacific Ocean. Most of these floats will employ high-bandwidth communications and deliver high vertical resolution data. We plan to collaborate with US Argo and NIWA, New Zealand on a dedicated deployment cruise. The standing Australian Argo array is expected to remain near or larger than 350 active floats, which is well over the original milestone of 240 active floats. We also aim to acquire a further 50 floats. Due to the availability of new floats from alternate companies we are required to proceed with a tender process. Due to the irreparable damage that large numbers of float failures can have on the Argo data stream, we plan to carry out a 'Proof of Concept' to assess the fitness for purpose of the new models before going to a full and open tender.

The real-time (within 24 hours) and delayed-mode (within 1 year) Argo Australia data stream will remain up-to-date and meet Argo quality standards. The Facility will also begin to move our Iridium fleet to use RUDICs where possible to reduce communications cost and make processing more robust. We will remain strong contributors to international Argo leadership and coordination: Wijffels will continue to co-chair the International Argo Steering Team and Thresher will co-chair the International Argo Data Management Team. The Facility will also ensure the data stream delivered to users is bias free by continuing to carry out regular audits of the global data set for pressure errors.

#### A.2 **Material variations from the agreed plan which are proposed - None.**

#### A.3 **Key risk factors for the year and strategies to address them**

- Technical failure of floats remains a key risk every year. We will continue to closely monitor the array performance, including sensor activity.
- Going to tender poses two risks. The first risk we face is that the process will result in the Facility having to purchase floats that perform poorly. The second risk is a legal challenge around a fair and open tendering process. We are liaising closely with CSIRO Legal and Procurement Teams to ensure Australian government requirements and guidelines are met, but that the tender process delivers the best value for the tax payer, which is through floats that operate correctly for the longest, not floats that are the lowest price.

### B **Status of the Facility** - The Argo Australia array has over 370 active floats. As initially proposed, the Facility maintains 50% of the total Argo array in the oceans around Australia (90-180°C, equator to sea ice edge), with international partners supplying the remaining half of active floats.

#### **Highlights:**

The Facility was able to make up for a backlog of deployments caused by a halt in 2009. This was partly achieved through use of the sailing schooner Lady Amber, developed as an Argo deployment

vessel between the Argo Information Centre based in Toulouse, France and CSIRO. We trained the crew and had them execute test deployments off South Africa in 2010. On their success we planned two long deployment voyages across the Indian Ocean, targeting gaps where commercial shipping does not operate. The Lady Amber has now deployed 55 floats for Argo Australia. After her long Indian Ocean deployment voyage the crew also worked with the IOC office in Perth and CSIRO communications in a media story on ocean observing which gained considerable coverage and involved Ministers from the Western Australian government.

Another highlight is renewed partnership with the Navies. As is true for many elements of the ocean observing system, pirate activity in the Northwest Indian Ocean is restricting the collection of data streams from fully over 1/3 of the basin. Commercial shipping is highly restricted in this region and safety considerations preclude sending in leased vessels to deploy floats – indeed deployments from Lady Amber were moved to avoid expanding pirate activity around the Seychelles. In response to the thinning array in that region, we began working with Navies – in particular the US and Australian Navies. HMAS Parramatta and USS Samuel B Roberts deployed floats into the pirate-affected northwestern area. Maintaining Argo density is particularly important in this region as the Tropical Moored Array RAMA is not able to be serviced and is largely offline there and surface ship reports are very few as shipping is avoiding that area. The media story the Facility did (with Ann Thresher leading the story) on the impact of the activity of pirates on Argo went viral and received some of the largest numbers of reports and media interviews than we have seen in several years.

Our piloting of floats in the sea-ice zone continues successfully with float survival rates much higher than early attempts to do this. We now are receiving hither-to scarce winter under-ice profiles from several floats, delivered in spring are groups of 10-20 stored profiles when the float finds ice-free conditions to transmit through. During winter, sea ice forms, rejecting salt into the upper ocean layer and driving an increase in salinity and mixed layer depths (along with cooling) during winter. As spring approaches, ice melt ensues, which, along with warming, shoals and freshens the mixed layer.

**Difficulties:**

As has been true in the past, continued vigilance around technical performance has been required. While problems this year were fewer than in the past, we did diagnose (along with international groups) that a particular batch of Iridium antennas were prone to leak, which eventually interferes with data transmission enough to make the float fail. To clearly reveal the problem, we facilitated a retrieval of such a float by the manufacturer in Solomon Islands, with our technicians assisting at their expense. This allowed a thorough diagnostic analysis in lab by the manufacturer confirming the cause of the leak. It will prevent future problems through changes in manufacturing and is also leading to warranty claims for replacement floats where this problem is identified.

Some floats also continued to experience air-system failures (diagnosed last year). This is particularly fatal on Iridium floats where the antenna must be lifted clear of the ocean surface. We are also making warranty claims for some of these floats.

The international Argo infrastructure (the Argo Information Centre), which is housed in the IOC/UNESCO JCOMM-OPS in Toulouse, France has an uncertain future around the continuity of US funding (over half currently). This issue has arisen due to the granting of membership to Palestine by UNESCO, which has triggered a stop in US payments to that organization. The Argo Information



Centre is critical to Argo as it independently tracks the Argo array for IOC member states and helps Argo adhere to IOC resolutions around collection of data in countries EEZ's.

**Breakthroughs:** None to report.

## **C Facility Infrastructure**

**C.1 New equipment to be provided during 2012-13** - Around fifty new Argo floats will be deployed into thinning parts of the regional array during the upcoming year, particularly into the South Pacific Ocean. Most of these profilers will feature high bandwidth communications and thus return high vertical resolution profiles.

**C.2 Datastreams to be commissioned during 2012-13** - Data from newly deployed floats will be delivered in realtime to the GTS via the Bureau of Meteorology and the Argo Global Data Assembly Centres (GDACs) via the internet. The IMOS portal routinely synchronises with the GDACs to serve local users. All data streams from the array will conform to Argo data standards in timeliness and quality control.

**C.3 Planned activities to position researchers and others to utilise the Facility** - As a well established facility, Argo data is used routinely throughout ocean and climate sciences. Uptake can be enhanced through the provision of gridded products. CSIRO are working on such a product (not funded by the Facility) to complement those available internationally ([http://www.argo.ucsd.edu/Gridded\\_fields.html](http://www.argo.ucsd.edu/Gridded_fields.html)), but release must await complete peer-review. The Facility will promote the next Argo Science Workshop being held in Venice in September 2012 in conjunction with the '20 Years of Radar Altimetry' Symposium.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - The Facility partners meet annually to review operations, discuss problems and plan next year's activities. Meetings are held on a rotation basis at Navy Headquarters, Sydney; Bureau of Meteorology, Melbourne and CSIRO, Hobart.

## **D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

### **D.2 Implementation Plan July 2012 to June 2013**

<b>Activity / Deployment / Location</b>	<b>Responsible Organisation(s)</b>	<b>Responsible Person(s)</b>	<b>Start</b>	<b>Finish</b>
Deploy ~50 Argo profiling floats/oceans around Australia in places where the global array is thinning	CSIRO	Susan Wijffels, Ann Thresher	June 2012	June 2013

## **E Project Resources**

**E.1 EIF budget** - Total EIF Budget unchanged. The Argo Facility routinely budget for deployment voyages. In the 2011/12 budget, CSIRO included \$150K earmarked for a NIWA Kaharoa trip scheduled for June/July/August 2012. This trip has now been delayed until January 2013 and, although there are funds for voyages in the 2012/13 budget, these are also earmarked for specific

deployment trips, including further funding for the Kaharoa. Therefore the Facility will be allowed to roll-forward the 2011/12 funds.

**E.2 Co-investments** - EIF co-investments unchanged. There is some uncertainty surrounding the Bureau of Meteorology float purchases. Despite CSIRO's reasonable endeavours, it is unknown whether the Bureau will proceed with the planned 8 floats to be purchased in 2012/13.

**E.3 Staffing**

<b>Name</b>	<b>Role</b>	<b>EIF FTE</b>	<b>ACCSP</b>	<b>BoM</b>
Susan Wijffels - CSIRO	Facility Leader	0.10	0.10	
Ann Thresher- CSIRO	Facility Operations and Data Manager	0.75	0.25	
Vito Dirita-CSIRO	Argo Engineer	1.00		
Alan Pool-CSIRO	Argo Technician	0.90	0.10	
Craig Hanstein-CSIRO	Argo Technician	0.15	0.70	
Ping Robinson-BoM	Real-time data programmer			0.20
Jeff Dunn - CSIRO	Programmer	0.70		
Esmee Van Wijk	Delayed Mode QC Expert	1.00		
<b>Totals</b>		<b>4.60</b>	<b>1.15</b>	<b>0.20</b>

## Attachment A.2

Facility: **Enhanced Measurements from Ships of Opportunity (SOOP)**  
 Leader: Ken Ridgway, CSIRO  
 Contact: Phone: 03 6232 5226; email: ken.ridgway@csiro.au

No.	Sub-Facility	Leader	Operator	Phone	Email
2aa	Expendable Bathythermograph (XBT)	Ann Thresher	CSIRO	03 6232 5419	ann.thresher@csiro.au
2ab	Biogeochemical (BGC)	Bronte Tilbrook	CSIRO	03 6232 5273	bronte.tilbrook@csiro.au
2ac	Continuous Plankton Recorder (AusCPR)	Anthony Richardson	CSIRO	07 3826 7183	anthony.richardson@csiro.au
2b	Sensors on Tropical Research Vessels	Miles Furnas	AIMS	07 4753 4323	m.furnas@aims.gov.au
2c	Sea Surface Temperature (SST) Sensors for Australian Vessels	Helen Beggs	BoM	03 9669 4394	h.beggs@bom.gov.au
2d	Research Vessels Real-Time Air-Sea Fluxes	Eric Schulz	BoM	03 9669 4618	e.schulz@bom.gov.au
2e	Bio-Acoustic	Rudy Kloser	CSIRO	02 6232 5389	rudy.kloser@csiro.au

### A Executive Summary

#### A.1 Expected progress with the Facility in the 2012-13 year

Overall the sub-facilities have now reached a relatively 'mature' level with almost complete deployment/implementation of equipment and sampling routes. The data are being routinely collected, processed and submitted to eMII in both real-time and delayed modes. Further progress is expected in the following areas:

- An auto-launcher for XBT deployment is still under development and the basic design has now been established. The only limiting factor is that our technicians have been busy maintaining the network with no time available to complete the build. Hopefully this year we will be able to find further resources required for the task.
- We plan to install an iridium system on the Solander which will enable real-time transmission of the TSG data.
- We will explore the possibilities of collaboration with NIWA to use the NZ research vessels as SOOP platforms.
- Data are already being collected and archived for the air-sea flux sub-facility.
- Over this year planning will continue for the transfer of our equipment from the Southern Surveyor to the Investigator. Already we have used this transfer as an opportunity to improve and streamline our data collection procedures.
- We are to place an acoustic system on a fishing vessel off the east coast of Australia that will transect the EAC and venture off into the Tasman and Coral Seas at regular times.

**A.2 Material variations from the agreed plan which are proposed** - We have no variations from the plan to report. A necessary modification is that the CPR tows are being conducted with AIMS

vessels in order to cover both NW Australia and off the GBR as no suitable and available commercial vessels have been located.

**A.3 Key risk factors for the year and strategies to address them** - The main risks remain the difficulty in locating, and retaining vessels to use as SOOP platforms. As mentioned above one strategy where suitable vessels have not been found is to use research vessels. In general, where our existing ships are taken off routes, or are no longer available to us we rely on our experience and many contacts in the industry to identify alternative vessels.

## **B Status of the Facility**

### ***2aa Expendable Bathythermograph:***

Highlights: A plus for this line will be the use of the Southern Surveyor in April. She will also be testing XBTs for fall rate changes on the transit to Brisbane and across to Fiji.

Difficulties:

- Recruiting ships and keeping them. The route for PX30 has been broken up into two sections for some time now. We were running one ship from Brisbane to Noumea and then on to Fiji. In mid-2011 the route changed so the ship went from Noumea to Vila and we subsequently lost this ship completely. We then recruited another two ships but their routes were mirror images – one started in Noumea and ran to Fiji, the second started in Noumea and ran to Brisbane. This effectively doubled our travel costs. We were in discussion with IFREMER to see if they could supply a person for half the run (we would pay expenses). This would decrease our costs considerably.
- The Sydney-New Zealand line (PX34) has also been changeable. We now have a new ship on that run as well. We did, unavoidably, miss one section last year on PX34 because of ship changes.
- The autolauncher is still under consideration but on hold pending time.

Breakthroughs: Late breaking news: we have managed to find a ship to do the entire PX30 run in one hit. This ship is opportunistic (a gas supplier). The operators and crew seem keen to help out.

### ***2ab Biogeochemical:***

Highlights: An underway system damaged by seawater spray from faulty Aurora Australis pipework was completely rebuilt, reinstalled on the ship and is working. The subfacility has also had a substantial input to the design of a new underway lab for the RV Investigator that should make data collection more streamlined than on the Southern Surveyor.

Difficulties: Some loss of data occurred on the Southern Surveyor due to a manufacturer fault in the LICOR CO2 sensor that has been difficult to replicate in the laboratory. The Southern Surveyor system is being rebuilt in time for the next cruise on the ship.

Breakthroughs: Nil to report.

### ***2ac Continuous Plankton Recorder:***

Highlights:

- Starting NW Australia route

- Planning for Brisbane-Fiji proof of concept tow and secured some funding
- AusCPR has signed onto the new Global Alliance of CPR Surveys (GACS), and Graham Hosie is the inaugural Chair of the Board of Governance
- Acquired all CPR units
- Documented range expansion of a warm-water phytoplankton species into the Southern Ocean with climate change (McLeod et al. in press).
- Documented a massive fungal bloom off the east coast of Australia following the dust event in September 2009 (Hallegraeff et al. submitted).
- The Southern Ocean Survey has entered its 22nd year. To date collecting approximately 35,000 samples (175,000 nautical miles) with another 2,400 expected for 2011/12 season.

Difficulties:

- AFMA permit for sampling plankton in our EEZ for the Tas-NZ route. Trying to solve by discussion with AFMA
- Lack of commercial vessels in NW Australia that have regular and consistent routes. Solved by using AIMS research vessels
- Problems with getting permissions from Rio vessel on GBR for pH monitoring – we were going to tow the CPR on this vessel. Solved by using AIMS research vessel.
- Finding a small suitable CTD-F

Breakthroughs: Webserver for AusCPR data so eMII data can be updated daily (from 1 Mar 2012)

**2b Sensors on Tropical Research Vessels:**

Highlights: The thermosalinographs on the AIMS vessels (R.V. Cape Ferguson, Solander) provided operational SST, salinity and chlorophyll data throughout the year.

Difficulties: Minor short-term operational difficulties with sensors, plumbing, IT infrastructure – all fixed ASAP. No significant data gaps.

Breakthroughs: Nothing dramatic.

**2c Sea Surface Temperature Sensors for Australian Vessels:**

Highlights: Since Feb 2011 two near real-time, QC'd ship SST data streams from RV Tangaroa and MV Pacific Celebes have been added to eMII and the GTS through collaboration with NIWA and NOCS. We now have 15 IMOS ship SST data streams available from the Ocean Portal and the GTS – 12 of these in real-time (within 24 hours). The usefulness of these data streams have been assessed at the Bureau of Meteorology by Helen Beggs, Ruslan Verein and George Paltoglou and the results reported in a paper to appear in the Journal of Operational Oceanography "Enhancing Ship of Opportunity sea surface temperature observations in the Australian region".

Difficulties: Poor quality SST data from Rottneest Ferry (PV SeaFlyte) – likely cause low water flow-rate past the sensor and/or engine room heating of the water being measured. Reported in web document by Verein et al. (2011) Report on Rottneest Ferry SST Validation Tests (5-7 April 2011) located at <http://imos.org.au/soopdoc.html>. Helen Beggs requested CSIRO Marine and Atmospheric Research to relocate the SBE 38 sensor on the vessel. Not yet done.

Breakthroughs: Nil to report.

### ***2d Research Vessels Real-Time Air-Sea Fluxes:***

Highlights: Maintained real-time quality controlled data delivery from the Southern Surveyor and Aurora Australis over the last 12 months.

Difficulties: The Optical Rain Gauges (ORG) on the Aurora Australis and Southern Surveyor have proved less than reliable. The manufacturers have also been very unresponsive to repairing the instruments. The ORG are an alternative measure of precipitation as the vessels also have siphon rain gauges deployed. The ORG problems have not impacted on the precipitation data stream availability to eMII.

Breakthroughs: Recruited the New Zealand Research Vessel RV Tangaroa into the sub-facility fleet. Provided IMOS meteorological instruments to complete the sensor suite. Have been receiving data from this vessel in real-time and continuously since April 2011.

### ***2e Bio-Acoustic:***

Highlights: We are to place an acoustic system on a fishing vessel off the east coast of Australia that will transect the EAC and venture off into the Tasman and Coral Seas at regular times. We have identified a large tuna vessel (Santo Rocco) and have recently run some checks to ensure all systems are in place. It is looking promising and assuming final checks prove to be OK we should have an instrument on by March.

Difficulties: Negotiating with vessels owners over the formal acknowledgement of the data access agreement and what happens if the vessel moves off this route or is sold.

Breakthroughs: Finally locating a vessel to cover a trans-Tasman section. Acquisition of data to posting with AODN has been reduced to 3 weeks

## **C Facility Infrastructure**

### ***2aa Expendable Bathythermograph:***

**C.1 New equipment to be provided during 2012-13 - None**

**C.2 Datastreams to be commissioned during 2012-13 - All existing datastreams operating as normal**

**C.3 Planned activities to position researchers and others to utilise the Facility - Nil to report**

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users -** The XBT team have regular meetings to ensure all activities are under control. Technicians (Alan and Craig) have developed very good connections in the shipping industry that greatly assist the management of constant changes in shipping schedules and routes.

### ***2ab Biogeochemical:***

**C.1 New equipment to be provided during 2012-13 - N/A**

**C.2 Datastreams to be commissioned during 2012-13** - Data from l'Astrolabe, Aurora Australis and Southern Surveyor. Bioptical data collected through the project on Astrolabe is also being made available to IMOS through UTAS/AAD researchers.

**C.3 Planned activities to position researchers and others to utilise the Facility**

The data collected on the ships is available through IMOS data portal. These data are supplied in a standard and format acceptable to the international community in order to facilitate. This is the only available set of underway CO<sub>2</sub> data for shelf and coastal waters in the Australian region. These data are being used by at least one PhD student and one postdoc at UTAS, and data has been provided to researchers at UTS and used by UNSW and UWA researchers in publications or presentations. The sub facility has also supported other projects at UTAS, Australian Antarctic Division, and USA institutions (Princeton and Duke Universities) by collecting samples for production, bioptics, pigment, and particulate measurements that would not have happened otherwise.

The use of these data is also a recommended input to university researchers applying for the CSIRO carbon cluster collaboration funds and is being used in CSIRO research on ocean CO<sub>2</sub> uptake. These data have been submitted to the Surface Ocean Carbon Atlas (SOCAT) project which is an international effort through the International Carbon Coordination Project (IOCCP; IOC/SCOR) to develop a comprehensive database for the entire ocean. The first version of SOCAT was for data collected until 2007. The next version of SOCAT will contain the IMOS data and the anticipated release data is in 2013. The IMOS contribution to SOCAT is significant, particularly for the Southern Ocean. Effort is also being directed toward integrating the measurements with the moored CO<sub>2</sub> observations at NRS sites and with underway measurements made by other countries in the Southern Ocean (South Africa, USA, Japan, France). This is occurring through the IOCCP, the newly formed Southern Ocean Observing System panel, and the direct links with overseas researchers, including a New Zealand-Australia meeting in Dec 2012, with a New Zealand proposal now being prepared to instrument RV Tangaroa for underway CO<sub>2</sub> observations.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - Regular meetings and budget reviews are held.

***2ac Continuous Plankton Recorder:***

**C.1 New equipment to be provided during 2012-13** - Evaluation and purchase of multiple CTD-Fs;  
Purchase of pitch and roll sensors

**C.2 Datastreams to be commissioned during 2012-13** - All data collected to be made available via the Ocean Portal

**C.3 Planned activities to position researchers and others to utilise the Facility** - Nil to report

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - Nil to report

***2b Sensors on Tropical Research Vessels:***

**C.1 New equipment to be provided during 2012-13**

- A low-cost Iridium phone system was purchased in late 2011 for the development of a near-real time data transmission system for the AIMS vessels that is compatible with the AIMS IT

infrastructure and network security. This phone system will be tested on shore, and when proven effective, installed on the R.V. Solander.

- The logging computers on the Solander and Cape Ferguson were replaced by new rack-mount units.

**C.2 Datastreams to be commissioned during 2012-13** - No new data streams.

**C.3 Planned activities to position researchers and others to utilise the Facility** - Project staff remain vigilant to opportunities for use on the data. There is ongoing activity to ensure maximal data transmission to users (e.g. BOM).

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - Nothing formal at present.

***2c Sea Surface Temperature Sensors for Australian Vessels:***

**C.1 New equipment to be provided during 2012-13** - Satellite terminals (IDP 690), Xtreme Radio modems and modem control enclosures to be purchased for hull-contact sensor installations on MV Wana Bhum and MV Xutra Bhum. Note: some or all of the equipment may be purchased before end June 2012.

**C.2 Datastreams to be commissioned during 2012-13** - We expect to instrument the MV Wana Bhum and MV Xutra Bhum with hull-contact sensors by the end of 2012 and supply near real-time SST data streams to eMII by early 2013. A near real-time QC'd SST data stream from RV Linnaeus will also be available to eMII by mid-2012 (currently being tested at BoM).

**C.3 Planned activities to position researchers and others to utilise the Facility** - Informing the Group for High Resolution SST (GHRSSST) Science Team of the existence of the IMOS ship SST data streams via the GHRSSST web site and GHRSSST Science Team Meetings and Workshops.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - Nil to report

***2d Research Vessels Real-Time Air-Sea Fluxes:***

**C.1 New equipment to be provided during 2012-13** – Nil, but will be transitioning from the Southern Surveyor to the Investigator.

**C.2 Datastreams to be commissioned during 2012-13** - Nil

**C.3 Planned activities to position researchers and others to utilise the Facility** - Continue to champion the use of the data for scientific research.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - Nil to report

***2e Bio-Acoustic:***

**C.1 New equipment to be provided during 2012-13** - None

**C.2 Datastreams to be commissioned during 2012-13** - New transects across the EAC (see above).



### C.3 Planned activities to position researchers and others to utilise the Facility

Presentation made at following meetings

- NZ/Aus IMOS
- ICES – FAST
- IUGG
- Sub-Antarctic forum

### C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users - Nil to report

## D Milestones and Implementation Plan

### D.1 Milestones – a separate table has been provided showing contracted Milestones

### D.2 Implementation Plan July 2012 to June 2013

#### *2aa Expendable Bathythermograph:*

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Maintain observations on all routes Sydney-Wellington, Brisbane-Fiji, Astrolabe, Fremantle-Singapore	CMAR / BOM	Ann Thresher	July 2012	June 2013

#### *2ab Biogeochemical:*

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Maintain BGC observations on Astrolabe	CSIRO	J.Akl/C. Neill	Jul 12	Jun 13
Completion of final fit-out of lab van for Astrolabe prior to start of field season	CSIRO	Tilbrook	Jul 12	Oct 12
Maintain BGC observations on Aurora Australis	CSIRO	C. Neill/J.Akl	Jul 12	Jun 13
Complete oxygen consumption tests in Aurora Australis underway lines	CSIRO	C. Neill	Jul 12	Aug 12
Maintain BGC observations on Southern Surveyor	CSIRO	C. Neill/J. Akl	Jul 12	Jun 13
Plan transition of BGC measuring equipment from RV Southern Surveyor to replacement ship, RV Investigator	CSIRO	C. Neill/Tilbrook	Jul 12	Jun 13

#### *2ac Continuous Plankton Recorder:*

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Brisbane-Sydney (Aug, Oct, Dec, Feb, Apr, Jun)	CSIRO	Richardson	July 2012	June 2013
Sydney-Melbourne (Aug, Oct, Dec, Feb, Apr, Jun)	CSIRO	Richardson	July 2012	June 2013
Melbourne-Adelaide (Aug 12, Oct 12, Dec 12, Feb 13, Apr 13, Jun 13)	CSIRO	Richardson	July 2012	June 2013

Northwest (Jul 12, Aug 12, Jan 13?, Jun 13?)	CSIRO	Richardson	July 2012	June 2013
Great Barrier Reef (Sep 12, Oct 12, Mar 13, May 13)	CSIRO	Richardson	July 2012	June 2013
Southern Surveyor (Jul 12 Syd-Hob, Aug 12 Hob-Fre, Sep 12 Broome-Darwin, Oct 12 Darwin-Cairns, Feb 13 Syd-Hob)	CSIRO	Richardson	July 2012	June 2013
Tasmania – NZ (Aug 12, Jun 13?)	CSIRO	Richardson	July 2012	June 2013
Hobart-Antarctica (6 tows Oct 12-Mar 13) – AusCPR	AAD	Hosie	July 2012	June 2013
Hobart-Antarctica (19 tows Oct 12-Mar 13) – SOCPR	AAD	Hosie	July 2012	June 2013

**2b Sensors on Tropical Research Vessels:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Operation of TSG on RV Ferguson (opportunistic basis)	AIMS	Irene Sakorsky	Feb 2012	Dec 2012
Operation of TSG on RV Solander	AIMS	Irene Sakorsky	Feb 2012	Dec 2012
Maintain quality controlled data stream	AIMS	Miles Furnas	July 2012	June 2013

**2c Sea Surface Temperature Sensors for Australian Vessels:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Test, quality assure, reformat and upload RV Linnaeus SST data stream to eMII	BoM	Ruslan Verein	01/01/12	01/03/12
Test Sutron Data logging and transmission systems for Wana Bhum and Xutra Bhum	BoM	John Horvath	01/11/11	01/03/12
Install hull-contact sensors and data transmission equipment on Wana Bhum and Xutra Bhum	BoM	Alan Thomas/ Martin Bugelln/ John Horvath	01/03/12	01/09/12
Test data streams from Wana Bhum and Xutra Bhum	BoM	Ruslan Verein	01/09/12	01/12/12
Upload Wana Bhum and Xutra Bhum SST data to eMII	BoM	Ruslan Verein	01/12/12	01/02/13

**2d Research Vessels Real-Time Air-Sea Fluxes:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Instrument calibration on Southern Surveyor	MNF	Steve Thomas	Dec 2011	Mar 2012
Instrument calibration on Aurora Australis	AAD	Kim Briggs	May 2012	Sept 2012
Maintain quality controlled data stream	BoM	Ruslan Vereiin	July 2012	June 2013

**2e Bio-Acoustic:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Continue all existing lines. Engaged with 6 fishing vessels and 3 Research vessels	CMAR	Rudy Kloser	July 2012	June 2013
Commence EAC lines on large tuna vessel (Santo Rocco)	CMAR	Rudy Kloser	March 2012	June 2013

## **E Project Resources**

### ***2aa Expendable Bathythermograph:***

**E.1 EIF budget** - unchanged

**E.2 Co-investments** – unchanged

### **E.3 Staffing**

<b>Individual</b>	<b>FTE</b>
Craig Hanstein	0.15

### ***2ab Biogeochemical:***

**E.1 EIF budget** - unchanged, although some small carryover of funds for the Astrolabe lab van allocated for 2011/12 may be required to complete fit out prior to the field season later in 2012. This will not affect data collection and is to avoid problems with obtaining workshop staff that are busy on many other projects.

**E.2 Co-investments** - unchanged

**E.3 Staffing** - FTE allocated to the project are still to be resolved for 2012-13. Current estimates are as follows:

<b>Individual</b>	<b>FTE</b>
Craig Neill	0.50
John Akl	0.60
Tony Veness	0.40
Bronte Tilbrook	0.10
<b>Total</b>	<b>1.60</b>

### ***2ac Continuous Plankton Recorder:***

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - unchanged'

### **E.3 Staffing**

<b>Individual</b>	<b>FTE</b>
Frank Coman	0.75
Claire Davies	1.00
Anita Slotwinski	1.00
Mark Tonks	0.60
Dave McLeod	1.00
Joanna Strzelecki	0.30
James McLaughlin	0.10
Margaret Miller	0.10
<b>Total</b>	<b>4.85</b>

**2b Sensors on Tropical Research Vessels:**

- E.1 **EIF budget** - unchanged
- E.2 **Co-investments** - unchanged
- E.3 **Staffing** - Miles Furnas and Irene Sakorsky.

**2c Sea Surface Temperature Sensors for Australian Vessels:**

- E.1 **EIF budget** - unchanged
- E.2 **Co-investments** - unchanged
- E.3 **Staffing**

BoM: Ruslan Verein, IMOS Ocean Observations Scientist, 0.1 FTE PO2 (IMOS)  
BoM: Helen Beggs, 2c Project Manager, 0.1 FTE SPOC (co-investment)  
BoM: Alan Thomas, 2c technical support, 0.05 FTE TO4 (co-investment)  
Note: John Horvath (TO4 – currently funded by IMOS 2c) and Martin Buggeln (casual contractor) will probably finish their IMOS 2c work before 1 Jul 2012.

**2d Research Vessels Real-Time Air-Sea Fluxes:**

- E.1 **EIF budget** - unchanged
- E.2 **Co-investments** - Recruitment of RV Tangaroa has caused co-investment from NIWA. This is probably less than 10% of previously agreed and is estimated at \$3K pa.
- E.3 **Staffing**
  - Data management, Ruslan Verein, 0.5 fte, EIF Funded
  - Project Oversight, Eric Schulz, 0.15 fte, BoM co-investment
  - Project Management, Warwick Howland, 2 days, BoM co-investment
  - Accounts, Ivan Chen, 5 days, BoM co-investment
  - Admin, Margaret Hughes, 2 day, BoM co-investment
  - Legal/Contracts, B. Coutinho, 2 days, BoM co-investment
  - Surveyor at sea instrument maintenance, 32hr, MNF co-investment
  - Aurora at sea instrument maintenance, 32hr, AAD co-investment
  - Project management, Jono Reeve, 2 day, AAD co-investment
  - Tangaroa at sea instrument maintenance, 32hr, NIWA co-investment
  - Project management, Murray Smith, 2 day, NIWA co-investment

**2e Bio-Acoustic:**

- E.1 **EIF budget** - unchanged
- E.2 **Co-investments** - unchanged'
- E.3 **Staffing**

Individual	FTE
Tim Ryan	0.25
Rudy Kloser	0.10

Gordon Keith	0.35
Ryan Downie	0.80
<b>Total</b>	<b>1.50</b>

Staff FTE summary for the Facility:

Sub-Facility	IMOS Funded	Co-invest	Total
2aa XBT	0.15		0.15
2ab BGC	1.60		1.60
2ac CPR	4.85		4.85
2b Tropical	1.00	1.00	2.00
2c SST	0.10	0.15	0.25
2d Fluxes	0.50	0.25	0.75
2e Bio-acoustic	1.50		1.50
<b>Total</b>	<b>9.70</b>	<b>1.40</b>	<b>11.1</b>

## Attachment A.3

Facility: **Australian Bluewater Observing System (ABOS)**  
 Leader: Tom Trull, University of Tasmania / CSIRO  
 Contact: Phone: 03 6226 2988; email: tom.trull@utas.edu.au

No.	SubFacility	Leader	Operator	Phone	Email
3a	Air-Sea Flux Stations	Eric Schulz	BoM	03 9669 4618	e.schulz@bom.gov.au
3b	Southern Ocean Time Series Observations	Tom Trull	CSIRO / UTAS	03 6226 2988	tom.trull@utas.edu.au
3c	Deepwater Arrays	Bernadette Sloyan	CSIRO	03 6232 5152	bernadette.sloyan@csiro.au

### A **Executive Summary**

ABOS has a very ambitious program of mooring builds, refurbishments, deployments and recoveries. The January-June 2012 period is expected to be extremely busy at CSIRO in Hobart with builds for SOTS and Deepwater Arrays and at WHOI in the USA for the build of the second SOFS mooring. Staffing levels and workshop space at CSIRO are just sufficient to complete the work, with little margin for error and none for additional work.

Shiptime is either in place or pending evaluation via competitive proposals for all mooring work. There is no redundancy in the ship arrangements, and delays in builds or changes in ship schedules could cause significant disruption to the data streams. Avenues for redundancy have been explored but are difficult to achieve.

Overall the Facility is already performing at or above target levels for data gathering. Data output and uptake is also increasing. All sub-facilities are moving into full data delivery modes in this year. The Southern Ocean Time Series and Deepwater Arrays sub-facilities have each added a ~1/2 time staff member to facilitate the data delivery (SOTS in 11/12 and DA in 12/13).

#### A.1 **Expected progress with the Facility in the 2012-13 year**

##### ***3a Air-Sea Flux Stations***

The 2012-13 period will mark the transition from a cycle of single mooring deployment followed by land-based refurbishment, to a two-mooring operation allowing for continuous site occupation. This will enable an uninterrupted time-series to be generated and also allow for more flexible logistical planning and execution.

The SOFS-2 mooring is currently deployed. Woods Hole oceanographic Institution (WHOI) is currently constructing a second duplicate SOFS mooring which is due for delivery to Hobart in the first half of 2012. The new mooring will be deployed as SOFS-3 during July 2012 from the Southern Surveyor. SOFS-2 will be recovered on the same voyage.

July 2012-June 2013 will be spent refurbishing the mooring for deployment as SOFS-4 in July 2013. Data quality control and delivery of earlier deployments will be conducted on earlier SOFS deployments during this time.

### ***3b Southern Ocean Time Series***

The 2011-12 year is the first period with a full year duration deployment of the Pulse mooring. Assuming this works correctly, the facility will henceforth move from 6-monthly to annual servicing voyages at great savings in shiptime and staffing resources. This may require some modifications to instruments if bio-fouling is found to be an issue in extending from 6-month to full year deployments.

Starting in the last half of the 2011-12 year, we will build the SAZ-15 and Pulse-9 moorings for deployment in July 2012 from Southern Surveyor (recovering SAZ-14 and Pulse-8 on the same voyage). The second half of 2012 will then focus on sample and data analysis from the recovered moorings. In the first half of 2013 we will then build the SAZ-16 and Pulse-10 moorings. Arrangements for their deployment (and simultaneous recoveries of SAZ-15 and Pulse 9) are not yet fully clear. Options are currently ~August 2013 from RV Investigator, or if its delivery is delayed in ~March 2013 from an extension to the RV Southern Surveyor schedule.

### ***3c Deepwater Arrays***

The East Australian Current array is currently being built and will be deployed by June 2013 - with an 18 month deployment timeline, recovery is planned for December 2013. In 2012-2013 we will build, recover and redeploy the ITF and the Polynya mooring arrays. This will be a significant year for the sub-facility and will require substantial effort of mooring personnel in the first six months of the year. During this period we will build the three ITF moorings and three Polynya moorings.

The ITF mooring turn-a-round will be undertaken on the MNF Southern Surveyor from 25 September- 10 October 2012. The voyage departure/return port is Darwin. All mooring components and instrumentation will be transported to Darwin prior to the voyage departure. Mooring turn-a-round voyages require significant planning and coordination; a number of new instruments for "hot-swapping" will be used; a number of instruments will be redeployed that will require data download, calibration, cleaning and reprogramming. Floatation will be assessed for integrity, cleaned and redeployed. We will take a number of spare instruments and floatation as replacements as required.

The Polynya mooring recovery and redeployment will occur on the RV Tangaroa between December 2012 and January 2013 – exact dates and ports are not yet confirmed. We have anticipated that the departure/return port will be Christchurch, NZ. All Polynya instruments will be "hot-swapped" with like instruments.

Given the tight timeline between recovery/deployment of the ITF mooring array and lead time to ship Polynya mooring equipment to New Zealand, and other commitments to SOTS, it is essential that a significant amount of construction of the Polynya moorings be completed prior to September.

With the recovery of mooring data, we will begin the task of quality assessing and controlling ITF and Polynya current meter and temperature, salinity and pressure data. Data quality control and

data formatting procedure will be compliant with international standard as provided by OceanSITES. Data will be submitted to OceanSITES and IMOS eMII.

In summary, progress expected in 2012-13 is:

- Build, recovery, redeployment of ITF mooring array
- Build, recovery, redeployment of Polynya mooring array
- Data processing of ITF and Polynya mooring data to OceanSITES standards
- Submission of quality controlled data to IMOS eMII and OceanSITES.

## **A.2 Material variations from the agreed plan which are proposed**

### ***3a Air-Sea Flux Stations***

SOFS-2 mooring deployed equipment in excess of the agreed plan. An ADCP and Acoustic Water Column Profiler were deployed at 30m and 500m depth. This will allow for current profiles and biological acoustic data to be collected which will broaden the scientific applications of the mooring. The addition of new instruments of significant bulk and mass does place additional stresses on the mechanical integrity of the mooring – which need to be monitored and assessed carefully. The piggy-back of non-IMOS instrumentation is an ultimate goal of the sub-facility.

### ***3b Southern Ocean Time Series***

Earlier proposed option of adding acoustic communication between subsurface Pulse mooring instruments will not be pursued. This option was considered because of concerns to retrieve some data before potential mooring loss. Now that the mooring has survived two 6-month deployments the option appears less important than focusing on improving data quality and delivery.

### ***3c Deepwater Arrays***

During 2011-2012 we reviewed the use of the AIMS RV Solander as a platform for the deployment of the ITF mooring array. While the RV Solander successfully deployed these mooring in 2010, significant additional costs were incurred by the sub-facility to ensure the successful use of this vessel. During our post-voyage assessment we decided that the MNF RV Southern Surveyor would be a more appropriate vessel to for the turn-a-round vessel for the ITF mooring array. Therefore we submitted a proposal to the MNF national proposal call and were successful in obtained the required 14 days of ship time. The RV Southern Surveyor is a larger vessel that will allow us to recovery and redeploy all three ITF moorings without the need for a mid-voyage port call. It has the sufficient deck space to sort three large anchors, numerous ADCP syntactic spheres, floatation and instruments. It has a shallow and deep ship board ADCP to monitor ocean velocity to 500m and has a multi-beam swath system that will provide accurate bottom topography in water depth of 3500m.

## **A.3 Key risk factors for the year and strategies to address them**

### ***3a Air-Sea Flux Stations***

Delivery in time for deployment. There was some risk that WHOI would not deliver the duplicate SOFS mooring in time for the July 2012 deployment, however advice received on 15 March 2012 confirms that WHOI are on schedule for an on-time delivery. We are talking to the MNF to arrange alternate deployment options to mitigate the risk if it eventuates.



Mooring loss is a risk. Post recovery analysis of SOFS-1 showed minimal fatigue of the mooring from 12 months at sea. SOFS-2 carried a heavier payload but for a shorter 9-month deployment. Increased payload will need to be managed against increased fatigue leading to mooring failure.

### ***3b Southern Ocean Time Series***

Mooring loss –build robust designs, with some redundancy across Pulse, SAZ and SOFS moorings  
Mooring team capacity – same issues and strategies as detailed for 3c in next section.

### ***3c Deepwater Arrays***

Work load of mooring team. As stated this will be a very busy year for the ABOS facility. Peter Jansen and Tom Trull are proactively monitoring the work load and time lines for successful completion on all milestones.

As stated there were some issues with the capability of the RV Solander in deploying the ITF moorings. These issues (deck space) would have been exacerbated with the increased amount of gear required for the ITF recovery and redeployment voyage. Given this we have now moved the ITF mooring operations to the MNF RV Southern Surveyor. This vessel will provide the best platform for a successful and efficient mooring voyage.

## **B Status of the Facility**

### ***3a Air-Sea Flux Stations:***

Highlights: SOFS-1 recovered. SOFS-1 real-time and delayed mode data successfully recovered.

Difficulties: SOFS-1 broke loose after 12 months deployment, but was successfully recovered at the scheduled pick-up voyage with no loss of data or financial penalty to the sub-facility.

Breakthroughs: World first in situ 12-month flux observations in the Southern Ocean.

### ***3b Southern Ocean Time Series Observations:***

Highlights: Addition of ISUS ultra-violet nitrate sensor to Pulse instrument package.

Difficulties: Staff time for data quality assessment and control is very difficult to resource.

Breakthroughs: Successful recovery of water samples for phytoplankton identification and silicate ion concentration measurements using new sample preservation protocols.

### ***3c Deepwater Arrays:***

Highlights: Deployment of ITF moorings array (Timor Sill, Timor North and Ombia). Design of EAC mooring array

Difficulties: The ITF moorings were deployed from the AIMS vessel RV Solander. While the RV Solander successfully deployed these moorings, this required work that was not budgeted in the Facility contract. The unexpected activities included

- the need to use the CMAR mooring winch. This required return shipping between Hobart and Darwin (an additional 20ft sea container), modification of the winch bottom plate such that it would bolt down into existing strong point on the RV Solander main deck. Maintenance of the winch to ensure it was in good working order on shipment and return from Darwin.

- Purchase of 2 electrical operated lift points (2 and 5 tonne) to enable us to deploy the 4 tonne moorings used on the Timor Sill and Ombai moorings. The RV Solander A-frame lift capacity was only 2 tonne.
- The hire of a 12 kHz depth sounder that would provide bottom depth in water greater than 1500m. The RV Solander sounder has a maximum water depth range of 1500m. The Timor Sill mooring was deployed in water depths greater than 3000m and in a region where no accurate swath or ship sounding data were available.
- The hire of a crane to install and remove the CMAR mooring winch on the back deck of the RV Solander.
- The space on the back deck of the Solander was too small to have all moorings loaded onto the vessel. We therefore had to return to Darwin after deployment of the two Timor Passage moorings to load the Ombai mooring. This resulted in needing 13 days of RV Solander ship time rather than the planned and budgeted 10 days. We also incurred the additional cost associated with operating the RV Solander in international waters.

The final design of the EAC mooring array has been completed. From design studies based on numerical models (Blue link) and previous observations (WOCE PCM3, mooring array at 30S) we increased the buoyancy on the array due to strong episodic bottom counter current. The increased buoyancy has resulted in re-evaluation of the mooring array budget and whole-of-life budget for the sub-facility. Budget adjustments to the Deepwater Arrays have been agreed between CMAR and IMOS. The deployment of the PIES, as identified in the node plan, will not be delivered, however the EAC array will still meet the science goals of providing a time series of mass, heat and salt transport of the EAC.

Breakthroughs: Nil to report

## **C Facility Infrastructure**

### ***3a Air-Sea Flux Stations:***

**C.1 New equipment to be provided during 2012-13** - The duplicate SOFS mooring is due to be delivered for deployment in July 2012. This is a significant enhancement to the sub-facility and completes the infrastructure required to continuously occupy the SOTS site.

**C.2 Datastreams to be commissioned during 2012-13** - SOFS-3 real-time data will be available. SOFS-2 delayed mode data will be processed during this time.

**C.3 Planned activities to position researchers and others to utilise the Facility** - Continue efforts to integrate data into OceanSITES and engage with the OceanSITES community. Work with researchers using the SOFS data:

- Fullbright scholar Marvin Alfaro (supervised by Rintoul, Sloyan & England) examining Southern Ocean mixed layer dynamics.
- Simon Josey (NOCS) Global fluxes and NCEP validation
- Lisan Yu (WHOI) validation of OAFflux

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - None

### ***3b Southern Ocean Time Series Observations:***

- C.1 New equipment to be provided during 2012-13** - Four-frequency Acoustic Water Column Profiler to be deployed on the SOFS mooring will add new information on zooplankton distributions and their seasonal variations, helping to constrain biogeochemical models of the ecosystem controls on carbon export.
- C.2 Datastreams to be commissioned during 2012-13** - ISUS nitrate sensor data from Pulse mooring; Acoustic zooplankton data from SOFS mooring
- C.3 Planned activities to position researchers and others to utilise the Facility**  
P.I. Trull will be convenor of special session on Southern Ocean biogeochemistry at AMSA meeting in Hobart in July 2013, to showcase data to Australian research community.  
UWA Honours Student will participate in mooring voyage.  
UTAS-CSIRO QMS PhD Project has been advertised to use SOTS data.  
P.I. Trull as member of OceanSITES scientific steering committee will work to expand awareness of data.
- C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - None

### ***3c Deepwater Arrays:***

- C.1 New equipment to be provided during 2012-13** -Potential for provision of additional CTDS and Current Meters (SBE 37s, RDI-Teledny ADCPs) as CMAR co-investment subject to CAPEX bids.
- C.2 Datastreams to be commissioned during 2012-13**  
ITF mooring array data records for period June 2011 – September 2012  
Polynya mooring array data records for period January 2011 – January 2012
- C.3 Planned activities to position researchers and others to utilise the Facility**
- A research assistant (data QC and QA) will be employed 50% FTE to processes recovered data stream from the ITF and Polynya mooring arrays. Rebecca Cowley will fill this position. She was involved in the data management of the previous INSTANT mooring array and therefore has the necessary skills to manage the mooring data.
  - ITF and Polynya data streams, for period given above, will be made available to national and international research via the eMII and OceanSITES data servers.
  - Sloyan and Wijffels are writing a proposal to ACCSP to utilise ITF mooring data
  - Sloyan and Wijffels will submit a PhD project proposal to CSIRO-UTAS QMS program. The PhD project will investigate the dynamic of the Indonesian Throughflow, and interaction with large scale climate modes of the Pacific (ENSO) and Indian (IOD) Oceans.
  - Steve Rintoul and ACE CRC colleagues will assess the Polynya mooring array data.
- C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**
- The Deepwater Array budget will be subdivided into three projects: EAC, ITF and Polynya. This will provide more assessable budget tracking of all projects in the sub-facility.
  - ABOS is represented on the OceanSITES committee. Data will be sent to OceanSITES for international access and uptake.

- We are members of the international community (CLIVAR, SOOS) that will acknowledge the CMAR –IMOS investment in high quality long-term monitoring of key ocean regions. We will work in these groups and internationally to increase the visibility of the ITF, Polynya and EAC mooring arrays and availability of data.
- We have membership on the CLIVAR ITF task team, and initiated communication between this task team and the Indian Ocean CLIVAR-IGOOS panel.
- We have strong links with the SOOS that will increase the visibility of the Polynya mooring data.
- Presentations at national and international conferences promoting the availability of the mooring data time-series.

## D Milestones and Implementation Plan

### D.1 Milestones – a separate table has been provided showing contracted Milestones

**3a Air-Sea Flux Stations:** Deployment of SOFS-3, recovery of SOFS-2 brought forward ~2 months due to ship availability.

**3b Southern Ocean Time Series Observations:** Minor deploy/recovery changes associated with extension of deployment durations from 6 to 12 months. Other milestones unchanged.

**3c Deepwater Arrays:** Milestones unchanged

### D.2 Implementation Plan July 2012 to June 2013

#### **3a Air-Sea Flux Stations:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Provide SOFS-3 tether, anchor, tower	BoM/CSIRO	Schulz/Jansen	Jan 12	Jun12
Deploy SOFS-3	BoM/CSIRO	Schulz/Jansen	Jul 12	Jul12
Recover SOFS-2	BoM/CSIRO	Schulz/Jansen	Jul 12	Jul12
Build SOFS-4	BoM/CSIRO	Schulz/Jansen	Jul 12	Jun 13

#### **3b Southern Ocean Time Series Observations:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Build SAZ-15 mooring	CSIRO/UTAS	Trull/Jansen/Bray	Jan 12	Jun 12
Build Pulse-9 mooring	CSIRO/UTAS	Trull/Jansen	Jan 12	Jun 12
Deploy Pulse-9, SAZ-15	CSIRO/UTAS	Trull/Jansen/Bray	July 12	July 12
Recover Pulse-8, SAZ-14	CSIRO/UTAS	Trull/Jansen/Bray	July 12	July 12
Build SAZ-16 mooring	CSIRO/UTAS	Trull/Jansen/Bray	Jan 13	Jun 13
Build Pulse-10 mooring	CSIRO/UTAS	Trull/Jansen	Jan 13	Jun 13

**3c Deepwater Arrays:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Construction and instrument preparation of the Polynya and ITF moorings arrays	CMAR	Bernadette Sloyan	1-July 2012	1 November 2012
Recovery and re-deployment of ITF mooring array	CMAR	Bernadette Sloyan	24 September 2012	10 October 2012
Recovery and redeployment of Polynya Mooring array	CMAR	Bernadette Sloyan	~December 2012	January 2013
Quality control and formatting of data recovered from the Polynya and ITF mooring array. Data submitted to eMII and OceanSITES	CMAR	Bernadette Sloyan	November 2012	June 2013

**E Project Resources**

**3a Air-Sea Flux Stations:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - unchanged

**E.3 Staffing**

<u>EIF Funded Positions:</u>		<u>In-kind Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>	<b>Individual</b>	<b>FTE</b>
Verein, Ruslan - Data Management (BOM)	0.50	Schulz, Eric, Oversight (BOM)	0.15
OEB Tech - Met Support/Deploy (BOM)	0.20		
Rosenberg, Mark - Deploy (UTAS)	TBC		
Jansen, Peter - Project Managing Eng (UTAS)	TBC		
LaDuke, James - Mech/Elec (CSIRO)	0.20		
Cherry, Dave - Mech/Deploy (CSIRO)	0.30		
<b>Totals</b>	<b>1.20</b>		<b>0.15</b>

**3b Southern Ocean Time Series Observations:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - unchanged

### E.3 Staffing

EIF Funded Positions:		In-kind Funded Positions:	
Individual	FTE	Individual	FTE
LaDuke, James - Mech/Elec (CSIRO)	0.70	Trull, Tom - Oversight (CSIRO)	0.15
McLaughlan, Dan - Mech (CSIRO)	0.20	Trull, Tom - Oversight (UTAS)	0.15
Cherry, Dave - Mech/Deploy (CSIRO)	0.40	Rosenberg, Mark - Deploy (UTAS)	0.15
TBA - Bio-optical sensor data (CSIRO)	0.25	Bray, Stephen - SAZ Build, Deploy (UTAS)	0.90
TBA - Design, procure, build (CSIRO)	0.40		
Bray, Stephen - SAZ Build, Deploy (UTAS)	0.10		
Trull, Tom - Oversight (UTAS)	0.20		
Jansen, Peter - Managing Eng (UTAS)	1.00		
<b>Totals</b>	<b>3.25</b>		<b>1.35</b>

#### 3c Deepwater Arrays:

- E.1 EIF budget** - As a result of the difficulties outlined at part B Status of the Facility, the IMOS Board agreed to invest an additional \$525,000 in the Deep Array facility.
- E.2 Co-investments** - As agreed at the IMOS Board Meeting in December 2011, CSIRO will provide an additional \$515,000 cash co-investment. \$425,000 was contributed in 2011/12 to fund the additional instrumentation on the ITF array. Another \$90,000 will be funded in 2012/13 to cover a prospective overspend on consumables and additional labour for the ITF array.

### E.3 Staffing

EIF Funded Positions:		In-kind Funded Positions:	
Individual	FTE	Individual	FTE
McLaughlan, Dan - Mech (CSIRO)	0.35	Sloyan, Bernadette (CSIRO)	0.10
Derrick, Jamie – Mech/Deploy (CSIRO)	0.35		
De Boer, Phil - Mech/Deploy (CSIRO)	0.35		
Cowley, Rebecca - Data Analysis (CSIRO)	0.50		
Adams, Phil - Mech/Elec (CSIRO)	0.30		
TBA - Mech/Elec/Manage (CSIRO)	0.20		
<b>Total</b>	<b>2.05</b>		<b>0.10</b>

Staff FTE summary for the Facility:

Sub-Facility	IMOS Funded	Co-invest	Total
3a SOFS	1.20	0.15	1.35
3b SOTS	3.25	1.35	4.60
3c Deepwater	2.05	0.10	2.15
<b>Total</b>	<b>6.50</b>	<b>1.60</b>	<b>8.1</b>

## Attachment A.4

Facility: **Australian National Facility for Ocean Gliders (ANFOG)**  
Leader: Charitha Pattiaratchi, The University of Western Australia  
Contact: Phone: 08 6488 3179; email: chari.pattiaratchi@uwa.edu.au

### A **Executive Summary**

#### A.1 **Expected progress with the Facility in the 2012-13 year**

The facility has matured significantly in the provision of data streams from ocean gliders to the nodes as per node science and implementation plans. Gliders have been deployed at all scientific node locations multiple times. The total number of glider deployments exceeds 110 and, allowing for trials and early recoveries, the total number of deployments providing extended data streams is over 70. Processed QA/QC data to December 2011 is now available. This level of activity is expected to continue to June 2013. A total of 31 Slocum deployments and 16 Seaglider deployments are proposed from July 2012 to June 2013. Provision of real-time digital data through the GTS was achieved for the Seagliders in 2011 and will be extended to include the Slocum gliders in 2012.

#### A.2 **Material variations from the agreed plan which are proposed**

Glider transects to the Southern Ocean Time Series site will be paused during 2012-13, in part to excessive bio-fouling and concerns about integrity of bio-optical data. Data streams collected to date will be analysed and anti-fouling options investigated before any further transects are undertaken.

#### A.3 **Key risk factors for the year and strategies to address them**

The second half of 2011 was challenging with the loss of 3 gliders (1 Slocum and 2 Seagliders) and two others experiencing communication problems. This highlighted the risks associated with the deployment and recovery of ocean gliders. The Slocum glider was lost during recovery when the boat bumped onto the glider resulting in the glider sinking. One Seaglider is stuck in the Perth Canyon whilst the other was lost due to communication problems. A major strategy to be implemented in 2012 includes the installation of Argos tags on the Seagliders. Currently, Seagliders depend only on the iridium communication (satellite phone) and having an independent system to locate the glider builds redundancy.

### B **Status of the Facility**

#### **Highlights:**

- The major highlight has been the publication of 2 papers in a high impact journal using the ocean glider data. In the first, researchers in Western Australia using the Slocum glider data along the Two Rocks transect demonstrated that formation of dense shelf water to be a regular process. This process has not been identified as a regular occurrence prior to obtaining ocean glider data. Off the south-east of Australia, researchers demonstrated that dense water which is initially formed in Bass Strait is transported northward and subsequently entrained into eddies of the East Australian Current, are then transported southwards and are present off the east coast of Tasmania.
- All of the ocean glider deployments completed prior to December 2011 are now available on

the IMOS data portal.

- The real-time data broadcast of the Seaglider on GTS means that the data stream is available globally for assimilation into numerical models.
- A new version of 'Gliderscope' was released.

**Difficulties:** In the second half of 2011, the facility lost 3 gliders (1 Slocum and 2 Seagliders) with two other Seagliders experiencing communication problems.

- The Slocum glider was lost during recovery when the boat bumped onto the glider resulting in the glider sinking.
- One Seaglider is stuck in the Perth canyon whilst the other was lost due to communication problems. Two other gliders (Coral Sea and SOTS) experienced difficulties but were recovered. The SOTS glider failed to communicate for almost 3 months but then suddenly re-surfaced and was recovered off the south coast of Tasmania. In light of these difficulties, Glider transects to the Southern Ocean Time Series site will be paused during 2012-13, in part to excessive bio-fouling and concerns about integrity of bio-optical data. Data streams collected to date will be analysed and anti-fouling options investigated before any further transects are undertaken. Due to the problems described, Seaglider deployments ceased in December 2011, and will recommence late March 2012 when the new Argos communications are fitted.

**Breakthroughs:** The availability of real-time data through the GTS is a major breakthrough.

## **C Facility Infrastructure**

### **C.1 New equipment to be provided during 2012-13**

- 1 Slocum glider has been ordered for Tasmania to be delivered in May 2012.
- 2 Slocum gliders have been ordered for WAIMOS as part of WA State Government funding
- 1 Seaglider to be purchased from self-insurance funds to replace a sea-glider lost in late 2011

### **C.2 Datastreams to be commissioned during 2012-13**

- All of the data to December 2011 are available through the IMOS portal.
- Data from 2012 and 2013 will be available through the portal when complete.
- Real-time data from Slocum gliders will be available through GTS in 2012.

### **C.3 Planned activities to position researchers and others to utilise the Facility**

- Dialog with Nodes to ensure timely availability of data streams.
- Dialog with Nodes to promote the uptake of the ocean glider data. To be undertaken through the quarterly meetings of the ocean glider data user group.
- Development of Ocean glider tutorial using 'Gliderscope' to demonstrate the utility of ocean glider data.
- Promote the use of 'Gliderscope' which will facilitate the uptake of the ocean glider data.

### **C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

The Facility has matured significantly over the past few years and consists of sound governance. Two new personnel will join the facility in 2012. Regular meetings (quarterly) of the ocean glider data user group has been effective in providing comments on the adequacy and QA/QC procedures which have improved the quality (and accuracy of the data). There has been considerable interest



from overseas to visit the Facility – in the past 12 months we have had personnel from India, China, South Africa and UK visiting the facility as well as from the ocean glider manufacturers: Webb Research and iROBOT, respectively.

## D Milestones and Implementation Plan

### D.1 Milestones – a separate table has been provided showing contracted Milestones

### D.2 Implementation Plan July 2012 to June 2013

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Slocum deployments	Seaglider deployments
SW- Western Australia (WAIMOS)	UWA	Pattiaratchi	6	3
NSW- IMOS	SIMS	Pattiaratchi / Suthers	4	3
SAIMOS	SARDI	Pattiaratchi / Middleton	4	2
Bluewater	CSIRO	Pattiaratchi / Ridgway	-	4
QIMOS (Coral Sea)	AIMS	Pattiaratchi / Steinberg	-	4
TasIMOS	CSIRO	Pattiaratchi / Thompson	9	
		<b>IMOS funded</b>	<b>23</b>	<b>16</b>
Pilbara- Western Australia	UWA	Pattiaratchi	4	-
Kimberley – Western Australia	UWA	Pattiaratchi	4	-
		<b>WA Govt funded</b>	<b>8</b>	-
		<b>Totals</b>	<b>31</b>	<b>16</b>

Note – based on previous experience, it has been decided with the Nodes that an annual allocation of gliders to the Node will be given with the exact dates to be determined 3 months in advance. This removes the reliance on boats and availability gliders and thus will be more definite.

## E Project Resources

**E.1 EIF budget** – in line with the additional funding co-invested by the WA Government (see E.2 below) IMOS funds of \$245,000 were provided as additional support to extend slocum glider deployments into the Pilbara and Kimberly regions.

### E.2 Co-investments

The WA Government provided an additional \$1,099,000 to extend the slocum glider deployments into the Kimberley and Pilbara regions over the period 2011-2014.

### E.3 Staffing

EIF Funded:

- Ben Hollings (operations manager) – 1.0 FTE
- Dr Mun Woo (data officer) – to 31 January 2012 as 1.0 FTE. Continuing as 0.2 FTE to June 2013.
- Dennis Stanley (technical officer) – 1.0 FTE
- Dr Paul Thomson (Biogeochemical data) – 1.0 FTE – to 30 June 2012.

- Dr Christine Hanson (Biogeochemical data) – 0.8 FTE from 1 July 2012 (currently on maternity leave).
- Ruth Gongora-Mesas (administrative officer) – 1.0 FTE

Co-investment:

- Technical officer – 1.0 FTE (to be appointed, funded through WA State Government)
- Technical officer (Lindsay McDonald) – 0.2 FTE (CSIRO, Hobart funded through Tasmanian State Government)

Total staff are IMOS 5 FTE; Co-invest 1.2 FTE

## Attachment A.5

Facility: **Australian Autonomous Underwater Vehicle Facility (AUV)**  
Leader: Stefan Williams, Sydney Institute of Marine Science  
Contact: Phone: 02 9351 8152; email: stefanw@acfr.usyd.edu.au

### A Executive Summary

**A.1 Expected progress with the Facility in the 2012-13 year** - In 2012-13 we will revisit sites in WA (at Ningaloo, Rottnest Island, Jurien Bay and the Abrolhos Islands), Tasmania, NSW, SE Queensland. We will also establish new sustained observing sites at the Solitary Islands (funded in part through NERP co-investment) and in the Southern GBR.

**A.2 Material variations from the agreed plan which are proposed** - As outlined below, the AUV was lost during surveys in SE Queensland in November 2011, and recovered a few weeks later. This resulted in planned deployments in NSW at Bateman's Bay and Port Stephens having to be missed. This incident also delayed the start of the new vehicle design as there were a number of changes to the existing vehicle required to minimize the risk of loss following its recovery. This consumed significant technical staff resources over the December to February 2012 period.

**A.3 Key risk factors for the year and strategies to address them** - As highlighted by the near loss of the AUV in late 2011, there are risks associated with the deployment of these sorts of systems. We have revised our operating and maintenance procedures, redesigned the emergency drop weight mechanism, as well as rewritten much of the vehicle's software systems to give us greater control of the vehicle while it is underway. We have also integrated an independently powered GPS/Iridium tracking system that will allow the vehicle to be tracked while it is on the surface independent of the ship itself.

### B Status of the Facility

#### Highlights:

In 2011-12, the AUV Facility completed repeat surveying in Tasmania, WA (at Rottnest Island, Jurien Bay, the Abrolhos Islands and Scott Reef) and SE Queensland at Moreton Island. Additional benthic reference sites were also established in the GBR lagoon and outer reef at Myrmidon Reef in Queensland.

- GBR Lagoon (02/2011): The objectives of this trip was to survey historical seagrass beds in the GBR lagoon and to evaluate the ability of the ACFR Iver2 AUV, a smaller torpedo shaped vehicle, to conduct water column surveys of fresh water plumes associated with fresh water outfalls.
- WA (04/2011) Rottnest Island, Jurien Bay and the Abrolhos Islands: These dives featured a combination of repeated surveys at sites initially surveyed in 2010 as well as the establishment of new sites at locations where the initial surveys were not positioned over features of interest. The repeat surveys confirmed the ability of the vehicle to revisit sites with high precision. Evidence of significant coral bleaching were seen at the Abrolhos Islands which may be associated with a significant warming event along the west coast. During initial deployments off Rottnest Island, the vehicle impacted on the vessel's transom during deployment. This resulted in damage to the vehicle's thrusters and battery systems. The AUV Facility team

performed repairs onboard and the mission objectives were met.

- Tasmania (06/2011). The objectives for this cruise were repeat surveys of urchin barrens at St. Helens and the establishment of benthic reference sites in the Flinders Commonwealth Marine Reserve. The equipment shipped from Sydney to Hobart appeared to have been left out during a storm and the Facility's computer enclosure, which is meant to be sealed against the elements, leaked. This resulted in damage to one of the servers used to support operations. The UV Facility team improvised a workaround and was able to complete all of the planned dives.
- GBR Lagoon and Outer Reef (07/2011): Objectives were establishing reference sites in the GBR lagoon and on the outer reef at Myrmidon Reef. The lagoon surveys were designed to replicate surveying conducted previously as part of the seabed biodiversity project. Despite visiting all of the sites that featured dense seagrass beds in the historical surveys, no evidence of seagrass beds were seen as part of this survey. Additional dives were completed on the outer reef near Myrmidon Reef.
- SE Queensland (10/2011): Cruise objectives were to revisit sites off of Moreton Island. On the final day of operations, after completing the mission and having surfaced briefly, the vehicle sank below the surface and ended up on the bottom. The trim of the vehicle had been checked prior to operations but heavy rain the evening before it was lost may have resulted in a reduction of water density resulting in a change in the vehicle's buoyancy. The ship's captain alerted the team to the fact that he did not have sufficient fuel to stay on station with the vehicle to wait for the emergency drop weight to release. Refuelling took four hours and when the vessel returned the vehicle was no longer at the last known location. Despite three days of searching by air and sea, no evidence of the vehicle was seen. We decided to abandon the direct search and to distribute flyers alerting fishing operators, dive crews and yacht clubs that the vehicle might be adrift in the area. Two weeks later a reporter on the Sunshine Coast called telling us that the vehicle had been found on a beach approximately 100 km north of where it was lost. The vehicle was loaded into its shipping boxes and returned to Sydney by Facility personnel. Despite having been adrift for two weeks and having washed up on the beach, the main vehicle sensors did not sustain substantial damage and the AUV was rebuilt during January 2012 without significant additional cost to the Facility budget.

**Difficulties:**

- As outlined above, in November 2011 the AUV was lost on the final day of surveys at Moreton Island at SE Queensland. The AUV washed up on shore on the Sunshine Coast. This resulted in planned surveys in NSW being deferred.
- In September 2011 George Powell, our technical officer in charge of deck operations and maintenance, passed away. Much of his experience and discipline has been missed training new staff.

**Breakthroughs:** We have demonstrated the ability of the vehicle to revisit survey sites at locations around Australia. This was the objective of the sustained benthic-observing program design.

## **C Facility Infrastructure**

- C.1 New equipment to be provided during 2012-13** - We will continue working on the design and commissioning of a new vehicle. The loss of Sirius has resulted in some additional maintenance work and a significant rewrite of the vehicle's software systems. We will also continue improving

the imaging systems on the vehicle and have had a number of requests for forward looking and higher resolution downward looking cameras. We are investigating the possibility of meeting these requests using funds already committed to the Facility.

**C.2 Datastreams to be commissioned during 2012-13** - We plan the following deployments during 2012-13. These will result in repeat surveys at most sites around the country.

Location	Dates	Objective
Solitary Islands, NSW	Aug., 2012	Establish sites at Solitary Islands
SE Queensland	Oct., 2012	Sustained observing of kelp/coral habitats
Bateman's Bay/Port Stephens NSW	Nov., 2012	Sustained observing of kelp habitats
Southern Great Barrier Reef	Dec., 2013	Sustained observing of kelp/coral habitats
Western Australia	Apr., 2013	Sustained observing of kelp/coral habitats
Tasmania	June, 2013	Resurvey of coral reef habitats

We have also been approached by SAIMOS to consider establishing benthic reference sites in South Australia. A discussion between the IMOS office, the AUV Facility and SAIMOS may be required in order to investigate options for funding such an activity and to determine how it might be accommodated given the current vehicle deployment schedule.

**C.3 Planned activities to position researchers and others to utilise the Facility** - We are planning a workshop in March 2012 to solicit input from our end user community to capture requirements for online access to the data and collaborative analysis tools. Representatives from all of the nodes, research partners and government agencies have been invited to attend the meeting.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users** - The data for the majority of the historical AUV dives is now available through the eMII portal. A first prototype of an interface for browsing the AUV data has been developed and the workshop in March 2012 will set the direction for further development of this area. We have secured funding the ANDS and NeCTAR to facilitate this work. The AUV Facility scientific advisory group continues to monitor our progress and provide feedback on the Facility activities.

## **D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

**D.2 Implementation Plan July 2012 to June 2013**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Solitary Islands, NSW	SIMS	S.B. Williams	Aug., 2012	Aug., 2012
SE Queensland	SIMS	S.B. Williams	Oct., 2012	Oct., 2012
Bateman's Bay/Port Stephens NSW	SIMS	S.B. Williams	Nov., 2012	Nov., 2012
Southern Great Barrier Reef	SIMS	S.B. Williams	Dec., 2013	Dec., 2013
Western Australia	SIMS	S.B. Williams	Apr., 2013	Apr., 2013
Tasmania	SIMS	S.B. Williams	June, 2013	June, 2013

## **E Project Resources**

**E.1 EIF budget** - unchanged.

**E.2 Co-investments** - unchanged.

### **E.3 Staffing**

- Mr. Andrew Durrant (1.0 FTE EIF funded; hired April 2011 to replace Dr. Duncan Mercer) – coordinates logistics associated with maintenance and deployment of the AUV. Responsible for data upload to eMII. Also contributes to electronics and mechanical upgrades.
- Mr. Jeremy Randle (1.0 FTE EIF funded; seconded from other projects in Jan. 2012 to replace Mr. George Powell) – coordinates logistics and responsible for mechanical design. Will lead the mechanical design requirements for the facility to support the integration of additional sensors and the new vehicle design.
- Mr. Christian Lees (1.0 FTE co-investment from University of Sydney; hired Sept. 2011 using co-investment from University of Sydney after being seconded for a year from DSTO) – leads software and electronic design of the vehicle. Participates in fieldwork.
- Mr. Ritesh Lal (0.5 FTE co-investment from University of Sydney) – embedded electronics design, particularly of lighting systems.

Total EIF funded– 2.0 FTE; Total co-investment funded – 1.50, plus

In addition, the following academic staff contribute to the operations of the facility. Times indicated relate to the percentage of time the participants contribute to activities that directly impact on IMOS AUV Facility activities.

- Assoc. Prof. Stefan B. Williams (0.5 FTE; ARC Future Fellow at University of Sydney) – leads the IMOS AUV Facility, coordinates mission scheduling and planning, leads fieldwork.
- Dr. Oscar Pizarro (0.25 FTE; ARC QEII Fellow at University of Sydney) – co-leader of the IMOS AUV Facility, contributes to vehicle upgrade and design, leads fieldwork, research in clustering and classification related to marine imagery.
- Dr. Michael Jakuba (0.25 FTE; University of Sydney postdoctoral fellow) – research in adaptive surveying, leads fieldwork, returned to the US in mid-2011 to take up a position as a research engineer at the Woods Hole Oceanographic Institution.
- Dr. Matthew Johnson-Roberson (0.25 FTE; ARC Super Science Fellow) – leads software development of 3D visualisation and image analysis.
- Dr. Mitchell Bryson (0.25 FTE; ARC Linkage Fellow) – leads change detection research, participates in fieldwork.
- Dr. Navid Nourani-Vatani (0.25 FTE; SIEF research fellow) – leads research in classification of marine imagery, participates in fieldwork.

Total EIF funded– 2.0 FTE; Total co-invested – 3.25 FTE

## Attachment A.6

Facility: **Australian National Mooring Network (ANMN)**  
 Leader: Tim Lynch, CSIRO  
 Contact: Phone: 03 6232 5239; email: tim.lynch@csiro.au

No.	SubFacility	Leader	Operator	Phone	Email
6a	Queensland and Northern Australia Moorings	Craig Steinberg	AIMS	07 4753 4444	<a href="mailto:c.steinberg@aims.gov.au">c.steinberg@aims.gov.au</a>
6b	New South Wales Moorings	Moninya Roughan	SIMS	02 9385 7067	<a href="mailto:mroughan@unsw.edu.au">mroughan@unsw.edu.au</a>
6c	South Australia Moorings	John Middleton	SARDI	08 8207 5449	<a href="mailto:john.middleton@sa.gov.au">john.middleton@sa.gov.au</a>
6d	Western Australia Moorings	Ming Feng	CSIRO	08 9333 6512	<a href="mailto:ming.feng@csiro.au">ming.feng@csiro.au</a>
6e	Acoustic Observations	Rob McCauley	CUT	08 9266 5219	<a href="mailto:r.mccauley@cmst.curtin.edu.au">r.mccauley@cmst.curtin.edu.au</a>
6f	National Reference Stations	Tim Lynch	CSIRO	03 6232 5239	<a href="mailto:tim.lynch@csiro.au">tim.lynch@csiro.au</a>
6g	Acidification Moorings	Bronte Tilbrook	CSIRO	03 6232 5273	<a href="mailto:bronte.tilbrook@csiro.au">bronte.tilbrook@csiro.au</a>

### A Executive Summary

#### A.1 Expected progress with the Facility in the 2012-13 year

By the start of the 2012-13 year the last six of the facility's 77 moorings will have been deployed (Figure 1 & 2) bringing the facility to design density. The facility's 15 water sampling sites are all now operational and the four central processing laboratories are up-loading data independently to eMII. The facility will continue to carry out scheduled mooring rotations, sampling and processing throughout the 2012-13 year.

A basic quality control (QC) procedure for delayed mode mooring data will move from its current design phase across three National Reference Stations (NRS) into operation for the facility as a whole. The procedure is based on the 9 tests developed by Morello et al 2011 and will allow flagging of data that pass or fail these tests as it is processed with the Matlab toolbox. The tests procedures are also being coded for the NRSMAI and NRSNSI telemetry feeds and will allow assessment of real-time QC in 2012-13.

Five QC working groups – Salinity and Temperature, Fluorescence, profiling CTD, ADCP and BGC will provide advice both throughout the year and formally at the QC summit in August 2012 on their progress. QC working groups for Oxygen and Turbidity will be developed. Each component in the facility now has scientific oversight of data streams.

Both raw and QC datasets will be forwarded to eMII within timelines that will be agreed between the ANMN and eMII based on the facility's workflow.

A variety of methodological publications are in progress and are expected to be published in 2012-13. Several international collaborations, such as with Ocean Observatories Initiative (OOI), are also being developed based on the knowledge gained in the start up phase of the IMOS program.

The Bio-optical data stream from the Wetlab ecotriplets will be acquired for 4 NRS stations: Maria Island, Port Hacking, Rottneest Island and Yongala. The data will be uploaded in delayed mode to the IMOS portal

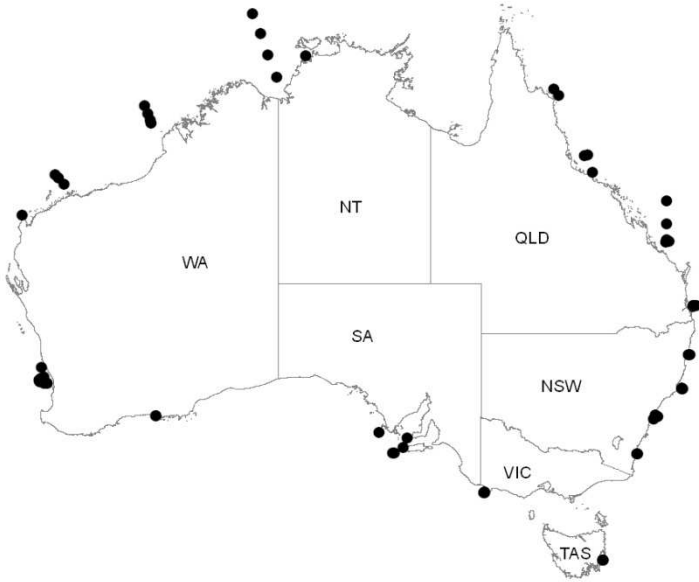


Fig 1. Design density of the moored components of the ANMN

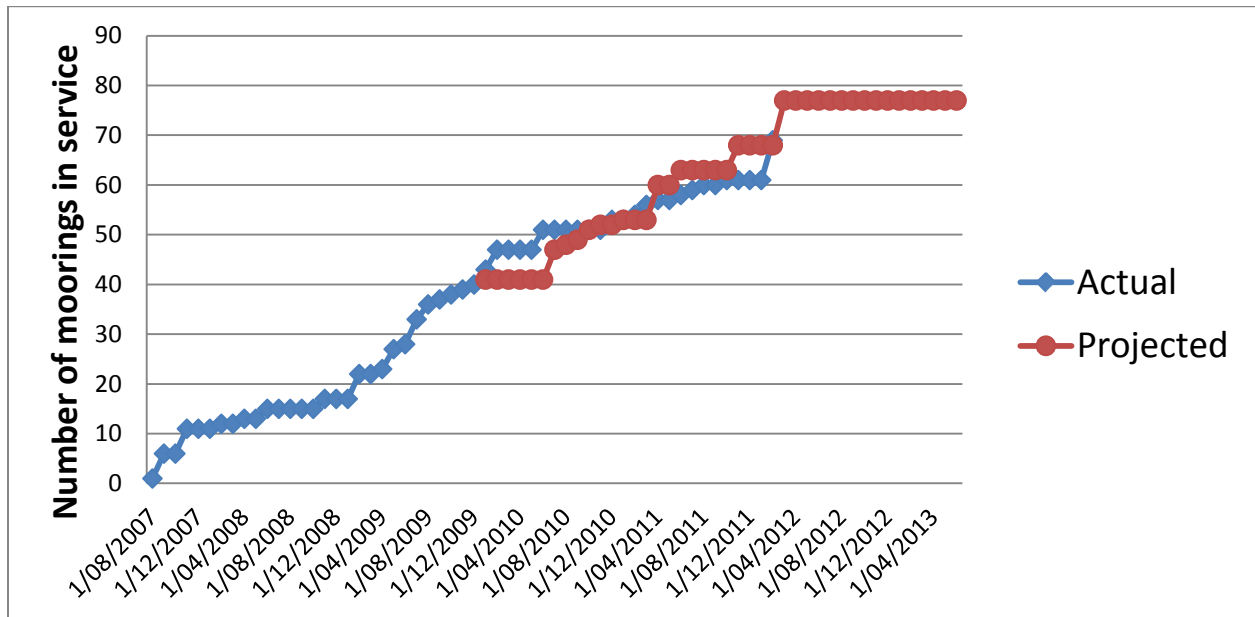


Fig 2. Rate of growth towards design density of the ANMN moorings.



## A.2 Material variations from the agreed plan which are proposed

- The South Australian sub-facility Cabbage Patch mooring (SAM2CP) has been discontinued as the data there was very similar to that off Coffin Bay (SAM5CB). Also, reducing the number of moorings is required as we are now maintaining three of the moorings continuously rather than seasonally. With two CTD's being calibrated by CSIRO at any given time this is the maximum number we can support and provide sufficient reserves for the mooring hot-swaps.
- Favourable exchange rates have meant the extra ITF shelf mooring is to be retained and extra temperature and salinity loggers to be attached to the moorings, increasing frequency of sampling to capture significant internal tide activity.

## A.3 Key risk factors for the year and strategies to address them

Given the number and variety of data streams being delivered from across the facility, there is a risk that too high a proportion of available resources will be taken up by deployment and recovery activities, leaving insufficient resources available for quality control (QC) of the data streams. We are developing several strategies to address risks involved with QC. These include QC working groups, data teams, supervising scientists for each sub-facility and an annual summit.

The facility is also fostering relationships regarding QC with the CSIRO ICT division and CSIRO Calibration laboratory, our manufacturers at Seabird and Wetlabs and with the USA Ocean Observing Initiative (OOI).

Staff attrition is a potential risk, due to the rate of work required to maintain the network at design density (Fig 3), and a tension between resourcing sampling/rotations, processing of data and publishing of methods. Multi-skilling of technical officers skills has been implemented to ensure any loss of key personal will result in minimal impact to mooring rotations, BGC sampling and facility management.

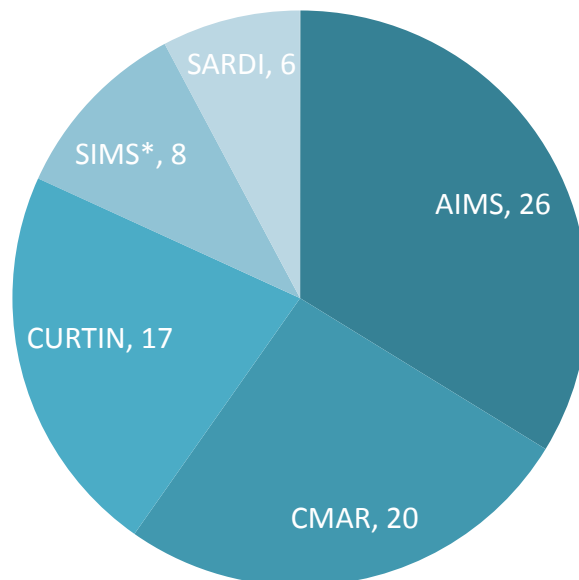


Fig 3. Division of moorings by institute - \* SIMS has the ORS mooring maintained in-kind by Sydney Water.

Key risk factor for all fieldwork is weather, and OHSE issues that develop with the combination of rough weather and deploying heavy equipment from small boats and small ships.

The CO<sub>2</sub>/acidification mooring at the NRS site near Kangaroo Island is in a challenging location due to frequent high waves and strong currents. This is the only surface mooring at the site. A rough weather, bungee and catenary mooring system, similar to that deployed at PULSE and NRSNSI, has been designed by the CSIRO coastal mooring team to minimise the chances of loss. The mooring location will also be monitored with an automated email alarm system established to alert the facility if the mooring breaks away.

Gear loss is an ongoing risk. To mitigate this risk, moorings are closely monitored in order to schedule appropriate rotation intervals. It is planned that subsurface moorings will be fitted with beacons to indicate if they have broken loose. Automatic monitoring of real time feeds is proposed to give early warning of mooring problems. The facility has requested that all sub-facilities register gear within their institutes to allow for insurance claims.

## **B Status of the Facility**

### ***6a Queensland and Northern Australia Moorings:***

Highlights: The mooring array continues to operate well with good data returns. The ITF shelf moorings on the NW Shelf have been joined by the Kimberley array in January 2012. The Pilbara line was deployed in February 2012, completing the Northern Australian array co-funded by the WA State Government announced in May 2011.

Difficulties: No difficulties were reported

Breakthroughs: Favourable exchange rates have meant the extra ITF shelf mooring is to be retained and extra temperature and salinity loggers to be attached to the moorings. The NW Shelf array is being incorporated into a number of complementary regional process based observations for ARC, WAMSI and US NRL/UWA and AIMS ADAPTER, NICOP studies.

### ***6b New South Wales Moorings:***

Highlights:

- SIMS / UNSW hired a mooring technician
- Brad Morris took on the role of moorings operations manager
- SIMS/UNSW deployed the Batemans Marine Park mooring pair off Narooma on 30-Mar-2011
- Since this time, we have had 6 successful deployments off Narooma, with the 7th currently in the water.
- SIMS/UNSW took over the operation of the Coffs Harbour mooring pair, undertaking their first deployment independent of Manly Hydraulics Lab (previously the sub-contractors employed to do this)
- Since last report (beginning 2011) there have been;
  - 5 Sydney Deployments
  - 7 PH deployments
  - 6 CH Deployments
  - 6 BMP Deployments.

Difficulties: Ongoing issues with the WQM's, both in software and hardware. Ongoing problems with WQM power issues. Have had trouble getting a response out of Wetlabs and IMBROS. IMBROS took many months to return instruments that were sent back from repair/ calibration so we have some data gaps. This highlighted issues with the QC of bio-optical data.

Breakthroughs: Having identified issues with step changes in WQM data the bio-optics community and the moorings sub-facility have come together to resolve some of these issues. Numerous papers have been presented at conferences in 2011.

#### **6c South Australia Moorings:**

Highlights: The highlight for SAIMOS is that we have successfully maintained this sampling schedule and with a 90% or so return of valid data. The Kangaroo Is NRS reported lost in February 2011 was recovered on a subsequent cruise. The ADCP was damaged and sent back and repaired by Underwater Video Systems. With some minor exceptions, the deployments were made as outlined in the 2011-2012 SAIMOS mooring business plan. Three moorings, NRSKI (Ref. Station), SAM8SG (Spencer Gulf) and SAM5CB (Coffin Bay) are maintained continuously. During the summer period the shelf moorings (SAM7DS and SAM3MS) are also deployed. Biological data has been collected from the mooring sites NRSKAI, SAM8SB, SAM2CP, SAM5CB) (and at 3 depths) during each field cruise and since February 2008.

Difficulties:

- a) Following the recovery of the NXIC CTDs from the reference station in February 2011, it was found that the batteries had died some 6 weeks earlier. This was sourced to a feature in the NXIC CTDs whereby there can exist a slight power drain to the conductivity cell when batteries are connected, even when the instruments are not deployed (confirmed by discussions with Teledyne technicians). The problem manifests itself through a faint but audible high pitched noise coming from the un-deployed instrument. This situation is now avoided by only installing the batteries immediately prior to deployment.
- b) As the SAIMOS region of study lies some 12-14 hours steaming from Adelaide, unforeseen changes in predicted weather can lead to the disruption/cancellation of field cruises.

Breakthroughs: 'Lost' NRSKAI mooring recovered and CTD battery problem rectified.

#### **6d Western Australia Moorings:**

Highlights: The WA sub-facility has successfully maintained the Two Rocks mooring line and two Perth Canyon moorings. Some moorings were enhanced with the CSIRO CAPEX funds and some moorings were re-designed in order to avoid instrument losses. The sub-facility employed a physical oceanographer Liejun Zhong at 0.3 FTE and CSIRO Wealth from Oceans Flagship co-invested an additional 0.4 FTE to assist the mooring data QC process. The sub-facility has now maintained a relatively high data return rate.

Other highlights were:

- The 500m Two Rock mooring was redesigned to have a single bottom mounted ADCP and the mooring was last deployed in November 2011.
- A RBR multi sensor was added at 70m of the 200m Two Rocks mooring, along with a Nortek ADCP. The mooring was last deployed in December 2011.
- An RBS multi sensor and a bottom mounted ADCP were added to the 150m Two Rocks mooring.

The mooring was last deployed in December 2011.

- A Seabird multi sensor and a bottom mounted ADCP were added to the 100m Two Rocks mooring. The mooring was last deployed in January 2012.
- The 50 Two Rocks mooring was last deployed in January 2012.
- The Perth Canyon 500 m mooring has been maintained and was last deployed in January 2012.
- The Perth Canyon 200 m mooring is enhanced with a bottom mounted Nortek ADCP and the mooring was last deployed in October 2011.
- The sub-facility has also been maintaining the Rottneest and Esperance NRS station moorings, and ADCP moorings have been deployed at the NRS sites since mid-2011.
- The sub-facility has been maintaining the physical samplings for the Rottneest, Esperance and Ningaloo NRS stations.

Difficulties: Occasionally there have been competitions from other projects about personnel and ship time usage, which have been largely resolved through CSIRO internal negotiations. The data QC is still delayed by the matlab toolbox development. CSIRO scientists have fully engaged in the toolbox development in terms of strategy and technical advice.

Breakthroughs: The shelf mooring array captured the “marine heat wave” phenomena in 2011.

#### ***6e Acoustic Observations:***

Highlights: The Passive acoustic moorings will carry on as planned for the Perth Canyon, Portland and NSW moorings with mooring service visits expected: April-2012 NSW; June-2012 Perth Canyon; November-2012 Portland; April-2013 NSW; and June-2013 Portland and Perth Canyon. The new north Western Australian moorings are expected to be ready to deploy early in the second half of 2012, according to the agreed schedule. The hardware is currently being assembled for the instruments and mooring.

- Recovering the third consecutive full data set from the Perth Canyon with tracking capability. Analysis of tracking data for pygmy blue whale source movements in the Perth Canyon agrees and enhances available visual observations (from a handful of tracked animals to hundreds).
- Detection of Antarctic blue whales moving up and down the east Australian coast over winter;
- Use of IMOS data in several publications;
- An increase in the number of users of IMOS passive acoustic data, widespread interest in access to archived information especially in assessing changes in ocean noise and several new projects and students in the offing or in progress utilising IMOS passive acoustic data.
- Observation of feeding humpback and southern right whales in Perth Canyon during June-2011 service visit.
- Continuation of instrumentation of passive acoustic moorings with temperature loggers.

Difficulties:

- We had problems in late 2012 with a leading Australian freight company (Toll) on-shipping freight back to the source location after it had arrived at its destination. This combined with weather and vessel delays caused a cascading series of problems for the 2010-2011 Portland deployments (gear recovered and re-deployed Feb-2012) which has degraded quality of 2010-2011 data.
- Problems with ORE acoustic releases currently believed to be a service issue.
- Strong currents and poor weather off NSW in early 2011 causing problems in recovering gear.

- Slow pace passive acoustic data access through the eMII web portal and little support and feedback in enabling us to assist.
- Issues with display of temperature logger data from moorings at eMII.

Breakthroughs: Use of IMOS data to confirm downward shift in call frequency of pygmy and Antarctic blue whale calls over seasonal and decadal time at small and large scales. We have no idea why this is occurring.

#### **6f National Reference Stations:**

Highlights: Near continuous operation of the telemetry moorings NRSMAI and NRSNSI with less than 5% downtime. Rotations of ADCP moorings at Maria and NSI, provided the first delayed mode data of currents at these sites. We have up-loaded to eMII test QC'ed data from NRSMAI using the new QC functionality of the Matlab toolbox. Mr Ken Ridgeway has provided scientific over-view of the NRS MAI data streams and has been allocated 0.2 FTE for the 2012-13 financial year to continue this role and expand oversight to NRS NSI.

The SEQ shelf array has been designed, equipment purchased and is nearing build completion. A deployment vessel has been sourced and the deployment is on track for timely delivery of the milestone.

The phytoplankton data show that we are sampling phytoplankton in space and time scales that allow us to see broad spatial patterns and assess temporal changes, and it is encouraging to see these patterns emerging. Phytoplankton data has been taken up and used in publications.

Pigment data (HPLC) has been formatted to be consistent with other data streams provided by the IMOS data centre, to make these data more usable to a variety of researchers.

- BGC samples from NRS DAR and NRS NIN come online in the 2011-12 financial year
- NRS NSI has managed to collect 12 samples despite difficult weather. Samplers are receiving backup and training and know exactly what should be done.
- A new microscope bought with CSIRO Capex funds has improved zooplankton analysis efficiency
- Mark Tonks has completed his Cox's certificate giving NRS sampling extra flexibility.
- Training in South Africa in non-copepod zooplankton is a big step in zooplankton taxonomic resolution capability.

For NRSMAI sampling the new CSIRO vessel *South Cape* is a more reliable and safer platform and handles better in rough weather, so sampling can be done in more marginal conditions than previously.

#### Difficulties:

The sub surface mooring broke loose at NRS MAI over the Christmas holidays due to a faulty shackle. Acoustic ranging of the acoustic modems allowed recovery of mooring assembly and re-installation on site. A new shackle type of higher quality is now being used.

Raw profiling CTD data up-loaded to eMII is not useful for analysis. A new processing method, under development by the profiling CTD working group and eMII, will solve this issue.

Delays in getting samples, CTD and other bottle data are a difficulty for QC of carbon samples, but improvements are being made by the NRS community.

Surface instrumentation on the Yongala NRs was damaged by TC Yasi in Feb 2011 requiring the mooring to be removed and some components to be replaced. Delayed mode water column moorings have been deployed until the real time mooring has been refurbished. Equipment losses were covered by Comcover insurance so no financial impost to IMOS.

A delay in acquiring the ecotriplets from Wetlabs means that a roll out of the instrument to the NRS stations will start in the last quarter of FY 11/12. Deployment at Maria Island is planned for April 2012

Breakthroughs:

Loss of NRSMAI sub-surface allowed proving of acoustic ranging as a valid mooring search and recovery technique.

All analysis lab technicians are now, like the mooring technicians, fully trained to enter data directly to eMII. We are starting to see all NRS stations coming on stream with uniform data handling and reporting, making it a much more efficient process.

Formation of the PBL facility with several staff trained in HPLC analysis is a major breakthrough – and a highlight – because there is now no issue with staff absences delaying data delivery.

We identified that the CMAR flow cytometer was inadequate to detect a key part of the phytoplankton (*Prochlorococcus*) and arranged for UWA to do the analysis. This may continue or CMAR may acquire an appropriate instrument and resume analysis.

#### ***6g Acidification Moorings:***

Highlights: Maria Island has been delivering data since April 2011 and continues to perform well. Kangaroo Island mooring will be deployed in early February 2012, weather permitting.

Difficulties: The large Yongala mooring that houses the CO<sub>2</sub> sensors was damaged by Cyclone Yasi and is awaiting redeployment, planned for April 2012. Re-commencement of this data stream from Yongala requires a successful redeployment.

Breakthroughs: The sub-facility has developed a reliable and accurate method for calibration of the Aanderra Optode Oxygen sensor.

## **C Facility Infrastructure**

### ***6a Queensland and Northern Australia Moorings:***

#### **C.1 New equipment to be provided during 2012-13**

Most equipment capital purchase has been finalised in 2011-12 and so only minor replacements are expected to be made

#### **C.2 Datastreams to be commissioned during 2012-13**

Kimberley and Pilbara arrays will be recovered in July and August 2012 after their initial deployment in January and February 2012. These will provide additional ADCP, temperature and salinity profiles

with additional water quality. Yongala and Darwin NRS are being redesigned to improve real time data reliability

**C.3 Planned activities to position researchers and others to utilise the Facility**

Continuously improve and implement QA and QC procedures. Design user friendly interfaces and data products for specific users and stakeholders

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

Participation in national and international conferences (SPICE, ICRS, AMOS, AMSA, ACRS) and workshops to highlight the data streams

***6b New South Wales Moorings:***

**C.1 New equipment to be provided during 2012-13**

With the exception of replacements for lost or damaged equipment, no new equipment will be purchased.

**C.2 Datastreams to be commissioned during 2012-13**

No new data streams to be commissioned.

**C.3 Planned activities to position researchers and others to utilise the Facility**

We continue to run annual data user workshops in conjunction with eMII. Further we have been heavily involved in the development of a masters in Marine Science and Management course where the capstone subject is an introduction to the wonderful data available through the IMOS portal. In order to facilitate ease of use of the data each of the modules have developed data processing tools that can be used to visualise the data and extract maximum value from it.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

UNSW has taken over the operation of the CH and Narooma moorings. With the savings from not paying MHL we are now in a position to hire a part time admin assistant and an additional 50% technician. This will grow the breadth of the team so that we are able to operate sustainably. We will also train some back up field personnel, who can be available if required due to injury etc.

***6c South Australia Moorings:***

**C.1 New equipment to be provided during 2012-13**

With the exception of replacements for lost or damaged equipment, no new equipment will be purchased.

**C.2 Datastreams to be commissioned during 2012-13**

No new data streams to be commissioned.

**C.3 Planned activities to position researchers and others to utilise the Facility**

The SAIMOS field surveys have hosted other add-on research activities that have not involved significant additional time or resources. Indeed, any additional scientific staff are required to assist with the collection of SAIMOS data.

This research in 2011-2013 includes:

- a) Collection of isotope data to assist in water mass analyses of the region (L. Richardson, PhD, SARDI)
- b) Collection of dolphin DNA data to examine the ecology and molecular ecology of dolphins (Dr Luciana Moller, Flinders University)
- c) Collection of phytoplankton data off Port Stanvac to determine community composition and abundance (Dr Sophie Leterme, Flinders University).
- d) Proposal to collect benthic sediments to understand their origin and relation to physical processes (Prof. Noel James, Queens, Ontario).
- e) Proposal to collect water samples to assess trace metals in the region (Dr Sophie Leterme, Flinders University and Dr Zanna Chase, University of Tasmania).

In addition, to encourage SAIMOS data uptake, we plan, in conjunction with eMII, to encourage data uptake through additional data workshops: that run in September and in 2011 attracted 40-50- attendees. Furthermore, industry/community workshops will run in October at Port Lincoln, Adelaide, Kangaroo Is and Robe. These workshops have been most successful in raising awareness of SAIMOS in the past and in encouraging marine industry participation.

Finally, the development of the second phase Marine Innovation South Australia (MISA) is seeking to provide a co-ordinated, whole of S.A. approach to new and significant developments in the exploitation of our marine resources. MISA-2 involves all SA and related marine research agencies (e.g. CSIRO) and will inevitably lead to greater uptake of SAIMOS data and in the likely growth of SAIMOS itself. This is exemplified by the proposed drilling for oil and gas by BP, in the Great Australian Bight, and by Bight Petroleum in the SAIMOS region. These major industry programs will need to provide substantive Environmental Impact Studies that will need to incorporate SAIMOS data.

#### **C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

In light of the development of MISA-2, we will redevelop the SAIMOS Node and ANMN sub-facility management committees to better integrate with and inform the MISA Steering and Advisory Committees. This will encourage more effective management and governance of SAIMOS as well as providing the key stakeholders in MISA of opportunities in SAIMOS

##### ***6d Western Australia Moorings:***

#### **C.1 New equipment to be provided during 2012-13**

No new equipment will be purchased.

#### **C.2 Datastreams to be commissioned during 2012-13**

No new data streams will be commissioned

#### **C.3 Planned activities to position researchers and others to utilise the Facility**

- Alan Pearce from the Department of Fisheries plans to use the mooring data to quantify the development of the marine heat wave in 2011, which will have management implications for fisheries and marine environment.
- Liejun Zhong from CSIRO will use ROMS model to simulate ocean circulation and temperature/salinity characteristics during the IMOS operation time period and understand the mechanism of short term and annual variability.



- Olga Bondarenko (PhD student) from UWA is going to use the IMOS mooring data to understand the drivers of Perth Canyon production and link it to whale sightings in the region.
- There are also plans to use the mooring data, in combination with surface Radar data, to understand mesoscale, and sub-mesoscale variability on the shelf (Chari Pattiaratchi from UWA).

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

Through WA IMOS Node, the sub-facility presents mooring data at the Node annual conference to engage external users of IMOS data.

***6e Acoustic Observations:***

**C.1 New equipment to be provided during 2012-13**

Two new passive acoustic moorings are to be deployed in north Western Australia, one along the line of moorings running NW of Broome at the shelf break in 250-300 m water depth and one on the shelf edge west of Dampier. The expected date of deployment will be early in the second half of 2012 (depending on AIMS vessel schedule)

**C.2 Datastreams to be commissioned during 2012-13**

Data streams expected are: 1) Passive acoustics – Portland Dec-2010 to Dec-2011 (recovered, in QC process); NSW 2011 to 2012 to be recovered April-2012; Perth Canyon June-2011 to June-2012 to be recovered June-2012; Portland Feb-2012 to Nov-2012 to be recovered Nov-2012; NSW April-2012 to April-2013 to be recovered April 2013; Perth Canyon June-2012 to June-2013 to be recovered June 2013; Portland Nov-2012 to June-2013 to be recovered June 2013; Broome line mid 2012 to mid 2013; Dampier line mid 2012 to mid 2013. 2) Temperature data – all moorings instrumented with temperature loggers on seabed and 30-50 m above seabed.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Several publications have been produced with IMOS data, several are in progress. Three PhD students we know of are utilising IMOS data. Curtin staff will be presenting at several national and international conference/workshops on topics which utilise IMOS data.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

None beyond those proposed in our IMOS agreement and evolving from existing collaborations.

***6f National Reference Stations:***

**C.1 New equipment to be provided during 2012-13**

- CAPEX bid for an appropriate flow cytometer to enable picoplankton analysis to be performed at CMAR may occur.
- Purchase of pumping system or other options for collecting an integrated water column sample over 50m.
- The calibration lab needs time to calibrate profiling CTDs between monthly samplings. We suggest a spare Seabird, pooled around the NRS sites, may be necessary to overcome slight delays waiting for calibrations.
- A replacement zooplankton net is needed for NRSKAI.
- Corrosion problem with connectors on Seabird SBE19 plus profiling CTD are creating problems

for data accuracy. All Seabirds may need connector and cable replacement.

- Need to purchase 4 Pelican salinity cases, c \$800 each.
- No mooring capital items a programmed for purchase in 2012-13.

## **C.2 Datastreams to be commissioned during 2012-13**

- Results from the 2009-2011 flow cytometry (picoplankton) samples analysed at UWA, should be available mid-2012.
- A template will be established for flow cytometry (picoplankton) data so formatting of the data from picoplankton analysis will stay the same irrespective of where the analysis is carried out.
- The ZooScan may provide a new data stream or at least an additional table to the zooplankton data base.
- Bio-optical Data stream from the triplets will be acquired for 4 NRS stations: Maria Island, Port Hacking, Rottneest Island and Yongala. The data will be uploaded in delayed time to the IMOS portal
- SEQ is programmed to be first recovered in October 2013.

## **C.3 Planned activities to position researchers and others to utilise the Facility**

- SCOR working group 137 has been provided with all the phytoplankton data and is investigating whether the data is suitable for time series analysis.
- Lesley Clementson showcased the IMOS bio-optical database to a phytoplankton functional group workshop on satellite PFT algorithms in Sapporo, Japan, November 2011. Conversion of the BGC pigments data to similar templates - this work is almost completed - will allow inter-comparison of the pigment data. Information will be presented at other meetings which extend the public knowledge of availability of the data base.
- The NRS and AUSCPR zooplankton data will be showcased at the CMAR Science Symposium in Hobart, March 2012, and included in a session on zooplankton at AMSA in Hobart, July 2012. Other scientists are using the NRSNSI sampling vessel as a platform for their own research.
- A UTAS PhD project based on water collected at NRSMAI is underway. The logistics of glider deployment in conjunction with NRSMAI sampling is being investigated. Genetics potential sampling is being discussed.
- ACE-CRC post doc Elizabeth Shadwick is utilising the NRS carbon data. The NRS data is contributing to the International Acidification Network stations.
- Further training in NRS sampling and processing, and phytoplankton counting and identification will be provided in early 2012.
- The sub-facility leader Tim Lynch is working closely with members of the Bio-optics data user group on the FLNTU data streams. NRSMAI datastreams are also being assessed by Tim Lynch and Ken Ridgeway. Various grant proposals are also in development. Several papers are in Preparation for methods in Oceanography on the NRS network and the QC system.
- Quality of the Bio-optics data will be discussed and assessed by the Bio-Optics working group.

## **C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

- Oversight of the facility management moving to the Deputy Chief Marine (research) Tony Worby will hopefully be beneficial for science uptake.
- Greater coordination with eMII in development of pigment, phytoplankton and zooplankton data bases will increase public access to data, which will all be in a more suitable format.
- Monthly budget reviews are held across this sub-facility.

- Post rotation reviews are conducted on the mooring infrastructure.

***6g Acidification Moorings:***

**C.1 New equipment to be provided during 2012-13**

None

**C.2 Datastreams to be commissioned during 2012-13**

Final QC products for Yongala and Kangaroo Island moorings.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Projects are planned to enhance the use of mooring data by the research community. This includes involvement in the CSIRO Carbon Collaboration Cluster that will support university researchers and encourages the use of these data, and proposals for postdocs. The moorings are highlighted at national and international meetings and described in international programs such as the International Ocean Carbon Cycle Project (IOC/SCOR).

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

Frequent planning meetings and budget reviews occur in conjunction with the NRS sub-facility. Software to handle and reduce raw data is being constructed and is aimed at more rapid QC and identification of problems and solutions.

**D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

***6a Queensland and Northern Australia Moorings:*** With the expansion to include Kimberley and Pilbara arrays there are additional milestones (see the AIMS contract with UTas/IMOS). This has also affected the scheduled servicing has been changed in order to fit in the extra work. This means the Ningaloo and Darwin NRS servicing is moved forward. So instead of servicing by Jun 12, Dec 12..., it should be Mar 12, Sep 12..., also the data submission for NIN and DAR should be in Jun 12, Sep 12...

***6b New South Wales Moorings:*** Milestones unchanged

***6c South Australia Moorings:*** We have had to reduce the number of moorings maintained during summer from six to five: the Cabbage Patch mooring (SAM2CP) has been discontinued as the data there was very similar to that off Coffin Bay (SAM5CB). The reason for reducing the number of moorings is that we are now maintaining three of the moorings continuously rather than seasonally. With two CTD's being calibrated by CSIRO at any given time this is the maximum number we can support and provide sufficient reserves for the mooring hot-swaps.

***6d Western Australia Moorings:*** Milestones unchanged

***6e Acoustic Observations:***

Milestones are unchanged at the moment, though the Portland array is under review due to issues with logistics, calibration and data return.

**6f National Reference Stations:** Milestones are unchanged

**6g Acidification Moorings:** Milestones are unchanged

## D.2 Implementation Plan July 2012 to June 2013

### **6a Queensland and Northern Australia Moorings:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
WAIMOS ITF array + Darwin NRS service	AIMS	Steinberg	2/7/2012	15/7/2012
WAIMOS Kimberley array service	AIMS	Steinberg	18/7/2012	29/7/2012
WAIMOS Pilbara array + Ningaloo NRS service	AIMS	Steinberg	1/8/2012	13/8/2012
Q-IMOS Southern GBR service	AIMS	Steinberg	10/8/2012	25/8/2012
Submit data to eMII collected up to June 30	AIMS	Steinberg	1/7/2012	30/9/2012
Q-IMOS Northern GBR + Yongala service	AIMS	Steinberg	19/10/2012	25/10/2012
Submit data to eMII collected up to Sep 30	AIMS	Steinberg	1/10/2012	30/12/2012
WAIMOS ITF array + Darwin NRS service	AIMS	Steinberg	Jan 2013	Jan 2013
WAIMOS Kimberley array service	AIMS	Steinberg	Feb 2013	Feb 2013
WAIMOS Pilbara array + Ningaloo NRS service	AIMS	Steinberg	Feb 2013	Feb 2013
Q-IMOS Southern GBR service	AIMS	Steinberg	Feb 2013	Mar 2013
Submit data to eMII collected up to Dec 30	AIMS	Steinberg	1/1/2013	30/3/2013
Q-IMOS Northern GBR + Yongala service	AIMS	Steinberg	Apr 2013	May 2013
Submit data to eMII collected up to Mar 30	AIMS	Steinberg	1/4/2013	30/6/2013

### **6b New South Wales Moorings:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Coffs Harbour Service/CH070 + CH100 (Dpl020)	SIMS/UNSW	Roughan/Morris	Jul-2012	Sep-2012
Coffs Harbour Service/CH070 + CH100 (Dpl021)	SIMS/UNSW	Roughan/Morris	Sep-2012	Nov-2012
Coffs Harbour Service/CH070 + CH100 (Dpl022)	SIMS/UNSW	Roughan/Morris	Nov-2012	Jan-2013
Coffs Harbour Service/CH070 + CH100 (Dpl023)	SIMS/UNSW	Roughan/Morris	Jan-2013	Mar-2013
Coffs Harbour Service/CH070 + CH100 (Dpl024)	SIMS/UNSW	Roughan/Morris	Mar-2013	May-2013
Coffs Harbour Service/CH070 + CH100 (Dpl025)	SIMS/UNSW	Roughan/Morris	May-2013	Jun-2013
Sydney Service/SYD100 (Dpl028)	SIMS/OFS	Roughan/Morris	Jul-2012	Oct-2012
Sydney Service/SYD100 (Dpl029)	SIMS/OFS	Roughan/Morris	Oct-2012	Jan-2013
Sydney Service/SYD100 (Dpl030)	SIMS/OFS	Roughan/Morris	Jan-2013	Apr-2013
Sydney Service/SYD100 (Dpl031)	SIMS/OFS	Roughan/Morris	Apr-2013	Jun-2013
Sydney Service/SYD140 (Dpl028)	SIMS/OFS	Roughan/Morris	Aug-2012	Nov-2012
Sydney Service/SYD140 (Dpl029)	SIMS/OFS	Roughan/Morris	Nov-2012	Feb-2013
Sydney Service/SYD140 (Dpl030)	SIMS/OFS	Roughan/Morris	Feb-2013	May-2013
Sydney Service/SYD140 (Dpl031)	SIMS/OFS	Roughan/Morris	May-2013	Jun-2013
Port Hacking Service/PH100 (Dpl023)	SIMS/OFS	Roughan/Morris	Jun-2012	Sep-2012
Port Hacking Service/PH100 (Dpl024)	SIMS/OFS	Roughan/Morris	Sep-2012	Dec-2012
Port Hacking Service/PH100 (Dpl025)	SIMS/OFS	Roughan/Morris	Dec-2012	Mar-2013
Port Hacking Service/PH100 (Dpl026)	SIMS/OFS	Roughan/Morris	Mar-2013	May-2013
Port Hacking Service/PH100 (Dpl027)	SIMS/OFS	Roughan/Morris	May-2013	Jun-2013
Narooma Service/BMP090+BMP120 (Dpl010)	SIMS/UNSW	Roughan/Morris	Jul-2012	Sep-2012
Narooma Service/BMP090+BMP120 (Dpl011)	SIMS/UNSW	Roughan/Morris	Sep-2012	Nov-2012
Narooma Service/BMP090+BMP120 (Dpl012)	SIMS/UNSW	Roughan/Morris	Nov-2012	Jan-2013
Narooma Service/BMP090+BMP120 (Dpl013)	SIMS/UNSW	Roughan/Morris	Jan-2013	Mar-2013

Narooma Service/BMP090+BMP120 (Dpl014)	SIMS/UNSW	Roughan/Morris	Mar-2013	May-2013
Narooma Service/BMP090+BMP120 (Dpl015)	SIMS/UNSW	Roughan/Morris	May-2013	Jun-2013

**6c South Australia Moorings:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
SAM7DS 600 m isobath S.E. of K.I.	SARDI	Charles James/John Middleton	October 2012	April 2013
SAM3MS 200 m isobath S.E. of K.I.	SARDI	Charles James/John Middleton	October 2012	April 2013
NRSKAI 110 m isobath west of K.I.	SARDI	Charles James/John Middleton	July 2012	May 2013
SAM8SG 50 m isobath at mouth of Spencer Gulf	SARDI	Charles James/John Middleton	July 2012	May 2013
SAM5CB 100 m isobath south of Coffin Bay	SARDI	Charles James/John Middleton	July 2012	May 2013
Deployment of NRSKAI of Kangaroo Is	SARDI	Charles James	August 2008	May 2013

**6d Western Australia Moorings:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Two Rocks moorings	CSIRO	Ian Darby / Ming Feng	July 2012	June 2013
Perth Canyon moorings	CSIRO	Ian Darby / Ming Feng	July 2012	June 2013
Rottneest NRS moorings	CSIRO	Ian Darby / Ming Feng	July 2012	June 2013
Esperance NRS moorings	CSIRO	Ian Darby / Ming Feng	July 2012	June 2013
Physical sampling at three NRS stations	CSIRO	Ian Darby / Ryan Crossing / Ming Feng	July 2012	June 2013

**6e Acoustic Observations:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Deploy two NW WA moorings with two sea noise loggers on each mooring	CMST	McCauley	June-Aug 2012	Aug 2012
Recover – redeploy Portland mooring	CMST	McCauley	Nov-2012	Nov-2012
Recover NSW mooring, redeploy if continued	CMST	McCauley	Apr-2013	Apr-2013
Recover – redeploy NW WA moorings	CMST	McCauley	Apr/May-2013	Apr/May-2013
Recover Perth Canyon mooring, redeploy if continued	CMST	McCauley	Jun-2013	Jun-2013
Recover Portland mooring, redeploy if continued	CMST	McCauley	Jun-2013	Jun-2013

**6f National Reference Stations:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
NSI Rotation	CSIRO	David Hughes	July 2012	
MAI Rotation	CSIRO	David Hughes	October 2012	
NSI Rotation	CSIRO	David Hughes	November 2012	
NSI Rotation	CSIRO	David Hughes	March 2013	
MAI Rotation	CSIRO	David Hughes	April 2013	
SEQ deployment	CSIRO	David Hughes	March 2013	
Roll out and rotation of bio –optics triplets at 4 NRS	CSIRO	Rex Keen / Vittorio Brando	7/12	6/13
Upload in delayed time to the IMOS portal of bio –optics triplet data	CSIRO	Rex Keen / Vittorio Brando	7/12	6/13

**6g Acidification Moorings:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Mooring servicing turnaround/Maria Island	CSIRO	Tilbrook	Oct-12	Nov-12
Mooring servicing turnaround/Kangaroo Is	CSIRO	Tilbrook	03/02/2012	May 2013
Mooring servicing turnaround/Yongala	CSIRO	Tilbrook	Sept-12	Dec-12
Mooring servicing turnaround/Maria Island	CSIRO	Tilbrook	Apr-13	May-13
Mooring servicing turnaround/Kangaroo Is	CSIRO	Tilbrook	Aug-12	Oct-12
Mooring servicing turnaround/Yongala	CSIRO	Tilbrook	Sept-12	Dec-12

**E Project Resources**

**6a Queensland and Northern Australia Moorings:**

**E.1 EIF budget**

EIF Budget increased by \$833,000 in line with the agreement with the WA Government to extend the IMOS mooring network into the Kimberly and Pilbara regions of WA.

**E.2 Co-investments**

There is a proposal for co-investment from Darwin Port Corp to extend the Darwin observations \$250K. All other co-investment is as planned. The WA Government provided \$3,528,000 over the period 2011-14 to extend the IMOS mooring network into the Kimberly and Pilbara regions of WA.

**E.3 Staffing**

Individual	FTE
Craig Steinberg	0.75
Paul Rigby ES	1.00
Felicity McAllister ES	0.80
Simon Spagnol ES	0.40
David K Williams ES	0.05
WAIMOS ES	1.00
John Luetchford TO	0.72

Chris Bartlett TO	1.00
Juergen 'Baly' Zier TO	1.00
WAIMOS TO	1.00
Michelle Skuza	0.10
Margaret Wright	0.07
Peter Speare	0.05
Johnston Davidson	0.05
Jonathon Windsor	0.20
Kristy McAllister	0.15
<b>Total</b>	<b>9.34</b>

### **6b New South Wales Moorings:**

#### **E.1 EIF budget**

An insurance claim was put in by MHL for lost instrumentation however we have been advised that their insurance company will not cover the claim.

- loss of one Aquatec 520 Temperature logger from CH070 on 14 April 2011 - loss value of \$799
- loss of complete thermistor riser from CH100 in June 2011, including 9 x Aquatec temperature loggers, 4 x Aquatec temperature/pressure loggers, 1 x ORE acoustic release, 2 x large Viny buoys (for torpedo) plus freight - loss value of \$20,554
- loss of ADCP mooring from CH100 in June 2011, including 1 x ADCP, 1 x ADCP external battery pack, 2 x ORE acoustic release, 4 x Viny buoys plus freight - loss value of \$47,108.

The above loss values are based on a quote provided by UVS on 23 August 2011 and exclude GST. Total Replacement cost \$68,461.

MHL has received advice from the NSW Department of Finance and Services' (DFS) Insurance Services Co-ordinator that the three insurance claims submitted for the IMOS Coffs Harbour moorings instrumentation losses have been declined by the Treasury Managed Fund (TMF) Claim Manager based on the advice of the appointed Insurance Adjuster, Cerno Limited.

The following is an extract from an email to the DFS Insurance Services Co-ordinator from the TMF Claim Manager outlining the reasons for declining the insurance claims:

*"As previously discussed the NSW Treasury Managed Fund will be declining claim MPD9000040 as the damage to the temperature logger is due to corrosion and as such will not be covered by the NSW Treasury Managed Fund as the damaged water line resulted from wear, tear and maintenance related issues. Under the Contract of Coverage Section 5.2 Property it specifically excludes under (b) "wear and tear".*

*In regard to claims MPD9000041 & MPD9000042 the contract supplied shows that the Department of Finance and Services are not liable for these items therefore the loss of the oceanographic mooring systems will not be covered by the NSW Treasury Managed Fund. Therefore please be advised that MPD9000040, MPD9000041 & MPD9000042 will now be finalised."*

The DFS Insurance Services Co-ordinator has also advised that:

*"There are no grounds to appeal the declined claims due to coverage exclusion clause (MPD9000042) and conditions of Sub-Contract Agreement (MPD9000041 & MPD9000042) because DFS was not negligent. As suggested by Cerno, it will be up to the owner of the equipment to decide whether they wish to make a claim against their insurers or simply accept the loss as part of their operations."*

At this stage, we believe the Sub-Facility budget can absorb this loss.

We are in discussions with ADFA regarding ownership of the thermistor string that was purchased by IMOS central funds in 2008/2009. We hope to deploy these instruments off Sydney in a real time acquisition system.

**E.2 Co-investments** - EIF co-investments unchanged

**E.3 Staffing**

<u>EIF Funded Positions:</u>		<u>In-kind Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>	<b>Individual</b>	<b>FTE</b>
Roughan	0.75	Schaeffer	0.50
Morris	1.00	Mark Scognamiglio	0.30
DECCW	0.15	Gordon Macdonald	0.50
<b>(approx for NRS sampling)</b>	<b>1.90</b>		<b>1.30</b>

**6c South Australia Moorings:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - unchanged

**E.3 Staffing**

<u>EIF Funded Positions:</u>		<u>In-kind Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>	<b>Individual</b>	<b>FTE</b>
John Luick	0.50	Louise Renfrey (FUSA)	1.00
Charles James	0.50	Laurent Seuront (FUSA)	0.05
Shaun Byrnes	1.00	John Middleton (SARDI)	0.30
Sophie Leterme	0.30	Paul van Ruth (SARDI)	0.20
Casual	0.45	Mark Doubell (SARDI)	0.10
<b>Total</b>	<b>2.75</b>		<b>1.65</b>

**6d Western Australia Moorings:**

**E.1 EIF budget** - No changes in agreed budget

**E.2 Co-investments** - Co-investments from CSIRO is increased from \$228,320 to \$339, 494 following the addition of \$111, 174 co-investment form CSIRO Wealth from Oceans Flagship for 40% of a physical oceanographer’s time to assist the mooring data QC process and an additional 5% of Ming Feng’s time for oversight of the sub-facility.

**E.3 Staffing**

<u>EIF Funded Positions:</u>		<u>In-kind Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>	<b>Individual</b>	<b>FTE</b>
Ming Feng	0.05	Ming Feng	0.05
Ian Darby	0.80	Liejun Zhong	0.40



Mark Snell	0.30		
Carl Winkler	0.60		
Liejun Zhong	0.30		
Dirk Slawinski	0.20		
Ryan Crossing	0.75		
Peter Hughes	0.10		
Marty Lourey	0.10		
<b>Total</b>	<b>3.50</b>		<b>0.45</b>

**6e Acoustic Observations:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** – The WA Government provided \$551,000 over the period 2012-14 to extend the passive acoustic observations into the Kimberly and Pilbara regions of WA.

**E.3 Staffing** – technical staff included in capital costs

**6f National Reference Stations:**

**E.1 EIF budget** - Approximately \$234,000 will need to be rolled over from the 2011-12 financial year to the 2012-13 financial year to meet milestones. This is for a range of reasons:

- 1) Approximately \$100,000 is attributable to delays in recruitment following uncertainty regarding the ABOS EAC and SEQ mooring arrays. In the 2012-13 year a new mooring technician will be employed, which will also allow for excessive leave and flex entitlements to be taken by staff who have been responsible for NRS MAI, and NRS NSI rotations and the SEQ build, while continuing to service the infrastructure.
- 2) Approximately \$54,000 is rolled over contingency funds. The plan for contingency is to split half into self insurance for gear loss and half into investments in Quality Control. For the gear loss component, approximately 100,000 is budgeted each year, which is reduced to \$50,000 in the second half of the financial year if gear is not lost. In the 2011-12 financial year these funds were spent on enhancements to the profiling CTD through additions of DO and FLNTU streams on AIMS and other instruments. This strategy will also be adopted in 2012-13. The financial plan is to end the year with a \$50,000 surplus, which will also provide a buffer against small variations on the end point of the contract financials.
- 3) The balance of the projected underspend relates to minor operating variances across the various activities within the sub-facility. Please note, the 2012-13 financial year includes budget for the initial retrieval and post calibration of the SEQ array. The array is planned to be deployed for 18 months, which takes it outside of the contract period, but approximately \$80,000 is available to deliver data within the EIF2 contract period if this is desired or necessary.

**E.2 Co-investments** - unchanged for NRS at \$829, 653 from CSIRO

**E.3 Staffing**

<u>EIF Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>
<b>Bio-optics</b>	
Joseph Kemei	0.15

Paul Daniel	0.05
Arnold Dekker	0.05
Vittorio Brando	0.05
Rex Keen	0.25
Aaron Hawdon	0.05
	0.60
<b><i>BGC Central Processing &amp; NRSMAI</i></b>	
Francis Coman	0.55
Katrina Berry	0.35
Mark Rayner	0.25
Susan Reynolds	0.15
David Terhell	0.20
Valerie Latham	0.80
Alicia Navidad	0.15
	2.45
<b><i>CO2</i></b>	
Mareva Kuchinke	0.15
Kristina Paterson	0.30
Erik Van Ooijen	0.70
Tony Veness	0.10
Phil De Boer	0.10
Brendan Dando	0.05
Curt Chalk	0.30
Tim Fountain	0.05
	1.75
<b><i>NRSMAI NRSNSI SEQ</i></b>	
Karl Forcey	0.10
Jamie Derrick	0.20
Brendon Dando	0.85
Phillip de Boar	0.30
Shona Lyden	0.10
David Hughes	0.55
Darren Moore	0.75
Curt Chalk	0.30
Tim Fountain	0.10
TBA – Data Processing	0.40
Ben Howell	0.10
TBA - Mooring Tech	1.00
	3.76
<b><i>Management and QC</i></b>	
Tim Lynch	0.50
Bee Morello	0.50

Ben Howell	0.30
Ken Ridgway	0.20
	1.50
<b>Total</b>	<b>10.06</b>

**6g Acidification Moorings:**

**E.1 EIF budget**

Due to delays in deployment of NRSKAI CO2 mooring and replacement of NRSYON mooring due to cyclone Yasi, approximately \$78,000 will need to be rolled over to the 2012-13 financial year to meet milestones.

**E.2 Co-investments**

EIF co-investments unchanged at \$47,486 from CSIRO.

**E.3 Staffing**

<u>EIF Funded Positions:</u>	
<b>Individual</b>	<b>FTE</b>
Mareva Kuchinke	0.10
Erik Van Ooijen	0.20
Tony Veness	0.10
Phil De Boer	0.25
Curt Chalk	0.10
Tim Fountain	0.15
<b>Total</b>	<b>0.90</b>

**Staff FTE summary for the Facility:**

Sub-Facility	IMOS Funded	Co-invest	Total
6a Q&NA	4.67	4.67	9.34
6b NSW	1.90	1.30	3.20
6c SA	2.75	1.65	4.40
6d WA	3.50	0.45	3.95
6f NRS	10.60		10.60
6g CO2	0.90		0.90
<b>Total</b>	<b>24.32</b>	<b>8.07</b>	<b>32.39</b>

## Attachment A.7

Facility: **Australian Coastal Ocean Radar Network (ACORN)**  
Leader: Lucy Wyatt, James Cook University  
Contact: Phone: 07 4781 6774; email: lucy.wyatt@jcu.edu.au

### A Executive Summary

#### A.1 Expected progress with the Facility in the 2012-13 year

- The Coffs Harbour installation was completed 10 March. The software and data configuration details are being finalized, and data is expected to flow during March 2012.
- Subject to the provisos in C2 we will commission the new data streams outlined therein. However it should be noted that the radar configurations have been optimised to obtain maximum coverage for currents. As a result, although some new data will be available the amount is likely to be limited.

#### A.2 Material variations from the agreed plan which are proposed

Coffs Harbour installation was delayed due to legal issues. Everything that can be done on the sites was done and we were waiting for the licenses giving permission to occupy Crown land to finally be agreed. This agreement was received on 14 Feb and the installation was completed 10 March 2012.

#### A.3 Key risk factors for the year and strategies to address them

- Staff resources. The previous ACORN Director carried out a bench-marking exercise which, amongst other things, indicates that technical staffing levels within ACORN are roughly the same as those for the Monterey Bay HF radar system and other similar setups in the US. However, the geographical locations of the ACORN systems (thousands rather than 10s of miles apart) and the use of two different technologies, points to a higher staff resource requirement than we currently have. Our two field technicians spend much more time away from the office and their homes than would be typical in the US and this is leading to some tensions which could lead to resignations. I think we need to make better use of local support by training them to do the routine maintenance so that the technical staff can focus more on improving the reliability and quality of the data and do less travelling. In the longer term, if the network remains in place and particularly if it is enlarged, we need to reconsider the model of one central hub that has been adopted to date. A successful trial has been carried out using technical staff from the Lincoln Marine Science Centre at Port Lincoln to service the Cape Wiles installation. If we are to apply this approach in general then we need to account for any additional costs in future budgeting. There are clear advantages in organising the data processing, oversight of quality and training of technical staff in a central hub but distributed technical support would help in timeliness of response to problems.
- Equipment wear and tear and replacement will become more of an issue as time goes by. At the moment we have a good stock of spares but renewal of some components will need to be built into forward planning beyond June 2013 and contingency planning is needed now.
- There are a number of risks associated with the operation of radar sites in public and/or remote locations that have been identified in previous risk reports (vandalism, environmental damage, power and phone outages, equipment faults and failures) and are ongoing. Formalising current arrangements and building networks of more technically competent local support will help to alleviate some of these. The improved monitoring already implemented and being further

developed is essential.

- There are also problems with power and network outages at JCU which can delay data delivery and sometimes prevent access to monitoring of sites. We are designing our computer systems to minimise this impact as much as possible.

## B Status of the Facility

### Highlights:

- New computing facilities were commissioned to improve the efficiency of reprocessing of the on-site archived data collected during maintenance visits to provide QC data to ARCS/QCIF.
- ACORN staff and associated JCU researchers presented papers at a number of conferences/workshops during the year. Of particular note were 4 presentations at the IEEE Oceans meeting in Kona, Hawaii, USA, in September 2011.
- A new Director was appointed, taking up the post at the end of November 2011.
- We are in a transition from ad-hoc data availability reporting (figures below taken from last year's annual report) to reporting by calendar year (as shown for 2011). The July 2010 figures include part of the data in the 2011 column. These figures measure the fraction of time each system is running and delivering radial current data to the ARCS/QCIF archive. The ACORN goal is 90% and the figures below are similar to those reported by operators in the US during the bench-marking exercise.

Site	% data 2011	Jul 2010 1 year in most cases
TAN	98.1	99.7
LEI	85.7	78.5
CSP	89.8	92.6
CWI	87.6	94.1
FRE	99.0	93.3
GUI	93.8	91.8
SBRD	89.3	91.5
CRVT	93.9	96.3
NOCR	95.9	91.8
BFCV	96.5	96.2
mean	93	92.6
median	93.9	93

### Difficulties:

- Coffs Harbour. In mid 2011, JCU was advised by LPMA that they were not a 'public authority' in terms of the Act to receive and hold the Licence to Occupy Crown Land in NSW. At this point the installation could not go ahead. JCU entered into an agreement with UNSW on the advice that they were a 'public authority' in these terms and this agreement was eventually signed by both parties in January 2012. LPMA then sought a determination from their legal services team on whether UNSW is a public authority and therefore entitled to rely on the Infrastructure SEPP to undertake the development. This finally came through on 14<sup>th</sup> February. Deployment of the radar was completed 10 March 2012.
- Staff resources. The difficulties associated with this have been identified in the risks list in A.3.

**Breakthroughs:** Coffs Harbour – legal issues finally all resolved.

## **C Facility Infrastructure**

### **C.1 New equipment to be provided during 2012-13**

The Coffs Harbour radar system was installed and commissioned on 10 March 2012.

### **C.2 Datastreams to be commissioned during 2012-13**

Wind direction and the directional spectrum and derived parameters (significant wave height, period, peak direction etc) are potentially available from the WERA radar systems. Requirements to achieve these are:

- good quality radar data;
- additional on site processing for longer averaging;
- good data links if these data are required in near real time in which case we may need to upgrade some of these;
- enhancements to local computer systems.

The steps we need to take are:

- estimate staffing resources needed for this development and, if possible, manage existing resources to accommodate this;
- development with eMII of suitable netcdf formats and QC categories;
- budget for and implement local computer enhancements;
- process archived data and provide data obtained to the ARCS/QCIF archive;
- re-configure on-site processing software to provide longer averaged radar Doppler spectra files without interrupting data flow for currents;
- process future long average archived radar data and provide to ARCS/QCIF;
- establish requirements for and, if necessary, budget for any data link enhancements for real time operation and then implement.

In addition, we will establish the available spatial and temporal coverage of these data and use this information to advise on future deployment configurations where these parameters are important. We cannot give a time frame for this development until the resources required (staff, equipment upgrades etc) have been established.

### **C.3 Planned activities to position researchers and others to utilise the Facility**

- We are planning a workshop to be held in Townsville in June 2012; the purpose of which is to:  
(a) have an opportunity to discuss the data streams available and the requirements / expectations of users; (b) provide a forum for data users to present their radar related research; (c) publicise the existence of the facility and of the data (through wide spread meeting announcements) with a view to extending the user base.
- We are developing material to provide more information on the IMOS ACORN website and have implemented a site at JCU (further development needed) with a link from the School of Earth and Environmental Science web page for local publicity. Also linking in with research groupings within JCU (TropWATER, Environmental and Marine GeoSciences Group) to spread the word.
- We need to have ongoing discussions with eMII about the visual presentation of the data and its availability both within and outside the data portal to ensure that we can address the needs of different user groups.

- ACORN staff will be publishing in journals and presenting papers at various workshops and conferences over the next year (e.g. PIRR Radar Meeting, Adelaide, April; Radio Oceanography Workshop, France, April; Ocean radar conference and Oceans 2012, Korea, May; International Coral Reef Symposium, Cairns, July) and this is an opportunity to promote the facility and the use of the data.

#### **C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

We are seeking to formalise a number of ad-hoc arrangements with various organisations associated with the radar sites, their operation and maintenance. Such arrangements were workable when the Director was very familiar with everything concerned and the numbers of sites were small but this is not sustainable in the longer term.

Promoting the rapid development of Global High Frequency (HF) radar has been accepted as a task under the GEO-Work Plan 2012-2015. We are participating in the Inaugural Meeting of the GEO Global High Frequency (HF) Radar task to be held in London in March organised by NOAA.

No formal plans have been made as yet to address the following but they will be part of our activities over the next year.

- Access to data requires high skills - Need investment in postdoc(s) at JCU to seek out and work with other users on data access and interpretation and to develop new applications.
- Need to build interest in the technology from outside the research community to find potential co-funders for present and future deployments. Small initial steps taken with two local public lectures being organized.
- New deployments take a long time from idea to installation. Need to start engaging the community as soon as possible to review proposals that have already been made and to establish the need for any additional ones with a view to having a clearly costed and prioritized list for funding proposals beyond IMOS-EIF.

## **D Milestones and Implementation Plan**

### **D.1 Milestones – a separate table has been provided showing contracted Milestones**

Milestones unchanged but operating only 5 stations to end of February, the sixth coming on stream in March.

### **D.2 Implementation Plan July 2012 to June 2013**

<b>Activity / Deployment / Location</b>	<b>Responsible Organisation(s)</b>	<b>Responsible Person(s)</b>	<b>Start</b>	<b>Finish</b>
Coffs Harbour deployment	JCU/ACORN	Lucy Wyatt	Feb 27 2012	Mar 10 2012
Data flow from Coffs Harbour to ARCS/QCIF	JCU/ACORN	Lucy Wyatt	Within 1 month of installation	ongoing
Operate Ocean Radar Network and deliver data to archive	JCU/ACORN	Lucy Wyatt	ongoing	
Maintenance visits to QLD radars quarterly, exact dates subject to change if repairs are required here or elsewhere	JCU/ACORN	Lucy Wyatt	Next one in early April 2012	July, Nov, 2012; Feb, May 2013

Maintenance visits to SA radars quarterly exact dates subject to change if repairs are required here or elsewhere	JCU/ACORN	Lucy Wyatt	Next one in May 2012	Sept, 2012 Jan, April 2013
Maintenance visits to WA radars quarterly exact dates subject to change if repairs are required here or elsewhere	JCU/ACORN	Lucy Wyatt	Next one in April 2012	Aug, Dec 2012 Mar, June 2013
Maintenance visits to NSW radars quarterly exact dates subject to change if repairs are required here or elsewhere	JCU/ACORN	Lucy Wyatt	Next one in Aug 2012, may be a short interim visit	Dec 2012 Mar, June 2013
Troubleshooting and repair visits to sites as required	JCU/ACORN	Lucy Wyatt	Not scheduled	

## **E Project Resources**

### **E.1 EIF budget**

On the basis of the latest report received from Finance at JCU, we appear to be roughly on track with the budget and I have no immediate concerns that the budget is not viable. The EIF funded contract with IMOS was only signed in November 2011 and the new account was not set up until December so expenditure from July 2011 to end of Feb 2012 is all bundled into the first report that has been available. This covers therefore 2/3 of the 2011-2012 financial year with budgeted expenditure of about \$470K compared with actual of about \$400K. It should be noted that we have been delaying certain items of necessary expenditure until the budget was clearer and that being under budget now is not an indication of being under budget in the longer term. I also draw attention to the equipment wear and tear issue raised earlier. Now that we have a clearer indication as to our current financial position, we will be carrying out a more detailed budgetary analysis to underpin our plans for the next year.

### **E.2 Co-investments**

Changes agreed during 2011 are in salary support from JCU and AIMS for the Director (for 2 years) and Chief Researcher (for 1 year) as indicated below. These are included in the current contract with IMOS. The levels of co-investments from SARDI and Flinders, for which there are budgeted figures in the contract, are under discussion with Louise Renfrey, SAIMOS. Although this has not yet been finalised the amounts concerned are small and do not affect the viability of our budget.

### **E.3 Staffing**

Director: Lucy R Wyatt 50% EIF, 25% JCU, 25% AIMS

Technical Staff: Arnstein Prytz (data management, software), Dan Atwater (field work, installation planning, website/wiki, data quality monitoring tools, SeaSonde), Sven Ryder (field work, computer and monitoring systems, WERA) all 100% EIF

PA: Robyn Nickalls: 50% appointment, 100% EIF

Chief Researcher: Mal Heron 25% appointment, 50% JCU, 50% AIMS

Total EIF funded – 4.00 FTE

Total Co-Invested – 0.75 FTE



## Attachment A.8

Facility: **Australian Animal Tagging and Monitoring System (AATAMS)**  
Leader: Rob Harcourt, Sydney Institute of Marine Science  
Contact: Phone: 02 9850 7970; email: Robert.harcourt@mq.edu.au

### A Executive Summary

#### A.1 Expected progress with the Facility in the 2012-13 year

All deployments completed Australia wide; All data stored in eMII; Continued uptake of biologging and acoustic data

#### A.2 Material variations from the agreed plan which are proposed - None

#### A.3 Key risk factors for the year and strategies to address them

Key Risk: Failure to provide the means by which users can readily access data resulting in user community not using eMII. Management Strategy:

1. Continue to work closely with IMOS Director and eMII Facility Director to ensure eMII has full functionality
2. Restructure of AATAMS Scientific Committee to reflect changes in size and scope of AATAMS and facilitate communication between Data users and Data Management
3. Promotion of eMII utility and training workshops now that eMII data portal for AATAMS is operational

Key Risk: IP issues between receivers (AATAMS/IMOS) and tags bought by researchers. Management Strategy:

1. Continue information transfer and manage data security concerns through Data Committee
2. Improve reporting mechanism of data committee to scientific committee

Key Risk: Logistic failure for deployments/ retrievals of receivers / biologgers Management Strategy:

1. For the receivers the main risk is boat unavailability or clashes in scheduling between boat availability in different regions. Mitigation is achieved through alternative scheduling and training and skill transfer to local users.
2. For biologgers multiple teams and multiple sites has ensured successful deployment each year and this will be continued, with reviews at the end of each season.

### B Status of the Facility

#### Highlights:

Governance: Restructure of AATAMS Scientific Committee undertaken in 2011 to reflect the expanded scope of AATAMS (Acoustics, Biologging, Data and their integration).

#### Infrastructure:

##### Biologging:

- 1) Deployment of 4 (CTD) tags on Australian sea lions in 2010/11 produced cross-shelf transects with several thousand vertical CTD Profiles between November and May – 7 new deployments underway in Jan/ Feb 2012

- 2) Deployment of 21 (CTD) tags on southern elephant seals at Davis station with >10000 vertical CTD profiles with again broad temporal and spatial coverage of the southern ocean spanning 23 degrees of latitude (45° S to 68° S) and 45 degrees of longitude (45°E to 90°E) to depths of 2225m and 19 SRDL (temp and depth only) tags on Weddell seals. 50 new CTD tags being deployed at Davis and Casey Stations Antarctica and Campbell Island (6 deployed as of 13<sup>th</sup> Feb 2012). 20 SRDLs deployed on Emperor penguins, Jan 2012

Acoustics:

- 3) Deployment of Scott and Rowley Shoal arrays. (WA Govt)
- 4) Deployment of Maria Island curtain (OTN/NCRIS)
- 5) AATAMS Northern arrays linked to the FAIMMS sensors via vr2c units delivering real time data.
- 6) Completion and ongoing maintenance (data downloads) of all existing AATAMS lines and curtains (NCRIS & EIF)
- 7) Service and recovery of Ningaloo WA
- 8) Service and recovery Mangrove Bay WA
- 9) Service and recovery Perth recovery (partial) WA
- 10) Service and recovery Bondi recovery (partial) NSW
- 11) Service and recovery Coffs recovery (partial) NSW
- 12) Service and recovery Heron Island QLD
- 13) Service and recovery One Tree island QLD
- 14) Service and recovery Orpheus island QLD
- 15) Service and recovery Glenelg line South Australia

Datastreams:

Biologging:

- 16) CTD data uploaded in real-time on SMRU database and Coriolis database and to the GTS-
- 17) Roger is negotiating with SMRU for an automatic uplink from their server to eMII
- 18) PTT data also uploaded through AAD database

Acoustics:

- 19) Release of eMII AATAMS database specification 1.1
- 20) 50% AATAMS data entered, 50% of OTN data entered, 5% of non-AATAMS Australian data entered
- 21) Locations of all AATAMS purchased receivers is now in database, 10% of AATAMS community

Community Uptake:

Biologging

- 22) Successful Super Science Fellowship linked to the Southern Ocean Seals as Samplers dataset (Nicols and Gales of the Australian Antarctic Division (AAD) Hindell of UTas & Harcourt of Macquarie University) candidate commenced, Linked Phd awarded and candidate commenced
- 23) Projects: 7 – including ARC Linkage (2011-14) MQ/Taronga Zoo/MPA NSW
- 24) Phds & Postdocs: 6
- 25) MSc: 2
- 26) Conferences: 25
- 27) International Collaborations: Marine Mammals Exploring the Poles (MEOP) and Global Tracking of Pelagic Predators (GTOPP)

Acoustics:

- 28) Projects registered on eMII AATAMS database: 32
- 29) OzTrack NeCTAR proposal awarded CI Hamish Campbell
- 30) ARC Future Fellowship awarded Michelle Heupel JCU- AATAMS Acoustic subcommittee chair

### 31) International Collaboration: Ocean Tracking Network

#### **Difficulties:**

1. Biologging deployments on seabirds slower than intended due to logistic difficulties at Antarctic Bases
2. Geolocation database yet to be brought to eMII
3. Data format can have its own challenges- and two buy outs of BAS GLS (manufacturer's of the BAS GLS loggers) last year has further complicated the process as the units have changed format in the process
4. eMII remote upload of acoustic receivers still in progress
5. Availability of tags from alternative suppliers has presented potential difficulties with system integrity

#### **Breakthroughs:**

1. eMII user specification completed November 2011
2. Version 1.1 database completed and 50% AATAMS data entered, 50% of OTN data entered, 5% of non-AATAMS Australian data entered
3. Locations of all AATAMS purchased receivers is now in database, 10% of AATAMS community receivers is in database

## **C Facility Infrastructure**

### **C.1 New equipment to be provided during 2012-13**

- 1) Biologgers at Davis station and Macquarie Island
- 2) Deployment of Flinders Island line (OTN TASIMOS)
- 3) Acoustic network servicing and replacement of acoustic moorings as needed only

### **C.2 Datastreams to be commissioned during 2012-13**

Geolocator data will be incorporated into eMII upon retrieval of loggers as delayed, raw data streams. The mechanism for the latter is being discussed with eMII personnel and yet to be generated.

### **C.3 Planned activities to position researchers and others to utilise the Facility**

1. Database roadshow timed to coordinate with ASFB/OCS, Coral Reefs and AMSA all in July this year, plus key groups in other capitals
2. YouTube instructional database Videos to be filmed and broadcast on AATAMS website
3. Suite of Public Outreach planned along with User Spec 2 for National database implementation and development.

### **C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

New AATAMS Scientific Committee structure now has Node Representatives for each stream (Acoustics and Biologging)- the role of each Node Representative is to a) ensure structured regional/State feed-back of actions and events, b) instigate and lead Node discussions, c) report to Scientific Committee on engagement and opportunities for AATAMS community d) assign Scientific Committee members to actively engage where needed and improve alignment between Scientific Committee and Node representation. Node Representatives are expected to lead their community/users in their Node

## D Milestones and Implementation Plan

### D.1 Milestones – a separate table has been provided showing contracted Milestones

### D.2 Implementation Plan July 2012 to June 2013

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Biologging deployments/ Antarctica	AATAMS (SIMS) / AAD/UTas/ Macquarie	Rob Harcourt/Mark Hindell/ MA Lea/Iain Field/Colin Southwell/ Barbra Wienecke/ Louise Emmerson	July 2012	June 2013
Biologging deployments/ South Australia	AATAMS (SIMS)/SARDI	Simon Goldsworthy/Rob Harcourt	Oct 2012	March 2013
Receiver pool /Mobile	AATAMS (SIMS)	Michelle Heupel/Andrew Boomer / AATAMS Scientific Committee- Acoustic Subcommittee	March 2011	March 2013
Deployment / OTN TasIMOS Line2 Flinders Island	AATAMS (SIMS) /TAFI/CSIRO	Jayson Semmens/Andrew Boomer	June 2012	July 2012
Deployment / New East Coast line Batemans Bay, NSW	AATAMS (SIMS) / UNSW/MPA NSW	Andrew Boomer/ Phil McDowall/ Matt Taylor	Feb 2012	March 2012
Servicing and downloading / NRETA receivers, Ningaloo WA	AATAMS (SIMS) /AIMS	Peter Doherty/Russ Babcock/ Andrew Boomer	April / October 2012	April/ October 2012
Servicing and downloading / Glenelg line, South Australia	AATAMS (SIMS) /SARDI	Andrew Boomer /Charlie Huveneers	Dec 2012	December 2012
Servicing and downloading / OTN Perth line, Western Australia	AATAMS (SIMS)//WA Fisheries	Andrew Boomer /Rory McAuley	Dec 2011 /Oct 2012	March 2013
Servicing and downloading / East Coast lines, Sydney & Coffs Harbour NSW	AATAMS (SIMS)//SIMS	Andrew Boomer / Phil McDowall	March /Dec 2012	March/Dec 2012
Servicing and downloading/ Scott Reef and Rowley Shoals WA	AATAMS (SIMS) /AIMS	Mark Meekan/Rob Harcourt/ Andrew Boomer	Feb 2012	Dec 2013
Servicing and downloading / North Queensland lines	AATAMS (SIMS) /AIMS/JCU	Michelle Heupel/ Colin Simpfendorfer/ Andrew Boomer / Phil McDowall/ Peter Doherty	April 2012 bimonthly	June 2013

## E Project Resources

### E.1 EIF budget - unchanged

**E.2 Co-investments** – and additional \$334,000 has been provided by the WA Government to install new AATAMS receiver lines in the Rowley Shoals and Scott Reef regions of WA.

### E.3 Staffing

Andrew Boomer, Operations Manager, EIF Funded

Phil McDowall Technical officer, EIF Funded

## Attachment A.9

Facility: **Facility for Automated Intelligent Monitoring of Marine Systems (FAIMMS)**  
Leader: Scott Bainbridge, Australian Institute of Marine Science  
Contact: Phone: 07 4753 4377; email: s.bainbridge@aims.gov.au

### **A Executive Summary**

#### **A.1 Expected progress with the Facility in the 2012-13 year**

With the network fully operational after the rectification work from Tropical Cyclone 'Yasi' the focus is now on maintaining the equipment, rolling out new generations of equipment and in the re-development of the Heron Island site. Parallel to this is a focus on user uptake with a number of new projects starting that will utilise the FAIMMS data.

The network of seven sites has been restored to full operational status following the impact of Yasi in February 2011 with all data streams resumed and flowing to eMII. During the 2012-13 year each site will be maintained and serviced to ensure continuity of the data streams. Each site will progressively be upgraded to the latest generation of equipment with some of the older sites requiring a major refurbishment as the equipment is now four or more years old. Part of the upgrade will be the move to a full 802.11 wireless network allowing the infrastructure to support a wider range of devices and users.

One major site upgrade will be at Heron Island due in mid 2012. This was the first site deployed and so now has the oldest equipment. Since the deployment there has been an increasing interest in the data and there is an opportunity to re-develop the network to both preserve the original data streams but also to re-deploy equipment to address emerging needs. This is being done both within IMOS and through other projects, so building on and leveraging the original IMOS investment through other funding sources. A consultative process was begun in early 2012 that will better align the Heron Island network with the needs of the research community.

A major outcome has been the inclusion of FAIMMS in a three million dollar ARC grant via the University of Queensland and the US National Oceanic and Atmospheric Administration (NOAA) work at Heron Island. The real time IMOS data will form an important part of climate change work to be done under the grant by providing real time data to validate mesocosm experiments. This use of the FAIMMS data and network is in-line with the goals of IMOS in delivering both data and infrastructure to the research community, the grant also allows for new sensors and equipment to be installed on the FAIMMS network along with funds to assist with the refurbishment of the network.

The roll out of data kiosks at the island research stations is continuing and this is generating a high level of user engagement and uptake. The kiosks allow for users at the Island Research Stations to access and use the real time data for their work. This is being extended by the co-development with the stations of smaller real-time buoys to encourage the use of the IMOS infrastructure. Presentations at conferences and peer-reviewed journal articles will continue to be an important way of engaging with the user community. The main anticipated conference is the International

Coral Reef Symposium (ICRS) that is held every four years with Cairns the venue for the 2012 meeting. Three presentations from the FAIMMS work are currently scheduled for ICRS.

## **A.2 Material variations from the agreed plan which are proposed**

There are no material variations from the agreed to plan. The main new work is the Heron Island deployment which is a delayed milestone from previous years.

## **A.3 Key risk factors for the year and strategies to address them**

The key risk factor remains the potential impact of Tropical Cyclones. Tropical Cyclone Yasi did considerable damage in early 2011 resulting in the need to move some deadlines and resulting in a break of some data streams of up to eight months while systems were repaired or replaced. There were no real issues with insurance as all claims have been honoured so the AIMS insurance remains the main strategy to deal with this risk.

## **B Status of the Facility**

### **Highlights:**

- Damage from Tropical Cyclone 'Yasi' that destroyed equipment in February 2011 has been rectified with all planned stations now on-line as per late 2010. Work to rectify the damage has included servicing of the network at Davies Reef, replacement of three stations at Orpheus Island, replacement of a buoy at Rib Reef and another at Myrmidon Reef. All data streams have been re-established.
- The FAIMMS Facility is a partner in an ARC grant through the University of Queensland to look at impacts of climate change on coral reefs. The three million dollar five year grant uses FAIMMS data from Heron Island to calibrate, in real time, mesocosm experiments looking at the collective impacts of temperature, light and nutrients on coral health as well as developing a better understanding of the role of light in coral bleaching.
- The Facility has developed live data kiosks to be installed at the island research stations to allow users to directly view and interact with the real time data. The first kiosk has been installed at Orpheus Island and gives real time information on weather, tides, potential coral bleaching risks as well as in-water parameters such as temperature and salinity. Kiosks will be rolled out to the other stations as updates are completed.
- The Facility has been a major part of a number of real time data related proposals including ones to NeCTAR and the Queensland State Government Smart-Futures fund. It has been active in developing real time data delivery systems nationally and internationally. The Facility continues to lead in the delivery of real time information products both through IMOS and via other relationships such as the CREON group.

### **Difficulties:**

- The main difficulty has been in lost time from needing to rectify the damage from Tropical Cyclone 'Yasi', this has led to a delay in re-furbishing the Heron Island site and re-prioritisation of other work. By the end of 2011 the only remaining item was the Heron Island work, the delay has been used to better engage with the user community to ensure the re-development aligns with as many research needs as possible while continuing the long term data streams. Heron

Island is due to be updated in July/August 2012.

**Breakthroughs:**

- Data from the long term observations at One Tree Island are giving new insights to the role of atmospheric processes in forcing lagoonal temperatures. The strong linkage between atmospheric processes and cooling / heating events may allow for better predictions of conditions that lead to coral bleaching.
- The FAIMMS suite of technologies have been up-taken by the Queensland Department of Environment and Resource Management (DERM) via a program of technology transfer between the Facility and DERM. The initial deployment will be a DERM led deployment at Raine Island looking at turtle monitoring. While the activity is not an IMOS one it shows direct flow-on impacts of the capability being built under IMOS and there is a hope that if the deployment is on-going it may form a suitable future Q-IMOS site.

**C Facility Infrastructure**

**C.1 New equipment to be provided during 2012-13**

The refurbishment of Heron Island will see an optimisation of the equipment currently deployed along with a number of new sensors deployed as part of the ARC Linkage grant. These including water quality sensors, more sophisticated above and underwater light sensors and potentially some low cost pCO<sub>2</sub> sensors. All data from the new ARC provided sensors will be made publically available via eMII as per the core FAIMMS data.

Other new equipment will include the addition of light sensors and above water cameras at some sites to complement the existing equipment and the addition of other sensors as opportunities arise. Investigations are underway to use the FAIMMS networks to provide real-time access to key Vemco acoustic stations around Heron and One Tree Islands.

**C.2 Datastreams to be commissioned during 2012-13**

The main new datastreams will come from the refurbished Heron Island deployment and the sensors to be deployed in conjunction with the ARC Linkage project. Apart from this the main focus of the Facility is the maintenance of the existing long term datastreams and the provision of these to the research community.

**C.3 Planned activities to position researchers and others to utilise the Facility**

The Facility is working to develop user groups around the Island Research Stations, one exists for Heron Island and this is being used to strongly engage with this community. The provision of real-time data kiosks at each of the Stations is one advance, the co-development of project proposals, such as done with the successful ARC grant, is another. The Facility hopes to engage at the student / supervisor level in the major Universities associated with the research stations to increase the awareness of the project and uptake of the project data.

The second approach is to continue to advertise the Facility, and IMOS, through conferences, papers and invited talks. Examples of this in the past included invited attendance at workshops in Brussels, Bangkok and Santa Barbra. Some co-authored papers include one in Marine Biology using the FAIMMS data from One Tree Island to understand the impact of cyclone 'Hamish'. Future conferences include the ICRS meeting in Cairns in mid 2012 and future CREON meetings.

The third approach is to make the FAIMMS infrastructure easier to engage with. This includes the roll out of standard 802.11 networks at all sites, the provision of smaller platforms suitable for other people’s equipment and the co-development of solutions with key players. This has already seen the development of prototype real time Vemco receivers, underwater cameras at Davies Reef and was a critical part of FAIMMS being included in the ARC Linkage grant.

A final approach is to work more closely with eMII in the development of real-time components to the Oceans Portal. The Facility is keen to continue to drive real time data and information systems to better deliver outcomes from the data collected.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

The Facility is embedded within the Q-IMOS Node and is using this relationship to support the governance of the Facility including user and technical groups. This relationship also provides opportunities for further engagement with external users, continued Node meetings, e-mail lists and technology transfer will help increase the uptake of the data and the FAIMMS network.

**D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

**D.2 Implementation Plan July 2012 to June 2013**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Refurbishment of Heron Island network	AIMS / UQ	Scott Bainbridge	July 2012	August 2012
Service of Lizard Island network	AIMS/ Aust Museum	Scott Bainbridge / Lyle Vail	September 2012	October 2012
Local reefs / Orpheus Island service	AIMS	Scott Bainbridge	November 2012	December 2012
Heron Island / One Tree Island service	AIMS/UQ/Uni Sydney	Scott Bainbridge	March 2013	April 2013
Local reefs / Orpheus Island service	AIMS	Scott Bainbridge	May 2013	May 2013

**E Project Resources**

**E.1 EIF budget** - unchanged. Note that the Queensland contribution via DEEDI has been fully secured.

**E.2 Co-investments** - unchanged

**E.3 Staffing**

The number and roles of the Facility staff have not changed since the last report, there has been a turn-over of one position, that of the Data and Field Technician.

Facility Leader: Mr Scott Bainbridge (unchanged)  
 Communications Technician: Mr Geoff Page (unchanged)  
 Data and Field Technician: Mr Scott Gardner (replacement for Mr Damien Eggeling)



## Attachment A.10

Facility: **eMarine Information Infrastructure (eMII)**  
Leader: Roger Proctor, University of Tasmania  
Contact: Phone: 03 6226 1977; email: roger.proctor@utas.edu.au

### A Executive Summary

#### A.1 **Expected progress with the Facility in the 2012-13 year**

With the complete rewrite of the portal architecture during 2011-12 it is expected that the milestones for 2012-2013 will be met. The new portal technologies allow for rapid development of powerful web applications, and will allow exciting new features to be easily and quickly added in the future. This will be important to allow for the continued growth in the IMOS data streams and to meet the continued requests for additional data products, both for single and multi-disciplinary datasets. Through the latest development in eMII data delivery, the Ocean Current project, which is building access to and interpretation of the current state of the ocean, we expect to significantly increase interaction with the marine and climate science research community and the general public. During this period we anticipate the full integration of IMOS data delivery within the Australian Ocean Data Network (AODN) so that through the AODN the IMOS datastreams will drive the discoverability and access to the much wider collection of Australian marine data assets. A Government agreement between Australia and New Zealand to enhance collaboration in marine observing and data management is likely to lead to the establishment of a NZ-node of the AODN.

The cyber infrastructure in Australia, on which IMOS and the AODN depend, is going through significant changes with the transition from ARCS services to RDSI and NeCTAR. eMII has been active in safeguarding the functionality of the infrastructure which underpins IMOS/AODN so that in 2012-2013 we expect minimal alterations to our information infrastructure and in fact look forward to opportunities for increasing the scope of data discovery, access and delivery. To this end, eMII is engaged in establishing a node of RDSI in Tasmania for marine and climate data; is engaged with NeCTAR in establishing a Virtual Laboratory for marine scientists; and is engaged with ANDS in establishing a marine information system to produce data products (from the Virtual Laboratory) to support marine aquaculture management and environmental assessment.

#### A.2 **Material variations from the agreed plan which are proposed**

There are two variations which can be identified:

- 1) The milestone for Sep-12 mentions "portal interaction with ARCS GRID computing". Since the cessation of ARCS this service has seen diminishing use. It is likely that this service will not be offered (or even available) through the portal. Instead, through the NeCTAR Virtual Laboratory, we expect to offer computing within the research cloud, but details have yet to be finalised.
- 2) One of the NCRIS milestones is "Release 3D data visualisation and analysis tool – Sep-10 in progress". This relates to collaboration between IMOS and CMAR (Hobart) which has had ongoing staffing difficulties. IMOS (eMII) position has changed over the last 2 years from lead developer to become a minor partner in a project called "TrikeND" being run by CMAR; IMOS contribution occurs when the project has substantial form and our contribution is to add modules to facilitate the visualisation of IMOS/AODN data. Currently TrikeND is being considered as an output tool for the NeCTAR Virtual Laboratory, in which CMAR are also involved.

### **A.3 Key risk factors for the year and strategies to address them**

For eMII the continual risk is loss of key staff. In the past 12 months we have had ~50% staff turnover. Our staff is a mix of software engineers and data scientists, both in short supply in Tasmania. Our strategy is to be continually on the lookout for potential staff, and to offer competitive salaries.

## **B Status of the Facility**

### **Highlights:**

- 1) eMII and the AODN Development Office have merged into a single entity resulting in improved coordination and productivity in the group.
- 2) IMOS data streams continue to be discoverable, accessible and downloadable. Aggregated datasets have been created for some datastreams (Argo, SOOP XBT).
- 3) AODN data sets available from most Commonwealth agencies and some other sources. Clear enthusiasm for the AODN across the broad sector of Australian marine data holders.
- 4) the portal architecture has been completely revised, moving away from a ZK Java framework to a more flexible structure developed through Grails and extJS.
- 5) this more flexible structure means users can now search on any combination of spatial extent, temporal extent, keyword, parameter, or organisation, and multiple datasets can be aggregated into a single zip file for easier access.
- 6) a data audit was conducted in July-August 2011, resulting in the development of improved workflow schemas.
- 7) international collaboration has been enhanced through the staging of an EU-Australian marine information infrastructure workshop in Brussels in April 2011 and subsequent follow-up activities; contribution to and (hopeful) participation in an EU Research Infrastructure capacity proposal "ODIP" (Ocean Data Interoperability Platform) involving 10 EU, 8 US and Australian partners.
- 8) linkages with the modeling community have taken several steps forward: the NeCTAR Virtual Laboratory (a collaboration between UTAS and CMAR) will provide a geographically relocatable system for the integration of ocean observations and numerical models; the ANDS Information System will build on this and develop observation-model data products; a discussion document has been written outlining closer collaboration between IMOS and BlueLINK with a series of modeling workshops proposed, starting in the first half of 2012.
- 9) the matlab Toolbox, developed for the IMOS ANMN facility, has increased its range of equipment/sensors and become more robust.
- 10) version 1 of the AATAMS web-browser data upload and publishing tool has been completed.
- 11) early engagement with NPEI - IMOS data as a demonstrator within prototype NEIS.
- 12) As part of business systems development for the IMOS Office eMII has produced a Publications Database reporting tool, to permit easy compilation of IMOS publications.

### **Difficulties:**

- 1) eMII operated at under-strength for at least six months of the last year. Loss of key personnel, and recruitment of suitable replacements, is the biggest single difficulty we face
- 2) continued slow progress in some of the Commonwealth agencies of the AODC-JF in making their data publicly available for the AODN
- 3) software written for IMOS is always considered Opensource. In this spirit we make use of, and contribute to, other Opensource projects. The release of the new portal architecture has been

delayed by at least 2 months because one component of Opensource software (Geonetwork) postponed its new release unexpectedly.

**Breakthroughs:**

- 1) the new portal architecture opens up new opportunities for the discovery and access to new data types and data sources. This will result in new products and the potential for integrated physical-biological datasets.
- 2) The deployment of geoserver software at AODN contributors has resulted in access, through web services, to significant data holdings.

**C Facility Infrastructure**

**C.1 New equipment to be provided during 2012-13**

Probable upgrade of desk-top machines and some web servers.

**C.2 Datastreams to be commissioned during 2012-13**

Reliant on other facilities for datastream delivery.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Data User Workshops, AODN roadshows.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

- Closer engagement with the AODC-JF Technical Committee to ensure the needs of Commonwealth Agency (and other) contributors to join the AODN are met.
- Presentations at targeted national and international conferences/workshops.
- Membership of OGC to be aware of (and contribute to developing) latest international standards for geospatial information.
- Collaborative activity with the international community (e.g. Australian-EU collaboration; Australian-NZ collaboration; Australian-US collaboration) to increase potential for interoperability.

**D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

Milestones unchanged, subject to modifications discussed in A.2.

Some additional milestones added for co-funded activities associated with RDSI, NeCTAR and ANDS.

**D.2 Implementation Plan July 2012 to June 2013**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Enhancements to the information infrastructure	eMII	Peter Blain	July 2012	June 2013
Expansion of the Ocean Current information content	eMII/CMAR	Roger Proctor / David Griffin	July 2012	June 2013
Developing integration links with the modeling community	eMII/IMOS Office	Roger Proctor / Katy Hill	July 2012	June 2013

Development of multi-disciplinary data products	eMII	Sebastian Mancini	July 2102	June 2013
Data User Workshops / AODN Roadshows	eMII	Jacqui Hope	July 2012	June 2013
Development of the Marine Virtual Laboratory (MARVL) - NeCTAR	IMAS/eMII/CMAR	Brendan Davey / Roger Proctor / Peter Oke	July 2012	June 2013
Development of the MARVL Information System (MARVLIS) - ANDS	IMAS/eMII	Brendan Davey / Roger Proctor	July 2012	June 2013
Engagement with NPEI demonstrator	eMII	Roger Proctor	July 2012	Sept 2012

## E Project Resources

	Estimate Jan12-Jun12	Estimate Jul12-Dec12	Estimate Jan13-Jun13	<b>Estimate Total Jan 2012- 2013</b>
Salaries	1,073,703	1,099,251	1,136,251	<b>3,399,204</b>
Capital	17,000	10,000	10,000	<b>37,000</b>
Operational	110,000	110,000	110,000	<b>330,000</b>
	<b><u>1,200,703</u></b>	<b><u>1,219,251</u></b>	<b><u>1,256,251</u></b>	<b><u>3,766,204</u></b>

As identified in the accepted AODN Business Plan 2011-2013 the allocated funding for AODN is \$0.945 million. The sharing of eMII staff to deliver IMOS and AODN objectives puts the costing for the AODN effort over the 2 years 2011-2013 at \$1.5 million. These figures indicate a significant IMOS in-kind contribution to AODN. This excludes any funds arising from successful proposals to RDSI and/or NeCTAR.

**E.1 EIF budget** - unchanged.

**E.2 Co-investments** - unchanged. Expected additional funding from RDSI, NeCTAR and ANDS (\$192,245 to date)

### **E.3 Staffing**

We anticipate the existing staff complement to continue in 2012-2013, dealing with both IMOS and AODN, i.e. Director, Executive Officer, Administration Assistant/Helpdesk Coordinator, Information Infrastructure Team (8), Data Services Team (7) (17.2FTE – some staff part-time, these variations may alter to a maximum 18 FTE).

## Attachment A.11

Facility: **Satellite Remote Sensing (SRS)**  
 Leader: Edward King, CSIRO  
 Contact: Phone: 03 6232-5334; email: edward.king@csiro.au

No.	SubFacility	Leader	Operator	Phone	Email
11a	Australian Satellite SST L2P Products	Helen Beggs	BoM	03 9669 4394	<a href="mailto:h.beggs@bom.gov.au">h.beggs@bom.gov.au</a>
11b	Australian Oceans Data Access and Archive Centre	Edward King	CSIRO	03 6232 5334	<a href="mailto:edward.king@csiro.au">edward.king@csiro.au</a>
11c	Upgrade of Townsville Ground Station	Craig Steinberg	AIMS	07 4753 4444	<a href="mailto:c.steinberg@aims.gov.au">c.steinberg@aims.gov.au</a>
11d	Satellite Ocean Colour	Vittorio Brando	CSIRO	02 6246 5716	<a href="mailto:vittorio.brand@csiro.au">vittorio.brand@csiro.au</a>
11e	Satellite Altimetry Calibration and Validation	Chris Watson	UTAS	03 6226 2489	<a href="mailto:christopher.watson@utas.edu.au">christopher.watson@utas.edu.au</a>

### A Executive Summary

#### A.1 **Expected progress with the Facility in the 2012-13 year**

The 2012-13 year will see all sub-facilities delivering contemporary data on a routine basis, and the SST and Ocean Colour sub-facilities will complete their respective historical data sets. The SST sub-facility will deliver the Southern Ocean data set incorporating data from the Antarctic stations, and the high time resolution full-disk data set from MTSAT-2 will be well established. The AODAAC will be accessible from within the AODN portal and, once the enhanced V2 system is deployed, will be capable of indexing and delivering the full range of gridded satellite data produced by the SST and Ocean Colour sub-facilities. The Townsville reception station will provide all-weather acquisitions once the new radome is installed.

LJCO data streams should be operational from late June 2012 onwards after the rebuild of the site. Data streams for two DALEC spectroradiometers installed on board RV Southern Surveyor and RV Solander will provide the first radiometry dataset around the whole continent. Data in the Bio-Optical DataBase will be contributed to NASA and ESA and used by the international community for calibration and validation of ocean colour sensors, including the VIIRS sensor launched in late 2011. All these data will also be available to the community of regional algorithm developers via the AODN portal. Comprehensive national data sets of ocean colour products with unequalled spatial resolution and daily time step will be available on-line.

The altimetry cal/val sub-facility will continue routine data collection and the growing series of high quality data will enable improved understanding of the characteristics of the satellite altimeter data sets.

## **A.2 Material variations from the agreed plan which are proposed**

The AODAAC, AIMS reception system and altimetry cal/val sub-facilities are expected to deliver according to plan during 2012-13. Both the SST and Ocean Colour sub-facilities will continue to struggle to achieve the bulk data processing throughput for the historical data, though this should ease during the year as the processing systems and hardware environments mature. The technical challenges associated with deploying the DALEC spectroradiometers, together with negotiations for appropriate levels of support on the RV Solander, mean that the commissioning of that data stream will be delayed until 2012-13. Despite these challenges, the only variations to the agreed plan are with respect to timing, not what will actually be delivered.

## **A.3 Key risk factors for the year and strategies to address them**

With the large (multi-TB) data sets being produced, there is a risk to both the SST and Ocean Colour sub-facilities that they will be unable to sustain resourcing of the online storage necessary to serve their data products to researchers. The SRS facility is working with the EIF-supported Research Data Storage Initiative and NCI to secure long-term support for these data as data sets of national significance.

Strong and early engagement between the AODAAC sub-facility and eMII is ensuring well matched expectations in the transfer of the software system to the AODN portal. The V1 AODAAC deployment during early 2012 will act as a pathfinder for the more complex V2 system during 2012-13. This use of staged deployment as a risk mitigant has also been used in the SST and Ocean Colour sub-facilities where the initial effort has focused on the production of contemporary data streams before embarking on the much larger tasks of the historical data sets.

AIMS are mitigating the severe weather risk to the reception system by providing a radome to protect it.

The key risk in the Ocean Colour sub-facility is an inability to sustain the in-situ observation program due to vulnerability to the instrumentation contingency funding pool (which is itself a risk mitigation tool) in the event that CSIRO's insurance claim for cyclone YASI damage to LJCO is unsuccessful. This risk is being underwritten by the CSIRO Wealth from Oceans flagship.

The risk factors identified for the altimetry cal/val sub-facility remain the same as in previous years. A remote tracking capability has been created for the GPS buoys which minimises the risk of lost equipment during a buoy deployment.

## **B Status of the Facility**

### ***11a Australian Satellite SST L2P Products:***

Highlights:

- Release of reprocessed and real-time single swath GHRSSST L2P and L3U (back to 1998), multi-swath L3C (back to 2008) and multi-sensor L3S files (back to 2011). We are now producing multi-sensor L3S files from NOAA-15, NOAA-17, NOAA-18 and NOAA-19 satellites for 1, 3 and 6 day periods comprising day-only, night-only and day+night skin SST data over the Australian region. The new L3S files have been compared against the CSIRO 3-day composite AVHRR SST maps and the Bureau's Legacy 14-day Mosaic AVHRR SST maps. During Feb-Mar 2012 we plan to optimise the L3S compositing technique to maximise spatial coverage and minimise error.
- Release of reprocessed MTSAT-1R skin SST hourly L3U files over the full disk back to June 2006.

New applications for IMOS satellite SST data in 2011/12:

- AVHRR L2P files are used in real-time, pre-operational SST analyses at BoM (RAMSSA and GAMSSA)
- AVHRR L3U files are used for real-time SST maps at <http://imos.aodn.org.au/oceancurrent/> .
- AVHRR 1-day and 3-day night-only L3S files are being used by Dr Claire Spillman for the ReefTemp coral bleaching prediction system as part of the eReefs Project.
- AVHRR 1-day day-only and night-only L3C and MTSAT-1R L3U files used to measure diurnal warming as part of the GHRSSST Tropical Warm Pool Diurnal Variability Project

Difficulties: The IMOS Scientific Programmer, George Paltoglou, plans to leave the project 4 April 2012 and from 6 Feb 2012 has been working 2 days per week.

Breakthroughs:

- BoM has recruited Dr Christopher Griffin who will commence as IMOS Scientific Programmer 5 March 2012, allowing one month overlap with George to enable training in the IMOS satellite SST processing system.
- Development of novel calibration and processing method for AVHRR SST data from NOAA-15 enabling relatively accurate SSTs to be derived from this early generation AVHRR sensor. For example: standard deviation (NOAA-15 SST – drifting buoy SST) = 0.41°C for quality\_level 5 day+night AVHRR data for period 1 Jan 1999 to 1 Jan 2011. Similar standard deviation estimates for NOAA-17, 18 and 19 are ~0.3°C.

### **11b Australian Oceans Data Access and Archive Centre:**

Highlights:

- Development of the V2 system has progressed according to plan throughout the year, with the refactored crawler/harvester, upgraded geolocation model, and web query service components now complete.
- AusCover, the remote sensing facility of TERN, has installed an instance of the V1 system to trial its utility for indexing and accessing terrestrial remote sensing data.
- The data server operated by the AODAAC is the central point of distribution for the SST data set, now being used in production in the Ocean Current web system. All these data sets (including the swaths) are being successfully indexed by the V2 system under development.

Difficulties:

- Staff turnover in eMII, together with the pressing need to upgrade the AODN portal, have resulted in the integration of the V1 AODAAC system into the AODN being delayed by almost 12 months. The V1 production system has been maintained by CMAR staff throughout the past year and it is expected that eMII staff will progress the integration in Feb-Apr 2012.
- CMAR was unable to retain the services of Li Zhou, a talented software engineer based in Canberra, at the end of June 2011. Li made a substantial contribution to the code refactoring and development of the enhanced geolocation model in the V2 system.
- Glen Smith, a software engineer in CMAR in Hobart, who has been involved in the development of the AODAAC system since its inception, has taken 6 months long service leave during the year. Ken Suber has filled this gap by working close to full time on the AODAAC system in the second half of 2011.

Breakthroughs:

- The major challenge in the development of the V2 system was the creation of a sufficiently general abstract model for representing the wide range of geolocation information commonly used in gridded data files. The design, implementation and successful testing of this enhanced geolocation model represents a critical step forward for the sub-facility and has under-pinned the ongoing development of the V2 system.

**11c Upgrade of Townsville Ground Station:**

Highlights: Performance of the system is nominal. No IMOS-funded upgrades are planned.

Difficulties: Nil to report

Breakthroughs: Nil to report

**11d Satellite Ocean Colour:**

Highlights:

- LICO data streams were picked up by the international community for calibration and validation of ocean colour sensors: (Seaprism data was used to validate the new atmospheric correction algorithm for MERIS)
- Data in the Bio-Optical DataBase contributed to NASA and ESA and used by the national and international community for calibration and validation of ocean colour sensor, including the VIIRS sensor launched in late 2011.
- The compilation of the Australian regional MODIS base data set (40 TB) has been completed at the NCI in Canberra.
- Regular production of some 60 standard ocean colour L2 products based on the near real time (direct broadcast reception) Australian data set commenced in August 2011. These products are being archived and made available via a web site and THREDDS data server.

Difficulties:

- Uncertainties relating to the status of insurance funds resulted in a delay in the re-installation of LICO, LICO data streams should be operational from late June 2012 onwards
- The second DALEC Spectroradiometer, to be installed on RV Solander, will be acquired by June 2012, due to delays in negotiations with AIMS. Instrument support and data management can be offered by AIMS only if interested scientists (e.g. Miles Furnas or Craig Steinberg) can devote their time on board to the datastream. An agreement was reached during the Brisbane APM with Tim Moltmann and Peter Doherty that in 2012/13 a limited number of deployment days (~50-80) will be deemed sufficient.
- There was an interruption of ocean colour data production of approximately 1 month duration in November due to a security compromise at the NCI. This, together with complications with a refresh of storage hardware at the NCI, has resulted in the delay of the primary production data production milestone.
- Remapping and formatting of the ocean colour products to meet both end-user and partner project needs has proven more complex than anticipated. A solution has been identified and is being implemented. Once tested it is anticipated that regular production of the near real time and historical data sets will proceed.



Breakthroughs: Data streams for the DALEC spectroradiometer installed on board RV Southern Surveyor is of good quality and will be used by NASA and NRL for calibration and validation of the VIIRS ocean colour sensor launched in late 2011.

**11e Satellite Altimetry Calibration and Validation:**

Highlights: Highlights for the 2011/12 EIF period include the first complete cycle of the Bass Strait and Storm Bay oceanographic moorings, and subsequent generation of our data streams to the Ocean Surface Topography Science Team (OSTST). The OSTST is the science team behind the NASA/CNES/NOAA/EUMETSAT Jason-2/OSTM satellite mission, and the primary end-user for this sub-facility. The sub-facility is now well established into its cyclic deployment strategy, culminating in the annual OSTST meeting.

Difficulties: The sub-facility worked hard to recover from the setback caused by an error in configuration of pressure sensors in the first mooring deployment in Bass Strait and Storm Bay in 2011. Subsequent cycling of the moorings in 2011 was highly successful with all data now available through the IMOS portal. These data provided our first look at the Storm Bay site which remains a challenge for our sub-facility. Settlement into sediment or sensor drift appears to be an issue at this site, with further detail to be revealed when the existing moorings are cycled in late Feb 2012.

Breakthroughs: The sub-facility has made great progress in the generation of a robust bias drift data stream, with the first non-preliminary release planned for 2012. This has involved the new collaboration international experts (Dr Matt King et al) in the field of vertical velocity determination. This data stream should yield valuable further insight into the spatial and temporal error characteristics of altimeter data for the user community.

**C Facility Infrastructure**

**11a Australian Satellite SST L2P Products:**

**C.1 New equipment to be provided during 2012-13**

May need to purchase additional RAM or data storage disks for computers in Antarctica (yet to be determined if necessary).

**C.2 Datastreams to be commissioned during 2012-13**

Australian and Southern Ocean region GHRSSST L2P, L3U, L3C and L3S files back to at least 1998. Reprocessing data prior to 1998 (potentially back to 1992) will depend on the quality of SST data from the earlier satellites – NOAA-11, 12, 14 and 16.

**C.3 Planned activities to position researchers and others to utilise the Facility**

- IMOS AVHRR L2P, L3U and L3S file production will be ported to the Bureau's operational systems in order to allow the IMOS satellite SST data to be used in operational analyses, models and systems
- The IMOS AVHRR SST L3C and MTSAT-1R L3U files have been provided to the GHRSSST Tropical Warm Pool Diurnal Variability (TWP+) Project via the Bureau's OPeNDAP server. These products will be promoted and used during the upcoming GHRSSST Workshop on Tropical Warm Pool and High Latitude SST Issues in Melbourne, 5-9 March 2012 (<https://www.ghrsst.org/ghrsst-science/Meetings-and-workshops/workshop-on-tropical-warm-pool-and-high-latitude-issues/> )
- IMOS satellite SST products will be promoted during the following conferences during 2012:

- GHRSSST Workshop on Tropical Warm Pool and High Latitude SST Issues, Melbourne, 5 – 9 Mar 2012-02-08
- 13<sup>th</sup> GHRSSST Science Team Meeting, Tokyo, 4 – 8 Jun 2012
- 2012 International Coral Reef Symposium, Cairns, 9 – 15 Jul 2012
- ISPRS 2012 Congress, Melbourne, 25 Aug – 1 Sep 2012

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

- In addition to the IMOS satellite SST products being provided in real-time to the IMOS FTP server in Canberra, AODAAC and Ocean Portal, the products are currently also provided in real-time to researchers via the Bureau's OPeNDAP server (www3).
- In order to disseminate the IMOS satellite SST products to users outside of Australia it is planned to provide them in real-time to the GHRSSST Global Data Assembly Centre (hosted by JPL PO.DAAC in the U.S. – see <http://podaac.jpl.nasa.gov/> )

***11b Australian Oceans Data Access and Archive Centre:***

**C.1 New equipment to be provided during 2012-13**

It is anticipated that the V2 system will be integrated into the AODN portal in the second half of 2012. Given the modular nature of the system, and that it will build on the infrastructure already in place from the V1 deployment, this is not expected to require a substantial upgrade of the AODN interface.

**C.2 Datastreams to be commissioned during 2012-13**

The ocean colour products from sub-facility 11d will become available, initially through the V1 system, and then more completely via the V2 system.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Integration of the AODAAC system into the AODN portal, and transfer of its operation and maintenance to eMII staff, will expose the system to a much larger group of users and ensure support.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

Nil to report.

***11c Upgrade of Townsville Ground Station:***

**C.1 New equipment to be provided during 2012-13**

AIMS is providing a RADOME for the system, and relocating it to a new building in late 2012.

**C.2 Datastreams to be commissioned during 2012-13**

It is likely that reception from SUOMI NPP will commence.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Present data sharing arrangements will remain in place

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

Nil to report

***11d Satellite Ocean Colour:***

**C.1 New equipment to be provided during 2012-13**

A DALEC spectroradiometer will be installed on RV Solander to complement the initial installation on the Southern Surveyor.

**C.2 Datastreams to be commissioned during 2012-13**

- The historical reprocessing of the SeaWiFS data set will complete early in 2012/13
- VIIRS products will be trialed during the year and moved to production mode if satisfactory.

**C.3 Planned activities to position researchers and others to utilise the Facility**

Data in the Bio-Optical DataBase and the LICO and DALEC datastreams will be contributed to NASA and ESA so that they can be used by the national and international community for calibration and validation of ocean colour sensor, including the VIIRS sensor launched in late 2011.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

The standard ocean colour and primary productivity data streams will be made accessible directly via a data server at the NCI, and will also be indexed via the AODAAC system integrated into the AODN portal.

***11e Satellite Altimetry Calibration and Validation:***

**C.1 New equipment to be provided during 2012-13**

New equipment to be provided over 2012-13 includes the procurement of new and planned replacement oceanographic sensors (SBE26 and SBE37) and associated mooring hardware including acoustic releases. These sensors contribute to the CMAR Coastal Moorings Team pool of equipment from which this sub-facility has drawn heavily from to facilitate its 6 monthly return visit cycle to its moorings in Bass Strait and Storm Bay. A minor additional piece of equipment will be the addition of new remote tracking units on both GPS buoys. These will enable remote tracking and geo-fence alarm capabilities, providing a risk reduction for each buoy deployment.

**C.2 Datastreams to be commissioned during 2012-13**

The datastreams to be commissioned include the updated absolute bias and bias drift streams. For the first time, we will be approaching a useful data length at the Storm Bay validation site to make meaningful inference on any temporal difference in the bias difference between Bass Strait and Storm Bay. As per previous years, our intermediate datastreams that include all raw data from our oceanographic sensors will be made available via the IMOS portal.

**C.3 Planned activities to position researchers and others to utilise the Facility**

As articulated in the sub-facility plan, the primary user group for this sub-facility is the Ocean Surface Topography Science Team (OSTST) that is associated with the TOPEX/Poseidon and Jason-class satellite altimeters. The broader user community, including users in the Australian community, therefore utilises this sub-facility indirectly in the knowledge a comprehensive international validation process is undertaken.

**C.4 Other activities planned to ensure effective management and governance of the Facility, including providing access to external users**

The team involved with this sub-facility has a long history of engagement with the user community, and collaborates closely with the other international teams involved in altimetry validation. This is evidenced through both publication (e.g. Bonnefond, Haines and Watson, 2011, publication that involved the US, French and Australian validation teams), invitations to attend international working groups (e.g. Crete workshop 2011) and collaborative proposals (e.g. the lead CIs from this sub-facility and the NASA validation team are named as external partners in a 2012 European Framework 7 bid for personal exchange led by the French CNES and Greek validation teams).

**D Milestones and Implementation Plan**

**D.1 Milestones – a separate table has been provided showing contracted Milestones**

***11a Australian Satellite SST L2P Products:***

Jun-12 milestone may be delayed by several months due to resignation of George Paltoglou, IMOS Scientific Programmer at BoM, effective 4 Apr 2012. Although a replacement has been recruited and will commence on 5 Mar 2012, there may still be delays due to spin-up time required to master the complex IMOS satellite SST processing system.

***11b Australian Oceans Data Access and Archive Centre:***

The milestones relating to the production deployment of the V1 system have been delayed by the altered priorities within eMII. With the imminent release of the new AODN portal, it appears that this obstacle has now been overcome and these milestones will be achieved in the first half of 2012.

***11c Upgrade of Townsville Ground Station:*** Milestones unchanged.

***11d Satellite Ocean Colour:***

Milestones relating to the production of the standard products and primary productivity products from both SeaWiFS and MODIS sensors are delayed due to technical issues at the NCI. The causes of these delays are being addressed and, with the signing of the services contract with Geoscience Australia to operate the regular production system, it is expected they will be achieved. The milestones for the data series from LICO could not be achieved during the year while the jetty has been inaccessible. Re-establishment of the LICO at the end of June 2012 will allow these milestones to be achieved early in 2012/13.

***11e Satellite Altimetry Calibration and Validation:*** Milestones unchanged.

**D.2 Implementation Plan July 2012 to June 2013**

***11a Australian Satellite SST L2P Products:***

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Test and develop optimum method for producing L3S (multi-sensor) composite products	BoM	George Paltoglou/Helen Beggs/Leon Majewski	2012-01-01	2012-02-15

Reprocess 1-day L3S back to 2002	BoM	George Paltoglou	2012-02-10	2012-04-04
Produce L2P, L3U, L3C and L3S files using archived Antarctic data back to 1997	BoM	George Paltoglou/Chris Griffin	2012-03-15	2012-06-30
Test AVHRR SST calibration over Southern Ocean using IMOS in situ SST data and existing BoM AVHRR/in situ SST Matchup Database	BoM	Chris Griffin/George Paltoglou/Helen Beggs	2012-03-15	2012-06-30
Port L2P processing code to Casey and Davis computers	BoM	Chris Griffin/Leon Majewski	2012-03-15	2012-06-30
Investigate improving cloud and ice detection in AVHRR SST over Southern Ocean	BoM	Chris Griffin	2012-07-01	2012-12-31
Implement real-time transmission of IMOS AVHRR L2P SST data from Casey and Davis and real-time processing these data in Melbourne to GHRSSST products	BoM	Chris Griffin/Leon Majewski	2012-07-01	2012-12-31
Update BoM systems so RT and reprocessed (back to at least 1998) AVHRR L2P, L3U, L3C and L3S files are available to GHRSSST and IMOS from Casey and Davis Stations in addition to Australian region	BoM	Chris Griffin/Leon Majewski	2013-01-01	2013-03-04

**11b Australian Oceans Data Access and Archive Centre:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Testing and any remediation of V2 system	CSIRO	K Suber	5/12	06/13
Integration of V2 system into AODN portal	CSIRO, IMOS/eMII	E King/P Blain	7/12	12/12
Completion of V2 documentation	CSIRO	K Suber/E King	3/12	9/12

**11c Upgrade of Townsville Ground Station:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Normal operation and regular acquisition	AIMS	C Steinberg	7/12	6/13

**11d Satellite Ocean Colour:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Installation of DALEC on board RV Solander	CSIRO	Vittorio Brando / Rex Keen / Paul Daniel	5/12	9/12
Commissioning of delayed time upload of QA DALEc data from RV Southern Surveyor and RV Solander	CSIRO	Vittorio Brando / Rex Keen / Paul Daniel	7/12	6/13
Data in the Bio-Optical DataBase be contributed to NASA and ESA database	CSIRO	Vittorio Brando / Lesley Clementson	continuing	
Re-commissioning of LICO data streams should be operational	CSIRO	Vittorio Brando / Rex Keen /	6/12	10/12

Establishment of VIIRS data set and basic production system for ocean colour	CSIRO	E King/V Brando	7/12	3/13
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**11e Satellite Altimetry Calibration and Validation:**

Activity / Deployment / Location	Responsible Organisation(s)	Responsible Person(s)	Start	Finish
Cycle Bass Strait and Storm Bay moorings on a 6 month visit cycle	CMAR Coastal Moorings Team	N White	Ongoing with a 6 month visit cycle	
Deploy / retrieve GPS equipped buoys	UTAS	C Watson	Ongoing episodic deployments	
Generate bias drift data stream	UTAS / CMAR	C Watson N White J Church	Ongoing. Updated stream to be presented at OSTST 27-29 Sep 2012.	
Generate absolute bias data stream	UTAS	C Watson	Ongoing with each update to follow mooring retrieval. Updated stream to be presented at OSTST 27-29 Sep 2012. Annual update complete by 31 Dec 2012.	
Update SRS 11e Sat Altim Website	UTAS	C Watson	Ongoing	
Attend annual OSTST meeting and disseminate data streams	UTAS / CMAR	C Watson N White	September 22-29 2012	

**E Project Resources**

**11a Australian Satellite SST L2P Products:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - unchanged

**E.3 Staffing**

George Paltoglou (PO2 Scientific Programmer): 100% to 3 Feb 2012 then 40% to 4 Apr 2012

Christopher Griffin (PO2 Scientific Programmer): 80% from 5 Mar 2012 to 4 Mar 2013

Helen Beggs (RS IMOS 11a Project Manager): 10% coinvestment

Leon Majewski (SPOC Satellite Observation Scientist): 25% coinvestment

**11b Australian Oceans Data Access and Archive Centre:**

**E.1 EIF budget** - unchanged

**E.2 Co-investments** - In 06/2011 TERN/AusCover and the AODAAC made a joint investment (\$25k ea) in storage for satellite data at the NCI facility in Canberra. This storage is being used to support the base data and products for the MODIS ocean colour stream.

**E.3 Staffing** - Only two staff (Suber & King) will support the AODAAC development during 2012/13, for a total input of 0.45 EFT. The SRS facility leadership by King is also supported out of this component.

***11c Upgrade of Townsville Ground Station:***

- E.1 EIF budget** - unchanged.
- E.2 Co-investments** - AIMS is purchasing and installing a radome for the system
- E.3 Staffing** - AIMS continues to resource the reception facility at levels that support ongoing 24x7 operations.

***11d Satellite Ocean Colour:***

- E.1 EIF budget** - It is anticipated that the CSIRO insurance claim will cover the cost of the re-establishment of LJCO, using some of the instrument contingency funds in the interim, as agreed with the IMOS office. In the event that the insurance claim does not cover the re-establishment cost, CSIRO will underwrite the instrumentation contingency funds. There have been delays in expending the funds for contract labour in the bio-optical database activity, largely due to the time taken to come to agreement with the agencies that have data to contribute. The sub-facility is forecasting a \$145k underspend as at 30 June 2012. All of these funds will be required in the 2012/13 financial year to cover this contracted labour for the bio-optical database.
- E.2 Co-investments** - In the event that CSIRO's insurance claim for LJCO is unsuccessful or insufficient, CSIRO will underwrite the instrumentation contingency funds used, representing a co-investment. Since this co-investment is contingent on several unknowns it is difficult to quantify at present. Several CSIRO projects that will use ocean colour data (eg eReefs, Marine Monitoring program) have recognised the value of the processing and archive infrastructure under development at the NCI and chosen to base their systems upon it. This is resulting in additional staff contributing to the common elements (catalogues, quicklook imagery, standard tools, data services) representing an informal co-investment of around 0.5 EFT. The partnership with TERN/AusCover is contributing a similar level of co-investment.
- E.3 Staffing** - The named personnel and their fractional allocation to the SRS-OC sub-facility include Vittorio Brando (0.25 FTE, sub facility leader); Raghu Cherukuru (0.1) and Thomas Schroeder (0.25) for production and validation of ocean colour; Rex Keen (0.1), Aaron Hawdon (0.1) and Paul Daniel (0.2) for LJCO and the ship-based radiometers; Lesley Clementson (0.3) and Janet Anstee (0.2) for bio-optical database.

The sub-facility also includes provision for contract labour to contribute to the compilation of the bio-optical database and the production and validation of ocean colour. Several agencies with bio-optical data will participate in these activities on a to-be-negotiated basis. Geoscience Australia have entered into an agreement to support the regular production of the ocean colour data at the NCI.

***11e Satellite Altimetry Calibration and Validation:***

- E.1 EIF budget** - unchanged.
- E.2 Co-investments** - EIF co-investments are unchanged at the +/- 10% level. It is worth noting however, between December 2011 and February 2012, in-kind investment from the new EIF funded Australian Geodetic Observing System (AGOS) was sought and received. This took the form of new advanced GPS reference sites for use in GPS buoy deployments in Bass Strait and Storm Bay.

**E.3 Staffing** - The agreed staffing allocation for the sub-facility remains unchanged. The named personnel and their fractional allocation to this sub-facility include Christopher Watson (0.6 FTE, UTAS), Neil White (0.25 FTE, CSIRO) and John Church (0.08 FTE, CSIRO). Additional staffing includes allocations to the CSIRO Coastal Moorings Team (CSOF4 @ 0.1 FTE, CSOF3 @ 0.1 FTE, CSOF4 @ 0.05 and CSOF6 @ 0.05), and a UTAS based field assistant for GPS buoy / tide gauge related work (0.5 FTE). Reed Burgette has been in the field assistant position and will leave in March 2012 to return to the United States. Suitable replacement is currently being sought.

Staff FTE summary for the Facility:

Sub-Facility	IMOS Funded	Co-invest	Total
11a Satt SST	1.80	0.35	2.15
11b AODAAC	0.45		0.45
11d Ocean Colour	1.40		1.40
11e Altimetry	1.73		1.73
<b>Total</b>	<b>5.38</b>	<b>0.35</b>	<b>5.73</b>



### Attachment B – 2012-13 Milestone Table

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
01 Argo	01 Argo	CSIRO	Wijffels, Susan	Maintain an array of 240 active Argo floats and deliver their data in realtime to eMII the global Argo data system	Maintain an array of 240 active Argo floats and deliver their data in realtime to eMII the global Argo data system	Maintain an array of 240 active Argo floats and deliver their data in realtime to eMII the global Argo data system	Maintain an array of 240 active Argo floats and deliver their data in realtime to eMII the global Argo data system
02 SOOP	02aa XBT	CSIRO	Thresher, Ann			All XBT data for 2012 processed, QCd and delivered to eMII, NODC, BoM and RAN	XBT data for 2013 processed, QCd and delivered to eMII, NODC, BoM and RAN
02 SOOP	02ab BGC	CSIRO	Tilbrook, Bronte	Delayed mode data for 2011-2012 complete for <i>l'Astrolabe</i> , <i>Aurora Australis</i> and <i>Southern Surveyor</i> .		Complete 2012-2013 field season for <i>Aurora Australis</i> and <i>l'Astrolabe</i>	Delayed mode data complete for <i>l'Astrolabe</i> , <i>Aurora Australis</i> and <i>Southern Surveyor</i> .
02 SOOP	02ac CPR	CSIRO	Richardson, Anthony	Continuation of AusCPR routes	Continuation of AusCPR routes. Annual evaluation of strengths, weaknesses and opportunities for the AusCPR survey	Continuation of AusCPR routes	Continuation of AusCPR routes. Data delivered to eMII
02 SOOP	02b Tropical	AIMS	Furnas, Miles		All new data processed and lodged in AIMS Data Centre for transfer to eMII		All new data processed and lodged in AIMS Data Centre for transfer to eMII
02 SOOP	02c SST	BoM	Beggs, Helen		Data stream coverage expanded by all new vessels (up to max 4) being installed with hull-contact temperature sensors		Near real-time, QC'd, SST from additional ships provided to GTS and eMII for access by users

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
02 SOOP	02d Flux	BoM	Schulz, Eric				Real-time data stream maintained (including instrument calibration and Meta-data) and provided to eMII over last 12 months to enable user access
02 SOOP	02e Bio-Acoustic	CSIRO	Kloser, Rudy	Review uptake of data and modify collections and data processing to match user uptake.	Report on progress with development of alternative uptake / funding options by fisheries management.	Draft report of the project.	Final report of project highlighting the developments and its impact and methods for ongoing data collections
03 ABOS	03a ASFS	BoM	Schulz, Eric	Retrieve SOFS-A2 and deploy new SOFS-B3 mooring to ensure continuity and reliability of real-time data availability maintained		Delayed-mode SOFS meteorological and current meter data streams delivered to eMII to assist user access	Delayed-mode SOFS met and current meter data from previous deployment delivered to eMII
03 ABOS	03b SOTS	CSIRO / UTAS	Trull, Tom	Recover SAZ14 redeploy as SAZ15. Deploy Pulse9	Deliver plan for ongoing observations following the EIF period	Recover Pulse9	All Pulse, SAZ, Profiler data delivered to eMII
03 ABOS	03c DA	CSIRO	Sloyan, Bernadette	Construction and instrument preparation of Polynya and ITF mooring turn-a-round	Recovery and re-deployment of ITF mooring array.	Recovery and re-deployment of Polynya mooring array.	Quality controlled ITF and Polynya mooring data submitted to eMII
04 ANFOG	04 ANFOG	UWA	Pattiaratchi, Chari	All glider deployments producing real-time data via eMII and GTS	Annual total deployments of 24 gliders at all sites (Coral Sea, NSW, Tasmania, SOTS, SA and WA). All glider deployments producing real-time data via eMII and GTS	All glider deployments producing real-time data via eMII and GTS	All glider deployments producing real-time data via eMII and GTS

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
05 AUV	05 AUV	SIMS	Williams, Stefan	Repeat of reference sites in tropical WA	Repeat of reference sites in NSW & Qld		Repeat of reference sites in Tasmania and temperate WA. Data delivered to eMII.
06 ANMN	06a Qld&NA	AIMS	Steinberg, Craig	Service SGBR array and ITF transect. Submit QA NGBR, Yongala, Darwin, Ningaloo datastreams to eMII	Service NGBR array and Yongala, Ningaloo and Darwin NRS; Submit QA SGBR and ITF datastreams to eMII	Service SGBR array and ITF transect. Submit QA NGBR, Yongala, Darwin, Ningaloo datastreams to eMII	Service NGBR array and Yongala, Ningaloo and Darwin NRS; Submit QA SGBR and ITF datastreams to eMII
06 ANMN	06b NSW	SIMS	Roughan, Moninya	Development of mooring research infrastructure at 8 mooring sites and 4 stations at Port Hacking to produce data streams	Development of mooring research infrastructure at 8 mooring sites and 4 stations at Port Hacking to produce data streams	Development of mooring research infrastructure at 8 mooring sites and 4 stations at Port Hacking to produce data streams	Development of mooring research infrastructure at 8 mooring sites and 4 stations at Port Hacking to produce data streams
06 ANMN	06c SA	SARDI	Middleton, John	Development of mooring research infrastructure at 4 sites to produce data streams	Development of mooring research infrastructure at 6 sites to produce data streams	Development of mooring research infrastructure at 6 sites to produce data streams	Development of mooring research infrastructure at 4 sites to produce data streams
06 ANMN	06d WA	CSIRO	Feng, Ming	Development of mooring research infrastructure at 9 sites to produce data streams	Development of mooring research infrastructure at 9 sites to produce data streams	Development of mooring research infrastructure at 9 sites to produce data streams	Development of mooring research infrastructure at 9 sites to produce data streams
06 ANMN	06e Acoustic	Curtin	McCauley, Rob	Turnaround Perth Canyon moorings (recover PCA-5, deploy PCA-6)	Turnaround NSW & Portland moorings (recover NSW-3 deploy NSW-4, recover PORT-4, deploy PORT-5)	Data from PCA-5, NSW-3 & PORT-4 submitted to eMII	Recover all 3 arrays, all outstanding data submitted to eMII
06 ANMN	06f NRS	CSIRO	Lynch, Tim			Maintain NRS ADCP MAR	Maintain SEQ shelf array and NSI NRS
06 ANMN	06g pCO2	CSIRO	Tilbrook, Bronte		Maintain pCO2 KAI	Maintain pCO2 MAR	

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
07 ACORN	07 ACORN	JCU	Wyatt, Lucy	Maintain and operate 6 radar sites. Provide near real-time, raw and delayed mode data to eMII to enable eMII to deliver radar data and products to the Nodes.	Maintain and operate 6 radar sites. Provide near real-time, raw and delayed mode data to eMII to enable eMII to deliver radar data and products to the Nodes.	Maintain and operate 6 radar sites. Provide near real-time, raw and delayed mode data to eMII to enable eMII to deliver radar data and products to the Nodes.	Maintain and operate 6 radar sites. Provide near real-time, raw and delayed mode data to eMII to enable eMII to deliver radar data and products to the Nodes.
08 AATAMS	08 AATAMS	SIMS	Harcourt, Rob	Servicing and redeployment of AATAMS curtains, provide delayed mode data to eMII .	Review AATAMS program and strategic planning going forward	Biologgers deployed, provide delayed mode data to eMII .	Servicing and redeployment of AATAMS curtains, provide delayed mode data to eMII .
09 FAIMMS	09 FAIMMS	AIMS	Bainbridge, Scott	Development of data discovery and delivery client systems and tools. Delivery of data from all sensor networks to eMII.	Pre-summer servicing of equipment and updating of sensors to support monitoring of summer conditions. Delivery of data from all sensor networks to eMII.	Development of sensor network test bed at one site for the testing of new sensors and sensor technology. Delivery of data from all sensor networks to eMII.	Delivery of data from all sensor networks to eMII.
10 eMII	10 eMII	UTAS	Proctor, Roger	Portal interaction with ARCS GRID computing. All IMOS data discoverable and accessible through the IMOS Ocean Portal.	Portal v6 released. All IMOS data discoverable and accessible through the IMOS Ocean Portal.	EIF data products available – for public. All IMOS data discoverable and accessible through the IMOS Ocean Portal.	All IMOS data discoverable and accessible through the IMOS Ocean Portal. Final report
11 SRS	11a SST L2P	BoM	Beggs, Helen		Real-time AVHRR SST files incorporating all Antarctic and Australian data available to the AO-DAAC and eMII in GHRSSST format for access by users		Reprocessed AVHRR SST data available for the Australian and Antarctic region back to 1992, full 1 km resolution, calibrated and validated and with estimated errors, available to the AO-DAAC and eMII in GHRSSST format as L2P, L3C and L3S files.

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
11 SRS	11b AODAAC	CSIRO	King, Edward	Decision point to determine whether feasible to support spatial sub-setting of non-rectangular grids	Prioritised list of outstanding issues/bugs to be resolved over final six months of project	Non-rectangular grids subsetting supported	No outstanding bugs needing to be fixed in agreed feature set, full operations support and documentation
11 SRS	11c T'ville GS	AIMS	Steinberg, Craig		Routine reception and delivery of L+X band satellite data streams to AO-DAAC and eMII		Routine reception and delivery of L+X band satellite data streams to AO-DAAC and eMII
11 SRS	11d Colour	CSIRO	Brando, Vittorio	Commissioning of bio-optical data base of Australian Waters		Commissioning of bio-optical data base of Australian Waters	
11 SRS	11e SatAltim	UTAS	Watson, Christopher	Update the bias drift data stream. Cycle Bass Strait and Storm Bay oceanographic instrument moorings.	Update the absolute bias data stream and disseminate data to the international community.	Complete GPS buoy deployments at Bass Strait and Storm Bay sites.	Compile the final set of absolute and bias drift data streams. Disseminate to the community.
12 Office	12 Office	UTAS	Moltmann, Tim	Annual Report 3; Milestone Report 13	Milestone Report 14	Milestone Report 15	Milestone Report 16. (by Sep 2013 Final Report; by Mar 2014 Completion of requirements under the EIF Agreement)

**New 2012-13 Milestones resulting from the additional co-investment provided by the WA Government**

Facility	Sub-facility	Operator	Leader	Due by 30Sep12	Due by 31Dec12	Due by 31Mar13	Due by 30Jun13
04 ANFOG	04 ANFOG	UWA	Pattiaratchi, Chari	Fourth deployment of Slocum glider along the Kimberley line completed. Third deployment of Slocum glider along the Pilbara line completed. Data for deployments in previous quarter available through eMII	Fifth deployment of Slocum glider along the Kimberley line completed. Fourth deployment of Slocum glider along the Pilbara line completed. Data for deployments in previous quarter available through eMII	Sixth deployment of Slocum glider along the Kimberley line completed. Fifth deployment of Slocum glider along the Pilbara line completed. Data for deployments in previous quarter available through eMII	Seventh deployment of Slocum glider along the Kimberley line completed. Sixth deployment of Slocum glider along the Pilbara line completed. Data for deployments in previous quarter available through eMII
06 ANMN	06a Qld&NA	AIMS	Steinberg, Craig	Aug12 Maintain Kimberley and Pilbara transacts and retrieve data	Oct12 Raw data to IMOS Portal; Nov12 QC data to AODN	Feb13 Maintain Kimberley and Pilbara transacts and retrieve data	Apr13 Raw data to IMOS Portal; May13 QC data to AODN
06 ANMN	06e Acoustic	Curtin	McCauley, Rob		Passive acoustic lines deployed		Mobilise for turnaround mid-2013
08 AATAMS	08 AATAMS	SIMS	Harcourt, Rob	Aug12 first download data uploaded via eMII and retagging of animals.			
12 Office	12 Office	UTAS	Moltmann, Tim		WA-IMOS Progress Report 2011-12		WA-IMOS Business Plan 2012-13
WAIMOS	WAIMOS	UWA	Pattiaratchi, Chari	Completion of September 2012 reporting requirements	Completion of December 2012 reporting requirements	Completion of March 2013 reporting requirements	Completion of June 2013 reporting requirements

## Attachment C – List of Acronyms

<b>Acronym</b>	<b>Full Title</b>
AATAMS	Australian Animal Tagging and Monitoring System (Facility 8)
ABOS	Australian Bluewater Observing System (Facility 3)
ACORN	Australian Coastal Ocean Radar Network (Facility 7)
ADCP	Acoustic Doppler Current Profiler
AIMS	Australian Institute of Marine Science
ANFOG	Australian National Facility for Ocean Gliders (Facility 4)
ANMN	Australian National Mooring Network (Facility 6)
ANU	Australian National University
AO-DAAC	Australian Ocean [Remote Sensing Data] Distributed Active Archive Centre
AODN	Australian Ocean Data Network
ARCS	Australian Research Collaboration Service
Argo	Argo Australia (Facility 1)
AusCPR	Australian Continuous Plankton Recorder
AUV	Autonomous Underwater Vehicle Facility (Facility 5)
AVHRR	Advanced Very High Resolution Radiometer
BGC	Biogeochemical
BoM	Bureau of Meteorology
CMAR	CSIRO Marine and Atmospheric Research
CPR	Continuous Plankton Recorder
CTD	Conductivity Temperature Depth
EAC	East Australian Current
EIF	Education Investment Fund
eMII	electronic Marine Information Infrastructure (Facility 10)
ESA	European Space Agency
FAIMMS	Facility for Automated Intelligent Monitoring of Marine Systems (Facility 9)
GBR	Great Barrier Reef
GHRSSST	Group for High Resolution SST
GPS	Global Positioning System
IMOS	Integrated Marine Observing System
ITF	Indonesian Through Flow
LJCO	Lucinda Jetty Coastal Observatory
MODIS	Moderate Resolution Imaging Spectro-radiometer
MPA	Marine Protected Area
NASA	National Aeronautics and Space Administration
NCI	National Computing Infrastructure
NCRIS	National Collaborative Research Infrastructure Strategy
NIWA	National Institute of Water and Atmospheric Research, NZ
NRS	National Reference Station moorings
OPeNDAP	Open-source Project for a Network Data Access Protocol
OSTST	Ocean Surface Topography Science Team
QA	Quality Assurance
QC	Quality Control
QIMOS	Queensland Integrated Marine Observing System (Node)

<b>Acronym</b>	<b>Full Title</b>
SAIMOS	Southern Australian Integrated Marine Observing System (Node)
SARDI	South Australian Research and Development Institute
SEQ	South East Queensland
SIMS	Sydney Institute of Marine Science
SOFS	Southern Ocean Flux Station Meteorological Mooring
SOOP	Enhanced Measurements from Ships of Opportunity (Facility 2)
SOTS	Southern Ocean Time Series
SRS	Satellite Remote Sensing (Facility 11)
SST	Sea Surface Temperature
TasIMOS	Tasmanian Integrated Marine Observing System (Node)
TERN	Terrestrial Ecosystem Research Network
TSG	thermosalinograph
UNSW	University of New South Wales
UQ	University of Queensland
UTAS	University of Tasmania
UWA	University of Western Australia
WAIMOS	Western Australian Integrated Marine Observing System (Node)
WHOI	Woods Hole Oceanographic Institute
WQM	Water Quality Meter
XBT	Expendable bathy-thermograph



## Attachment D – Budget and Financial Tables

**D.1:** Summary of the overall contributions to the Project (GST exclusive)  
[Updates Schedule 1, Table 1, IMOS EIF Funding Agreement 2009-13]

	FY 2009/10	FY 2010/11	FY 2011/12	FY 2012-13	FY 2013-14	Total
EIF Cash	16,000,000		18,000,000	18,000,000	0	52,000,000
EIF Interest	291,430	338,135	540,000	560,000	0	1,729,565
<b>EIF Total</b>	<b>16,291,430</b>	<b>338,135</b>	<b>18,540,000</b>	<b>18,560,000</b>	<b>0</b>	<b>53,729,565</b>
Co-invest Cash	55,500	2,485,819	7,445,821	5,721,301	2,000,000	17,708,441
Co-invest In-kind	1,564,436	3,630,222	19,453,275	20,325,859	805,918	45,779,710
<b>Co-invest Total</b>	<b>1,619,936</b>	<b>6,116,041</b>	<b>26,899,096</b>	<b>26,047,160</b>	<b>2,805,918</b>	<b>63,488,151</b>
<b>Total Resources</b>	<b>17,911,366</b>	<b>6,454,176</b>	<b>45,439,096</b>	<b>44,607,160</b>	<b>2,805,918</b>	<b>117,217,716</b>

**D.2:** Summary of overall EIF costs of the Project by Facility and Operator (GST exclusive)  
[updates Schedule 1, Table 2, IMOS EIF Funding Agreement 2009-13]

Facility	Operator	2009/10	2010/11	2011/12	2012/13	Total
<b>01 Argo</b>	CSIRO	1,113,044	2,741	1,814,413	1,852,820	4,783,018
<b>02 SOOP</b>	AIMS			46,310	47,246	93,556
	BOM			260,151	257,611	517,762
	CSIRO		503,625	1,874,496	1,176,436	3,554,557
			<b>503,625</b>	<b>2,180,957</b>	<b>1,481,293</b>	<b>4,165,875</b>
<b>03 ABOS</b>	BOM			1,401,437	262,509	1,663,946
	CSIRO	341,733	778,568	2,072,538	718,788	3,911,627
	UTAS			578,900	231,336	810,236
		<b>341,733</b>	<b>778,568</b>	<b>4,052,875</b>	<b>1,212,633</b>	<b>6,385,809</b>
<b>04 ANFOG</b>	UWA	1,249,503	345,040	2,168,100	1,301,242	5,063,885
<b>05 AUV</b>	SIMS		180,190	372,310	330,000	882,500
<b>06 ANMN</b>	AIMS	577,883	670,101	2,343,694	1,100,604	4,692,282
	CSIRO	1,766,790	949,849	3,400,987	2,360,234	8,477,860
	CUT			146,564	211,142	357,706
	SARDI	50,000	104,606	636,511	632,101	1,423,218
	SIMS	50,000	0	850,606	867,973	1,768,579
		<b>2,444,673</b>	<b>1,724,556</b>	<b>7,378,362</b>	<b>5,172,054</b>	<b>16,719,645</b>
<b>07 ACORN</b>	JCU			707,655	734,962	1,442,617
<b>08 AATAMS</b>	SIMS	397,958	686,675	2,380,230	1,505,774	4,970,637
<b>09 FAIMMS</b>	AIMS			291,127	298,303	589,430
<b>10 eMII</b>	UTAS			1,600,000	1,680,000	3,280,000
<b>11 SRS</b>	AIMS			51,310	52,246	103,556
	BOM			215,305	178,990	394,295
	CSIRO		233,680	849,941	525,379	1,609,000
	UTAS		307,069	397,931	337,000	1,042,000
			<b>540,749</b>	<b>1,514,487</b>	<b>1,093,615</b>	<b>3,148,851</b>
<b>12 Office</b>	UTAS			775,000	816,000	1,591,000

Facility	Operator	2009/10	2010/11	2011/12	2012/13	Total
<b>Unallocated</b>				155,298	551,000	706,298
		<b>5,546,911</b>	<b>4,762,144</b>	<b>25,390,814</b>	<b>18,029,696</b>	<b>53,729,565</b>

**D.3 Cash and In-kind Contributions by each participant Organisation other than DIISRTE**  
[Updates Schedule1, Table 3, IMOS EIF Funding Agreement 2009-13]

Co-investor	2009/10	2010/11	2011/12	2012/13	2013/14	Total
<b>Cash Co-investments</b>						
Antarctic Climate & Ecosystems CRC		448,019	819,000			1,267,019
Australian Institute of Marine Science		80,000	250,500	228,900		559,400
Bureau of Meteorology			264,896	267,492		532,388
CSIRO		1,431,800	640,057	650,659		2,722,516
Curtin University			156,000	156,000		312,000
Flinders University			12,500	12,500		25,000
James Cook University			70,500	48,900		119,400
Macquarie University	20,000	20,000	10,000			50,000
NOAA, USA		306,000				306,000
NSW Government		200,000	200,000	200,000		600,000
Ocean Tracking Network, Canada			716,000	43,200		759,200
Queensland Government			992,886	1,007,115		2,000,001
Royal Australian Navy			514,842	535,435		1,050,277
SA Department Environment & Heritage			65,000	0		65,000
Scripps Institution of Oceanography, USA			248,640	256,100		504,740
South Australian Research & Development Institute			12,500	12,500		25,000
Sydney Institute of Marine Science			222,500	52,500		275,000
Tas Department Economic Development Tourism & Arts			125,000	125,000		250,000
University of Tasmania	35,500		125,000	125,000		285,500
WA Government			2,000,000	2,000,000	2,000,000	6,000,000
	<b>55,500</b>	<b>2,485,819</b>	<b>7,445,821</b>	<b>5,721,301</b>	<b>2,000,000</b>	<b>17,708,441</b>
<b>In-kind Co-investments</b>						
Antarctic Climate & Ecosystems CRC		70,668	291,550	297,865		660,083
Austral Fisheries		35,000	35,000	35,000		105,000
Australian Antarctic Division	632,388	500,000	3,093,450	3,400,700		7,626,538
Australian Climate Change Science Program			666,547	687,737		1,354,284
Australian Institute of Marine Science	215,699	682,665	3,253,697	3,590,289	805,918	8,548,268
Bureau of Meteorology			557,434	581,900		1,139,334
CSIRO	429,849	1,267,035	4,392,217	3,605,395		9,694,496

Co-investor	2009/10	2010/11	2011/12	2012/13	2013/14	Total
Curtin University			35,000	35,000		70,000
Flinders University		143,000	295,457	304,629		743,086
James Cook University	4,500		255,465	265,685		525,650
Korea, KORDI			306,000			306,000
l'Astrolabe			50,000	50,000		100,000
Macquarie University	125,000	129,000	135,000	40,000		429,000
Marine National Facility		42,000	942,000	1,542,000		2,526,000
Marine Park Authority			16,360	16,360		32,720
Melbourne University ISSNIP			50,000	50,000		100,000
National Institute of Water and Atmospheric Research, NZ				3,000		3,000
NOAA, USA				630,000		630,000
NSW Department of Environment, Climate Change and Water			1,197,000	1,197,000		2,394,000
Petuna Sealord		35,000	35,000	35,000		105,000
Queensland Department Employment, Economic Development & Innovation			120,000	120,000		240,000
Queensland Department Environment & Resource Management		2,500	2,500	2,500		7,500
South Australian Research & Development Institute		381,188	614,775	637,512		1,633,475
Sydney Institute of Marine Science			206,199	213,726		419,925
Sydney Water Corporation			250,000	250,000		500,000
Tropical Marine Network			308,000	310,000		618,000
University of Sydney			180,000	180,000		360,000
University of Tasmania	157,000	309,000	1,976,800	2,050,680		4,493,480
University of Western Australia		33,166				33,166
Victoria Parks			10,000	10,000		20,000
WA Fisheries			177,824	183,881		361,705
	<b>1,564,436</b>	<b>3,630,222</b>	<b>19,453,275</b>	<b>20,325,859</b>	<b>805,918</b>	<b>45,779,710</b>
	<b>1,619,936</b>	<b>6,116,041</b>	<b>26,899,096</b>	<b>26,047,160</b>	<b>2,805,918</b>	<b>63,488,151</b>

**D.4 IMOS EIF Project Resources by Facility for 2009-13**  
 [Updates Annex A, Final IMOS EIF Project Plan, IMOS EIF Funding Agreement 2009-13]

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
01 Argo		DIISRTE	DIISRTE	1,113,044	2,741	1,814,413	1,852,820		4,783,018
		CI Cash	Antarctic Climate & Ecosystems CRC			280,000			280,000
			Bureau of Meteorology			200,000	200,000		400,000
			CSIRO			265,057	275,659		540,716
		<i>CI Cash</i>				745,057	475,659		1,220,716
		CI In-Kind	Australian Climate Change Science Program			499,910	515,803		1,015,713
			Bureau of Meteorology			145,709	151,537		297,246
			CSIRO			483,037	483,037		966,074
		<i>CI In-Kind</i>				1,128,656	1,150,377		2,279,033
<b>01 Argo</b>				<b>1,113,044</b>	<b>2,741</b>	<b>3,688,126</b>	<b>3,478,856</b>		<b>8,282,767</b>
02 SOOP	02aa Expendable bathythermograph	DIISRTE	DIISRTE			85,651	78,833		164,484
		CI Cash	Bureau of Meteorology			64,896	67,492		132,388
			Royal Australian Navy			514,842	535,435		1,050,277
			Scripps Institution of Oceanography, USA			248,640	256,100		504,740
		<i>CI Cash</i>				828,378	859,027		1,687,405
		CI In-Kind	Australian Climate Change Science Program			166,637	171,934		338,571
			Bureau of Meteorology			167,324	175,689		343,013
			CSIRO			13,423	13,423		26,846
		<i>CI In-Kind</i>				347,384	361,046		708,430
	02aa Expendable bathythermograph					1,261,413	1,298,906		2,560,319
	02ab Biogeochemical	DIISRTE	DIISRTE		62,658	335,010	257,455		655,123
		CI In-Kind	CSIRO			179,744	179,744		359,488
			l'Astrolabe			50,000	50,000		100,000
			Marine National Facility			50,000	50,000		100,000

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		<i>CI In-Kind</i>				279,744	279,744		559,488
	02ab Biogeochemical				62,658	614,754	537,199		1,214,611
	02ac Aust Continuous Plankton Recorders	DIISRTE	DIISRTE		141,118	1,110,279	630,899		1,882,296
		<i>CI In-Kind</i>	Australian Antarctic Division			156,450	161,700		318,150
			CSIRO		73,132	389,547	389,547		852,226
		<i>CI In-Kind</i>			73,132	545,997	551,247		1,170,376
	02ac Aust Continuous Plankton Recorders				214,250	1,656,276	1,182,146		3,052,672
	02b Tropical Research Vessels	DIISRTE	DIISRTE			46,310	47,246		93,556
		<i>CI In-Kind</i>	Australian Institute of Marine Science			65,346	67,000		132,346
	02b Tropical Research Vessels					111,656	114,246		225,902
	02c SST Sensors	DIISRTE	DIISRTE			155,133	143,226		298,359
		<i>CI In-Kind</i>	Australian Institute of Marine Science			28,000	28,000		56,000
			Bureau of Meteorology			29,211	30,379		59,590
		<i>CI In-Kind</i>				57,211	58,379		115,590
	02c SST Sensors					212,344	201,605		413,949
	02d Air-sea Fluxes	DIISRTE	DIISRTE			105,018	114,385		219,403
		<i>CI In-Kind</i>	Bureau of Meteorology			29,993	31,193		61,186
			National Institute of Water and Atmospheric Research, NZ				3,000		3,000
		<i>CI In-Kind</i>				29,993	34,193		64,186
	02d Air-sea Fluxes					135,011	148,578		283,589
	02e Bio-acoustic	DIISRTE	DIISRTE		299,849	343,556	209,249		852,654

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		CI In-Kind	Austral Fisheries		35,000	35,000	35,000		105,000
			Australian Antarctic Division			110,000	110,000		220,000
			CSIRO		286,119	503,830	518,324		1,308,273
			Marine National Facility		42,000	42,000	42,000		126,000
			Petuna Sealord		35,000	35,000	35,000		105,000
		<i>CI In-Kind</i>			<i>398,119</i>	<i>725,830</i>	<i>740,324</i>		<i>1,864,273</i>
	02e Bio-acoustic				697,968	1,069,386	949,573		2,716,927
02 SOOP					974,876	5,060,840	4,432,253		10,467,969
03 ABOS	03a Air-Sea Flux Stations	DIISRTE	DIISRTE			1,401,437	262,509		1,663,946
		CI In-Kind	Bureau of Meteorology			123,113	128,534		251,647
	03a Air-Sea Flux Stations					1,524,550	391,043		1,915,593
	03b Southern Ocean Time Series	DIISRTE	DIISRTE			940,060	502,518		1,442,578
		CI Cash	Antarctic Climate & Ecosystems CRC			539,000			539,000
		CI In-Kind	Antarctic Climate & Ecosystems CRC			220,882	228,565		449,447
			Australian Antarctic Division			425,000	425,000		850,000
			CSIRO			223,255	146,153		369,408
			Marine National Facility			850,000	850,000		1,700,000
			University of Tasmania			76,379	79,034		155,413
		<i>CI In-Kind</i>				<i>1,795,516</i>	<i>1,728,752</i>		<i>3,524,268</i>
	03b Southern Ocean Time Series					3,274,576	2,231,270		5,505,846
	03c Deepwater Arrays	DIISRTE	DIISRTE	341,733	778,568	1,711,378	447,606		3,279,285
		CI Cash	Antarctic Climate & Ecosystems CRC & CSIRO		448,019				448,019
			CSIRO		974,000	375,000	375,000		1,724,000
			NOAA, USA		306,000				306,000
		<i>CI Cash</i>			<i>1,728,019</i>	<i>375,000</i>	<i>375,000</i>		<i>2,478,019</i>

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		CI In-Kind	Antarctic Climate & Ecosystems CRC		70,668	70,668	69,300		210,636
			Australian Antarctic Division		500,000		500,000		1,000,000
			Australian Institute of Marine Science		140,000		100,000		240,000
			CSIRO	3,502	162,167	624,151	163,447		953,267
			Korea, KORDI			306,000			306,000
			Marine National Facility				600,000		600,000
			NOAA, USA				630,000		630,000
		<i>CI In-Kind</i>		3,502	872,835	1,000,819	2,062,747		3,939,903
	03c Deepwater Arrays			345,235	3,379,422	3,087,197	2,885,353		9,697,207
<b>03 ABOS</b>				<b>345,235</b>	<b>3,379,422</b>	<b>7,886,323</b>	<b>5,507,666</b>		<b>17,118,646</b>
04 ANFOG		DIISRTE	DIISRTE	1,249,503	345,040	2,168,100	1,301,242		5,063,885
		CI Cash	NSW Government		34,000	33,000	33,000		100,000
			WA Government			446,000	253,000	400,000	1,099,000
		<i>CI Cash</i>			34,000	479,000	286,000	400,000	1,199,000
		CI In-Kind	University of Western Australia		33,166				33,166
<b>04 ANFOG</b>				<b>1,249,503</b>	<b>412,206</b>	<b>2,647,100</b>	<b>1,587,242</b>	<b>400,000</b>	<b>6,296,051</b>
05 AUV		DIISRTE	DIISRTE		180,190	372,310	330,000		882,500
		CI Cash	NSW Government		50,000	50,000	50,000		150,000
			Sydney Institute of Marine Science			17,500	17,500		35,000
		<i>CI Cash</i>			50,000	67,500	67,500		185,000
		CI In-Kind	Australian Institute of Marine Science			280,000	280,000		560,000
			NSW Department of Environment, Climate Change and Water			25,000	25,000		50,000
			Queensland Department Employment, Economic Development & Innovation			30,000	30,000		60,000
			University of Sydney			180,000	180,000		360,000
			University of Tasmania			64,200	64,200		128,400
			Victoria Parks			10,000	10,000		20,000

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
			WA Fisheries			26,400	26,400		52,800
		<i>CI In-Kind</i>				615,600	615,600		1,231,200
05 AUV					230,190	1,055,410	1,013,100		2,298,700
06 ANMN	06a Qld&NthAust	DIISRTE	DIISRTE	577,883	670,101	2,343,694	1,100,604		4,692,282
		CI Cash	Queensland Government			701,760	708,810		1,410,570
			WA Government			1,364,000	1,055,000	1,109,000	3,528,000
		<i>CI Cash</i>				2,065,760	1,763,810	1,109,000	4,938,570
		CI In-Kind	Australian Institute of Marine Science	35,699	542,665	1,877,280	2,083,576	805,918	5,345,138
	06a Qld&NthAust			613,582	1,212,766	6,286,734	4,947,990	1,914,918	14,975,990
	06b New South Wales	DIISRTE	DIISRTE	50,000	0	850,606	867,973		1,768,579
		CI Cash	NSW Government		50,000	50,000	50,000		150,000
			Sydney Institute of Marine Science			187,500	17,500		205,000
		<i>CI Cash</i>			50,000	237,500	67,500		355,000
		CI In-Kind	NSW Department of Environment, Climate Change and Water			1,172,000	1,172,000		2,344,000
			Sydney Institute of Marine Science			18,000	18,000		36,000
			Sydney Water Corporation			250,000	250,000		500,000
		<i>CI In-Kind</i>				1,440,000	1,440,000		2,880,000
	06b New South Wales			50,000	50,000	2,528,106	2,375,473		5,003,579
	06c Southern Australia (SARDI)	DIISRTE	DIISRTE	50,000	104,606	636,511	632,101		1,423,218
		CI Cash	Flinders University			2,500	2,500		5,000
			South Australian Research & Development Institute			2,500	2,500		5,000
		<i>CI Cash</i>				5,000	5,000		10,000
		CI In-Kind	Flinders University		20,000	161,833	165,780		347,613
			South Australian Research & Development Institute		42,188	233,745	241,321		517,254



Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		<i>CI In-Kind</i>			62,188	395,578	407,101		864,867
	06c Southern Australia			50,000	166,794	1,037,089	1,044,202		2,298,085
	06d Western Australia	DIISRTE	DIISRTE			518,997	541,435		1,060,432
		CI In-Kind	CSIRO			496,320	339,494		835,814
	06d Western Australia					1,015,317	880,929		1,896,246
	06e Acoustic Observatories	DIISRTE	DIISRTE			146,564	211,142		357,706
		CI Cash	Curtin University			156,000	156,000		312,000
			WA Government				378,000	173,000	551,000
		<i>CI Cash</i>				156,000	534,000	173,000	863,000
		CI In-Kind	Curtin University			35,000	35,000		70,000
	06e Acoustic Observatories					337,564	780,142	173,000	1,290,706
	06f National Reference Stations	DIISRTE	DIISRTE	1,766,790	734,970	2,555,854	1,672,786		6,730,400
		CI In-Kind	CSIRO	426,347	491,507	829,653	829,653		2,577,160
	06f National Reference Stations			2,193,137	1,226,477	3,385,507	2,502,439		9,307,560
	06g Acidification moorings	DIISRTE	DIISRTE		214,879	326,136	146,013		687,028
		CI In-Kind	CSIRO		14,340	47,486	47,486		109,312
	06g Acidification moorings				229,219	373,622	193,499		796,340
<b>06 ANMN</b>				<b>2,906,719</b>	<b>2,885,256</b>	<b>14,963,939</b>	<b>12,724,674</b>	<b>2,087,918</b>	<b>35,568,506</b>
07 ACORN		DIISRTE	DIISRTE			707,655	734,962		1,442,617
		CI Cash	Australian Institute of Marine Science			70,500	48,900		119,400

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
			Flinders University			10,000	10,000		20,000
			James Cook University			70,500	48,900		119,400
			NSW Government		33,000	33,000	34,000		100,000
			South Australian Research & Development Institute			10,000	10,000		20,000
		<i>CI Cash</i>			33,000	194,000	151,800		378,800
		CI In-Kind	Flinders University			5,624	5,849		11,473
			James Cook University			255,465	265,685		521,150
			South Australian Research & Development Institute			23,622	24,567		48,189
		<i>CI In-Kind</i>				284,711	296,101		580,812
<b>07 ACORN</b>					33,000	1,186,366	1,182,863		2,402,229
08 AATAMS	08a AATAMS Receivers	DIISRTE	DIISRTE			346,649	450,774		797,423
		CI Cash	Australian Institute of Marine Science		80,000	180,000	180,000		440,000
			CSIRO		457,800				457,800
			NSW Government		33,000	34,000	33,000		100,000
			Ocean Tracking Network, Canada			716,000	43,200		759,200
			Sydney Institute of Marine Science			17,500	17,500		35,000
			WA Government			40,000	152,000	142,000	334,000
		<i>CI Cash</i>			570,800	987,500	425,700	142,000	2,126,000
		CI In-Kind	Australian Institute of Marine Science	180,000		321,501	333,961		835,462
			CSIRO			174,979	134,316		309,295
			James Cook University	4,500					4,500
			Marine Park Authority			16,360	16,360		32,720
			Queensland Department Environment & Resource Management		2,500	2,500	2,500		7,500
			South Australian Research & Development Institute			5,408	5,624		11,032
			Sydney Institute of Marine Science			188,199	195,726		383,925
			University of Tasmania			49,656	49,656		99,312
			WA Fisheries			151,424	157,481		308,905

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		<i>CI In-Kind</i>		184,500	2,500	910,027	895,624		1,992,651
	08a AATAMS Receivers			184,500	573,300	2,244,176	1,772,098	142,000	4,916,074
	08b AATAMS Sat Tags	DIISRTE	DIISRTE	397,958	686,675	2,033,581	1,055,000		4,173,214
		CI Cash	Macquarie University	20,000	20,000	10,000			50,000
			SA Department Environment & Heritage			65,000	0		65,000
			University of Tasmania	35,500					35,500
		<i>CI Cash</i>		55,500	20,000	75,000	0		150,500
		CI In-Kind	Australian Antarctic Division	632,388		2,402,000	2,204,000		5,238,388
			Flinders University		123,000	128,000	133,000		384,000
			Macquarie University	125,000	129,000	135,000	40,000		429,000
			South Australian Research & Development Institute		339,000	352,000	366,000		1,057,000
			University of Tasmania	157,000	57,000	57,000	57,000		328,000
		<i>CI In-Kind</i>		914,388	648,000	3,074,000	2,800,000		7,436,388
	08b AATAMS Sat Tags			1,367,846	1,354,675	5,182,581	3,855,000		11,760,102
<b>08 AATAMS</b>				<b>1,552,346</b>	<b>1,927,975</b>	<b>7,426,757</b>	<b>5,627,098</b>	<b>142,000</b>	<b>16,676,176</b>
09 FAIMMS		DIISRTE	DIISRTE			291,127	298,303		589,430
		CI Cash	Queensland Government			291,126	298,305		589,431
		CI In-Kind	Australian Institute of Marine Science			588,683	603,579		1,192,262
			Melbourne University ISSNIP			50,000	50,000		100,000
			Queensland Department Employment, Economic Development & Innovation			90,000	90,000		180,000
			Tropical Marine Network			308,000	310,000		618,000
		<i>CI In-Kind</i>				1,036,683	1,053,579		2,090,262
<b>09 FAIMMS</b>						<b>1,618,936</b>	<b>1,650,187</b>		<b>3,269,123</b>
10 eMII		DIISRTE	DIISRTE			1,600,000	1,680,000		3,280,000

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
		CI In-Kind	University of Tasmania			1,024,708	1,065,696		2,090,404
10 eMII						2,624,708	2,745,696		5,370,404
11 SRS	11a SST L2P Products	DIISRTE	DIISRTE			215,305	178,990		394,295
		CI In-Kind	Bureau of Meteorology			62,084	64,568		126,652
	11a SST L2P Products					277,389	243,558		520,947
	11b AODAAC	DIISRTE	DIISRTE			115,000	65,000		180,000
		CI In-Kind	CSIRO			110,948	40,927		151,875
	11b AODAAC					225,948	105,927		331,875
	11c Townsville Groundstation	DIISRTE	DIISRTE			51,310	52,246		103,556
		CI In-Kind	Australian Institute of Marine Science			92,887	94,173		187,060
	11c Townsville Groundstation					144,197	146,419		290,616
	11d Satellite Ocean Colour	DIISRTE	DIISRTE		233,680	734,941	460,379		1,429,000
		CI In-Kind	CSIRO		91,770	163,844	163,844		419,458
	11d Satellite Ocean Colour				325,450	898,785	624,223		1,848,458
	11e Satellite Altimetry CalVal	DIISRTE	DIISRTE		307,069	397,931	337,000		1,042,000
		CI In-Kind	CSIRO		148,000	152,000	156,000		456,000
			University of Tasmania		252,000	259,000	267,000		778,000
		<i>CI In-Kind</i>			<i>400,000</i>	<i>411,000</i>	<i>423,000</i>		<i>1,234,000</i>
	11e Satellite Altimetry CalVal				707,069	808,931	760,000		2,276,000
11 SRS					1,032,519	2,355,250	1,880,127		5,267,896

Facility	Sub-Facility	Source	Co-investor	A2009/10	A2010/11	B2011/12	B2012/13	B2013/14	Total
12 Office		DIISRTE	DIISRTE			775,000	816,000		1,591,000
		CI Cash	Tas Department Economic Development Tourism & Arts			125,000	125,000		250,000
			University of Tasmania			125,000	125,000		250,000
		<i>CI Cash</i>				<i>250,000</i>	<i>250,000</i>		<i>500,000</i>
		CI In-Kind	University of Tasmania			445,857	468,094		913,951
12 Office						1,470,857	1,534,094		3,004,951
		DIISRTE	DIISRTE			155,298	551,000		706,298
Unallocated						155,298	551,000		706,298
WAIMOS	WAIMOS	CI Cash	WA Government			150,000	162,000	176,000	488,000
WAIMOS						150,000	162,000	176,000	488,000
Total				7,166,847	10,878,185	52,289,910	44,076,856	2,805,918	117,217,716

**END OF 2012/13 IMOS Annual Business Plan**