

Berrimah Waste Stabilisation Ponds Environmental Management Plan



D2018/444944



DOCUMENT HISTORY

Revision	Purpose	Date	PWC
0.1	Internal Draft for review	10/01/2019	Wayne Sharp Di Rose Danny Browne Skefos Tsoukalis Jess D'Arcy Steve Knight Mahesh Ankolekar Laura Haycock
0.2	Internal Draft for review	21/03/19	Wayne Sharp Di Rose Danny Browne Skefos Tsoukalis Jess D'Arcy Steve Knight Mahesh Ankolekar Laura Haycock
1.0	Final Version	11/04/2019	DENR



Abbreviations and Glossary

AA	Administering Agency (DENR acting on behalf of NT EPA)
AA	Australian Standard
BOD	Biochemical Oxygen Demand
BPEM	Best Practice Environmental Management
Cfu	Colony Forming Units
Controller	Controller as specified in the Waste Discharge Licence. In this case, DENR.
DAGJ	Department of the Attorney General and Justice
DEE	Department of Environment and Energy
DENR	Department of Environment and Natural Resources
DO	Dissolved Oxygen
DoH	Department of Health
Effluent	Treated wastewater
EMP	Environmental Management Plan
EP	Equivalent persons
EPBC Act	Environment Protection and Biodiversity Conservation Act
Licence	Waste Discharge Licence 146 issued under the Water Act
MEB	Medical Entomology Branch
NEPC	National Environment Protection Council
NHMRC	National Health and Medical Research Council
NOHSC	National Occupational Health and Safety Council
NWQMS	National Water Quality Management Strategy
NRMMC	National Resource Management Ministerial Council
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority.
PIR	Performance Improvement Report
PPE	Personal Protective Equipment
PWC	Power and Water Corporation
SDS	Safety Data Sheets
TSS	Total Suspended Solids
TPWC Act	Territory Parks and Wildlife Conservation Act
VSS	Volatile Suspended Solids
WDL	Waste Discharge Licence
WM	Weeds Management
WMPC Act	Waste Management and Pollution Control Act
WQO	Water Quality Objectives
WSPs	Waste Stabilisation Ponds
WWTP	Wastewater Treatment Plant



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1 Background

1.1 Overview of Facility

The Berrimah WSP's are located approximately two kilometres southwest of the suburb of Berrimah as per Figure 1. The WSP's are situated on Section 4126 Hundred of Bagot which is owned by PWC and covers an area of 13.5 hectares with some four hectares covered by ponds.



Source: Dekho (2018)

Figure 1 – Location of Berrimah Waste Stabilisation Ponds

The immediate surrounding of the Berrimah WSP's is a conservation zone (Section 388), and adjacent (east, southeast, and south and west) to Section 388 are development zones (Sections 389, 4248, 5629, and 5630).

The nearest residences/sensitive receptors to the site are located as follows:

- Hidden Valley Motor Sports Complex located approximately 500 metres north-west of the Berrimah WSP site;
- Haileybury Rendall School situated approximately 1.5 kilometres to the north-east of Berrimah WSP's;
- Berrimah Farm and the Northcrest Residential area are situated approximately 2.0 kilometres to the north-east; and
- An industrial area located approximately 1.5 kilometres to the south east of the Berrimah WSP site.

Figure 2 shows the layout of the Waste Stabilisation Ponds (WSP) and the approximate location of the outfall.



Source: Dekho (2018)

Figure 2 – Berrimah Waste Stabilisation Pond Layout and Outfall Location

Constructed in 1979, the site treats sewage from the suburb of Berrimah and industrial wastes from the Darwin Business Park. Sewage from Berrimah is collected and transported to the WSP site via the Berrimah Trunk Sewer. Industrial wastes from the Darwin Business Park are collected and transported via the Darwin Business Park Trunk Sewer. All wastewater is combined and directed to the primary waste stabilisation pond (WSP). There are three WSPs which operate in series providing secondary treatment for all wastewater received at the plant using physical (settling) and biological processes occurring within the ponds. The ponds are as follows:

- One primary facultative pond (aerobic upper zone and anaerobic lower zone) (Pond 1); and
- Two secondary maturation ponds (aerobic with less vertical stratification) (Pond 2 and Pond 3).

Treated effluent is disposed via:

- Evaporation losses from ponds; and
- Discharge into an estuary (Bleesers Creek and then Darwin Harbour).

Facultative ponds provide the initial physical settling of solids matter (primary treatment). This is followed by algal growth, which uses sunlight and oxygen to drive the initial breakdown of organic matter and the removal of nutrients in the wastewater. Well performing facultative ponds are often dark green due to the large numbers of micro-algae ([PWC, 2015](#)).

Maturation ponds provide biological or secondary treatment of the wastewater. At Berrimah the maturation ponds are arranged in sequence and receive primary treated effluent from the facultative pond. Their primary function is to remove pathogens, principally faecal bacteria and viruses prior to effluent discharge. Sunlight intensity, time and temperature are important factors in this process. The size and number of maturation ponds are important factors in determining the efficacy of pathogen removal ([PWC, 2015](#)).

There is currently no screening, grit removal, maceration or storm flow separation on the inlet. The major loss process for gross pollutants and other entrained materials is settling out into the sludge layers (removed by desludging) or entrapment in concentrated surface scums that can be physically removed. Biosolids are transported off site.

The estimated retention times based on the process model for the WSP's is as follows:

- Pond 1 – 6.87 days
- Pond 2 – 5.05 days



- Pond 3 – 2.23 days, giving a total estimated retention time of 14 days across the treatment train.

PWC have been granted a Waste Discharge Licence under Section 74 of the *Water Act 1992* for the discharge of wastewater from the Berrimah Waste Stabilisation Ponds (WSP) to Bleasers Creek. The Environment Division of the Northern Territory Government Department of Environment and Natural Resources (DENR) act as the Administering Agency of the Waste Discharge Licence on behalf of the Controller of Water Resources.

Overflows from Berrimah WSP's to adjacent mangroves other than via the authorised outlet can occur during wet weather events and these discharge events are reported as unauthorised discharges (licence non-compliance).

1.2 Scope of Environmental Management Plan

This document is designed to provide environmental guidance to key personnel involved in the operation of the WSP's, in order to manage environmental risks and to address the requirements of the WDL.

This EMP addresses requirements pertaining to the operation of the WSPs and includes the following:

- Outlines the legislative and management requirements;
- Identifies key environmental risks;
- Outlines procedures for managing and mitigating risks;
- Identifies roles and responsibilities;
- Outlines monitoring, audit and reporting requirements;
- Provides a response plan for handling incidents;
- Outlines the aims of community consultation and complaints and processes to address complaints; and
- Provides a summary of environmental commitments.

2 Relevant Legislation

Personnel involved in the operation of the Berrimah WSP's need to be aware of provisions contained in the legislation and related regulations.

Table 1 provides an overview of key legislation relating to environmental issues associated with the licenced activity.

Table 1 – Summary of Key Legislation

Key Legislation	Administering Authority
<i>Dangerous Goods Act 1996</i>	Department of the Attorney General and Justice (DAGJ)
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Department of Environment and Energy (DEE)
<i>Environmental Offences and Penalties Act 1996</i>	Department of Environment and Natural Resources (DENR)
<i>National Environmental Protection Measures for Ambient Air Quality (NEPC 1998)</i>	National Environment Protection Council (NEPC) (administered in the NT by DENR)
<i>Public and Environmental Health Act 2013 (NT)</i>	Department of Health (DoH)
<i>Territory Parks and Wildlife Conservation Act 1977</i>	DENR
<i>Waste Management and Pollution Control Act 1998 (NT)</i>	DENR
<i>Water Act 1992 (NT)</i>	DENR
<i>Water Supply and Sewerage Services Act 2000 (NT)</i>	Department of Treasury and Finance (DTF), DoH, Minister of Renewables, Energy and Essential Services (MREES)
<i>Weeds Management Act 2001</i>	DENR
<i>Work Health and Safety (National Uniform Legislation) Act 2011</i>	Work Safe NT



2.1 Power and Water Corporation Policies, Guidelines and Procedures

PWC has developed policies, guidelines and procedures applicable to various activities. Those of particular relevance to the operation of the WSP's are listed below:

- Power and Water Corporation, 2006, Emergency Response Procedure - [QDOC2006/862](#);
- Power and Water Corporation, Waste Stabilisation Ponds Operation Manual - [BDOC2012/113](#);
- Power and Water Corporation, 2006, Guidelines for Buffer Zones, Sewage Treatment, Sludge Management and Effluent Reuse Schemes - [D2009/126468](#);
- Power and Water Corporation, Land Management Procedure - [QDOC2008/444](#);
- Water Services Water Quality Complaint and Query Process - [D2017/232539](#);
- Sewerage Overflow Response Work Instruction - [BDOC2012/24](#); and
- Biosolids Management Plan - [D2019/121692](#).

These guidelines and procedures should be adhered to for all operations of the WSP's.

Also available to PWC employees is the Environmental Management System (EMS) accessible via the Intranet. The EMS contains a document register which provides management procedures for environmental risks associated with PWC activities, including risks associated with the licenced activity. To access this resource follow the link:

http://intranet.powerwater.com.au/bu/shared_services/health_safety_environment_and_risk/environment/ems/document_register

2.2 Licences

PWC Waste Discharge Licence WDL 146-08 was issued by DENR under the Water Act for the discharge of treated wastewater from Berrimah Waste Stabilisation Ponds to Bleasers Creek within Darwin Harbour Catchment. The licence is valid until October 2020.

The licence specifies reporting limits, environmental requirements, monitoring requirements, complaints monitoring, non-compliance reporting, annual report requirements, and environmental management requirements in relation to discharges from the treatment plant to the waters of Darwin Harbour.

Licence conditions are incorporated into this EMP where appropriate.

2.3 Environment Policy

An Environment and Sustainability Policy ([CONTROL0028](#)) has been developed by PWC with the following Policy statement:

"Power and Water Corporation delivers electricity, water and sewerage services across the Northern Territory encompassing urban and remote locations over a vast distances. Power and Water is committed to the protection of, and minimisation of harm to the environment in which we work, and contributing to a sustainable future for the Northern Territory. This commitment is guided by our Values, Statement of Corporate Intent, Risk Appetite Statement and Code of Conduct."

As per the policy statement PWC is committed to minimising its own adverse environmental impact and implementing programs to reduce resource use.

PWC will:

- Comply with legislation, standards and industry codes of practice relevant to the Corporation.
- Prevent pollution and minimise waste as much as is practicable to do so.
- Minimise any adverse impact on the environment from operations and activities.
- Ensure employees and contractors have the necessary information, training and supervision to meet regulatory requirements and PWC's environmental expectations.
- Undertake regular monitoring and strive for effective continuous improvement of environmental systems and processes.
- Develop and review meaningful objectives and targets in line with the Statement of Corporate Intent to measure performance.
- Ensure this policy is actively communicated, displayed and made available to employees, relevant stakeholders and the public.



- Ensure employees understand how their individual actions can make a difference and will work together to continually improve our environmental performance.
- Periodically review this policy so that it remains relevant and appropriate to the Statement of Corporate Intent.

This policy applies to all PWC employees, apprentices, contractors, consultants, and suppliers undertaking work on behalf of PWC.

3 Roles and Responsibilities

Individual personnel roles and responsibilities for key personnel associated with the Berrimah WSP's are as outlined in Table 2 below.

Table 2 – Roles and Responsibilities for Berrimah WSP's

Role/Title	Responsibility
Chief Executive Officer Power and Water Corporation	• The licence holder for all waste discharge licences
General Manager Water Services	• Overall responsibility for urban sewerage infrastructure NT wide
Senior Manager Strategy and Planning	• Planning and Infrastructure Development
Senior Manager Asset Management	• Asset Management
Senior Manager Operations / Service Delivery	• Overall responsibility for the Berrimah WSP's
Water Quality and Treatment Teams	• Technical advice on treatment, water quality monitoring • Communication with regulatory authorities as required (i.e. licence non-compliances)
Operations/Service Coordinator	• Coordination of works at Berrimah WSP's • Responsibility for day to day operation of the plant
Operator	• Routine plant inspections • Basic maintenance and pond operations as required
Environmental Services (ES)	• Responsible for environmental regulation associated with the ponds – however licence compliance is undertaken by Water Quality Team in conjunction with ES

4 Contact Register – Incident Response Plan

A pollution incident is any event that causes or is threatening to cause or may threaten to cause pollution resulting in harm, adverse effect, or nuisance on the environment, and may include emergency events and non-compliances with the WDL.

If an incident occurs during the operation of the facility or in the course of the licenced activity to which Waste Discharge Licence 146 relates, then the person responsible for site operations must:

Table 3 – Incident Response Actions

1	Ensure the site is safe	First, consider personnel safety , and <i>if safe to do so</i> , take all practicable action to minimise any adverse environmental effects from the incident (i.e. control and contain overflow from unauthorised discharge where it is practicable and safe to do so.)
2	Notify	Report the incident to Power and Water Corporation's (PWC):



		• Water Services Operations Manager • Water Services Licence Compliance Officer (Water Quality Team) • Environmental Services (see Table 1) • HSE Officer for incidents that include worker injury or incident For environmental incidents relating to discharges or emissions from the facility, as soon as reasonably practicable, but no later than 24 hours after becoming aware of the incident, notify the Department of Environment and Natural Resources (DENR) via the Pollution Hotline 1800 064 567 and emailing pollution@nt.gov.au. Note: • In the case of a non-compliance with the WDL – the Water Quality Team will notify DENR • In the case of an incident not related to the licensed activity – the Environmental Services Team will notify DENR
3	Follow procedure	Follow PWC's site procedures/plans: • Waste Discharge Licence 146-08 – D2018/454699 • Emergency Response Procedure – QDOC2006/862 • Sewerage Overflow Response Work Instruction – BDOC2012/24 • Sewage Overflow Notification Log Sheet – BDOC2012/23
4	Report incident / non-compliance to the Administering Agency in writing	Incident: As per Section 14 of the WMPC Act, for an incident that causes, or is threatening or may threaten to cause, pollution resulting in material environmental harm or serious environmental harm, the person conducting the activity must notify the NT EPA in accordance with subsection (3) as soon as practicable after (and in any case within 24 hours after) first becoming aware of the incident or the time he or she ought reasonably be expected to have become aware of the incident. A notification to the NT EPA is to specify: - the incident causing or threatening to cause pollution; - the place where the incident occurred; - the date and time of the incident; - how the pollution has occurred, is occurring or may occur; - the attempts made to prevent, reduce, control, rectify or clean up the pollution or resultant environmental harm caused or threatening to be caused by the incident; and - the identity of the person notifying. Section 14 notification templates can be found on the NT EPA website: https://ntepa.nt.gov.au/waste-pollution/compliance/pollution-incidents Notification should be emailed to DENR's Pollution Team. Licence Non-compliance: As per Condition 28 of the licence, the licensee must notify the Administering Agency of any non-compliance with the licence by emailing waste@nt.gov.au, as soon as practicable after (and in any case within 24 hours after) first becoming aware of the non-compliance. The licensee must include in the notification of non-compliance the following information: - when the non-compliance was detected and by whom; - the date and time of the non-compliance; - the actual and potential causes and contributing factors to the non-compliance; - the risk of environmental harm arising from the non-compliance; - the action(s) that have or will be undertaken to ensure the non-compliance does not reoccur; - if no action was taken, why no action was taken, and - a date when an incident investigation report will be submitted to the



	Administering Agency As detailed above notifications should be emailed to the DENR's Authorisations Team. PWC's Water Services Licence Compliance Officer (Water Quality Team) will be responsible for formally notifying the Administering Agency of incidents/non-compliances with the WDL.
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Note: Due to legislative restrictions DENR officers cannot share information between the Environmental Authorisations and Pollution Response teams, in circumstances where both sections are to be notified emails should be directed to both pollution@nt.gov.au and waste@nt.gov.au.

To ensure that there is a consistent approach to incident reporting, the site personnel/contractor must contact PWC's Water Services Operations / Service Delivery Manager as soon as practicable. The Operations Manager will communicate the situation to the relevant staff.

If pollution goes unreported, then the persons who carried out the activity that caused the pollution, and/or those who knew of the pollution incident, and are guilty of an offence may be fined up to \$180,000 and/or up to five years in prison.

In the event of an incident/non-compliance or emergency at the site, contact will be made with relevant key contacts identified in Table 4.

Table 4 – Incident Contact Register

Organisation	Contact	Phone Number/Email Address
PWC	Water Services Operations Manager	08 8936 4646
	Water Services Licence Compliance Officer (Water Quality Team)	08 8924 5268
	Environmental Services	08 8924 5051
	24hr Emergency Contact Number	1800 045 090
DENR	Pollution Team - Pollution incidents and nuisance issues including air, water, noise and waste	1800 064 567 pollution@nt.gov.au
	Authorisations Team - Waste Discharge Licence related matters	08 8924 4218 waste@nt.gov.au
Fire Brigade	Emergency	000
Police		
Ambulance		
Royal Darwin Hospital	Emergency	08 8922 8888
NT Emergency Services	Emergency	08 8922 3630
DENR – Erosion and Sediment Control	Erosion and Sediment Control Issues	08 8999 4678
		08 8999 4572
DENR – Wildlife Callout	In the event a threatened species is identified or an animal is injured PWC must notify a representative of DENR.	1800 453 210
		0409 326 307
		08 8999 5511



WorkSafe NT	In the event that and injury or illness occurs requiring medical treatment or hospitalization the manager must contact the Health and Safety Team who will determine if WorkSafe NT are to be contacted and make the appropriate report.	1800 019 115
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5 Existing Environment

Berrimah Waste Stabilisation Ponds are located 8km east of Darwin and north of the East Arm of Darwin Port. Road access is via an authorised access road off Tiger Brennan Drive. Bleesers Creek is located within Darwin Harbour which is listed as a Site of Conservation Significance (SOC's No.6 – Appendix 1) and as a Nationally Important Wetland as per EPBC Act Protected Matters Report ([D2019/21138](#)).

Bleesers Creek is a short (approximately 3 km long) tidal creek within the large Darwin Harbour macrotidal estuary. The Bleesers Creek outfall discharges directly into a mangrove forest (Figure 3) and travels for approximately 60 m across a mangrove tidal flat at low tide into a tributary of Bleesers Creek. The discharge enters the minor tributary 800 m upstream of the confluence of this tributary with the north-western arm of Bleesers Creek. This arm varies between 16 - 51 m across, with the confluence with the minor tributary situated 110m upstream of the main channel of Bleesers Creek. The main Bleesers Creek channel extends for a further 2 km to the south-west to its mouth. The mouth of Bleesers Creek and Reichardt Creek to the north-west, are within 600 m of each other and situated within 1 km of the East Arm Wharf. The mouths of these creeks are situated in Frances Bay in Darwin Harbour as per Figure 4 ([PWC, 2018](#)).



Source: Daniel Lane, *Tropical Water Solutions* (2/12/15)

Figure 3: Berrimah WSP Outfall



No heritage or archaeological sites are located within close proximity of the facility, with the closest sites being 2 km away, as per Heritage Branch advice ([D2019/21760](#)). There are no sacred sites or Restricted Work Areas within the PWC property (Lot 4126), however there is a registered sacred site within close proximity in the adjoining property (Lot 388), as per AAPA certificate J2006/0095 ([D2006/273439](#)). If any previously unknown sites are located the relevant authorities must be contacted immediately.

Vegetation surrounding the Berrimah WSP's consists of open woodland to the north-eastern side of the facility with the remaining area consisting of mangrove forest. The open woodland consists of typical Top End species such as *Eucalyptus Tetradonta* (Stringybark) and *Eucalyptus Miniata* (Darwin Woollybutt) with a tussock grass understorey. The mangrove forest is dominated by *Rizophora stylosa* along with pockets of *Sonneratia alba* as displayed within Figure 5.

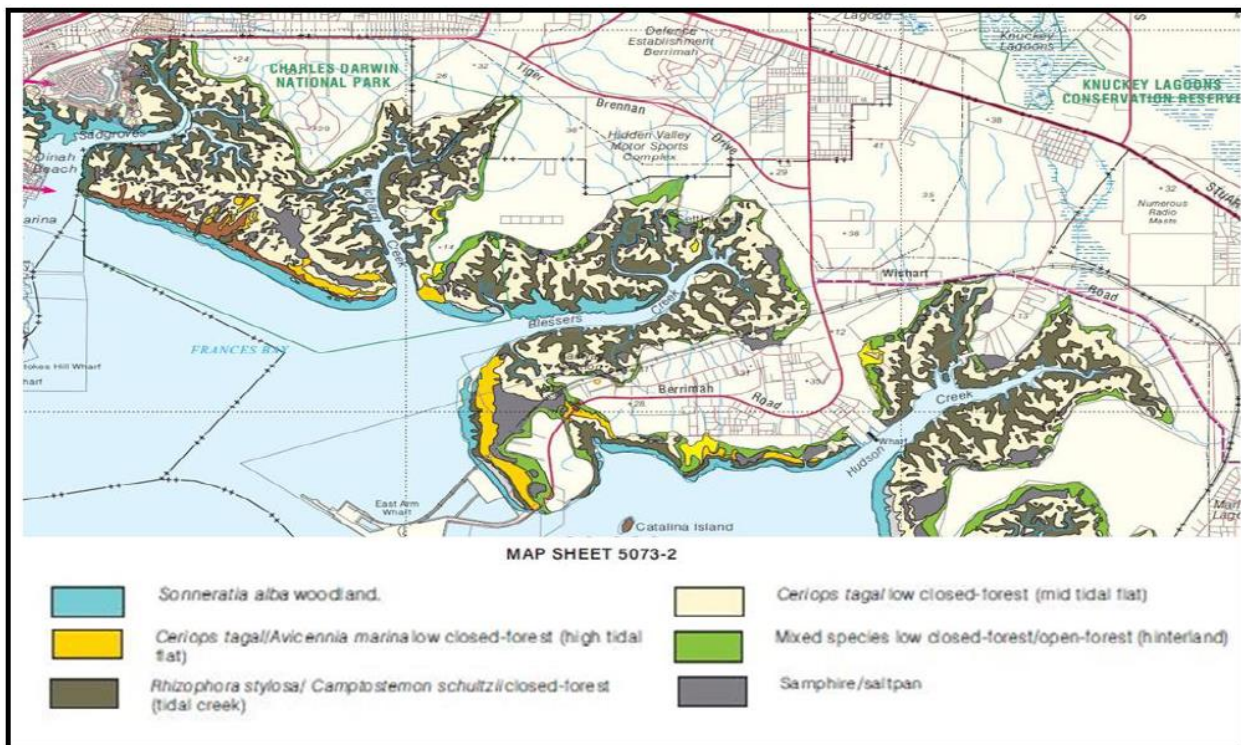


Source: Base image from Dekho

Figure 4 – Berrimah WSP's and Receiving Environment

The open woodland surrounding the facility has an average slope of -1.72% from North to South; and is assessed as having a very low chance of dryland salinity and an extremely low probability of acid sulphate soils (ASS), while the mangrove forest is relatively flat and with a high probability of ASS (ASRIS 2019). Soil types within the open woodland consist of Tenosols (sandy soils) which are highly erodible, while the soils within the closed mangrove forest consist of Hydrosols, which are water logged soils found near coastal areas and are unlikely to erode (Natural Resource Management Infonet 2019 – [D2019/16126](#)).

A desktop search was also undertaken utilising the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) Protected Matters Search for the facility with a 1 km buffer ([D2019/21138](#)). The report indicated that a number of threatened species may occur within the PWC property, along with a number of weeds and pests, indicating that any upgrade works or changes to the current landscape will need to undergo an internal environmental risk assessment by PWC Environmental Services to identify any risks and implement mitigation controls as required.



Source: Extract of NT Government Mangrove Mapping 'Darwin' Map Sheet 5073-2

Figure 5: Mangrove Communities in Blesers Creek, Darwin Harbour

6 Risk Assessment

6.1 Risk Assessment Method

PWC's corporate procedure for risk management is outlined in [D2014/166391](#). In summary the method outlines ways to identify, analyse, evaluate and treat risks and how to monitor and review risks and also the management of risks i.e. strategic, operational and task.

PWC's corporate procedure for risk management has been adopted for assessing risks for the Berrimah WSP's.

Environmental element categories to be considered in the risk assessment are in accordance with the procedure. The environmental categories include:

- Water;
- Land;
- Biodiversity;
- Community (includes environmental amenity values of public health; odour and noise impacts); and
- Legal.

6.2 Risk Rankings

The operational activity and potential risks and impacts on environmental elements were categorised.

Risks are categorised by how 'likely' they are to occur, providing a measure of the known or anticipated frequency of occurrence as per Figure 6, versus the consequence (impact or outcome) associated with the risk as assessed using Figure 7. By combining the likelihood and consequence as per Figure 8 provides a risk ranking for each aspect assessed, allowing mitigation actions to be identified and implemented. The risk assessment for Berrimah WSP's is provided in Appendix 2.



(E) Almost Certain	Event is expected to occur on a regular basis. Multiple times per year.	Probability of occurring is greater than 90%
(D) Likely	An event is expected to occur from time to time. At least once per year.	Probability of occurring is 60%-90%
(C) Possible	An event could occur at some time. Once every 1 – 3 years.	Probability of occurring is between 40%-60%
(B) Unlikely	Event not expected but possible that one could occur. Once every 3 – 9 years.	Probability of occurring is between 10% and 40%
(A) Rare	An event will occur only in exceptional circumstances. Once every 10 years or greater.	Probability of occurring is less than 10%

Figure 6 – Likelihood

	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)
Health & Safety	Incident with or without minor injury; No impact on human health.	Injuries requiring first aid treatment; Minor short term inconvenience or symptoms to human health.	Injury or illness requiring medical treatment; Short term or reversible disabling effect to human health.	Injuries requiring hospitalisation; Long term or permanent disabling effects on human health (a single person).	Fatality; Long term or permanent disabling effects on human health (more than one person).
Financial	Loss less than \$500K; Less than 1% of net cash flow; Budget overrun <1%	Loss between \$500K-\$2M; Between 1% and 4 % of net cash flow; Budget Overrun between 1%-3%	Loss between \$2m-\$10m; Between 4% and 20% of net cash flow; Budget Overrun between 3%-5%	Loss between \$10m-\$40m; Between 20% and 80% of net cash flow Budget Overrun between 5-10%	Loss greater than \$40m; Greater than 80% of net cash flow Budget overrun >10%
Legal / Regulation	Legal issues managed by corporate procedures or practices; Breach of internal policies or procedures without the need for formal investigation.	Matter requires legal advice to address issues; Internal breach of policies or procedures requiring a formal investigation	Required to operate under limited regulatory restrictions or orders; Serious incident which requires legal representation.	Significant prosecution and fines; Required to operate under significant regulatory restrictions or orders; Government inquiry/ intervention.	Criminal charges / civil litigation against the Corporation and/or personnel; Operating licences revoked.
Environmental	Contained within controls. No measurable impact.	Localised low level damage controlled and remedied with minimal resources.	Widespread temporary damage with extended resources to remedy.	Long-term effect on environment and once controlled results in minor permanent damage.	Substantial permanent damage to widespread and sensitive areas.
Strategic Management	No measurable impact on the ability to achieve Corporate objectives and strategies. Managed by Line Management	Minor impairment on the ability to achieve Corporate objectives and strategies; Managed by Executive Management	Moderate impairment on the ability to achieve Corporate objectives and strategies; Requires MD involvement	Significant impact on the ability to achieve Corporate objectives and strategies; Requires Board level intervention	Permanent impediment to achieving Corporate objectives and strategies; Requires reporting to Government
Service Delivery	No loss of service. Issues rectified with corrective action.	Service restored within expected timeframes (<=2 hours).	Short term disruption to service outside of expected timeframes (<=12 hours).	Long term disruption to service with extended resources required to remedy (>12 hours< 24 hours).	Complete and indefinite disruption to service (>24 hours).
Corporate Image	No media attention; Isolated community or individual issue-based concern;	Occasional once-off negative media attention; Localised community impacts and customer concerns;	Brief adverse media attention and/or community/customer condemnation (days); Limited, localized loss of confidence by the community;	Prolonged adverse media attention and/or community/ customer condemnation (weeks); Prolonged, widespread community/ customer loss of confidence (weeks);	Sustained adverse media attention and/or community/customer condemnation (months); Irreconcilable community/ customer loss of confidence;
Stakeholder Management	Localised dissatisfaction which is managed by normal business processes	Localised staff dissatisfaction which requires Human Resources in resolution	Localised staff dissatisfaction with localised impacts to service delivery	Widespread dissatisfaction and loss of confidence by staff resulting in temporary service delivery issues	Loss of confidence in Board and/or Management by Government Widespread dissatisfaction by staff resulting in sustained service delivery issues

Figure 7 – Consequence

Likelihood	Almost Certain E	Medium	Medium	Very High	Extreme	Extreme
	Likely D	Low	Medium	High	Very High	Extreme
	Possible C	Low	Low	Medium	High	Very High
	Unlikely B	Low	Low	Medium	High	High
	Rare A	Low	Low	Medium	Medium	High
		Insignificant 1	Minor 2	Moderate 3	Major 4	Severe 5
		Consequence				

Figure 8 – Risk Matrix



7 Environmental Monitoring

7.1 Monitoring

An intensive monitoring regime is implemented at the Berrimah WSP's consisting of two wastewater monitoring programs. Sampling of the wastewater treatment ponds is undertaken as part of the [Wastewater and Reclaimed Water Quality Monitoring Program](#) (WRWQMP), details as per Figure 9 below, and monitoring of the receiving environment is undertaken as part of the [Darwin Harbour Surface Water Monitoring Program](#) (DHSWMP), this program is focused on meeting requirements of the WDL, details as per Table 6 below.

7.2 Sampling Methods and Frequencies

FACILITY	SITE CODE	Description	Monitoring Frequencies – refer to Key below											Associated PI Tags	
			Analytical Suites and Laboratory Codes ²												
			Gen Chem. Nutrients & Major Ions (Table 9)					Bacteriological (Table 7)			In-situ Field (Table 8)	Metals (Table 11)			Algal (Table 12)
			+CPN ^{DA}	-CPN ^{DA}	CP ^{AD}	J	N ^{AD}	+B ^{DA}	-B ^{DA}	B ^{AD}	F	+M ^{DA}	M ^{AD}		A
BERRIMAH WSPs (Figure 6 & 7)	SBe001	Raw – Trunk Sewer Inlet	Not routinely tested												
	STDZ01	Raw – TDZ Pump Station wet well	Not routinely tested												
	SBe010	Raw – Combined influent from Berrimah trunk sewer and TDZ	F			A		F		F	A			C (flow): STP005_Pond_InFlo	
	SBe015	Berrimah Pond 1 (Facultative) outlet – 1 ^o		F					F		F				
	SBe025	Berrimah Pond 2 (Maturation) outlet – 2 ^o		F					F		F				
	SBe100	Berrimah Pond 3 (Maturation) outlet – 2 ^o effluent to Bleasers Creek	F			A		F		W ¹	A			C (flow): STP005_Pond_OuFlo	
Monitoring Frequency Key		W WEEKLY	F FORTNIGHTLY	M MONTHLY	6-M 6-MONTHLY (FEBRUARY & OCTOBER)				A ANNUAL (OCTOBER)		C CONTINUOUS				

Note: ¹ The outlet is monitored monthly in conjunction with the receiving environment monitoring program in Myrindon Creek (site codes SPeMXX) and in Bleasers Creek (site codes SBeBLXX) and is subject to change in accordance with WDL compliance requirements (D2017/91684). This program is managed and implemented separately to the WWMP. However, some aspects of the WWMP are conducted to achieve compliance with WDL specified monitoring frequencies (i.e. > monthly field measurements).

² Refer to Appendix D – Bottle Guideline for description of sampling bottle requirements.

Figure 9 – Berrimah WSP's Sampling Details (WRWQMP)

Table 6 – Receiving Environment Monitoring Schedule (WDL146-08)

Parameter	Sampling Frequency
Physico-chemical	
Flow	Fortnightly
pH	Fortnightly
Electrical conductivity	Fortnightly
Dissolved oxygen	Fortnightly
Temperature	Fortnightly
Turbidity	Fortnightly
Total suspended solids	Monthly
Biological	
Biochemical oxygen demand	Monthly
Chlorophyll-a	Monthly
Nutrients	
Ammonia (Total as N)	Monthly
Total Nitrogen	Monthly
Oxidised Nitrogen (NOx as N)	Monthly
Total Phosphorous	Monthly
Filterable Reactive Phosphorous	Monthly
Metals	
Copper (filtered)	Monthly
Zinc (filtered)	Monthly
Pathogens	
Escherichia coli	Fortnightly
Enterococci	Fortnightly



7.3 Data

PWC uses the system BI Portal to enter, store and retrieve wastewater quality data. PWC also utilise the system [Maximo](#) which provides an efficient process for work order creation and subsequent sampling by contractors. These systems assist PWC with routine monitoring of the facility and receiving environment while meeting regulatory requirements under the WDL for data retention.

7.4 WDL Annual Reporting

As per WDL146-08 an Annual Audit and Compliance Report (AACR) and a Monitoring Report are both required within 30 business days after the anniversary date of the licence.

The AACR requires the licensee to undertake a self-assessment of compliance against each condition of the WDL. The Administering Agency provides a template to be completed by the licence holder in which compliance for each condition is to be assessed and evidence provided supporting the decision. Upon review the Administering Agency may require the licensee to revise, amend and/or resubmit the AACR.

The Monitoring Report requires the following information to be included as per Condition 32 of the licence:

- is prepared in accordance with the monitoring requirements of the Administering Agency 'Guideline for Reporting on Environmental Monitoring';
- includes a tabulation of all monitoring data required as a condition of this licence;
- includes a long term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licenced Activity over a minimum period of three years (where the data is available);
- includes an assessment of environmental impact from the activity;
- reports on progress of the Berrimah Waste Stabilisation Ponds Improvement Plan dated September 2016;
- contain a summary of the reporting limit exceedance that have occurred during the reporting period; and
- report on the following parameters associated with wastewater discharge:
 - total discharge (ML/year);
 - total biochemical oxygen demand (tonnes/year);
 - total phosphorous (tonnes/year); and
 - total nitrogen (tonnes/year).

7.5 Audits/Review

A review of the EMP is to be conducted every three years, with an updated version provided to the Administering Agency. In addition amendments to licence requirements, other updates in relation to changes within the Berrimah Waste Stabilisation Ponds or to the receiving environment will occur as required.

8 Environmental Strategies

8.1 Air Quality Sub-plan

8.1.1 Air Quality

Raw sewage generally contains reduced sulphur compounds which at low pH (below pH 7.0) the chemical equilibrium favours the formation of hydrogen sulphide (H_2S) resulting in odours (rotten egg smell). H_2S forms in anaerobic conditions (no free oxygen); above pH 7.0 the equilibrium favours the formation of hydrosulphides which remain in solution. Odours can signal that pond health may be degrading and that action may need to be taken to rectify. In healthy ponds these odorous compounds are digested by bacteria and converted into nutrients, sulphate reducing bacterial activity is greatest in the pH range 6.8 to 7.2. Algal activity within the ponds can help keep pH levels above 7.2 thus minimising the formation of odour producing H_2S .

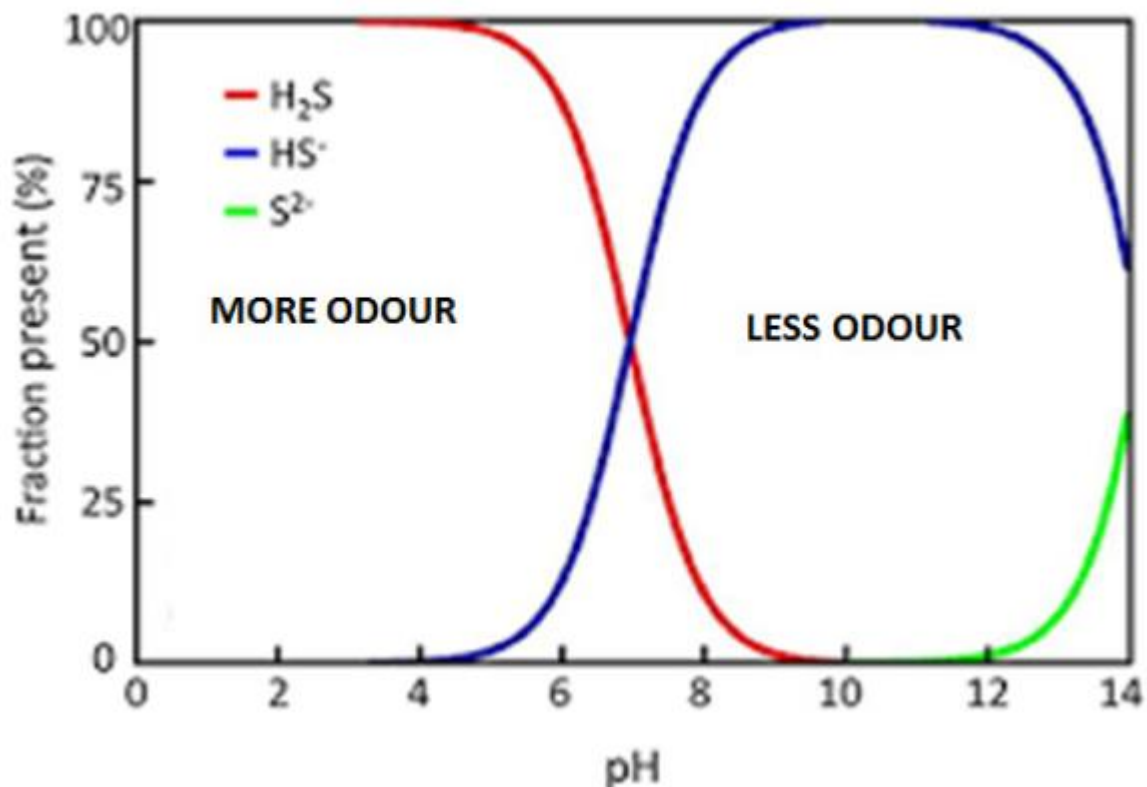
Gross pollutants such as rags and sanitary products may also lead to poor water quality and contribute to increased odour within pond systems. This can be due to a number of reasons such as a reduction in the active working volume of the ponds, potential blocking of inter-pond transfer pipes or channels, and the formation of accumulation within scum mats on the surface of the ponds.

Stratification of ponds can also occur during changes of season resulting in the release of unpleasant odours.

Generally at the start of the dry season as temperature and humidity drops, the surface layer may become cooler and



more dense than the bottom layer resulting in the layers 'turning over' or mixing due to the density difference. This change can occur quite quickly, generally overnight and results in the release of odours which have been trapped in the anaerobic bottom layer and also result in an increased amount of surface scum due to sludge being moved to the surface.



Source: PWC Waste Water Stabilisation Pond Operation Manual - 2018

Figure 10: Relationship between odorous H₂S, non-odorous HS⁻ (bisulphide), S²⁻ (sulphide) and pH

Note: In enclosed spaces (i.e. sewer pipes) H₂S can exceed the toxic threshold and at these levels the presence of the characteristic odour is not a good indicator of dangerous H₂S levels as it can overwhelm the receptors. If high levels are possible monitoring equipment must be used rather than relying on odour.

8.1.2 Objective

To control and minimise odorous emissions to the surrounding environment caused by WSP operations.

8.1.3 Management Strategy

Pond operation to be undertaken as per PWC Operations Manual to ensure odour is minimised. If odour complaints are received an investigation process should be undertaken to review pond characteristics for abnormal/upset conditions along with investigation options to reduce odour (i.e. aeration). Buffers zones assigned to WSP's are to be adhered preventing encroachment of development and associated increased risk of odour complaints.

8.1.4 Action

Senior Wastewater Coordinator will ensure that:

- Pond operation is undertaken as per PWC Operations Manual;
- Undertake investigation process if odour complaints are received;
- All plant and equipment is operated and maintained in accordance with acceptable industry standards;
- Scum and floating gross pollutants will be removed from the pond surface on a weekly basis;
- Desludging to occur as per maintenance schedule;
- Biosolids are managed in accordance with the approved Biosolids Management Plan;



- Material removed from ponds (scum, gross pollutants, sludge) is not stockpiled onsite and removed to an appropriate site for disposal/stockpiling;
- Transportation of material removed from the ponds is to be transported from site in approved, covered trucks; and
- Monitor temperature and weather forecasts to assist with prediction of pond stratification.

8.1.5 Performance Indicators

- No odour complaints received from the public; and
- Acceptable odour levels during routine pond inspections and sampling.

8.1.6 Reporting

In regards to air quality the following internal reporting is required:

- All complaints received to be recorded and resolved as per PWC Complaints process ([D2017/232539](#)) and logged on a register;
- Details of site conditions including odour to be documented in field notes during inspections and sampling runs; and
- The discharge does not cause or generate odours which would adversely affect the use of surrounding waters.

8.1.7 Reference

- PWC. 2017. Water Services Water Quality Complaint and Query Process. Water Services, Power and Water Corporation, Darwin.
- PWC. 2018. Waste Water Stabilisation Pond Operation Manual. Water Services, Power and Water Corporation, Darwin.

8.2 Water Sub-plan

8.2.1 Water Quality

The Waste Stabilisation Ponds at Berrimah receive a number of different inputs including sewage as expected, along with trade waste and stormwater. All of these inputs are fed into the pond system and treated before being discharged into the environment via the authorised discharge point. PWC's sampling programs monitor pond performance and the health of the receiving environment allowing PWC to determine how the ponds are coping with the varying inputs, along with different conditions related to weather at different times of the year. The associated Waste Discharge Licence also stipulates Surface Water and Discharge Reporting Limits (Trigger Values) which the discharge quality has to meet, or exceedances need to be reported against the licence as they occur.

WSPs provide a significant centralised treatment barrier to the nutrient and pathogen loads inherent in wastewater. They largely rely on natural processes for water flow and contaminant removal. WSP's can contain a number of contaminants with the potential to harm the environment, including pathogens, metals, nutrients and physical and chemical parameters.

Pathogens are microorganisms which have the potential to cause disease. Pathogens may accumulate in shellfish making consumption a public health risk, and discharge of pathogens can contaminate waterways making secondary contact recreational use unsafe. *Escherichia coli* (*E.coli*) is used as an indicator microorganism to indicate the potential presence of pathogens ([PWC, 2018](#)).

Waste stabilisation ponds reduce pathogens to relatively low levels (1,000 – 10,000 *E.coli*/100ml) through natural process such as ultraviolet light penetration. Pathogen reduction levels are site specific and can vary at different time of the year, as well as being influenced by external factors such as large bird populations.

The discharge can also contain metals such as Copper and Zinc which are associated with the sewer network infrastructure. These inputs can be toxic to aquatic organisms such as fish, crustaceans, molluscs, annelids and algae. These metals can accumulate within shellfish; however bioaccumulation is commonly regulated by the organisms and considered a low safety risk to human consumers ([Padovan et al, 2017](#)).



Treated effluent discharges can also result in high nutrient loads within the receiving environment. Nutrient inputs can contribute to eutrophication and lead to increased primary production in mangroves and of phytoplankton biomass. Mangroves may have affected growth patterns, with associated fauna responses due to physical changes in the environment. An increase in phytoplankton biomass can disrupt DO cycles and be harmful to aquatic organisms, and when blooms die-off DO can become suppressed resulting in fish kills. Blooms can also contain toxin producing species which are harmful to aquatic organisms.

Certain physical and chemical parameters can also have an adverse effect on the receiving environment. Organic Matter within the discharge can result in high Biochemical Oxygen Demand (BOD) within the receiving waters, resulting in DO suppression. Total Suspended Solids and Turbidity can also reduce light penetration and reduce photosynthesis of aquatic plants/phytoplankton, and also result in smothering of benthic habitats through settling. For more detail regarding key risks associated with the discharge refer to Table 1 of the Berrimah Risk Assessment ([D2017/487049](#)).

8.2.2 Objective

To minimise and prevent potential impacts on the surrounding waterways and environment resulting from the disposal of treated effluent.

8.2.3 Management Strategy

Pond operation to be undertaken as per PWC Operations Manual to ensure sufficient treatment of wastewater is provided before discharge to the environment. Routine sampling of the wastewater ponds and receiving environment is undertaken as per the [Wastewater and Reclaimed Water Quality Monitoring Program](#) (WRWQMP) and the [Darwin Harbour Surface Water Monitoring Program](#) (DHSWMP) respectively. Compliance reporting is also undertaken as per Waste Discharge Licence 148-06 with information provided to the Department of Environment and Natural Resources.

8.2.4 Action

Senior Wastewater Coordinator will ensure that:

- Pond operation is undertaken as per PWC Operations Manual;
- Undertake investigation process if abnormal pond signals abnormal water quality results detected;
- All plant and equipment is operated and maintained in accordance with acceptable industry standards;
- Scum and floating gross pollutants will be removed from the pond surface on a weekly basis; and
- Desludging to occur as per maintenance schedule.

Water Quality Officer will ensure that:

- Sampling undertaken as per monitoring program schedules;
- Sampling data continually monitored and exceedances reported to the relevant authorities; and
- Assistance provided to operations as required.

8.2.5 Performance Indicators

- No fish or aquatic organism kills;
- No dieback of mangrove community within receiving environment; and
- Compliant with WDL requirements.

8.2.6 Reporting

In regards to water quality the following internal reporting is required:

- Details of site conditions to be documented in field notes during inspections and sampling runs

External reporting is also required as per WDL146-08:

- A monitoring report is required annually tabulating all monitoring data received, along with an analysis of the data demonstrating any environmental impact associated with the licenced activity.



- An Annual Audit and Compliance Report (AACR) is also required where the licence holder undertakes a self-assessment of compliance against each of the licence conditions.
- Exceedance reporting of water quality triggers values to be provided to DENR as per Appendix 1 of the WDL.

8.2.7 Reference

- Padovan, A. C., Neave, M. J., Munksgaard, N. C. and Gibb, K. S. 2017. Multiple approaches to assess the safety of artisanal marine food in a tropical estuary. *Environmental Monitoring and Assessment*, 189, 1-15. (125). <https://doi.org/10.1007/s10661-017-5842-5>
- PWC. 2018. Risk Assessment for the Discharge of Treated Effluent from the Berrimah Waste Stabilisation Ponds to Bleasers Creek. Water Services, Power and Water Corporation, Darwin.
- WDL 146-08

8.3 Biosolids Sub-plan

8.3.1 Biosolids

The management of biosolids (sludge, scum and associated materials) will be undertaken in accordance with the Power and Water Corporation's [Biosolids Management Plan](#) (2018) and the Power and Water Corporation's Biosolids Manual of Practice (2018) to minimise the impact of biosolids on land.

8.4 Trade Waste Sub-plan

8.4.1 Trade Waste

Trade waste is received at the Berrimah WSP's from three main clients being Veolia, Northern Territory Recycling Solutions (NTRS) and Global Resource Recovery (GRR). Each of these clients have trade waste agreements with Power and Water stipulating the terms and conditions of accepting certain wastes. The agreements in place detail a range of conditions as follows, which need to be complied with before a discharge is approved for release into the sewer system:

- Sampling of trade waste needs to occur prior to being released and ensure it meets the acceptance guidelines;
- There are certain prohibited wastes which are not accepted for trade waste disposal;
- Each trade waste customer is expected to meet certain reporting requirements; and
- Failure to comply with conditions within the agreement can result in suspension and/or termination of agreement.

Please refer to the following agreements for further management details.

[Veolia Trade Waste Agreement \(D2016/444533\)](#)

[NTRS Trade Waste Agreement \(D2016/438073\)](#)

[GRR Trade Waste Agreement \(D2018/574696\)](#)

Irregular discharges of trade waste can also occur after consultation with Power and Water and an agreement is made between both parties.

8.5 Land Sub-plan

8.5.1 Land

Treated effluent is discharged to an estuarine creek however during low tides the treated effluent is discharged to mangrove mud within a dense mangrove forest.

As a result of the discharge a number of impacts can occur such as soil and groundwater contamination. Inputs such as metals and gross pollutants can accumulate within the soil and result in harmful effects on the environment. Gross pollutants can reduce the visual amenity of the receiving environment for recreational users and these pollutants can be consumed by biota and have deleterious effects.



Increased nutrient loads and freshwater intrusion into the local groundwater system can affect the growth of mangrove species. Some species may favour increased freshwater inputs and flourish while other species may die-off due to the change in salinity present. Nutrients can also promote growth of mangroves resulting in denser communities and a thicker canopy, which in turn may affect fauna species utilising the mangroves as habitat.

There is also the potential for the discharge to impact on the surrounding land and result in erosion from the physical release of water. Erosion at the discharge site could lead to increased sedimentation loads on receiving waterways resulting in impacts on flora, fauna or local hydrology. In addition, presence of acid sulphate soils in the area is likely. Therefore any erosion and/or any potential excavation works at the discharge site will require implementing appropriate controls to prevent exposure of affected soils. For further details refer to PWC Corporate Procedure – [Soil and Water Management](#) and Environmental Work Practice – [Soil and Erosion Management](#).

Grounds maintenance is to be completed routinely to assist with keeping the WSP's pest free. Long grass and similar habitats can harbour pests such as rats and cane toads. For further details refer to PWC Environmental Work Practice – [Weeds, Pest and Disease Management](#).

Weeds should also be monitored for and eradicated as required during grounds maintenance works. Due to the year round water supply and nutrient supply available, weeds can become a significant problem if not detected early and managed accordingly. For further details refer to PWC Corporate Procedure – [Weed Management](#) and Environmental Work Practice – [Weed Management](#).

The management of biosolids (sludge, scum and associated materials) will be undertaken in accordance with the Power and Water Corporation's [Biosolids Management Plan](#) (2018) and the Power and Water Corporation's Biosolids Manual of Practice (2018) to minimise the impact of biosolids on land. Biosolids are not to be dewatered on site.

8.5.2 Objective

To minimise and prevent the potential negative impacts on lands resulting from activities of the WSP's and or resulting from the discharge.

8.5.3 Management Strategy

Pond operation and treatment of wastewater is paramount to ensure effluent discharged is of a high quality, reducing environmental harm. During routine inspections of the WSP's several checks should be completed to monitor for weeds, pests and erosion within the facility and at the discharge site.

8.5.4 Action

Senior Wastewater Coordinator will ensure that:

- During routine pond inspections that:
 - Removal of gross pollutants from the outfall is undertaken; and
 - Inspections of outfall undertaken for any signs of erosion as a result of the discharge.
- Grounds maintenance to be routinely undertaken to assist with the prevention of pest infestations and spread of weeds.

Environmental Services will ensure that:

- Operations are given assistance with identification and management of weeds, and assistance with removing pest infestations.

8.5.5 Performance Indicators

- No spread of pest flora or fauna within or outside of works area due to operational activities;
- Declared weeds and pests removed by appropriate means upon detection; and
- No complaints related to pest flora or fauna associated with WSP activities from the local community.

8.5.6 Reporting

Any declared weeds or pest infestations identified onsite should be reported to PWC Environmental Services for further assistance.



8.5.7 Reference

- PWC. 2015. Weed Management. Power and Water Corporation Procedure. Environmental Services, Power and Water Corporation, Darwin.
- PWC. 2015. Weed Management. Environmental Work Practice. Environmental Services, Power and Water Corporation, Darwin.
- PWC. 2015. Weeds, Pest and Disease Management. Environmental Work Practice. Environmental Services, Power and Water Corporation, Darwin.

8.6 Biodiversity Sub-plan

8.6.1 Biodiversity

Treated effluent discharged from the Berrimah WSP's has the potential to effect flora and fauna in the receiving environment.

The fresh nature and the high nutrient content of the effluent may alter the vegetation around the WSP's and Bleesers Creek. Some species of mangrove may become more dominant due to the change in conditions while other species die-off. This situation has occurred at the Palmerston WSP outfall as detailed within the [Environmental Risk Assessment](#), however has not been detected thus far at Berrimah WSP's.

Changes of flora species within the receiving environment can also affect the fauna species within this habitat. Changes to the mangrove community can affect the food and shelter present for fauna to utilise, therefore governing the population of certain fauna species present.

The abundance of freshwater from the discharge and within the ponds also creates the risk of a suitable breeding habitat for biting insects such as mosquitoes. Biting insects need to be controlled to reduce the likelihood of health threatening diseases being spread. To assist with this threat maintenance of facility need to occur and eliminate possible breeding habitats such as long grass and stagnant pools of water.

Herbicides are also currently in use at the site to control the spread of weeds and should be applied as per PWC Procedures to prevent damage or death of native species and to ensure weeds are targeted specifically. Weed control poses a major threat to pond processes as dense weed thickets can form within ponds if not controlled preventing the penetration of sunlight and inhibiting biological process required for wastewater treatment. Weeds can also harbour pests therefore should be managed adequately to prevent any pest infestations.

8.6.2 Objective

To ensure WSP activities have minimal environmental impacts on flora and fauna species.

8.6.3 Management Strategy

- Ongoing monitoring of pond performance and effluent discharge quality;
- Ongoing programmed visual inspections of facility including discharge area should be undertaken to check for any issues;
 - If significant impacts on the receiving environment are observed then undertake required compliance reporting as per WDL
 - where feasible, options for effluent reuse shall be investigated and implemented (and where a positive environmental benefit is identified).
- Weed species are to be removed (proper chemical handling procedures to be adhered to); and
- Medical entomology unit to be advised of any significant biting insect species breeding sites.

8.6.4 Action

Senior Wastewater Coordinator will ensure that:

- During routine pond inspections that:
 - Changes in mangrove community are reported to Environmental Services in the first instance. Reporting to DENR required if changes to community are confirmed.



- Grounds maintenance to be routinely undertaken to assist with the prevention of pest infestations and spread of weeds. Infestations should be directed to Environmental Services for further assistance.

Environmental Services will ensure that:

- Operations are given assistance with identification and management of weeds, and assistance with removal of pest infestations; and
- Information is relayed to relevant authorities, such as mosquito breeding to the Medical Entomology Unit, or Weed infestations to DENR's Weed Branch.

8.6.5 Performance Indicators

- No changes to mangrove community present in receiving environment;
- No avoidable loss of flora and fauna species due to WSP activities;
- No increase in weeds or populations of pests that can be directly contributed to the facility;
- Declared weeds and pests removed by appropriate means upon detection; and
- No complaints related to pest flora or fauna associated with WSP activities from the local community.

8.6.6 Reporting

- Any declared weeds or pest infestations identified onsite should be reported to PWC Environmental Services for further assistance;
- Monitoring and reporting requirements as outlined in WDL 146 will also be met;
 - Any changes to the mangrove community within the receiving environment should be reported to the DENR as per licence conditions.
- Inspection reports will be retained on file in association with this EMP and will be available for audit.

8.6.7 Reference

- PWC. 2017. WDL 148 Environmental Risk Assessment for the Discharge from Palmerston Waste Stabilisation Ponds to Myrmidon Creek. Water Services, Power and Water Corporation, Darwin.
- WDL146-08

8.7 Community Sub-plan

8.7.1 Community

Operations at the Berrimah WSP's within close proximity of sensitive receptors can lead to potential risks in relation to the community. Potential issues arising from this process include:

1. Odour;
2. Noise;
3. Visual Amenity; and
4. Public health.

Due to the nature of wastewater treatment, negative impacts on air quality, particularly odorous impacts, may arise. Odour may be generated from a number of sources, including scum formation on the surface of the ponds, stratification of sewage within the ponds, and disposal of the treated effluent. Surface scums can accumulate over time on the surface of ponds and can contain gross pollutants which can generate strong odours if not removed in a timely manner. As detailed in Section 9.1, changes in temperature and humidity generally during the change of season can result in water columns mixing and releasing odours. Odour can also be generated at the discharge site due to the disturbance and aeration of the treated effluent, however if treatment within the ponds is sufficient, odours at the outfall should be minimal.

Strategies to mitigate impacts associated with odour include regular monitoring, maintenance of the buffer zones around the WSP's, improvements to the treatment process and maintenance of the systems, including aeration of the ponds. The type of treatment and the size of the plant determine the desired buffer zone. The design equivalent persons (EP) for the Berrimah WSP's is approximately 5,000 EP (PWC, 2006). Based on the PWC Guidelines for Buffer Zones, 2006, the desired buffer zone is 500 metres around the primary ponds and 350 metres around the secondary



ponds. As noted in Section 2.1, the sports complex is located some 500 – 600 metres to the northwest of the WSP's. It is outside the buffer zones required for the ponds. Should the WSP's capacity be increased beyond 10,000 EP then the applicable buffer is some 700 metres around the primary ponds and 400 metres around the secondary ponds. Compliance may not be achieved in this scenario.

Noise is expected to be a low risk at the Berrimah WSP's due to the nature of the treatment process and the buffer zones present. However communications with nearby neighbours should be considered during situations which may alter the existing conditions of the facility. Works at the site involving heavy machinery and an increase of noise levels are a low risk due to the proximity to sensitive receptors; however checks should be made to ensure compliance with relevant guidelines, such as the NT EPA's [Northern Territory Noise Management Framework Guideline](#), which provides recommended noise levels for various situations.

Grounds maintenance of the facility is to be undertaken routinely to maintain acceptable visual amenity of the site and should be conducted in accordance with the NT EPA's [Northern Territory Noise Management Framework Guideline](#).

Presence of faecal coliforms from effluent discharged to the estuarine creek is also a risk to public health. Pathogens can contaminate water making recreational use unsafe due to the risk of secondary contact. Recreational pastimes such as retrieving crab pots can lead to the potential secondary contact via inadvertent ingestion or possible dermal entry in the case of skin abrasions. Pathogens may also accumulate in shellfish which can then pose a public health issue if these shellfish are consumed. PWC need to ensure that maximum disinfection is achieved through treatment within the ponds.

8.7.2 Objective

To maintain a good working relationship with the community and neighbours of the facility.

8.7.3 Management Strategy

- Ongoing monitoring of pond performance, effluent discharge quality and receiving environment; odour monitoring implemented as required;
- Ongoing programmed visual inspections of facility including discharge area should be undertaken to check for any issues;
- Monitoring of the change of season should also be undertaken and notice given to the nearby public of any potential odours anticipated due to stratification of the ponds;
- Signage in place to warn public of risk associated with discharge; and
- Buffer zones enforced and remain in place.

8.7.4 Action

Senior Wastewater Coordinator will ensure that:

- Complaints from the nearby community are monitored and action as required;
- Where possible neighbours are notified prior of any potential disturbances i.e.:
 - odours due to change of season – stratification
 - noise due to works at ponds involving heavy machinery
- Grounds maintenance is undertaken regularly; and
- Pond operation undertaken as per Manual to ensure maximum treatment is provided and in turn minimum odour generated from the ponds.

8.7.5 Performance Indicators

- Zero complaints received.

8.7.6 Reporting

- All complaints received are to be logged within [Maximo](#) system and within the [Complaints Tracking spreadsheet](#).
 - Details regarding each complaint should meet requirements as per WDL.



8.7.7 Reference

- NT EPA. 2018. Northern Territory Noise Management Framework Guideline. Northern Territory Environment Protection Authority.
- PWC. 2005. Wastewater Treatment, Reuse and Discharge. Water Services, Power and Water Corporation, Darwin.

9 Community Relations and Liaison

9.1 Community Engagement

PWC see community engagement and awareness of wastewater issues as a high priority. PWC note that community engagement aims to:

- Understand issues associated with wastewater and the discharge;
- Minimise impacts of wastewater discharge by adhering to regulations associated with trade waste and stormwater discharge;
- Improve the community's confidence in how PWC treat and discharge wastewater; and
- Participate during the decision making process to develop strategies for managing sewage discharges.

9.2 Complaint Handling

All complaints received in regards to the Berrimah WSP's, whether it a complaint about the facility itself or in regards to the licenced activity, are all recorded and follow up contact is made to the complainant by the relevant PWC staff member with the intention of resolving their issue.

As per WDL146-08 Conditions 11 and 12, the licensee must maintain a Complaint Log for all complaints received by the licensee in relation to the activity. For each complaint received the following information must be recorded:

- The person to whom the complaint was made;
- The person responsible for managing the complaint;
- The date and time the complaint was reported;
- The date and time of the event(s) that led to the complaint;
- The contact details of the complainant if known, or where no details are provided a note to that effect;
- The nature of the complaint;
- The nature of event(s) giving rise to the complaint;
- Prevailing weather conditions at the time (where relevant to the complaint);
- The action taken in relation to the complaint, including any follow up contact with the complainant; and
- If no action was taken, why no action was taken.

All complaints are recorded within [Maximo](#), and complaints in regards to the licenced activity are also recorded within the [Complaints Tracking spreadsheet](#).

10 References

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PWC. 2015. Weeds, Pest and Disease Management. Environmental Work Practice. Environmental Services, Power and Water Corporation, Darwin. <http://pwdchedp01/HPRMWebDrawer/record/5692931/view>

PWC. 2018. Risk Assessment for the Discharge of Treated Effluent from the Berrimah Waste Stabilisation Ponds to Bleasers Creek. Water Services, Power and Water Corporation, Darwin. [D2017/487049](#)

PWC. 2018. Waste Water Stabilisation Pond Operation Manual. Water Services, Power and Water Corporation, Darwin. [BDOC2012/113](#)



Appendix 1 – SOC's in the NT

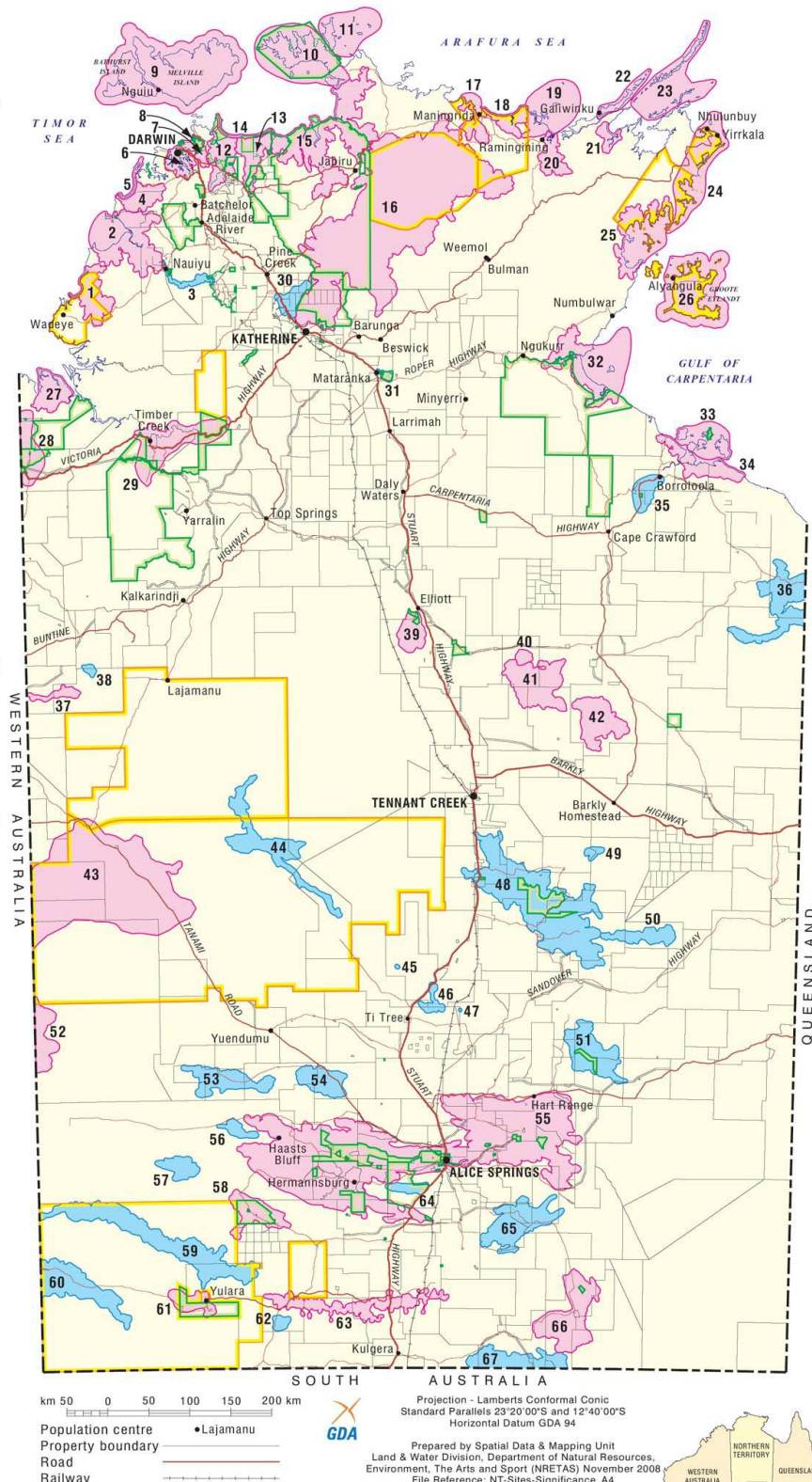
SITES of CONSERVATION SIGNIFICANCE in the NT

 **Northern Territory Government**
RECOGNISING SITES OF CONSERVATION SIGNIFICANCE FOR BIODIVERSITY VALUES IN THE NORTHERN TERRITORY

 Site of International Significance
 Site of National Significance

- 1 Hyland Bay and associated coastal floodplains
- 2 Anson Bay and associated coastal floodplains
- 3 Daly River middle reaches
- 4 Finnis River coastal floodplain
- 5 Fog Bay
- 6 Darwin Harbour
- 7 Howard sand plains
- 8 Shoal Bay
- 9 Tiwi Islands
- 10 Cobourg Peninsula
- 11 Croker Island group
- 12 Adelaide River coastal floodplain
- 13 Mary River coastal floodplain
- 14 Chambers Bay
- 15 Alligator Rivers coastal floodplains
- 16 Western Arnhem Plateau
- 17 Maningrida coastal habitats
- 18 Boucaut Bay and associated coastal floodplains
- 19 Castlereagh Bay and associated islands
- 20 Arafura Swamp
- 21 Buckingham Bay and associated coastal floodplains
- 22 Elcho Island group
- 23 Wessel and English Company island groups
- 24 Gove Peninsula and north-east Arnhem coast
- 25 Blue Mud Bay and associated coastal floodplains
- 26 Groote Eylandt group
- 27 Legune coastal floodplain
- 28 Keep River area
- 29 Victoria River middle reaches and Gregory area
- 30 Yinberrie Hills
- 31 Mataranka thermal pools
- 32 Limmen Bight and associated coastal floodplains
- 33 Sir Edward Pellew island group
- 34 McArthur River coastal floodplain
- 35 Borroloola area
- 36 Wollogorang and China Wall sandstone ranges
- 37 Birrindudu wetlands
- 38 Nongra Lake
- 39 Lake Woods
- 40 Eva Downs Swamp
- 41 Tarrabool Lake
- 42 Lake Sylvester system
- 43 South-west Tanami Desert
- 44 Lake Surprise and the Lander River floodout swamps
- 45 Mud Hut Swamp
- 46 Anmatyerr North
- 47 Wood Duck Swamp
- 48 Davenport and Murchison Ranges
- 49 Frew River floodout swamps
- 50 Elkedra River floodout swamps
- 51 Dulcie Range and surrounds
- 52 Lake MacKay
- 53 Newhaven Lakes
- 54 Lake Lewis and surrounds
- 55 Greater MacDonnell Ranges
- 56 Mount Liebig and surrounds
- 57 Cleland Hills and surrounds
- 58 George Gill Range and surrounds
- 59 Lake Amadeus and Lake Neale
- 60 Petermann Ranges and surrounds
- 61 Uluru and surrounds
- 62 Mount Conner and surrounds
- 63 Karinga Creek paleodrainage system
- 64 Waterhouse Range
- 65 Rodinga Range and adjacent ranges
- 66 Addado and Snake Creek lakes
- 67 Beddome Range and Wilyunpa Tablelands

 Park/Reserve
 Indigenous Protected Area,
Declared or Consultation Project



Projection - Lambert's Conformal Conic
Standard Parallels 23°20'00"S and 12°40'00"S
Horizontal Datum GDA 94
Prepared by Spatial Data & Mapping Unit
Land & Water Division, Department of Natural Resources,
Environment, The Arts and Sport (NRETAS) November 2008
File Reference: NT-Sites-Significance_A4
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Appendix 2 – Risk Assessment



Power and Water Corporation - Risk Register

Last Revised:	Next Review:
13/03/19	13/03/22

Procedure Version:	RM8 Folder:	RM8 Ref No:
1.0	F2009/1092	D2008 /214307
2.0	F2009/1092	D2018 /456132

Berrimah Waste Stabilisation Ponds

Risk ID	Environmental Category	Activity / Product / Service / Function / Issue	Source of Risk	Description of Risk (Potential Impact)	Inherent Risk			Existing Controls					Residual Risk		
					Likelihood	Consequence	Risk Score	Procedure / Work Instruction	Legal	Monitoring	Monitoring Freq	Other Controls	Likelihood	Consequence	Risk Score
1	Legal	Effluent disposal	Failure to implement water quality monitoring program involving breach of Wastewater Discharge Licence	Failure to meet regulatory requirements	Possible	Moderate	Medium	WSP Operation Manual & Wastewater, Reclaimed Water Quality Monitoring Program and WDL 146-08	Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Monitoring water quality to comply with the WDL	Fortnightly & Monthly (dependant on testing being performed)	Schedule sampling program in Maximo	Unlikely	Moderate	Medium
2	Water	Effluent disposal	Illegal disposal of Non Approved Waste	Effects effluent quality and receiving environment	Possible	Moderate	Medium	Ongoing trade waste tests and monitoring	Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Monitoring at ponds, discharge and receiving environment. Inspection of pump stations and treatment facilities, Public Reports	Fortnightly & Monthly (dependant on testing being performed)	Heavy Gattick Covers, public awareness / education, secure treatment facilities	Possible	Moderate	Medium
3	Water	Effluent disposal	Wastewater treatment process involving continuous discharge to Bleasers Creek (pathogens, metals, nutrients, physchem parameters)	Surface water contamination; Increase nutrient load in receiving waters (algal blooms); biodiversity change in receiving environment (fish kills, or increased number of aquatic plant species and mosquitoes)	Possible	Moderate	Medium	WSP Operation Manual & Wastewater and Reclaimed Water Quality Monitoring Program	Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Continuous monitoring of outfall volume and monitoring of wastewater quality in accordance with WDL	Fortnightly & Monthly (dependant on testing being performed)	Participate in Darwin Harbour Report Card, Hydrodynamic modelling	Possible	Moderate	Medium

4	Water / Land	Wastewater Treatment	Pond embankment erosion / failure resulting in effluent escaping (unauthorised discharge) to the environment	Surface water and groundwater contamination; increase in nutrient and organic load in receiving environment (i.e. algal blooms); flora and fauna impacted (i.e. fish kills), exposure of acid sulphate soils	Rare	Major	Medium	WSP Operation Manual	Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Routine inspections	Daily	Pond maintenance and upgrades as per asset planning / budgetary constraints	Rare	Moderate	Medium
5	Land / Biodiversity	Wastewater Pond Maintenance	Propagation of declared weed species at discharge site	Habitat loss; Biodiversity change; Increased cost and resources to combat weeds in the future; Failure to meet regulatory requirements	Possible	Moderate	Medium	WSP Operation Manual & PWC Weed Management Corporate Procedure (CONTROL0080)	Weeds Management Act 2001 (NT)	Routine inspections	Daily	Scheduled Weed spraying. Liaison with PWC Environmental Services for any Weed Identification.	Unlikely	Moderate	Medium
6	Land / Biodiversity	Wastewater Pond Maintenance	Pest Infestation	Biodiversity change; Increased cost and resources to combat pests; Failure to meet regulatory requirements	Possible	Moderate	Medium	PWC Weeds, Pest and Disease Management Work Practice (BDOC2015/187)	Weeds Management Act 2001 (NT)	Routine inspections	Daily	Scheduled Weed spraying. Liaison with PWC Environmental Services for any Weed Identification.	Unlikely	Moderate	Medium
7	Community	Wastewater Treatment	Odour related to wastewater treatment process. i.e. stratification, floating scums, gross pollutants	Localised odour; Public complaints	Likely	Minor	Medium	WSP Operation Manual	Waste Management and Pollution Control Act 1998 (NT)	Routine Inspections Register of customer complaints Odour Loggers	Daily As required basis Continuous odour logging	Maintenance of buffer zones around wastewater treatment system and discharge area If performance criteria regarding odour complaints are breached then instigate actions to minimise odour impacts. This may include: • Reviewing influent characteristics for abnormal/ upset conditions; • Reviewing pond performance; and • Investigating options for reduced odour (e.g. increased aeration, upstream treatment of sewage etc.).	Unlikely	Minor	Medium
8	Community	Effluent Disposal	Odour related to continuous effluent discharge	Localised odour; Public complaints	Likely	Minor	Medium	WSP Operation Manual	Waste Management and Pollution Control Act 1998 (NT)	Routine Inspections Register of customer complaints Odour Loggers	Daily As required basis Continuous odour logging	Maintenance of buffer zones around wastewater treatment system and discharge area If performance criteria regarding odour complaints are breached then instigate actions to minimise odour impacts. This may include: • Reviewing influent characteristics for abnormal/ upset conditions; • Reviewing pond performance; and • Investigating options for reduced odour (e.g. increased aeration, upstream treatment of sewage etc.).	Likely	Minor	Medium

9	Water / Land / Biodiversity	Trade Waste Management	Acceptance of licensed trade wastes to Power and Water's sewerage system involving contamination of effluent discharged	Reduced wastewater quality;Surface water and groundwater contamination;Soil contamination;Uptake of metals into the food chain (bioaccumulation)	Likely	Minor	Medium	Ongoing trade waste tests and monitoring	Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Monitoring at ponds, discharge and receiving environment	Fortnightly & Monthly (dependant on testing being performed)	Trade Waste Code, Natural Fuels Trade Waste Agreement, Bulk Waste Agreement for Hidden Valley sewage disposal	Likely	Minor	Medium
10	Land	Effluent disposal	Discharge impacting on outfall area	Erosion as a result of the physical release of water onto the surrounding land	Possible	Moderate	Medium	PWC Soil and Water Management Corporate Procedure (CONTROL0038) & Work Practice Soil and Erosion Management (BDOC2015/184)	Soil Conservation and Land Utilisation Act 1995	Routine inspections	Daily	International Erosion Control Association (IECA) Guidelines	Unlikely	Moderate	Medium
11	Water / Land / Biodiversity	Wastewater Pond Maintenance	Chemical Spill i.e. Preparation of herbicide involving a spill of concentrated chemical	Soil contamination; Surface water and groundwater contamination; Biodiversity Loss	Possible	Minor	Low	WSP Operation Manual & PWC Weed Management Corporate Procedure (CONTROL0080)	Weeds Management Act 2001 (NT)	Routine inspections	Daily	Do not bring concentrated chemicals on site (i.e. have it already prepared for application)	Unlikely	Minor	Low
12	Community	Wastewater Treatment	Noise related to onsite activities i.e. heavy machinery	Increase in noise levels due to onsite works	Unlikely	Minor	Low	PWC Corporate Procedure - Operational Risk Management (CONTROL0081) & Environmental Work Practice - Noise, Vibration and Light (BDOC2015/190)	Waste Management and Pollution Control Act 1998 (NT) & NT EPA Northern Territory Noise Management Framework Guideline	Routine Inspections Register of customer complaints Noise Loggers as required	Daily As required basis Continuous noise logging	Maintenance of buffer zones around wastewater treatment system and discharge area If significant noise is expected from the site contact PWC Environmental Services for assistance. A noise management plan may need to be developed and submitted to the NT EPA before undertaking works.	Rare	Minor	Low
13	Community	Wastewater Treatment	Reduced Visual Amenity	Unmaintained site resulting in public complaints.	Unlikely	Minor	Low	WSP Operation Manual	-	Routine Inspections Register of customer complaints	Daily As required basis	Maintenance as per works schedule	Rare	Minor	Low
14	Community	Wastewater Treatment	Wastewater discharge promoting the breeding of biting insects	Public health issues	Possible	Moderate	Low	WSP Operation Manual	Public and Environmental Health Act 2013 (NT) & Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations 1960 (NT)	Monitoring at ponds, discharge and receiving environment. Inspection and treatment for mosquitoes by Medical Entomology (ME) as required.	As required basis	Signage within Bleasers Creek near outfall warning public of risk.	Unlikely	Moderate	Low

15	Community	Effluent disposal	Effluent disposal to Bleasers Creek resulting in secondary contact by members of the public resulting in health issues (i.e. pathogens, algal blooms, consumption of contaminated shellfish)	Public health issues	Possible	Minor	Low	WSP Operation Manual	Public and Environmental Health Act 2013 (NT), Water Act 1992 (NT) and Waste Management and Pollution Control Act 1998 (NT)	Monitoring at ponds, discharge and receiving environment. Visual observations undertaken while sampling including receiving environment for any algal blooms.	Fortnightly & Monthly (dependant on testing being performed)	Ensure adequate disinfection is maintained within treatment ponds including adequate detention times. Signage within Bleasers Creek near outfall warning public of risk.	Unlikely	Minor	Low
16	Biodiversity	Effluent disposal	Wastewater treatment process involving continuous discharge to Bleasers Creek (pathogens, metals, nutrients, physchem parameters)	Biodiversity change in receiving environments; Decrease in natural aquatic species; Contamination of shellfish; Increase in pest species – weeds, mosquitos	Unlikely	Minor	Low	WSP Operation Manual	Weeds Management Act 2001 (NT), Public and Environmental Health Act 2013 (NT), Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations 1960 (NT) and Environment Protection and Biodiversity Conservation Act 1999	Routine inspections; Inspection and treatment for mosquitoes by Medical Entomology (ME) as required.	Daily	Monitoring vegetation changes in line with WDL. Monitoring water quality of Bleasers Creek as a background/reference point (under varying tidal influence).	Unlikely	Minor	Low
17	Water / Land / Biodiversity	Overflow	Unauthorised discharge; 1 in 50 year flood event	Surface water contamination; Groundwater contamination; Loss of gross pollutants to environment	Unlikely	Minor	Low	WSP Operation Manual and Sewer Spills/Overflow Response Work Instruction	Water Act 1992 (NT); Wastewater Discharge No. WDL87 (Expires Dec 07)	Routine inspections	Daily	Increased inspections dependant on rainfall received	Unlikely	Minor	Low