Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

Part V Division 3 of the *Environmental Protection Act 1986*

Works Approval Number W6771/2023/1

Applicant Water Corporation

File number DER2022/000591 and APP-0026088

Premises Mt Barker Woodlot
47 Omrah Road
MOUNT BARKER 6324

Legal description –

Lot Number	Plan/Diagram Number	Volume	Folio
Lot B 21	Diagram 111	1886	142
Lot 1367	Deposited Plan 114634		
Lot 1611	Deposited Plan 122001		
Lot 5262	Deposited Plan 163872		
Lot 2063	Deposited Plan 131157	1809	472

As defined by the coordinates in Schedule 2 of the works approval

Date of report 13 February 2025

Decision Works approval granted

Melissa Chamberlain

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Date: 2025.02.13 11:21:10 +08'00'

MANAGER WASTE INDUSTRIES
REGULATORY SERVICES
an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of the premises. As a result of this assessment, Works Approval W6771/2023/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary

On 27 October 2022, the applicant (Water Corporation) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application is to undertake construction works relating to a treated sewage storage dam and associated pumping infrastructure for irrigating a pre-existing Blue Gum woodlot at the premises. The application also includes time-limited operations of the constructed infrastructure.

The premises is situated on 47 Omrah Road, Mount Barker at the lots listed in Table 1. The premises is located approximately 1.2 km southwest of the Mount Barker townsite.

Table 1: Land within the premises

Lot Number	Plan/Diagram Number	Volume	Folio
Lot B 21	Diagram 111	1886	142
Lot 1367	Deposited Plan 114634		
Lot 1611	Deposited Plan 122001		
Lot 5262	Deposited Plan 163872		
Lot 2063	Deposited Plan 131157	1809	472

The premises relates to the category and assessed design capacity under Schedule 1 of the Environmental Protection Regulations 1987 (EP Regulations) which are defined in Works Approval W6771/2023/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020a) are outlined in Works Approval W6771/2023/1.

2.3 Overview of premises

The premises was historically licensed to discharge treated sewage under Licence L8016/2005/1 as the Omrah Vineyard and was operated by The Great Southern Wine Partnership. In 2010 the vineyard was purchased by Penris, converted to a Tasmanian Blue Gum (*Eucalyptus globulus*) woodlot and was not operated under a licence. Water Corporation purchased the premises in 2018 to have more control over future wastewater disposal requirements. Treated sewage discharged at the premises is received from the Mount Barker Water Resource Recovery Facility (WRRF) and irrigated to meet the demands of the Blue Gum woodlot.

Existing dam infrastructure was assessed and considered to be deficient by the applicant. As a result, the applicant determined to construct a single large storage dam to replace the multiple storage dams existing on the premises. Existing storage dams will be decommissioned following construction, however existing irrigation infrastructure will be retained for use. The Blue Gum woodlots are already established in the irrigation areas and do not require replanting.

Following construction of the new infrastructure, the intent is for the premises to be included in the Mount Barker WRRF licence (L9273/2020/2).

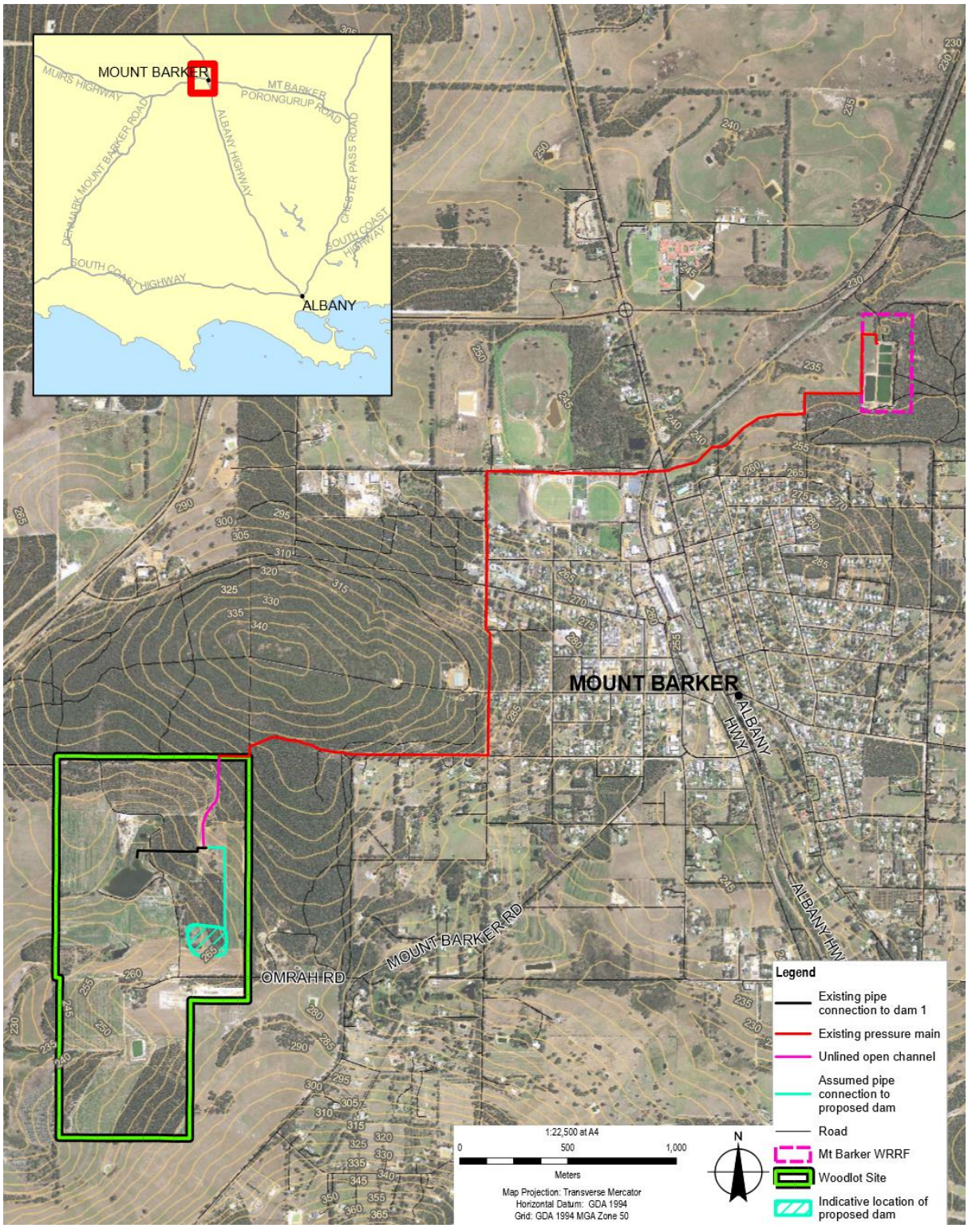


Figure 1: Premises locality

2.4 Proposed works

2.4.1 Infrastructure

The application is proposing to undertake works to construct the key infrastructure summarised in Table 2 below and Figure 2, Figure 3 and Figure 4.

Table 2: Proposed infrastructure and key design features

Infrastructure	Design features
Storage dam for treated sewage	
General arrangement	Shaped in a turkey nest arrangement using cut-to-fill construction with earth fill embankments on the downslope sides and a cutting on the upslope side. An emergency overflow spillway will be installed to allow for controlled releases during overflow events. This prevents structural damage to the dam during overflows. No stormwater is diverted to the dam so that the rainfall catchment is limited to the dam surface area and inner embankment slopes. The inlet and outlet are located the maximum possible distance apart to maximise storage turnover. The inlet pipe is concrete encased for erosion protection and features an energy dissipation structure on the dam floor. The outlet pipe is concrete encased through the dam embankment and is attached to a floating offtake capped with a stainless-steel strainer.
Capacity	Capacity: • 60 megalitre (ML) operating capacity. • 85 ML containment capacity prior to spillway operation. • 98 ML total capacity prior to overtopping of embankments. • Minimum operating level of 300 mm above base of dam (0.3 ML). Freeboard: • 300 mm spillway freeboard. • 1,000 mm top of embankment freeboard. Rainfall design: • The dam is capable of storing a 1 in 100 Annual Exceedance Probability (AEP) rainfall event prior to operation of the spillway. • The spillway is capable of controlling discharge up to a 1 in 10,000 AEP rainfall event before overtopping of embankments occurs.
Embankments	Embankment material: • Compacted earthfill sourced from site derived silty clay residual soils. Embankment slopes: • Internal 1V : 3H. • External 1V : 2.5H. Dam crest: • Width of 4 m, with a gravel access road and 2% fall towards the internal slope.

Infrastructure	Design features
Liner	Liner material: • Compacted clay sourced from site derived clay residual soils. • Re-moulded clay soil samples were tested to 98% standard maximum dry density (SMDD) at optimum moisture content (OMC) and had a permeability ranging between 8.84 x 10^{-9} to 2.16 x 10^{-9} m/s under a surcharge pressure of 12.5 kPa (1.27 m head). Liner thickness: • Minimum 450 mm vertical floor thickness. • Minimum 3 m thickness horizontal to embankments. Liner permeability: • Average < 5 x 10^{-9} m/s. Protective layers: • 150 mm thick gravel layer on floor and embankments. • 300 mm thick rip-rap layer above the gravel layer on embankments.
Earthen dam wall drainage	Vertical filter: • 600 mm wide chimney filter. • Extends vertically beneath the dam crest for intercepting seepage through the embankment to control pore pressure and internal erosion. • Terminates in a horizontal filter. Horizontal filter: • 300 mm thick blanket filter. • Extends beneath the downgradient embankment above the subgrade, starting in line with the crest and extending to the toe of the embankment. • Terminates in a rockfill toe. Rockfill toe: • Approximately 2.5 m thick consisting of crushed rock and rockfill, with intervening geofabric layers. • Discharges seepage collected from the filters in a controlled manner.
Intercept drains	The dam footprint will intersect the surficial sandy colluvium layer at the premises. As there is likely to be seasonal perched groundwater flow through this layer there is potential for pore pressure build up to adversely affect the stability of the dam wall along the eastern and southern cut slopes. This will be managed through installation of intercept drains external to the embankment walls. • An upgradient drain will be installed along the outer edge of the dam embankment to intercept groundwater flow and to collect surface water run-off from the catchment area uphill to the east and south of the dam. • A downgradient drain will be installed on the outer edge of the toe embankment to intercept groundwater flow and to collect drainage from the vertical and horizontal dam filters. • Both drains will have a weighted filter installed in the groundwater flow path and be lined with rock-pitching for erosion protection.

Infrastructure	Design features
Irrigation pump station	
Pump system	The pump station will be comprised of two pumps in a duty/standby arrangement with a minimum flow rate of 6 L/s at 58 m/head. The pump station controller will be linked to the controller for the irrigation network. A flow meter will be installed after the pumps and prior to the filtration system.
Chlorination	The pump station will include a chlorination unit that doses 12.5 % sodium hypochlorite into two 15 L pails.
Filtration	A 200 µm mesh 3 inch disc filter system will be installed that is set to backwash on a timer and a set pressure difference. Backwash from the filter will be sent back to the dam. A flow meter will be installed that measures filtered wastewater volumes being sent to irrigation.
Irrigation controls	A Supervisory Control and Data Acquisition (SCADA) system and irrigation control system will be installed at the pump station.

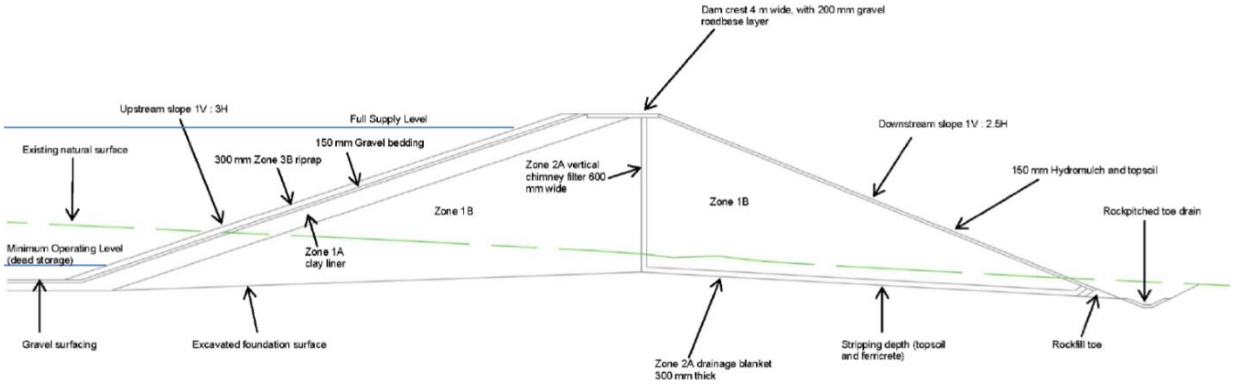


Figure 2: Cross section of storage dam embankment

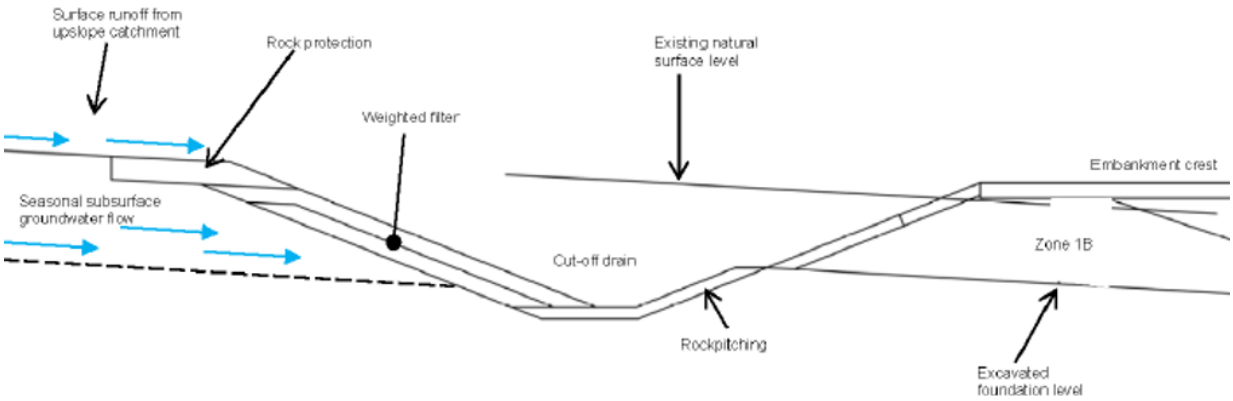


Figure 3: Upgradient cut-off drain

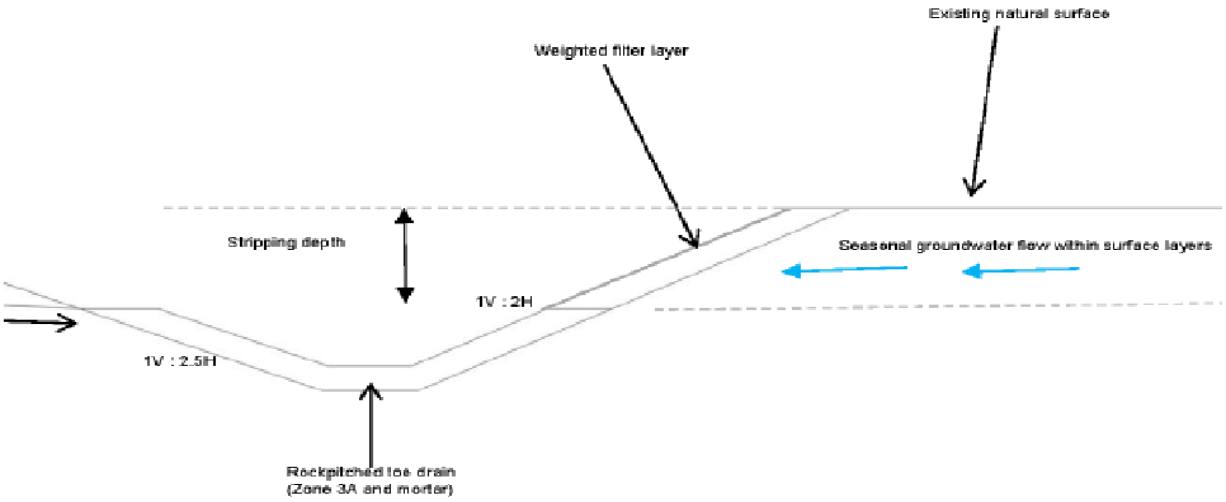


Figure 4: Downgradient cut-off drain

2.4.2 Construction

The works required to construct the infrastructure listed above are contained in Table 3 below.

Table 3: Activities undertaken during construction

Work aspect	Construction methodology
Storage dam	
Earthworks and site preparation	• In-situ materials are generally expected to be excavated using conventional earthmoving equipment such as excavators and standard bucket attachments. If ferricrete caprock is intersected, hydraulic rock breaking will likely be required. • Topsoil will be stripped and stockpiled for reuse on the outer edge of the downstream embankments. • Colluvial sand and lateritic gravel will be used as fill for general dam construction, surface bedding or roadbase. • Silty clay residual soil will be used for embankment construction and may potentially be used for clay liner material where laboratory testing provides confirmation of appropriate material properties. • Clay residual soil will be used for construction of the liner. • Excavation to the subgrade level will be carried out using excavators, dump trucks or scrapers. Pockets of weak or otherwise unsuitable material will be removed from below the general subgrade level.
Liner construction	• Immediately prior to receiving clay liner material, the surface of the subgrade will have all water removed from depressions and the top 150 mm of subgrade will be sufficiently moistened and compacted. The subgrade will then be worked with a harrow, scarifier or other suitable equipment, to a sufficient depth to provide a satisfactory bonding surface. • Clay liner material will be placed in continuous lifts that are compacted to a thickness of no more than 150 mm. The material in each layer will have a moisture content during and after compaction of ±1% OMC and be compacted to minimum 98% SMDD. • The surface of each lift will be worked with a harrow, scarifier or other suitable equipment, to a sufficient depth to provide a satisfactory bonding surface and moistened if necessary, before placement of the next lift.

2.4.3 Construction Quality Assurance

The applicant submitted an example of their standard superintendent administered three party contract for a treated wastewater storage dam, which corresponds to how the construction works will be managed. The example document sets out the minimum construction quality assurance (CQA) testing frequencies, inspections and hold points that will be used for the dam works and requires the contractor to create a CQA Plan prior to construction.

The applicant will provide a Quality Assurance Inspector with suitable construction experience to witness, review, and sign off on the contractor's inspection and test plans and records. A suitably qualified geotechnical, environmental or civil engineer will also be provided to validate and confirm that the storage dam has been built to specification, including certification through a CQA validation report.

The minimum CQA testing requirements for the extracted clay material and the installed clay liner that are listed in the example specification are contained in Table 4 below.

Table 4: Testing procedures and frequency for the clay liner

Parameter	Procedure	Minimum testing frequency	Compliance values
Clay material extracted on-site			
Particle size distribution and hydrometer	AS 1289.3.6.3	1 per 3,000 m^3	> 65 % by weight passing a 4.75 mm sieve; and Between 35 % and 90 % by weight pass a 0.075 mm sieve.
Plasticity index	AS 1289.3.3.1		> 15 %
Liquid limit	AS 1289.3.1.1		< 80 %
Moisture content	AS 1289.2.1.1		Optimum moisture content ±1 %
Standard maximum dry density	Standard compactive effort in accordance with AS 1289.5.1.1		> 98 %
Installed clay liner			
Particle size distribution	AS 1289.3.6.1	Whichever is the greater number of: – 1 per day – 1 per layer placed; or – 1 per 300 m^3.	> 65 % by weight passing a 4.75 mm sieve; and Between 35 % and 90 % by weight pass a 0.075 mm sieve.
Plasticity index	AS 1289.3.3.1		> 15 %
Liquid limit	AS 1289.3.1.1		< 80 %
Field density and moisture content	AS 1289.5.3.1 and 1289.2.1.1		Optimum moisture content ±1 %

Parameter	Procedure	Minimum testing frequency	Compliance values
Hilf density ratio (R_{HD}) and moisture variation	AS 1289.5.7.1 using standard compactive effort in accordance with AS 1289.5.1.1 and field density in accordance with AS 1289.5.3.1		> 98 %

2.5 Time-limited operations and ongoing operations

The premises will receive up to 1,280 kL/day of treated sewage into the storage dam via a pipeline connection to the Mt Barker WRRF. During periods of irrigation up to 595 kL/day of the treated sewage will be irrigated based on the current average volumes from the Mt Barker WRRF.

2.5.1 Typical treated wastewater quality

A summary of the final effluent monitoring results collected between 2013 to 2021 from the Mt Barker WRRF are contained in Table 5. These are considered representative of the likely effluent quality to be irrigated at the premises.

Table 5: Summary of treated wastewater quality from the Mt Barker WRRF

Parameter	Range	Median
Total nitrogen	5.8 – 46 mg/L	17 mg/L
Nitrate + nitrate as nitrogen	0.05 – 12 mg/L	1 mg/L
Ammonium as nitrogen	0.05 – 41 mg/L	5 mg/L
Total phosphorus	1.7 – 9.7 mg/L	5.2 mg/L
Filterable reactive phosphorus	0.4 – 7.3 mg/L	3.8 mg/L
Total dissolved solids	540 – 1,050 mg/L	810 mg/L
Total suspended solids	5 – 100 mg/L	35 mg/L
Biological oxygen demand	5 – 55 mg/L	20 mg/L
Chemical oxygen demand	82 – 180 mg/L	140 mg/L
pH	7.2 – 9.7	8.2
Alkalinity as calcium carbonate	170 – 230 mg/L	230 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Copper	> 0.002 – 0.05 mg/L	0.007 mg/L
Lead	> 0.02 mg/L	> 0.02 mg/L
Cadmium	> 0.02 mg/L	> 0.02 mg/L

Parameter	Range	Median
Calcium	52 – 60 mg/L	53 mg/L
Magnesium	14 – 15 mg/L	15 mg/L
Sodium	125 – 140 mg/L	130 mg/L
Chloride	205 – 225 mg/L	205 mg/L
Escherichia coli	10 – 24,000 CFU / 100 mL	30 CFU / 100 mL

2.5.2 Woodlot irrigation

A summary of the woodlot and proposed irrigation scheme is contained in Table 6 below.

Table 6: Proposed woodlot and irrigation scheme features

<table>
<tr><th>Aspect</th><th>Design and operational features</th></tr>
<tr><td>Woodlot size and irrigation area</td><td>Total 88 ha of woodlot separated into 21 plots.

Initially only approximately 20 - 24 ha will be irrigated within primary irrigation plots 4 (ECV 7), 5 (ECV8), 10, 15, 16 and 17. After 2031 additional areas will be added for irrigation up to approximately 25 ha. These will nominally be Plot 3 (ECV 4 and ECV 5) and Plot 4 (ECV 6) or a similar sized alternative area.

Alternative irrigation areas totaling approximately 13 ha (Plots 3, 4 (ECV6) 7 and 11) are also equipped with headworks and dripper lines. These areas have been provided as contingency zones during harvesting periods, excess water in the dam or operational issues.

A further area of approximately 9 ha (Plot 6) will be setup as a redundancy zone, to be activated in times of extreme seasonal weather, fire damage or potentially during a harvesting/establishment of the irrigation zone.

The remaining 41 ha of woodlot will not be irrigated (Plots A-D, 1, 2, 14, 18-21).</td></tr>
<tr><td>Crop type</td><td>Blue Gum (Eucalyptus globulus) plantation with varying densities up to 1,800 stems/ha. On-site test pitting indicates that plants have a rooting depth between 50 - 80 cm.

No additional nutrient application is proposed.</td></tr>
<tr><td>Irrigation discharge</td><td>Surface drip irrigation lines installed between each planted row that will operate for up to 22 hours per day to meet the maximum irrigation rate of 2.7 mm/day.

The inner diameter of the dripline is 14.2 mm with 0.8 m spacing between each dripper. Each dripper has an application rate of 2.3 L/hr.</td></tr>
<tr><td>Irrigation scheduling</td><td>Irrigation will be scheduled in consideration of plant requirements, climatic conditions and dam storage volumes. Irrigation will take place daily and at reduced application rates during Autumn and Spring. Irrigation will be ceased during winter.
<table>
<tr><th>Schedule</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>mm/day</td><td>2.7</td><td>2.7</td><td>2.3</td><td>2.1</td><td>1.6</td><td>0</td><td>0</td><td>0</td><td>0.6</td><td>1.8</td><td>2.4</td><td>2.7</td></tr>
<tr><td>kL/day</td><td>595</td><td>595</td><td>507</td><td>463</td><td>353</td><td>0</td><td>0</td><td>0</td><td>132</td><td>396</td><td>529</td><td>595</td></tr>
<tr><td>ML/month</td><td>20.1</td><td>18.1</td><td>17.1</td><td>15.1</td><td>11.9</td><td>0</td><td>0</td><td>0</td><td>4.3</td><td>13.4</td><td>17.3</td><td>20.1</td></tr>
</table>
</td></tr>
</table>

Aspect	Design and operational features
Harvesting plan	A 12-year growth cycle will be adopted with no thinning of the plantations during cycles. Generally after 12 years the Blue Gums will be harvested by clear felling, with each harvest event covering at least 10 ha and not occurring in consecutive years. Plots 16 and 17 will be harvested after 10 years (in 2026), and Plots 3 and 4 will be harvested after 11 years (in 2030) to enable a better long-term schedule for harvesting and ensuring sufficient irrigation areas are available in any one year. No irrigation will occur in a plot during the year of harvest and the following year, during re-establishment. All harvested material will be removed from the premises. An outline of the harvesting plan is shown in Figure 5 below.
Vegetation management	Inter-row grasses and weeds will be managed by either spraying or cutting. Cut material will be removed offsite or transferred to unirrigated areas for use as mulch to ensure nitrogen and phosphorus from the material does not contribute additional nutrients within the irrigated areas. Herbicide and pesticide requirements (need/type/application rate) will be determined through an inspection by an appropriately qualified contractor with woodlot weed control experience. No pesticides or herbicides are to be stored on site and will be administered by contractors when and where required. Pruning will not routinely be undertaken except on every 4th or 5th row of a plot to provide internal access for monitoring and maintenance requirements. Ad-hoc pruning may occasionally occur to avoid edge tree branches encroaching on access tracks or infrastructure, to ensure adequate visibility along adjacent roads and for firebreak maintenance. Pruned material will be disposed off-site.

Harvesting group	Irrigation Group	Year Established	Plot ID	Total Irrigation Area (ha)	Plantation age (years)																
					Stage 2																
					2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	Group 3	2015	15 (ECV 27)	2.16	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12
		2015	15 (ECV 28)	2.97	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12
	Group 4	2015	7 (ECV 11)	2.77	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12
		2015	7 (ECV 12)	1.86	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12
		2015	11 (ECV 20)	2.74	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10	11	12
2	Group 2	2015	16 (ECV 22)	2.79	9	10	0	1	2	3	4	5	6	7	8	9	10	11	12	0	1
		2015	16 (ECV 23)	2.62	9	10	0	1	2	3	4	5	6	7	8	9	10	11	12	0	1
	Group 1	2015	17 (ECV 21)	2.49	9	10	0	1	2	3	4	5	6	7	8	9	10	11	12	0	1
		2015	17 (ECV 24)	2.04	9	10	0	1	2	3	4	5	6	7	8	9	10	11	12	0	1
3	Group 6	2017	10 (ECV 19)	2.07	7	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10
		2018	4 (ECV 7)	1.14	6	7	8	9	10	11	0	1	2	3	4	5	6	7	8	9	10
		2017	5 (ECV 8)	1.56	7	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10
	Group 5	2018	4 (ECV 6)	1.57	7	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10
		2018	3 (ECV 5)	2.55	6	7	8	9	10	11	0	1	2	3	4	5	6	7	8	9	10
		2018	3 (ECV 4)	1.11	6	7	8	9	10	11	0	1	2	3	4	5	6	7	8	9	10
Redundancy Blocks	Group 7	2017	6 (ECV9)	4.14	7	8	9	10	11	12	0	1	2	3	4	5	6	7	8	9	10
	Group 8	2017	6 (ECV10)	4.05	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10	11	12
Total irrigated area (ha)					19.84	19.84	22.50	22.50	19.94	19.94	22.44	22.44	25.07	25.07	25.07	25.07	25.07	25.07	25.07	22.50	22.50
Total area available for irrigation (ha)					40.63	40.63	30.69	30.69	24.08	24.08	26.49	26.49	40.63	40.63	40.63	40.63	40.63	40.63	40.63	30.69	30.69
Total harvested area (ha)					0.00	0.00	9.94	0.00	16.55	0.00	14.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.94	0.00

Figure 5: Harvest plan

2.5.3 Monitoring

Monitoring of treated sewage quantity being sent for storage at the premises will occur at the Mount Barker WRRF premises in accordance with existing licence L9273/2020/2. The applicant intends to undertake the monitoring program summarised in Table 7 below at the premises.

Table 7: Proposed monitoring program

Monitoring point	Parameters	Frequency	Type of monitoring
System monitoring			
Irrigation network	Defective sprinklers or blockages	Monthly and ad-hoc	Visual inspection
	Pooling or runoff of TWW	Every 3 months	
	Pump performance tests	Annually	Testing flow and current draw
	Leaks or bursts in piping	Ad-hoc	Inspection where considered necessary
	Asset condition assessment	Ad-hoc	
Storage dam	Water level	Continuous	Water level sensor connected to SCADA management system
Irrigation water meter	Volume of TWW discharged to irrigation	Weekly	Automatic logging/telemetry
Weather station rain gauge	Rainfall	Routinely	Operational staff will monitor BoM forecasts to determine when and if a system change is required and will undertake a manual adjustment to the irrigation system accordingly.
Surface water monitoring			
Western irrigation valve: SW2, SW4 and SW10	TSS, TDS, BOD, TKN, NO_x, NO_2, NO_3, NH_3, TN, TP, reactive phosphorus as P, *E. coli*, pH, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc	Twice yearly during periods of flow	Spot sampling
Eastern irrigation valve: SW6, SW7 and SW8			

Monitoring point	Parameters	Frequency	Type of monitoring
Groundwater monitoring			
PEN_MB02, PEN_MB03, PEN_MB05C, MtB02/19, MtB03/19, MtB04/19, MtB05/19, MtB06/19, PEN_MB06, PEN_MB07	TDS, TKN, NO_x, NO_2, NO_3, NH_3, TN, TP, standing water level, pH, arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc	Biannually targeting post-summer (peak irrigation) and post winter (peak rainfall)	Spot sampling
Soil monitoring			
SM1, SM2, SM3, SM4, SM5, SM6 and SM7	EC, SAR, effective cation exchange capacity, exchangeable sodium percentage, chloride, soil residual PRI/PBI, Colwell P and potassium. Forms of N, organic carbon, sulfur, boron. Trace elements, pH, dispersion.	Every 5 years	Frequency will increase if increasing P observed in downstream groundwater, surface water or if tree health issues are noted. Sampling along dripper lines and mid-row at varying soil depths to 1.2 m. Composite sampling within a plot area targeted across a minimum of 5 locations within each plot that the sample location is indicated.

2.6 MEDLI modelling

The applicant commissioned a site suitability assessment using the Model for Effluent Disposal Using Land Irrigation (MEDLI) V2 modelling program. MEDLI assesses the ability of plants and soils to uptake nutrients from effluent irrigation under different cropping and irrigation regimes. The model uses site specific input data for climate, soil, effluent quality and pond information to determine the plant growth, nutrient cycling, soil salinity and soil water balance for potential irrigation schemes.

2.6.1 Hydraulic loading

To both reduce irrigation in periods when deep drainage is more likely to occur (winter) and to manage storage volumes to maintain supply when plant demands are highest, a peak irrigation rate of 2.7 mm/day was modelled. The peak irrigation rate occurs in summer, is reduced during spring/autumn and ceases in winter (See Table 6).

Modelling of the 2.7 mm/day peak irrigation profile found that the vast majority of deep drainage occurs between May and October with 88% of the total occurring in those months. This was considered ideal, as deep drainage to prevent salt build up within soils was predominately occurring due to rainfall rather than irrigation water with an increased nutrient content. Deep drainage for the three soil types ranged between 211.6 – 229.1 mm/yr. The model also found that there was effectively no irrigation generated runoff, with results of <1 mm/yr.

2.6.2 Nutrient loading

Modelling outputs determined that the proposed peak irrigation schedule of 2.7 mm/day was appropriate. This resulted in the least amount of nutrient leaching while also optimising plant health. Key findings of the nutrient modelling are contained in Table 8 below.

Table 8: MEDLI model average outputs for nutrients

Soil type	Nitrogen	Phosphorus
Type 1 (see Figure 7)	Amount applied: 119.3 kg/ha/yr Blue Gum uptake: 152 kg/ha/yr Leaching below soil profile: 17.2 kg/ha/yr during early years of tree establishment	Amount applied: 28.7 kg/ha/yr Blue Gum uptake: 29.6 kg/ha/yr Leaching below soil profile: 3.7×10^{-4} kg/ha/yr
Type 2 (see Figure 7)	Amount applied: 119.3 kg/ha/yr Blue Gum uptake: 159.4 kg/ha/yr Leaching below soil profile: 6.9 kg/ha/yr during early years of tree establishment	Amount applied: 28.7 kg/ha/yr Blue Gum uptake: 28.3 kg/ha/yr Leaching below soil profile: 3.4×10^{-4} kg/ha/yr
Type 3 (see Figure 7)	Amount applied: 119.3 kg/ha/yr Blue Gum uptake: 218.7 kg/ha/yr Leaching below soil profile: 37.7 kg/ha/yr during early years of tree establishment	Amount applied: 28.7 kg/ha/yr Blue Gum uptake: 32.4 kg/ha/yr Leaching below soil profile: 2×10^{-2} kg/ha/yr

Excluding during early tree establishment, the modelling found that nutrient demand of the Blue Gum's exceeds the amount of nitrogen and is generally equal to the amount of phosphorus being applied through irrigation. The model found leached fractions to only occur during early growth stages of the trees where applied quantities can become less available due to limited root development.

2.6.3 Sodicity and salinity

The exchangeable sodium percentage (ESP) of soil samples taken from the Soil 1 and Soil 2 areas were classified as non-sodic (ESP < 6) while soil samples from the Soil 3 area were classified as non-sodic at the surface to strongly sodic below the surface (ESP 2 - 23).

The MEDLI simulation found that the 2.7 mm/day irrigation rate had only a minor increase overtime in average and bottom of rootzone salinity for the three soil profiles ranging from 0.1 - 0.2 dS/m and 1 - 1.2 dS/m respectively. The soils had leaching fractions of 0.33 - 0.36. The average and bottom of rootzone salinity ranged between 0.78 - 0.84 dS/m and 3.4 - 3.58 dS/m. which is within the predicted Blue Gum tolerance of 2 - 4 dS/m.

The modelling concluded that soil sodicity, compaction and salinity are not expected to be issues at the premises. MEDLI results indicate that the deep drainage component of the water balance prevents the build-up of salts in the soil profile up to the end of the model period in 2040.

2.7 Water balance

The applicant commissioned a water balance model to simulate daily fluctuations in dam storage when responding to varying inputs of treated sewage, irrigation rates and weather conditions. A number of different scenarios were modelled over an approximately 40-year period.

At the proposed peak irrigation rate of 2.7 mm/day and irrigation schedule shown in Table 2, the new storage dam was found to contain sufficient storage for all treated sewage being received at the premises. For optimal irrigation the model determined that the size of the woodlot area to be irrigated in each year needed to vary slightly over time (Table 9). A visual representation of the water balance is shown in Figure 6.

Table 9: Variability in required irrigation area over time

Year (20YY)	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Area (ha)	19.8	19.8	22.5	22.5	19.9	19.9	22.4	22.4	25.1	25.1	25.1	25.1	25.1	25.1	25.1	22.5	22.5

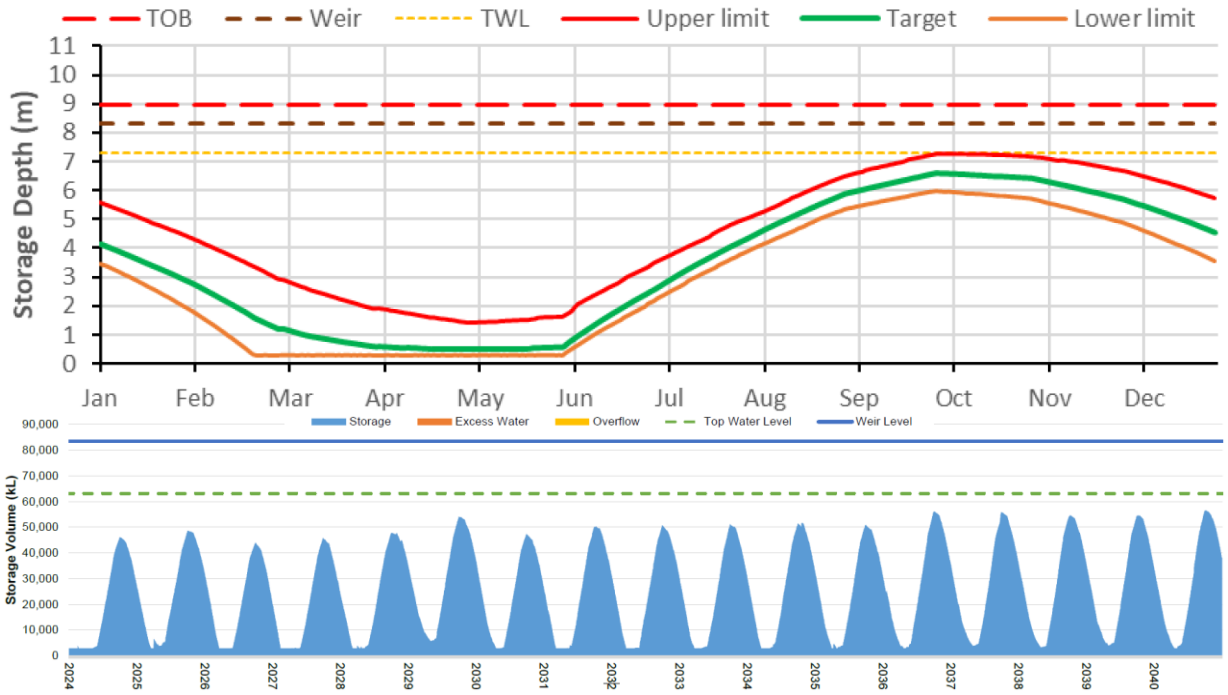


Figure 6: Dam storage curve for one year (top) and until 2041 (bottom)

2.8 *Environment Protection and Biodiversity Conservation Act 2001*

The applicant has informed the department that the infrastructure footprint will require the clearing of black cockatoo habitat and has been referred for approval under the *Environment Protection and Biodiversity Conservation Act 2001*.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020a).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and operation which have been considered in this decision report are detailed in Table 10 below. Table 10 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 10: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Dam construction Vehicle and machinery movements (reversing beepers) Hydraulic rock-breaking (where required)	Air/windborne pathway	A Construction Environmental Management Plan (CEMP) will be prepared by the contractor to manage any potential issues from construction dust and noise.
Noise			
Dissolved metals and nutrients	Disturbance and oxidation of acid sulfate soils during construction	Groundwater transport of mobilised metals and nutrients from the soil profile	Prior to commencement of construction, a detailed ASS investigation will be undertaken to determine the extent of the ASS and prepare a management plan. The plan will: • Clearly map the AASS/PASS across the site. • Quantify the volume of ASS material to be excavated. • Detail storage location and pad design requirements (permeability, drainage, etc). • Provide clear guidance on the acceptability of the material to be used in the construction of the storage dam clay liner (Zone 1A) and dam walls (Zone 1B), including whether there is any requirement to treat the material prior to use in either zone.

Emission	Sources	Potential pathways	Proposed controls
			• Provide guidance on the construction requirements to ensure AASS /PASS material is either returned to an anoxic state or that no acidification or mobilisation of metals etc will occur from the use as construction material (no risk of environmental impact). • Recommend any monitoring requirements based on expected summer and winter conditions to verify above management.
Operation (including time limited operations)			
Odour	Acceptance and storage of treated sewage	Air/windborne pathway	• None proposed.
Disease vectors		Attraction and harbouring of pests	• None proposed.
Contaminants associated with treated sewage (nutrients, metals, pathogens, PoPs)		Runoff from overflow events and seep drains	• Weekly monitoring of water levels when volume stored is between 10% - 90% of operating capacity. • Daily monitoring of water levels when volume stored is below 10% and above 90% of operating capacity. • 300 mm spillway freeboard (1:100 AEP rainfall design). • 1,200 mm top of embankment freeboard (1:10,000 AEP rainfall design).
		Seepage through dam lining to soil Infiltration through soil to groundwater Downgradient groundwater discharge	• Clay liner with a minimum 450 mm basal thickness and 1 m slope thickness. • 150 mm thick gravel protective layer above clay liner. • Minimum operating level of 300 mm to be maintained to avoid desiccation of clay liner. • Minimum 150 mm thick layer of compacted subgrade below clay liner.
Contaminants associated with treated sewage (nutrients, metals, pathogens, PoPs)	Discharge of treated sewage via irrigation to a woodlot	Runoff from irrigation Infiltration through soil to groundwater Downgradient groundwater discharge	• Nutrient and Irrigation Management Plan (NIMP) and Nutrient Operational Management Plan (NOMP). • Irrigation will be ceased the day prior to forecast rain events >5 mm for the following 24 hrs. • Irrigation will be shutoff when >5 mm of rainfall was received within the prior 24 hrs.

Emission	Sources	Potential pathways	Proposed controls
			• Application rate lower than soil infiltration capacity. • Small diameter (14.2 mm) irrigation pipes will limit losses in the event of failure. • Irrigation will be ceased during winter and occur at a reduced rate during autumn and spring. • No additional fertiliser application. • Redundancy irrigation areas provided with irrigation infrastructure and suitably mature trees.
		Direct contact	• Stock proof fencing around the perimeter of the premises. • Chlorination of treated wastewater. • Drip irrigation.
Sediment		Loss of soil structure and erosion	• Use of drip irrigation to limit erosion. • The ESP or sodium adsorption ratio (SAR) of the soil will be monitored as part of sampling procedures (see Section 6) to prevent soil structural issues developing in the long term. Soil amendment through the addition of additives such as gypsum and lime will be undertaken where required.

3.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020a), the Delegated Officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies and is provided for under other state legislation.

Table 11 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020b)).

Table 11: Sensitive human and environmental receptors and distance from prescribed activity

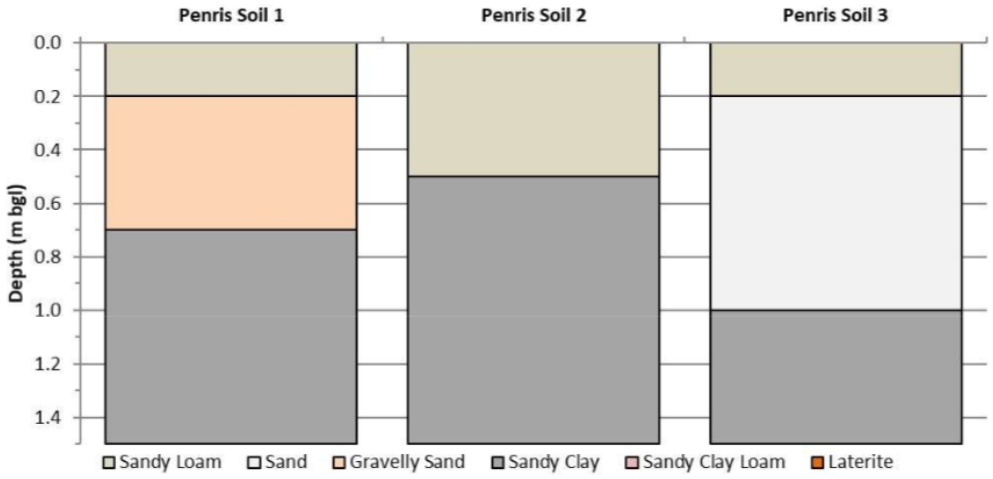
Receptors	Distance from prescribed activity
Human receptors	
Sensitive receptor – Residential homestead	Located within the premises boundary
Sensitive receptor – Residential premises	Approximately 415 m southeast of the premises boundary

Receptors	Distance from prescribed activity
Sensitive receptor – Residential premises	Approximately 1.47 km west of the premises boundary
Environmental receptors	
Underlying groundwater – Non-potable purposes	The actual depth to permanent groundwater below the treated sewage storage dam is not known, however field investigations undertaken by the applicant terminated at a depth of 13 mBGL and did not encounter groundwater. Depth to groundwater in monitoring bores located across the remainder of the premises range from 1.5 mbgl (west and south) to 18.81 mbgl (east and north) depending on location. It is inferred from wider groundwater investigations undertaken across the premises that groundwater levels decrease down the hillside. A seasonal perched groundwater layer is likely to be present when infiltrating rainfall and waterlogging of the basal portion of surface soils occurs. Groundwater is inferred to generally flow from east to west, towards Hay River and is likely to discharge into unnamed water courses at the lower portions of the premises, particularly in winter months when the groundwater table is elevated. Groundwater salinity is above 2000 mg/L. The closest registered down-gradient bore is approximately 3.2 km southwest. The status/use of the bore is unknown. A rural residence approximately 1 km to the west of the Woodlot may use unregistered bores for non-potable use, irrigation or livestock watering.
Surface water – Minor non-perennial watercourse	Two minor non-perennial watercourses that are tributaries of the Hay River are located in the west of the premises. The watercourses converge and run in an inferred southwesterly direction to connect to the Hay River.
Surface water – Hay River	Approximately 3.5 km downstream from the premises.
Surface water – Farm dam	A farm dam is located approximately 300 m to the west of the premises. This dam is in very close proximity to the non-perennial waterway and may experience groundwater interaction. The dam is likely used for livestock watering and/or irrigation use.
Groundwater dependent ecosystem (GDE) –	Four GDEs intersects the premises, with each defined as an ecosystem that relies on subsurface presence of groundwater. A GDE is also located approximately 1.2 km down-gradient of the premises and is identified as an ecosystem that relies on subsurface presence of groundwater.

3.1.3 Pathways

Information relating to pathways and environmental conditions at the premises are provided in Table 12. This information is generally derived from the Mt. Barker Woodlot NIMP (GHD 2023).

Table 12: Potential pathways and environmental conditions relevant to the premises

Aspect	Details
Surface soils	<u>Soil profile</u> Soils at the premises range from sandy to sandy loam topsoil overlying sandy clay to clay subsoil, and include duplex sandy gravel, loamy gravel, brown deep loamy duplex, grey deep sandy duplex and shallow gravel. The three soil profiles shown below were typically identified during site investigations commissioned by the applicant.  **Figure 7: Typical soil profiles at the premises** Soils 1 and 2 cover the majority of the premises and are considered preferable for irrigation. The majority of the irrigation will take place in areas containing Soil 1. Soil 3 is comprised of deeper sand to sandy loam soil over clay based lower soils. Some areas containing Soil 3 were confined by a lateritic base which restricts vertical drainage and promotes water logging. These areas were more prevalent outside of valley floors. <u>Infiltration</u> Soil infiltration testing was commissioned by the applicant that found saturated hydraulic conductivity was generally rapid to very rapid in the upper sandy material and tended to be slower in the clay subsoil. Surface infiltration ranged from approximately 20 to 60 cm/h across sampling locations. The underlying clay subsoils were found to have appreciably lower saturated permeability, resulting in perching of infiltrating rainfall and waterlogging of the basal portion of the surface sand. <u>Phosphorus retention</u> Analysis of soil samples for phosphorus retention index and phosphorus buffer index found that soils on the premises generally have a very low phosphorus sorption capacity. Accordingly, the Blue Gums will be able to take up the majority of available phosphorus in the soil but phosphorus applied in excess of crop demand will be susceptible to leaching.
Acid sulfate soils	A preliminary acid sulfate soils (ASS) investigation was undertaken at the premises which found both actual ASS and potential ASS was present at irregular intervals within the proposed storage dam location. The acid generating potential of samples was found to be low, however the action criterion of 0.03 %S was exceeded.

<table>
<tr><th>Aspect</th><th>Details</th></tr>
<tr><td>Geology</td><td>Regional geology indicates that the area is underlain by gneissic basement rocks, which will exhibit a variably developed lateritic weathered profile. The lateritic profile (weathered clays derived from basement rocks) may extend to a depth of 30 to 50 metres thick, before transitioning and grading into fresh basement rocks.

The applicant commissioned geotechnical investigations at the woodlot site in April - May 2022, which involved the collection of representative samples for inspection and laboratory testing. Conditions at the premises were found to be variable but primarily comprise:

• Organic, sandy topsoil: up to about 0.3 m thick, overlying;
• Variable colluvium / laterised soil: variably present as clayey gravel, clayey sand and gravel, typically around 1 m to 2 m thick and typically dense/very stiff to hard, overlying;
• Residual soil from weathered in-situ granitic rock: variably present as mixtures of clay, silt and sand that was typically sandy clay, sandy silt or clayey sand, very stiff to hard near the top of the layer, progressively becoming very stiff to stiff at depth, and present to the maximum investigated depth of 13 m.</td></tr>
<tr><td>Topography</td><td>The premises generally slopes in a south-westerly direction, with the northern and south-eastern boundaries exhibiting the highest elevations (approximately 300 mAHD). The slope of the premises is relatively steep with an average gradient of approximately 5%.</td></tr>
<tr><td>Meteorology</td><td>The SILO database offered by the Queensland Department of Environment and Science provided the following information, based on records from the Bureau of Meteorology’s Mount Barker weather station (No. 009581) for 1980 to 2016:
<table>
<tr><th rowspan="2">Parameter</th><th rowspan="2">Average</th><th colspan="3">Percentile year</th></tr>
<tr><th>5th</th><th>50th</th><th>95th</th></tr>
<tr><td>Rainfall (mm/yr)</td><td>657</td><td>518</td><td>639</td><td>845</td></tr>
<tr><td>Pan evaporation (mm/yr)</td><td>1,373</td><td>1,289</td><td>1,374</td><td>1,448</td></tr>
</table>
The majority of rainfall occurs between May and October, with larger volumes falling in the winter months and peaking in July.</td></tr>
<tr><td>Hydrology</td><td>The premises lies within the greater Wilson Inlet catchment.

In the eastern area of the premises surface flow is generally re-directed via manmade channels towards the various existing dams. Surface water in the western portions drain into two unnamed minor non-perennial watercourses which combine and discharge into the Hay River approximately 3.5 km to the southwest. These watercourses are also likely to receive groundwater discharge from the premises.

The applicant has calculated run-off from the premises by proportioning total daily streamflow data from DWER Station No. 603010 by catchment area. Average annual effective run-off was determined to be approximately 9 ML/yr (7% of rainfall for the premises catchment area of 3.3 km^2).

Excluding localised gullies and waterways where runoff is concentrated, the premises is unlikely to be susceptible to flooding due to its location near the highest point in the catchment and approximate 100 m elevation above the Hay River.</td></tr>
</table>

Aspect	Details
Hydrogeology	Regional geology suggests that within valleys and surface drainage systems, accumulated sediments may support thin localised aquifers. The basement rocks and lateritic clayey profile typically possesses significant groundwater flows although minor groundwater storage and flow may be associated with fractures in the basement rocks (if present) and within the transition zone where the weathered profile grades into the fresh basement rocks. It is inferred that the groundwater flow direction is generally from east to west, towards Hay River, with surface expressions of groundwater occurring in storages and in non-perennial creeks where the underlying confined layer intersects the waterway. The predominately sandy textured soils at the premises have reportedly high saturated hydraulic conductivities and very low water holding capacities, which are underlain by a low permeability clayey subsoil. This is considered likely to result in perching of infiltrating rainfall and waterlogging of the basal portion of surface soils. Groundwater flow rates estimated on the premises indicate that movement through clayey subsoils (deeper lateritic profile) is likely to be slower (15 to 20 m/year) in comparison to the more rapid transport occurring in saturated sandy sediments (10 to 50 m/year). Groundwater flux for the lateritic aquifer is in the range of 50 to 100 m^3/day. Groundwater residence times are considered to be influenced by location on the premises and distance to groundwater discharge locations. Residence times are likely to range from five years in areas located near to the on-site watercourses (west) and up to 50 years in the upper parts (east) of the premises.

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020a) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 13.

Works approval W6771/2023/1 that accompanies this decision report authorises construction and time-limited operations. The conditions in the issued works approval, as outlined in Table 13 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the ongoing operation of the premises i.e. acceptance, storage and irrigation of treated sewage. A risk assessment for the operational phase has been included in this decision report, however licence conditions will not be finalised until the department assesses the licence application.

Table 13: Risk assessment of potential emissions and discharges from the premises during construction and operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Construction								
Dam construction Vehicle and machinery movements (reversing beepers) Hydraulic rock-breaking (where required)	Dust	Air / windborne pathway causing impacts to amenity	Residential homestead (within the premises) Residential premises (415 m southeast)	Refer to Section 3.1.1	C = Minor L = Unlikely **Medium Risk**	Y	N/A	N/A
	Noise			Refer to Section 3.1.1	C = Moderate L = Possible **Medium Risk**	Y	N/A	The *Environmental Protection (Noise) Regulations 1997* apply.
Excavation and exposure of ASS/PASS	Dissolved metals	Acidification causing leaching of metals to ground and surface water	Underlying groundwater Minor non-perennial watercourses (within the premises)	Refer to Section 3.1.1	C = Minor L = Unlikely **Medium Risk**	Y	N/A	N/A
Operation (including time-limited-operations operations)								
Storage and discharge of treated sewage	Odour	Air / windborne pathway causing impacts to amenity	Residential homestead (within the premises) Residential premises (415 m southeast)	Refer to Section 3.1.1	C = Slight L = Possible **Low Risk**	Y	N/A	N/A
	Disease vectors	Attraction and harbouring of pests causing impacts to health and amenity		Refer to Section 3.1.1	C = Minor L = Unlikely **Low Risk**	Y	N/A	N/A
Containment of treated sewage within the storage dam	Contaminants associated with treated sewage (nutrients, metals, pathogens, PoPs)	Seepage through dam lining to soil causing impacts to soil quality	Underlying soil and groundwater Groundwater dependent ecosystems (within the premises)	Refer to Section 3.1.1	C = Moderate L = Unlikely **Medium Risk**	Y	1, 2, 3, 4, 12, 13, 14, 15, 17, 19, 20, 24 **<u>16</u>**	The key applicant controls and infrastructure specifications identified in the application and Nutrient Irrigation Management Plan have been included in the works approval as regulatory controls. The Delegated Officer has specified yearly nutrient loading limits for irrigation to the woodlot as an additional regulatory control during time limited operations. These limits are also proposed to be used in any subsequent licence granted in relation to these operations. The loading limits are 132 kg/ha/yr and 32 kg/ha/yr for total nitrogen and total phosphorus respectively. These limits have been derived as 10 % more than the total nitrogen (119.3 kg/ha/yr) and total phosphorus (28.7 kg/ha/yr) inputs assumed in the MEDLI modelling.
Containment of treated sewage within the storage dam Discharge of treated sewage via woodlot irrigation		Infiltration through soil to groundwater causing impacts to groundwater quality						
		Downgradient groundwater migration causing impacts to beneficial use or terrestrial and aquatic ecosystems	Minor non-perennial watercourses (within the premises) Farm dam (300 m west) Rural residence (1 km west) Groundwater dependent ecosystem (1.2 km downgradient of the premises)	Refer to Section 3.1.1	C = Moderate L = Unlikely **Medium Risk**	Y		
Storage dam overflow events and seep drains Discharge of treated sewage via woodlot irrigation		Surface runoff causing impacts to terrestrial and aquatic ecosystems or beneficial use	Minor non-perennial watercourses (within the premises) Groundwater dependent ecosystems (within the premises) Farm dam (300 m west) Rural residence (1 km west)	Refer to Section 3.1.1	C = Moderate L = Rare **Medium Risk**	Y	1, 2, 3, 4, 12, 13, 14, 15, 17, 19, 20, 24	The key applicant controls and infrastructure specifications identified in the application and Nutrient Irrigation Management Plan have been included in the works approval as regulatory controls.
		Direct contact causing impact to human health	Residential homestead (within the premises)	Refer to Section 3.1.1	C = Moderate L = Rare **Medium Risk**	Y	1, 2, 3, 4, 12, 13, 14, 15, 24	

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Discharge of treated sewage via woodlot irrigation	Sediment	Loss of soil structure and erosion causing impact to surface water quality and aquatic ecosystems	Minor non-perennial watercourses (within the premises) Farm dam (300 m west)	Refer to Section 3.1.1	C = Minor L = Rare **Low Risk**	Y	20, 24	N/A

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020a).

Note 2: Proposed applicant controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

4. Consultation

Table 14 provides a summary of the consultation undertaken by the department.

Table 14: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website	None received	N/A
Department of Health (DoH) advised of proposal on 16 February 2023	***1. Wastewater Disposal*** In relation to the management of wastewater, the DoH is currently in consultation with the proponent. The proposal was raised during the last interagency committee and the department is in favour of supporting the proposal. In addition to the upgrading works, the proponent will be required to update their recycled water quality management plan (RWQMP). ***2. Medical Entomology*** The risk of mosquitoes and mosquito-borne diseases such as Ross River and Barmah Forest virus disease is largely unknown for this region. There may be seasonal freshwater mosquito breeding habitat within close proximity to the subject land. Additionally, there is the potential for mosquitoes to breed in on-site infrastructure and constructed water bodies if they are poorly designed. The DoH recommends that the proponent ensures proposed infrastructure and site works do not create additional mosquito breeding habitat as follows: Changes to topography resulting from earthworks (e.g. the installation of pipelines, footpaths, roads etc) must prevent run-off from creating surface ponding as it may become mosquito breeding habitat. Water tanks and other water-holding containers must be sealed or screened to prevent mosquito access and breeding. Regular monitoring for mosquito larvae and treatment with larvicide may also be required. Waste items (tyres, drums and other water holding receptacles) should be filled with sand/soil; kept undercover or punctured to reduce the chances of these items holding water and becoming mosquito breeding habitat. Constructed water bodies must be located, designed and maintained so they do not create or contribute to mosquito breeding. Constructed water bodies may require regular monitoring and application of herbicides and/or removal of invasive vegetation to prevent the harbourage of mosquito larvae.	***1. Wastewater Disposal*** Noted. ***2. Medical Entomology*** Relevant aspects relating to infrastructure design appear to have been met by the applicant and have been incorporated in the works approval.

Consultation method	Comments received	Department response
Local Government Authority advised of proposal on 16 February 2023	None received	N/A
Applicant was provided with draft documents on 20 December 2023	The Applicant responded on 1 November and 25 November 2024. Refer to Appendix 1	Refer to Appendix 1
Applicant was provided with revised draft documents on 22 January 2025	The Applicant responded on 5 February 2025. Refer to Appendix 2	Refer to Appendix 2

5. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020a, *Guideline: Risk Assessments*, Perth, Western Australia.
3. DWER 2020b, *Guideline: Environmental Siting*, Perth, Western Australia.
4. GHD 2023, *Nutrient and Irrigation Management Plan: Mount Barker Woodlot Treated Wastewater Irrigation*, unpublished report prepared for the Water Corporation.

Appendix 1: Summary of applicant's comments on draft risk assessment and conditions

Condition	Summary of applicant's comment	Department's response
Works approval conditions		
2: Table 2 – Capacity	The storage dam has been designed to contain full operating capacity of 60ML and retain a 1 in 10-year, 72-hour rainfall event with a minimum 300 mm freeboard from bottom of spillway to top of water level. The storage dam does not contain 85ML without overflow of the spillway.	Removed the requirement for the 85 ML capacity and changed reference from 1% AEP to 1 in 10 year, 72-hour rainfall event. The 85 ML capacity previously listed was in reference to the volume of water before overtopping of embankments.
2: Table 2 – Spillway	The storage dam has been designed to retain a 1 in 100- year, 72-hour rainfall event before overtopping of embankment occurs.	Changed reference from 0.001% AEP to 1 in 100-year, 72-hour rainfall event.
2: Table 2 – Embankments	Replace the word "crest" with "embankment".	Wording replaced.
2: Table 2 – Intercept drains	The drains will not be fully lined with rock-pitching, only some locations depending on the flow potential for erosion. Filters have been removed from design.	Reference to filters removed and wording modified to reflect the need for rock-pitching only in areas where there is an erosion risk.
Environmental commissioning	Water Corporation requests an Environmental Commissioning Phase to be included in the Works Approval to allow for the testing and commissioning of the storage dam including pipework, liners, etc.	Conditions allowing for environmental commissioning have been included in the works approval.
5 – Critical Containment Infrastructure Compliance Reporting 7 – Environmental Compliance Report	Requesting a longer timeframe of 90 days to conduct audit, obtaining as constructed drawings, engineering endorsement and prepare the report.	Submission timeframe changed to 90 days.
16 (was 12): Table 3 – Waste acceptance criteria	Request amendment to include treated wastewater to be directed to the storage pond by either pipeline or via controlled tanker from the WWTP to give operational flexibility if there is pipeline/pump maintenance etc.	Acceptance by tanker included.
19 (was 15): Table 6 – Irrigation requirements during time limited operations	In any one year there may be a need to irrigate more due to higher-than -average evapotranspiration or to manage increased rainfall on the winter storage. The NIMP (GHD, 2023) irrigation schedule is only intended as an average irrigation rate calculated from long term climate averages. Requesting removal of hydraulic limit and use nutrient limit instead to manage irrigation. Request removal of 1(a) of Table 6.	Requirement 1(a) of Table 6 has been changed to specify that no irrigation is to take place during June, July and August and reference to daily application rates for each month have been removed. Table 7 has also been removed.
	Require ability to be able to irrigate during the following year of re-establishment depending upon climate and weather conditions, such as reduced rainfall and higher evaporation rates creating low soil moisture.	Requirement 1(h) changed to include contingency for irrigation in the following year of re-establishment in the event of low soil moisture conditions.
21 (was 17): Table 9 – Vegetation management requirements and Schedule 4 – Harvest plan	Water Corporation requires flexibility to adjust harvesting in response to market dynamics, vegetation growth, performance/health, climate variability and resource constraints. If the general maturity profile of the woodlot is maintained to undertake the required nutrient and hydraulic uptake, it is not recommended to specify the exact plots for harvest each year in the Works Approval due to the potential change in the strategic factors outlined above. Harvesting and vegetation management will be managed under the Nutrient Irrigation Management Plan (NIMP). Request removal of Condition 17 and Schedule 4.	The need for harvesting flexibility in response to vegetation growth, performance/health and climate variability is noted. However, this condition also includes additional requirements relating to the management of harvested material to prevent nutrient contributions after harvesting. The condition also includes key requirements related to condition 24 which allows the NIMP to be an adequate and enforceable regulatory control. To allow flexibility in harvest scheduling, requirement 1(a) and Schedule 4 have been removed. Requirement 1(b) has been changed to 'Harvesting must be scheduled to ensure that adequate nutrient and hydraulic uptake is maintained in each woodlot plot, and there are sufficient irrigation areas available in any one year'.
23 (was 19): Table 11	The monitoring locations request to be confirmed were provided.	Noted and included.
22 (removed) and Schedule 3: Table 14 – Monitoring	Request to amend the monitoring frequency requirement to biannual to target post-summer (peak irrigation) and post winter (peak rainfall) seasonality is considered to be proportionate to the level of risk that the activity poses to human health, the environment and environmental values.	Given the larger monitoring suite and number of bores the required frequency has been changed to biannual monitoring targeting the relevant peak seasonal periods.
28 (was 25) – Time limited operations report	Request increased time period of 60 days to allow for compiling monitoring data and reporting.	Reporting timeframe changed to 60 days.

Condition	Summary of applicant's comment	Department's response
Schedule 3: Table 14 – Groundwater monitoring during time limited operations	Request removal of PEN_MB02, PEN_MB03 and MTB02-19 from Table 14. Monitoring location PEN_MB02 is no longer serviceable due to an obstruction/collapse in the casing above the water table. Monitoring location PEN_MB03 is artesian and not suitable for water quality monitoring. Monitoring location MTB02-19 is dry and no longer serviceable. Request replacement of PEN_MB06 and PEN_MB07 to be replaced with Proposed Bore 1, Proposed Bore 2 and Proposed Bore 3. Proposed bores PEN_MB06 and PEN_MB07 have been renamed and moved to improve the monitoring network's ability to monitor changes to down hydraulic gradient groundwater quality in the northern portion of the site. This also acknowledges that the locations of proposed bores PEN_MB06 and PEN_MB07 are unlikely to be feasible or optimal. The additional proposed bore would be beneficial to monitor groundwater quality changes down hydraulic gradient of the proposed new storage dam. Refer replacement Figure 10 in Attachment 1 of this document.	Noted and included. Proposed monitoring bores 1, 2 and 3 have been included in condition 1 and reporting of the bore logs have been included in condition 8.
	Request to amend the monitoring frequency requirement to biannual to target post-summer (peak irrigation) and post winter (peak rainfall) seasonality is considered to be proportionate to the level of risk that the activity poses to human health, the environment and environmental values.	Required frequency has been changed to biannual monitoring targeting the relevant peak seasonal periods.
	Request removal of water quality parameter TDS from Table 14 as this will be assessed through field measurements of EC in groundwater monitoring.	TDS parameter removed from the table.
Schedule 3: Table 15 – Surface water monitoring during time limited operations	Request removal of the SW2, SW4, SW7 and SW10 monitoring locations from Table 15. TWW will be conveyed from the WWTP to the proposed storage dam by an underground pipeline. Given the unlined open channel is no longer in use and dry, monitoring locations SW2 and SW4 are no longer required. Monitoring location SW10 is already addressed by Condition 19 (Table 11) (emissions and discharge monitoring). SW8 monitors surface water quality at the site boundary before it flows off-site onto agricultural properties. SW7 is ~75m east of SW8 and adds limited value. Refer to updated Figure 10 in Attachment 1 of this document.	The SW2, SW4, SW7 and SW10 locations were removed from the table.
	The ephemeral drainage lines typically only flow during the winter months. Amend to sample twice in Winter months only when there is flow.	Noted, required frequency has been changed to reflect periods of surface water flow.
	Request removal of water quality parameter TDS from Table 15 as this will be assessed through field measurements of EC in surface water monitoring.	TDS parameter removed from the table.
	Request removal of SWL in Table 15 as this is not an appropriate parameter for surface water.	SWL has been changed to 'Water level' as this is relevant information for interpreting sample results.
Schedule 3: Table 16 – Soil monitoring during time limited operations	Request removal of monitoring location SM7 as it is in the same irrigation plot as SM1. SM1 will provide the data required to monitor the soil condition within the plot. Refer to updated Figure 10 in Attachment 1 of this document. Request removal of parameters ESP, chloride, and Colwell potassium as they present a duplication. Salinity and soil sodicity risks are already well characterised through parameters EC1:5, calcium, sodium, magnesium, potassium and ECEC. The woodlot vegetation is not sensitive to foliar injury from chloride. Request removal of parameters reactive iron and reactive aluminium. Phosphorus adsorption ability of the soil is already well characterised by parameters Colwell phosphorus, PRI, and PBI. Request removal of parameter boron. TWW irrigation is not considered to be a source of boron that could impact the woodlot.	SM7 has been removed from the monitoring locations. Chloride, Colwell potassium, reactive iron, reactive aluminium and boron were removed from the table. ESP has been retained as it measures how much sodium is taking up soil exchange sites under the specific site conditions and provides useful information on sodicity risk.
Figure 10 – Monitoring locations	Replace Figure 10 – Monitoring Locations with the updated Figure 10 provided as an attachment.	Figure replaced.
Decision report		
Table 7 – Proposed monitoring program system monitoring	Request amendment of rainfall monitoring to be routinely as it is impossible for operational staff to monitor the rainfall continuously 24/7, 7-days a week.	Changed.

Appendix 2: Summary of applicant's comments on revised draft risk assessment and conditions

Condition	Summary of applicant's comment	Department's response
Works approval conditions		
19: Table 6 Row 1a (removed) – No irrigation in winter	Water Corporation requests Condition 19, Table 6 Row 1(a) is removed. Water Corporation notes that Condition 19 – Table 6 (a) is aimed to be a regulatory control to reduce the risk of surface water runoff and infiltration of contaminants to groundwater at the woodlot. However, these risks can be adequately controlled by the following conditions: Condition 19, Table 6: (b) Irrigation generated runoff or discharge must not occur beyond the boundary of the irrigation plots; (c) Irrigation must not occur on land that is waterlogged; (d) Irrigation must not be undertaken immediately prior to, during or after a rainfall event; (e) Irrigation must be evenly distributed over the irrigation plots, so that no ponding or pooling occurs; Condition 19 – Table 6 (a) presents a risk to woodlot health and hence the ability of the woodlot to uptake nutrients. Reviewing the SILO Patch climate dataset for Mt Barker from 1 January 2010 – 31 January 2025, 6 instances of monthly total pan evaporation exceeding rainfall in the months of June, July, and August have been identified (Plate 1). This equates to monthly total pan evaporation exceeding rainfall 13.3% of the time in the months of June, July, and August between 2010 and 2024 at Mount Barker. Pan evaporation exceeding rainfall is a trigger to commence irrigation at the woodlot, dependent upon the soil-water status of the irrigation area. By not allowing irrigation during these periods, the soil-water status may fall below the permanent wilting point and tree distress, or die-off may occur. This would be detrimental to the vegetation nutrient uptake potential of the woodlot. The GHD (2023) NIMP irrigation schedule, which is the basis of the original Condition, indicates 0 mm of irrigation for June, July, and August. It is important to note that this schedule only represents a typical irrigation rate derived from long-term climate averages (average pan evaporation is less than the average rainfall during these months). It was devised to calculate the recommended TWW water use at the woodlot and ensure the corresponding nutrient loading does not exceed the uptake potential of the woodlot. However, this schedule does not preclude year-to-year irrigation in June, July, and/or August when pan evaporation exceeds rainfall, as the data indicates that such months do occur. Condition 19 – Table 6 (b-e) already control irrigating when not appropriate to prevent surface runoff, and Condition 20 – Table 7 (nutrients) is present as a regulatory control to manage nutrient loading at the woodlot. The Guide to Future Climate Projections for Water Management in Western Australia (DWER, 2024) reports that observed drying trends in the south-west region are projected to continue with declines in wet season rainfall and an increase in evapotranspiration. The frequency of instances where pan evaporation is greater than rainfall in the months of June, July, and August will likely increase. Therefore, the condition 19 – Table 6 (a) would likely cause impacts on vegetation health at the woodlot based on future climate predictions.	The provided information relating to monthly pan evaporation and occurrences of very low winter rainfall has been noted. To allow woodlot irrigation to occur during low winter rainfall situations, the requirement to cease all irrigation during June, July and August has been removed. In consideration of the information provided and the medium rating of the risk event, the Delegated Officer considers the remaining requirements to provide an adequate level of regulatory control.