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Cover Image: Rainfall Simulation on 'The Beacon'

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'The Beacon' Project – Mackay Botanic Gardens Organic Cane Farming Demonstration Site

June 2019

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DISCLAIMER

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Executive Summary

'The Beacon' project is associated with the 'Watershed Land Art' program, situated at the Mackay Regional Botanic Gardens. 'The Beacon' is a 26-metre diameter demonstration plot using regenerative farming practices.

Water quality pollutants of concern in the region are dissolved and organic forms of nitrogen and phosphorus, suspended sediment and the residual herbicides Ametryn, Atrazine, Diuron, Hexazinone, and Tebuthiuron. Rainfall simulation has been used to assess the sugarcane paddock water quality run-off associated with regenerative sugar cane management at 'The Beacon'.

The technical specifics of apparatus design, calibration and operation were undertaken in accordance with Catchment Solutions standard operating procedure, which is based upon relevant industry protocols.

'The Beacon' plot (with regenerative farming practices) demonstrated a marked reduction in nutrient and pesticide loss, when compared to run-off results from trashed blanketed conventional farming systems (post 100 days application). Very low-level residual pesticide run-off results were found at the two plots for Atrazine and Imidacloprid, which may be associated with historical pesticide usage.

Due to the lack of plot replication and an appropriate farmed control site, there is a degree of uncertainty with respect to the findings. Comparisons are limited to the two test plots and rainfall simulation findings may be influenced by historical impacts (e.g. residual pesticides).

1. Introduction

1.1 Background

'The Beacon' project is associated with the 'Watershed Land Art' program and is situated at the Mackay Regional Botanic Gardens. 'The Beacon' is a 26-metre diameter demonstration farm at the Botanic Gardens, showing how diverse plant species can be incorporated into sugarcane production.

The project received funding from two sources: The Great Barrier Reef Marine Park Authority (GBRMPA), through their Reef Guardians program; and the Queensland Regional Arts Development Fund (RADF), through its "Green Arts" program. Funding for the rainfall simulation assessment has been provided by Reef Catchments Limited.

The Beacon, is a small "demonstration farm" – not only trialling and showcasing a range of methods which will help build soil, reduce chemical use, and cut down on the run-off which travels from the land out to the reef, but also testing out how land management can be done in a respectful, inclusive and cross-cultural way (http://www.watershedmackay.land/community-engagement-at-the-beacon/).

Pollutions of concern

Water quality pollutants of concern in the region are dissolved and organic forms of nitrogen and phosphorus, suspended sediment and the residual herbicides Ametryn, Atrazine, Diuron, Hexazinone, and Tebuthiuron. The majority of the nutrient and herbicide pollutants are from agricultural diffuse sources (sugarcane farming followed by grazing). Sugarcane farming is the dominant intensive agricultural land use (18% of land area in the region) and produces about 32% of the regional load of particulate nitrogen, approximately 65% of the regional dissolved inorganic nitrogen load, 40% of the filterable reactive phosphorus load, and 26% of the regional suspended sediment load. Sugarcane farming produces the majority of filterable reactive phosphorus, Ametryn, Atrazine, Diuron, and Hexazinone (MWWQIP 2014).

Rainfall simulation has been used to assess the sugarcane paddock water quality run-off associated with regenerative sugar cane farming practices at 'The Beacon'.

2. Methods

2.1 Experimental Design

The project required assessment of water quality run-off to demonstrate the effects of regenerative sugar cane farming. This rainfall simulation included assessment of run-off water at two locations at the Mackay Botanic Gardens directly adjacent to each other.

Site A the rainfall simulation investigated water quality run-off results from the 'The Beacon'.

Site B was used as a control site for the rainfall simulation on an adjacent grasses area to discount any historical residuals.

2.1.1 Water Quality assessment

The water quality assessment involved the use of rainfall simulation to replicate rainfall events. Water quality analysis included:

- Chemical: Pesticides
- Nutrients: Dissolved and Total Nitrogen and Phosphorous

2.2 Trial Site

An overview of the geographical positioning of the rainfall simulation site is presented in Figure 1.

Figure 1 - Site location – Mackay Botanic Gardens

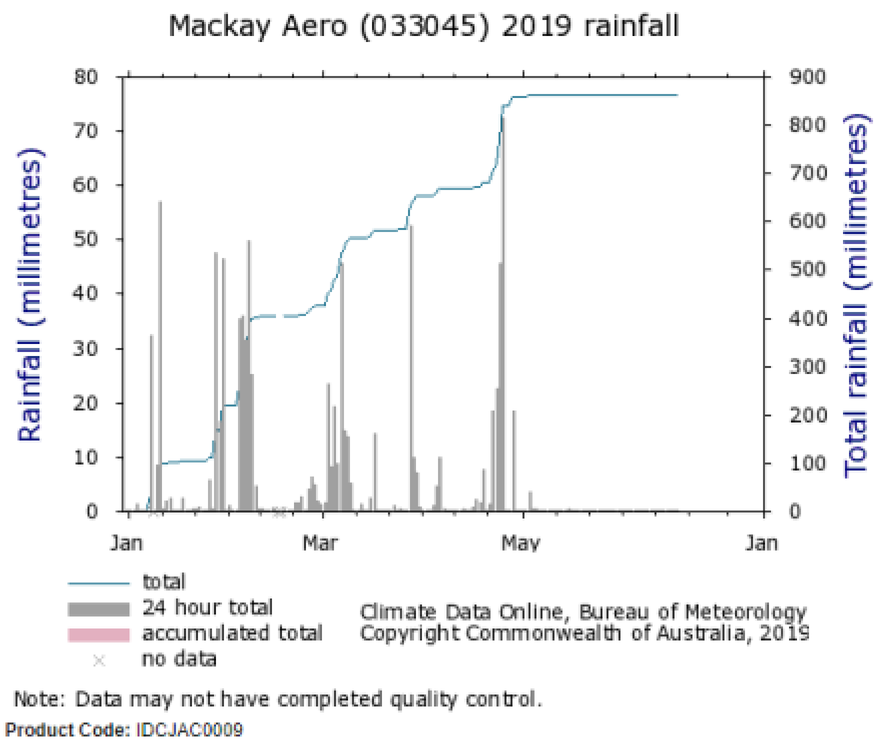
2.4 Survey Timing

The rainfall simulation trial was completed on the morning of the 28th May 2019.

2.5 Environmental Conditions

At the time of sampling environmental conditions were generally good, with clear skies, very light winds and warm weather. Figure 2 shows the rainfall events for the year until June 2019 (BOM 2019).

Figure 2 – Rainfall Data



2.6 Rainfall Simulation Procedures

The setup, calibration and operation of the rainfall simulation device was completed generally in accordance with Catchment Solutions' *Rainfall Simulator Standard Operating Procedures* (Rohde, 2015). A brief summary of key information is presented below.

2.6.1 Description of Apparatus

The portable rainfall simulator used by Catchment Solutions is similar to that described by Loch *et al.* (2001; example presented in Figure 3). The apparatus consists of an a-frame module, 3 m in length. Toward the top of the frame is a nozzle boom with three solid cone nozzles raining across the plot width. Rainfall intensity was controlled by the pump pressure.

The operational sequence of the rainfall simulator relied on a continuous flow of water through the nozzles. Adjusting the pump pressure alters rainfall intensity delivered to the plot surface.

Water is supplied to the simulator from a 240V electric pump and 120 L reservoir. A 1000 L cube is used to supply water to the reservoir. A pressure gauge installed at the top of the module allows for setting a consistent water pressure supplied to the simulator, once the required pressure is obtained (generally >10 PSI). Catch trays can be used to collect water from each nozzle that is not sprayed onto the plot. The trays have provision for slight adjustment up and down to ensure that the sprays overlap the plot sides sufficiently to ensure even coverage, but wasteful, excessive application is prevented. Similarly, lateral adjustment along the module allows control of the spray at the plot ends.

2.6.2 Apparatus Setup and Operation

Simulated rainfall was applied at a rate of approximately 70 mm/hr for about 30 min. Simulated rainfall was applied with drop sizes and energy consistent with natural rainfall in Northern Queensland. The supply water for the rainfall simulator was sourced from local water supply source (Mackay Water town water supply).

Figure 3 - Example Setup and Operation of the Rainfall Simulation Device

2.6.3 Plot Preparation and Setup

Plots were established over the sugarcane “furrow”, with the dimensions of the plot measuring 1700 x 1000 mm. The edge of each plot was bound by 150 mm width metal plates, driven approximately 75 mm into the soil and leaving 75 mm above the soil surface. A separate metal gutter was installed across the downslope edge of the plot in order to direct runoff for collection. A small hole was dug around the gutter outlet pipe, so that samples could be collected with a 1 L measuring flask. Gaps in the plot edging were sealed with sodium bentonite.

2.6.5 Sample Collection

Samples collected during the process were: runoff rate, runoff water quality and source water quality. A brief overview of the sample collection process, and rationale for inclusion in the program, is presented below for each.

Runoff Rate

The discharge rate of water running off each plot was measured four times, the first occurring near the commencement of runoff, the other three spread evenly across the remaining simulation time. Runoff measurement was completed manually by recording the time taken to fill a measured volume. Runoff rate was measured to enable the determination of load calculations of target parameters in runoff water.

Runoff Water Quality

Four water quality samples were collected per plot, the first occurring near the commencement of runoff, the other three spread evenly across the remaining simulation time; the time of water quality sample collection directly corresponds with the time of runoff rate measurement. Samples were transferred into laboratory supplied, labelled plastic containers, and were preserved in an ice filled esky chilled to approximately 4°C. Runoff water quality was measured to generate the primary data-set upon which trial validation was based.

Source Water Quality

One sample of the water source was collected and sent to the laboratory for analysis. The sample collection process was completed exactly as per that outlined above for runoff water quality, with the exception that the sample was taken directly from the 1000 L portable water cube immediately prior to completion of the simulation exercise. Source water quality was measured to ensure the source water did not act as a contaminant.

2.7 Laboratory Testing

The schedule of parameters included in the laboratory testing regime is presented in **Table 1**. Laboratory testing was completed by the NATA accredited ALS laboratory in Brisbane for nutrients, sediments and the pesticide analysis. All analysis was completed within laboratory specified technical holding periods, with the exception of nitrite, which could not be upheld due to logistical issues associated with meeting the very short holding period (48 hours).

Table 1: Laboratory Testing Parameters and Associated Limits of Reporting

Parameter	Abbreviation	Units	LOR
Electrical conductivity	EC	µS/cm	0
pH	pH	pH units	1
Total suspended solids	TSS	mg/L	1
Nutrients			
Ammonia as N	NH3	mg/L	0.01
Nitrite as N	-NO2	mg/L	0.01
Nitrate as N	-NO3	mg/L	0.01
NOX (Nitrate + Nitrite as N)	NOx	mg/L	0.01
Inorganic Nitrogen as N [Dissolved]	DIN	mg/L	0.01
Total Kjeldahl Nitrogen as N	TKN	mg/L	0.1
Total N	TN	mg/L	0.1
Total Phosphorus as P	TP	mg/L	0.01
Reactive Phosphorus as P	FRP	mg/L	0.01
Pesticides (Optional)			
Diuron	-	µg/L	0.01
Ametryn	-	µg/L	0.01
Atrazine	-	µg/L	0.02
Tebuthiuron	-	µg/L	0.02
Hexazinone	-	µg/L	0.02
Other pesticides with ALS pesticide parameters suite (including imidacloprid)	-	µg/L	0.02

2.8 Data Analysis

2.8.1 Load Calculations

For runoff water quality loads, extrapolation was used to estimate concentrations between sampling points. The concentrations measured in the first sample are used for the beginning of the event, and each concentration was used as representative of the preceding minutes from sample time to sample time with the last sample representative of concentration until the end of the run-off period.

Water quality concentrations are then calculated for each minute of runoff, and averaged to calculate an event mean concentration from each simulation plot over the run-off period. For water quality concentrations that were below the limit of reporting (LOR) were excluded from the assessment as not detected. Water quality loads from source water were considered to be 'inputs', and deducted from the calculated concentrations. To summarise the water quality concentrations, an event mean concentration (EMC) can be calculated as per the following equation:

EMC (mg/L) = Sum of Concentration in runoff for each minute during run-off period / run-off period

Load Concentration (mg/min) = EMC (mg/L) x surface run-off (l/min)

2.8.2 Runoff Calculations

Discharge was calculated on a one-minute interval basis, using interpolation between measured points during run-off times. Based upon this, runoff was calculated as per the following equation:

The total runoff from each plot was calculated as the sum of the runoff for each one-minute interval over 60 minutes from the surface area (converted to Kg/ha in one hour).

Kg/Ha/hour = (Load Conc./1000,000)/(Surface area/10,000) x run-off minutes in one hour.

Essentially the results are compared on the data obtained for a simulated rainfall event for a one-hour rainfall event at 70mm/hour.

2.9 Limitations of Experimental Design

2.9.1 Treatment Comparison

The experimental design employed by this investigation is limited to the comparison of treatments between two different trial plots. Despite this limitation, analysis and interpretation of the relative success of treatments has been completed. Care must be taken when considering the validity of such inter-site comparisons; the results are intended to be broadly indicative only.

2.9.3 Source Water Correction

In order to accurately measure the levels of nutrient in runoff water, it is necessary to calculate the load of these parameters being contributed from source water and 'correct' (deduct from) the results. To perform these corrections, source water quality samples were collected and sent to the laboratory with runoff samples. For this investigation, one source water quality sample was collected for the rainfall simulation event, with a single source water location used for the rainfall simulation trial-site.

3. Results and Discussion

3.1 Runoff Amount and Rate

A summary of key runoff statistics is presented in Table 2, a treatment comparison of time to runoff, runoff amount, and peak runoff rate for the different times and treatments is outlined.

Time to runoff ranged from eight (8) to twenty (20) mins between the two treatments, with the control site running off quicker.

Based on the data, there was a substantial recordable different between the time to runoff for 'The Beacon' in comparison to the grassed control site.

Averaged runoff amount varied with 'The Beacon' plot running-off at a very slow run-off rate, from 8.49 mm/hour compared to 31.2 mm/hour for the grassed and mowed control site (Table 2). 'The Beacon' results demonstrated a high rate of water penetration and slower run-off rate.

Table 2 - Summary of Key Runoff Result Statistics at 70mm/hr rainfall application

Treatment	Time to Runoff (mins)	Rainfall Duration (mins)	Rainfall applied (mm)	Runoff Amount (l/min)	Runoff Rate (mm/hr)	Peak Runoff Rate (mm/hr)
Control – mowed grass area	8	31	36.17	0.464	31.20	32.60
The Beacon Demonstration Plot	20	38	44.33	0.240	8.49	9.90

3.2 Runoff Water Quality

A summary of runoff water quality results for run-off loads and EMC are presented Tables 3, 4 and 5.

There was little difference in pH between the mowed grassed control area and 'The Beacon' site, with the pH event mean at 7.59 on the grass and 7.51 at the Beacon site, which was slightly lower than the source water (pH - 7.78). The conductivity was generally the same concentration at both sites (ranging between 193 to 209 µS/cm), with the source water at 199 µS/cm. Run-off loads from 'The Beacon' plot have been compared against an adjacent mowed and grassed area to discount any residual soil factors within the area. A general comparison was also made against the nutrient and pesticide rainfall run-off simulation results at 100 days post application undertaken as part of the Department of Agriculture and Fisheries' Stool Zippa trials for run-off reduction (Hughes and Gonzales 2018).

Table 3 - Nutrients – Nitrogen of Runoff Water Quality Load and Event Mean Concentration

Treatment	Runoff Rate (mm/hr)	Total Nitrogen		Total Kjeldahl Nitrogen		Organic Nitrogen	
		Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)
Control – moved grass area	31.20	0.117	0.825	0.117	0.825	0.111	0.784
The Beacon Demonstration Plot	8.49	0.259	4.584	0.255	4.516	0.250	4.429

Notes: * Values corrected for inputs from source water quality

Table 4 –Nutrients –Runoff Water Quality Load and Event Mean Concentration

Treatment	Runoff Rate (mm/hr)	Ammonia		Nitrites / Nitrates		Dissolved Inorganic Nitrogen	
		Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)
Control – moved grass area	31.20	0.006	0.041	ND	ND	0.006	0.041
The Beacon Demonstration Plot	8.49	0.005	0.087	0.002	0.035	0.007	0.122

Notes: * Values corrected for inputs from source water quality. ND – Not detected (below LOR).

Table 5 – Sediment and Nutrients – Sediment and Phosphorous Runoff Water Quality Load and Event Mean Concentration

Treatment	Runoff Rate (mm/hr)	Total Phosphorus		Reactive Phosphorus		Suspended Solids	
		Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)	Load (kg/ha)	EMC (mg/L)
Control – moved grass area	31.20	0.049	0.347	0.043	0.305	3.361	23.708
The Beacon Demonstration Plot	8.49	0.064	1.142	0.001	0.015	23.472	420.71

Notes: * Values corrected for inputs from source water quality.

3.2.1 Nitrogen Loss

The Total Nitrogen (TN) estimated mean concentration (EMC) within the run-off from 'The Beacon' plot was substantially higher than the mowed grassed area, with mean TN concentration of 4.584 mg/l compared to 0.825 mg/l for the control site (Table 3). As the rate of run-off was much lower in 'The Beacon' plot, the total run-off load of Total Nitrogen (TN) were more compared but still higher in 'The Beacon' plot, with mean TN loads of 0.259 kg/ha compared to 0.117 kg/ha for the control site (Table 3). This nitrogen load in 'The Beacon' plot in comparison to the control plot may be associated with the uncompacted soil and the trash blanket at this location undergoing effective plant decomposition at the soil interface. The results for the TN run-off load at 'The Beacon' are at least 50% lower than that recorded from other rainfall simulation trials undertaken on trash blanketed paddocks within the Mackay area (Hughes and Gonzalez 2018), with between 2.9 to 4.9 kg/ha recorded (post 100 days urea application), compared to 0.259 kg/ha (at 'The Beacon').

Total Kjeldahl Nitrogen (TKN) demonstrated a similar pattern for both mean concentrations and run-off loads to the Total Nitrogen results, with TKN concentration (EMC) within the run-off higher in 'The Beacon' plot, with mean TKN concentration of 4.516 mg/l compared to 0.825 mg/l for the control site. With run-off loads from TKN loads of 0.255 kg/ha compared to 0.117 kg/ha for the control site (Table 3).

The Ammonia concentration (EMC) within the run-off load was limited in concentration but again higher in 'The Beacon' plot in comparison to the grassed control area, with mean ammonia concentration of 0.087 mg/l compared to 0.041 mg/l for the control site (Table 4). Ammonia loads demonstrated overall much lower loads as a subset of Total Nitrogen loads with 'The Beacon' ammonia loads being similar to the control (due to lower run-off rates) with 0.005 kg/ha compared to 0.006 kg/ha for the control site (Table 4). As ammonia concentrations and loads were generally low across the two treatments ranging from 0.005 – 0.0.006 kg/ha, the total nitrogen run-off loads appear to be predominately Organic Nitrogen.

With Organic Nitrogen (Organic N), measured as TKN minus the Ammonia, the results demonstrated a similar pattern for both mean concentrations and run-off loads to the Total Nitrogen results, with Organic N concentration (EMC) within the run-off higher in 'The Beacon' plot, with mean Organic N concentration of 4.429 mg/l compared to 0.784 mg/l for the control site. With run-off loads from Organic N loads of 0.250 kg/ha compared to 0.111 kg/ha for the control site (Table 3).

The Dissolved Inorganic Nitrogen (DIN) concentrations within the run-off were different. 'The Beacon' plot, had a mean DIN concentration of 0.122 mg/l compared to 0.041 mg/l for the control site (Table 4). "The Beacon' plot results for Dissolved Inorganic Nitrogen (ammonia and nitrogen oxides - DIN) runoff loads did not vary between the control and 'The Beacon'. DIN runoff loads were 0.006 kg/ha for the control, compared to 0.007 kg/ha for 'The Beacon' plot. The results for the DIN run-off load at 'The Beacon' are lower than that recorded from other rainfall simulation trials undertaken on trash blanketed paddocks within the Mackay area (Hughes and Gonzalez 2018), with between 2.25 to 2.85 kg/ha (post 100 days application). compared to 0.007 kg/ha for 'The Beacon'.

3.2.2 Phosphorus Loss

The Total Phosphorous concentration (EMC) within the run-off were higher in the 'The Beacon plot, with mean Total Phosphorous concentration of 1.142 mg/l compared to 0.347 mg/l for the control site (Table 5). Due to the different run-off rates, levels of Total Phosphorous (TP) run-off loads varied slightly between the two plots, with mean Total Phosphorous loads of 0.064 kg/ha in 'The Beacon' plot compared to 0.049 kg/ha for the control site (Table 5). Total Phosphorus concentrations did not demonstrate a substantial difference in runoff concentration loads between the two plots (Table 5). The results for the TP run-off load at 'The Beacon' are lower than that recorded from other rainfall simulation trials undertaken on trash blanket paddocks within the Mackay area (Hughes and Gonzalez 2018), with about 0.14 to 0.26 kg/ha (post 100 days application) usually recorded compared to 0.064 kg/ha (at 'The Beacon').

The Filterable Reactive Phosphorous (Orthophosphate - FRP) concentration within the run-off were high in control plot, with mean FRP concentration of 0.305 mg/l compared to 0.015 mg/l at 'The Beacon' (Table 5). Due to the different run-off rates, 'The Beacon' plot results for FRP runoff were again substantially lower than the control. With mean Filterable Reactive Phosphorous loads (FRP) loads of 0.001 kg/ha in 'The Beacon' plot compared to 0.043 kg/ha for the control site (Table 5). As FRP concentrations were low at 'The Beacon' (0.001 kg/ha), the phosphorous run-off loads appear to be predominately organic in origin rather than related to inorganic fertiliser usage. While the control site, the Total Phosphate load appears to be predominantly influenced by the FRP, which potentially represents the historical application of fertiliser on the grassed control site.

3.2.3 Sediment Loss

The Total Suspended Solids (TSS) mean concentration within the run-off were substantially different in 'The Beacon' plot, with mean TSS concentration of 420.71 mg/l compared to 23.7 mg/l for the control site (Table 5). Levels of Total Suspended Solids (TSS) run-off loss varied across the two treatment plots, with mean Suspended Solids (Sediment) loads higher at "The Beacon' plot due to soil disturbance, with TSS loads of 23 .47 kg/ha compared to 3.36 kg/ha for the control site (Table 5). The grassed area was an undisturbed control site, which would not have any soil disturbance. In comparison to other rainfall simulation projects (Hughes and Gonzalez 2018), trash blanked paddocks generally have higher loads than that recorded at 'The Beacon' plot, with previous rainfall simulation trials recording between 35 to 489 kg/ha sediment run-off loads (post 100 days disturbance).

3.2.4 Pesticides

Only Diuron, Atrazine and Imidacloprid were detected above the level of laboratory reporting limit. No pesticides were detected in the town water sample used as the source water, so pesticide results were not required to be off-set for pesticides. All detected pesticides were well below the Australian Drinking Water Guidelines. Overall pesticide run-off levels for Diuron, Atrazine and Imidacloprid were very low, with Diuron not detected on 'The Beacon' plot. Run-off concentrations for the both plots were well below the water quality improvement targets as outlined in the Mackay Whitsunday Water Quality Improvement Plan.

There was a slight difference in the loss of pesticides from the control in comparison to "The Beacon' for Atrazine, Diuron, and Imidacloprid. 'The Beacon' plot had a slightly higher residual run-off level of Atrazine (5 g/ha compared 1 g/ha for the grassed control), whereas the run-off residual for Imidacloprid was the same as the control plot (2 g/ha) (see Table 6). The grassed control plot had a Diuron run-off of 17 g/ha. These results are generally lower in comparison to other rainfall simulation projects, where trash blanked paddocks generally have slightly higher loads pesticide run-off loads than that recorded at 'The Beacon' plot, with previous rainfall simulation trials (Hughes and Gonzalez 2018) recording between 5 to 30 g/ha of residual pesticide parameter run-off (post 100 days pesticide application).

The low-level residual pesticides found would be influenced by factors not associated with 'The Beacon' regenerative practices and may be the result of historical pesticide usage on the two plots. Over time, the remaining pesticide residuals should decline further under regenerative cane farming practices.

Table 6 - Pesticides- Summary of Runoff Water Quality Load and Event Mean Concentration

Treatment	Runoff Amount (mm)	Diuron		Atrazine		Imidacloprid	
		Load (g/ha)	EMC (µg/L)	Load (g/ha)	EMC (µg/L)	Load (g/ha)	EMC (µg/L)
Control – moved grass area	31.20	17	0.012	1	0.001	2	0.002
The Beacon Demonstration Plot	8.49	ND	ND	5	0.008	2	0.003

Notes: * Values corrected for inputs from source water quality, if required. ND – Not detected (below LOR).

4. Conclusion

'The Beacon' plot (with regenerative farming practices) demonstrated a marked reduction in nutrient and pesticide loss, when compared to trashed blanked sites (post 100 days application). Residual pesticide run-off results found at the two plots ('The Beacon' and control) which may be associated with historical pesticide usage. 'The Beacon' plot appeared to have an improved soil health demonstrated by the un-compacted nature of the soil and the increased rainfall absorption. Due the lack of plot replication and appreciate farmed control site, there is a degree of uncertainty with respect to the findings. Comparisons are limited to the two test plots and rainfall simulation finding may be influenced by historical impacts (e.g. residual pesticides).

6. References

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Water Quality Improvement Plan 2014-2021 Mackay Whitsunday Water Quality Improvement Plan. http://reefcatchments.com.au/water/wqip/

Appendix A: Laboratory Results

Matrix:	WATER		Sample Type:	REG	REG	REG	REG	EMC	Load – mg /min	kg/ha/hr	REG	REG	REG	REG	EMC	Load – mg /min	kg/ha/hr
Workgroup:	EB1913566		ALS Sample Number:	EB1913566002	EB1913566003	EB1913566004	EB1913566005				EB1913566006	EB1913566007	EB1913566008	EB1913566009			
Project name/number:	Rainfall Sim - The Beacons		Sample Date:	28/05/2019	28/05/2019	28/05/2019	28/05/2019				28/05/2019	28/05/2019	28/05/2019	28/05/2019			
			Client sample ID (1st):	Grass A1	Grass B1	Grass C1	Grass D1				Cane A1	Cane B1	Cane C1	Cane D1			
			mmencement (minutes)	9	17	24	29				20	25	30	35			
			Collection Time (Sec)	70	70	68	65	67.96			172	150	150	160	155.37		
			Collection Volume (ml)	500	400	700	500	525			500	700	600	600	621.05		
			Run-off Rate (mm/hr)	30.3	30.3	31.1	32.6	31.20			6.2	9.9	8.5	7.9	8.49		
			Surface Run-off (l/min)	0.014	0.014	0.015	0.015	0.464			0.003	0.005	0.004	0.004	0.240		
			Run-off time from Rain					8							20		
Analyte grouping/Analyte	**CAS Number**	**Unit**	**Limit of reporting**														
EA005P: pH by PC Titrator																	
pH Value		pH Unit	0.01	7.46	7.56	7.62	7.64	7.59			7.81	7.30	7.67	7.50	7.51		
EA010P: Conductivity by PC Titrator																	
Electrical Conductivity @ 25°C		µS/cm	1	10	1	0	0	1.17			2	0	2	0	0.63		
EA025: Total Suspended Solids dried at 104 ± 2°C																	
Suspended Solids (SS)		mg/L	5	162	14	5	14	23.708	10.989	3.361	158		276	544	420.71	100.90	23.742
EK055G: Ammonia as N by Discrete Analyser																	
Ammonia as N	7664-41-7	mg/L	0.01	0.09	0.04	0.04	0.03	0.041	0.019	0.006	0.08	0.11	0.11	0.06	0.087	0.021	0.005
EK057G: Nitrite as N by Discrete Analyser																	
Nitrite as N	14797-65-0	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01	<0.01		
EK058G: Nitrate as N by Discrete Analyser																	
Nitrate as N	14797-55-8	mg/L	0.01	0	0	0	0	<0.01			0	0.07	0	0.04	0.035	0.008	0.002
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser																	
Nitrite + Nitrate as N		mg/L	0.01	0	0	0	0	<0.01			0	0.07	0	0.04	0.035	0.008	0.002
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser																	
Total Kjeldahl Nitrogen as N		mg/L	0.1	1.4	0.9	0.7	0.7	0.825	0.382	0.117	2.4	6.9	4.5	3.3	4.516	1.083	0.255
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser																	
Total Nitrogen as N		mg/L	0.1	1.4	0.9	0.7	0.7	0.825	0.382	0.117	2.4	7.0	4.5	3.4	4.584	1.099	0.259
EK067G: Total Phosphorus as P by Discrete Analyser																	
Total Phosphorus as P		mg/L	0.01	0.48	0.37	0.34	0.29	0.347	0.161	0.049	0.57	1.87	1.22	0.71	1.142	0.274	0.064
EK071G: Reactive Phosphorus as P by discrete analyser																	
Reactive Phosphorus as P	14265-44-2	mg/L	0.01	0.38	0.33	0.29	0.27	0.305	0.141	0.043	0.01	0.02	0.02	0.01	0.015	0.004	0.001
EP234A: Pesticides																	
Diuron	330-54-1	µg/L	0.02	0.14	0	0	0	0.012	0.005	0.0017	0	0	0	0	<0.02	#VALUE!	
Atrazine	1912-24-9	µg/L	0.01	0.01	0	0	0	0.001	0.000	0.0001	0.03	0.01	0	0.01	0.008	0.002	0.0005
Imidacloprid		µg/L	0.01	0.02	0	0	0	0.002	0.001	0.0002	0.01	0.01	0	0	0.003	0.001	0.0002

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