

# **Southern GBR Coastal Habitat Archive and Monitoring Program**

**Progress Report June 2016**

Norman Duke and Jock Mackenzie



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Norman C Duke<sup>1</sup> and Jock Mackenzie<sup>1</sup>

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James Cook University



Supported by the Australian Government's  
National Environmental Science Programme  
Project 2.3.4: Working with Traditional Owners and local citizens to better manage GBR estuarine wetlands

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# TABLE OF CONTENTS

|                                                                                                                            |     |
|----------------------------------------------------------------------------------------------------------------------------|-----|
| List of Tables .....                                                                                                       | ii  |
| List of Figures .....                                                                                                      | iii |
| Acronyms .....                                                                                                             | v   |
| Acknowledgments .....                                                                                                      | vi  |
| EXECUTIVE SUMMARY .....                                                                                                    | 1   |
| 1.0 INTRODUCTION .....                                                                                                     | 3   |
| 2.0 METHODOLOGY .....                                                                                                      | 6   |
| 2.1 Project operations, logistics and management .....                                                                     | 6   |
| 2.2 Mapping of tidal wetland resources .....                                                                               | 10  |
| 2.3 Boat-based shoreline surveys .....                                                                                     | 13  |
| 3.0 RESULTS to June 2016 .....                                                                                             | 15  |
| 3.1 NESP TWQ Hub Project Leaders Workshop .....                                                                            | 15  |
| 3.2 Stakeholder workshop – launch of the Southern GBR CHAMP Project .....                                                  | 16  |
| 3.3 Training sessions and survey work by Rangers .....                                                                     | 17  |
| 3.4 Talk by NC Duke at the 2016 AMSN Conference .....                                                                      | 18  |
| 3.5 Further training and survey work by the Rangers .....                                                                  | 20  |
| 3.6 Survey work by Rangers .....                                                                                           | 21  |
| 3.7 Mapping of case study areas .....                                                                                      | 22  |
| 3.8 Preliminary historical perspective .....                                                                               | 27  |
| 3.9 News media reports .....                                                                                               | 31  |
| REFERENCES .....                                                                                                           | 34  |
| Appendix A: Launch invitation flyer .....                                                                                  | 35  |
| Appendix B: Media release by JCU TropWATER. ....                                                                           | 36  |
| Appendix C: Display banner used at various talks about the project .....                                                   | 38  |
| Appendix D: Agenda for the stakeholder workshop .....                                                                      | 39  |
| Appendix E: Presentation cover slides used in the Australian Mangrove and Saltmarsh<br>Network (AMSN) Conference talk..... | 41  |

## LIST OF TABLES

|                 |                                                                                                                                                                                                                                                                                                                                                                                                           |    |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Table 1:</b> | Research End Users and Stakeholders for the Southern GBR CHAMP. ....                                                                                                                                                                                                                                                                                                                                      | 6  |
| <b>Table 2:</b> | Project Milestone Schedule 2016-2018 .....                                                                                                                                                                                                                                                                                                                                                                | 8  |
| <b>Table 3:</b> | Planned Diary Dates for the Southern GBR CHAMP project, 2016-2018.....                                                                                                                                                                                                                                                                                                                                    | 9  |
| <b>Table 4:</b> | Regional Ecosystem Codes Used to Extract Areas Containing Mangroves. ...                                                                                                                                                                                                                                                                                                                                  | 12 |
| <b>Table 5:</b> | Regional Ecosystem Codes Used to Extract Areas Containing Saltmarsh.....                                                                                                                                                                                                                                                                                                                                  | 13 |
| <b>Table 6:</b> | Agenda for the NESP TWQH Project Leaders workshop in February 2016. ...                                                                                                                                                                                                                                                                                                                                   | 15 |
| <b>Table 7:</b> | Invited participants attending the public workshop as part of the Southern GBR CHAMP program Launch on 19 April 2016 in Bundaberg, Queensland. ....                                                                                                                                                                                                                                                       | 16 |
| <b>Table 8:</b> | Schedule of river systems being surveyed prior to, and during, the Southern GBR CHAMP project. Where surveys in the eight (8) study estuaries are repeated, this gives opportunities for measuring change like flood recovery. Note that systems surveyed to date are those in southern parts of the Southern GBR shoreline. The emphasis will shift to the north in the next year of field surveys. .... | 20 |

## LIST OF FIGURES

|                   |                                                                                                                                                                                                                                                                                                           |    |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 1:</b>  | TropWATER scientists in collaboration with the Gidarjil DC and BMRG run the 2016 stakeholder workshop to launch the Southern GBR CHAMP project in Bundaberg, Queensland. ....                                                                                                                             | 1  |
| <b>Figure 2:</b>  | TropWATER scientists with Gidarjil DC Rangers survey shorelines of the Burnett River estuary with the Southern GBR CHAMP project. ....                                                                                                                                                                    | 2  |
| <b>Figure 3:</b>  | Google Earth satellite imagery of the Southern GBR CHAMP study area (yellow line) compared to the smaller PCPA CHAMP study area (red line). The major estuaries in this region are listed as the case study locations throughout the region. The locations of these locations are shown in Figure 4. .... | 4  |
| <b>Figure 4:</b>  | Map of the Southern GBR shoreline showing the location of the 8 estuarine systems used as case studies in this project. ....                                                                                                                                                                              | 10 |
| <b>Figure 5:</b>  | Project workshop for stakeholders and end users of mangroves and saltmarsh habitats launch the Southern GBR CHAMP project in Bundaberg, Queensland. ....                                                                                                                                                  | 17 |
| <b>Figure 6:</b>  | Field training and surveys followed the Stakeholder Workshop, with practical sessions using the JCU boat ‘Guyala’ in the Burnett River estuary. ....                                                                                                                                                      | 18 |
| <b>Figure 7:</b>  | TropWATER supports the Australian Mangrove and Saltmarsh Network and its website, promoting its cause and its annual network conferences each year. The latest was in Darwin, early in May 2016. The 2017 meeting will held be in Hobart. ....                                                            | 19 |
| <b>Figure 8:</b>  | Mangrove dieback along the shorelines from earlier flooding of the Boyne River remains obvious several years after the 2013 event. ....                                                                                                                                                                   | 21 |
| <b>Figure 9:</b>  | Filming the Boyne River during S-VAM surveys (photo: Arthur Dahl). ....                                                                                                                                                                                                                                   | 21 |
| <b>Figure 10:</b> | Map of the Fitzroy River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                            | 23 |
| <b>Figure 11:</b> | Map of the Calliope River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                           | 24 |
| <b>Figure 12:</b> | Map of the Boyne River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                              | 24 |
| <b>Figure 13:</b> | Map of the Baffle Creek estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                             | 25 |
| <b>Figure 14:</b> | Map of the Kolan River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                              | 25 |
| <b>Figure 15:</b> | Map of the Burnett River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                            | 26 |
| <b>Figure 16:</b> | Map of the Elliot River estuarine system pre 2009, tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                                     | 26 |
| <b>Figure 17:</b> | Map of the Burrum River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading). ....                                                                                                                                                             | 27 |
| <b>Figure 18:</b> | Old charts of the Burnett River estuarine system drafted in 1869-70 (sourced by Merv Hopton) show notable changes to the mouth of the river as we know it today (also see Fig. 15). The system had two distinct mouths, one to the north and another to the east. ....                                    | 28 |

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |    |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 19:</b> | The 1869-70 charts of the Burnett River (Fig. 18) laid over the 2008-10 satellite image (Fig. 10) show more specific changes, and a number of features that have remained largely unchanged. Landward and seaward margins of mangrove areas along the Hervey Bay shoreline appear notably comparable. The northern mouth was blocked off with a rock wall and has now filled with sediments occupied by mangroves. There are also indications of an earlier single river mouth between the two – in alignment with a large mangrove-filled ox-bow area on the western side just upstream from the mouth. .... | 28 |
| <b>Figure 20:</b> | Another map of the Burnett River estuary (see Fig. 15) showing the severe impact of the 2013 floods on mangroves upstream. While there was little change at the mouth, it is clear that upstream stands fluctuate widely in response to flooding events and alterations to hydrology like the installation of the barrage upstream. More recent surveys with the NESP project are needed to show the longer term status of such events. ....                                                                                                                                                                  | 29 |
| <b>Figure 21:</b> | Flood damage is notable in the Boyne River estuary (Inset B, also Fig. 12). Prior Shoreline Video Assessment Method (S-VAM) survey locations surveyed by Gidarjil Rangers in the Southern GBR study area in 2014. ....                                                                                                                                                                                                                                                                                                                                                                                        | 30 |
| <b>Figure 22:</b> | Flood damage is notable in the Boyne River estuary (Fig. 12). Prior Shoreline Video Assessment Method (S-VAM) survey show large upstream sections of the river estuary with severe damage and loss of mangroves. ....                                                                                                                                                                                                                                                                                                                                                                                         | 30 |
| <b>Figure 23:</b> | Gidarjil Rangers conducting S-VAM surveys filming shorelines of estuaries throughout the Southern GBR region. ....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 31 |
| <b>Figure 24:</b> | The NESP Southern GBR region project in the news. ....                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 32 |
| <b>Figure 25:</b> | A single picture is a record of shoreline condition. A continuous series of pictures is a permanent library about the whole estuarine system. And, each time it is refilmed, there is a new library from which to measure change anywhere in the system. ....                                                                                                                                                                                                                                                                                                                                                 | 33 |

## **ACRONYMS**

|                    |                                                       |
|--------------------|-------------------------------------------------------|
| <b>BIEEC</b> ..... | Boyne Island Environment Education Centre             |
| <b>CHAMP</b> ..... | Coastal Habitat Archive and Monitoring Program        |
| <b>FBA</b> .....   | Fitzroy Basin Association                             |
| <b>GBR</b> .....   | Great Barrier Reef                                    |
| <b>GDC</b> .....   | Gidarjil Development Corporation                      |
| <b>NDVI</b> .....  | Normalized Difference Vegetation Index                |
| <b>NESP</b> .....  | National Environmental Science Programme              |
| <b>NRM</b> .....   | Natural Resource Management                           |
| <b>PCCC</b> .....  | Port Curtis Coral Coast                               |
| <b>QWMPC</b> ..... | Queensland Wetland Mapping and Classification Project |
| <b>S-VAM</b> ..... | Shoreline Video Assessment Method                     |
| <b>TUMRA</b> ..... | Traditional Use Marine Resource Agreement             |
| <b>TWQ</b> .....   | Tropical Water Quality                                |

## ACKNOWLEDGMENTS

We thank the Gidarjil Ranger team members with the Gidarjil Development Corporation project staff in Gladstone and Bundaberg for their contributions and support throughout this project. This project is funded by the Australian Government's National Environmental Science Programme.

### Traditional Owner Project Partners



**Gidarjil Development Corporation**



### NRM Group Project Partners



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## EXECUTIVE SUMMARY

- 1) This 2016 June Progress Report documents the status and key current findings from the program of works for 2016 (commencing on 1 January 2016) directed by Dr Norm Duke with Jock Mackenzie from James Cook University (JCU) TropWATER Centre, plus key project partners: Prof John Kovacs of Nipissing University in Canada, Peter Brockhurst and Ric Fennessy with the Rangers of the Gidarjil Development Corporation, Sue Sargent with Burnett Mary Regional Group, and, Rebecca French and Shannon van Nunen with Fitzroy Basin Association.
- 2) On Friday 12 February 2016, Dr Duke, JCU TropWATER scientist, attended the workshop for Project Leaders organised by the Tropical Water Quality (TWQ) Hub of the National Environmental Science Programme (NESP). Project Leaders were briefed about overall NESP goals and aspirations, as well as shown how they might get support for the successful conduct of their respective projects. An important additional outcome was the sharing of project objectives amongst Project Leaders, with the idea of exploring synergies between projects both within the TWQ Hub as well as other Hubs within NESP.
- 3) On Tuesday 19<sup>th</sup> April 2016, a community public workshop was organised by the JCU TropWATER project team, Burnett Mary Regional Group (BMRG) and Gidarjil Development Corporation partners in Bundaberg, followed by two days of training sessions. Work with this component was initially about building relationships, and informing community, as well as with the establishment of the work program and building skills (Fig. 1). Our goals for field work will be met with key contributions from the skilled-up Ranger teams of the Gidarjil DC. Works have involved ranger and staff training, support and consultation, briefings on methodology and approach, as well as the compilation and preliminary assessment of field data.



**Figure 1:** TropWATER scientists in collaboration with the Gidarjil DC and BMRG run the 2016 stakeholder workshop to launch the Southern GBR CHAMP project in Bundaberg, Queensland.

- 4) On Wednesday and Thursday, 20-21 April 2016, the JCU team conducted training sessions for both the Sea Ranger teams from Gidarjil DC, plus with community volunteers. An important part of the training involved the practical application of the Shoreline Video Assessment Method (S-VAM) with boat-based shoreline surveys. This was undertaken by conducting the training experience whilst making a start on the planned surveys of the 8 designated, case study estuarine systems, starting with the Burnett River estuary. Other field training included identification of mangrove and tidal saltmarsh plants, including weeds in these environments.
- 5) During the week of 3-6 May, Dr Duke gave a talk about the Southern GBR CHAMP project at the 2016 Australian Mangrove and Saltmarsh Network Conference in Darwin. This talk focused on this project's engagement and partnership with indigenous rangers in the monitoring and assessment of shoreline habitats in the southern GBR region.
- 6) During the week of 9-13 May, Jock Mackenzie supervised the further training of Gidarjil DC rangers whilst they surveyed using S-VAM additional river systems in the southern case study estuaries of Koolan River, Elliott River and Burrum River.
- 7) On Thursday 10 June 2016, Arthur Dahl a ranger supervisor with Gidarjil DC led an independent ranger team in the survey filming of the Boyne River estuary.
- 8) During the period up to 10 June 2016, Prof Kovacs had his students prepare preliminary maps of the 8 case study estuarine systems for the Southern GBR study area. Maps have been compiled showing existing mangrove and saltmarsh habitat classifications. The intention is to refine these measures and classifications through space and time for this project, to produce better definition maps from which future change can be accurately monitored. This initial mapping exercise is essential for establishment of the project baseline from which all change will be measured, both in the past, as well as into the future. Specific high resolution satellite imagery has been sourced for the next phase of this mapping work and change detection.



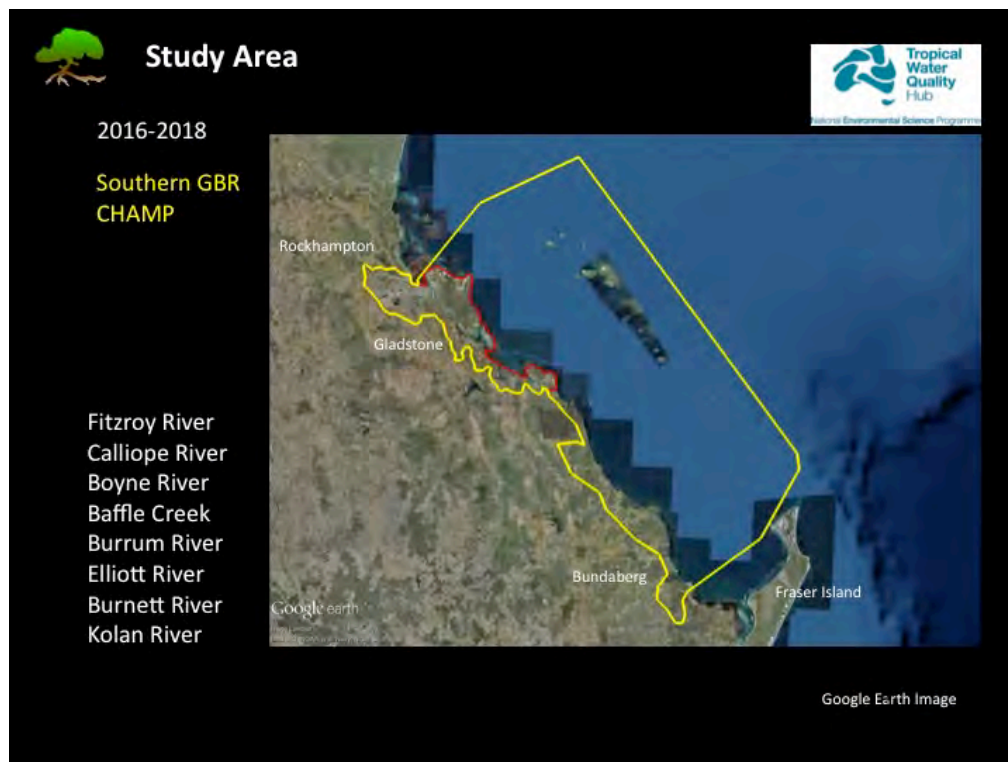
**Figure 2:** TropWATER scientists with Gidarjil DC Rangers survey shorelines of the Burnett River estuary with the Southern GBR CHAMP project.

## **1.0 INTRODUCTION**

Mangrove tidal wetland shorelines are being surveyed and monitored as part of this new Coastal Habitat Archive and Monitoring Program (CHAMP) for the southern GBR region. The project is led by scientists from James Cook University's TropWATER Centre. The project forms part of the National Environmental Science Programme (NESP) with the Tropical Water Quality (TWQ) Hub.

Traditional Owner rangers and local citizens of the Port Curtis Coral Coast (PCCC) TUMRA are being engaged in the development of a Mangrove Management Plan (MMP) that provides a strategic basis for estuarine repair activity and maximizes water quality outcomes in the southern GBR. Development of this MMP is building capacity amongst staff and rangers of the Gidarjil Development Corporation (GDC), as well as within the local community for gathering ecological monitoring and assessment data that is scientifically-rigorous. These management and rehabilitation strategies will help protect sea country resources through our partnership between community, scientists and local Natural Resource Management (NRM) agencies. The MMP is enabling rangers and citizen scientists to conduct scientifically valid surveys of estuarine monitoring, management and rehabilitation within the Port Curtis Coral Coast (PCCC) TUMRA area.

This first milestone report, plus appendices, is the first in a project with two years of assessment and monitoring of mangrove tidal wetlands of the southern GBR area (see Figure 3). Over the first six months of 2016, the plan has been to generate the baseline data, to inform communities in the region about the project, to work with local NRM managers, and to train local community volunteers and the Gidarjil Rangers to conduct surveys and monitoring.



**Figure 3:** Google Earth satellite imagery of the Southern GBR CHAMP study area (yellow line) compared to the smaller PCPA CHAMP study area (red line). The major estuaries in this region are listed as the case study locations throughout the region. The locations of these locations are shown in Figure 4.

The information presented in this first report has been gathered mostly with the establishment of project logistics, planning, personnel and training. These tasks have been fundamental to meeting the objectives of this program. This preparation is essential to the projects' success in being fully prepared with the necessary skill levels and facilities for meeting the tasks required; as specified further below.

Current data presented have been generated as a result of observations made mostly during training sessions, and from prior *ad hoc* opportunities conducted in similar projects. While the gathering of these data may be considered opportunistic, they have been extremely beneficial in the establishment of some baseline records as well as being extremely useful as training and familiarisation for all participants.

Briefly, the program proposed is to complete the three (3) components for the Southern GBR area, as:

1. High resolution maps of tidal wetlands, plus historical assessment plus change detection;
2. Shoreline condition monitoring using boat-based video image data acquisition by Gidarjil DC rangers and community volunteers; and,
3. Compilation of any other information pertinent to the health, viability and rehabilitation of tidal wetlands of the region, supporting their role in improving water quality along the southern GBR coastline.

Over the project life, each component will be addressed in detail by personnel from JCU TropWATER Centre who are primarily responsible for the delivery of the program with the

TWQH. The program is led by TropWATER specialists in tidal wetland research, who will help characterise shoreline environmental values for the Southern GBR area. This is being achieved through the implementation of the Shoreline Video Assessment Method (S-VAM) along with an integrated monitoring and archiving program, bringing together partners in field research, remote sensing, IT and teaching skills.

This project is an important opportunity to achieve world best practice for compilation and dissemination of data and expert advice gathered from the field surveys and stakeholder meetings with key contributors from industry, government, universities and with indigenous rangers and community volunteers. The planned outcomes will be a comprehensive baseline assessment of ecological condition and health for the region (building on prior surveys like Duke et al. 2003; 2005; 2010; Mackenzie & Duke 2011). The information collected in this project is intended for future use; being a tangible, permanent resource for regional managers, industry stakeholders and community members wishing to maximise conservation benefits while maintaining environmentally appropriate coastal development works.

The project integrates scientific, industrial, management and Indigenous cultural knowledge to better inform environmental managers of tidal wetlands for improved mitigation actions in the Southern GBR region. Our partnership approach is expected to enhance local capacity for implementation of ongoing shoreline assessment as well as maintaining sustainable environmental monitoring outcomes.

## 2.0 METHODOLOGY

### 2.1 Project operations, logistics and management

The JCU Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER) is ideally placed to draw upon a wide range of expertise available and necessary for the delivery of the Southern GBR CHAMP project. The works include monitoring the condition, survival and recovery of shorelines, specifically regards tidal wetlands.

While the TropWATER Centre at JCU is the lead agent for this project, we are collaborating in partnership with the following organisations using individual sub-contract arrangements for each, as appropriate:

- a. Gidarjil Development Corporation Indigenous Rangers along with community volunteers in the Southern GBR region, are assisting in the field surveys of monitoring and assessment of coastal tidal wetland habitats (Component 2);
- b. Collaboration with Prof John Kovacs of Nipissing University, Canada, for specialised remote sensing assessments and mapping of tidal wetland habitats in the region (Components 1 primarily, plus taking other opportunities for ground truth and data validation);
- c. Partnerships with two (2) NRM regional groups, the Burnett Mary Regional Group, and the Fitzroy Basin Association, for development and implementation of the planned Mangrove Management Plan (all components).

While the program is an integrated package, it is being achieved under the three broad Project Components. To a large extent, the project outcomes will be influenced and enhanced during the collaborations generated with potential end users and stakeholders in tidal wetlands and shorelines of the Southern GBR region. Our core end users for this project are listed in Table 1.

**Table 1:** Research End Users and Stakeholders for the Southern GBR CHAMP.

| <b>Research End Users<br/>(section/programme/organisation)</b>                                                                                                             | <b>Name/s</b>   | <b>Email (optional)</b>            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------|
| DoE – Wetlands                                                                                                                                                             | Janine Cullen   | janine.cullen@environment.gov.au   |
| DoE – Reef 2050                                                                                                                                                            | Celeste Powell  | Celeste.powell@environment.gov.au  |
| DoE – Reef Trust                                                                                                                                                           | Tulsi Rajyaguru | Tulsi.rajyaguru@environment.gov.au |
| DoE – Migratory Species                                                                                                                                                    | Fiona Bartlett  | fionaJ.bartlett@environment.gov.au |
| DoE – ERIN, Science Partnerships                                                                                                                                           | Damian Wrigley  | Damian.wrigley@environment.gov.au  |
| GBRMPA – Indigenous Partnerships                                                                                                                                           | Jessica Hoey    | Jessica.hoey@gbrrmpa.gov.au        |
| <b>Key Stakeholders<br/>(organisation/programme)</b>                                                                                                                       |                 |                                    |
| Queensland Marine Parks, Marine Resource Management (QNPSR) Fish Habitat Area (FHA) development and management – specifically the declaration of a new Calliope River FHA. | Nicola Udy      | nicola.udy@npsr.gov.au             |
| Queensland Fisheries Service (QDAF)                                                                                                                                        | Melissa Dixon   | melissa.dixon@daf.qld.gov.au       |

|                                                        |                                                                         |                                                                                                               |
|--------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| fish habitat protection policy                         |                                                                         |                                                                                                               |
| Gidarjil Development Corporation Ltd                   | Kerry Blackman,<br>Peter Brockhurst,<br>Annette<br>Rutherford           | kerry.blackman@gmail.com<br>tumra@gidarjil.com.au<br>go.projectmanager@gidarjil.com.au                        |
| QPWS                                                   | Rachell Jupp                                                            |                                                                                                               |
| GBRMPA – Reef Recovery                                 | Donna Audas<br>Paul Groves<br>Carol Honchin<br>Leigh Gray               | donna.audas@gbmpa.gov.au<br>paul.groves@gbmpa.gov.au<br>carol.honchin@gbmpa.gov.au<br>leigh.gray@gbmpa.gov.au |
| GBRMPA – Reef 2050                                     | Katherine Martin<br>Margaret Gooch<br>Renee Madsen                      | Katherine.martin@gbmpa.gov.au<br>Margaret.gooch@gbmpa.gov.au<br>Renee.madsen@gbmpa.gov.au                     |
| DoE – Indigenous Policy                                | Liz Davies                                                              | Liz.davies@environment.gov.au                                                                                 |
| DoE – National Indigenous Heritage                     | Sarah Titchen                                                           | Sarah.titchen@environment.gov.au                                                                              |
| DoE – Natural Heritage                                 | Joanne Nathan                                                           | Joanne.nathan@environment.gov.au                                                                              |
| Gladstone Healthy Harbour Partnership (GHHP)           | Ian Poiner<br>John Kirkwood                                             | ian.poiner@me.com<br>john.kirkwood@ghhp.org.au                                                                |
| Fitzroy Basin Natural Resource Management Group        | Rebecca French<br>Shannon Van<br>Nunen<br>Coastal and<br>Marine Manager | Rebecca.French@fba.org.au<br>Shannon.Vannunen@fba.org.au                                                      |
| Burnett Mary Regional Group                            | Penny Hall, CEO<br>Sue Sargent,<br>Joel Hodge                           | Penny.Hall@bmr.gov.au<br>Sue.Sargent@bmr.gov.au<br>Joel.Hodge@bmr.gov.au                                      |
| Gladstone Ports Corporation, Marine Environment Office | Megan Ellis                                                             | EllisM@gpcl.com.au                                                                                            |
| Estuarine Research and Monitoring Program              | Chris Crossland                                                         | chris.crossland44@gmail.com                                                                                   |
| Wildlife Queensland Coastal Citizen Science            | Simon Baltais<br>Debra Henry                                            | baltais@bigpond.net.au<br>DebraHenry@wildlife.org.au                                                          |
| Society for Growing Australian Plants (SGAP)           | Ruth Crosson,<br>John Holzapfel                                         | sgap-gladstone@hotmail.com<br>johnholzapfel@bigpond.com                                                       |
| Conservation Volunteers Australia (CVA)                | Jodi Jones                                                              |                                                                                                               |

Milestone activity scheduling for the Southern GBR CHAMP project are shown in Table 2.

**Table 2:** Project Milestone Schedule 2016-2018

| <b>Milestone Activities</b>                                                                                           | <b>Jun 2016</b> | <b>Dec 2016</b> | <b>Jun 2017</b> | <b>Dec 2017</b> | <b>Feb 2018</b> |
|-----------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Consultation with Stakeholders</b>                                                                                 | X               | X               | X               | X               | X               |
| <b>Stakeholder Workshops</b><br>Bundaberg & Gladstone                                                                 | X               |                 |                 | X               |                 |
| <b>Training Workshop - Field Team</b><br>Bundaberg & Gladstone                                                        | X               | X               | X               | X               |                 |
| <b>Field Surveys</b> by Gidarjil Rangers<br><b><i>Southern estuaries:</i></b> Baffle, Burrum, Elliott, Burnett, Kolan | X               | X               |                 |                 |                 |
| <b>Field Surveys</b> by Gidarjil Rangers<br><b><i>Northern estuaries:</i></b> Boyne, Calliope, Fitzroy                |                 |                 | X               | X               |                 |
| <b>Condition Data Assessment</b><br>JCU assessment of Field Survey data about estuarine tidal wetlands                |                 | X               | X               | X               |                 |
| <b>Restoration Protocols</b><br>& Potential Target Sites                                                              |                 |                 |                 | X               |                 |
| <b>Towards a Mangrove Management Plan (MMP)</b><br>for southern GBR, with Traditional Owners                          | X               | X               | X               | X               | X               |
| <b>Photos</b> to eAtlas/RRRC                                                                                          | X               |                 | X               | X               |                 |
| <b>Data management plan</b> to eAtlas                                                                                 |                 | X               | X               | X               |                 |
| <b>Datasets for publication</b> in eAtlas, publication standards                                                      |                 |                 |                 | X               |                 |
| <b>Milestone REPORTING by JCU</b><br>GDC Ranger engagement and Data Acquisitions and JCU Assessments                  | X               | X               | X               | X               | X               |

The proposed scheduling of project activities is shown in Table 3.

**Table 3:** Planned Diary Dates for the Southern GBR CHAMP project, 2016-2018.

| <b>2016</b>                       |                                                                                                                                                                                                                                                                                       |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 Feb                            | NESP TWQ Project Leaders Meeting #1 – ND to attend in Townsville.                                                                                                                                                                                                                     |
| 18-22 Apr                         | Stakeholder Meeting (one day), BMRG & Southern Training Workshop (2-3 days), Bundaberg, GDC                                                                                                                                                                                           |
| Apr-May                           | Field data collection by Rangers for Baffle, Burrum, Elliott, Burnett, Kolan - GDC lead (~2 days S-VAM & 2 days walkabout each estuary). Dates for surveys are dependent on tides and weather conditions. An earlier start to surveys is encouraged for Ranger teams already trained. |
| Apr-June                          | Wetland mapping by JCU of Baffle, Burrum, Elliott, Burnett, Kolan, in collaboration with BMRG and JK. Map cover and quality depends on availability of aerial/satellite imagery from BMRG and other sources.                                                                          |
| <b>15 June</b>                    | <b>Milestone #1 of 5 – First Report, JCU with GDC, BMRG, FBA advice</b>                                                                                                                                                                                                               |
| June-July                         | Assessment of field data by JCU for Baffle, Burrum, Elliott, Burnett, Kolan.                                                                                                                                                                                                          |
| 8-12 Aug                          | Northern Ranger Training & Ranger Feedback (2-3 days), Consultation, JCU Field Surveys in Southern Estuaries (4 days)                                                                                                                                                                 |
| <b>15 Dec</b>                     | <b>Milestone #2 of 5 – Southern Surveys Report, JCU with GDC, BMRG, FBA advice</b>                                                                                                                                                                                                    |
| <b>2017</b>                       |                                                                                                                                                                                                                                                                                       |
| NB: dates for some activities TBA |                                                                                                                                                                                                                                                                                       |
| Apr-May                           | Field data collection by Rangers for Boyne, Calliope, Fitzroy - GDC lead (~3 days S-VAM & 3 days walkabout each estuary. Survey dates dependent on tides and weather conditions.                                                                                                      |
| Apr-June                          | Wetland mapping by JCU of Boyne, Calliope, Fitzroy, in collaboration with FBA and JK. Map cover and quality depends on availability of aerial/satellite imagery from FBA and other sources.                                                                                           |
| <b>15 June</b>                    | <b>Milestone #3 of 5 – Northern Surveys &amp; Southern Assessments Report, JCU with GDC, BMRG, FBA advice</b>                                                                                                                                                                         |
| June-July                         | Assessment of field data by JCU for Boyne, Calliope, Fitzroy.                                                                                                                                                                                                                         |
| 7-11 Aug                          | Ranger Feedback Workshop (one day), Consultation & JCU Field Surveys in Northern Estuaries (4 days), plus Stakeholder Meeting (one day), FBA                                                                                                                                          |
| <b>15 Dec</b>                     | <b>Milestone #4 of 5 – Northern Assessments &amp; Management Plan Report, JCU with GDC, BMRG, FBA advice</b>                                                                                                                                                                          |
| <b>2018</b>                       |                                                                                                                                                                                                                                                                                       |
| 31 Jan                            | Finalise Mangrove Management Plan, eAtlas requirements and final reporting components with all participants                                                                                                                                                                           |
| <b>10 Feb</b>                     | <b>Milestone #5 of 5 – FINAL REPORT, JCU with GDC, BMRG, FBA advice</b>                                                                                                                                                                                                               |

## 2.2 Mapping of tidal wetland resources

**Criteria:** Mapping of tidal wetland vegetation types along with historical change detection to identify areas of net loss and gain in key habitat components (mangroves, saltmarsh and saltpans)

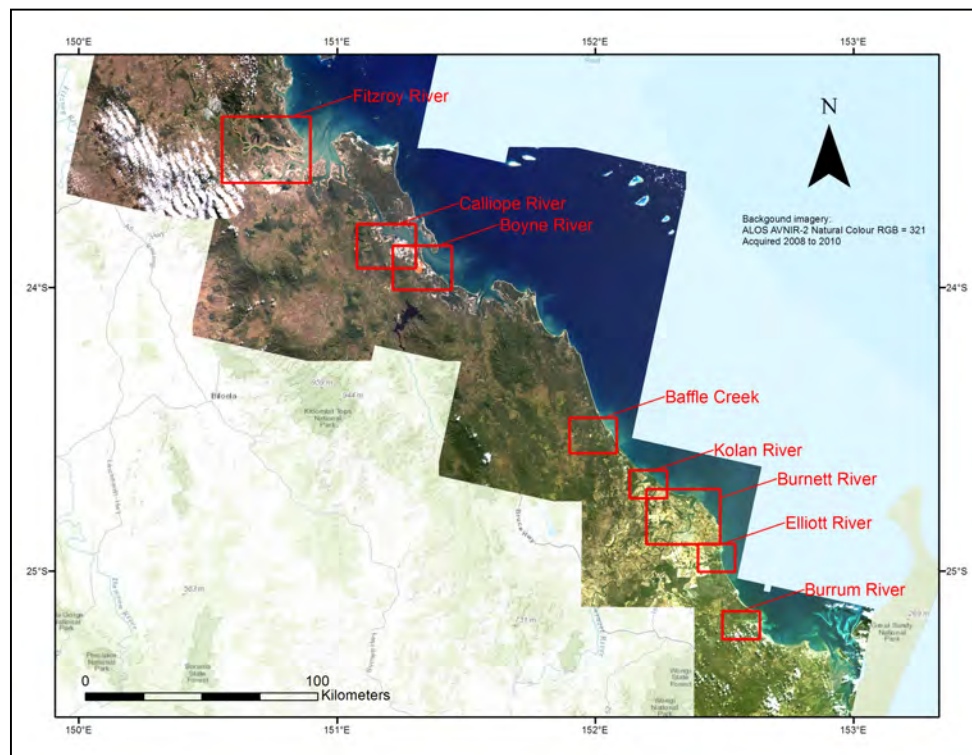
**Project Lead:** Dr Norm Duke, TropWATER, JCU

**Partners:** Prof. John Kovacs, Nipissing University, Canada

### Specific Tasks:

The team will acquire suitably fine-scaled, multispectral Image data for mapping mangroves, tidal saltmarsh and tidal saltpan flats, as the key vegetation types of tidal wetlands in each of the case study estuaries.

To display areas of mangrove and saltmarsh which had been previously identified, a series of maps were produced for the major estuaries which extend along the Southern Great Barrier Reef (GBR) study area (Figure 4).



**Figure 4:** Map of the Southern GBR shoreline showing the location of the 8 estuarine systems used as case studies in this project.

Specifically, polygons were extracted from the Queensland Wetland Mapping and Classification Project (QWMCP) that represents saltmarsh and mangrove ecosystems. The QWMCP was last updated in 2009. Within this dataset, each ecosystem is identified by a specific three number code that describes both the physical and vegetative conditions. The codes used for the mangrove polygon extraction are shown in Table 4 whereas the codes used for the saltmarsh ecosystems identification are listed in Table 5. In total eight (8) maps

were produced for the following major estuaries along the SGBR coast (ordered from North to South):

- Fitzroy River
- Calliope River
- Boyne River
- Baffle Creek
- Kolan River
- Burnett River
- Elliott River
- Burrum River

For each map (Figures 5-12), the extracted mangrove and saltmarsh regional ecosystem polygons were overlaid on a background base map derived of mosaiced ALOS AVNIR-2 satellite imagery. Specifically, the base map employed the spectral band 3 of the AVNIR-2 imagery which represents the red region (630-685 *nm*) of the electromagnetic spectrum.

The polygons extracted from the QWMCP will be used as a general guide for assisting in the classification of these ecosystems using updated high resolution satellite imagery. Higher spatial resolution imagery, possibly *GeoEye-1*, *RapidEye* or *SPOT-7*, will be acquired for either 2014 or 2015. Once collected, these data will first be radiometrically corrected to surface reflectance using *PCI Geomatica's* *ATCOR* module. If necessary these images may also be geometrically corrected using *PCI Geomatica's* *Orthoengine*. Since several swaths of imagery are likely to be needed to cover the study area, the many surface reflectance images may also be mosaiced. The Normalized Difference Vegetation Index (NDVI) will then be produced from each surface reflectance mosaic. NDVI is calculated using the following formula:

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

The NDVI images can then be used to monitor changes in the health of the vegetation by comparing them with future NDVI images collected of the same locations. Finally, using ancillary data (e.g., QWMCP, Gidarjil field surveys), a per pixel classification procedure will be applied to the newly acquired imagery in order to map the most recent areas of mangrove and saltmarsh land cover.

**Table 4:** Regional Ecosystem Codes Used to Extract Areas Containing Mangroves.

| Regional Ecosystem Code | Description*                                                                                                                                                                                                           |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.1.4                   | Mangrove and vine forest closed forest of the brackish zone.                                                                                                                                                           |
| 11.1.4                  | Mangrove forest and/or woodland on marine clay plains                                                                                                                                                                  |
| 12.1.3                  | Mangrove shrubland to low closed forest on marine clay plains and estuaries                                                                                                                                            |
| 2.1.3                   | Tidal channels and associated levees, usually with mangroves                                                                                                                                                           |
| 7.1.1                   | Mangrove closed scrub to open forest of areas subject to regular tidal inundation                                                                                                                                      |
| 8.1.5                   | <i>Melaleuca</i> spp. and/or <i>Eucalyptus tereticornis</i> and/or <i>Corymbia tessellaris</i> woodland with a ground stratum of salt tolerant grasses and sedges, usually in a narrow zone adjoining tidal ecosystems |
| 12.1.1                  | <i>Casuarina glauca</i> +/- mangroves woodland. Occurs on margins of Quaternary estuarine deposits. (BVG1M: 28a)                                                                                                       |
| 3.1.3                   | <i>Ceriops tagal</i> +/- <i>Avicennia marina</i> low closed forest on intertidal areas                                                                                                                                 |
| 8.1.1                   | Mangrove closed forest of marine clay plains and estuaries                                                                                                                                                             |
| 3.1.2                   | <i>Avicennia marina</i> (grey mangrove) low open forest on landward side of tidal zone                                                                                                                                 |
| 3.1.1                   | <i>Rhizophora stylosa</i> +/- <i>Bruguiera gymnorhiza</i> closed forest. Occurs as outer mangroves                                                                                                                     |
| 7.1.5                   | <i>Melaleuca viridiflora</i> (broad leaf tea-tree) or <i>Melaleuca</i> spp. +/- <i>Acacia</i> spp. +/- mangrove spp. open woodland to open forest and shrubland. Plains adjacent to mangroves. (BVG1M: 22b)            |
| 3.2.30                  | <i>Pemphis acidula</i> +/- <i>Rhizophora stylosa</i> +/- <i>Avicennia marina</i> low closed forest on coral atolls, shingle cays and sand cays                                                                         |

\*Descriptions adapted from Regional Ecosystem descriptions (2016).

**Table 5:** Regional Ecosystem Codes Used to Extract Areas Containing Saltmarsh.

| <b>Regional Ecosystem Code</b> | <b>Description*</b>                                                                                                                                                                                          |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11.1.3                         | Sedgelands on marine clay plains                                                                                                                                                                             |
| 8.1.3                          | <i>Sporobolus virginicus</i> tussock grassland on marine sediments                                                                                                                                           |
| 7.1.2                          | <i>Sporobolus virginicus</i> grassland, samphire open forbland to sparse forbland and bare saltpans on plains adjacent to mangroves                                                                          |
| 3.1.5                          | <i>Sporobolus virginicus</i> closed tussock grassland on coastal plains                                                                                                                                      |
| 3.3.63                         | <i>Eleocharis dulcis</i> dominated closed sedgeland on seasonally flooded marine plains                                                                                                                      |
| 7.1.3                          | <i>Schoenoplectus subulatus</i> and/or <i>Eleocharis dulcis</i> sparse sedgeland, or <i>Melaleuca quinquenervia</i> low open forest, in swamps which fluctuate periodically between freshwater and estuarine |
| 11.1.1                         | <i>Sporobolus virginicus</i> grassland on marine clay plains                                                                                                                                                 |
| 8.1.2                          | Samphire open forbland on saltpans and plains adjacent to mangroves                                                                                                                                          |
| 8.1.4                          | <i>Schoenoplectus subulatus</i> and/or <i>Eleocharis dulcis</i> sedgeland or <i>Paspalum vaginatum</i> tussock grassland                                                                                     |
| 11.1.2                         | Samphire forbland on marine clay plains                                                                                                                                                                      |
| 2.3.1                          | Grassland on low plains adjacent to estuarine zone                                                                                                                                                           |
| 12.1.2                         | Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains                                                                                                                         |
| 3.1.6                          | Sparse herbland or bare saltpans on salt plains and saline flats                                                                                                                                             |

\*Descriptions adapted from Regional Ecosystem descriptions (2016).

### 2.3 Boat-based shoreline surveys

**Criteria:** Shoreline condition monitoring using boat-based video image data acquisition by Gidarjil Rangers and community volunteers.

**Project Lead:** Dr Norm Duke, JCU TropWATER  
Jock Mackenzie, JCU TropWATER

**Partners:** Gidarjil Development Corporation  
MangroveWatch Ltd

#### Specific Tasks:

The methods used in these surveys are geo-referenced videography called the Shoreline Video Assessment Method (Mackenzie & Duke 2016). All imagery is collected by either indigenous rangers or by community volunteers – supervised by TropWATER science specialists. All participants are trained by the TropWATER project team. In the study area, many Indigenous rangers have been trained, and they are operationally ready to conduct the surveys identified for the study area – namely the eight estuarine case study areas. These

data collection surveys are well advanced. Processing of image data collected by community members will be done by the TropWATER project team at the Mangrove Hub at JCU. Data taken from imagery and from survey diaries are used to further visualise and describe coastline condition, to make ecological assessments of shoreline composition, the status and health of those shorelines. These data and information will contribute directly to the Southern GBR Mangrove Management Plan.

The specific methodology that will be employed is:

1. Collect source video and still imagery taken laterally from small boats around 50 m distance to shoreward margins. Filming will be undertaken such that it covers continuous shorelines of specific sections of estuarine areas and embayments. The intent of the project team is to cover all seaward margins in the study area, but limitations of funding dictate that only approximately 200 km of shoreline will be filmed and assessed. Ideally, the extent of shorelines filmed will include continuous coverage of most mainland and island shorelines (as mangrove seaward margins mostly, but not restricted to them) in the study area. Attention will be made of specific sections of the coastline as the eight (8) estuarine river systems.
2. Training has been given to the Gidarjil Rangers by the TropWATER project team to ultimately develop their skill base for the effective, independent gathering of imagery and other data for description of shoreline profiles relevant to this project.
3. The project team plans to make annual temporal assessments. There is sufficient funding support in the budget proposed to make at least 2 surveys during the 2 full years of the project, working with the Gidarjil Rangers until the project end in 2018. If there is spare time, or other funding available, the intention is to fill gaps and/or expand the existing number of local estuarine systems. A number of strategies will be employed: 1) additional funds will be sought with appropriate grant applications to further employ Gidarjil Rangers; and 2) community volunteers will be enlisted, trained and equipped. In this way, additional locations may be assessed.
4. The choice of days for boat surveys will be determined by the suitability of weather conditions, the time of day, coupled with periods of relatively low to mid tide.
5. Initial, sometimes prior, survey data will be used as baseline condition. Subsequent records will provide measures of differences. Specific observations will describe occurrences of habitat type, condition and change; noting: vegetative condition like species type; biomass; dieback condition; presence of plant mutations; notable erosion; root/bank exposure; sediment deposition; presence of seedlings; and seasonal changes along with species present in each habitat assemblage.
6. These findings will provide backup, support and validation for the mapping component.

## 3.0 RESULTS TO JUNE 2016

### 3.1 NESP TWQ Hub Project Leaders Workshop

On Friday 12 February 2016, Dr Duke, JCU TropWATER scientist, attended the workshop for Project Leaders organised by the Tropical Water Quality Hub (TWQ) Hub of the National Environmental Science Programme (NESP). Project Leaders were briefed about overall NESP goals and aspirations (see Table 6), as well as shown how they might get support for the successful conduct of their respective projects. An important additional outcome was the sharing of project objectives amongst Project Leaders, with the idea of exploring synergies between projects both within the TWQH as well as other Hubs within NESP.

**Table 6:** Agenda for the NESP TWQ Hub Project Leaders workshop in February 2016



#### PROJECT LEADERS MEETING #1

FRIDAY 12 FEBRUARY 2016

Room 030, Ground floor,

ATSIP (Aust Tropical Science and Innovation Precinct) Building,

JAMES COOK UNIVERSITY, TOWNSVILLE

#### AGENDA

| TIME              | ITEM                                                       | LEAD                             |
|-------------------|------------------------------------------------------------|----------------------------------|
| 9.00 – 9.15am     | Tea and Coffee available on arrival                        |                                  |
| 9.15 – 9.40am     | Welcome, Apologies & Objectives of the TWQ Hub             | Damien Burrows & Sheriden Morris |
| 09.40 – 10.40am   | Introductions & Project collaborations                     | All                              |
| 10.40 – 11.10am   | Project management, variations, expectations, budgets, etc | Damien Burrows & Sheriden Morris |
| 11.10 – 11.30am   | MORNING TEA                                                |                                  |
| 11.30 – 11.50am   | Media                                                      | Boyd Robertson                   |
| 11.50am – 12.15pm | Communications, publications and milestone reporting       | Julie Carmody                    |
| 12.15 – 1.00pm    | LUNCH                                                      |                                  |
| 1.00 – 1.30pm     | End-user engagement                                        | Damien Burrows and Leith Bouilly |
| 1.30 – 2.00pm     | eAtlas & Data Management                                   | Eric Lawrey                      |
| 2.00 – 2.30pm     | Indigenous Engagement                                      | Stan Lui                         |
| 2.30 – 3.00pm     | Discussion and questions                                   | All                              |
| 3.00pm            | Meeting close                                              |                                  |

**Apologies:** Nathan Waltham (JCU), Anthony Richardson (CSIRO), Natalie Stoeckl (JCU), Wayne Spencer (RRRC)

| Attendee                  | Institution | Representing Project Leader | Attendee             | Institution | Representing Project Leader |
|---------------------------|-------------|-----------------------------|----------------------|-------------|-----------------------------|
| David Westcott            | CSIRO       |                             | Katharina Fabricius  | AIMS        |                             |
| Damien Burrows            | JCU         | Nathan Waltham              | Susanne Becken       | GU          |                             |
| Lynne Eagle & Marina Farr | JCU         | Natalie Stoeckl             | Marcus Barber        | CSIRO       |                             |
| Rebecca Bartley           | CSIRO       |                             | Norm Duke            | JCU         |                             |
| Stephen Lewis             | JCU         |                             | Eric Lawrey (eAtlas) | AIMS        |                             |
| Sven Uthicke              | AIMS        |                             | Aaron Smith (eAtlas) | AIMS        |                             |
| Aaron Davis               | JCU         |                             | Leith Bouilly        | TWQ Hub     |                             |
| Mike Bell                 | UQ          |                             | Damien Burrows       | TWQ Hub     |                             |
| Ross Jones                | AIMS        |                             | Sheriden Morris      | RRRC        |                             |
| Andrew Brooks             | GU          |                             | Boyd Robertson       | RRRC        |                             |
| Jane Waterhouse           | JCU         |                             | Stan Lui             | RRRC        |                             |
| Simon Apte                | CSIRO       |                             | Julie Carmody        | RRRC        | + Wayne Spencer             |
| Mike Kingsford            | JCU         | Anthony Richardson (CSIRO)  | Damian Wrigley       | DotE        |                             |

### 3.2 Stakeholder workshop – launch of the Southern GBR CHAMP Project

On Tuesday 19<sup>th</sup> April 2016, a community public workshop was organised by the JCU TropWATER project team, BMRG and Gidarjil Development Corporation partners in Bundaberg, followed by two days of training sessions. Invited attendees are listed in Table 7.

**Table 7:** Invited participants attending the public workshop as part of the Southern GBR CHAMP program Launch on 19 April 2016 in Bundaberg, Queensland.

| Name              | Affiliation            |
|-------------------|------------------------|
| Cheryl Bolzenius  | Wetland Care           |
| Peter Brockhurst  | Gidarjil DC            |
| Arthur Dahl       | Gidarjil DC            |
| Norm Duke         | JCU TropWATER          |
| Ric Fennessy      | Gidarjil DC            |
| Gabriel Little    | Gidarjil DC            |
| Bart MacKenzie    | QDAF Fisheries         |
| Jock Mackenzie    | JCU TropWATER          |
| Nick Maclean      | Bundaberg City Council |
| Symean Maror      | Gidarjil DC            |
| Faye McGowan      | Gidarjil DC            |
| Jason Pascoe      | Gladstone Ports Corp.  |
| Sue Sargent       | BMRG                   |
| Anjana Singh      | Gladstone Ports Corp.  |
| David Weribone    | Gidarjil DC            |
| Shannon van Nunen | FBA                    |

Invitations to the workshop were dispatched amongst selected nominees as potential stakeholders and end users (see Table 7). A number of apologies were received with almost universal agreement about the value of the project, and with offers of assistance when needed.

Work for this component was initially about building relationships, informing community, plus getting agreement of the work program and building skills. Our goals for field work are being met with key contributions from skilled-up Ranger teams of the Gidarjil DC. Works have involved ranger and staff training, support and consultation, briefings on methodology and approach, as well as the compilation and preliminary assessment of field data.

The 2016 **Southern GBR CHAMP workshop** for monitoring tidal wetlands, and development of the Mangrove Management Plan, was held on Tuesday April 19th in the Gidarjil Training Facilities at Burnett Heads, Queensland. The meeting was chaired by the Burnett Mary Regional Group, noting that the 2017 workshop will be hosted by the Fitzroy Basin Association. See the workshop invitation flyer, for more information (see Appendix A.1).

To facilitate stakeholder involvement, participants were asked to provide a short presentation

(4-5 slides max) to help get the conversation started about their contributions to the better manage of mangroves and tidal wetlands in the Southern GBR region.

Specific supportive information included:

- **current projects** – as those actively managing tidal wetlands (mangroves/saltmarsh) in the Southern GBR;
- **main values and threats** to tidal wetlands (mangroves/saltmarsh) in the region and options for their better management;
- **rehabilitation project opportunities** for tidal wetlands (mangroves/saltmarsh); and
- **available primary and secondary resources** (spatial data, on-ground data, imagery, reports, skills and local knowledge) available for the development of a Mangrove Management Plan, over the next 2 years.

These ideas and suggestions have been collected for further assessment as the project develops.



**Figure 5:** Project workshop for stakeholders and end users of mangroves and saltmarsh habitats launch the Southern GBR CHAMP project in Bundaberg, Queensland.

### 3.3 Training sessions and survey work by Rangers

On Wednesday and Thursday, 20-21 April 2016, the JCU team conducted training sessions for both the Sea Ranger teams from Gidarjil DC, plus with community volunteers. These sessions included a combination of indoor and field work on foot and in a small vessel.

An important part of the training involved the practical application of the Shoreline Video Assessment Method (S-VAM) culminating in its immediate practical application in boat-based shoreline surveys of the Burnett River. This is one of the 8 designated case study estuarine sites. Filming of the Burnett River was completed during these training sessions over two days. Other field training included identification of mangrove and tidal saltmarsh plants, including weeds in these environments. Teams of trainee Rangers were each given the

opportunity to join in the boat surveys, whilst the alternate group received training in habitat biodiversity and species identification of mangrove and salt marsh plants.



**Figure 6:** Field training and surveys followed the Stakeholder Workshop, with practical sessions using the JCU boat 'Guyala' in the Burnett River estuary.

### 3.4 Talk by NC Duke at the 2016 AMSN Conference

The presentation made by Dr Duke was done to raise awareness of this NESP TWQ Hub project amongst members of the Australian Mangrove and Saltmarsh Network ([www.amsn.net.au](http://www.amsn.net.au)).



TropWATER scientists directly support the informal independent network for people and organizations. The AMSN was established over a number of years. It was formed in response to the growing need for better communication amongst all stakeholders concerned about mangrove and saltmarsh tidal wetland habitats around Australia, and elsewhere. The network has supported regular independent conferences each year since 2014. With over 100 registered network members to date, the network includes professional researchers, managers, industry officers and environmental consultants, as well as community enthusiasts from every Australian State and Territory, plus a growing number from other countries. The aim has been to provide a professional focus group, a listing of current issues and pressures, a repository for information about solutions as with rehabilitation projects, and an overall one-stop-shop for anyone interested in tidal wetlands around the country. For more information about the network, please visit the website. Dr Duke facilitates the AMSN.



**Figure 7:** TropWATER supports the Australian Mangrove and Saltmarsh Network and its website, promoting its cause and its annual network conferences each year. The latest was in Darwin, early in May 2016. The 2017 meeting will held be in Hobart.

**Box 1:** Abstract for the oral presentation made on 3<sup>rd</sup> May 2016 at the Australian Mangrove and Saltmarsh Conference in Darwin, Northern Territory.

### **Indigenous ranger management of Southern GBR estuarine mangrove wetlands**

Norman C Duke, MangroveWatch Hub, TropWATER Centre, James Cook University (JCU),  
Townsville, Qld.

Jock Mackenzie, MangroveWatch Hub, TropWATER Centre, James Cook University (JCU),  
Townsville, Qld.

Peter Brockhurst, Gidarjil Development Corporation (GDC), Bundaberg, Qld.

We report on two new projects aiming to improve management of southern GBR estuarine mangrove wetlands. Both enlist the support of local Traditional Owners and volunteers in the area from Rockhampton to Hervey Bay in Queensland. The JCU research team in partnership with the GDC is supported by: the Gladstone Ports Corporation's Estuarine Research and Monitoring Program for Port Curtis and Port Alma areas until 2020; and, by the National Environmental Science Programme (NESP) Tropical Water Quality Hub for the wider area of the Port Curtis Coral Coast TUMRA until 2018. Both projects employ MangroveWatch-style monitoring methods (see: [www.mangrovetwatch.org.au](http://www.mangrovetwatch.org.au)) like the Shoreline Video Assessment Method combined with walkabout cultural evaluations plus identification of practical shoreline rehabilitation works. One key outcome is to develop a Mangrove Management Plan (MMP) in collaboration with local Natural Resource Management groups, the Burnett Mary Regional Group, and the Fitzroy Basin Association. The MMP will provide a strategic basis for estuarine repair activities and for maximizing water quality outcomes in the southern GBR region. These projects build human capacity and skills amongst Gidarjil rangers and local community volunteers for the conduct of scientifically-rigorous, ecological monitoring, assessment and rehabilitation. Such management and mitigation strategies will bolster efforts to effectively protect estuarine sea country resources as well as build lasting partnerships between community, scientists, industry, managers and local NRM agencies.

### 3.5 Further training and survey work by the Rangers

During the week of 9-13 May 2016, Jock Mackenzie supervised further training of Gidarjil DC Rangers as they surveyed estuarine shorelines using S-VAM. Additional river systems surveyed, include southern case study estuaries of the Koolan, Elliott and Burrum Rivers.

**Table 8:** Schedule of river systems being surveyed prior to, and during, the Southern GBR CHAMP project. Where surveys in the eight (8) study estuaries are repeated, this gives opportunities for measuring change like flood recovery. Note that systems surveyed to date are those in southern parts of the Southern GBR shoreline. The emphasis will shift to the north in the next year of field surveys.

| COMPLETED  |            |                         |           |           |           |           |           |
|------------|------------|-------------------------|-----------|-----------|-----------|-----------|-----------|
| #          | NRM region | PCCC System             | 2012-2013 | 2013-2014 | 2014-2015 | 2015-2016 | 2016-2017 |
| 1          | FBA        | Fitzroy River           |           |           |           |           | 1         |
| 2          | FBA        | Balaclava Island        |           |           | 3         |           | 3         |
| 3          | FBA        | Port Alma               |           |           | 3         |           | 3         |
| 4          | FBA        | Maria Inlet             |           |           |           |           |           |
| 5          | FBA        | Barker Ck               |           |           |           |           |           |
| 6          | FBA        | Mosquito Ck             |           |           |           |           |           |
| 7          | FBA        | Deception Ck            |           |           |           |           |           |
| 8          | FBA        | Badger Ck               |           |           |           |           |           |
| 9          | FBA        | Monte Christo Ck        |           |           |           |           |           |
| 10         | FBA        | Middle Ck               |           |           |           |           |           |
| 11         | FBA        | The Narrows Ck          |           |           |           |           |           |
| 12         | FBA        | Black Swan              |           |           |           |           |           |
| 13         | FBA        | Graham Ck               |           |           |           |           | 4         |
| 14         | FBA        | Targinie Ck             |           |           | 4         |           |           |
| 15         | FBA        | Endfield Ck             |           |           |           |           | 4         |
| 16         | FBA        | Port Curtis             |           |           | 3         |           | 3         |
| 17         | FBA        | Calliope (Upper +Lower) |           |           | 4         |           | 4         |
| 18         | FBA        | Auckland Ck             |           |           |           |           | 4         |
| 19         | FBA        | W Facing Island         |           |           |           |           | 3         |
| 20         | FBA        | South Trees             |           | 2         |           |           | 4         |
| 21         | FBA        | Boyne R.                |           | 2         | 4         | 5         | 5         |
| 22         | BMRG       | Wild Cattle Ck          |           |           |           |           |           |
| 23         | BMRG       | Pancake Ck              |           |           |           |           |           |
| 24         | BMRG       | Rodds Bay               |           |           | 3         |           | 3         |
| 25         | BMRG       | Eurimbula               |           |           |           |           |           |
| 26         | BMRG       | Round Hill Ck           |           |           |           |           |           |
| 27         | BMRG       | Deepwater               |           |           |           |           |           |
| 28         | BMRG       | Wentworth               |           |           |           |           |           |
| 29         | BMRG       | Littabella              |           |           |           |           |           |
| 30         | BMRG       | Kolon                   | 1         |           |           |           |           |
| 31         | BMRG       | Winter                  | 1         |           |           |           |           |
| 32         | BMRG       | Elliott                 | 1         |           |           |           |           |
| 33         | BMRG       | Coomarr                 |           |           |           |           |           |
| 34         | BMRG       | Theodilite              |           |           |           |           |           |
| 35         | BMRG       | Burrum                  | 1         |           |           |           |           |
| 36         | BMRG       | Gregory                 |           |           |           | 5         |           |
| 37         | BMRG       | Isis                    |           |           |           | 5         |           |
| 38         | BMRG       | Cherwell                |           |           |           |           |           |
| Survey #/s |            |                         | 4         | 3         | 7         | 7         | 1         |

Legend - survey teams

|   |                     |
|---|---------------------|
| 1 | JCU BMRG            |
| 2 | JCU C-4-C           |
| 3 | JCU CHAMP           |
| 4 | GDC PCPA CHAMP ERMP |
| 5 | GDC SGBR CHAMP APPA |

Legend - survey teams

|   |                     |
|---|---------------------|
| 1 | JCU BMRG            |
| 2 | JCU C-4-C           |
| 3 | JCU CHAMP           |
| 4 | GDC PCPA CHAMP ERMP |
| 5 | GDC SGBR CHAMP PCPA |



**Figure 8:** Mangrove dieback along the shorelines from earlier flooding of the Boyne River remains obvious several years after the 2013 event.

### 3.6 Survey work by Rangers

On Thursday 10 June 2016, Arthur Dahl a ranger supervisor with Gidarjil DC led an independent survey where the rangers re-filmed shorelines of the Boyne River estuary. Field notes show that the rangers involved were: Arthur Dahl, Noah Saumalu Johnson, Jayme Cook and William Waia (an EQIP work experience student).

The vessel used was a hire boat from the Boyne Island Environmental Education Centre (BIEEC), inflatable about 4m long. About 26 km of the Boyne River was surveyed, covering both sides of the river up to the bridge. The mangroves were all looking stressed to some degree, and many have died (see Figure 8). They do not seem to like having debris (even branches and wigs) caught up in them. There was a small green turtle (about **40cm** carapace length) at the mouth of the Boyne River at high tide, and another larger green turtle (about **100cm** carapace length) was seen about 10 km upstream, moving with the incoming tide.



**Figure 9:** Filming the Boyne River during S-VAM surveys (photo: Arthur Dahl).

### 3.7 Mapping of case study areas

Prof. Kovacs is working in partnership with Dr Duke to manage mapping activities and outcomes. A preliminary set of map outcomes are presented in this report based mostly on existing data.

During the period up to 10 June 2016, Prof Kovacs directed his students to prepare preliminary maps of the eight case study estuarine systems for the Southern GBR study area. The maps were made to show existing mangrove and saltmarsh habitat classification data. These closely match those independently drafted by Mackenzie and Duke (2011) for the southern part of the region, but there are some notable points of difference. The mangrove areas do not always match. And, the saltmarsh category appears to include non-tidal communities as well as tidal saltmarsh.

The intention is to refine these baseline displays, measures and classifications through space and time for this project. In this way, we intend to produce better definition maps from which future change can be accurately monitored. This initial mapping exercise is essential for establishment of the project baseline from which all change will be measured, both in the past, as well as into the future. Specific high resolution satellite imagery has been sourced, and is currently being purchased for the next phase of the mapping work and change detection for this project.

Preliminary maps were produced for the eight (8) study estuaries of the Southern GBR coast (see Figure 4, sites ordered from North to South):

- Fitzroy River
- Calliope River
- Boyne River
- Baffle Creek
- Kolan River
- Burnett River
- Elliott River
- Burrum River

For each map (Figures 10-17), the extracted mangrove and saltmarsh regional ecosystem polygons were overlaid on a background base map derived of mosaiced ALOS AVNIR-2 satellite imagery. Specifically, the base map employed the spectral band 3 of the AVNIR-2 imagery which represents the red region (630-685 *nm*) of the electromagnetic spectrum.

The polygons extracted from the QWMCP will be used as a general guide for assisting in the classification of these ecosystems using updated high resolution satellite imagery. Higher spatial resolution imagery, possibly *GeoEye-1*, *RapidEye* or *SPOT-7*, will be acquired for either 2014 or 2015. Once collected, these data will first be radiometrically corrected to surface reflectance using *PCI Geomatica's* *ATCOR* module. If necessary these images may also be geometrically corrected using *PCI Geomatica's* *Orthoengine*. Since several swaths of imagery are likely to be needed to cover the study area, the many surface reflectance images may also be mosaiced.

The Normalized Difference Vegetation Index (NDVI) will then be produced from each surface

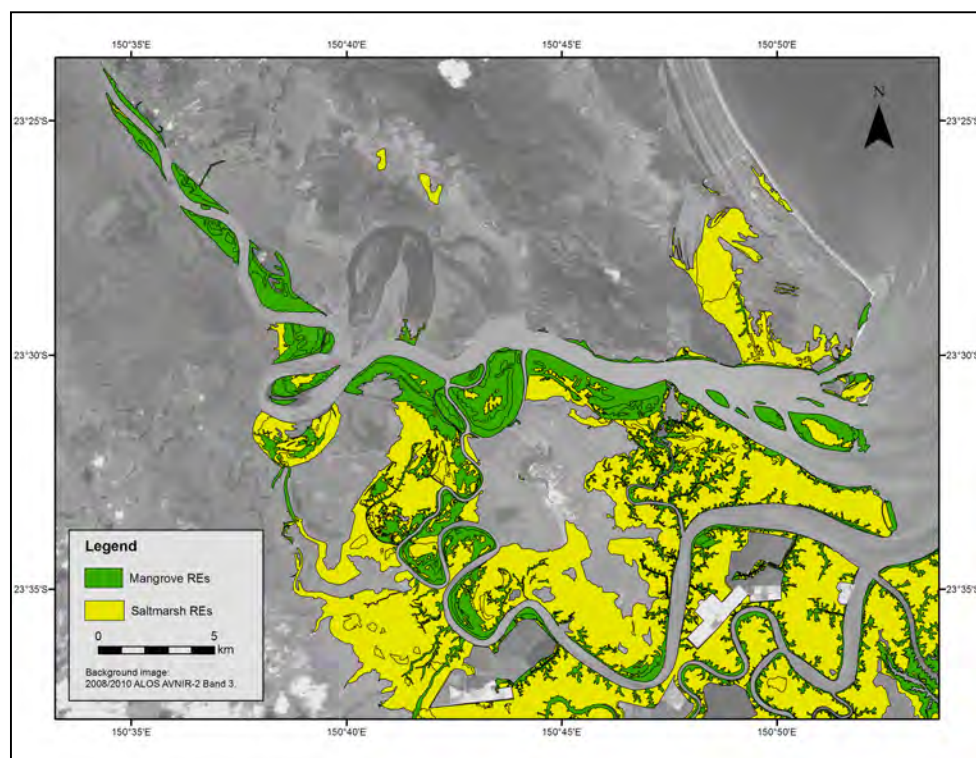
reflectance mosaic. NDVI is calculated using the following formula:

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NIR} + \text{Red})}$$

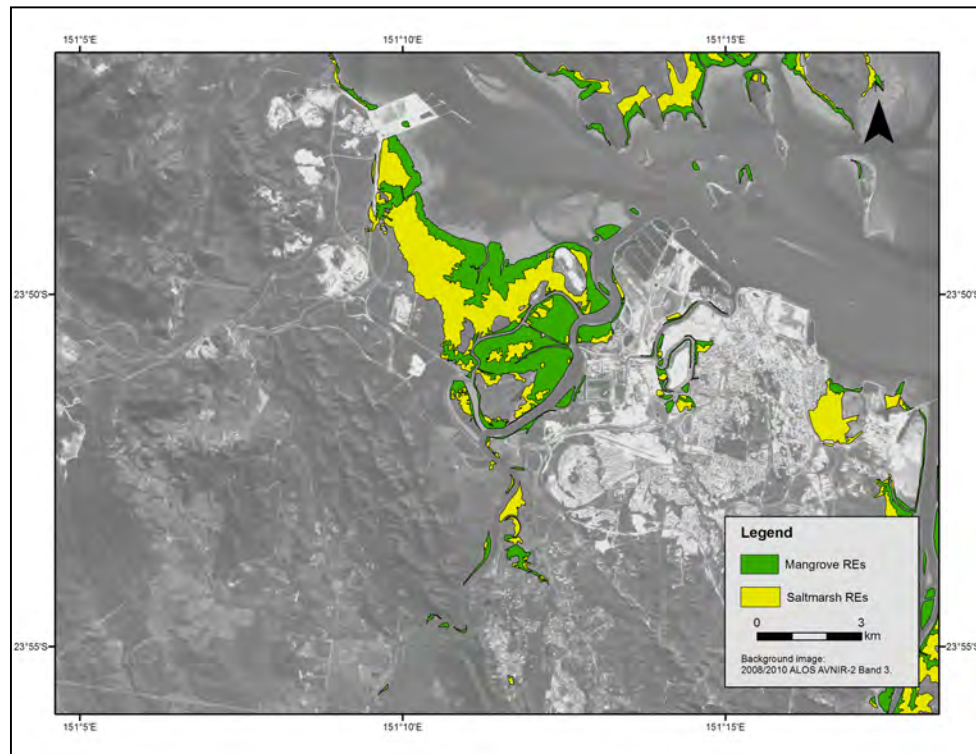
The NDVI images can then be used to monitor changes in the health of the vegetation by comparing them with future NDVI images collected of the same locations. Finally, using ancillary data (e.g., QWMCP, Gidarjil field surveys), a per pixel classification procedure will be applied to the newly acquired imagery in order to map the most recent areas of mangrove and saltmarsh land cover.

Commitments made for this period have been met with the sourcing of preliminary and key imagery. The production of high resolution maps and their assessment of image data is planned for in the next phase.

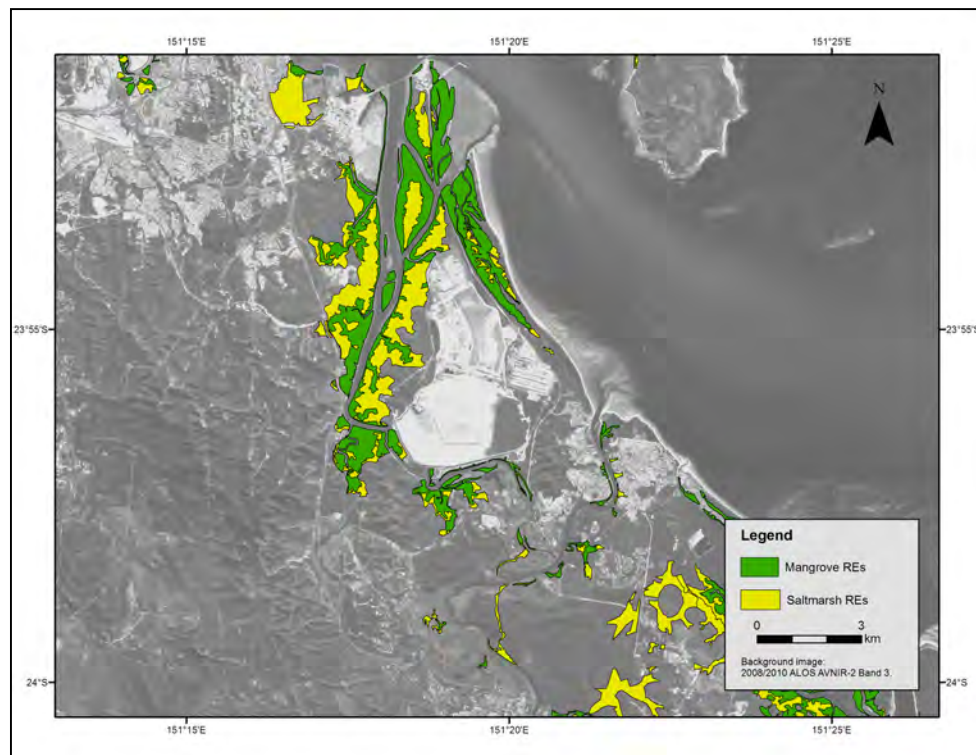
As shown in Figure 4, there are maps for each of the eight (8) estuarine systems used as case studies in the Southern GBR project. Prior information about the southern estuarine system is documented in earlier reports about the Burnett Mary Region (Duke & Prange, 2005; Schaffelke et al., 2005; Moss et al., 2008; Mackenzie & Duke 2011).



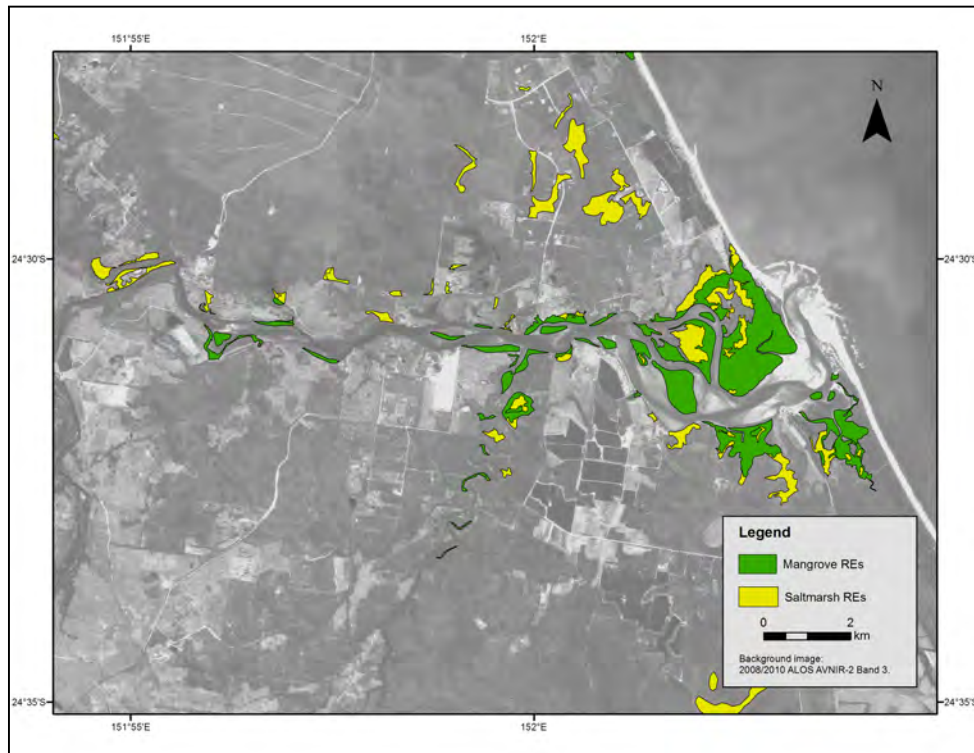
**Figure 10:** Map of the Fitzroy River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



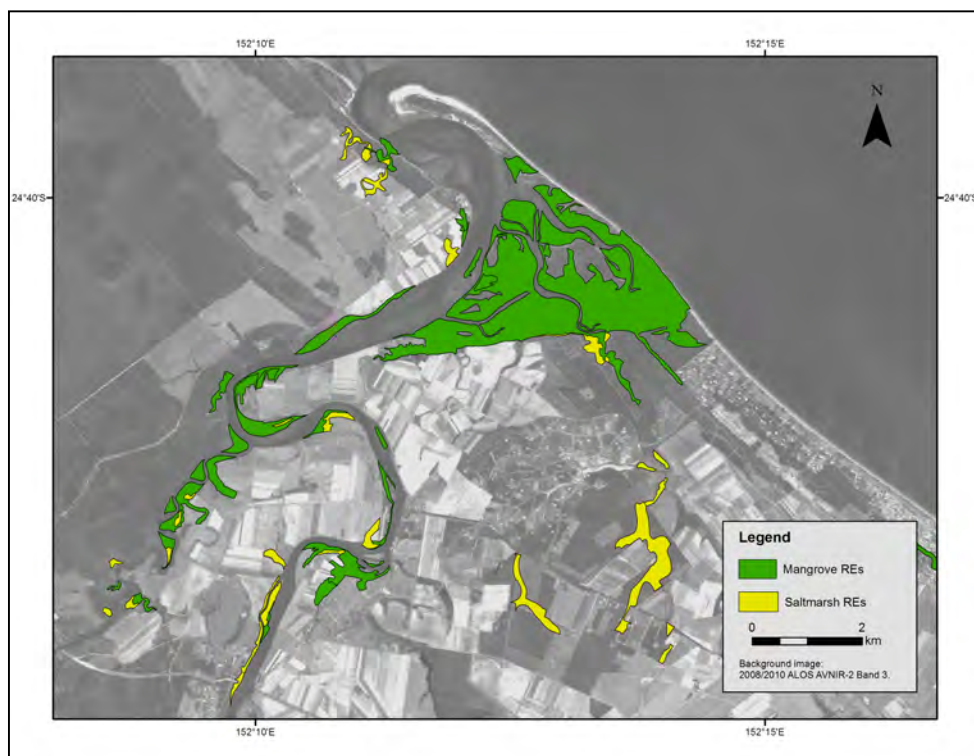
**Figure 11:** Map of the Calliope River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



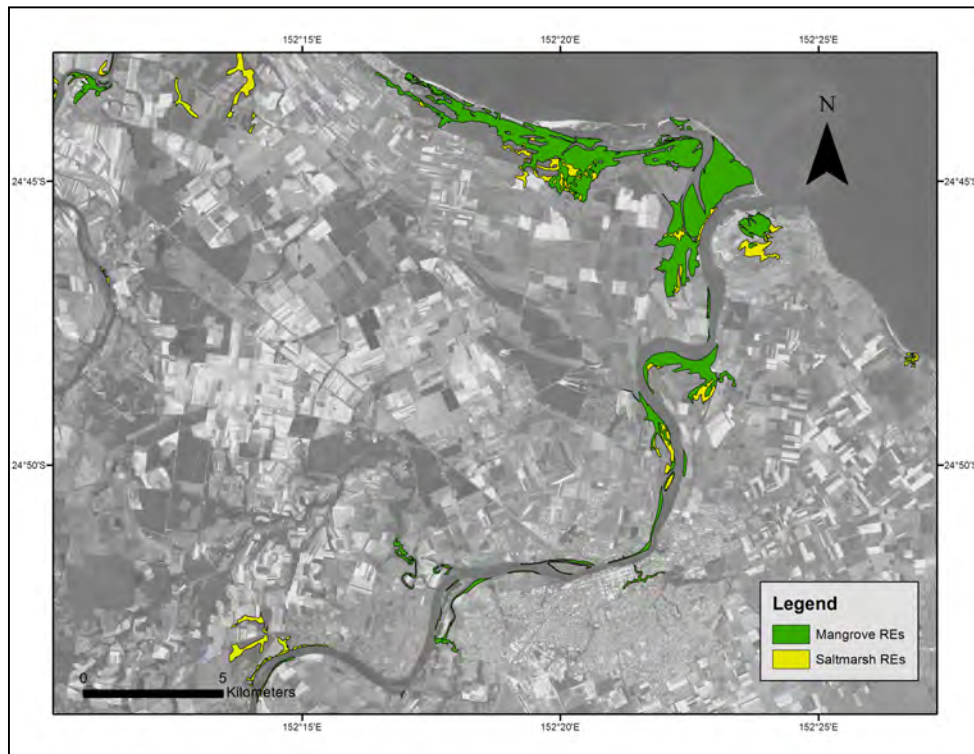
**Figure 12:** Map of the Boyne River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



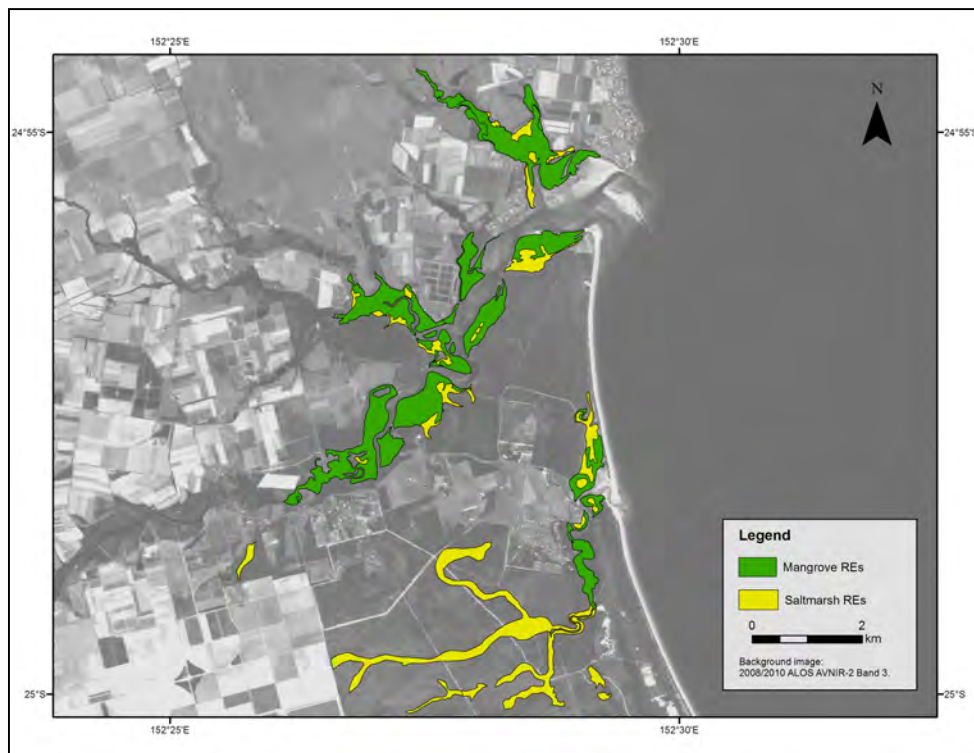
**Figure 13:** Map of the Baffle Creek estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



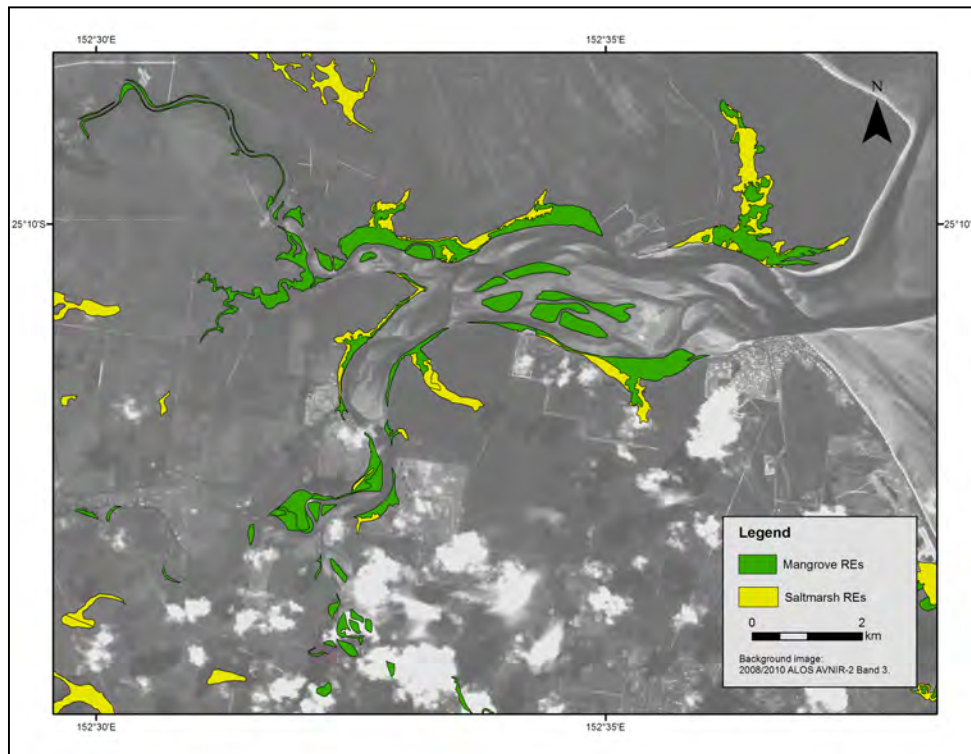
**Figure 14:** Map of the Kolan River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



**Figure 15:** Map of the Burnett River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).



**Figure 16:** Map of the Elliot River estuarine system pre 2009, tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).

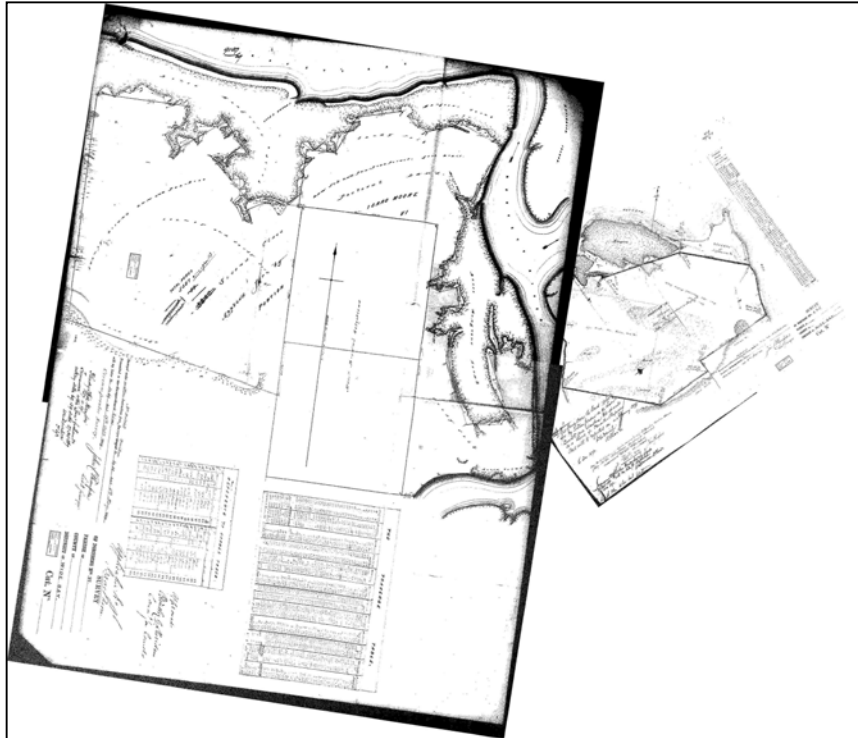


**Figure 17:** Map of the Burrum River estuarine system pre 2009, showing tidal wetland mangroves (green shading) and tidal saltmarsh (yellow shading).

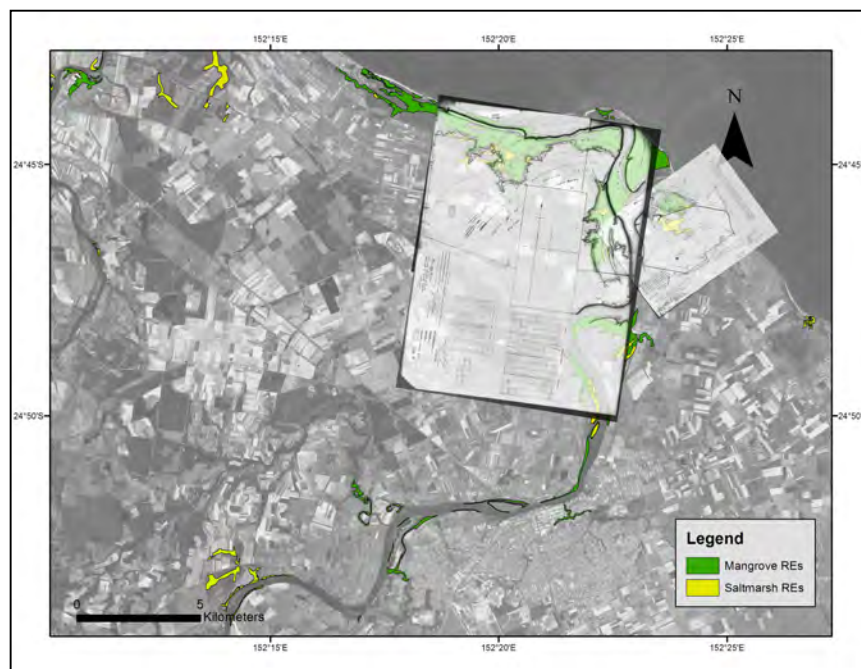
### 3.8 Preliminary historical perspective

Local historian, Merv Hopton shared some historical information and some old charts with the TropWATER scientist team.

One example, are two charts of the mouth of the Burnett River, as surveyed in 1869 and 1870 (Figure 18). The accuracy of these old charts was so good that they could easily be laid over current satellite imagery to show many corresponding features (see Figure 19). The most compelling similarity was the upland mangrove margins of the landward zone. These appear mostly unchanged over the 140 odd years. However, there were other notable changes to the mouth which in 1870 was divided in two, one heading north and the other east. The eastern mouth remains today, but the northern mouth was blocked with a rock wall. This has resulted in sediments accumulating behind, and being occupied with mangroves. Another notable feature was the pre 1870 presence of another river course, marked by a large mangrove area to the west.



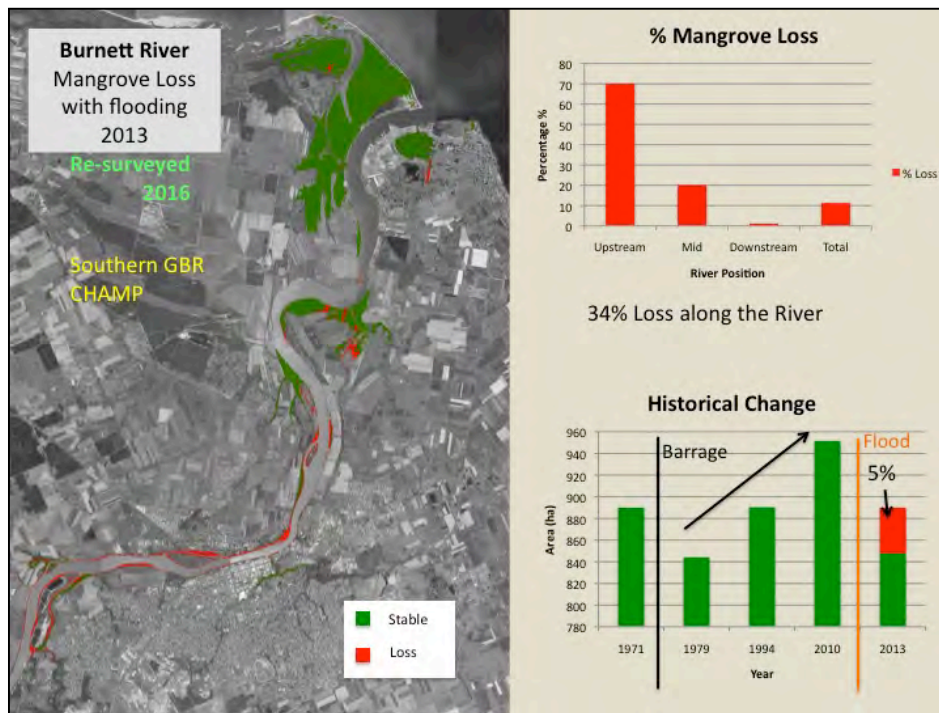
**Figure 18:** Old charts of the Burnett River estuarine system drafted in 1869-70 (sourced by Merv Hopton) show notable changes to the mouth of the river as we know it today (also see Fig. 15). The system had two distinct mouths, one to the north and another to the east.



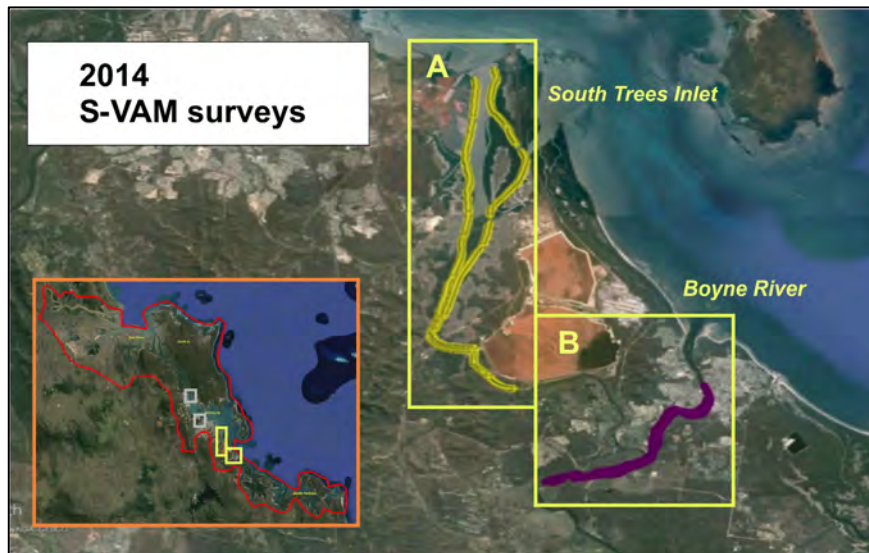
**Figure 19:** The 1869-70 charts of the Burnett River (Fig. 18) laid over the 2008-10 satellite image (Fig. 10) show more specific changes, and a number of features that have remained largely unchanged. Landward and seaward margins of mangrove areas along the Hervey Bay shoreline appear notably comparable. The northern mouth was blocked off with a rock wall and has now filled with sediments occupied by mangroves. There are also indications of an earlier single river mouth between the two – in alignment with a large mangrove-filled ox-bow area on the western side just upstream from the mouth.

In more recent times, many of the estuarine systems within the Southern GBR region have been affected by severe flooding events, as in 2013. Because of the prior S-VAM surveys conducted in this region, the continued surveys as part of the current project can better evaluate the longer term changes resulting from such severe changes. Do mangrove systems bounce back after severe flood damage? How long does this take? Does the mangrove regrowth have the same resilience and tolerances as less damaged stands?

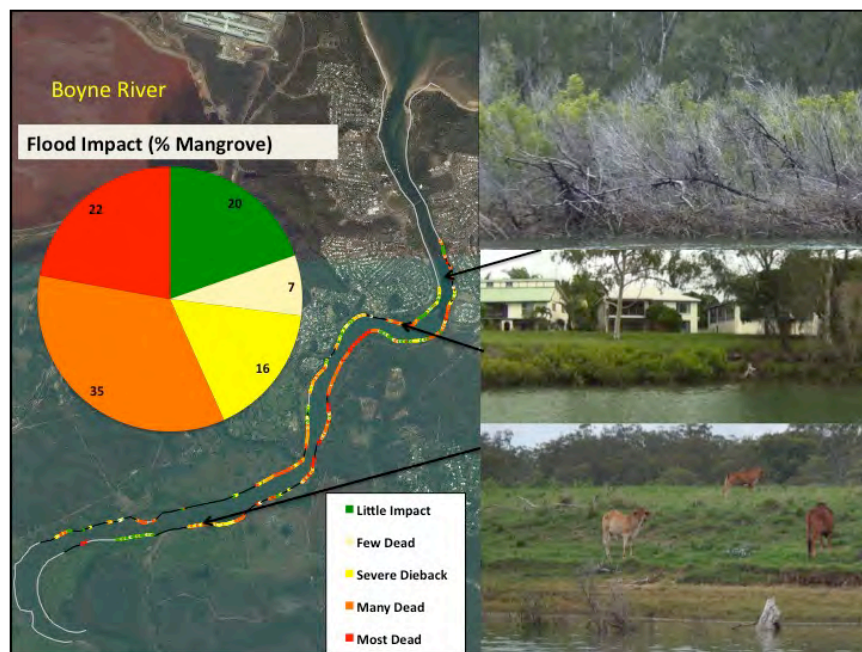
The objective of this project will be to fully describe and quantify the recovery process based on the prior data collected from river estuarine systems like the Boyne and the Burnett Rivers in the Southern GBR region (see Figures 12 & 15, respectively).



**Figure 20:** Another map of the Burnett River estuary (see Fig. 15) showing the severe impact of the 2013 floods on mangroves upstream. While there was little change at the mouth, it is clear that upstream stands fluctuate widely in response to flooding events and alterations to hydrology like the installation of the barrage upstream. More recent surveys with the NESP project are needed to show the longer term status of such events.



**Figure 21:** Flood damage is notable in the Boyne River estuary (Inset B, also Fig. 12). Prior Shoreline Video Assessment Method (S-VAM) survey locations surveyed by Gidarjil Rangers in the Southern GBR study area in 2014.



**Figure 22:** Flood damage is notable in the Boyne River estuary (Fig. 12). Prior Shoreline Video Assessment Method (S-VAM) survey show large upstream sections of the river estuary with severe damage and loss of mangroves.

### 3.9 News media reports

A press release was prepared and disseminated by JCU Media Liaison, posted 14 April 2016. See the online version or refer to the Appendices.

<https://www.jcu.edu.au/news/releases/2016/april/help-develop-a-plan-to-manage-precious-mangroves>



**Figure 23:** Gidarril Rangers conducting S-VAM surveys filming shorelines of estuaries throughout the Southern GBR region.

**News Mail, posted 16 Feb 2016.**

<http://www.news-mail.com.au/news/plants-are-not-the-problem/2932480/>

#### **“Mangroves get an unfair reputation”.**

MANGROVES get an unfair reputation, according to author of Australia's Mangroves and leader of James Cook University's MangroveWatch program, Dr Norm Duke.

The mosquitoes and sandflies that come with them can be irritating, but those problems only come with unhealthy mangrove systems, Dr Duke said.

"Biting insects and bad smells occur when the drainage has been altered and you get impounded areas with smelly rubbish," he said.

"Mangroves get a bad rap because they get a bad rap - it's a self-fulfilling prophecy. People see them as a place you dump rubbish.

"That's very unfortunate because they have great value."

Mangroves are nurseries for young fish, which later migrate out to sea, making them critical to the commercial fishing industry.

They store more than five times more carbon than other plants.

They're valuable to beekeepers who produce mangrove honey.

Their shallow root systems which trap and hold sediment, preventing the loss of riverbanks in storms, cyclones and big tides.

**News Mail** on Mangroves. Additional and supportive interviews about mangroves.  
<http://www.news-mail.com.au/topic/mangroves/#biography>

**Press Reader, News Mail, posted 26 April 2016.**

**“Burnett River ‘is in a bad way’”.** Research Trip: Burnett banks slowly recovering.  
<http://www.pressreader.com/australia/news/20160426/281479275601033>



**Figure 24:** The NESP Southern GBR region project in the news.

**Extract from News Mail Bundaberg Qld. April 26, 2016**

**Citizen Science Alliance website**

<http://greatbarrierreefcitizenscience.org.au/news/citizen-science-success>

#### **“MangroveWatch supporting GBR mangrove management”**

After the 2013 floods, many mangroves and saltmarsh habitats in the southern GBR catchments were damaged. 35% of the Burnett Rivers were severely damaged or lost in the 2013 floods. These critical habitats are now slowly recovering in some areas. Monitoring is important to understand recovery and set in place best-practice management approaches. MangroveWatch & [TropWATER](#), [James Cook University](#), have teamed up with Gidarjil Development Corporation, the [Burnett Mary Regional Group for Natural Resource Management](#) and Fitzroy Basin Authority for a new project funded by the Australian Government National Environmental Monitoring Programme (NESP), called the Southern GBR CHAMP (Coastal Habitat Archive and Monitoring Program). Our goal is to develop a Mangrove Management Plan for the Southern Great Barrier Reef region. The plan will manage local threats to mangroves and help prioritise investment in mangrove rehabilitation that improves water quality in Southern GBR estuaries. In April 2016, scientists, traditional owners, managers, industry experts and local residents gathered to launch a new mangrove monitoring program and develop an action plan to

better manage mangroves and saltmarsh in the Bundaberg and Gladstone Regions. Citizen scientists will also have the opportunity to work with Gidarjil Sea Country Rangers on intensive mangrove monitoring between Rockhampton and Bundaberg, to measure the health of mangrove habitat and related issues.



**Figure 25:** A single picture is a record of shoreline condition. A continuous series of pictures is a permanent library about the whole estuarine system. And, each time it is refilmed, there is a new library from which to measure change anywhere in the system.

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- Schaffelke, B., J. Mellors, N.C. Duke. **2005**. Water quality in the Great Barrier Reef region: responses of mangrove, seagrass and macroalgal communities. Marine Pollution Bulletin 51: 279-296.

## APPENDIX A: LAUNCH INVITATION FLYER

The public flyer used to invite participants (date claimer) to the series of workshops associated with the project launch during 19 April 2016 in Bundaberg, Queensland.



# Southern GBR CHAMP

(Coastal Habitat Archive & Monitoring Program)



## YOUR INVITATION

to attend a workshop on developing a  
**Mangrove Management Plan for the Southern Great Barrier Reef**

Do you have an interest in estuaries, waterways, mangroves, saltmarsh or fisheries in the Southern GBR region? We want your input!

Dr Norm Duke from TropWATER, JCU in partnership with Gidarjil Development Corporation, MangroveWatch, BMRG & FBA are working together to monitor and better manage tidal wetlands in the SGBR region.

Our project team **invite you to a workshop to discuss:**

- Local tidal wetland values & threats,*
- Tidal wetland monitoring strategies,*
- Tidal Wetland restoration opportunities*

*A regional Mangrove Management Plan for the SGBR*

This workshop is funded by the Australian Government's **National Environmental Science Programme (NESP)** to facilitate estuary repair that maximizes water quality outcomes for the SGBR.

### Workshop Details

*Date: Tuesday 19<sup>th</sup> April*  
*Time: 8:30 am to 4:30 pm*  
*Location: Gidarjil Marine Training Facility, 2 Marine Drive, Burnett Heads*

*Lunch & refreshments provided*

### Citizen-Science Tidal Wetland Monitoring Training

*Keen to become a MangroveWatch citizen scientist? Join us following the workshop on the 20<sup>th</sup> & 21<sup>st</sup> April to attend hands-on training in tidal wetland monitoring methods.*

For more information or to RSVP contact Sue Sargent: [sue.sargent@bmrq.org.au](mailto:sue.sargent@bmrq.org.au)







**Burnett Mary**  
REGIONAL GROUP



**Tropical Water Quality Hub**



**JAMES COOK UNIVERSITY AUSTRALIA**



**MangroveWatch**



**fba**  
FUTURES BASIN ASSOCIATION



National Environmental Science Programme

## APPENDIX B: MEDIA RELEASE BY JCU TROPWATER.

The public launch of the Southern GBR CHAMP project with the workshop and training sessions regards NESP TWQH, dated 8 April 2016.



### MEDIA RELEASE

For immediate release, with a focus on the Southern GBR region of Central Queensland.

For the JCU project, Southern GBR CHAMP

v. 8 April 2016

## Get involved in citizen science and help look after our precious mangroves!

Do you want to have some muddy fun and contribute to real science at the same time?

This is your opportunity to help look after our endangered tidal wetlands and find out more about marine environments along the southern Great Barrier Reef coast.

The Coastal Habitat Archive and Monitoring Program (CHAMP) will carry out intensive monitoring to measure the health of mangrove habitat and related issues between Rockhampton and Bundaberg.

This two year project, funded by the Australian Government through the National Environmental Science Programme (NESP) greatly extends upon an existing program focused on Port Curtis and Port Alma with the Gladstone Ports Corporation.

It will incorporate Land & Sea Country ranger knowledge, understanding, expertise and passion for appreciating the importance and beauty of our valuable coastal wetlands.

A research team from James Cook University's TropWATER Centre, together with Traditional Owner Rangers from Gidarjil Development Corporation, will introduce CHAMP and conduct training for shoreline environmental monitoring at the Gidarjil Marine Training Facility in Burnett Heads on April 19. Other project partners include the Burnett Mary Regional Group and the Fitzroy Basin Association.

CHAMP is looking for volunteers to become 'citizen-scientists' by helping out with field surveys of mangrove wetlands over coming months.

Citizen-scientists will collaborate with JCU mangrove scientists and report back to the wider community with annual reports and locally relevant observations.

Project Leader Dr Norm Duke said CHAMP was an excellent opportunity for people in the community to get involved in looking after their local environment.

"The offer is there to get involved in this two-year program helping protect natural coastal resources of the southern GBR region," Dr Duke said.

"This is a chance for interested locals to get involved, to learn about the health of local tidal wetlands, and to help gather valuable scientific knowledge about one of our most undervalued natural ecosystems, mangroves and saltmarshes."

"Scientists need local community help and support to properly protect and manage these natural places - if you have got the time and you want to help, come join us - or, just come along and find out what we are doing!

JCU scientist Jock Mackenzie said more information was needed about the health of the Gladstone Great Barrier Reef catchment's abundant mangrove and tidal saltmarsh areas.

"More the 75% of the fish, prawns and crabs from around the area depend on the mangroves," Mr Mackenzie said.

"If the mangroves aren't healthy then neither are the fish stocks, and that will impact the local economy."

To get involved with CHAMP, or to find out more about our field projects, come to the workshop being held on April 19<sup>th</sup> at the Gidarjil Marine Training Centre, 2 Marine Drive, Burnett Heads (8.30am to 4.30pm). For more information about the workshop, contact Sue Sargent at BMRG by email: [sue.sargent@bmrq.org.au](mailto:sue.sargent@bmrq.org.au) or phone: 04 2946 2041.

We also have 2 training days on the 20<sup>th</sup> and 21<sup>st</sup>. You will need to book, so please email Jock: [mangrovewatch@gmail.com](mailto:mangrovewatch@gmail.com) or Peter Brockhurst at Gidarjil Development Corporation, email: [tumra@gidarjil.com.au](mailto:tumra@gidarjil.com.au) or phone: 04 0969 6219.

We invite you further to browse the Australian Mangrove and Saltmarsh Network site ([www.amsn.net.au](http://www.amsn.net.au)) - your one stop shop for finding out who is doing what in Australia's tidal wetlands. For general information on mangroves and MangroveWatch programs, visit [www.mangrovewatch.org.au](http://www.mangrovewatch.org.au)

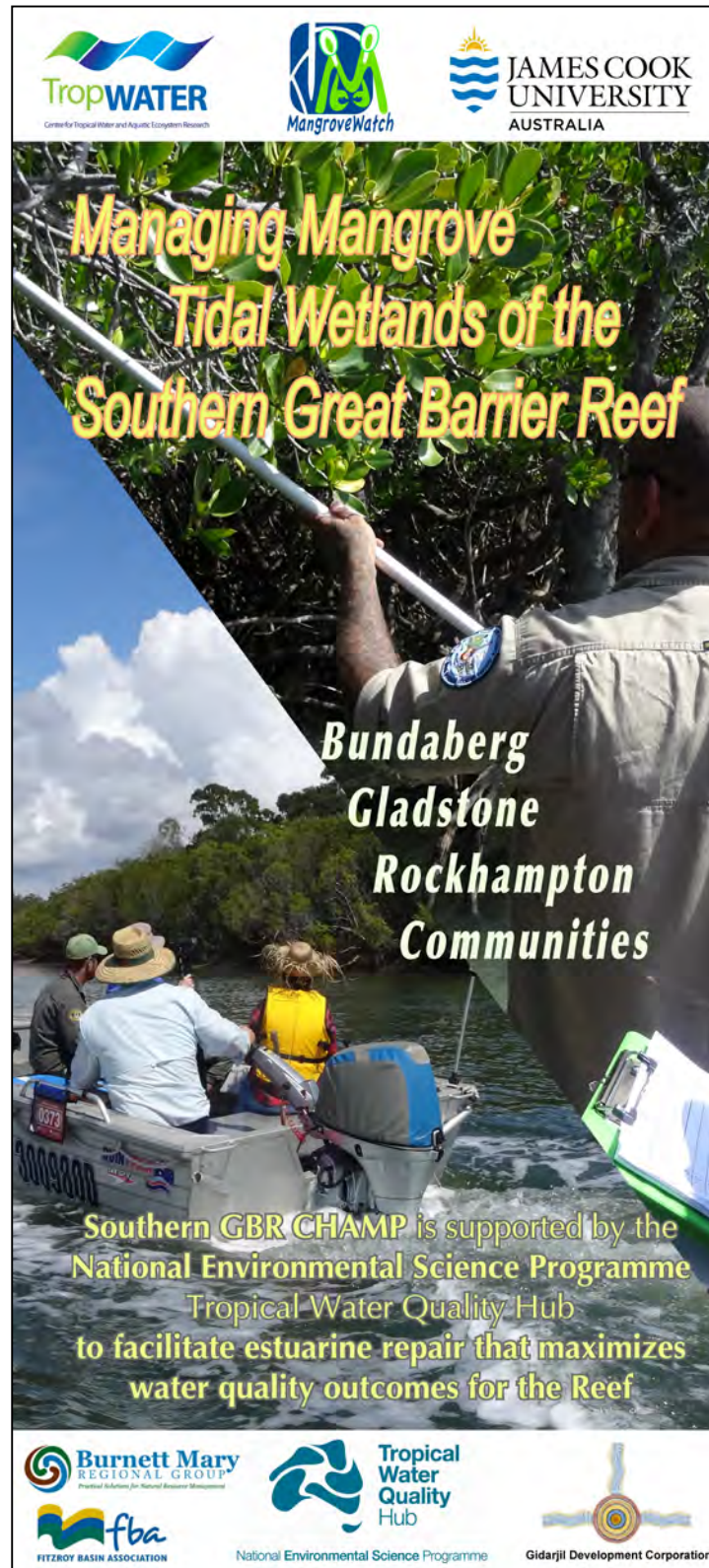
## **ENDS**

Contact:

Dr Norm Duke: [norman.duke@jcu.edu.au](mailto:norman.duke@jcu.edu.au) / 04 1967 3366

## APPENDIX C: DISPLAY BANNER USED AT VARIOUS TALKS ABOUT THE PROJECT

Banner prepared for use with S-GBR CHAMP talks, workshops and training sessions.



## APPENDIX D: AGENDA FOR THE STAKEHOLDER WORKSHOP

For the project launch on 19 April 2016.



**Southern GBR CHAMP** v. 7 April 2016

**A National (NESP) Environmental Research Programme  
Tropical Water Quality Hub Initiative.**  
**Project 2.3.4 Leader: Dr Norm Duke**  
**TropWATER Centre, James Cook University**

**WORKSHOP**  
**Southern GBR Mangrove Management Plan**  
Traditional Owner rangers, managers and local citizens of the Port Curtis Coral Coast (PCCC) TUMRA will be engaged in developing a Mangrove Management Plan (MMP) that provides a strategic basis for estuarine repair activity and maximizes water quality outcomes in the southern GBR.

**Aims**

1. Develop formal networks amongst key endusers
2. Identify and highlight tidal wetland and estuarine values and threats in the Southern GBR
3. Identify current management actions to protect and improve tidal wetland values in the Southern GBR
4. Identify knowledge gaps and management opportunities for monitoring, protecting and enhancing southern GBR tidal wetlands
5. Establish a citizen-science tidal wetland monitoring program led by Gidarjil Rangers to inform future tidal wetland management
6. Develop a Mangrove Management Plan framework for the Southern GBR.

**AGENDA**  
**19<sup>th</sup> April 2016**  
Gidarjil Marine Training Facility  
2 Marine Drive, Burnett Heads.

|      |                                                        |
|------|--------------------------------------------------------|
| 8:30 | Arrive                                                 |
| 9:00 | Welcome to Country – Gidarjil Representative           |
| 9:15 | Workshop MC Intro – Dr Norm Duke, JCU = project leader |
| 9:20 | Introduction to NESP – RRRC / TWQ Hub Representative   |
| 9:30 | Introduction to Southern GBR CHAMP – Dr Norm Duke, JCU |

- 10:00 The current state of knowledge of Southern GBR tidal wetlands – Jock Mackenzie, JCU MangroveWatch
- 10:30 Morning Tea
- 11:00 Current Mangrove Management in the Southern GBR – Short presentations by local and regional tidal wetland managers. Identify tidal wetland values & threats, existing management and tidal wetland projects, knowledge gaps and management opportunities, restoration priorities and resources available to assist in the design and development of a Southern GBR Mangrove Management Plan  
It is planned to have a number of Short Talk Speakers (each 5-10 minute updates, for later discussion)
- Department of Environment – Federal  
 Burnett Mary Regional Group & Fitzroy Basin Authority – Regional NRM  
 GBRMPA – Regional - Great Barrier Reef  
 QDAF, NPSR, EHP – State  
 Bundaberg Regional Council & Gladstone Regional Council – local  
 Gidarjil Rangers – Indigenous Management  
 Port of Bundaberg, QSIA ?? – Industry  
 WetlandCare Australia & Conservation Volunteers - Community
- 12:00 Introduction of other participants – comments from the floor
- 12:30 Lunch
- 13:30 Mangrove Management Plan Discussion – Facilitator: Sue Sargent  
 Addressing identified knowledge gaps to inform southern GBR tidal wetland management  
 Identifying & prioritizing tidal wetland restoration through monitoring  
 Opportunities and constraints for Mangrove Management Plan development and implementation  
 Where to from here!
- 16:30 Workshop Close

## APPENDIX E: PRESENTATION COVER SLIDES USED IN THE AUSTRALIAN MANGROVE AND SALTMARSH NETWORK (AMSN) CONFERENCE TALK.

Held in Darwin during 3-6 May 2016.



The slide features a collage of images: a mangrove forest, people in a boat, a person in a yellow shirt, a small orange plane, and a person with a camera. The TropWATER logo is in the top left, and the text 'Centre for Tropical Water and Aquatic Ecosystem Research' is in the top right.

**TropWATER**  
Centre for Tropical Water and Aquatic Ecosystem Research

**Indigenous ranger management of  
Southern GBR estuarine mangrove wetlands**

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The slide features a collage of logos and text. The top left text reads 'Working Smarter Current Technologies' and 'Science-based, Community Environmental Management'. The top right features the Tropical Water Quality Hub logo and 'National Environmental Science Programme'. The center has a pink box with 'Southern GBR CHAMP'. The bottom left lists logos for Gidarjil Development Corporation, Burnett Mary Regional Group, and FITZROY BASIN ASSOCIATION. The bottom right lists logos for MangrovesWatch, TropWATER, and JAMES COOK UNIVERSITY AUSTRALIA.

Working Smarter  
Current Technologies

**Science-based, Community  
Environmental Management**

**Tropical Water Quality Hub**  
National Environmental Science Programme

**Southern GBR CHAMP**

Gidarjil Development Corporation

Burnett Mary REGIONAL GROUP  
Practical Solutions for Natural Resource Management

FITZROY BASIN ASSOCIATION

MangrovesWatch

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