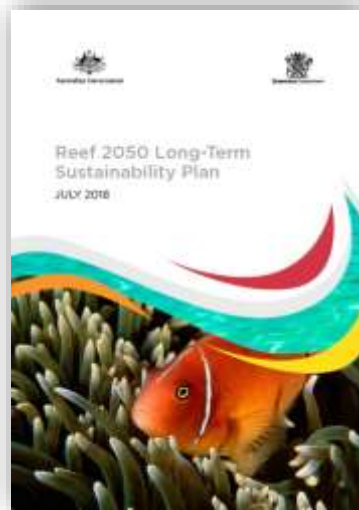


Cheaper by Choice: The hunt for cheaper nitrogen sensors

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The need for water quality data

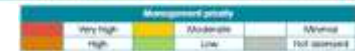
Queensland Government is committed to achieving Great Barrier Reef water quality improvement under the Reef Water Quality Improvement Plan 2017 – 2022



Catchment water quality targets



Region	Catchment/ basin	Area (ha)	Targets								Fertilide target to protect min 99% of aquatic species at end-of-catchment
			Dissolved inorganic nitrogen		Fine sediment		Particulate phosphorus		Particulate nitrogen		
			tonnes	% reduction	tonnes	% reduction	tonnes	% reduction	tonnes	% reduction	
Cape York	Jacky Jacky Creek	296,330	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
	Olive Pascoe River	417,950	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
	Lockhart River	288,330	MCL	MCL	1	2	2	2	5	2	
	Stewart River	274,280	MCL	MCL	2	6	2	6	7	6	
	Normanby River	2,439,490	MCL	MCL	15	10	5	10	15	10	
	Jeannie River	363,750	MCL	MCL	2	6	2	6	9	6	
	Endeavour River	218,240	MCL	MCL	3	10	3	10	11	10	
Wet Tropics	Daintree River	210,670	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
	Mossman River	47,240	52	50	MCL	MCL	MCL	MCL	MCL	MCL	
	Baron River	218,880	52	60	MCL	MCL	MCL	MCL	MCL	MCL	
	Mulgrave-Russell River	194,400	300	70	16	10	19	10	53	10	
	Johnstone River	232,390	350	70	100	40	250	40	490	40	
	Tully River	168,350	190	30	17	20	20	20	68	20	
	Murray River	110,840	120	50	8	20	11	20	32	20	
Burdakin	Herbert River	984,590	626	70	99	30	57	30	200	30	
	Black River	105,970	ND	ND	ND	ND	ND	ND	ND	ND	
	Ross River	170,820	74	50	ND	ND	ND	ND	ND	ND	
	Haughton River	405,080	640	70	MCL	MCL	MCL	MCL	MCL	MCL	
	Burdakin River	10,310,940	100	60	640	30	640	30	720	30	
	Don River	373,620	MCL	MCL	55	30	43	30	75	30	
	Proserpine River	249,440	110	70	MCL	MCL	MCL	MCL	MCL	MCL	
Mackay/ Whitsunday	O'Connell River	238,760	130	70	96	40	120	40	250	40	
	Pioneer River	157,360	140	70	35	20	23	20	61	20	
	Plains Creek	253,870	260	70	MCL	MCL	MCL	MCL	MCL	MCL	
	Styx River	301,340	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
Fitzroy	Shoalwater Creek	360,180	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
	Waterpark Creek	183,650	MCL	MCL	MCL	MCL	MCL	MCL	MCL	MCL	
	Fitzroy River	14,254,470	MCL	MCL	390	30	380	30	640	30	
	Collopye River	224,060	MCL	MCL	15	30	54	30	107	30	
	Boyne River	249,630	MCL	MCL	6	40	5	40	9	40	
Burnett/Mary	Baffle Creek	408,470	16	50	11	20	15	20	33	20	
	Kolan River	290,450	34	50	6	20	5	20	14	20	
	Burnett River	3,319,540	150	70	85	20	29	20	68	20	
	Burnum River	337,170	93	50	3	20	3	20	8	20	
	Mary River	946,580	180	50	130	20	160	20	470	20	



Threat of Nitrogen to the Reef

Excess nitrogen run-off from broad scale land use, particularly sugarcane and horticulture, is attributed with impacting on the reef environment, including:

- Altering the balance between marine algae and corals
- Increasing outbreaks of crown-of-thorns starfish



Need for Nitrogen Monitoring

- Enable growers to measure improvements in water quality from changes in farm management practices
- Inform models used to measure against targets
- Economic value – loss of nitrogen to the environment = fertiliser not being absorbed by the crop



What is the problem?

The current high cost of nitrogen sensors prohibits the broad scale roll out of on farm and sub-catchment monitoring, resulting in limited coverage across the Great Barrier Reef catchments.



What did we do about it?

Advance Queensland Small Business Innovation Research (SBIR) Pilot - releases challenge to the market and provides funds for the development of innovative solutions through a stage procurement process

1. Apply
2. Present
3. Feasibility
4. Proof of Concept
5. Commercialisation



What we were looking for?

Two components to the challenge:

1. Robust, low-maintenance, and low-cost sensor enabling precise, accurate and reliable monitoring of dissolved inorganic nitrogen (**PRIORITY**).
2. One-stop water quality unit, combining monitoring solutions for dissolved inorganic nitrogen, flow and suspended sediment for cost-effective deployment across wide areas of the Great Barrier Reef catchments.

The Wish List

1. Cheap with similar capabilities to current units (e.g. \$2000/unit)
2. Record near real-time data
3. Function without maintenance for a minimum 1 month
4. Robust and low-maintenance, enabling wide-scale deployment in remote GBR catchment locations
5. Data visualisation which is sophisticated and insightful, yet simple for stakeholders to interpret.



Why do we want it?



Expand fine scale near real time monitoring coverage within Reef catchments to enable:

1. More rapid feedback to be provided to growers and other key stakeholders, demonstrating the effects of their management practices on water quality
2. More data to evaluate the impact of government investments.

Feasibility Study

- Two applicants from the Small Business Innovation Research (SBIR) challenge were selected for a 6 month Feasibility Study.
- Both applicants developed and refined their prototype, and conducted laboratory and field trials.
- Submitted final report and presented to SBIR panel on Feasibility outcomes and 'Proof of Concept' proposal.



Proof of Concept

- One applicant selected by the panel for a 12 month Proof of Concept phase
- Proof of Concept to include:
 - Refinement of prototype
 - More extensive monitoring trial
 - Commercialisation and business development.



Proof of Concept Applicant



- AJJA Technologies, Lismore based company
- Specialise in analytical chemistry
- Background in electro-chemical development, including industrial processing, analysis and instrumentation
- No previous experience in Great Barrier Reef monitoring

The Technology

- Ion Selective Field Effect Transistors (ISFET) for field monitoring of Dissolved Inorganic Nitrogen (Nitrate and Ammonia)
- ISFET is a field-effect transistor used for measuring ion concentrations in solution
- When the ion concentration change, the current through the transistor will change accordingly
- ISFET commonly used to measure pH



Proof of Concept trial

- 10 prototypes being trialled at 10 different sites across the Great Barrier Reef catchment – in the Wet Tropics and Mackay-Whitsunday regions
- First sites installed in April 2018
- Near real time data
- Utilising existing monitoring program sites and comparing data with existing technologies
- Testing sensor usability and durability in tropical environments



What's to come

- Wet season durability
- Data comparison with established equipment in high flows
- Cost of final product



Benefits of the process

- Clear message to the market to lower cost of monitoring equipment
- Competition – a number of unsuccessful applicants have continued down this path
- Attract innovators from outside the traditional GBR space



BIG PICTURE: Ultimately it is about bettering our management of this...

