2025 Environmental Risk Assessment - Beswick Wastewater Treatment Plant WDL 228-02

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PowerWater

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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 ERA for the Beswick WwTP, prepared in accordance with Waste Discharge Licence 228-03, evaluates the environmental risks associated with the discharge of secondary-treated effluent to a secured irrigation field. The assessment was conducted by the PWC assurance team using the Victorian EPA Guidelines for Risk Assessment of Wastewater Discharges to Waterways.

Effluent monitoring demonstrates consistent secondary treatment performance, with low concentrations of BOD, nutrients, and free ammonia. This indicates an overall sufficient effluent quality for discharge into a closed irrigation field via an irrigation sprinkler system. Several site inspections showed no evidence of overflows or detrimental effects to the receiving environment.

The nearest surface water receptor, Waterhouse River, is located 277 m from the irrigation field. Only extreme wet-season flood events present a plausible pathway for effluent to reach the waterway. A dilution assessment indicates a worst-case dilution ratio of approximately 1:8546, confirming that any influent reaching the river would be reduced to concentrations unlikely to cause environmental harm.

Overall, the ERA concludes that the Beswick WwTP presents a low risk to cause any effects into the environment, including any risks to environmental and cultural benefits of the environment identified in this report. Treatment has been identified to be effective and natural attenuation processes mitigating potential impacts of discharge. Continued monitoring is recommended to maintain data integrity and support ongoing risk management.

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1. Introduction

Power and Water operate the Beswick WwTP pursuant to Waste Discharge Licence 228-02. This license allows discharge of secondary treated sewage effluent from an irrigation system to land that flows to Waterhouse River.

Beswick is a remote Aboriginal community located in the Top End region of the Northern Territory, 118 km southeast of Katherine, and is part of the Daly River Catchment (Figure 1). Beswick community has an estimated population of 542 in 2021 (CENSUS 2021). The WwTP is located approximately 580 m west of the Beswick Township (Figure 2).

Figure 1: Beswick WwTP location (Google Earth, 2025)

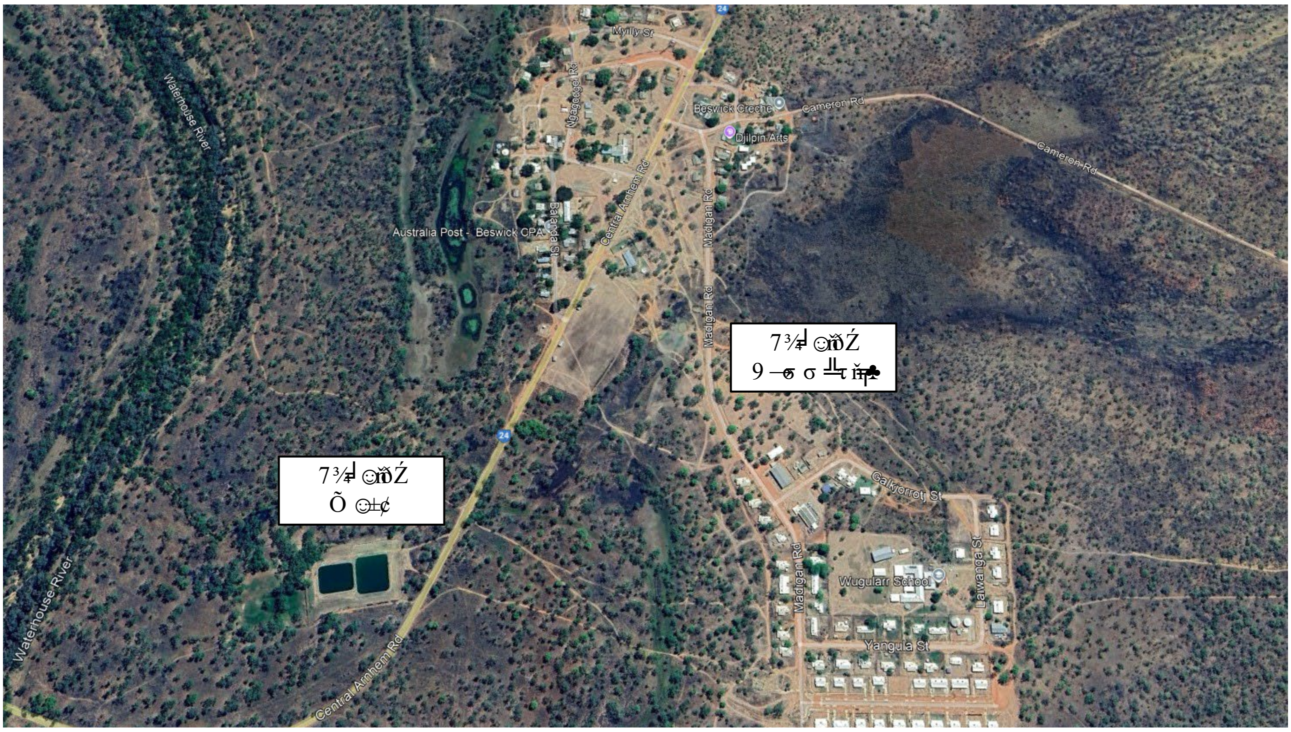

Figure 2: Beswick Community and WwTP site (NT ILIS 2025)

1.1 Background

Condition 32 of this WDL requires PWC to update the environmental risk assessment for the Licenced Activity.

Condition 32 of the WDLs specifies that the Environmental Risk Assessment must:

32.1 be conducted in reference to a conceptual site model;
32.2 *characterise the impacts of discharge(s) on the relevant Environmental Values of the receiving environment;*
32.3 *assess the risk to groundwater and surface water;*
32.4 *inform the development of the Performance Improvement Plan and Consultation Plan required in condition 32 and 33;*
32.5 *be submitted to the Administrating Agency every 2 years within 10 business days after each anniversary date of this licence; and*
32.6 *the administering agency may require the licensee to revise, amend and 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 2025). The guidelines utilise a framework (Figure 3) consistent with current nationally and internationally accepted risk assessment approaches.

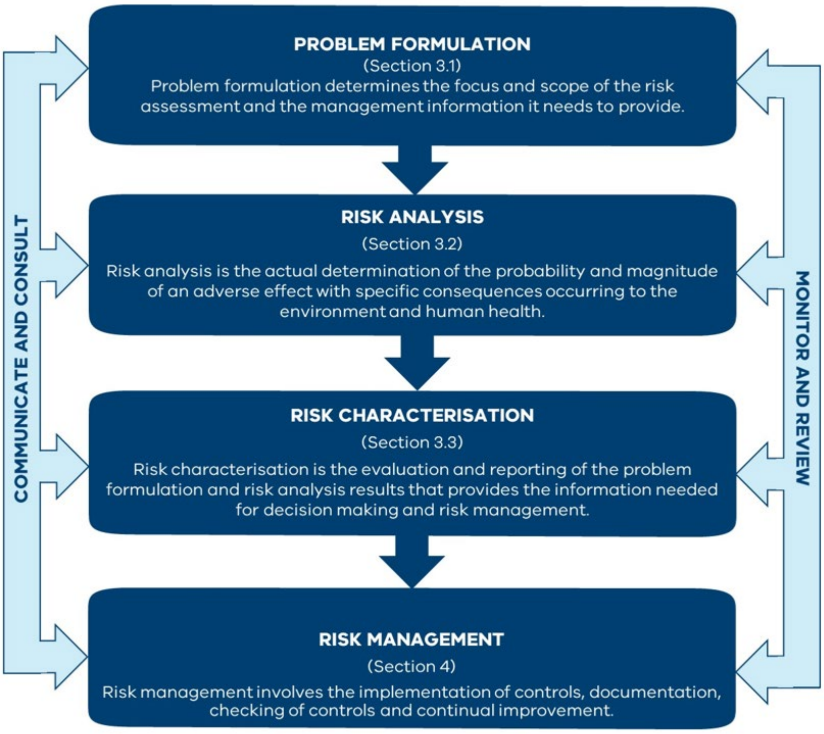

Figure 3: Risk Assessment framework for wastewater discharges to waterways (Victoria EPA, 2025)

2.1 Limitations

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

- limited availability of inflow/outflow data;
- Lack of data required for non-estimate calculations of dilution ratios and mass loads;
- remoteness of communities impacting on the ability to understand systems due to costs, logistics and available expertise; and
- limited ability to monitor discharge during river flooding to assess impacts

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;
- Likelihood of the treated effluent escaping the secured irrigation field; and
- Potential impact of the discharge on the surrounding environment in the event of effluent escaping the secured irrigation field.

3.1 Beswick Wastewater Treatment Plant

The community uses a pressure fed sewer reticulation system which pumps raw sewage from the community to Beswick WwTP. The inflowing sewage is primarily domestic and is treated using non-chemical pond technology to achieve secondary level treatment of sewage effluent. The plant was constructed in 1982 (PWC 2021) and consists of a primary facultative pond which gravity feeds into a secondary maturation pond before being discharged via an irrigation sprinkler system charged by a sewer pump station. Gross pollutants and other entrained materials are removed via sedimentation to sludge layers or entrapment in concentrated surface scums. These are then physically removed when required by desludging of the ponds which maintains their hydraulic performance.

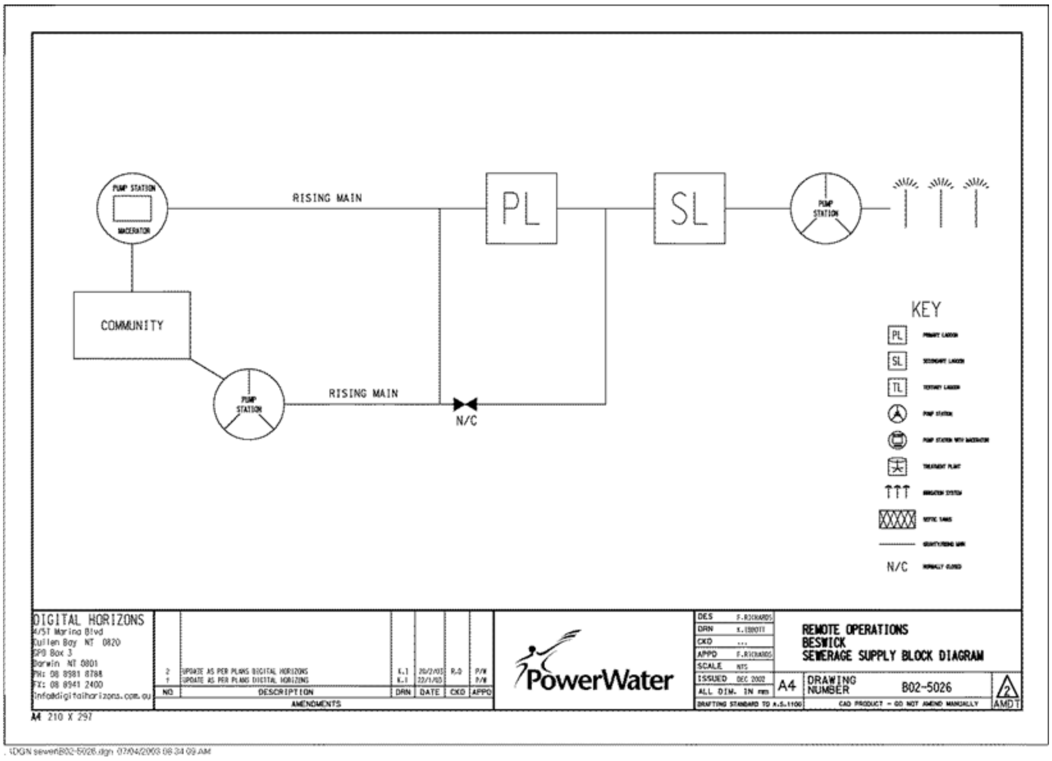

Figure 4: Beswick wastewater collection and treatment configuration.

3.2 Discharge Regime

Discharge from the facility occurs from a pressure fed discharge pipe located in the secondary maturation pond (Figure 4). Expected discharges from the ponds are continuous which are pumped into a sprinkler system on an irrigation field. During low discharge frequency in dry season, the sprinklers are turned off. All irrigated wastewater is contained onsite within an adjacent paddock owned by Beswick Aboriginal Land Trust (DENR 2018). The irrigation system is approx. 30m west of the secondary maturation pond.

As Beswick WwTP was historically unlicenced, no regular monitoring was undertaken until January 2017. Since then, samples of the final maturation pond outlet are taken monthly – consistent with the WDL 228-02 discharge monitoring plan. Monitoring results are included in the PWC Annual

Monitoring Report – Remote Community Waste Discharge Licences. Telemetry flow meter device installed in 2021 at the outfall is functioning and maintained.

Figure 5. Functioning flow telemetry device at Beswick WwTP

3.3 Pond Performance

Waste Stabilisation Ponds offer a cost-effective wastewater treatment solution in warm climates with ample land. Though driven by solar energy, the process complexity requires careful pond system design and maintenance for optimal treatment. Wastewater monitoring at Beswick primary pond inlet since August 2020 aims to characterise raw effluent and assess treatment performance by looking at removal efficiencies of Beswick WwTP.

Listed below are the removal efficiencies of Beswick WwTP derived from the data medians for this year's monitoring period:

- Biochemical Oxygen Demand (BOD): **56.69%**
- Free Ammonia (NH_3-N): **77.05%**
- Total Nitrogen (TN): **73.02%**
- Total Phosphorus (TP): **0.0%**
- *E. coli:* **83.62%**

The ponds provide a centralised treatment barrier that prevents direct raw sewage contamination of the irrigated paddock and have an important role in the protection of both surrounding environmental and public health in this context. The low removal of phosphorus is not concerning as median total phosphorus levels are low (~1,1 mg/L) and reactive phosphorus remains below detection limits. BOD removal efficiency is lower than usual due to lower-than-average inlet contributions however is still sufficient for environmental preservation.

3.4 Irrigated Fenced Facility

After maturation, effluent enters a secured irrigation field (Figure 7). The field is approximately 14,500m2 in size, with the sprinkler system extending along 4 rows parallel to the wastewater treatment ponds (Figure 6). Average daily discharge volume for the WwTP is 156.5 kL per day. Flow volume taken from 2025 remote communities WDL monitoring report (D2025/281404) and is based upon the population of the community.

The irrigation system is maintained, with regular cleaning of sprinkler heads and inspections revealing no apparent low points or issues. The grass undergoes frequent mowing, and the only other vegetation type within the irrigated area is eucalyptus trees (PWC 2021; PWC 2017). Beyond the effluent discharge irrigation area lies an open eucalyptus forest.

3.5 Receiving Environment

Waterhouse River is located 277 m north-west of the irrigation field. A small gully is located between the river and the irrigation field, however, minimal evidence has been found for its formation being due to discharges from the ponds and is most likely a natural formation from regular flooding of the surrounding environment (PWC 2017). Recreational swimming occasionally occurs 393 m downstream in the creek by the bridge on the Central Arnhem Road during the Wet Season.

The receiving environment is considered to be of minor disturbance value, due to the lack of recreational use or development of the area (PWC 2017).

Figure 6. Beswick WwTP irrigation Pipeline (PWC 2017)

Figure 7. Irrigation disposal area of Beswick WwTP (PWC 2017)

The receiving environment is not located within a site of conservation significance but is located within classified aboriginal land (NT Gov 2017a). The site is neither a Ramsar Wetland nor a world/national heritage site (Aus Gov, 2025).

The conservation status for recorded species in the vicinity, 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 (NT Gov 2017). Migratory species have been outlined in bold text. None of the species have been identified to be particularly sensitive to common waste constituents in domestic wastewater.

Table 1: Conservation status of species in vicinity of Beswick WwTP (Department of Climate Change, Energy, the Environment and Water, 2025).

Common name	Species name	National Status (EPBC)	NT Status (TPWC)
Bird			
Curlew Sandpiper	*Calidris ferruginea*	CE	CE
Australian Painted Snipe	*Rostratula australis*	EN	EN
Red Goshawk	*Erythrotriorchis radiatus*	EN	VU
Gouldian Finch	*Chloebia gouldiae*	EN	VU
Grey Falcon	*Falco hypoleucos*	VU	VU
Masked Owl (northern)	*Tyto novaehollandiae kimberli*	VU	VU
Sharp-tailed Sandpiper	*Calidris acuminata*	VU	N/A
Crested Shrike-tit (northern)	*Falcunculus frontatus whitei*	VU	N/A
Mammal			
Northern Quoll	*Dasyurus hallucatus*	EN	CE
Northern Brushtail Possum	*Trichosurus vulpecula arnhemensis*	VU	EN
Fawn Antechinus	*Antechinus bellus*	VU	EN
Northern Brush-tailed Phascogale	*Phascogale pirata*	VU	EN
Ghost Bat	*Macroderma gigas*	VU	N/A

Bare-rumped Sheath-tailed Bat	*Saccolaimus saccolaimus nudicluniatus*	VU	N/A
Reptile			
Mitchell's Water Monitor	*Varanus mitchelli*	CE	VU
Northern Blue-tongued Skink	*Tiliqua scincoides intermedia*	CE	N/A
Mertens' Water Monitor	*Varanus mertensi*	EN	VU
Gulf Snapping Turtle	*Elseya lavarackorum*	EN	N/A
Shark			
Largetooth Sawfish	*Pristis pristis*	EN	VU

CE – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient, N/A - not listed

3.6 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 11) 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 Beswick WwTP

Values	Receptors	
Cultural/ Human Health	Human	Hunting Swimming Sacred Sites
Environment	Aquatic	Fish Turtles Sharks Bivalve Shellfish
	Terrestrial	Mammals Reptiles Wading Birds Invertebrates
	Plants	Native vegetation • Open eucalypt woodland

Table 3. Screening level risk assessment for key indicator and stressors associated with Beswick 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/ HUMAN HEALTH	ENVIRONMENTAL	CULTURAL/ HUMAN HEALTH		
Gross pollutants	Presence and accumulation of gross pollutants from influent carried through to effluent	That gross pollutants are released into environment from overflow and ingested by biota leading to mortality and disturbed ecosystems. Gross pollutant accumulation in ponds affecting treatment of wastewater prior to discharge.	That gross pollutants released into environment resulting in the reduction of visual amenity in the receiving environment.	To maintain the presence of biota in the environment. To maintain the ponds treatment performance prior to discharge.	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 gross pollutant accumulation occurs using irrigator sprinkler system. No further investigation necessary at this stage.	No
Organic matter	Increase in BOD, decrease in DO	BOD increase inducing anoxia in receiving environment resulting in biota mortality and disturbed ecosystems.	BOD causing undesirable odours in receiving environment from anoxia-favoured reactions	To conserve biota and ecosystems in surrounding environment	To maintain oxygen levels in the environment sufficient to prevent production of odours.	The median concentration of BOD in the discharge of the WwTP is 0.4 mg/L. As BOD is present in the discharge, it is determined at a screening level that further investigation is necessary.	Yes
Nutrients (nitrogen and phosphorus)	Increase in nutrient concentrations	That nutrients are leading to excessive plant growth 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 the WwTP is 0.7 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 *E. coli* count in the discharge of the WwTP is 12825/100mL. 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 3 (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 3 (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 Beswick WwTP discharge.

Hypothesis	Consequence		Likelihood	Inherent Risk Ranking	
Environmental					
BOD is leading to oxygen depletion in the environment resulting in **loss of biota** and **changes to ecosystem structure**.	BOD median was 16.5 mg/L for the most recent monitoring period. This concentration is non-negligible but due to low discharge volumes, the total contribution is very low. Additionally, it will reach a concentration of 1.93 µg/L post-discharge due to dilution ratios which is insignificant compared to an expected BOD concentration of unpolluted waterways (K.S. Schmitz, 2025). Thus, discharge is unlikely to cause anoxia in receiving environment causing detrimental effects.	Minor	Likelihood of the discharge reaching the river or gulley is low due to geodetic distance. Even if the discharge was entering the river directly (which can happen during extreme flooding events), after dilution, BOD contribution is extremely low and highly unlikely to induce anoxic conditions which would disrupt ecosystems. Dilution ratio would also be significantly higher than calculated in appendix 3 during flooding further mitigating any effects.	Unlikely	Low
Free ammonia is resulting in **toxicity to aquatic organisms** in water and sediments.	Ammonia median was 0.7 mg/L for the monitoring period. The ANZECC guideline trigger value for ammonia to prevent environmental harm in freshwater ecosystems is 1.18 mg/L at expected conditions (ANZECC & ARMCANZ, 2000). Even prior to dilution, levels are not high enough to cause biota mortality and disturbed ecosystems. Post-dilution, the concentration of 81.9 ng/L is insignificant in regard to environmental effects.	Minor	Likelihood of the discharge reaching the river is low. Even if the discharge was entering the river directly (which could happen during extreme flooding events), after dilution, ammonia concentration is highly unlikely to reach a concentration that would cause any detrimental effects to the receiving environment. Dilution ratio would also be significantly higher than calculated in appendix 3 during flooding further mitigating any effects.	Rare	Low
Nutrients are leading to **nuisance plant growth** resulting in oxygen depletion; displacement of endemic species; diminished light availability; release of toxins; and changes to ecosystem structure.	The WwTP contributes very low levels of nitrogen and phosphorus via irrigation (0.85 mg/L and 1.1 mg/L, respectively). These concentrations are above the ANZECC screening trigger values (ANZECC & ARMCANZ, 2000) for nutrients which means a risk is present. Considering the large buffer zone caused by the land between the bodies and the concentrations post discharge (99.5 ng/L and 128.7 ng/L, respectively) the concentrations will likely be too low to cause any effects to the environment as are now far below the screening values.	Minor	When discharging smaller volumes via an irrigation system, environmental stressors are not typically observed. The likelihood of any nuisance plant growth occurring is reduced by the geodetic distance from the river and gully paired with the dilution that would occur at the river itself (PWC, 2017).	Unlikely	Low
Cultural/ Human Health					
BOD is leading to odours resulting in the **reduction of amenity** in the receiving environment.	BOD median was 16.5 mg/L for the most recent monitoring period. This concentration is non-negligible but due to low discharge volumes, the total contribution is very low. Additionally, it will reach a concentration of 1.93 µg/L post-discharge due to dilution ratios which is insignificant compared to an expected BOD concentration of unpolluted waterways (K.S. Schmitz, 2025). Thus, discharge is unlikely to cause anoxia in receiving environment leading to odour-causing, anoxia-favoured reactions.	Minor	Likelihood of the discharge reaching the river is low. Even if the discharge was entering the river directly (which could happen during extreme flooding events), after dilution, BOD concentration is highly unlikely to induce anoxia in the receiving environment. In the improbable event that some odours causing reactions were to occur, they would be in negligible.	Rare	Low
Nutrients are 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.	The nutrient contributions by the WwTP into the surrounding environment is not high enough to cause a significant harmful algal bloom that will cause shellfish to accumulate biotoxins (J.K. Andres *et al*, 2019).	Insignificant	When discharging smaller volumes via an irrigation system, environmental stressors are not typically observed. The likelihood of any algal growth occurring is reduced by the distance from the river paired with the dilution that would occur at the river itself (PWC, 2017). In the improbable event of any harmful algal biotoxin accumulation in shellfish, it would be a very small, non-toxic amount, and shellfish will naturally purge themselves of the toxin (N. Dowsett *et al*, 2011)	Rare	Low
Nutrients are resulting in the **reduction of amenity** of receiving environment through **reduction in water clarity**, objectionable **discolouration** and **odours**.	Discharge point is in a secured irrigation field only accessible by PWC employees. No/minimal cultural beneficial uses surrounding the irrigation field was observed or reported by the Australian government (Aus Gov, 2025). The nutrient contributions from the WwTP are not high enough to cause any noticeable effects in the receiving environment.	Insignificant	When discharging smaller volumes via an irrigation system, environmental stressors are not typically observed. The likelihood of any nuisance algal growth occurring is reduced by the distance from the river paired with the dilution that would occur at the river itself (PWC, 2017). Changes in colour/odours would also be unlikely due to low discharge volumes and significant dilution.	Unlikely	Low

Pathogens are leading to the **contamination of water** resulting in a public health risk through primary and secondary contact recreation.	Discharge point is in a secured irrigation field only accessible by PWC employees. No/minimal cultural beneficial uses surrounding the irrigation field was observed or reported by the Australian government (Aus Gov, 2025). Recreational swimming occurs downstream in the river. However, the only time the discharge would reach the river is in the event of heavy flooding where recreational swimming would be unlikely and significant dilution would occur.	Minor	When discharging smaller volumes via an irrigation system, environmental stressors are not typically observed. In the event of a flood where direct discharge into the river might occur, the likelihood recreational swimming is low. Additionally, the discharge would undergo significant dilution within the receiving environment meaning likelihood of illness from pathogen exposure downstream is highly unlikely.	Unlikely	Low
Pathogens are leading to **accumulation in shellfish** resulting in a public health risk through the consumption of shellfish.	Discharge point is in a secured irrigation field only accessible by PWC employees. The only time the discharge would reach the river is in the event of heavy flooding where significant dilution would occur. Accumulation of pathogens from our discharge would be negligible compared to contributions from environmental contributions from run off.	Minor	When discharging smaller volumes via an irrigation system, environmental stressors are not typically observed. In the event of a flood where direct discharge into the river might occur, significant dilution within the receiving environment would mean the pathogen concentration is very low meaning accumulation of pathogens in bivalves is highly unlikely.	Unlikely	Low

5. Summary

The ERA identified environmental and cultural receptors within the receiving environment of Beswick WwTP. The key stressors were assessed in this report and their individual risks to said identified receptors found in the receiving environment. The stressors analysed included BOD, Nutrients, free ammonia and pathogens.

Risk characterisation shows that all assessed stressors pose low risks under current operating conditions. Effluent quality is stable, discharge volumes are small, and the secured irrigation field provides reliable containment. Pathways to Waterhouse River are limited to rare extreme flooding, during which substantial dilution would occur.

No evidence was found to suggest adverse impacts to aquatic ecosystems, terrestrial fauna, cultural uses, or public health. The discharge regime is considered sustainable and appropriately managed.

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

- Continue monitoring quality of wastewater discharged to the environment
- Incorporate findings into Performance Improvements Plans
- Update the ERA and conceptual site model as new data becomes available
- Consider surrender of the Waste Discharge Licence

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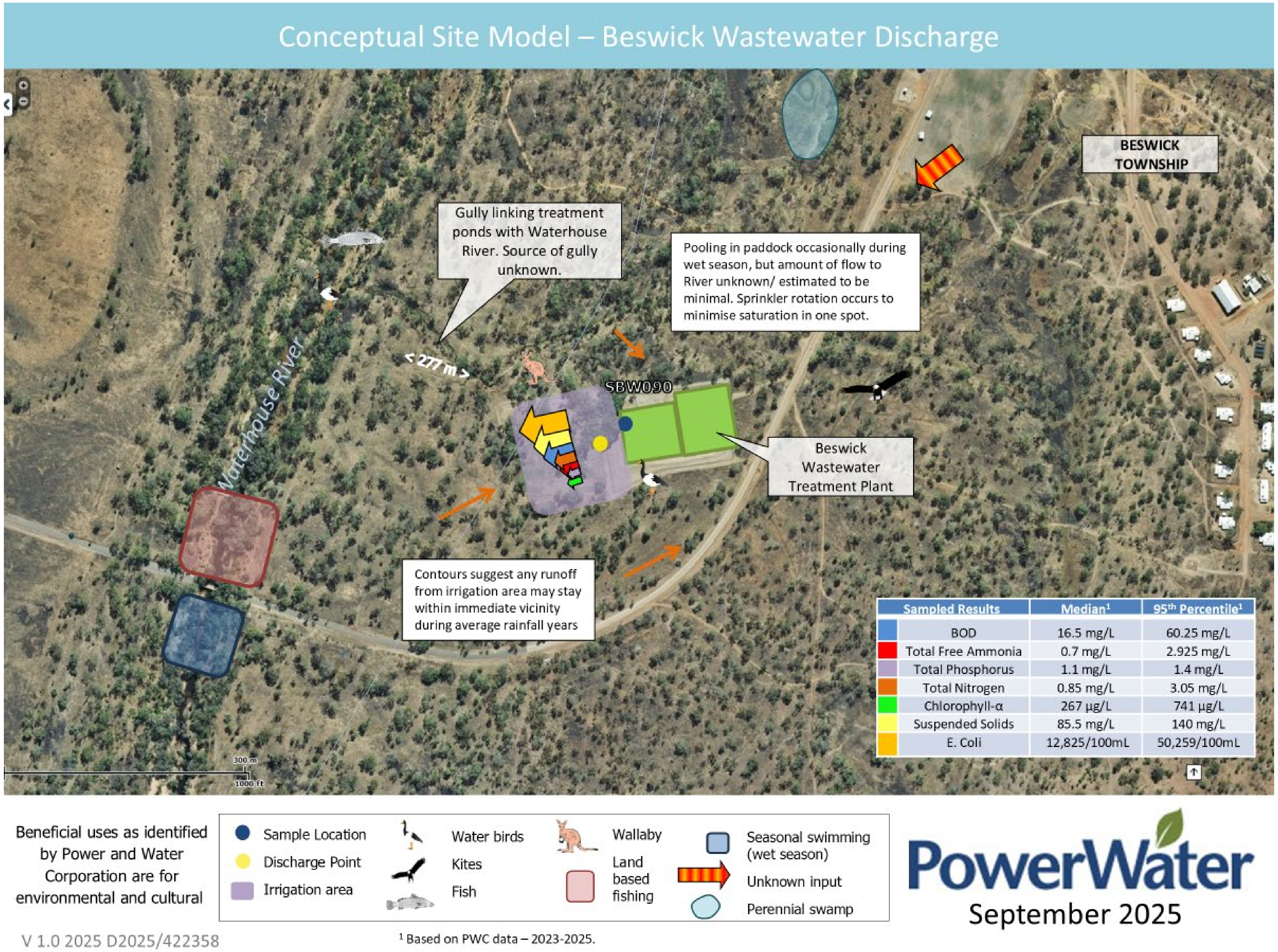
Appendices

Number	Title
Appendix 1	Beswick Conceptual Site Model
Appendix 2	Power and Water Risk Matrix
Appendix 3	Water Quality Results and Dilution Ratio Calculation for Beswick WwTP

Appendix 1 – Beswick Conceptual Site Model



Sampled Results	Median[1]	95th Percentile[1]
BOD	16.5 mg/L	60.25 mg/L
Total Free Ammonia	0.7 mg/L	2.925 mg/L
Total Phosphorus	1.1 mg/L	1.4 mg/L
Total Nitrogen	0.85 mg/L	3.05 mg/L
Chlorophyll-α	267 µg/L	741 µg/L
Suspended Solids	85.5 mg/L	140 mg/L
E. Coli	12,825/100mL	50,259/100mL

Figure 8: Conceptual site model for the Beswick 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 9: Power and Water likelihood, risk ranking, actions and reporting matrix.

Appendix 3 – Water Quality Results and Dilution Ratio Calculation for Beswick WwTP

The sewage treated at the Beswick Wastewater Treatment Plant (WwTP) undergoes a comprehensive secondary treatment process before entering a controlled facility that employs sprinkler irrigation. This strategic approach is further reinforced by maintaining a low average discharge rate of 156.5 kL/day into the securely enclosed facility. This estimated dilution ratio represents a worst-case scenario, considering effluent discharge encountering the creek during dry or no-rain conditions.

Table 6. Summary of 2024-2025 Beswick Dilution Ratio Calculations

Estimated River Width (m)	2024-25 Average Water Height (m)	Cross-sectional Area (m^2)	River Flow Velocity (kL/hr)	Time	River daily flow volume (kL/Day)	Average Daily Pond Outflow (kL/Day)	Dilution Ratio
14	2.43	34.02	1638	24 hrs	1337394.24	156.5	1:8546

Information source:

- River Width estimated using Google Earth Pro – slope was not included in the estimation of cross-sectional area
- Average Water Height: https://ntg.aquaticinformatics.net/Data/DataSet/Chart/Location/G9030089/DataSet/Measured%20Water%20Level/Publish/Interval/Latest
- River Flow Velocity: https://nt.gov.au/__data/assets/pdf_file/0016/450025/Mataranka-Tindal-WAP-Snapshot-Report-May-2014.pdf

River Daily Flow Volume Calculation:

- River Daily Flow = Cross-sectional area x River Flow Velocity X Time
- River Daily Flow = 34.02 m^2 x 1638 kL/hr X 24 (hrs)
- River Daily Flow = 1337394.24 kL/Day

Dilution Ratio: 1337394.24/156.5 = 8545.65 = 8546 **1:8546**

Table 7: Summary of 2024-2025 Beswick Water Quality Results

Sample Location/Asset: SBW0090 Pond 2 Outlet		
	Median	95th Percentile
Biological Parameters		
Biological Oxygen Demand (mg/L)	16.5	60.25
Chlorophyll-a (ug/L)	267.0	740.75
Nutrient Parameters		
Ammonia (mg/L)	0.7	2.925
Total nitrogen (mg/L)	0.85	3.05
Oxidised Nitrogen (mg/L)	0.1	0.2
Total Phosphorus (mg/L)	1.1	1.4
Pathogen Indicators		
Escherichia coli (MPN/100 mL)	12825	50259
Physio-chemical Parameters		
Suspended Solids (mg/L)	85.5	140