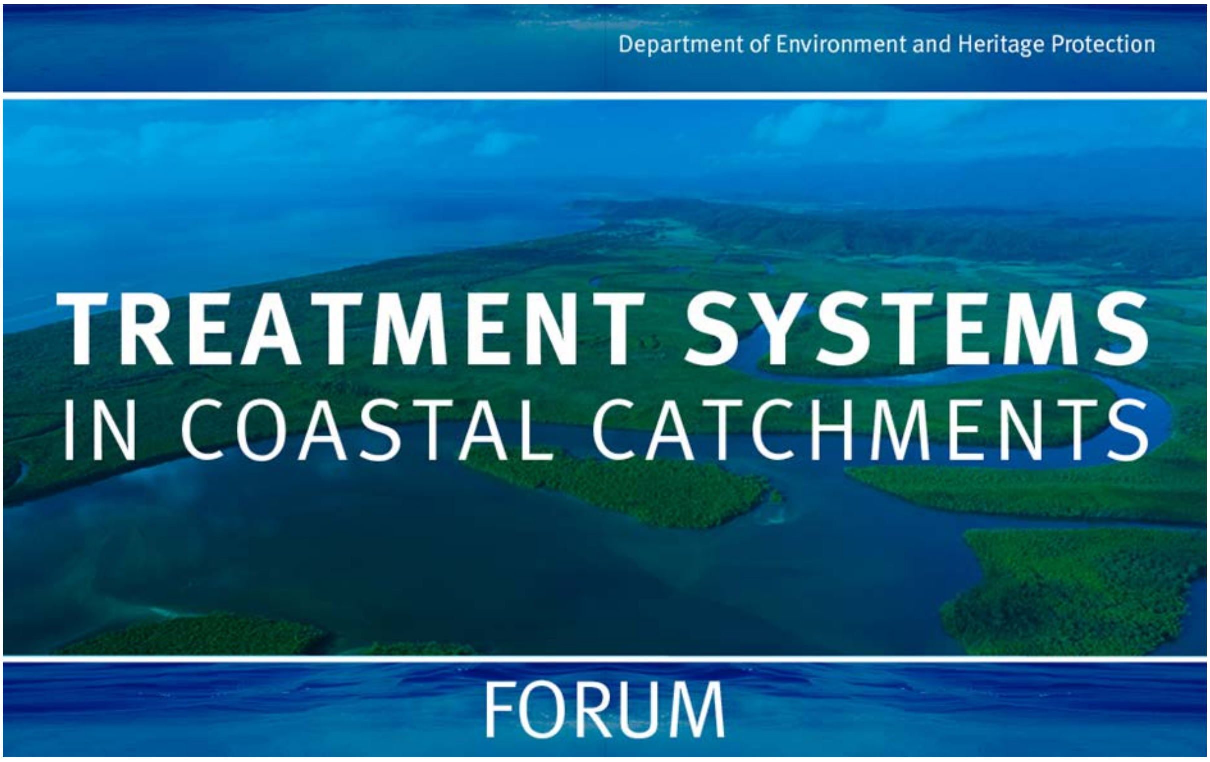

Summary Report

The Forum was an initiative of the Queensland Wetlands Program in collaboration with the Office of the Great Barrier Reef within the Queensland Department of Environment and Heritage Protection. It was held at 400 George Street, Brisbane, 8 July 2016.

This report provides a summary of the speakers' presentations, and the questions and answers raised during the Forum.

Purpose of the forum:

- to share information and options for treatment systems in coastal catchments of Queensland
- to identify how various treatment systems can be used to achieve nutrient and pesticide reductions and improve water quality.

Opening address - Queensland Government

Claire Andersen, Office of the Great Barrier Reef (OGBR), Department of Environment and Heritage Protection (EHP)

- Increasing attention is being given to innovation across government
    - i.e. Advance Queensland
- The Great Barrier Reef - Queensland Water Science Taskforce Report was handed to the Queensland Government in May 2016 http://www.gbr.qld.gov.au/taskforce/final-report/
    - focus around innovative approaches – full adoption of current farm management practices not enough to meet GBR nutrient targets
    - key recommendations, including Reef innovation fund (4 key focus areas):
        - innovation in monitoring
        - systems repair
        - land management
        - water treatment systems.

Session 1: Issues – Overview of monitoring in SEQ and GBR catchments

Ryan Turner, Water Quality Investigations (WQI), Department of Science Information Technology and Innovation (DSITI)

Summary points:

- South East Queensland (SEQ) and Great Barrier Reef (GBR) catchments are degraded and in need of repair. As a consequence of agricultural activities and other sources of nutrients and chemical contaminants, poor water quality is impacting the receiving waters and environments including the Great Barrier Reef and Moreton Bay.

- Aims and targets:
    - SEQ Regional Plan has set aspirational water quality targets that are intended to be met by 2031
    - Reef 2050 Long Term Sustainability Plan – aim is to ensure Outstanding Universal Value (OUV) of the GBR are maintained. https://www.environment.gov.au/marine/gbr/publications/reef-2050-long-term-sustainability-plan
    - Reef Water Quality Protection Plan (Reef Plan) (http://www.reefplan.qld.gov.au) – outlines water quality improvements required to ensure that by 2020 the quality of water entering the reef form broad scale land use has no detrimental impact on the health and resilience of the Great Barrier Reef
    - Reef Plan targets are currently under review. Possibly Reef Plan needs to include targets for uptake of innovative solutions.
    - most pesticides that are currently registered for use in Australia will degrade over time. Water treatment systems that capture and hold or slow down runoff containing pesticides (in impoundments) can provide the necessary retention times that permit degradation processes to occur
    - monitoring and evaluation – if you don't measure, you can't manage.

- General Water Quality (WQ) principles influencing trends in the data:
    - first flush – the majority of the high concentrations (e.g. nutrients) are released in first flush during a rainfall event
    - pesticide dissipation – different pesticides behave in different ways when they enter the environment. Management decisions, such as the timing of pesticide applications (particularly with respect to forecasted rainfall) or the manner in which the pesticide is applied, have implications for the concentrations measured in receiving waters.
    - catchments exporting sediments and nutrients will have exhaustion; i.e. concentrations and loads will deplete/reduce as the wet season continues
    - waterways with continuous flow (e.g. Wet Tropics, Burdekin) behave differently to intermittent systems

- land use affects which pesticides are released into waterways (i.e. nutrients and diuron from cane, tebuthiuron from grazing).

- GBR Dissolved Inorganic Nitrogen (DIN):
  - the Wet Tropics delivers the highest DIN load and yield (t/km^2) to the reef
  - different delivery of pollutants to marine environments in different catchments:
    - Tully: most of total DIN load (~60%) is delivered to the reef under ambient conditions
    - Fitzroy: majority of total DIN load is delivered in events (~10% delivered in ambient conditions) and in particulate form.

- GBR Pesticides:
  - multisubstance potentially affected fraction (msPAF) calculation can be used to represent the summed toxicity of all detected pesticides.
  - maximum detected levels (graph) showed that application timing is critical - dissipation curves show highest concentration closest to application date and concentrations decrease over time. Treatment trains could be useful for reducing impacts.

- SEQ pollutants:
  SEQ case study: Coochin Creek catchment - Back Creek
  - Back Creek (total catchment area ~10km2) has some of the poorest water quality in SEQ. It contributes up to ~73% of DIN load to the Coochin catchment load.
  - Back Creek contributes approximately four to seven times higher total pollutant yields compared to Sandy Creek in the Plane catchment in Mackay Whitsunday.

- Pesticide governance:
  - managing WQ in Australia is primarily governed under National WQ Management Strategy https://www.environment.gov.au/water/quality/national-water-quality-management-strategy
  - what are trigger values? Above = high risk, below = low risk (water quality guidelines are designated for different Environmental Values (e.g. – aquatic ecosystem protection, protection of irrigation waters, protection of human drinking water, etc.)
    - diuron trigger values – recent review has led to changes in product labels that has effectively limited where the or when the herbicide can be used (about half the rate)
    - despite a suspension and phase out period for the use of diuron in the pineapple industry, there has not been a reduction in detection.
- pesticides emerging with higher detection rates and concentrations e.g. Imidacloprid – which have no current Australian WQ guideline, but there are Canadian and Dutch guidelines.
  - very mobile, highly persistent
  - toxic to bees
  - crucial for cane farm grub management
  - trigger value is being developed.

Key questions:

Q: What do you attribute the high nitrate concentrations in SEQ monitoring in Coochin to?
A: Fertiliser use, and application in a leaky system.

Q: What is a 'leaky' system?
A: Refers to pollutant (namely nutrients) leaching through soil profile and lateral movement into streams and groundwater systems (e.g. a farming system that will lose markedly high proportions of applied product).

Q: Chemicals that have effects on the photosystem of organisms – is there concern for their impact on corals?
A: Yes, these chemicals are certainly of concern, but speaker was not able to clairfy. Water quality alone is not thought to be responsible for killing the outer reef, water quality affects resilience to stressors (such as extreme weather or high temperature).

Q: Will the next phase of Paddock to Reef Modelling and Monitoring Program focus on a wider suite of pesticides than the priority five?
A: Yes – the current focus on key PSIIs (pesticides that target the photosystem II in photosynthetic organisms), but there are thirteen to be included (i.e. imazapic, haloxyfop).

Q: Does the monitoring program use passive samplers?
A: Yes but passive samplers don't pick up the high concentrations of pesticides, but there is a passive sampler program. Details can be provided on request.

Q: Chemical affecting bees (imidacloprid) is a significant issue – who monitors the use of these pesticides in SEQ?
A: The State Government (DSITI) monitors detection in the environment, but not chemical use, and not across a broad suite of activities or area in SEQ. A one off wide sweep of monitoring was conducted over one year. Local councils could possibly conduct localised monitoring. Pesticide monitoring is about three-fold the cost of nutrient and sediment monitoring.

Q: Tully imidacloprid use – what actions are being taken?
A: There was anecdotal evidence that some growers could be broadcasting this pesticide over 100% of their fields as kind of 'stress shield' against cane grub protection to help grow healthy cane, but this has since been addressed and the industry is working on improving imidacloprid use and related water quality issues in a proactive manner.

Q: What proportion of the loss story is attributed to natural processes?
A: There is recognition that climatic and geographic factors result in higher losses in some farm regions; e.g. areas in the Mackay Whitsunday region can have high exceedances, and this is thought to be due to lower dilutions of nutrients and pesticides in waterways. Therefore, practice adoption/non-adoption can have very different water quality implications in different regions.

Session 2: Issues – Nutrient Cycle

Dr Phil Moody, Soil Processes, DSITI

Nitrogen (N) source control depends on:

- N cycle in cropping systems – surface applied urea – volatilisation losses to the atmosphere. Soil organic matter breakdown (microbial) ammonium – nitrite – nitrate
- nitrate form – very mobile, susceptible to 'leaking' out of the farm system to wider environment
- need to get as much N into the crop as possible to prevent losses to the environment.

Nutrient cycling in wetlands

- wetlands – a sink or source of N? Need a 'black box' nutrient budget (considering all inputs and outputs). Nutrient processes and transformations govern wetland system outputs
- complex nature of these processes – micro-sites causing different reactions and driving different processes.

Sediment and particulate nutrients

- Sediment impact on the reef depends on quantity, quality and size (fines – less than 10 microns can be carried further out into the reef – probably the matrix supporting 'marine snow').
- The fate of particulate N & phosphorus (P) needs to be looked at, as both become bioavailable at some stage (particulate N becomes DIN and dissolved organic nitrogen (DON), particulate P becomes dissolved reactive phosphorus (DRP) or dissolved organic phosphorus (DOP).
- Particles in low flow conditions may be subject to deposition and re-suspension, but under high flow conditions fine particles can travel straight out to reef.

Key Questions:

Q: How would a wet and dry phase in a wetland act on the cycling processes?
A: If nitrate is accumulated during the drying phase, once the system becomes anaerobic denitrification is possible (note: denitrification occurs under "anoxic" conditions). Wetland during wet season

- saturated to anoxic – possible increase in phosphorus sorption
- nitrate might be lost by denitrification when wetting up after dry season
- need to consider micro-site complexities and different conditions
- similar to rice cropping system.

Q: Does denitrification have an impact on greenhouse gas (GHG) emissions?
A: Yes, and this is certainly a concern/consideration.

- nitrogen use efficiency is the real focus – i.e. getting as much N as possible into the crop to prevent run-off, leaching and atmospheric losses
- denitrification can produce either nitrous oxide (potent GHG) or nitrogen gas (80% of atmosphere – not a GHG)
- acidic environment nitrous oxide reduced to nitrogen gas. Although we don't have a very good understanding of the processes affecting N_2O/N_2 ratio produced through denitrification.

Session 3: Treatment Options

Dr Tom Headley, Water and Carbon Group – Constructed Wetlands

What is a treatment/constructed wetland?

- engineered system to harness natural processes for the purpose of improving WQ involving interactions between water, soil, plants, micro-organisms, and atmosphere
- a range of wetland designs to serve different treatment functions – surface flow, horizontal sub-surface flow, vertical flow, sludge treatment reed beds, ponds, free floating macrophyte systems and floating treatment wetlands.

Design considerations:

- typical system layout includes a sedimentation basin followed by surface flow wetland
- key consideration – climate and flow variability, although systems can be engineered to suit a range of conditions
- in high rainfall areas it isn't realistic to expect treatment of all flow – bypass systems can be built into the design to allow bypass of high flow events.

Pesticide removal – limited data on pesticide transformations

- wetlands generally decrease concentration of pesticides, although removal rates vary depending on design, loading rate and pesticide
- retention time is an important factor
- dense vegetation can increase effectiveness of the process
- removal rate is dependent on chemical basis of the compound.

Nitrogen Removal
Constructed wetlands widely applied internationally for removal of N from agricultural catchments:

- N removal rates range from 200 – 1200 kg N/ha.yr, depending on design, level of engineering investment and loading rates.

How much wetland do we need to meet the Reef Water Quality Protection Plan targets for nitrogen?

- Reef Plan 2013 target = 50% reduction in 2009 baseline anthropogenic DIN loads in priority catchments (Wet Tropics, Burdekin and Mackay Whitsunday)
- based on the 2014 Reef Report Cards, we estimated the remaining N removal required to meet the targets after taking into account reductions to date (e.g. as result of Best Management Practice (BMP) on farms).

- the scenario of using constructed or restored wetlands to remove 30% of the remaining N removal targets was considered, assuming the rest would be achieved through other treatment train approaches and/or BMP.
- assuming a moderate removal rate of 400 kgN/ha.yr, the total area of restored or constructed wetlands required would be 1,188 Ha at an approximate cost of $6million - $60 million.

Is this too ambitious?

- case study: 700ha of wetlands and ponds installed in the desert of Oman to treat 115 ML/day of water from an oilfield (Bauer Resources).

Lessons from international case studies:

- wetland systems have proven successful in N retention in rural catchments
- wetlands provide a range of additional benefits than N retention (other contaminants, habitat, aesthetic values, recreation and tourism)
- to get the best outcome strategic planning and catchment modelling needed to prioritise sites
- greatest success when supported by a robust governance and funding framework
- ad-hoc projects generally much less effective
- bigger wetlands lower in catchment have bigger effect. Cheaper to build one big wetland than lots of smaller wetlands.

Key questions:

Q: Ongoing maintenance costs?
A: Centralised systems are much more cost effective to manage. Smaller systems in decentralised way – different operational situation – farmer's time often not accounted for, systems more prone to fail if maintenance not centrally managed. Farmers in NZ building own on-farm systems (with design stipulations).

Q: International case study (Everglades) – is cane land use prevalent?
A: Much of the lost Everglades area was drained to convert to agriculture since WW2. There's currently about 200,000 ha of sugar cane in the Everglades restoration area, with some of that area being purchased and converted back to wetlands. However, the Everglades restoration project has a somewhat different set of aims and targets to what we are talking about here – more complex than just nutrient removal targets. I.e. restoring the everglades, hydrological management, as well as removal targets. Phosphorus removal is a key focus.

Q: Wetland / stormwater vs bigger end-of-catchment system?
A: Stormwater and smaller wetlands – looking at building constructed wetlands with treatment train approach and more engineered. Further down the catchment look at restoring/ reinstating existing wetland areas / lost areas. Less of a design consideration and more about looking at simple modifications. Might be less efficient than constructed system, but can still achieve a range of goals, and probably more cost effective.

Dr Peter Breen, E2DesignLab – Constructed wetlands for Wet and Dry Tropics

Introduction

- treatment trains are the preferred approach as there isn't one single solution – land, water chemicals, etc.
- more pre-treatment (in treatment train) reduces size of required wetland
- toolkit to modify run-off treatment wetlands:
    - Buffer strips, vegetation swales, etc.

Constructed wetlands:

- densely vegetated waterbodies
- remove pollutants through filtration
- plants and epiphytes (on outside of plants are crucial)
- inlet zone drains to macrophyte zone and bypass zone.

- treatment effectiveness
  - removal rates TSS 80%, TP 60%, TN 50%. Particulate bound contaminants 80%
  - treatment effectiveness is dependent on the ratio of wetland area to catchment area
  - polar chemicals can move through all sorts of systems (including wetlands and biofilters).
- key design questions for the Wet and Dry Tropics:
  - what is the drying period?
  - how deep to make permanent pool to ensure plants survive dry spell?
  - seasonal inundation pattern?
    - drying phase – phosphorus binds more tightly to iron particles/flocs – releasing less P on re-wetting. Important to ensure enough P in system for macrophyte growth
    - permanent pools range from 600-800mm in depth.

Case studies:

- banana farm (Innisfail)
  - one major catchment
  - one smaller run-off zone. Concept – pool in riparian zone
    - sedimentation basin prior to treatment wetland
  - constructed by farmer, but not adequately planted. Needs to be assistance for adequate planting.

Key Questions:

Q: Has wetland carbon storage been considered/studied?
A: Carbon storage ability depends on the design of the system. Research would suggest that wetlands are net carbon sinks, particularly wooded ones. In a wetland that dries out, some carbon will be oxidised – so there are complexities. Melaleuca is good system, but marshland isn't a good system for carbon sequestration. Sequestration is a topic for further research.

Q: Biofuels – are there macrophytes in wetlands that could be harvested?
A: It is possible to harvest, but you would really want to be using systems such as algal treatment – they're much more productive and easier to handle.

Q: Could placement of wetlands in recharge zones be an option? Groundwater discharge could keep the system wetted up during drier periods. Much thought on this?
A: In reef catchments lots of areas of old cane land on floodplains may be suitable. Could be converted to wetlands, and push into disturbed estuarine systems also (ideally).

Dr Mark Bayley, Australian Wetlands Consulting – Landscape scale wetlands/floodplain reconnection

Landscape scale wetlands

- recreating the traditional floodplain function promotes healthy wetland systems.
- recreation of hydrology + recreation of vegetation = floodplain wetland that can reduce pollutants.

Floodplain rehabilitation design

- blocked drains to promote water flow over floodplains
- landscape scale constructed wetlands vs. smaller
- larger treats large catchment areas – reduced cost per m2/ha
- landscape and rehab design:
  - inundation assessment
  - local ecology
  - plant selection
  - availability
  - placement
  - density
  - bathymetry and water balance.

Case study: Babinda swamp wetland
Promoting overland flow across floodplain (converted from unproductive cane land)

- 45ha area (1-2% of contributing catchment - 2500ha catchment)
- aim – reconnecting floodplain and pollutant removal without hindering farm operations
- surrounding landholder willingness
- crocodile issues – site assessment and rehabilitation process
- treatment:
    - 1-3% of flows will pass through wetland
    - 40-50% nitrogen reduction target (monitoring will occur).

Key Questions:

Q: Are grab samples used to assess water quality at the Babinda site? DSITI monitor downstream, it would be good to see net 'take-out'.
A: Not sure. But part of funding requirement is to the monitor success.

Q: Likelihood of weed take-over?
A: Part of site selection was to choose somewhere not prone to weed emergence. Maintenance will also address weed emergence if it does occur. Weed management is an issue in all constructed wetland projects.

Q: Were some neighbouring landholders not in favour of the Babinda rehab work?
A: Neighbouring property owners were hesitant to begin with which was attributed to growers being concerned with how the changes might affect their farming practices. Design ensures that there is capability to prevent water going through reinvigorated system if local concerns were high.

Q: Small capture was reported at Babinda site (1-3% of flow of 1-2% of catchment). This seems to be a small order of magnitude in comparison to other systems discussed?
A: Different systems have different capacities. No stormwater wetland will treat all flows. Size of system dictates capacity / efficacy. Cost benefit needs to be taken into account. Catchment area ratio is also a consideration. Although this system is targeting a small proportion of catchment outputs, it's targeting a high risk area – essentially a cane drain. Most stormwater treatment systems aim to treat the 3 month ARI flow event, not all flows. The Babinda wetland achieves this.

Session 4: Treatment Options continued

Andy Horbuckle, SPEL - Floating wetlands

Floating wetlands

- need permanent volume – can have issues during dry season
- preferred location is out of stream to control flow, but can go in-stream – how might you control that flow in a high rainfall region in the wet season? High flow effect on treatment? – bypass
- to be used as part of a treatment train
- importance of biofilm on plant roots – more biofilm with more root surface area
- SPEL floating mattresses are constructed from approx. 139 x 500mL PET bottles per sqm
- samples for monitoring are taken at the inlet, middle of system and outlet on the Bribie research project by the University of Sunshine Coast
- efficiency – total suspended solids (TSS) reduction 74%, total nitrogen (TN) reduction 40% (mostly nitrate), total phosphorus (TP) reduction 59%
- can walk on the floating system for harvest
- netting for turtles on wastewater projects only, not necessary for stormwater, bird netting for the first 3 months if water hens around
- based on the Bribie Island trial data 2000sqm can remove approx. 732 tonnes TSS/yr, 8.6t N/yr, 1140kg P/yr.

Key Questions:

Q: Are there any environmental effects from putting PET in streams?
A: Lab testing - sensitive fish exposed – no reproductive effects. Sub strata raft not exposed to the water after plant development which takes 6 to 12 months.

Q: System trialled on a cane drain?
A: Not yet – min cost would be $200,000 over 3 years.

Q: Long-term efficacy?
A: Haven't tested for up to a 10 year period in Australia yet but tested in USA for 18 years. Work is being done to assess longer-term efficacy. Maximum performance (highest removal rates) has been noted when plant roots reach 1.5m. No drop in performance has been noted in the data.

Q: Major requirements of systems?
A: Anchor points (or bar across waterway for added stability).

Prof. Louis Schipper, University of Waikato - Denitrifying Bioreactors

Requirements for denitrifying bioreactors:

- source of organic matter – source of carbon
- anaerobic conditions – oxygen limits denitrification process
- relatively warm climate and soil temperature
- nitrate source.

Nitrate removal rates:

- the rate of removal does not increase but the total amount of nitrate that can be removed obviously increases with larger bioreactors
- higher removal rates with higher nitrate load inputs up to a maximum removal rate
- higher removal rates with higher soil/system temperature
- removal rate declines over time with degradation of organic material, however replacement is generally at or longer than every 10 years
- different organic sources have different removal rates, however a high removal rate early on in the life of the system may be indicative of faster degradation of organic sources, needing more frequent replacement.

Two key types of bioreactor in the literature:
Denitrification walls

- sub-surface wall of organic material intercepting groundwater moving to surface water
- low maintenance
- clay lenses (which prevents vertical movement of nitrate water) in sub layers lends site to denitrification wall/s.

Denitrification beds

- shallow subsurface bed of organic material
- useful for treatment of 'piped' flows
- require slightly more maintenance than walls due to propensity for sediment blockage of inlet and outlet structures.

Nitrous oxide

- bioreactors encourage anaerobic conditions and therefore encourage more conversion to nitrogen gas (N_2; rather than N_2O) than a natural system without a bioreactor in place
- P. Grace (QUT): addition of copper or iron to system could further encourage N_2 production (vs N_2O). Work is yet to be done on this.

Variation in inflows

- episodic events or spikes in nitrate run-off can be handled by the system, as the microbial activity is relatively fast-acting (retention over a few days is sufficient).
- Episodic high rainfall (i.e. Wet Tropics) is more difficult to manage and couldn't all be treated, however a bypass system can be included in the bioreactor design so that volumes of water above system capacity can bypass the system without damaging it.

Key Questions:

Q: Can you establish system in streams? Does wood in streams act similarly?
A: Issue with denitrification – requires anaerobic conditions.

Q: Other motivators for growers than N removal? Re-use?
A: No re-use of N as denitrification is the mechanism at play. Perhaps the small land area requirement by bioreactors could mean that it is favoured over other treatment systems. Bioreactors are likely far cheaper in cost than wetlands as a treatment option. Trials are important – failures could spread misconceptions.

Q: Would biochar aid in retaining/binding pesticides?
A: One study in Iowa has shown that atrazine and some other pesticides were sorbed in bioreactors. Water soluble chemicals are probably less likely to be sorbed. Researcher hasn't experimented with biochar.

Q: Supplementation of carbon - Add more soluble or fermented carbon to increase removal?
A: Yes, possibly bagasse – more biodegradable. Current research shows about 10 years before replacement of carbon source such as wood chips but may be less with highly decomposable substrates (such as bagasse). Perhaps could install more than one denitrification wall – i.e. two rows would increase the amount of removal.

Andrew Lawson, MBD - Bioremediation using freshwater algae

Algal treatment

- nitrogen removal by algae in high rate algal ponds (HRAP) ponds
- harvesting – need to have viable product, value and demand for product
- reef catchments – application in fisheries
- cane run-off 2016 demo trial - 900ha trial (Burdekin Bowen Integrated Floodplain
- Management Advisory Committee Inc (BBIFMAC) site – Jones farm) in-built bypass for 1 in 100 year flood rain
- thought to reduce up to 50% N, P and sediment run-off to the GBR.

Key Questions:

Q: Maintenance requirements of high rate algal ponds (HRAP) ponds?
A: Relatively low maintenance – biomass pull-out / basic harvest system

Q: Pesticide impact?
A: Inflow passes through wetland first in cane trial, so this may lessen the impact on algae.
The system allows for flow control, so where pesticide flux is anticipated volume can be reduced. No anticipated issues with large scale of biomass to absorb impact of a pesticide influx.

Q: System caters for a 1 in 10 year event is quite a high event – loss of algae?
A: Checking of volumes of rainfall data – can vary – much bigger area of catchment for 1 in 10 as opposed to 1 in 2 year event.

Q: Is the system flexible to be scaled up to treat high pollutant concentrations? i.e. in response to a high first flush event?
A: Started with WQ targets we wanted to achieve and work backwards in designing the system.

Session 5: Treatment Options continued

Malcolm Eadie, O2UDP – High efficiency sediment (HES) basin

Design and operational principles of the HES basin

- targets very fine colloidal particulate material which can have a tendency to be transported long distance (this was mentioned by Dr Phil Moody).
- dosing influent with coagulant to speed up sedimentation in pond. Floc settles out and water (supernatant) is decanted.
- typically located off-line on paddock, not end-of system
- one hour hydraulic detention time is generally all that is required (with the coagulant)
- only need to take up 2% of contributing catchment (farm) – attractive for cane and banana farm use
- retrofitting on existing recycle pits and sediment ponds is possible
- removal rates using coagulant: TSS – 80-90% TP 70-90% TN 45-65% (particulate fraction)
- sediment detention pond would be compatible with constructed or floating wetland, or other
- capture phosphorus that could be released under anaerobic conditions
- cost – upwards of $10,000. replacement every 5 years
- a farm might have three to four systems controlling all run-off zones
- coagulant typically only applied during wet season, mostly during fallow / bare periods (high risk times for sediment and particulate losses).

Paul Duncanson, NQ Dry Tropics – Irrigation scheme modernisation

Irrigation scheme modernisation - Automated gates to restore wetting and drying cycle

- flow regime (hydrology) – key driver of water quality
- reduce riparian / edge of stream weeds (e.g. typha, para grass) by restoring wetting drying cycle using automated gates on irrigation channels
- suited to other locations
- cost - $100,000– $250,000 per automated gate
- irrigation scheme modernisation – site specific. Uses telemetry and automation.

Key Questions:

Q: Have you considered slashing before the next re-wetting?
A: Not considered, but currently mowing

Q: What happens to the irrigation water when it is stopped upstream?
A: Automated gates stop all flow during downstream drying and the water sits in the channels. Possibly recharging the aquifer? There's a possibly to connect it up to an irrigation tail-water storage (recycle pit) for re-use.

Simon Tannock, AlgaEnviro – Diatomix

Nutrient reduction through diatoms

- nutrient uptake by diatoms and into food chain
- elemental ratios are an important consideration that are often over-looked
- boosting diatom (microalgae) growth with nano-silica and micronutrients
- dosing based on N and P concentrations – can be automated or manual. Drone trials underway for larger waterbodies
- some results in as little as 24 hrs (blue green algae)
- diatoms don't grow well where silica levels are lower than N levels
- pH limitation (doesn't work at below pH of 6)

- Andzac aerator (poster in break-out area) can be used in conjunction with Diatomix dispenser.

Key Questions:

Q: Dosing frequency?
A: Dosing is ongoing – at least twice a week in waste water treatment plant (WWTP) trials.

Q: Stratification issues in dosing?
A: It's possible, but hasn't been an issue yet, but would need to look at mixing stratification was an issue

Susie Chapman, Healthy Waterways and Catchments - Shellfish reefs

Shellfish reefs

- shellfish restoration – young area of work, especially denitrification metrics
- history: Indigenous significance, mining for lime and roadworks
- ecosystem services – water clarity, N removal, coastal protection, marine biodiversity and abundance
- one oyster can filter up to 190 litres / day
- need to consider diversity of shellfish to reduce disease pressure
- six trial projects ongoing around Australia including two in South East Queensland focusing on primary outcome of improving marine biodiversity
- national shellfish restoration network established to share learnings, administered by The Nature Conservancy
- US has established many shellfish reef projects.

Session 6: Panel Q&A

Q: Can you collectively comment on the complimentary nature of systems covered in practice?
A: General consensus was that many of the systems covered will link together to form treatment trains. The most notable mention was the synergies for paddock-scale systems to fit with sub-catchment / catchment scale systems. Treatment options should not be seen as the OK for poor farm management. Best practice should still be pursued in tandem with treatment methods.

Q: Regarding wetland design and advice, are local governments constraining outcomes by providing prescriptive requirements? Do these prevent more innovative solutions from being suggested / implemented?
A: Standards and guidelines can sometimes hinder innovation. Experience working with local government has proven that out of the box ideas can be problematic due to uncertainty of outcomes. Guidelines have not been so much of a problem. Apply care and caution. In agriculture – things aren't clearly defined – few guidelines yet about optimal treatment option design. One thought is that State government has catered for an innovative approach, but local government has struggled to take that on. State government department dealings can be long processes, requiring multiple lines of evidence – proof of restoration (shellfish were there before) fisheries archives, etc. this may limit innovative ideas.

Q: How do we get implementation and action?
A: Technologies covered are well proven. One notable comment is that we need action soon, rather than in 10 years. A triple bottom line is important to illustrate politically and socially as business case. State or Federal government need to play a role. Ideally would be good to see real-time data qualifying and auditing in every project.

Creating a connection between the source and the problem with farmers is important; at least at the level of local streams and rivers, if not the reef. Resistance to adoption / implementation is decreased if there is a local understanding of impacts.

It is important not just to generate an understanding, but to involve and collaborate with farmers. People on the ground who see opportunities should have access to technical assistance for feasibility assessment for the implementation of paddock scale systems.

Incentivising is an option, but there is a need to break-down the disconnection between farmers and funding. Farmers are busy farming and require assistance / support to apply, or at the least simplification of the processes.

Wrap-up and Next steps – Claire Andersen, Office of the Great Barrier Reef, EHP

<u>Take home messages</u>

- recognised importance of keeping this kind of contact ongoing to continue sharing stories and ideas
- a mix of solutions is likely required
- there are complexities, but it's achievable
- different technologies for different circumstances
- make it simple and practical
- encourage innovation in farmers
- working in effective partnerships will dictate the success
- monitoring is critical.

<u>Next steps</u>

- proposed innovation fund – $2million committed; to be matched (ideally) so $4mil expected in total
- capitalise on *Walking the Landscape* outcomes for site prioritisation
- ensure ongoing communication
- carbon consideration?
- effectively directing Reef funding.

This resource should be cited as:

Summary Report of the Treatment Systems in Coastal Catchments Forum 8th July 2016, 2016, Department of Environment and Heritage Protection, Queensland.

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