



Northern
Territory
Government

WASTE DISCHARGE LICENCE

(Pursuant to section 74 of the *Water Act*)

Licence Details

Licence Number: **WDL147-08**

Registered Business
Address: Level 2, Mitchell Centre
55 – 59 Mitchell Street
Darwin NT 0800

ABN: 15 947 352 360

Premises Address: 141 Fitzmaurice Drive LEANYER NT 0812
Lot 06204 and Lot 03388, Location Code 055

Anniversary Date: 14 April

Commencement Date: 15 April 2017

Amendment Date:

Expiry Date: 14 April 2022

Licensed Activity

The discharge of wastewater from the Leanyer Sanderson Waste Stabilisation Ponds (WSPs) to Buffalo Creek subject to the Licence Conditions.

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INFORMATION ABOUT THIS LICENCE

Duration of Licence

- This Licence will remain in force until its expiry date, it is surrendered by the Licensee, or until it is suspended or revoked by the Controller of Water Resources.
- The Licensee must notify the Northern Territory Environment Protection Authority (Adminstrating Agency) within 14 days after ceasing to conduct the activity.
- The Licensee may surrender the Licence to the Adminstrating Agency.

Amendment, Modification or Revocation of Licence (section 93 of the *Water Act*)

- As set out in section 93 of the Water Act, the Controller of Water Resources may, by notice:
 - amend or modify the terms and conditions of a Licence;
 - revoke a Licence; or
 - suspend a Licence.

Public Register

- A copy of waste discharge Licences and any plans for environmental management, reports, submissions or documents required as a condition of a waste discharge Licence, will be placed on a register.
- A copy of the Annual Return and Monitoring Report will be placed on the register.
- The Adminstrating Agency makes this register freely available from the Adminstrating Agency website.

Environmental Interests

- This section highlights the beneficial uses as declared under the *Water Act* and the sensitivity of the surrounding land use and environment associated with the location of the approved activity.
 - Declared beneficial uses and or water quality objectives are:
Declaration of Beneficial Uses and Objectives, Darwin Harbour Region, Northern Territory Government Gazette No. G27, 7 July 2010.
 - Sites of Conservation Significance
 - Ramsar Wetland

Cultural Interests

- It is the Licensee's responsibility to contact the Aboriginal Areas Protection Authority, appropriate land council or other governing body and ensure that any Authority Certificates required as a result of conducting the Licenced activity are obtained and complied with.

RULES FOR INTERPRETING THE CONDITIONS OF THIS LICENCE

- Where there is a discrepancy between the conditions of this Licence and any plan, standard, guideline or other document referred to in this Licence, the conditions of this Licence prevail to the extent of the inconsistency.

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- Any reference to any standard (Australian or international) in this Licence means the relevant parts of the current version of that standard.
- A reference to any guideline or code of practice (or to the relevant parts of any guideline or code of practice) in this Licence means the current version of the guideline or code of practice.
- Under section 76 of the *Water Act*, any contravention of or failure to comply with this Licence by the Licensee may be an offence.
- In this Licence, unless the contrary intention appears, words that are defined in the *Water Act* are intended to have the meaning given to them in that Act.

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LICENCE CONDITIONS

GENERAL

1. The Licensee must ensure the contact details recorded with the Administrating Agency for this Licence are correct at all times.
2. The Licensee must at all times have a 24 hour emergency contact.
3. The Licensee must notify the Administrating Agency prior to making any operational change that will cause, or is likely to cause, an increase in the potential for environmental harm.
4. The Licensee must cause clear and legible signage, in English, to be displayed in a prominent location at each public entrance to the premises that includes the following details; within 6 months of the commencement date of this licence:
 - 4.1. waste discharge licence issued under the *Water Act*; and
 - 4.2. 24 hour emergency contact details.
5. The Licensee must cause a copy of this Licence to be available for inspection by any person, in hard copy form, at the registered business address.
6. The Licensee must provide to the Administrating Agency, within 10 business days of a request, a copy of any document, monitoring data or other information in relation to the activity, in the format requested by the Administrating Agency.
7. All notices, reports, documents or other correspondence required to be provided as a condition of this Licence, unless otherwise specified as a condition of this Licence, must be provided in electronic form by emailing waste@nt.gov.au.
8. The Licensee must, for the duration of this Licence, implement, maintain and follow a Consultation and Communication Plan which includes a strategy for communicating with persons who are likely to have a real interest in, or be affected by, the activity.
9. The Licensee must submit to the Administering Agency a Communications Action Plan for WDL147-08 within 2 months from commencement date of this Licence
10. The Licensee must operate and maintain a community feedback number.
11. The Licensee must display the community feedback number:
 - 11.1. where the Licensee has a website, in a prominent location on the Licensees website;
 - 11.2. in the Consultation and Communication Plan; and
 - 11.3. in other publicly available documents relating to the activity.
12. The Licensee must maintain a Complaint Log for all complaints received by the Licensee in relation to the activity.
13. The Licensee must ensure that the Complaint Log includes, for each complaint received by the Licensee, the following information:
 - 13.1. the date and time of the complaint;
 - 13.2. the contact details of the complainant if known;
 - 13.3. the nature of the complaint and events giving rise to the complaint;
 - 13.4. prevailing weather conditions at the time of the complaint;
 - 13.5. the action taken in relation to the complaint;

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- 13.6. any conclusions the Licensee made regarding the cause of the complaint; and
- 13.7. any preventative measure put in place to prevent reoccurrence.
14. The Licensee must implement, maintain and follow an Emergency Response Plan that addresses procedures for responding to emergencies associated with the activity that may cause environmental harm.

EARLY SURRENDER OF LICENCE

15. Any reports, records or other information required or able to be provided by the Licensee under this Licence must be submitted to the Administrating Agency prior to the Licensee surrendering the Licence. If the date on which a report, record or other information is required falls after the date the Licensee requests to surrender this Licensee, the Licensee must provide the report, record or information as far as possible using data available to the Licensee up to and including the date the request to surrender the Licence is made.

OPERATIONAL

16. The Licensee must, without limiting any other condition of this Licence in conducting the Activity do all things reasonable and practicable to ensure the Activity does not adversely affect the Declared Beneficial Uses and Objectives as declared from time to time, including those applying to:
- The Darwin Harbour Region.

DISCHARGES

17. This Licence authorises discharge to water from the authorised discharge point(s) as identified in Table 1 and Appendix 3, and as otherwise allowed in accordance with the conditions of this Licence.

Table 1		
Authorised Discharge Point	Description	Location
Buffalo Creek Outfall SLEEOP	End of pipe for combined outlets from Leanyer Maturation Pond 5 and Sanderson Maturation Pond 5 to Buffalo Creek.	Longitude: 130.91060 Latitude: -12.35890

18. The Licensee must ensure that all discharges from the Authorised Discharge Point in Table 1 must not:
- 18.1. contain any visible matter, floating oil and grease or petroleum hydrocarbon sheen or scum, or litter or other objectionable matter;
 - 18.2. cause or generate odours which would adversely affect the use of surrounding waters;
 - 18.3. cause visible change in the behaviour of fish or other aquatic organisms;
 - 18.4. cause mortality of fish or other aquatic organisms; or
 - 18.5. cause adverse impacts on plants.

MONITORING

19. The licensee must conduct surface water and discharge water monitoring in accordance

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with Appendix 1.

20. The licensee must conduct sediment monitoring in accordance with Appendix 2.
21. The Licensee must for all terrestrial sampling points required by this Licence:
 - 21.1. install, maintain and provide appropriate identification signage so that they are easily identifiable at all times; and
 - 21.2. maintain safe access and egress, as is reasonably practicable.
22. The licensee must ensure that all samples and field environmental data are representative of the conditions at the time of sampling.
23. The licensee must ensure that all samples and field environmental data are collected in accordance with recognised Australian Standards and guidelines (such as AS/NZS 5667, ANZECC/ARMCANZ).
24. The licensee must ensure that all monitoring samples are analysed at a laboratory with current NATA accreditation or equivalent, for the parameters to be measured.
25. The Licensee must ensure that, for each sample collected in accordance with the activity the following information must be recorded and retained:
 - 25.1. the date(s) on which the sample was collected;
 - 25.2. the time(s) at which the sample was collected;
 - 25.3. the point(s) at which the sample was collected;
 - 25.4. the name of the person who collected the sample;
 - 25.5. the chain of custody forms relating to the sample(s);
 - 25.6. any field measurements and analytical results relating to the sample; and
 - 25.7. laboratory quality assurance and quality control documentation (where laboratory analysis is required).

RECORDING AND REPORTING

26. The Licensee must keep records of all non-compliances with this licence. These records must be adequate to enable the licensee to comply with the non-compliance notification conditions of this licence.
27. The Licensee must notify the Administrating Agency of any non-compliance with this licence by emailing waste@nt.gov.au, as soon as practicable after (and in any case within 5 Business days after) first becoming aware of the non-compliance.
28. The Licensee must include in the notification of non-compliance the following information:
 - 28.1. when the non-compliance was detected and by whom;
 - 28.2. the date and time of the non-compliance;
 - 28.3. the actual and potential causes and contributing factors to the non-compliance;
 - 28.4. the risk of environmental harm arising from the non-compliance;
 - 28.5. the action(s) that have or will be undertaken to mitigate any environmental harm arising from the non-compliance;
 - 28.6. corrective actions that have or will be undertaken to ensure the non-compliance does not reoccur
 - 28.7. if no action was taken, why no action was taken; and

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- 28.8. If further investigation is necessary, the date the Licensee will submit an investigation report to the Administrating Agency.
29. The Licensee must comply with the requirements of section 14 of the *Waste Management and Pollution Control Act*.
30. The Licensee must as soon as practicable and in any case within 5 Business days notify the Administering Agency of any exceedances of the surface water reporting limits specified in Appendix 4.
31. The Licensee must provide to the Administering Agency an assessment of water quality in a Periodic Report. The Periodic Reports must:
- 31.1. assess water quality in accordance with Appendix 5 for that seasonal reporting period;
 - 31.2. include a tabulation of data and trend analysis for the indicators in Appendix 5 for both surface water and discharge monitoring locations; and
 - 31.3. be submitted in accordance with the following schedule:

Seasonal Reporting Period	Report Submission at end of:
October to April (Wet season)	June
May to September (Dry season)	November

32. The Licensee must provide to the Administering Agency a Monitoring Report:
- 32.1. within 10 Business Days prior to the 1 September 2019; and
 - 32.2. 30 Business Days prior to the expiry date of this Licence.
33. The Licensee must ensure that each Monitoring Report:
- 33.1. is prepared in accordance with the requirements of the NT EPA 'Guideline for Reporting on Environmental Monitoring';
 - 33.2. includes a tabulation of all monitoring data required as a condition of this licence;
 - 33.3. includes long term trend analysis of monitoring data to demonstrate any environmental impact associated with the activity over a minimum period of six years (where the data is available); and
 - 33.4. reports on progress relating to the Leanyer Sanderson WDL 147 Improvement Plan 2017 dated March 2017 and the Darwin Region Sewerage Strategy.
34. The Administrating Agency may require the Licensee to revise or amend and resubmit any Monitoring Report. Where the Administrating Agency requires the Monitoring Report to be resubmitted, the Licensee must submit it to the Administrating Agency by the date specified by the Administrating Agency.
35. The Licensee must submit an updated Environmental Risk Assessment for the activity:
- 35.1. within 10 Business Days prior to the 1 September 2019; and
 - 35.2. 30 Business Days prior to the expiry date of this Licence.
36. The Licensee must submit a completed Annual Return within 10 business days prior to each anniversary date of this licence and within 30 Business days prior to the Licence expiry date.

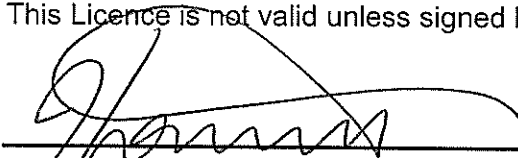
PERFORMANCE IMPROVEMENT

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37. The Licensee must progress the actions identified in the Leanyer Sanderson WDL 147 Improvement Plan 2017 dated March 2017.
38. Within 1 year from the commencement date of this Licence, the Licensee must develop and implement a plan to conduct further investigations to characterise the risks to human health relating to algal toxins in aquatic fauna harvested from Buffalo Creek for human consumption.

END OF LICENCE CONDITIONS

This Licence is not valid unless signed below:



Jo Townsend

Controller of Water Resources

Dated the 13 April 2017

END NOTES

This Licence supersedes WDL 147-07 which was issued 15 April 2015

WDL 147-06 was issued on 15 January 2015

WDL 147-05 was issued on 2 August 2013.

WDL 147-04 was issued on 22 March 2013.

WDL 147-03 was issued on 15 January 2013.

WDL 147-02 was issued on 11 May 2012.

WDL 147-01 was issued on 15 January 2011.

WDL 147 was issued on 13 October 2006.

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DEFINITIONS

In this licence, unless a contrary intention appears:

Term	Definition
24 hour emergency contact	the phone number of a person who can be contacted at any time and be capable of responding to and providing information about any incident associated with the activity.
Activity	the Licenced activity as described on the covering page of this licence.
Annual Return	A prescribed format for demonstrating and reporting compliance with the conditions of this licence.
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000: National Water Quality Management Strategy: <i>Australian Guidelines for Water Quality Monitoring and Reporting</i> .
Business days	a day not Saturday, Sunday or a public holiday, in the Northern Territory.
Community feedback number	a telephone number enabling members of the public to contact, at any time, a person or voice mail system that can accept, on behalf of the licensee, enquiries or complaints about the activity, and to which the licensee must respond.
Complaint Log	a register of complaints to be maintained by the Licensee that records the details of each complaint received in relation to the activity.
Consultation and Communication Plan	a written plan documenting proposed consultation and communications for the activity before, during and after the activity which includes a strategy for communicating with members of the public who are likely to have a real interest in, or be affected by, the activity.
Contact details	includes the 24 hour emergency contact, and name, position title and phone number of a representative of the licensee who can be contacted about the licence and activity.
Discharges	allow a liquid, gas or other substance to flow out from where it has been confined.
Emergency Response Plan	a written plan documenting the licensee's procedures for responding to emergencies caused by, resulting from or associated with the activity and that may cause environmental harm.
Environmental harm	any harm to or adverse effect on, or potential harm to or potential adverse effect on, the environment
incident	includes: (a) an accident, emergency or malfunction; and (b) a deliberate action, whether or not that action was taken by the person conducting the activity in the course of which the incident occurred.
Maintain	kept in a manner that it does not present or cause a risk of environmental harm or a hazard to persons or property or, for the purposes of documents including plans, a process of reviewing and amending documentation to ensure it is relevant.
NATA	National Association of Testing Authorities, Australia.
Non-compliance	failure or refusal to comply, whether by act or omission, with obligations or requirements and includes any exceedance of a licence limit.
Non-compliance notification	a prescribed format for notifying the Administrating Agency of a non-compliance.
Plant and equipment	all material items used in association with the activity, including (but not

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Term	Definition
	limited to) storage vessels and containers, pipe work and hosing, vehicles (including vessels), tools, and measuring equipment.
Pollute	in relation to water, means directly or indirectly to alter the physical, thermal, chemical, biological or radioactive properties of the water so as to render it less fit for a prescribed beneficial use for which it is or may reasonably be used, or to cause a condition which is hazardous or potentially hazardous to: (a) public health, safety or welfare; (b) animals, birds, fish or aquatic life or other organisms; or (c) plants.
Premises	the premises identified in this licence which includes equipment, plant and structures, whether stationary or portable, and the land on which premises are situated.
Public entrance	access to the premises that is utilised by the public.
Qualified sampler	a person who has training and experience in obtaining samples from the relevant environmental medium.
Waste	Includes matter or a thing, whether wholly or partly in a solid, liquid or gaseous state, which, if added to water, may pollute the water.
Wastewater	water that contains a contaminant or waste.
Water	means water, whether or not it contains impurities.
WMPC Act	the Northern Territory <i>Waste Management and Pollution Control Act</i> .

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Appendix 1: Surface Water and Discharge-Monitoring Plan

		Sampling Locations^a					
	Classification	Discharge	Upper zone		Transition zone	Outer zone	
	Site Code	SLEBCDP (SLe100)	SLEBC01	SLEBC03	SLEBC06	SLEBC08	SLESB02
	Latitude	-12.36033	-12.35148	-12.35246	-12.33833	-12.34260	-12.33546
	Longitude	130.90943	130.91045	130.90735	130.90816	130.92511	130.93008
Indicator		Monitoring Frequencies					
Physico-chemical							
Flow		D	NR	NR	NR	NR	NR
pH		F	M				
Electrical conductivity							
Dissolved oxygen							
Temperature							
Turbidity							
Total suspended solids		M					
Biological							
Biochemical oxygen demand		M					
Chlorophyll-a							
Nutrients							
Ammonia (total as N)		M					
Total nitrogen							
Oxidised nitrogen (NO _x as N)							
Total phosphorous							
Filterable reactive phosphorous							
Metals							
Copper (filtered)		M					
Zinc (filtered)							
Pathogen indicators							
<i>Escherichia coli</i>		F	M				
Enterococci							
Phytoplankton							
Total phytoplankton identification and enumeration		M					
Biovolume (cyanobacteria)		M					

a As identified in Appendix 3 (Location Map)

Where: NR = Not required; D = daily (if flow monitoring equipment is impaired data may be based on reasonable estimates for the period that the data is affected); F = fortnightly, M = monthly

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Appendix 2: Sediment Monitoring Plan

Indicators	Matrix		Assessment Protocol	Classification												
	Sediment	Pore waters		Site Code	Test Estuary – Buffalo Creek ^a			Reference – Mickett Creek ^a			Reference – Kings Creek ^a					
Interpretive				Latitude	SLEBC03	SLEBC04	SLEBC05	SLEBC06	SLEBC08	SLEMC01	SLEMC02	SLEMC03	SLEKC01	SLEKC02	SLEKC03	
				Longitude	-12.35148	-12.35246	-12.34738	-12.33833	-12.34260	-12.36251	-12.35688	-12.34661	-12.38004	-12.37464	-12.36144	
					130.91045	130.90735	130.90974	130.90816	130.92511	130.93801	130.94587	130.94912	131.00216	131.01808	131.01868	
Monitoring Frequency																
Total organic carbon	✓		x	C:N ratios	Dry season											
Aluminium	✓		x	AI normalisation of total sediment metals	Dry season											
pH	x		✓	pH adjustment of ANZECC and ARMICANZ SMD TV	Dry season											
Biological					Dry season											
Chlorophyll-a	✓		x	1. Compare to 2 x 80 th percentile of reference data; 2. Determine photosynthetic activity using ratios to pheophytin-a	Dry season											
Nutrients					Dry season											
Total nitrogen	✓		✓	1. Compare to 2 x 80 th percentile of reference data	Dry season											
Ammonia (Total as N)	x		✓	1. Compare to pH adjusted ANZECC and ARMICANZ SMD TV ^b 2. Compare to 2 x 80 th percentile of reference data	Dry season											
Total phosphorous	✓		✓	1. Compare to 2 x 80 th percentile of reference site data	Dry season											
Filterable reactive phosphorous	x		✓	1. Compare to 2 x 80 th percentile of reference site data	Dry season											
Metals					Dry season											
Copper	✓ T,B		✓ F	1. Compare to ANZECC and ARMICANZ ISQG Low ^c in sediment and SMD TV ^d in porewater	Dry season											
Zinc	✓ T,B		✓ F	2. Compare to 2 x 80 th percentile of reference data in sediment and porewaters 3. Compare AI normalised data in sediment to 2 x 80 th percentile of reference data in that season and assess for significant differences	Dry season											

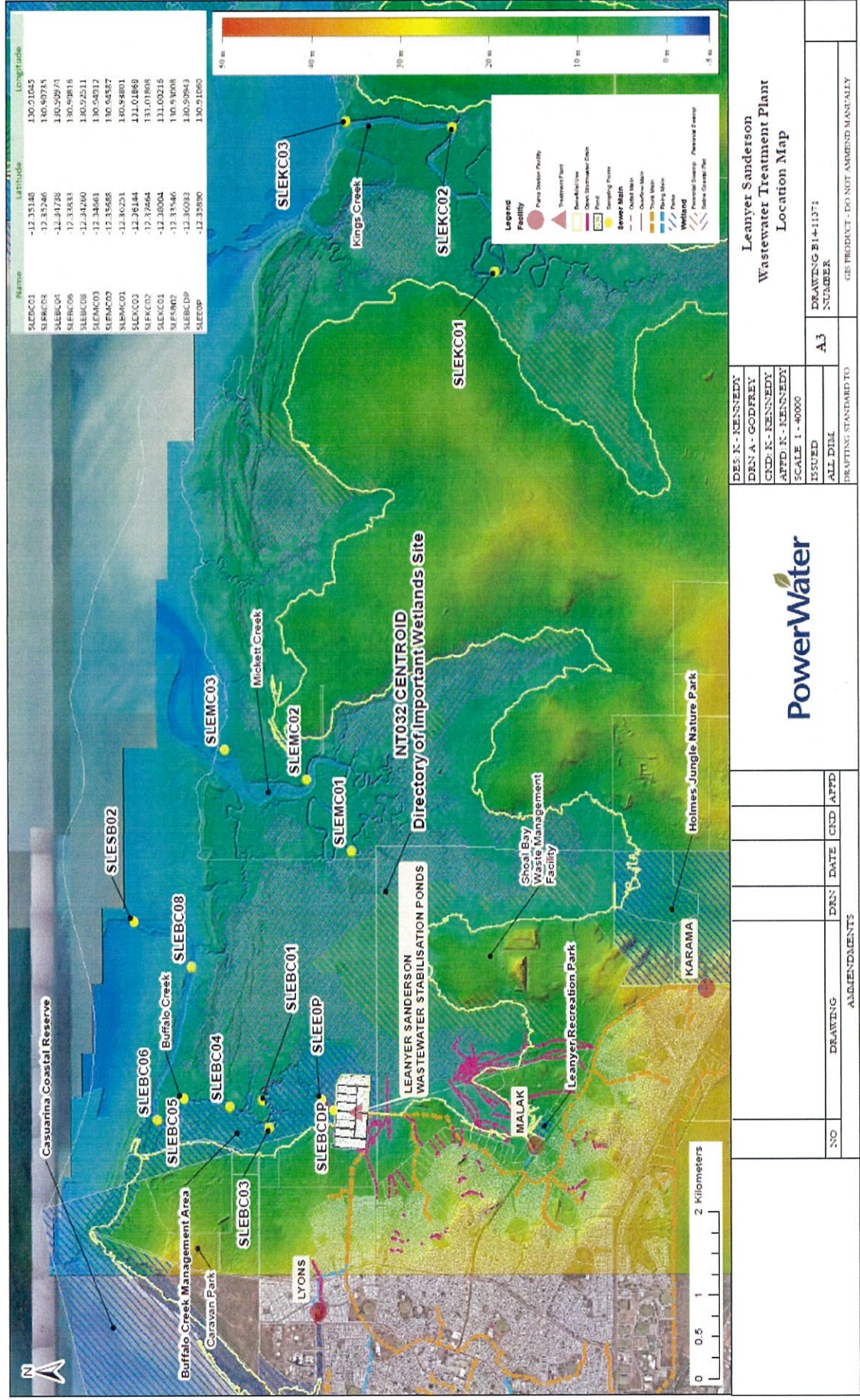
a As Identified in Appendix 3 (Location Map)

b Table 8.3.7 Volume 2; c Table 3.5.1 Volume 1; d Table 3.4.1 Volume 1

Where – T = Total; B = bioavailable estimated by dilute 1 M HCL extraction; F = filtered; ANZECC and ARMICANZ = Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMICANZ 2000); SMD = slightly to moderately disturbed; ISQG = interim sediment quality guidelines; TV = trigger value

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Appendix 3: Location Map for Sampling Sites and Authorised Discharge Point



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Appendix 4: Surface Water Reporting Limits

Sampling Locations^a				
Classification	Upper zone	Transition zone	Outer zone	
Site Code	SLEBC03	SLEBC06	SLEBC08	SLESB02
Latitude	-12.35246	-12.33833	-12.34260	-12.33546
Longitude	130.90735	130.90816	130.92511	130.93008

Indicator	Unit	Reporting Limits			
pH	pH Units	<6 and > 8.5			
Dissolved oxygen	% Saturation	<30 %	<50	<75	<75
Enterococci	Enterococci/ 100 mL	-	>200	>50 DRY and >200 WET	
Ammonia (total as N)	µg/L	-	>1700 ^b	>910 ^c	>20
Copper (filtered)	µg/L	-	>3 ^d	>1.3 ^c	>1.3 ^c

a As identified in Appendix 3 (Location Map)

b 80 % Level of Protection, Table 3.4.1 ANZECC and ARMCANZ (2000)

c 95 % Level of Protection, Table 3.4.1 ANZECC and ARMCANZ (2000)

d 90 % Level of Protection, Table 3.4.1 ANZECC and ARMCANZ (2000)

Where, DRY = reporting limit for data collected in the dry season between May and September and WET = reporting limit for data collected in the wet season between October and April

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Appendix 5: Assessment of Water Quality – Protocol for Periodic Reporting

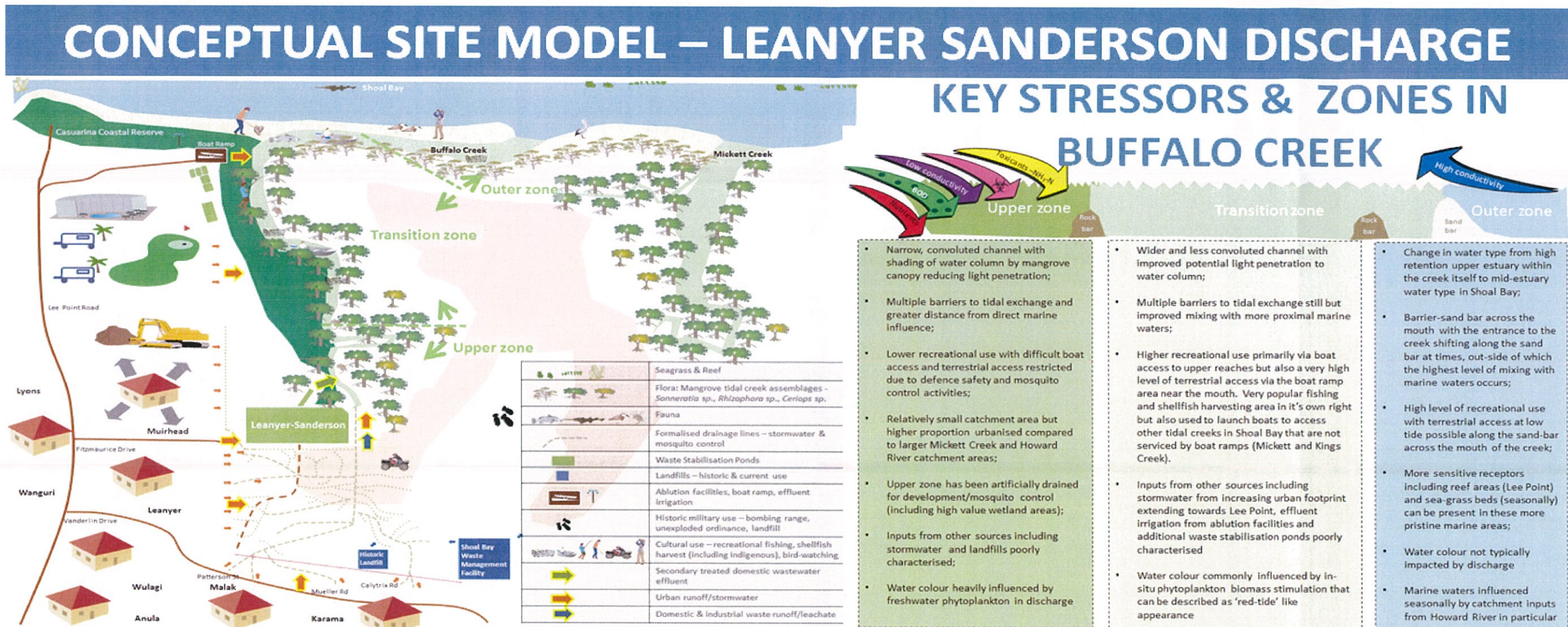
		Sampling Locations ^a					
Classification		Upper zone		Transition zone	Outer zone		
Site Code		SLEBC01	SLEBC03	SLEBC06	SLEBC08	SLESB02	
Latitude		-12.35148	-12.35246	-12.33833	-12.34260	-12.33546	
Longitude		130.91045	130.90735	130.90816	130.92511	130.93008	
Indicator	Unit	Assessment Criteria					Assessment Statistic
Dissolved oxygen	% saturation	<75 and > 100 ^b					median
Total suspended solids	mg/L	10 ^b			6 ^b		median
Chlorophyll-a*	µg/L	4 ^b			2 ^b		median
Ammonia (Total as N)	µg/L	20 ^b					median
		2490 ^c		1100 ^c			95 th percentile
Total nitrogen	µg/L	300 ^b			270 ^b		median
Oxidised nitrogen (NO _x as N)	µg/L	20 ^b			17 ^b		median
Total phosphorous	µg/L	30 ^b			20 ^b		median
Filterable reactive phosphorous	µg/L	9 ^b			5 ^b		median
Copper (filtered)	µg/L	1.3 ^d					95 th percentile
Zinc (filtered)	µg/L	15 ^d					95 th percentile
Enterococci	Enterococci/100 mL	50 ^b					maximum
		A, B,C,D ^e					Long term 95 th percentile (Hazen Method)

- a As identified in Appendix 3 (Location Map)
- b Water Quality Objectives for the Darwin Harbour Region – Background Document (Department of Natural Resources, Environment, The Arts and Sport, 2010)
- c Table 8.3.7 Volume 2 of ANZECC and ARMCANZ (2000) - pH adjusted SMD Trigger Value based on long-term average pH for sites in these zones
- d Table 3.4.1 ANZECC and ARMCANZ (2000) – SMD Trigger Value
- e Determine the Microbial Water Quality Assessment Category for the assessment statistic (A, B,C,D), Table 5.7 in order to apply these categories within Table 5.17 Classification Matrix for Faecal Pollution of Recreational Water Environments of the Guidelines for Managing Risks in Recreational Waters (National Health and Medical Research Council 2008)

Where, 'Long term' means all monitoring data collected to date pooled. Hazen based assessments require more data points to be reasonably accurate in terms of the true 95th percentile (i.e. N > 21)

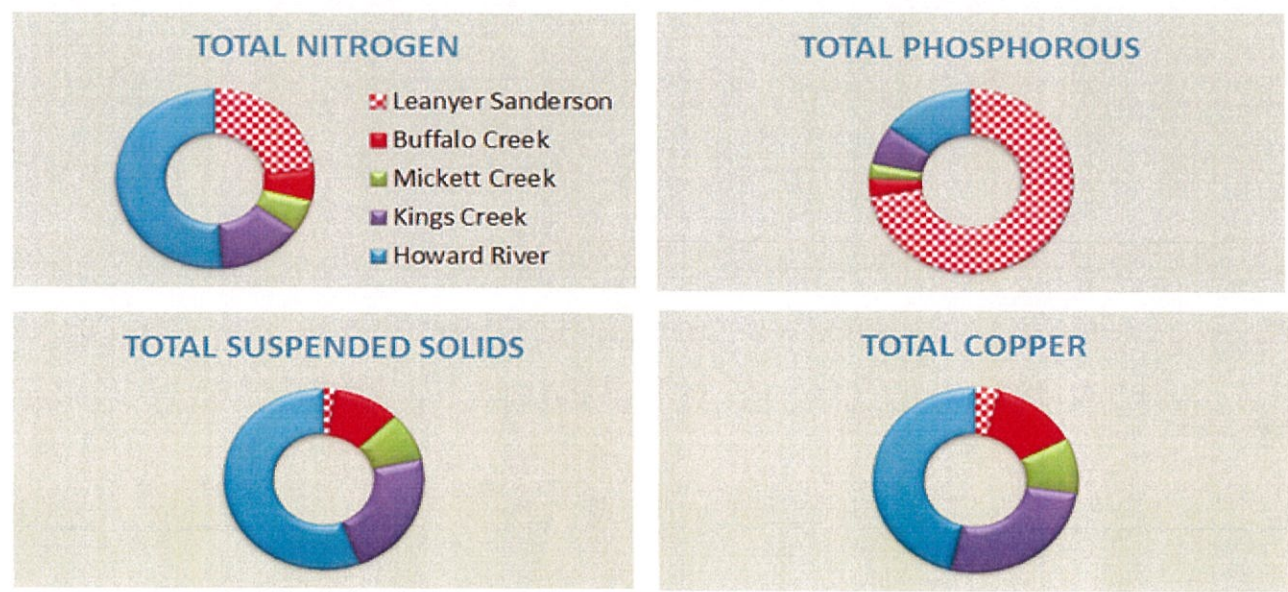
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Appendix 6: Leanyer Sanderson Wastewater Treatment Plant Site Layout Map





- Upper zone:**
 - Narrow, convoluted channel with shading of water column by mangrove canopy reducing light penetration;
 - Multiple barriers to tidal exchange and greater distance from direct marine influence;
 - Lower recreational use with difficult boat access and terrestrial access restricted due to defence safety and mosquito control activities;
 - Relatively small catchment area but higher proportion urbanised compared to larger Mickett Creek and Howard River catchment areas;
 - Upper zone has been artificially drained for development/mosquito control (including high value wetland areas);
 - Inputs from other sources including stormwater and landfills poorly characterised;
 - Water colour heavily influenced by freshwater phytoplankton in discharge
- Transition zone:**
 - Wider and less convoluted channel with improved potential light penetration to water column;
 - Multiple barriers to tidal exchange still but improved mixing with more proximal marine waters;
 - Higher recreational use primarily via boat access to upper reaches but also a very high level of terrestrial access via the boat ramp area near the mouth. Very popular fishing and shellfish harvesting area in it's own right but also used to launch boats to access other tidal creeks in Shoal Bay that are not serviced by boat ramps (Mickett and Kings Creek).
 - Inputs from other sources including stormwater from increasing urban footprint extending towards Lee Point, effluent irrigation from ablution facilities and additional waste stabilisation ponds poorly characterised
 - Water colour commonly influenced by in-situ phytoplankton biomass stimulation that can be described as 'red-tide' like appearance
- Outer zone:**
 - Change in water type from high retention upper estuary within the creek itself to mid-estuary water type in Shoal Bay;
 - Barrier-sand bar across the mouth with the entrance to the creek shifting along the sand bar at times, out-side of which the highest level of mixing with marine waters occurs;
 - High level of recreational use with terrestrial access at low tide possible along the sand-bar across the mouth of the creek;
 - More sensitive receptors including reef areas (Lee Point) and sea-grass beds (seasonally) can be present in these more pristine marine areas;
 - Water colour not typically impacted by discharge
 - Marine waters influenced seasonally by catchment inputs from Howard River in particular

DISCHARGE VS. CATCHMENT LOADS

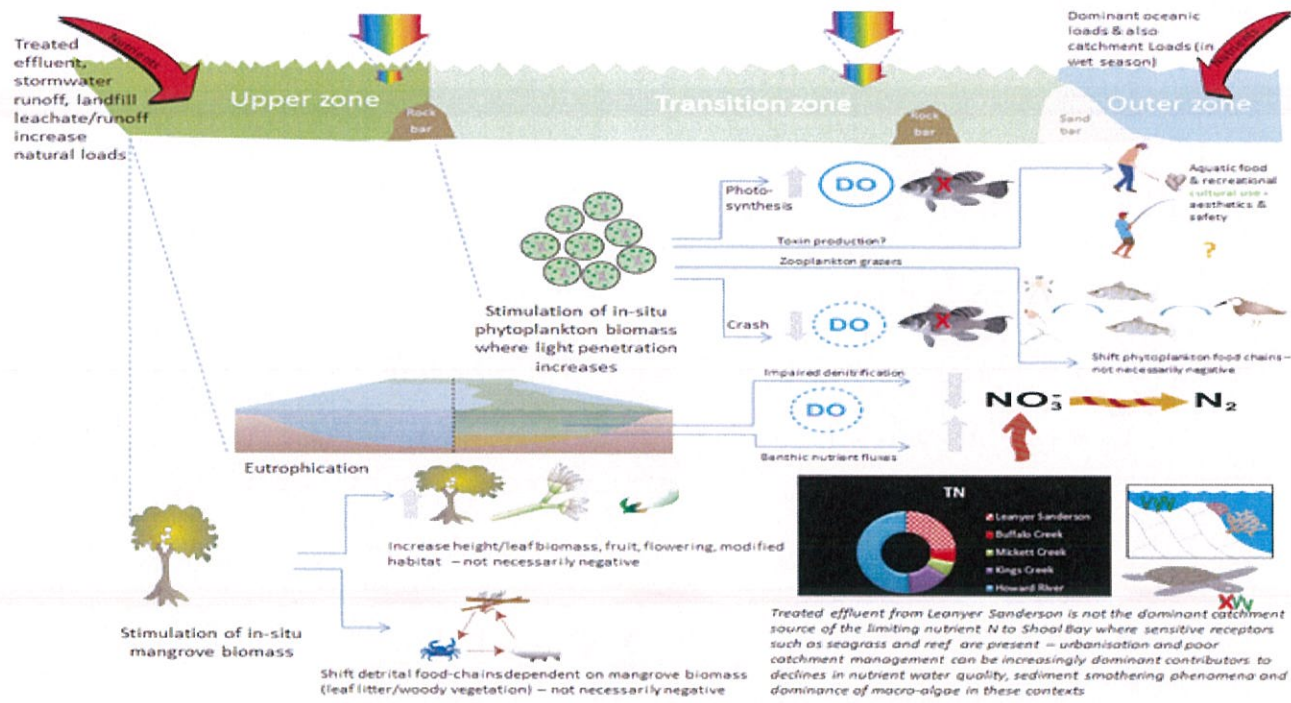


TREATMENT LOAD REDUCTION

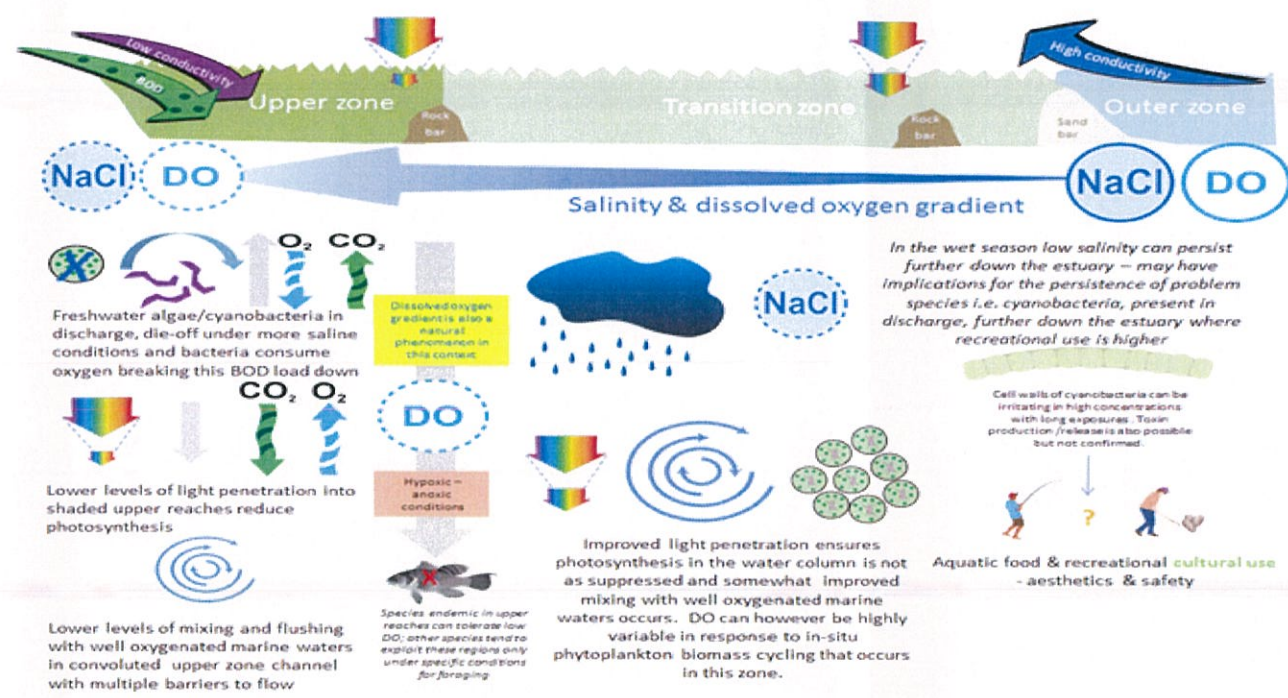
INDICATOR	TREATMENT
Nitrogen	↓ Load by 57 %
Phosphorous	↓ Load by 34 %
Ammonia	↓ Load by 75 %
BOD	↓ Load by 67 %
Copper	↓ Load by 94 %
E.coli	↓ Load by 4 orders of magnitude

CONCEPTUAL SITE MODELS FOR KEY PROCESSES THAT MAY IMPACT BENEFICIAL USES IN BUFFALO CREEK

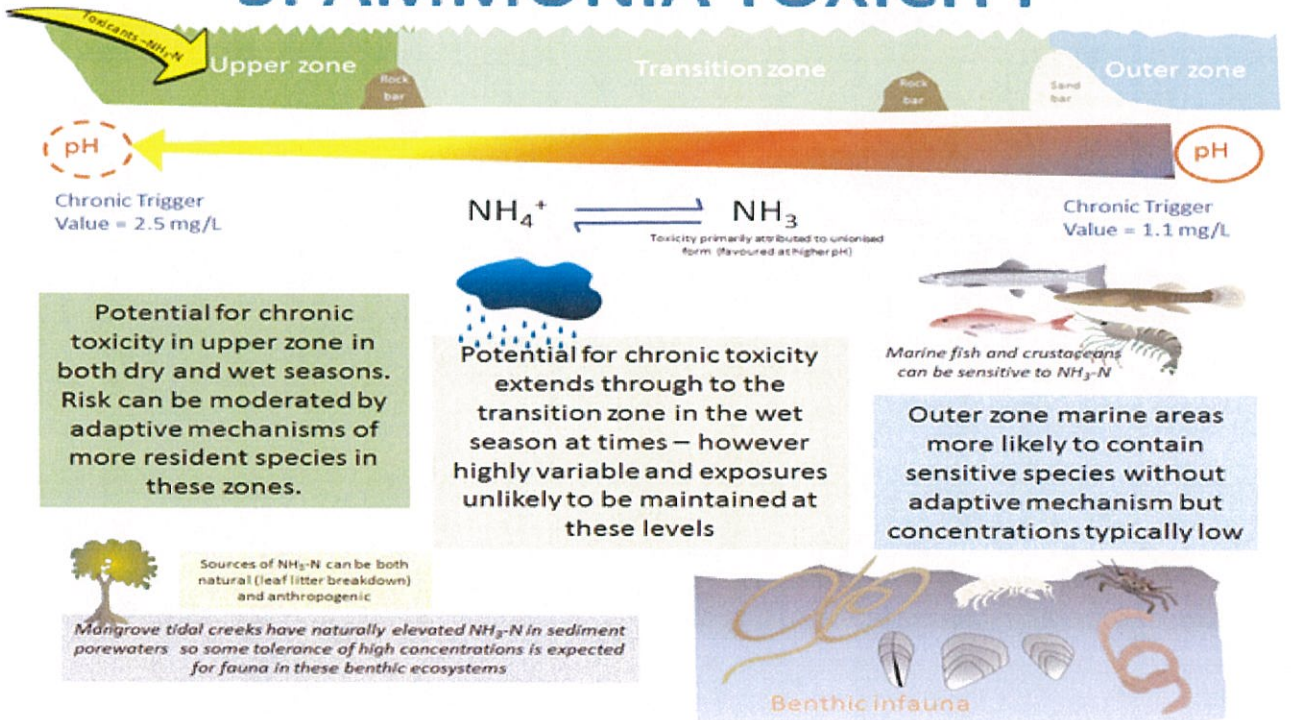
1. NUTRIENT ENRICHMENT



2. BOD & DISSOLVED OXYGEN



3. AMMONIA TOXICITY



4. PATHOGEN INDICATORS

