Environmental Risk Assessment - Gapuwiyak WwTP WDL 230-02

December 2025

PowerWater

Document History

Document Title:	Environmental Risk Assessment 2025 – Gapuwiyak WDL230-02			
TRIM Container:		F2016/4971	Document #	D2025/449597
Version:	**Date Prepared:**	**Prepared by:**	**Version reviewed by/Issued to:**	
Draft 0.1	17/04/2018	Emma Fakes Power and Water Corporation	Annie Andrews & David Sweeney Power and Water Corporation	
Final 1.0	22/05/2018	Remote Water Planning	Department of Environment and Natural Resources Northern Territory Government waste@nt.gov.au	
Draft 0.2	30/08/2021	Emma Fakes Power and Water Corporation	Tahlia Kemp Power and Water Corporation	
Final 2.0	17/09/2021	Remote Water Planning	Department of Environment, Parks & Water Security Northern Territory Government waste@nt.gov.au	
Draft 0.3	20/09/2023	Lenin Villamar Power and Water Corporation	Mark Rodriguez Power and Water Corporation	
Final 3.0	22/09/2023	Lenin Villamar Power and Water Corporation	Department of Environment, Parks & Water Security Northern Territory Government waste@nt.gov.au	
Draft 0.4	17/11/2025	Natasha McBride Power and Water Corporation	Tahlia Kemp Power and Water Corporation	
Final 4.0	19/12/2025	Natasha McBride Power and Water Corporation	Department of Environment, Parks & Water Security Northern Territory Government waste@nt.gov.au	

Abbreviations and Glossary

Abbreviation	Definition
ANZECC	Australian Water Quality Guidelines for Fresh and Marine Waters
ARMCANZ	Agriculture and Resources Management Council of Australia and New Zealand
Assessment endpoints	The explicit expressions of the actual environmental value that is to be protected, operationally defined by an ecological entity and its attributes.
BOD	Biochemical oxygen demand
BUD	Beneficial Use Declaration – the uses of water specified in subsection 3 of the *Water Act* (1992)
BOM	Bureau of Meteorology
CSM	Conceptual site model
Cultural values	To provide water to meet aesthetic, recreational and cultural needs.
DLPE	Department of Lands, Planning and Environment (NT)
DO	Dissolved oxygen
E. coli	*Escherichia coli*
Ebb tide	A falling tide - the phase of the tide between high water and the succeeding low water.
Environmental Values	To provide water to maintain the health of aquatic ecosystems.
EPBC	Environment Protection and Biodiversity Conservation Act
ERA	Environmental risk assessment
ET	Equivalent Tenement – an average residential dwelling or house. Other developments are converted to an ET value by relating their average water demand (or sewage flow) to demand from one average house.
Flood tide	A rising tide - the phase of the tide between low water and the next high tide.
ICEGs	Indigenous Community Engineering Guidelines
kL	Kilolitre
Km	Kilometre
L	Litre
m	Metre
m^2	Square metre
Macrotidal estuary	Estuaries where the tidal range is in excess of 4 metres.
mg	Milligram
mL	Millilitre
NOx	Nitrogen oxides – the sum of nitrate and nitrite ionic species.
NT	Northern Territory

NTU	Nephelometric turbidity units
NT EPA	Northern Territory Environmental Protection Authority
PL	Primary lagoon
Risk characterisation	The culmination of the planning, problem formulation and analysis of predicted or observed adverse ecological effects related to the assessment endpoints.
Risk hypothesis	Assumptions made in order to evaluate logical or empirical consequences, or suppositions tentatively accepted to provide a basis for evaluation. They are used to test if an activity (e.g. contaminant discharges) has adverse effects on an assessment endpoint.
SL	Secondary lagoon
SOCs	Site of conservation significance
SPS(s)	Sewage pump station(s)
SS / TSS	Suspended solids / total suspended solids
TDS	Total dissolved solids – the portion of solids in wastewater that passes through a 2.0 micron filter.
TN	Total nitrogen
TP	Total phosphorous
TPWC	Territory Parks and Wildlife Conservation Act
WDL	Waste discharge licence
WwTP	Wastewater treatment plant. All facilities that treat wastewater disposed of to the sewerage system consisting primarily of sewage as well as stormwater inflow and infiltration. These facilities may include a range of different types of treatment technologies e.g. waste stabilisation ponds.
WSP(s)	Waste stabilisation pond(s)

Executive Summary

This desktop environmental risk assessment (ERA) provides an assessment of the risks associated with the seasonal discharge of secondary treated effluent from the Gapuwiyak wastewater treatment plant (WwTP) point to an unnamed tributary of Habgood River.

Based on this ERA and water quality data, there is limited evidence to suggest deleterious impacts on the environmental values identified for this receiving environment.

Risks to the assessment endpoints, associated with the source, were assessed as having low risk rankings. Low risk rankings were associated with discharge to an allocated irrigation discharge area that may only overflow during extreme wet weather. It is not expected that treated effluent discharged from the Gapuwiyak WwTP will reach the tributary of the Habgood River often. Disposal of effluent from the facility is expected to occur through irrigation and evaporation on site.

The risk rankings may change as uncertainties associated with current assessments are addressed. A range of recommendations have been made in this risk assessment to address knowledge gaps and identify opportunities for improvement.

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1. Introduction

Power and Water operate the Gapuwiyak WwTP pursuant to Waste Discharge Licence (WDL) 230-02 issued on 11 December 2021. This WDL allows for continuous discharge of secondary treated sewage effluent from an authorised discharge point to an unnamed tributary of Habgood River.

Gapuwiyak is located on the shore of Lake Evella in north-east Arnhem Land, approximately 500 km east of Darwin (Figure 1). Gapuwiyak has an estimated population of 828 in 2021 (BushTel 2025). The Wastewater Treatment Plant (WwTP) is located approximately 320 m north-west of the Gapuwiyak Township.

Figure 1: Gapuwiyak location (Google Earth, 2025)

Figure 2: Gapuwiyak site layout including WwTP and Outfall (PWC ArcFM – Sewer 2025)

1.1 Background

Condition 31 of this WDL requires PWC to update the environmental risk assessment for the Licenced Activity.

Condition 31 of the WDLs specifies that the Environmental Risk Assessment must:

31.1 be conducted in reference to a conceptual site model;

31.2 characterise the impacts of discharge(s) on the relevant Environmental Values of the receiving environment

31.3 assess the risk to groundwater and surface water;

31.4 inform the development of the Performance Improvement Plan and Consultation Plan required in condition 32 and 33;

31.5 be submitted to the Administrating Agency every 2 years within 10 business days after each anniversary date of this licence; and

31.6 the Administrating Agency may require the licensee to revise, amend and/or resubmit the ERA.

2. Risk Assessment Methodology

The purpose of the desktop ERA is to:

- identify assessment endpoints;
- characterise environmental risks associated with the facility; and
- initiate an ongoing iterative environmental risk process associated with ongoing operation of the facility.

The methodology employed has been adapted from ERAs completed by the Power and Water's Assurance Team and the Victorian EPA *Guidance for Environmental and Human Health Risk Assessment of Wastewater Discharges to Surface Waters* (VIC EPA 2023). The guidelines utilise a framework (Figure 3) consistent with current nationally and internationally accepted risk assessment approaches.

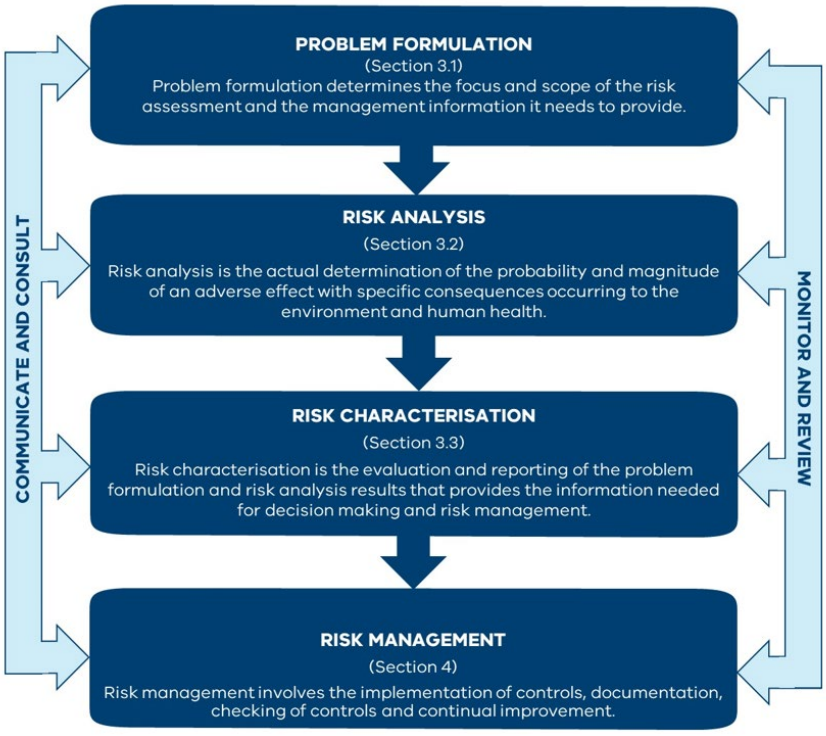

Figure 3: Risk Assessment framework for wastewater discharges to waterways (Victoria EPA, 2023)

2.1 Limitations

The following items have been identified as limitations associated with the preparation of this ERA:

- limited availability of inflow/outflow data; and
- remoteness of communities impacting on the ability to understand systems due to costs, logistics and available expertise.

3. Problem Formulation

The purpose of this ERA is to characterise the impacts of discharge on the relevant values and has been prepared with reference to section 1.1.

This problem is explored through the following:

- characterisation of the treated effluent discharged to the receiving environment;
- characterisation of the treated effluent discharge regime and subsequent dilution of treated effluent within receiving water; and
- identified values of receiving water and assessment endpoints representative of those values.

3.1 Gapuwiyak Wastewater Treatment Plant

The Gapuwiyak community utilises a sewer reticulation system that combines both pressure and gravity-fed mechanisms to transport raw sewage to the Gapuwiyak Wastewater Treatment Plant (WwTP), with the final 350 meters relying on gravity for conveyance. This WwTP employs waste stabilisation pond technology to achieve secondary-level treatment of sewage effluent. As of the current conditions, the sewage primarily comprises domestic waste with no chemical additives during the treatment process. The WwTP, including Ponds 1 and 2, was constructed in May 1988, while Pond 3 was later added around 1997.

The treatment process within the ponds involves a primary facultative pond that gravity feeds into a secondary maturation pond, with Pond 1 designed in a U-shape using concrete to enhance retention times and treatment rates. The treated effluent then flows from Pond 2 into the final maturation pond, where it is pumped out to an irrigation system triggered by an automatic float timer. When the water levels in the tertiary pond reach a certain threshold, a pump station activates, directing the treated effluent into the irrigation area. A generator and pump have been installed to recirculate and aerate effluent between Ponds 1 and 3, with Pond 1 requiring more circulation for optimal functioning.

Unlike some systems, there are no gross pollutant screening, grit removal, maceration, or storm flow separation components located at the inlet to the pond system. Instead, the removal of gross pollutants and other entrained materials primarily relies on sedimentation, leading to sludge layers or their entrapment in concentrated surface scums, which can then be physically removed. Periodic desludging of the WSPs is conducted as needed to eliminate accumulated solids and enhance hydraulic performance, potentially improving overall treatment efficiency. The most recent desludging activity at Gapuwiyak was completed in 2014. A pond capacity and performance assessment was undertaken in 2022 and found sludge content to be less than 30% in all ponds.

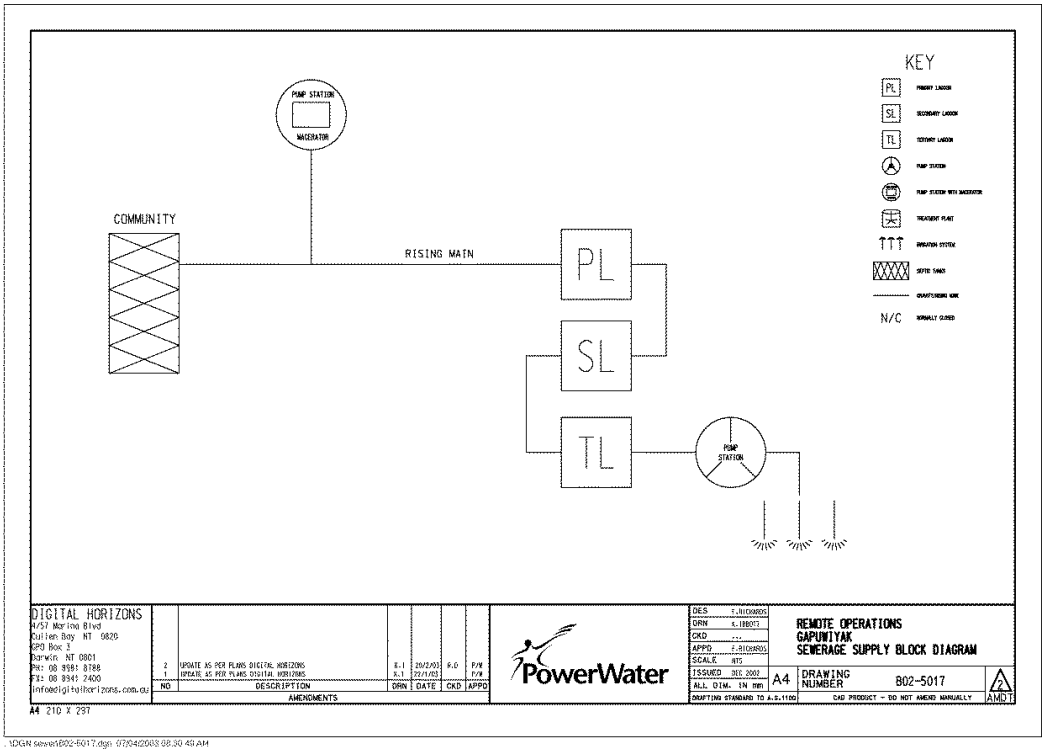

Figure 4: Gapuwiyak wastewater collection and treatment configuration.

3.2 Discharge Regime

The wastewater treatment facility in Gapuwiyak discharges effluent through an irrigation sprinkler system located in the northern corner of the facility. This system consists of approximately 40 sprinkler heads, extending over a 200-meter distance to the north and installed 50 cm above the ground on concrete footings. The sprinkler system operates consistently throughout the year, running for 2.5 to 10 hours per day, controlled by a timer. The discharge takes place within a designated irrigation paddock adjacent to the Wastewater Treatment Plant (WwTP) all year round. However, it has been identified that the irrigation system is prone to blockages and not operating optimally. Discussions are underway to improve address this issue.

A flow meter is installed at the Gapuwiyak discharge point. However, currently this data set contains inconsistencies, reducing confidence in the data statistics. Further data collation and assessment is required over a longer-term to provide more accurate measurements. Inflow data from flow meters is also not currently available, estimations have been utilised based on forecast sewage Equivalent Tenement (ET) flow, which may not accurately represent the inflow to outflow ratio on site.

- The estimated mean outflow from Gapuwiyak WwTP is **851.5 kL/day**

Note that the volume of treated wastewater discharged to the environment varies seasonally with changes in evaporation and rainfall, with maximum flow experienced during the wet season. The majority of this maximum flow is expected to be stormwater (Power and Water, 2014) and therefore the pollutant load is likely to be negligible.

3.3 Pond Performance

WSPs offer a low input, cost effective form of wastewater treatment that is particularly applicable in higher temperature environments with sufficient available land area. While the inputs are low, because it is largely driven by solar energy, the processes are no less complex and are largely controlled by the appropriate design and maintenance of the pond system to achieve the treatment performance required.

The ponds ultimately provide a centralised treatment barrier that prevents direct contamination of the receiving environment and have an important role in the protection of both environmental and public health.

Wastewater monitoring at the Gapuwiyak primary pond inlet commenced in August 2020. However, the dataset is limited, and additional monitoring is needed for a more accurate long-term assessment.

Pond treatment performance can be measured at remote community sites utilising median biochemical oxygen demand (BOD) removal performance and median predicted *E.coli* disinfection performance. The results are a reduction in concentration levels from the primary pond inlet to the final pond outlet.

Current median removal percentages at Gapuwiyak WwTP:

- Biochemical Oxygen Demand (BOD): **65%**
- Free Ammonia (NH_3-N): **54%**
- Total Nitrogen (TN): **29%**
- Total Phosphorus (TP): **6%**

The average log reduction for the pathogens indicator is:

- *E. coli:* **4.2 log reduction**

For the scope of this risk assessment, wastewater quality monitoring data collected at the final pond discharge point to the receiving environment are illustrated on the conceptual site model (CSM) Appendix 1 (Figure 10), and water quality table Appendix 3 (Table 7).

Figure 5. Irrigation disposal area at Gapuwiyak (PWC 2018)

Figure 6. Irrigation overflow culvert (PWC 2018)

Figure 7. Evidence of Buffalo in irrigation discharge area (PWC 2018)

Figure 8. Recirculation generator (PWC 2021)

3.4 Receiving Environment

The receiving environment consists of an irrigation paddock amongst open Eucalyptus Forest (DENR 2018). This irrigation system, characterised by a linear arrangement of sprinklers spaced at 5-meter intervals, extends all the way to the furthest northern end of the paddock (as depicted in Figure 5). However, there have been maintenance issues identified within the Gapuwiyak disposal area. Furthermore, an assessment indicates that the irrigation disposal area is situated upon a sloped terrain with compacted soil conditions, which, in turn, contribute to the treated effluent's natural flow towards the western edge of the irrigation paddock boundary. In response to this, a culvert had been constructed to contain and manage the irrigation flow within the boundaries of the paddock (Figure 6). Additionally, the presence of evapotranspiration processes plays a significant role in reducing the effluent volume that might exit the area.

During the Dry Season, Buffalo damage sprinkler heads while seeking water, adding to the existing issues. PWC are assessing options to address these issues.

A small, nameless tributary of the Habgood River lies approximately 800 meters to the north of the Wastewater Treatment Plant (WwTP) and currently receives water discharged from the irrigated paddock. The distance from this unnamed tributary to the Habgood River itself spans approximately 21 kilometres. It is currently unknown whether effluent reaches the Habgood River. The estimated area of the main river from the connected to tributary is approximately 2.76 square kilometres.

Figure 9. Distance between Gapuwiyak WwTP to Habgood River via an unnamed tributary is 21 km.

Lake Evella, situated to the south of the Gapuwiyak Wastewater Treatment Plant (WwTP), presents a reassuring scenario. Our online area survey indicates that the discharge is unlikely to reach the lake. This confidence is from the presence of substantial geographical barriers between the WwTP and the lake, even if the lake were closer in proximity than the Habgood River. The natural features of the landscape serve as a protective shield against any potential discharge impact on Lake Evella.

Gapuwiyak is not located in a site of conservation significance however does contain 1 threatened fauna species (DENR 2018). The conservation status for these species listed under the Territory Parks and Wildlife Conservation Act 2000 (TPWC) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC) are summarised below in Table 1.

Table 1: Conservation status of species at risk from the Gapuwiyak WwTP.

Common name	Species name	National Status (EPBC)	NT Status (TPWC)
Fauna			
Eastern Curlew	*Numenius madagascariensis*	CR	CR

CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient

3.5 Screening Level Risk Assessment

A screening level risk assessment is used to determine if a risk to the assessment end-point exists that should be further investigated. It is a method for prioritising risks and minimising effort in assessing low risks. Table 3 provides a summary of the screening level risk assessment.

Risk hypotheses for the stressors identified in the conceptual site model (CSM) (Appendix 1, Figure 10) are defined with respect to their potential effects on the identified values of the receiving environment.

The identified values of the receiving environment are summarised below in Table 2.

Table 2: Identified values of receiving environment at risk from the Gapuwiyak WwTP

Values	Receptors	
Cultural/ Human Health	Humans	Fishing (lines, nets and spears) Shellfish harvesting Visible water quality Sacred sites
Environment	Terrestrial	Wading birds Invertebrates (water insects) Mammals Reptiles
	Plants	Native vegetation

Table 3. Screening level risk assessment for key indicator and stressors associated with Gapuwiyak WwTP discharge.

Indicator (water quality parameter)	Stressor (change to indicator)	Risk Hypothesis		Assessment end-points		Scope of this desktop ERA	Further investigation required?
		ENVIRONMENTAL	CULTURAL	ENVIRONMENTAL	CULTURAL		
Gross pollutants	Presence and accumulation of gross pollutants from influent carried through to effluent	That gross and micro-scale pollutants are ingested by biota resulting in death of animals and environmental degradation.	That gross pollutants are resulting in the reduction of visual amenity in the receiving environment.	To maintain the presence of biota in the environment.	To maintain the visual amenity of the environment.	The WwTP is considered a relatively effective barrier to gross pollutant entry to the receiving environment. This is due to the settling out to sludge layers and accumulation on pond surface where gross pollutants are physically removed as required. No evidence of gross pollutant accumulation during visual monitoring of discharge site (qualitative discharge criteria). No further investigation necessary at this stage.	No
Organic matter	Increase in BOD, decrease in DO	That BOD is leading to oxygen depletion in the environment resulting in loss of biota (e.g. fish kills) and changes to ecosystem structure.	That BOD is leading to odours resulting in the reduction of amenity in the receiving environment.	To maintain the presence of biota in the environment.	To maintain oxygen levels in the environment sufficient to prevent production of odours.	The median concentration of BOD in the discharge of Gapuwiyak WwTP is 40.5 mg/L. As BOD is present in the discharge, it is determined at a screening level that a risk is present and further investigation is necessary.	Yes
Nutrients (nitrogen and phosphorus)	Increase in nutrient concentrations	That nutrients are leading to nuisance plant growth (e.g. phytoplankton blooms) resulting in oxygen depletion; displacement of endemic species; diminished light availability; release of toxins; and changes to ecosystem structure.	That nutrients are resulting in the reduction of amenity of receiving environment through reduction in water clarity, objectionable discoloration and odours; toxic blooms that are a public health risk; and blooms of toxin producing species whereby the toxins bio-accumulate in shellfish and fish ingested by humans.	To maintain nutrient levels so that the levels of primary production do not have an adverse impact on ecosystem structure.	To maintain the amenity of the environment.	As nutrients are present in the discharge, it is determined at a screening level that a risk is present and further investigation is necessary.	Yes
Toxicants	Increase in free ammonia concentration	That free ammonia is resulting in toxicity to aquatic organisms in water and sediments.		To maintain the presence of biota in the environment.		The median concentration of free ammonia in the discharge of Gapuwiyak WwTP is 16 mg/L. At a screening level it is determined that a risk is present and further investigation is necessary.	Yes
Pathogens	Presence of *E. coli*		That pathogens are leading to the contamination of water resulting in primary and secondary contact recreation a public health risk; and accumulation in shellfish resulting in the consumption of shellfish a public health risk.		To maintain that pathogens from municipal wastewater are not increasing the risk of illness via primary and secondary contact recreation and consumption of shellfish.	The median pathogen concentration in the discharge of Gapuwiyak WwTP is 8,185/100mL. At a screening level it is determined that a risk is present and further investigation is necessary.	Yes

4. Risk Analysis and characterisation

4.1 Power and Water Risk Management Framework

Power and Water has adopted a qualitative risk assessment methodology aligned to the Australia/New Zealand Standard *"AS/NZ 4360: Risk Management"*. This process is used to assess and manage activities that have potential to cause environmental harm.

The first step in the ERA process is to identify the aspects (problem formulation i.e. discharge of treated wastewater) (section 2.0) and corresponding potential impacts associated with each assessment endpoint identified in the screening level risk assessment as seen in Table 3.

This methodology is based on knowledge of the existing environment and incorporates site specific environmental factors into the analysis of the potential impacts. An assessment of each impact is analysed for likelihood and consequence.

The categories and associated rankings for environmental impact consequences are shown in Appendix 2 (Table 5). The likelihood of an event occurring and a risk score for each potential impact is determined by combining likelihood with consequence results as seen in Appendix 2 (Figure 11).

Low to medium risks can typically be managed by routine procedures and integration into management plans, while high to extreme risks require senior management attention, immediate action or more detailed research and management planning.

3.1.1 Risk assessment for key indicators and stressors identified in screening level assessment.

Table 4: Risk assessment for key environmental and cultural assessment endpoints associated with Gapuwiyak WwTP discharge.

Hypothesis	Consequence	Likelihood		Inherent Risk Ranking	
Environmental					
BOD leading to oxygen depletion in the environment resulting in **loss of biota** and **changes to ecosystem structure**.	Based on the most recent monitoring period, Gapuwiyak WwTP median BOD discharge quality is 40.5 mg/L. It is not expected that the discharge from the WwTP will reach a surface water body during the dry or wet seasons, with effluent filtered into soil within the irrigation area or evaporated; however if overflow was to reach the creek, the dilution rate to the receiving environment would be 1:34, therefore suggesting any observed oxygen demand would be absorbed by the environment.	Minor	Based on the dilution ratio between effluent and receiving environment and the nature of the receiving environment, PWC considers that the likelihood of oxygen depletion in receiving environmental waters may be unlikely. Ongoing sampling will assist to characterise discharge quality.	Unlikely	Low
Free ammonia resulting in **toxicity to aquatic organisms** in water and sediments.	Toxicity to aquatic organisms may only be applicable to localised invertebrate populations and sediment dwelling organisms at immediate discharge point. One of the most visible means by which toxicity presents in an aquatic ecosystem is through the occurrence of fish kills. No fish kills reported to date.	Minor	Stressor not typically observed with such small discharge volumes on to ground. Under extreme circumstances the distance to the creek would provide a buffer for any impacts from free ammonia in the discharge. Other source inputs within the discharge area are also unknown – birds, buffalo etc.	Unlikely	Low
Nutrients leading to **nuisance plant growth** resulting in oxygen depletion; displacement of endemic species; diminished light availability; release of toxins; and changes to ecosystem structure.	Based on WDL sampling to date, Gapuwiyak WwTP contributes very low levels of total nitrogen and phosphorus 1.5 and 0.48 tonnes/year respectively. No eutrophication/ algal blooms or scums have been observed in the creek. Nutrients would most likely be filtered out before reaching the creek.	Minor	Stressor not typically observed with such small discharge volumes, and nutrients may filter out into soil within immediate discharge area.	Unlikely	Low
Cultural/ Human Health					
BOD leading to odours resulting in the **reduction of amenity** in the receiving environment.	Access to the discharge point is possible; however, observations during site inspection suggest minimal cultural beneficial uses of the receiving environment. It is assumed all recreational activities occur in Lake Evella (PWC 2025).	Minor	Stressor not typically observed with such small discharge volumes. Odours would be contained within private property during dry season, during wet season further dilution would occur. PWC considers that the likelihood of reduction in amenity from BOD is unlikely.	Unlikely	Low
Nutrients resulting in the **reduction of amenity** of receiving environment through **reduction in water clarity**, objectionable **discoloration** and **odours**.	Minimal cultural beneficial uses of the receiving environment, on rare occasions the public may access the immediate discharge site. Effluent would be filtered through the 800 m distance to the creek.	Minor	Stressor not typically observed with such small discharge volumes to ground. PWC considers that the likelihood of reduction in amenity from nutrients is unlikely.	Possible	Low
Nutrients resulting in **toxic blooms** that are a public health risk; and **blooms of toxin producing species** whereby the toxins bio- accumulate in shellfish and fish ingested by humans.	Minimal cultural beneficial uses of the receiving environment observed. Nutrients in effluent would be absorbed by vegetation within the irrigation area; however, if overflow was to reach the creek, the dilution rate to the receiving environment would be 1:34.	Minor	Discharge in the dry season is restricted to the WwTP boundary. During the wet season high rates of dilution would occur. PWC considers that the likelihood of toxicant exposure is still unlikely.	Unlikely	Low
Pathogens leading to the **contamination of water** resulting in primary and secondary contact recreational a public health risk.	The area is identified as having minimal cultural beneficial uses for primary and secondary recreation. Crocodiles may inhibit use of the creek.	Minor	Based on the rare occasion that secondary contact recreation and cultural uses of the creek may occur, the distance for filtration from the immediate discharge point is significant, PWC considers that the likelihood of the illness from pathogen exposure is unlikely.	Possible	Low

5. Summary

The ERA found that the identified values of the nearby freshwater creek at risk from the Gapuwiyak WwTP discharge were environmental and cultural/ human health.

The key stressors that posed a risk to these values were increase in BOD; increase in nutrient concentrations; increase in free ammonia concentration and the presence of *E. coli*.

The ERA process has determined that the discharge from the Gapuwiyak WwTP poses low risk to the identified values of the receiving area. The influence of the discharge on the receiving environment is considered sustainable given irrigation and evaporation is used as a primary disposal method with most effluent disposed of on site. If discharge were to reach the creek during the wet season, significant dilution would occur. Based on this ERA and modelled water quality data, there is limited evidence to suggest deleterious impacts to the receiving environment.

All risk rankings have considerable uncertainties attached to the assessments. The risk rankings may change as uncertainties associated with current assessments are addressed.

Based on the ERA process and outcomes, Power and Water make the following recommendations:

- continue monitoring quality of wastewater discharged to the environment;
- assess pond performance;
- incorporate recommendations into future Performance Improvements Plans;
- implement options to accurately quantify the volume of treated wastewater discharged to the environment; and
- update the ERA and CSM based on new information and additional wastewater quality data.

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Appendices

Number	Title
Appendix 1	Gapuwiyak Conceptual Site Model
Appendix 2	Power and Water Risk Matrix
Appendix 3	Water quality and estimated dilution Ratio for Gapuwiyak WwTP

Appendix 1 – Gapuwiyak Conceptual Site Model

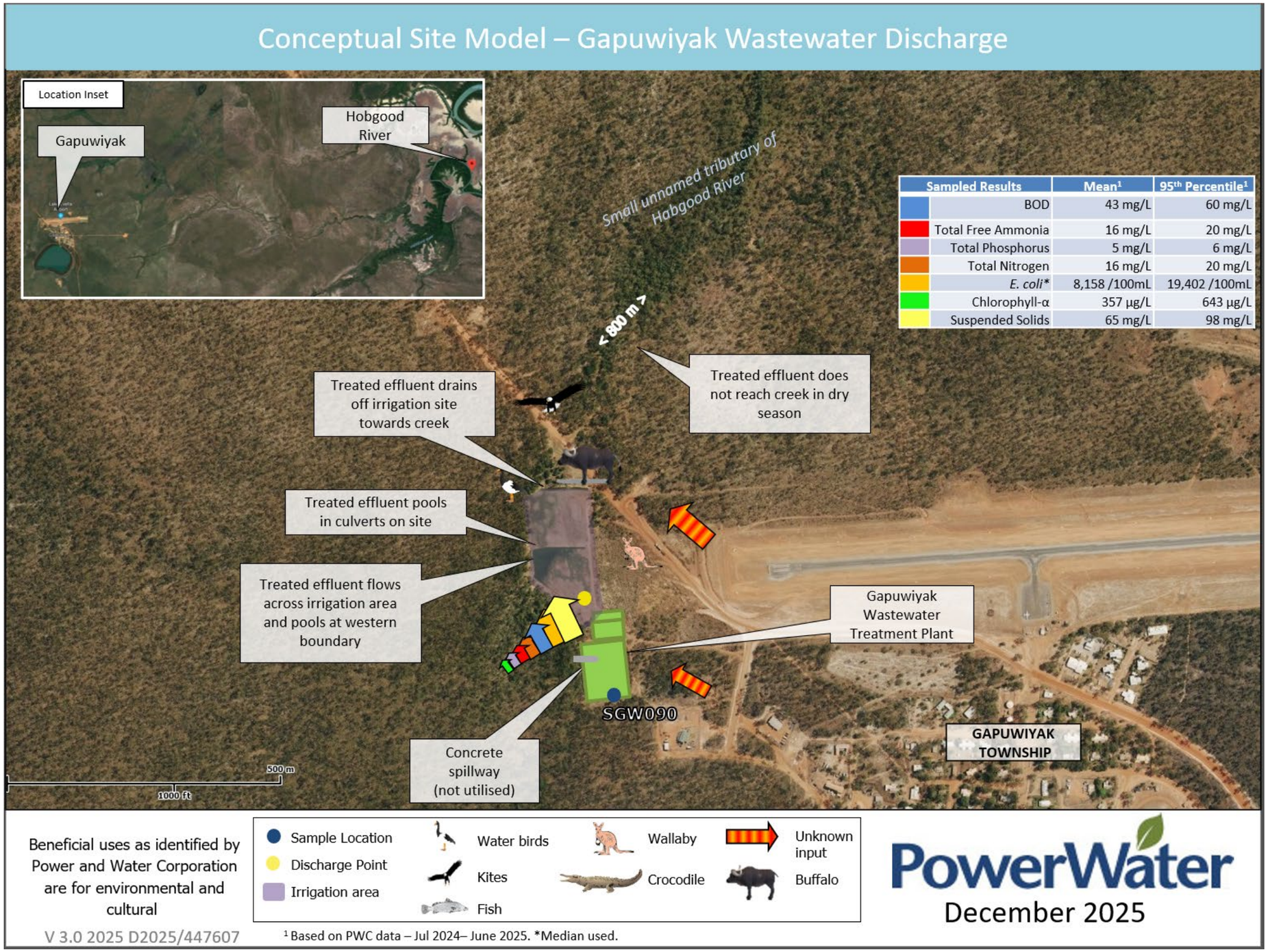

Figure 10: Conceptual site model for the Gapuwiyak WwTP.

Appendix 2 – Power and Water Risk Matrix

Table 5: Power and Water risk consequence table.

CONSEQUENCES

The consequence (impact or outcome) associated with a risk is assessed using the following criteria:

RISK CONSEQUENCE TABLE					
Category	**Insignificant**	**Minor**	**Moderate**	**Major**	**Severe**
Health and safety	**Physical**: A near miss incident without injury or illness. **Psychosocial*:** No treatment needed from a health professional. *Notes: Psychosocial harm relates to the factors in the design or management of work that increases the risk of work-related stress and can lead to psychological or physical harm.	**Physical:** An incident resulting in a minor injury or illness, and first-aid treatment applied. **Psychosocial**: Reduced ability to perform tasks, no professional treatment needed.	**Physical:** An incident resulting in an injury or illness requiring medical treatment*. **Psychosocial:** Reduced ability to perform tasks, likely needs ongoing support from a health professional. *Notes: Medical treatment relates to treatment by a medical professional at a medical facility. Treatment at a worksite by a paramedic is a first aid injury, unless they are transported to a medical facility.	**Physical:** A serious incident: ▪ Requiring hospitalisation (24hrs); and/or ▪ Resulting in long-term permanent disabling; or ▪ Exceeding of chemical exposure with acute health impacts. **Psychosocial:** Serious psychological treatment needed, reduced ability to perform tasks.	**Physical:** A serious incident resulting in any one or more of the following: ▪ One or more fatalities; ▪ One or more persons seriously injured (includes long-term disabling effect); ▪ Widespread hospitalisation of members of the public or Power and Water's workforce. **Psychosocial**: Inability to perform tasks, ongoing extensive psychological treatment.
Financial **(Impact on EBITDA)**	Loss less than $500K.	Impact between $500K and $5M.	Impact between $5m and $25m.	Impact between $25m and $50m.	Impact greater than $50m.
Legal/ regulation	▪ Individual breach of obligation, procedure or policy. ▪ Civil action, fines and/or civil penalties (refer to Financial definition)	▪ Notification to regulator required. ▪ Regulator/external auditor non-conformance or request for further explanation ▪ Functional breach of obligation, procedure or policy. ▪ Civil action, fines and/or civil penalties (refer to Financial definition)	▪ Regulator/ external auditor issues improvement notice, multiple non-conformances or provisional improvement notice. ▪ Systemic breach of obligation, procedure or policy. ▪ Civil action, fines and/or civil penalties (refer to Financial definition)	▪ Regulator issues notices, corrective action order and/or penalties ▪ Order to stop work ▪ Multiple provisional improvement notices, prohibition notice. ▪ Civil action, fines and/or civil penalties (refer to Financial definition)	▪ Successful criminal prosecution imprisonment of Power and Water director and/or officer. ▪ Royal Commission, parliamentary or other government inquiry, ▪ Loss of licence to operate. ▪ Civil action, fines and/or civil penalties (refer to Financial definition)
Environmental	Localised low level damage controlled but no remedial action required.	Localised low level damage controlled and remedied with minimal resources.	Widespread temporary damage with extended resources to remedy.	Long-term detrimental effect on environment and once controlled results in minor permanent damage.	Substantial permanent damage to widespread and sensitive areas.
Reputation	▪ No media attention; and/or ▪ Isolated community or individual issue-based concern; and/or ▪ Localised employees dissatisfaction which is managed by normal business processes;	▪ Occasional once-off negative media attention; and/or ▪ Localised community impacts and customer concerns; and/or ▪ Localised employees dissatisfaction which requires human resources in resolution;	▪ Brief adverse media attention and/or ▪ Community/customer condemnation; and/or ▪ Limited, localised loss of confidence by the community; and/or ▪ Reduced confidence of key stakeholders ▪ Localised employees dissatisfaction with localised impacts to service delivery	▪ Prolonged adverse media attention and/or ▪ Community/ customer condemnation; and/or ▪ Prolonged, widespread community/ customer loss of confidence; and/or ▪ Confidence of key stakeholders damaged ▪ Widespread dissatisfaction and loss of confidence by employees resulting in temporary service delivery	▪ Sustained adverse media attention and/or ▪ Community/customer condemnation; and/or ▪ Sustained community/ customer loss of confidence; and/or ▪ Loss of stakeholder confidence in Board and/or ▪ Management; and/or ▪ Widespread dissatisfaction by employees resulting in sustained service delivery and industrial action
Customer **(Impact due to disruption to services)**	▪ No loss of supply. Issues rectified with corrective action. ▪ Loss of water supply <= 2 hours in any urban or remote community	▪ An event resulting in loss of a single residential feeder for 15 to 30 minutes ▪ Loss of water supply >2 hrs and <= 6 hours in any remote community ▪ Loss of water supply in urban area, restored within expected timeframes (<=4 hours)	▪ An event resulting in loss of a single to multiple zone substations for up to 3 hours ▪ Loss of water supply >6 and <=12 hours in any remote community ▪ Loss of water supply in urban area outside of expected timeframes (> 4 hours and <=12 hours).	▪ An event resulting in loss of a single to multiple zone substations affecting CBD, town centres, commercial, and emergency services lasting up to 6 hours ▪ Loss of water supply >12 hours < =24 hours in any urban area or remote community.	▪ An event resulting in loss of a single to multiple zone substations affecting CBD, town centres, commercial, and emergency services lasting > 6 hours ▪ Complete loss of water supply (>24 hours) in any urban or remote community.

LIKELIHOOD

The likelihood of a risk occurring is assessed using the following scale:

(E) Almost certain	Event is expected to occur on a regular basis. One or more times per annum.	Not applicable
(D) Likely	An event is expected to occur from time to time. Once every 1 – 3 years	Probability of occurring is greater than 33%
(C) Possible	An event should occur at some time. Once every 4 – 10 years.	Probability of occurring is greater than 10% and up to and including 33%
(B) Unlikely	An event could occur at some time. Once every 11 to 30 years	Probability of occurring is greater than 3% and up to and including 10%
(A) Rare	An event not expected but possible. Less than once in 30 years	Probability of occurring is up to and including 3%

RISK RATING

Consequences and Likelihood

Likelihood \ Consequence	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Severe (5)
Almost certain (E)	Medium	High	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	Low	Medium	Medium

ACTIONS AND REPORTING

	Low	Medium	High	Very High	Extreme
Escalation (new risk or reassessment)	Reported through risk review process.	Reported through risk review process.	Reported to executive general manager	Reported to CEO / Executive Leadership Team as soon as practicable.	Reported to Board Chair as soon as practicable.
Reporting to ARMC	Not applicable.	Not applicable.	To be reported to Audit and Risk Management Committee on a quarterly basis.	To be reported to Audit and Risk Management Committee on a quarterly basis.	Exception reporting as soon as practicable.
Tolerance	Tolerable unless otherwise determined by management.	Tolerable unless otherwise determined by management.	Tolerance to be determined by executive general manager.	Tolerance to be determined by CEO / Executive Leadership Team.	Tolerance to be determined by Board.
Risk monitoring	Reporting frequency to be annual.	Reporting frequency as per related business process.	Status to be reported to executive general manager at each business unit management meeting. Reporting frequency to be quarterly.	Status to be reported to each ELT. Reporting frequency to be quarterly	Status reported to each Board meeting. Reporting frequency to be quarterly

Note: "Escalation" refers to the escalation of **risks** (i.e. events that could happen in future) not **incidents** (events that have happened). Escalation of incidents is covered by the *HSE Incident and Investigation Management Procedure (CONTROL0070)*.

Figure 11: Power and Water likelihood, risk ranking, actions and reporting matrix.

Appendix 3 – Water quality and estimated dilution Ratio for Gapuwiyak WwTP

Under the scenario where treated wastewater overflows towards the creek, significant dilution and augmentation of the flow by rainfall would occur. Dilution of the treated wastewater would occur both in the disposal area, and due to mixing with rainwater captured in the catchment upstream of the disposal area. The catchment upstream of the overflow point and the path of diluted outflow is identified in Figure 8. A conservative dilution factor is calculated below based on the volume of rainfall falling on this catchment and the disposal area during the wet season.

Figure 12. Catchment for Gapuwiyak WwTP (NT ILIS 2017)

Table 6. Discharge volume and dilution ratio calculation

Approx. catchment upstream of outflow point (m^2)	Disposal area (discharge area) (m^2)	Mean rainfall (Dec-Mar) (mm/d)	Mean evaporation (Dec-Mar) (mm/d)	Mean treated wastewater outflow (Dec-Mar) (kL/d)
1143500	162362	11.51	4	251
Volume of rain fall capture in disposal area and upstream of overflow point (rainfall-evap) (kL/d)	8587			
Dilution ratio at overflow point	1:34			

*BOM station 14517 (Ngayawili) has been used as this is the closest operational weather station.

Table 7: Summary of 2024-2025 Gapuwiyak water quality results

Sample Location/Asset: SGW090 (Pond 3 Outlet)	
Indicator	**Median**
Physio-chemical Parameters	
pH (pH units)	7.46
Electrical Conductivity (uS/cm)	400
Dissolved Oxygen (% Saturation)	10.0
Turbidity (NTU)	85.5
Total Suspended Solids (mg/L)	57.5
Biological Parameters	
Biochemical Oxygen Demand (mg/L)	40.5
Chlorophyll-a (ug/L)	262.5
Nutrient Parameters	
Ammonia (Total as N – NH3-N) (mg/L)	16.0
Total Nitrogen (mg/L)	16.1
Oxidised Nitrogen (NOx) (mg/L)	<0.1
Total Phosphorus (mg/L)	5.2
Pathogen Indicators	
Escherichia coli (CFU/100mL)	8,185
Enterococci (CFU/100mL)	9,020

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