Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6451/2020/1
Applicant	Water Corporation
File Number	DER2020/000327
Premises	Broome North Wastewater Treatment Plant Crab Creek Road BROOME WA 6725 Lot 1502 on Plan 75036 Certificate of Title Volume 2805 Folio 367 As defined by the coordinates in Schedule 1 of Works Approval
Date of Report	23 April 2021
Status of Report	Final

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1. Decision summary

This Decision Report outlines the risk assessment of emissions and discharges to the environment during the construction, commissioning and operational phases of the proposed works and details the Delegated Officers determination in accordance with DWER's Regulatory Framework.

As a result of this assessment, Works Approval W6451/2020/1 has been granted.

2. Purpose and scope of assessment

Water Corporation (the Applicant) lodged an application for a works approval under Part V of the *Environmental Protection Act 1986* (EP Act) on 3 August 2020 (the Application) to upgrade the existing Broome North Wastewater Treatment Plant (the Premises) (L9094/2017/1). The proposed works form Phase 2 of upgrades seeking to increase wastewater treatment capacity at the Premises. The Phase 2 upgrade includes:

- the reconfiguration of Ponds 1 and 2, including the installation of a deep anaerobic zone within Pond 2;
- installation of three new rotary screens at the inlet into the wastewater treatment plant;
- construction of a new sludge dewatering system;
- construction of a new pivot irrigation system (Pivot 3); and
- changes to the associated wastewater conveyance infrastructure.

The proposed works will increase the design capacity of the treatment infrastructure up to 7.0 ML/day, however treated wastewater disposal (irrigation) capacity will limit the actual throughput of the Premises to 4.77 ML/day (1,741 ML/annum). Phase 3 of upgrades at the Premises will be undertaken at a later date, through a separate application and will increase disposal capacity to allow for a throughput up to 7.0 ML/day.

The Application includes a request to undertake commissioning following completion of the works to allow for process optimisation for a period of up to eight months. Full operational capacity is not expected to be reached during commissioning and is not anticipated to occur until 2023.

The increase in proposed throughput under this works approval includes an increase in Category 61: Liquid waste facility from 1,200 tonnes per annum to 2,400 tonnes per annum and an increase in Category 54: Sewage facility from 3,500 m^3/day to 4,770 m^3/day. Table 1 lists the proposed changes to the approved production/design capacity for related prescribed premises categories.

Table 1: Prescribed Premises Categories in the Existing Licence

Classification of Premises	Description	Approved Premises production or design capacity or throughput
Category 54	Sewage facility: premises — (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or into waters.	4,770 cubic meters per day
Category 61	Liquid waste facility: premises on which liquid waste produced on other premises (other than sewerage waste) is stored, reprocessed, treated or irrigated	2,400 tonnes per annual period

2.1 Premises Background

The Broome North Wastewater Treatment Plant was constructed in 2011 under Works Approval W4531/2009/1 and included a primary facultative treatment pond with an anaerobic digestion pit (Pond 1), a secondary maturation pond (Pond 2) and a third treated wastewater storage pond.

The treatment plant was constructed in the middle of a 200 ha site and allows for multiple phases of development based on increasing demand from population growth. The development includes provision for treated wastewater discharges to land for the irrigation of a Rhodes grass cropping area and a native vegetation seedling area. The first irrigation area (Phase 1) was not completed until 2012, approximately 14 months after the first operating Licence was granted for the site. The site currently has two Rhodes Grass pivot irrigation areas (Pivot 1 and Pivot 2) and a seedling irrigation area operated by The Mamabulanjin Aboriginal Corporation (MAC).

3. Overview of works

The Application relates to the construction and development of Phase 2 of three proposed development phases as indicated by Table 2 below.

Table 2: Proposed phased development schedule

Development phases	Throughput capacity	Wastewater irrigation areas	Proposed implementation date
Phase 1	3.5ML/day	Pivot 1 (33Ha) Pivot 2 (26Ha) MAC seedling area (18Ha)	Completed 2012
Phase 2	4.77ML/day	Pivot 1 (33Ha) Pivot 2 (26Ha) Pivot 3 (28Ha) MAC seedling area (18Ha)	2023
Phase 3	6.1ML/day	Pivot 1 (33Ha) Pivot 2 (26Ha) Pivot 3 (28 Ha) Pivot 4 (24Ha) MAC seedling area (18Ha)	2033

Construction and commissioning of Phase 2 is proposed to occur over two dry seasons (1 May to 30 September) commencing in 2021. Table 3 below shows the anticipated schedule for the development of Phase 2.

Table 3: Proposed schedule for the Premises Phase 2 development

Construction	Commissioning	Operation
To occur over the dry seasons of 2021 and 2022	January 2023- August 2023	September 2023 onwards

3.1 Infrastructure - Construction aspects

Phase 2 is proposed to be constructed over a period of up to two years followed by a commissioning phase after which production increases up to the maximum volume of 4.77 ML/day. Site works include civil earthworks and preparations for the construction and alteration of infrastructure as detailed below in Table 4 and shown in the general site layout in Figure 1 below.

Table 4: Works proposed through the Application

	Infrastructure	Design and construction / installation requirements	Infrastructure location
1.	Inlet screening area	• Installation of 3 x 100 L/s rotary inclined screens with a combined capacity of 7.0 ML/day. • Pipework to and from the new inlet screens re-laid with the existing screen being taken off-line during commissioning. • New concrete hardstand free of leaks and defects and lined to achieve a permeability of less than 1 x 10^{-9} m/s. • Hardstand area designed to return leaks, spills and runoff to the treatment pond system.	Figure 1
2.	Pond 1	• Construction of a berm across Pond 1 to create an anaerobic digestion/facultative zone separated from a maturation zone within the existing pond (smart pond 1/maturation pond 1). • The berm will be lined with a Bituminous Geomembrane (BGM) liner with a permeability less than 1 x 10^{-9} m/s. • The BGM liner will be installed in accordance with manufacturer's specifications. • A dedicated sludge withdrawal pipe will be installed within the digestion pit.	Figure 1
3.	Pond 2	• Construction of a berm across Pond 2 to create an anaerobic digestion/facultative zone separated from a maturation zone within the existing pond (smart pond 2/maturation pond 2). • The berm will be lined with a BGM liner with a permeability less than 1 x 10^{-9} m/s. • The BGM liner is to be installed in accordance with manufacturer's specifications. • Excavation of an anaerobic digestion pit with a finished floor level of 11.6m AHD within the front section (digestion/facultative zone) of the pond. • The digestion pit will be concrete lined at the base with dimensions of 33 m wide (12 m at base) and 59 m long (38 m at base). • The slopes of the newly installed digestion pit (between new excavation and the concrete floor) will be lined with a Geosynthetic Clay Liner (GCL) overlain by compacted sand and rip-rap slopes. The liner will have a permeability no more than 2 x 10^{-10} m/s. • The new GCL will be sealed and bonded with the existing Bentofix X2000 GCL in Pond 2 and the concrete digestion pit base using a bentonite clay paste. • The new GCL will be installed in accordance with manufacturer's specifications. • New inflow pipework will be positioned to allow inflow directly into the digestion pit.	Figure 1

	Infrastructure	Design and construction / installation requirements	Infrastructure location
		• A dedicated sludge withdrawal pipe will be installed within the digestion pit.	
4.	Storage dam	• Replacement of inlet and outlet pipework between the Storage dam and Ponds 1 & 2.	Figure 1
5.	Sludge drying beds	• Alteration to allow sludge to be conveyed to the sludge drying beds via pipeline.	Figure 1
6.	New treated wastewater disinfection tanks	• 2 x 60kL wastewater holding tanks. • Fitted with an overflow pipeline designed to return overflow to the treatment plant.	Figure 1
7.	Pumping systems	• Reconfiguration of pipelines and pumping systems between ponds, wastewater holding tanks and irrigation systems.	NA
8.	Pivot 3	• New pivot irrigation system with an area of 23.76 ha. • May only be constructed following the grant of a valid vegetation clearing permit.	Figure 1
9.	Road upgrades	• Upgrades and amendments to existing roads to allow for vehicular access to new infrastructure.	NA

The works require each pond to be taken offline sequentially to allow for the base load treatment of sewage at the Premises to continue during the upgrade (approximately 2 ML/day). Works on Pond 2 will be completed first with sewage treatment in Pond 1 remaining active during this period. After the Pond 2 works have been completed, the pond will be put into service so that base load treatment can continue, then Pond 1 will be drained to allow works on Pond 1 to commence.

Construction hours will be between 7 am to 7 pm Monday to Friday but may occur outside these timeframes if required. Construction outside of the day-time hours (7 am to 7 pm Monday to Saturday) listed in the *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) will need to occur in accordance with Regulation 13 of the Noise Regulations and a Noise Management Plan approved by the Shire of Broome.

Once construction works are complete the Premises will transition into the commissioning phase.

Figure 1: Broome North Wastewater Treatment Plant proposed site layout

Source: Water Corporation (2020a)

3.2 Infrastructure - Commissioning aspects

Prior to being put back into service, functional testing of all the equipment and associated facilities for each pond will be undertaken to ensure each piece of infrastructure is independently operating as anticipated. This will include hydraulic testing of pipework and valves, liner testing and testing of inlet screens.

Water quality performance will be monitored throughout commissioning. Once all of the ponds have been reconfigured, the entire system will be commissioned under load, with both ponds in operation simultaneously. The commissioning under full load to demonstrate stable performance for a sustained period of time will not be possible while overall demand remains low.

Commissioning is anticipated to take a maximum of 18 months due to the need to continue sewage treatment during the works. Pond 2 and associated infrastructure will be commissioned independently for 12 months and Pond 1 and associated infrastructure will be commissioned independently for 2 months, concurrent with the remainder of the commissioning period for Pond 2. This will be followed by the full commissioning of the upgrade works for a further 6 months.

3.3 Infrastructure - Operational aspects

The Premises infrastructure, as it relates to Category 61 and 54 is detailed in Table 5 and with reference to the Site Plan (attached in the issued Works Approval). This infrastructure includes the existing approved infrastructure as currently operated under Licence L9094/2017/1 and incorporates the upgrade works to the Premises as proposed to be constructed in accordance with Works Approval W6154/2020/1.

Table 5: Broome North Wastewater Treatment Plant Facility Category 54 and 61 infrastructure

Infrastructure and proposed works	
Sewage treatment	
1.	Inlet screening area • 3 x 100 L/s rotary inclined screens with a combined capacity of 7.0 ML/day. • Concrete hardstand area graded to direct leaks, spills and runoff to the treatment pond system. • 3 x screening bins.
2.	Tanker receival bay • Bunded hardstand area for receival of septage into the beginning of the treatment process and which is graded to return surface run off and leachate to the treatment process.
3.	Sewage volumetric inflow meter.
4.	Pond 1: • Volume: 42,396 m^3. • Lined with GCL with a permeability of less than 2 x 10^{-10} m/s . • The front (west) part of the pond has a 7.5 m deep anaerobic digestion pit at depth, with a facultative zone above the digestion pit near the pond surface, a berm with an outflow pipe divides the pond, and creates a shallower maturation rear part of the pond. • Inflow and sludge removal pipes connect with the digestion pit. • Freeboard: 500 mm.

Infrastructure and proposed works	
5.	Pond 2: • Volume: 43,042 m^3. • Lined with GCL with a permeability of less than 2 x 10^{-10} m/s. The base of the deep anaerobic sump is lined with concrete that is sealed and bonded with the GCL. • The front (west) part of the pond has a 7.5 m deep anaerobic digestion pit at depth, with a facultative zone above the digestion pit near the pond surface, a berm with an outflow pipe divides the pond, and creates a shallower maturation rear part of the pond. • Inflow and sludge removal pipes connect with the digestion pit. • Freeboard 500 mm.
6.	Storage Dam • Volume: 149,280 m^3. • Lined with GCL with a permeability of less than 1 x 10^{-9} m/s. • Freeboard 500 mm. • Capable of containing annual inflows and a 1:50 year 72 hour rainfall event (2% annual exceedance probability). • Has a spillway to the south-east of the pond and sheds water away from the pond along drainage lines that discharge to south-east of the wastewater treatment plant.
7.	2 x Sludge drying beds • 2 x raised concrete drying beds, bunded with a sand filter to prevent leachate run off and redirects sludge and leachate back towards the treatment process. • Located to the north of Pond 1, may be fitted with geotextile bags during sludge removal processes and a polymer dosing system to encourage the precipitation of solids within the sludge.
8.	Premises is surrounded by a 1.8m fence and has a locked gate to secure the Premises.
9.	Diesel generators • 2 x 125kVA diesel generators. • 1 x double lined 10,000 L diesel storage tank.
10.	2 x pump stations.
11.	Stormwater cut off drains/ diversion channels and culverts to convey uncontaminated stormwater away from the treatment ponds, conveying water down slope and down hydraulic gradient to the south-east of the wastewater treatment plant.
Wastewater irrigation	
12.	Chlorination system • Located within a dedicated chlorination shed. • Includes 2 x 920 kg drums.
13.	Irrigation holding tanks • 6 x 60 kL fibre reinforced polymer tanks used to store treated wastewater prior to irrigation.
14.	1 x Fertigation unit located adjacent to the wastewater holding tanks.

Infrastructure and proposed works	
15.	2 x Water reuse meters • 1 x for the MAC seedling area. • 1 x pivot irrigation systems.
16.	4 x Irrigation systems • Pivot 1 (33 ha). • Pivot 2 (26 ha). • Pivot 3 (23.76 ha). • 1 x 18 ha MAC seedling drip irrigation area (up to 28 kL/day).
17.	1 x filtration system.
18.	1 x machinery shed. 1 x hay storage shed.
19.	Groundwater monitoring network The Premises has an established groundwater well monitoring network with 34 monitoring bores with the majority of the groundwater well being paired with one well sampling from the Pindan Sands aquifer and the other paired bore samples from the Broome Sandstone aquifer at the same location. Six single offsite bores occur outside of the Premises (north, south and east of the prescribed activity areas). The networks primary objective is to monitor changes in groundwater quality both up-stream and down gradient of the treatment ponds and irrigation areas to determine if impacts are occurring. The monitoring network is shown in Figure 2 below.

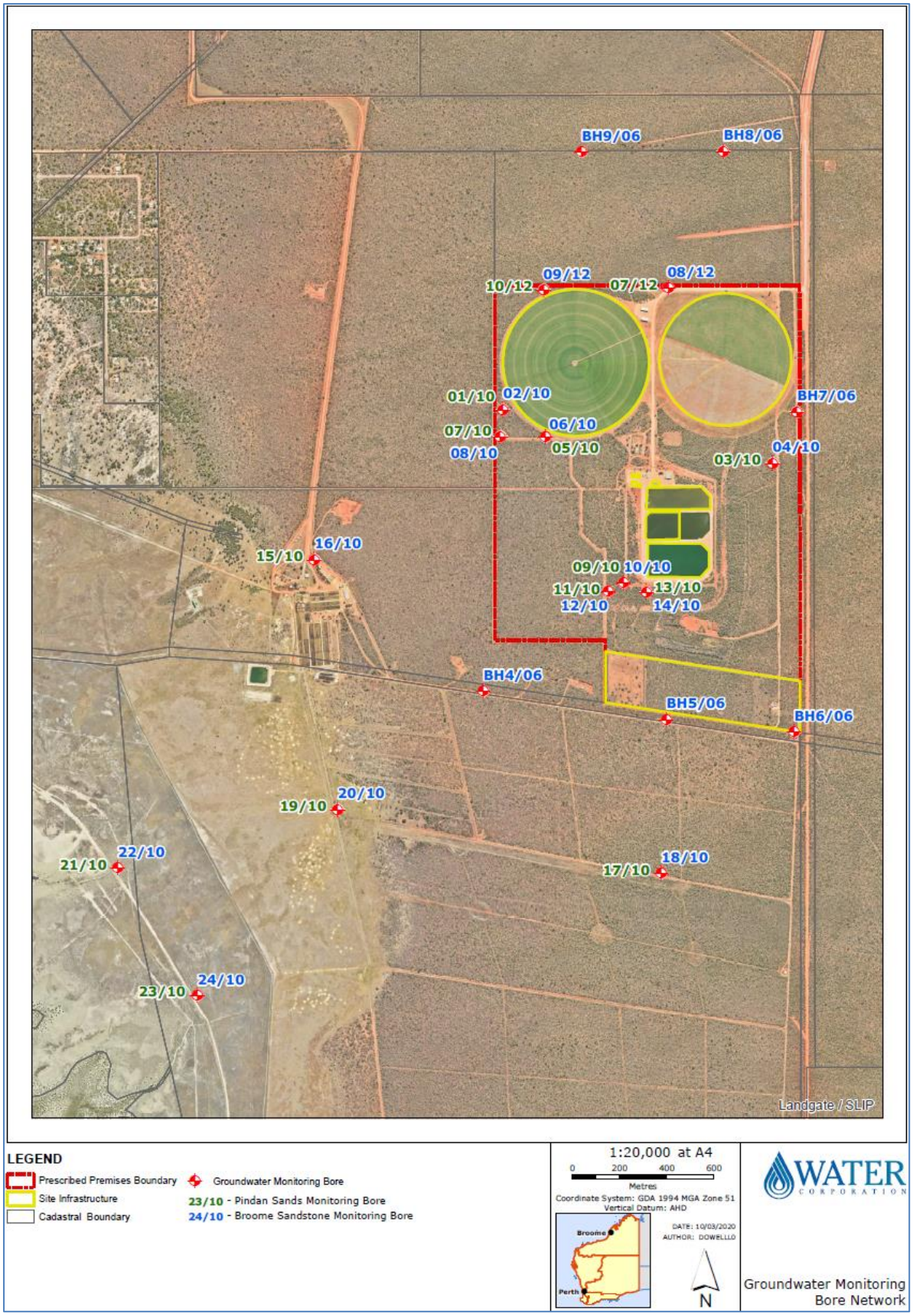

Figure 2: Broome North Wastewater Treatment Plant groundwater monitoring network

Source: Water Corporation (2020a)

3.4 Exclusions to the assessment

The construction and operation of ancillary infrastructure in not related to the prescribed activities. The following are excluded from the scope of this assessment:

- Pipeline conveying wastewater between Broome South Wastewater treatment Plant and the Premises;
- Employee facilities;
- Administration buildings and lay down areas;
- Crop and seedling sowing and harvesting equipment;
- Workshops;
- Fertigation unit; and
- Proposed changes to the monitoring bore network (to be addressed in the subsequent licence amendment).

4. Legislative context

Table 6 summarises approvals relevant to the assessment.

Table 6: Relevant approvals and tenure

Legislation	Number	Approval
Health Act 1911 *Recycled Water Scheme Approval*	M19/00000	Approval for the re-use of wastewater for the regulation of potential public health impacts.
Environmental Protection Act 1986 – native vegetation clearing	Under Assessment	A clearing permit is being assessed separately to this Works Approval. Clearing under the Works Approval is not permitted.
Environmental Protection Act 1986	Part V Licence L9094/2017/1	Following completion and validation of compliance of the works against the conditions of the Works Approval, the Applicant can seek to amend the Licence to operate the new infrastructure and at the increased throughput rate post commissioning.
Environmental Protection Act 1986	Part V Works Approval W6451/2020/1	Issued as a result of this decision.
Dangerous Goods Safety Act 2004	Dangerous Goods Licence DGS021433	The Premises stores 2 x 920 kg drums of compressed chlorine gas and has a 10,000 L diesel tank onsite. The chlorine gas volume meets the manifest threshold for a licence to be required (500 L or greater). Diesel is not included on the DG licence as the manifest threshold for C1 liquids is 100,000 L when no other fire risk dangerous goods are present. A manifest detailing location and quantities of dangerous good is required to be kept at the front gate of the Premises for use by emergency services in the event of an incident at the site.

4.1 EP Act Part V Division 2 (Clearing of Native Vegetation)

Water Corporation's current state-wide clearing permit CPS 185/8 (granted on 20 April 2017) allows for the clearing of native vegetation for new water services infrastructure, but does not allow for clearing to be undertaken for the proposed expansion to the irrigation area. As a result Water Corporation have applied for a separate clearing permit and clearing will not be authorised through the Works Approval.

4.2 Contaminated Sites Act 2003

The Premises is not classified under the *Contaminated Sites Act 2003* (CS Act 2003).

The Delegated Officer has sought advice from DWER's Contaminated Sites Branch, received on 4 November 2020 and revised on 8 February 2021 (DWER document reference: A1983760) to inform the risk assessment of the Application (refer to Section 6 and 7).

4.3 Rights in Water and Irrigation Act 1914

The subject land is within the Broome Groundwater Area, proclaimed under the *Rights in Water and Irrigation Act 1914*. In proclaimed groundwater areas a section 5C licence to take water is required for the use of groundwater and a section 26D licence is required for any production bore construction. Water Corporation currently holds a groundwater licence (GWL168987) to take 120,000 kL/annum for commercial irrigation purposes and product processing washdown on Lot 1502 on Plan 75036. If the Water Corporation requires additional or less water as a result of the proposed upgrade, they will need to apply to amend their licence.

4.4 Other relevant approvals

4.4.1 Planning approvals

In accordance *with the Planning Development Act 2005 (WA),* Broome Town Planning Scheme No.6 was amended so that the site is zoned "Public Purposes (S: Sewerage)" on 22 December 2005. The site is subject to the SCA3 – Essential Services Buffer Area which provides a buffer around the Premises due to potential odour emissions and to protect the area from future urban encroachment.

4.4.2 Department of Health

The Delegated Officer consulted with the Department of Health (DoH) on 10 November and 11 December 2020 (document reference: DWERDT366753 and DWERDT391276 respectively). The DoH advised that the Applicant requires an application under the *Health Act 1911* to update Recycled Water Scheme Approval M19/00000 to include the third irrigation pivot. It was noted within the advice that DoH considers the plant should have a minimum 25 day retention time (30 day target) for helminth larvae and ova management.

5. Location and siting

5.1 Siting context

The Premises is located within the hot-semi arid Kimberley Region, the northern most section of mainland Western Australia. Approximately 40% of the population of the Kimberley Region's residents live in Broome or Rubibi, as it is known by the Yawuru people. The permanent population is approximately 14,000 (according to the 2016 census and may reach up to 45,000 during the peak of the tourist season). The town is known for tourism, pearling and its fossilised Cretaceous period dinosaur footprints situated on a relatively flat low-lying peninsula and is bound by the Indian Ocean to the west and Roebuck Bay to the South. Roebuck Bay is also one of the most important sites world-wide for migratory species of wading birds (DPAW 2020).

The Premises is located approximately 12 km north-east of the centre of the Broome townsite.

5.2 Residential and sensitive receptors

The distances to residential and sensitive receptors are detailed in Table 7.

Table 7: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Residential dwelling within the Broome Common Stockyards (within premises L7864)	790 m west of the Premises boundary
Broome Airport and Industrial Park	2 km north
Residential Premises Morrell Park Aboriginal Community	1.4 km north-west to the nearest dwelling within the community
Broome townsite residential dwellings	3.95 km west to the nearest dwelling on Manilya Road

5.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or emissions and discharges from the Premises. The distances to specified ecosystems are shown in Table 8. Table 8 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting* (DER 2016).

Table 8: Environmental values and potential receptors

Specified ecosystems	Distance from the Premises
RAMSAR Wetland Roebuck Bay Site ID: 479	The RAMSAR wetland starts approximately 5.5 km south-east of the Premises boundary and is intertidal area that includes mangroves, mudflats and a sheltered bay within the Roebuck Bay Marine Park. The classification does not extend over the entirety of Roebuck Bay, it commences east of the Broome townsite to the south and extends to Sandy Point and covers an area of approximately 34,119 ha (Roebuck Bay Working Group 2020) as shown in Figure 3 below.
Important wetlands – Western Australia Dampier Creek Roebuck Bay Roebuck Bay Plains System Willie Creek Wetland	Permanent surface water of Dampier Creek is approximately 2 km south-west The Roebuck Bay wetland area is approximately 900m southwest from the Premises boundary (upper reaches of the system wetlands inundation area) Roebuck Bay Plains System- 5.9 km south-west (Commonwealth Department of Agriculture, Water and The Environment 2020)
Parks and Wildlife Managed Lands and Waters Crown Reserve ID: R 51380	1.5 km south-west of the Premises are lands vested in Yawuru Native Title Holders Aboriginal Corporation RNTBC and Conservation Commission of WA for the purpose of Conservation, recreation and traditional customary Aboriginal use and enjoyment. A map of the vested lands is shown in Figure 4 below.
Threatened Ecological Communities (TEC) and Priority Ecological Communities *Biodiversity Conservation Act 2016 (WA)* (BC Act)	The Premises is situated within the buffer area of the *Species-rich faunal community of the intertidal mudflats of Roebuck Bay* vulnerable Threatened Ecological Community.
Threatened Ecological Communities (TEC) *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act)	The *Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula* TEC is listed as vulnerable under the BC Act and endangered under the EPBC Act. Its habitat includes the coastal inundation areas surrounding Dampier Creek, the upper reaches of which are approximately 900 m southwest from the Premises boundary as shown in Figure 6 below. These thickets make up less than 0.01% of the Peninsula but support 25% of the plant species. Roebuck Bay Marine Park covers 304 km^2 and includes the coastal inundation areas surrounding Dampier Creek as shown in Figure 5 below. The upper reaches of Dampier Creek flood plain are approximately 900 m west from the Premises boundary.
Biological component	**Distance from the Premises**
Threatened/Priority Fauna	There are significant numbers of declared threatened and priority fauna of both wetland and terrestrial origins, recorded within proximity of the Premises (recorded sightings within 1km of the Premises). These are largely associated with the Roebuck Bay wetland and Roebuck Bay Plains System. 65 migratory species and 31 threatened species are recorded in the area, which includes 13 threatened bird species, 5 threatened mammals (including whales, a bat, rat and marsupial species), 7 threatened reptiles (including 5 turtle species, a snake and a skink) and 5 threatened shark species.

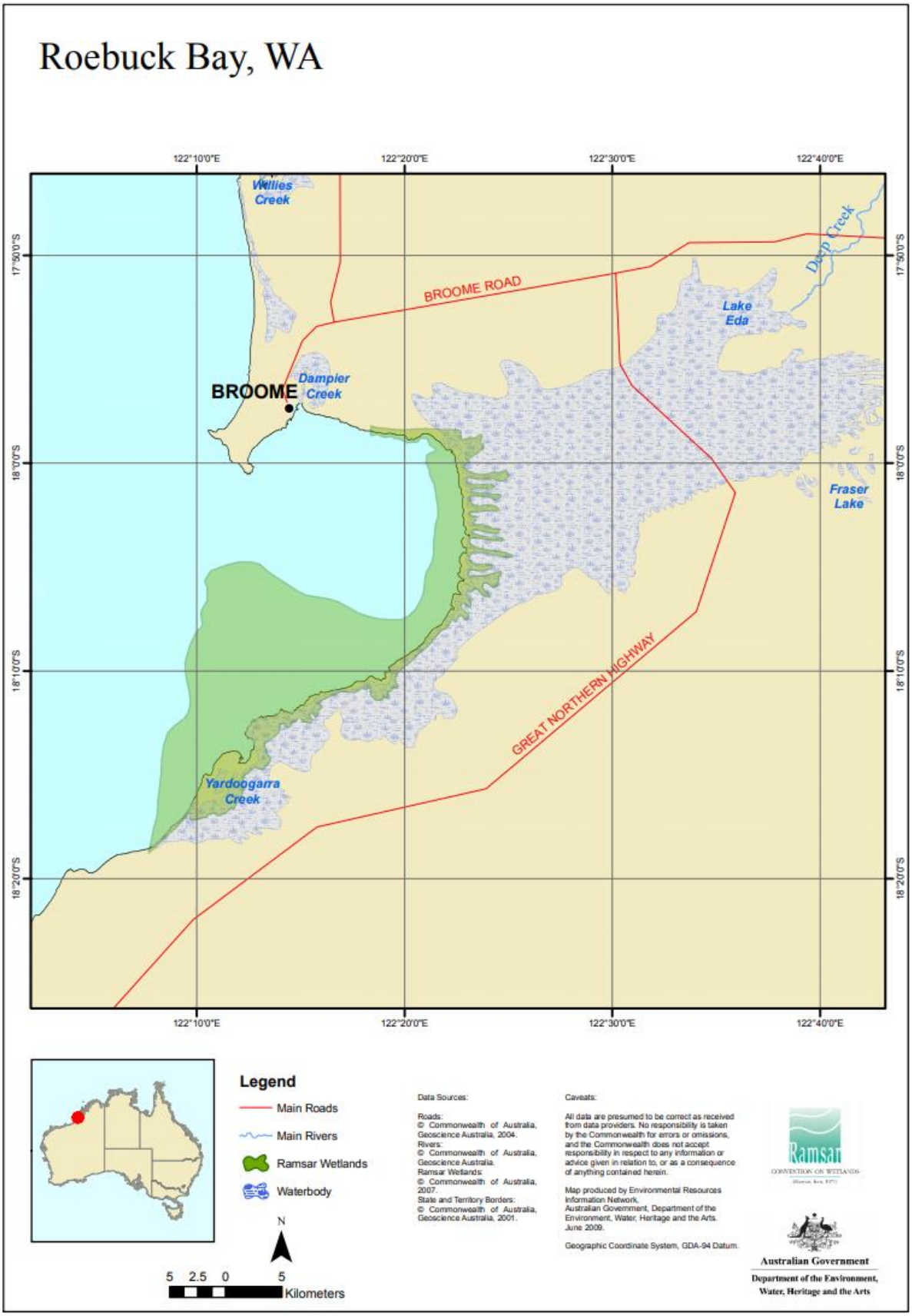

Figure 3: Map showing the Internationally Significant RAMSAR Convention listed Roebuck Bay Wetland in relation to Dampier Creek

Source: Commonwealth Department of Water, Heritage and the Arts (2020)

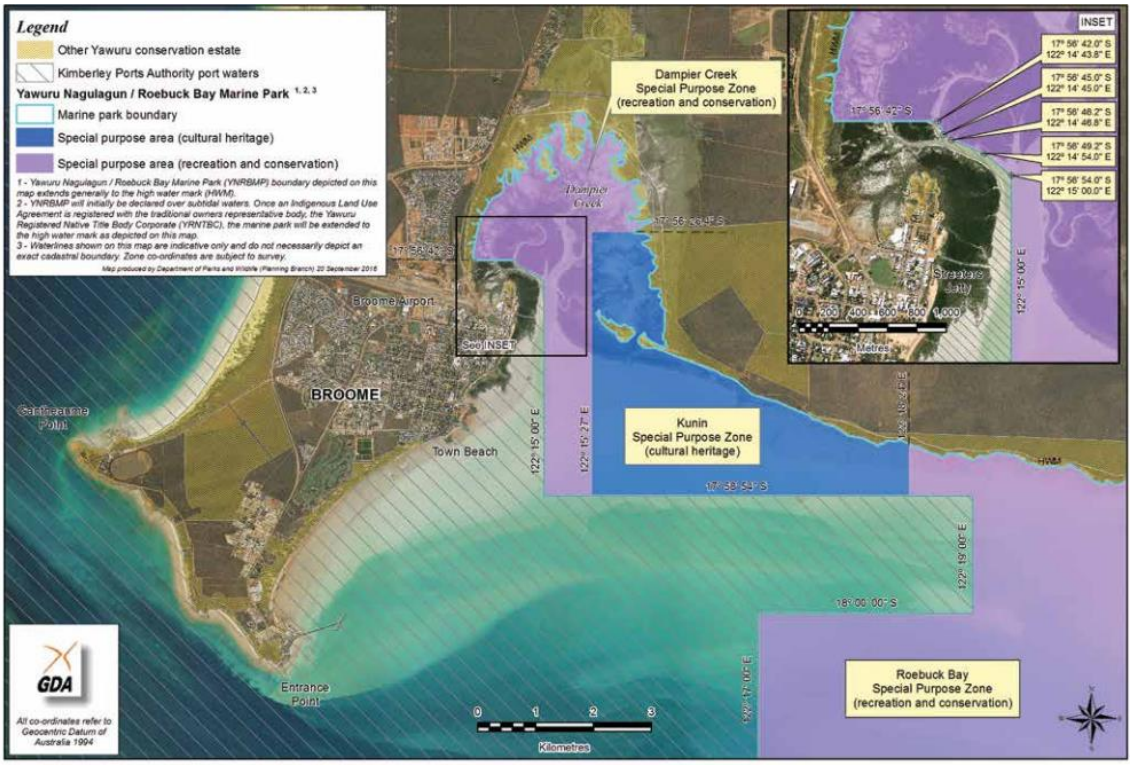

Figure 4: Map showing the Yawuru Nagulagun zoned land and water for cultural heritage, conservation and recreation.

Source: Western Australian Department of Parks and Wildlife (2016)

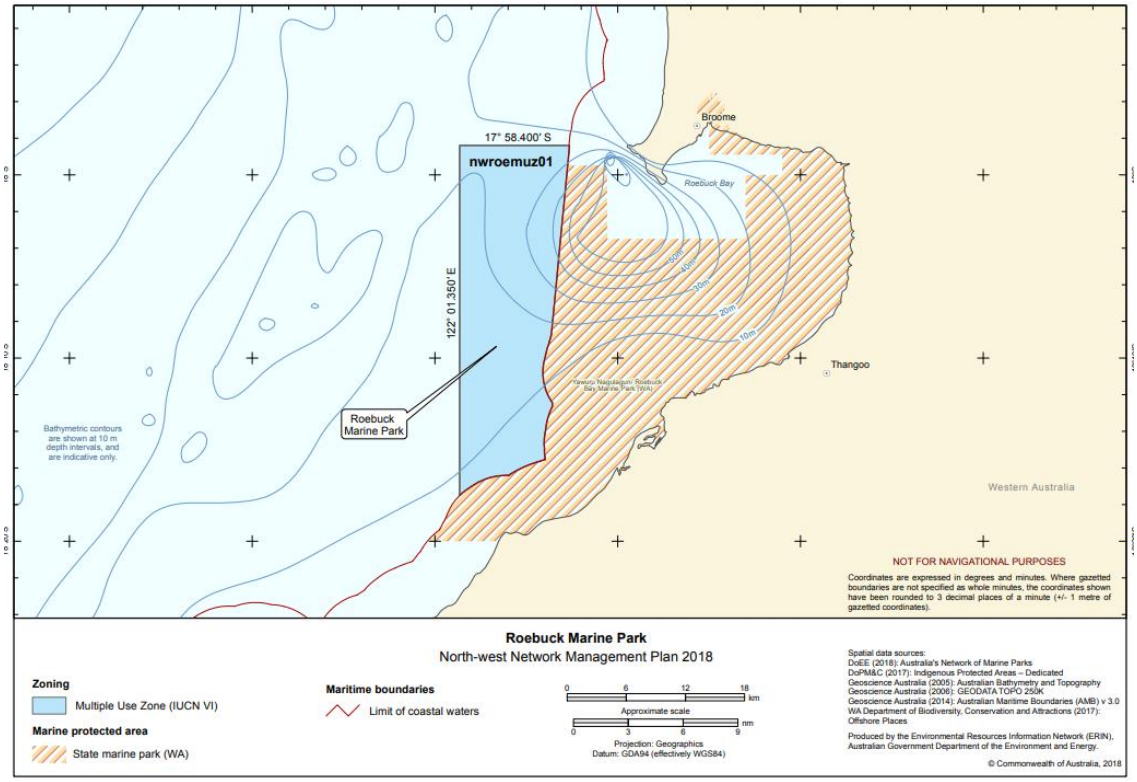

Figure 5: Map showing the land and water covered by the Nationally significant Roebuck Bay Marine Park (includes the inundation areas)

Source: Australian Government of the Environment and Energy (2018)

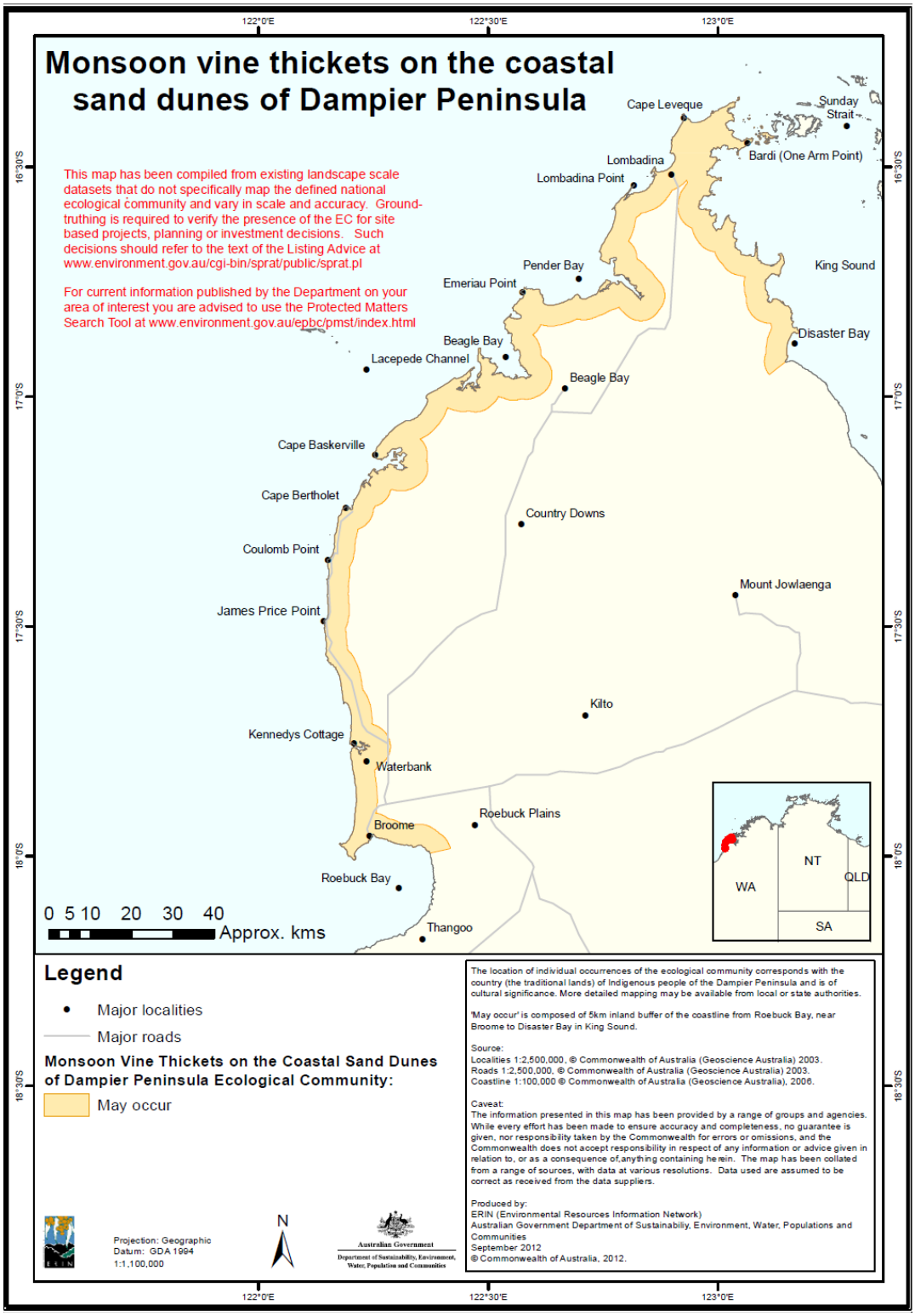

Figure 6: Map showing the nationally significant threatened ecological community of the monsoon Vine thickets of the Dampier Peninsula

Source: Commonwealth Department of Agriculture, Water and the Environment (2020)

5.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 9.

Table 9: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Public Drinking Water Source Area Broome Water Reserve (P1)	2.4 km north	Priority 1 drinking water source area.
Groundwater	During the last annual reporting period depth to groundwater was recorded as approximately: • Pindan Sands aquifer: 5.90 – 6.05 mbgl (3.1 – 5.95 m AHD) • Broome Sandstone aquifer: 5.75 - 17.80 mbgl (2.49 – 4.95 m AHD) The Broome Sandstone aquifer is considered to be unconfined. No bores located within 1km of Premises (based on available GIS dataset –WIN Groundwater Sites).	Groundwater down-gradient of the Premises is not currently used for potable or industrial use. Groundwater system linked to Roebuck marine ecosystem and threatened ecological fauna associated with the intertidal mangrove flats downstream of the Premises boundary.

The Premises is underlain by Pindan Sands which comprise red, fine to medium grained aeolian sand with minor silt overlying clayey sands of mixed aeolian and alluvial origin, and possibly some clays deposited on supratidal mudflats (GHD 2020a). The Pindan Sands unconformably overly the Broome Sandstone which is a fine to very coarse sandstone with local beds of shale and conglomerate. The lower part of the Pindan Sands is difficult to distinguish from the upper Broome Sandstone (GHD 2020a).

Paired groundwater bore locations at the Premises show similar groundwater levels between bores screened in the Pindan Sands and Broome Sandstone which indicates that these units are hydraulically connected (GHD 2020a). This is further supported by groundwater samples from shallow bores in the Pindan Sands and deeper bores in the Broome Sandstone which show similar major ion composition (GHD 2020a). These results from the Premises are consistent with the existing regional interpretation that the Pindan Sands and Broome Sandstone are hydraulically continuous and considered to be a single unconfined groundwater resource (GHD 2020a). Minor perched aquifers have been identified in the Pindan Sands previously, however there is little evidence for this at the Premises (Rockwater 2008).

The inferred direction of groundwater flow within the local geographic area of the Premises is in a south westerly direction towards Roebuck Bay and Dampier Creek with a hydraulic gradient of approximately 0.001. Post-wet season monitoring conducted in May 2020 recorded the groundwater table ranging from 5.6 m Australian Height Datum (AHD) at monitoring bore 1/20 up-gradient of the Premises, to 3.8 m AHD at bore 19/10 down-gradient and off-site from the Premises. Reported hydraulic conductivities in the Broome Sandstone range from 2 to 42 m/day but are generally around 15 m/day (GHD 2020a).

Post wet season monitoring conducted in May 2020 intercepted the groundwater table within the Premises boundary at depths from 6.0 to 16.2 m below top of casing (mbTOC). Groundwater levels show a strong seasonal trend with post-wet season (March) levels up to 3.1 m higher than post-dry season (September) levels (GHD 2020a). Recharge to the Broome Sandstone aquifer is predominately via direct rainfall infiltration during monsoonal and cyclonic rainfall events (GHD 2020a). Groundwater level fluctuations on the Dampier Peninsula predominantly occur in response to seasonal rainfall with tidal variation being a less significant source of variations (GHD 2020a).

Groundwater level monitoring of paired bores since 2012 shows that there is more deviation between groundwater levels in the Pindan Sands and Broome Sandstone inside the Premises compared to outside the Premises. It is unclear whether this difference is due to field measurement/data processing errors as suggested by GHD (2020a) or an indication of different groundwater recharge and flow regimes on and off the Premises.

Generally, groundwater in the Broome Sandstone aquifer is fresh inland, becoming marginal to saline approaching the coast. A saltwater wedge extends approximately 15 km inland within this aquifer and in the vicinity of the Premises is overlain by a freshwater layer approximately 100 m thick (Rockwater 2008).

There is a Priority 1 Drinking Water Source Protection Area located north and upgradient of the Premises and some minor localised draw down of the aquifer in that area is expected to occur. The impacts of wastewater seepage to groundwater through infiltration from the irrigation areas and through the base of the pond liners is expected to cause localised elevation of the groundwater. Modelling undertaken by Rockwater as part of the original approvals for this site (Works Approval W4531/2009/1) assumed the ponds were completely unlined, and proposed the transport of nutrients through the groundwater to the environmentally sensitive tidal mud flats associated with Dampier Creek would take 150 years to reach the creek and approximately 584 years for peak concentrations to reach the area based on the assumptions used within the model (Rockwater 2008).

5.5 Soil type

Table 10 details soil types and characteristics relevant to the assessment.

Table 10: Soil and sub-soil characteristics

Soil type	Depth (mbgl)	Description
Topsoil	0.1 - 0.2	Fine to medium grain, generally loose and dry containing organic matter (particularly grass roots).
Pindan Sands	4.5 - 9.8	Silty sand: red brown, fine to medium grained silty sands, with minor clay.
Alluvium	4.5 - 5.1	Gravelly sands: Gravel sub rounded to rounded particles of Broome Sandstone.
Broome Sandstone	9.8 - 30	Variably lithified silts and siltstone, with minor coarse quartz sand, feldspar and heavy minerals.

Source: Water Corporation (2020b)

5.6 Meteorology

The Premises is located in a hot semi-arid part of north western Australia which is characterized by tropical weather patterns, including a dry season which extends from April to November, and a wet season which extends from December to March.

5.6.1 Wind direction and strength

The nearest monitoring site which collects prevailing wind speed and direction information is the Broome Airport weather station. Based on wind speed and wind direction data collected between 1939 and 2010 morning winds are predominantly from the east and south-east and afternoon winds are predominantly from the west as shown in Figure 7 (Bureau of Meteorology (BOM) 2020). Winds from the east and south-east have the potential to carry odour emissions from the WWTP and overspray from irrigation areas toward the residential receptors located within the Broome Common Stockyard that lies approximately 750 m west of the Premises. Historically average morning winds occur approximately 20% of the time from the east and 20% of the time from the south east.

It is important to note these wind roses show historical winds speed and data and may not be representative of future wind direction or speed.

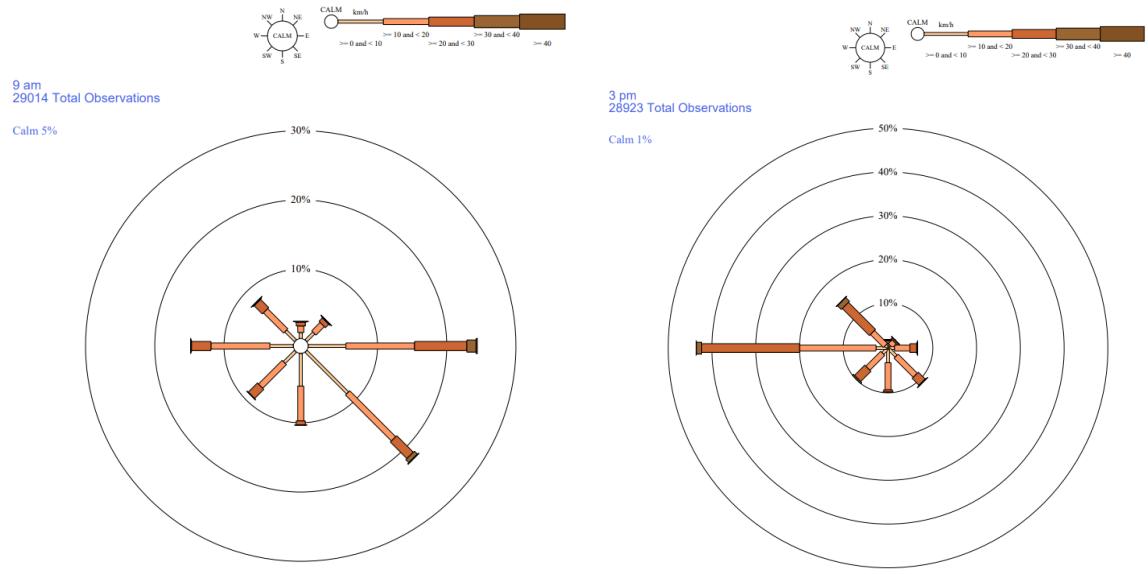

Figure 7: 9am and 3pm wind direction and wind speed roses for Broome Airport

5.6.2 Rainfall, temperature and evaporation rates

Most of the annual rainfall occurs between January and March, when temperatures and humidity are high, driven by cyclonic weather patterns. The annual average rainfall is approximately 528 mm but is highly variable and has ranged from 132 mm to 1496 mm per year (Weatherzone 2020). Rainfall tends to occur in short sharp bursts where large volumes are experienced over short timeframes which can lead to localised flood events.

Average minimum and maximum temperatures over the year vary from 15º C to 34º C and it is unusual for temperature to be recorded below 10º C or over 35º C Average pan evaporation rates are very high, greatly exceeding rainfall and average about 2950 mm per annum.

6. Matters considered in the assessment

6.1 Current groundwater quality

General water quality

Groundwater at the Premises ranges from fresh to saline with total dissolved solids (TDS) concentrations ranging from < 500 mg/L to > 5000 mg/L (GHD 2020b). Groundwater salinity shows significant variability within individual monitoring bores and has been observed to fluctuate between fresh and saline over less than a two-year period in some bores. This variability may reflect the influence of seasonal recharge patterns, including from rainfall and irrigation.

Groundwater pH at the Premises is typically neutral ranging between 6 - 8 except for observations from samples collected at monitoring bore 2/20, which recorded a more acidic pH of 4.59 in May 2020. Bore 2/20 is located down-gradient from Pivot 2 in the irrigation area. Redox potential and dissolved oxygen indicate that groundwater is generally oxidising and aerobic. In May 2020, shallow monitoring bores 3/10, 5/10, 5/20 and 19/10 reported the lowest dissolved oxygen concentrations and near neutral or reducing conditions.

The Baseline Environmental Assessment (GHD 2020a) identified nutrients, pathogens and metals as contaminants of potential concern (COPC) for the Premises. A summary of the available groundwater monitoring data for these COPC is presented in the following sections.

Nutrients

There is an extensive dataset for nutrient concentrations in groundwater at and surrounding the Premises, including pre-construction baseline monitoring conducted in 2007 and operational monitoring from 2011 to 2020. The groundwater monitoring program required by licence L9094/2017/1 includes total nitrogen (TN), ammonium as nitrogen (NH_4-N), nitrate + nitrite as nitrogen (NO_x-N) and total phosphorus (TP).

The Baseline Environmental Assessment (GHD 2020a) provided a summary of nutrient concentrations recorded in 2007 before construction of the Premises. Baseline monitoring was conducted in six bores installed in the Broome Sandstone, with three located up-gradient and three down-gradient of the proposed Premises. During the baseline monitoring event TN concentrations ranged from 2.3 to 7.8 mg/L, TP concentrations ranged from 0.06 to 5.66 mg/L, NO_x-N concentrations ranged from 1.78 to 5.64 mg/L and NH_4-N concentrations ranged from 0.086 to 1.97 mg/L.

The baseline concentrations exceeded the Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) tropical Australia trigger values for physical and chemical stressors in estuaries for TN, TP, NO_x and ammonia (ANZECC and ARMCANZ 2000). Nutrients were generally reported at higher concentrations in up-gradient bores compared to down-gradient bores. GHD interpreted these results as an indication of there being an up-gradient/ background contribution of nutrients to the aquifer (GHD 2020a). The potential source of nutrients in groundwater at the Premises has not been identified; before it was developed by the Applicant, the Premises was used for pastoral purposes.

The Baseline Environmental Assessment (GHD 2020a) assessed nutrient concentrations in key monitoring bores at the Premises in 2011 - 2019 against baseline concentrations recorded pre-construction. The results showed that the median concentrations of TN, TP, NO_x-N and NH_4-N recorded during operation of the Premises have typically been within the range of concentrations recorded in 2007.

Based on data presented in the Baseline Environmental Assessment (GHD 2020a) and the 2019-2020 Annual Environmental Report (AER), concentrations of TN, TP and NO_x-N recorded at some monitoring bores during 2011 - 2020 exceeded the baseline concentration range recorded in 2007. These results are summarised as follows:

- Concentrations of TN in bores down-gradient from the pivot irrigation area were recorded up to 43 mg/L, down-gradient from the ponds up to 12 mg/L and down-gradient from the seedling irrigation area up to 18 mg/L – these compare to the maximum baseline concentration of 7.8 mg/L.
- Concentrations of TP in off-site bores down-gradient from the ponds were recorded up to 6.9 mg/L – these compare to the maximum baseline concentration of 5.66 mg/L.
- Concentrations of NO_x-N in bores down-gradient from the pivot irrigation area were recorded up to 42.1 mg/L, down-gradient from the ponds up to 9.8 mg/L and down-gradient from the seedling irrigation area up to 17 mg/L – these compare to the maximum baseline concentration of 5.64 mg/L.

The Baseline Environmental Assessment (GHD 2020a) presented graphs from a Mann Kendall Trend Test for TN and TP concentrations at selected monitoring bores over the period 2011 to 2019. The assessment indicates that TN and TP concentrations in Pindan Sands and Broome Sandstone monitoring bores are generally stable or decreasing since Premises operations commenced. Statistical significance of the observed trends varied between individual monitoring bores and increasing trends were observed in some bores.

Monitoring bores which recorded increasing trends included down-gradient bores 15/10 (TP) and 19/10 (TN and TP) and up-gradient bore BH8/06 (TP). Though 15/10 and 19/10 recorded increasing concentrations of TN and/or TP, the concentrations remained within the range of baseline data recorded in 2007. GHD inferred that there may be a source of nutrients impacting these off-site bores which is not associated with the ponds or pivot 1 irrigation area because the concentrations of TP immediately down-gradient of Premises infrastructure are predominantly below the limit of reporting (LOR).

GHD (2020a) concluded that groundwater monitoring data collected during the operation of the WWTP suggests that there are no significant nutrient impacts to groundwater in the Pindan Sands and Broome Sandstone when compared to up-gradient concentrations and concentrations reported prior to construction of the WWTP.

Metals

There is an extensive dataset for metals concentrations in groundwater at the Premises comprising operational monitoring from 2011 to 2020. The groundwater monitoring program required by licence L9094/2017/1 includes arsenic, cadmium, copper, chromium, lead, mercury, nickel and zinc.

The Baseline Environmental Assessment (GHD 2020a) reported metal concentrations analysed during operations from 2011 to 2019 and identified the following assessment criteria for metals in groundwater:

- ANZECC and ARMCANZ (2000) 99% species protection trigger values for toxicants in marine waters. Although the tributary of Dampier Creek is considered to be slightly to moderately disturbed, the higher level of protection was selected based on the RAMSAR status of Dampier Creek and Roebuck Bay.
- ANZECC and ARMCANZ (2000) livestock drinking water guidelines because livestock watering was identified as a potential beneficial use of groundwater in the area.
- DWER (2014) non-potable use of groundwater (NPUG) guidelines because non-potable use was identified as a potential beneficial use of groundwater in the area.

The Baseline Environmental Assessment (GHD 2020a) and additional information provided by the Applicant (DWER reference A1982554) gave a summary of metals concentrations in groundwater from 2011 to 2019. The median concentrations of metals in each monitoring bore were generally equivalent to a result of less than the LOR because most of the recorded results were below the applicable reporting limit. One exception to this was copper which was regularly detected above the LOR in groundwater. Mann Kendall Trend Test plots were provided for copper concentrations in selected monitoring bores and show stable or decreasing trends with the exception of one up-gradient bore BH8/06 which showed an increasing trend.

The 2011 to 2019 results indicate that the livestock drinking water guidelines for arsenic, copper and selenium and the NPUG guidelines for arsenic, chromium and nickel, were exceeded in some bores during individual sampling events. The monitoring bores which recorded these exceedances do not show increasing trends for the relevant metals.

The assessment of metals concentrations in groundwater from 2011 to 2019 against assessment criteria was limited by the following factors:

- The LOR for some metal species (arsenic, cadmium, lead, nickel and selenium) in saline groundwater samples from 21/10 - 24/10 was equivalent to or higher than the relevant livestock drinking water guideline value and/or NPUG value. These bores have recorded a TDS concentration in the range of 33,000 – 49,000 mg/L and this would likely have caused matrix interference resulting in a higher LOR for the analysis. Other monitoring bores have recorded lower TDS concentrations (< 10,000 mg/L) and were analysed using a lower LOR.
- The LOR for all metals analysis was higher than the 99% species protection trigger values for marine water.
- The LOR for cadmium was higher than the livestock drinking water guideline.

The discussion and data presented in the Baseline Environmental Assessment (GHD 2020a) and subsequently provided by the Applicant (DWER reference A1982554) do not indicate gross groundwater impacts related to metal inputs from Premises activities.

The ESA (GHD 2020b) reported on groundwater monitoring conducted in May 2020 which was undertaken using a different metals analytical suite than that specified in the licence, including aluminium, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium and zinc. The analysis undertaken for this event also used lower LORs (ultra-trace analysis) which allowed an assessment of metals concentrations against the 99% species protection trigger values for estuaries. A summary of the findings are as follows:

- The livestock drinking water guidelines were not exceeded.
- Aluminium: The NPUG guideline (based on an aesthetic drinking water quality guideline) was exceeded at 1/20 and 7/12. This guideline was not exceeded at monitoring bores down-gradient of the irrigation areas or pond infrastructure. The 99% species protection trigger value was exceeded at most on- and off-site monitoring bores with the highest concentration recorded at 7/12 on the northern boundary of the Premises.
- Arsenic: The 99% species protection trigger value was exceeded at some on- and off-site monitoring bores with the highest concentration recorded at 5/10 down-gradient of pivot 1.
- Chromium: The total chromium concentration exceeded the 99% species protection trigger value for hexavalent chromium at most on-site monitoring bores with the highest concentration recorded at 7/12 on the northern boundary of the Premises.

- Cobalt: The 99% species protection trigger value was exceeded at most on- and off-site monitoring bores with the highest concentration recorded at 5/20 down-gradient of the proposed pivot 3.
- Copper: The 99% species protection trigger value was exceeded at all on-site and off-site monitoring bores with the highest concentration recorded at 1/20 up-gradient of the Premises infrastructure.
- Iron: The NPUG guideline (based on an aesthetic drinking water quality guideline) was exceeded at 3/10 near the eastern boundary of the Premises.
- Manganese: The 99% species protection trigger value was exceeded at 5/20 down-gradient of the proposed pivot 3.
- Nickel: The 99% species protection trigger value for nickel was exceeded at some on-site monitoring bores with the highest concentration recorded at 3/20 down-gradient of the ponds.
- Zinc: The 99% species protection trigger value for zinc was exceeded at some on-site monitoring bores with the highest concentration recorded at 1/10 down-gradient of pivot 1.
- The concentrations of cadmium, lead, mercury and selenium did not exceed the applicable guideline values.

The information provided in support of this application does not indicate the presence of gross groundwater impacts related to metal inputs from Premises activities. However, as the historical dataset (2011-2019) is mostly comprised of results below the LOR, there is some uncertainty regarding temporal and spatial trends and whether metals concentrations have been affected by Premises activities.

Groundwater monitoring from May 2020 shows that the 99% species protection trigger values were exceeded for several metals in the vicinity of the Premises, although these exceedances were comparable to upgradient concentrations and generally decreased with distance from the Premises. There is insufficient data to draw further conclusions about the source of these exceedances as the May 2020 groundwater monitoring event is the only monitoring event completed using ultra-trace analysis of metals. It should be noted that the 99% species protection trigger values for marine water are most relevant to groundwater discharging to the tributary of Dampier Creek.

Pathogens

The groundwater monitoring program required by licence L9094/2017/1 does not include any pathogen indicator organisms. The Baseline Environmental Assessment (GHD 2020a) did not provide a summary of pathogen monitoring data from baseline investigations in 2007 or operational monitoring at the Premises from 2011 to 2019. Supplementary information provided by the Applicant indicated that *E. coli* was monitored in the on-site groundwater monitoring bores between 2008 and 2012. A minimum of ten samples were monitored for *E. coli* from each groundwater bore over this period and the median concentrations of each individual bore was <10 colony forming units (CFU)/100mL.

The ESA (GHD 2020b) reported on pathogen concentrations analysed in May 2020 and identified the following assessment criteria for pathogens in groundwater:

- ANZECC and ARMCANZ (2000) recreational water, secondary contact guidelines based on the potential for human receptors to become exposed to groundwater via extraction for non-potable purposes. The guideline value is 1000 faecal coliform organisms/100 mL.
- ANZECC and ARMCANZ (2000) livestock drinking water guidelines because livestock watering was identified as a potential beneficial use of groundwater in the area. The guideline value is 100 thermotolerant coliforms/100 mL.

- DWER (2014) microbiological assessment levels for water – pasture and fodder for grazing animals excluding pigs and dairy animals. The guideline is 1,000 *E. coli* CFU/100 mL.

E. coli concentrations in May 2020 generally ranged between <1 CFU/100 mL and 50 CFU/100 mL, except for 5/20 which reported 2,500 CFU/100 mL. The concentration at 5/20 exceeded the three assessment criteria outlined above. The purpose of 5/20 is to be a sentinel bore for groundwater quality down-gradient of pivot 3 once it is constructed. This bore is about 400 m down-gradient from the WWTP ponds and about 150 m cross-gradient from the seedling irrigation area. The source of pathogens in this monitoring bore is uncertain and further monitoring would be required to verify if this result is indicative of ongoing contamination or was an anomalous result.

6.2 Site conceptual nutrient fate transport model

Prior to construction of the Premises under Works Approval W4531/2009/1, the Applicant commissioned Rockwater (2008) to undertake water modelling to determine the impacts from the irrigation of treated wastewater and the seepage of wastewater from the treatment ponds on local hydrogeology. As mentioned in sections 5.3 and 5.4 the Premises lies within the catchment of sensitive ecosystems which are hydrologically connected and downstream of the Premises.

The groundwater flow and solute transport models that were developed by Rockwater for the the Premises were reviewed against criteria outlined in the Australian groundwater modelling guidelines (National Water Commission, 2012) and the UK Environment Agency guidance for assessing subsurface fate and transport models (UK Environment Agency, 1999). On the basis of these assessments, the following comments are offered:

- A groundwater flow model was first developed for the site to form the basis of subsequent solute transport modelling of nitrogen and phosphorus compounds. The groundwater flow model was developed in an appropriate manner using the finite-difference code MODFLOW, and existing hydrogeological information from the area near the Premises.
- Given the limited availability of groundwater monitoring data within the model domain, and the limited calibration of the model, it should be categorised as a Class 1 groundwater flow model, the least reliable of the three model categories outlined in Section 2.5 of the national modelling guidelines (NWC, 2012). This would limit the reliability of calculated travel-times and concentrations of nutrients in groundwater in subsequent solute transport modelling that was undertaken using the code MT3DMS.
- The uncertainty in the flow modelling would be partially offset by the conservative assumption that nitrogen and phosphorus compounds would not be subject to denitrification or sorption processes in groundwater over time. That is, it was assumed that there would be no loss of mass of these chemical constituents along groundwater flowpaths between the Broome North wastewater irrigation areas and the Dampier Creek tidal flats.
- It can be concluded that the predicted concentrations of nutrients in groundwater when it arrives at the coast are likely to be overestimates, but there will be a large degree of uncertainty in the calculated travel times for these chemical constituents between the wastewater irrigation areas and the coast.

As discussed in Section 6.1, there has been extensive monitoring for nutrients in groundwater at the Premises and down-gradient areas since the development of the Rockwater model. Monitoring results suggest that there are no significant nutrient impacts to groundwater downgradient of the Premises when compared to up-gradient concentrations and pre-

construction conditions. Increases in nutrient concentrations observed in some downgradient bores have been suggested as coming from a historical or other source that is not associated with the WWTP.

6.3 Hydraulic loading rates in irrigation areas

A significant physical constraint for siting a wastewater irrigation scheme, is ensuring that the area of land selected is sufficiently large to enable the water and its dissolved constituents to be taken up by vegetation, or retained within the soil profile without excessive seepage into groundwater. The area required to meet this condition will depend on the volume and quality of the wastewater that is produced, on soil conditions, and on local climatic factors at the site. However, as a first approximation, the area of land required for irrigating a given production-rate of wastewater is provided by the following equation (United States Environmental Protection Agency (US EPA), 2006):

$$A = 3.65 \times \frac{Q}{L \times T_{app}}$$

Where:

- A = land area (hectares)
- Q = flow rate of wastewater (m^3/day)
- L = wastewater hydraulic loading to soil (cm/week)
- T_{app} = period of wastewater application each year (in weeks)

For the current wastewater irrigation area, the average daily irrigation rate is about 1,290 m^3/day (2019/2020 rate) and irrigation is carried out for 52 weeks per year. As the annual evaporation rate for Broome is about 3100 mm/yr and the crop-factor for Rhodes grass is about 0.7, the required wastewater loading rate to soil to match evapotranspiration is about 2170 mm/year. Substituting these values into the above equation gives a required irrigation area of about 21.7 ha.

This means that on an annual basis, there is sufficient land available (about 59 ha) to enable wastewater irrigation to take place without the excessive leaching of nutrients and other chemical constituents from wastewater to the water table.

However, this assessment does not take into account the potential for soils to be at their field capacity at times during the wet season and that some seepage of chemical constituents from the wastewater could infiltrate beyond the root zone, percolating to groundwater. This risk could be minimised by ensuring that wastewater irrigation only takes place when there is a soil-moisture deficit that is measured with soil monitoring probes and that wastewater is stored during periods when soils are at full saturation.

6.4 Nutrient removal from wastewater

Water Corporation have not undertaken a full mass-balance assessment of nutrient outputs from the irrigation scheme, or from the application of additional commercial nutrients to the cropping areas. This means that it is not possible to directly assess the extent to which vegetation and soil biological and chemical processes are actively removing nutrients that are applied to the irrigation areas. Consequently, it is not possible to directly assess the efficiency and long-term sustainability of the wastewater irrigation scheme at the Premises. However, some components of this mass-balance can be indirectly estimated using published information from similar wastewater irrigation schemes.

The uptake of nutrients by crops that are irrigated with wastewater is usually assessed by undertaking regular leaf-tissue analyses of the crop and determining the dry-mass of vegetation produced per hectare per year. This information is not available for the Premises. Published information from the irrigation of Rhodes grass in Jordan using municipal wastewater (Mazarih *et al*., 2018) indicates that typically, about 40.4 tonnes/ha of vegetation

can be produced from an irrigation area on a dry-weight basis, which contains on average about 2% of nitrogen and about 0.5% of phosphorus. This means that about 808 kg/ha/year of nitrogen, and 202 kg/ha/year of phosphorus would be taken up and removed from wastewater irrigation areas in harvested Rhodes grass biomass.

This harvested output of nutrients should then be compared with the nutrient content of the wastewater that is used in the irrigation scheme. Information provided in a report from the Applicant suggests that about 535 ML of wastewater is applied to the current pivot irrigation areas at the Premises. Assuming that the average nitrogen concentration in the wastewater is 19 mg/L (or 19 g/m^3) and its average phosphorus content is 6.6 mg/L, a total of about 199 kg/ha/year of nitrogen, and about 63 kg/ha/year of phosphorus are discharged in wastewater to the irrigation areas at the Premises. This indicates that there is a sufficient area of Rhodes grass available to remove all of the nutrients from the irrigated wastewater.

6.5 Additional fertiliser use

In addition to the nutrients available within the treated wastewater, the Applicant advised that commercial fertilisers “Troforte Cropping Plus” is applied as a granular fertiliser on a twice annual basis to the irrigation areas and liquid Nitroforte is applied through a fertigation unit every 8-10 weeks for distribution through the pivot irrigation system (RFI, DWER Document Reference: A1947304). Troforte Cropping Plus is 7% w/w phosphorus and 10% w/w nitrogen and Nitrofort liquid is 28% w/v nitrogen (Langley Fertilisers, 2020).

The Application does not specifically state the application rates of commercial fertilisers but suggests that up to 20 kg/ha of phosphorus may be applied per year in granular form (360 Environmental, 2020) and up to 370 kg/ha of nitrogen (granular and liquid form – total annual application across approximately 6 cropping cycles per annual period).

6.6 Alterations to wastewater processing and throughput

The Applicant has provided information to demonstrate that the existing number of ponds are capable of processing the projected increase of wastewater throughput following reconfiguration of Ponds 1 and Pond 2 to the advanced facultative pond design (or smart pond).

The Applicant advises that the increase in treatment capacity occurs due to the conversion of both ponds into the smart pond configuration. This reduces the residence time required per unit volume of wastewater treated when compared with conventional treatment methods where the anaerobic, facultative and maturation part of the treatment cycle occur within distinct lagoons. The efficiency gain is primarily due to the raw sewage inflow pipe being received directly into the 7.5 m deep anaerobic digestion pit within the front end of each smart pond. The digestion pit contains a sludge blanket which has the primary purpose of accelerating anaerobic treatment of the wastewater. The stripping of carbon (Biological Oxygen Demand, or BOD) from the wastewater decreases the time required for anaerobic treatment of sewage when compared to a conventional passive anaerobic primary treatment pond set up.

Table 11 below provides information supplied by the Applicant indicating that the proposed design capacities of the ponds are capable of processing 7 ML/day of wastewater under worst case treatment conditions (coldest month).

The design capacity of the system allows for up to 5 days retention within the anaerobic zone during lower throughput conditions, when the microbial sludge operates less efficiently due to reduced carbon (BOD) availability for achievement of the treatment objectives, which mainly includes solids being trapped within the sludge blanket which are then consumed by microbes (carbon stripping). The incoming sewage is a relatively dilute strength effluent and has a BOD of approximately 300 mg/L, with ambient BOD within the pond at approximately 50 mg/L. The

system works more efficiently at higher throughput rates due to the consistency of food for the microbial populations that function within the sludge blanket. The system is designed to cope with typical BOD loading rates of between 100 mg/L to 400 mg/L.

Table 11: Pond sizes required to treat the increase in throughput to 7 ML/day compared with the proposed design capacity

	Pond 1 Retention time	Pond 2 Retention time	Required combined capacity	Proposed combined capacity
	days	days	volume or area	volume or area
Anaerobic	1.31	1.02	7,000 m^3	7,971 m^3
Facultative	6.77	5.97	26,650 m^2	27,300 m^2
Maturation	2.46	2.36	21,237 m^2	21,700 m^2
Total	**10.54**	**9.35**		

Table 12 below shows the current effluent quality and the anticipated effluent quality prior to irrigation following implementation of the works. It should be noted that nutrient removal is expected to be greater whereas the suspended solids and BOD levels are expected to be higher than current median values.

Table 12: Current and expected changes in water quality post treatment plant upgrades

	Current Effluent quality (averaged from 2013-2019)		Anticipated effluent quality (post upgrades)		Value assumed for NIMP
Parameter (mg/L)	**Range**	**Median**	**Pond 1**	**Pond 2**	
BOD	0 - 45	15	40	35	-
SS	0 - 310	60	99	87	-
TN	15 - 43	15	8.8	9.9	25 - 40
TP	4.8 - 16	11	6.9	7.0	10 - 12
E. coli **(CFU/100mL)**	10 - 24,000	330	No change	No change	-

The final wastewater treatment pond is a storage dam located prior to the irrigation storage tanks. The pond is approximately 150 ML and provides a retention time of 21 days. No modifications to the storage dam are proposed in the application. The wastewater irrigation storage tank capacity will change from 240 kL to 360 kL.

When considering the retention time provided by the existing treated wastewater storage dam, the proposed works will allow for retention times of 31.54 days and 30.35 days for Pond 1 and Pond 2 respectively. These residence times meet the Department of Health's minimum requirement for 25 days as detailed in section 4.4.2.

The smart pond configuration will also allow for the direct periodic removal of sludge from within the digestion pit without requiring shut-down of the pond. The bleeding of sludge may occur simultaneously and it's anticipated the removals will occur at least twice annually.

6.7 Water Balance

The evaporation and evapotranspiration rates are very high in Broome and greatly exceed annual rainfall events. However due to the tropical climate of the Broome area, periods of high intensity rainfall over short durations are expected during the wet season. This can significantly impact on the ability of the ponds to contain wastewater inputs.

Water Corporation maintain that through wastewater treatment occurring within Pond 1 and Pond 2, the entire capacity of the treated wastewater holding dam is available to contain significant volumes of water in the event of high rainfall, and can be maintained to provide maximum air space in the lead up to the wet season. Water Corporation advise that the existing 150 ML treated wastewater storage dam is capable of containing annual inflows, as well as a 1 in 50 year rainfall event of 526 mm over 72 hours. This corresponds to a 2% annual exceedance probability (AEP). In the unlikely event that over flow should occur, the final effluent will be sufficiently diluted so as to have minimal impact on adjacent land.

The three ponds are interconnected with spillways and have freeboards of 500 mm. The final storage dam also has a spillway on the southeast corner which would covey water down gradient and away from the ponds embankments through drainage lines and culverts in the rare event of the final storage dam overtopping.

Table 13 shows the current and projected wastewater input and outflows predicted over the phased expansion for the site. The losses for the site are expected to exceed inflow, with the maximum 3.5 ML/day for Phase 1 unlikely to be achieved prior to the diversion of flow from the Broome South WWTP.

Table 13: Summary of inflows and outflow for 7.0ML/day capacity

	Inflow	**Rainfall**	**Evaporation**	**Reuse**
	ML/day	**mm/year**	**mm/year**	**ML/day**
Phase 1 Current (2019/2020)	1.71	624.5	2170	1.3
Phase 1 Maximum	3.5			1.89
Phase 2 Maximum (2023)	4.77			4.74
Phase 3 Maximum (2033)	6.1 (7.0)			7.38

Figure 8 below displays this information graphically, with the treatment capacity effectively doubling after the upgrade works are implemented, however the on-going inflow will be restricted by demand for wastewater treatment due to population growth over time (shown in red) and the establishment of irrigation areas (green).

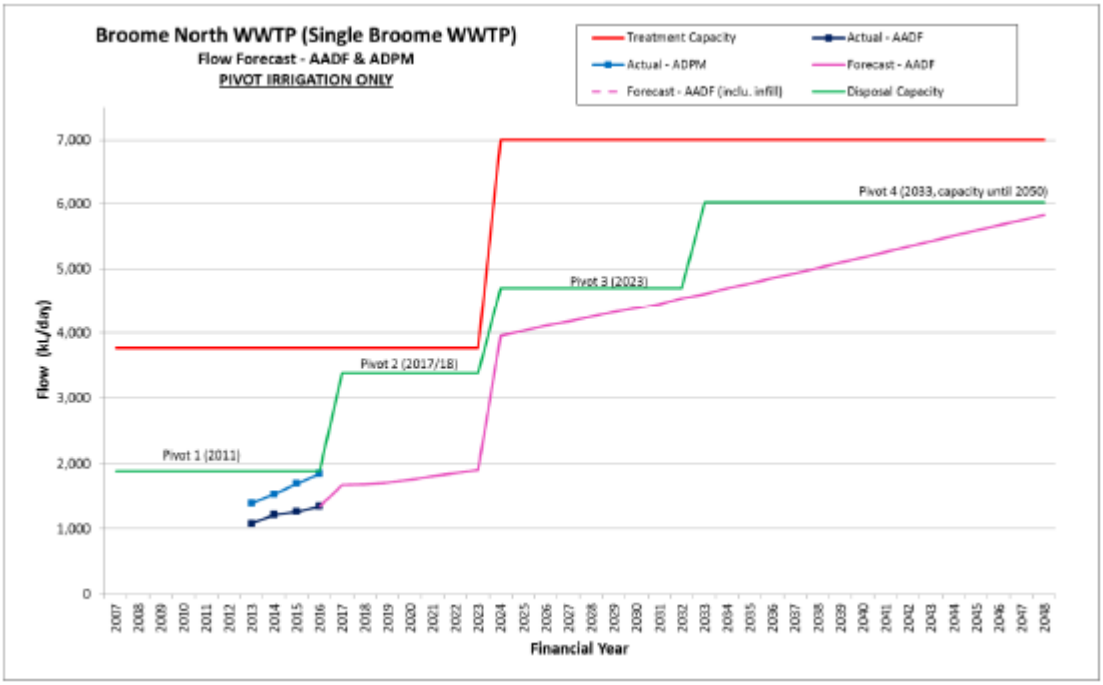

Figure 8: Broome North Projected

Source: Figure 6 Water Corporation (2020a)

7. Risk assessment

7.1 Determination of emission, pathway, receptor and initial risk assessment

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

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. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 14 and Table 15.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 14 and Table 15 below.

Table 14: Identification of emissions, pathway, receptors and initial risk assessment during construction

Risk Events					**Continue to detailed risk assessment**	**Reasoning**
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Vehicle movements on unsealed access roads. Civil and construction works to facilitate modifications to the Premises.	Noise Dust	Residential premises located 1.4km north-west of the Premises at the Morrell Park Aboriginal Community Residential dwelling within the Broome Common Stockyards 790 m west of the Premises boundary	Air / wind dispersion	Amenity impacts	No	**Consequence: Slight** Nearest sensitive receptors 790 m west and 1.4km north-west therefore no off-site amenity impacts expected. Minimal on-site impacts. **Likelihood: Unlikely** Historically wind from the Premises travels in a south-east direction is limited to approximately 20% of the time during the mornings only according to the 9am wind rose (BOM 2020). Construction works occur over a short duration and only between 7am to 7pm Monday to Friday. **Overall risk rating: Low** The *Environmental Protection (Noise) Regulations 1997* apply.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Installation of wastewater holding tanks, screening units and reconfiguration of pumping system. Installation of Pivot 3 irrigation area.	Discharges, runoff and spills of sewage, leachate and treated wastewater	Soil and groundwater	Overland flow and infiltration to soil and groundwater. Lateral movement of groundwater down-gradient of the site.	Soil and groundwater contamination	No	**Consequence: Slight** Isolation of sewage and treated wastewater conveyance infrastructure will occur prior to reconfiguration. Should accidental releases occur during reconfiguration through leaks and breakages of pipework, the duration and volume will be limited. Sludge removal will occur within a desludging bed which directs leachate and run-off back towards the treatment process. Onsite impacts will be limited with no offsite impacts. **Likelihood: Rare** The risk event may only occur in exceptional circumstances. **Overall risk rating: Low** The Environmental Protection (Unauthorised Discharge) Regulations 2004 apply.
	Odour from desludging and excavation of digestion pit within Pond 2	Residential premises located 1.4km north west of the Premises at the Morrell Park Aboriginal Community Residential dwelling within the Broome Common Stockyards 790 m west of the Premises boundary	Air / wind dispersion	Amenity impacts	No	**Consequence: Slight** Nearest sensitive receptors 790 m west and 1.4km north-west therefore minimal to no amenity impacts expected. **Likelihood: Unlikely** Historically wind from the Premises travels in a south-east direction is limited to approximately 20% of the time during the mornings only according to the 9am wind rose (BOM 2020). Winds to the west also occur approximately 20% of the time, however the dwelling within the stock yards are not considered overly odour sensitive due to the large numbers of animals on-site. Construction works occur over a short duration during. **Overall risk rating: Low**
	Sediments mobilised by stormwater	Vegetation within the Threatened Ecological Communities	Overland flow	Smothering of stomata on leaves, reducing plant respiration and smothering	No	**Consequence: Slight** Construction works will be undertaken over a two-year time period during the dry season only. Should unseasonal heavy rainfall occur impacts will be minimal and limited to within the Premises boundary. **Likelihood: Unlikely** as the risk event will probably not occur in most circumstances. **Overall risk rating: Low**

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Installation of wastewater holding tanks, screening units and reconfiguration of pumping system. Installation of Pivot 3 irrigation area.	Spills of hydrocarbons from vehicles and equipment	Soil and groundwater	Overland flow and infiltration	Soil and groundwater contamination	No	**Consequence: Slight** On-site refuelling of construction vehicles has not been confirmed, however the Applicant has advised that should contractor vehicles opt for on-site rather than off-site refuelling, then skid mounted refuelling stations will be required to comply with *AS1940-2017* (*The Storage and Handling of Flammable and Combustible Liquid*). **Likelihood: Unlikely** as the risk event will probably not occur in most circumstances. **Overall risk rating: Low** The *Environmental Protection (Unauthorised Discharge) Regulations 2004* apply

Table 15: Identification of emissions, pathway, receptors and initial risk assessment during commissioning and operation

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Increased potential for seasonal inversion/turnover of anaerobic and facultative zone within treatment ponds	Odour	Residential premises located 1.4km north west of the Premises at the Morrell Park Aboriginal Community Residential dwelling within the Broome Common Stockyards 790 m west of the Premises boundary	Air / wind dispersion.	Amenity impacts.	No	**Consequence: Slight** Nearest sensitive receptor 1.4 km north west therefore minimal to no amenity impacts are expected. **Likelihood: Rare** Historically wind from the Premises travels in a south-east and west direction approximately 20% of the time according to the 9am wind rose (BOM 2020). The dwelling within the stock yards is not considered overly odour sensitive due to the large numbers of animals on site. Pond 1 has an existing deep anaerobic zone and the Applicant has stated that an inversion of the treatment layers has not occurred since operations commenced in 2011. Seasonal turnover/inversion is generally an issue for pond systems in cold climates and is considered less relevant to the warm climate of the region. A review of the Department's Incident and Complaints Management System shows that the Premises does not have a history of odour complaints. **Overall risk rating: Low** Existing Licence Condition 1.3.3, 1.3.4 and 1.3.8 apply.
Increased risk of overtopping of ponds	Wastewater discharges to the environment	Soil and groundwater Residential dwelling and stock yards within the Broome Common Stockyards 790 m west of the Premises boundary	Overland flow/ Direct discharge to the environment. Infiltration through soil to groundwater. Lateral movement of impacted groundwater down-gradient of the site.	Potential impacts to human health from disease, inundation of TEC native vegetation and impacts to fauna outside the Premises boundary, potential impact on cattle livestock and suitability for human consumption. Soil and groundwater contamination.	No	**Consequence: Minor** Overtopping events are likely to be low level on-site impacts with minimal off-site impacts and are only likely to occur during extreme rainfall events which would significantly dilute effluent discharging to the environment. **Likelihood: Rare** The wastewater treatment Pond 1 and Pond 2 will be reconfigured so when the freeboard limit of 500mm is reached, overflow is directed towards the final effluent holding pond. The final effluent holding pond can contain a greater than 1:100 AEP event and can be managed prior to the commencement of the wet season to have a 1:300 year AEP capacity. Designated spillways divert wastewater away from the wastewater treatment plant and protect structural integrity of the ponds, thereby controlling any discharge to the environment. **Overall risk rating: Low** Works Approval Condition 1 requires spillways to be constructed. Existing Licence condition 1.3.5 applies.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Increased risk of seepage through pond liners	Wastewater discharge to ground Nutrients and other contaminants such as pathogens, persistent organic pollutants (POPs) and heavy metals	Soil and groundwater Bore water users within Broome Common Stockyards 790 m west of the Premises BC Act TEC Intertidal mud flats of Roebuck Bay- ~900m away EPBC Act TEC monsoon vines of the Dampier Peninsula ~ 900m away Roebuck Bay Marine Park ~900m away Yawuru Native title land vested for traditional customs, recreation and enjoyment	Infiltration through soil to groundwater Lateral movement of impacted groundwater down-gradient of the site	Soil and groundwater contamination Impacts to beneficial use of downstream stock bore water usage, or future potential usages. Degradation to TECs, Roebuck Bay Marine Park and cultural use of Native Title lands	Yes	See Section 7.2
Increase in volumes of desludging, biosolids and grit management	Odour	Residential premises located 1.4km north west of the Premises at the Morrell Park Aboriginal Community Residential dwelling within the Broome Common Stockyards 790 m west of the Premises boundary	Air / wind dispersion.	Amenity impacts	No	**Consequence: Slight** Nearest sensitive receptor 1.4 km north west therefore minimal to no amenity impacts are expected. **Likelihood: Unlikely** Historically wind from the Premises travels in a south-east direction and limited to approximately 20% of the time during the mornings only according to the 9am wind rose (BOM 2020). Winds to the west also occur approximately 20% of the time, however the dwelling within the stock yards is not considered overly odour sensitive due to the large numbers of animals on site. **Overall risk rating: Low** Existing Licence Condition 1.3.3, 1.3.4 and 1.3.8 apply. Existing Licence conditions may need to be reviewed to manage the risk from proposed increases to throughput rates for future operations.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Increase in volumes of desludging, biosolids and grit management (continued)	Solids discharge to land	Soil and groundwater	None	None	No	**No pathway** Solid waste material generated from inlet screens and desludging is contained within bins prior to being removed off site in accordance with existing Licence Condition 1.3.3, 1.3.4 and 1.3.8. Existing Licence conditions may need to be reviewed to manage the risk of increased throughput rates during operation.
	Leachate discharge to land	Soil and groundwater	None	None	No	**Consequence: Slight** Alterations to the inlet screening and desludging areas includes hardstands to accommodate an increase in throughput. The hardstands will be graded to direct any leachate or stormwater that comes directly into contact with the sludge and grit back towards the ponds for treatment. Spills and leaks are expected to have minimal on-site impacts only. **Likelihood: Unlikely** As the risk event will probably not occur in most circumstances. **Overall risk rating: Low** Condition 1 will be included in the Works Approval requiring all alterations to the Premises to be constructed in accordance with the design details and parameters as outlined in the Application. Existing Licence conditions 1.3.3 and 1.3.4 apply.
Increased risk of accidental release of wastewater via pump failure, pipeline ruptures	Wastewater discharge to the environment	Soil and groundwater	Direct discharge to ground and infiltration to groundwater Lateral movement of impacted groundwater down-gradient of the site	Soil and groundwater contamination	No	**Consequence: Slight** Each week-day, the Applicant undertakes remote monitoring of flow and pressure within the systems via a Supervisory Control & Data Acquisition System (SCADA). Abnormal flows and drops in pressure that may be caused by pipe leaks, off valves can be detected using this system and flows and pumps can be remotely isolated accordingly. Any spill and leaks will have minimal on-site impacts only. **Likelihood: Possible** in that it could occur from time to time. **Overall risk rating: Low** Works Approval Condition 7 and 8 require all pipe works, fittings and pumps to be tested during commissioning and to provide results

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Increased risk of contaminated stormwater runoff	Contaminated water discharge to the environment	Soil, groundwater and vegetation TEC fauna	Overland flow and infiltration to soil and groundwater Lateral movement of impacted groundwater down-gradient of the site	Soil and groundwater contamination Impacts to burrowing priority fauna such as the Bilby	No	**Consequence: Slight** The Applicant has provided a stormwater management plan which demonstrates that based on rainfall duration and frequency averages for the catchment area, the existing diversion channels, culverts and drains enable stormwater from a 1:100 year stormwater event to be diverted around the wastewater treatment ponds. Diversion is via a 15m wide drain that runs along the upstream eastern side of the plant, shedding water down catchment along the south eastern part of the plant. **Likelihood: Rare** as the risk event will may only occur in exceptional circumstances **Overall risk rating: Low** Existing Licence conditions 1.2.1 applies.
Increased risk of contamination of groundwater from expanded irrigation areas and volumes irrigated (increase in hydraulic loading rates)	Nutrients and other contaminants such as pathogens, POPs and metals	Soil and groundwater Impacts to bore water users within Broome Common Stockyards 790 m west of the Premises BC Act TEC Intertidal mud flats of Roebuck Bay- ~900m away EPBC Act TEC monsoon vines of the Dampier Peninsula ~ 900m Roebuck Bay Marine Park ~900m away Yawuru Native title land vested for traditional customs, recreation and enjoyment	Direct discharge to ground and infiltration to groundwater Lateral movement of impacted groundwater down-gradient of the site	Soil and groundwater contamination Impacts to beneficial use of downstream stock bore water usage, or future potential usages Degradation to TEC areas, Dampier Creek, Roebuck Bay Marine Park and cultural use of Native Title lands	Yes	See Section 7.3 Existing Licence conditions will need to be reviewed to manage the risk from proposed increases to throughput rates for future operations.
Addition of commercial fertilisers to cropping areas	Excess nutrients					

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Bulk chemical/ fuel/ fertiliser storage	Diesel and chlorine	Soil and groundwater within the Premises boundary TEC fauna	Direct discharge to ground and infiltration to groundwater (diesel) Air/Wind dispersion (chlorine)	Localised contamination of soil and groundwater (diesel) Acute respiratory toxicity/death from inspiration by humans fauna (chlorine)	No	Fuel and chemical storage is regulated in accordance with *Dangerous Goods Safety Act 2004*. Risk not assessed.

7.2 Risk Assessment – Seepage through pond liner

7.2.1 Description of risk event

There is potential for untreated sewage and treated wastewater to seep through the liners of wastewater treatment ponds at the Premises. The Application involves the liner in Pond 2 being altered to allow for the construction of a digestion pit and this requires cutting the existing liner, excavating a new digestion pit and installing a new side-wall liner with a concrete base. The new GCL will be fitted to the area between the concrete base and sealed with the existing liner in Pond 2. Due to the works taking place within existing lined ponds, there is also the potential for damage to occur through the movement of machinery and equipment across the existing liners.

7.2.2 Identification and general characterisation of emission

The Applicant proposes to accept up to 4.77 ML/day of sewage at the Premises which is directed to the deep anaerobic zones of Pond 1 and Pond 2. A summary of the sewage input and treated wastewater quality at the Premises is shown in Table 16 below.

Contaminants within any potential seepage will be affected by physical, hydraulic and biogeochemical processes within underlying soils and the groundwater aquifer. The effect these processes will have on contaminant concentrations has not been fully determined, however groundwater modelling conducted prior to operation of the Premises indicates that peak nitrogen and phosphorus loads discharging to Dampier Creek may be 16.7 and 0.24 kg/d respectively. The model suggests that nitrogen and phosphorus loads would take approximately 584 years to reach their peak. Metal loading in groundwater discharging to Dampier Creek was not predicted.

Table 16: Summary of influent and effluent quality at the Premises

Parameter (mg/L)	Median influent quality (from 2012-2019)	Median effluent quality (from 2012-2019)
BOD	190	15.0
SS	240	70.0
Oil and grease	35.0	<5
NH_4-N	49.0	4.95
TKN	65.0	17.0
NO_x-N	0.09	<0.05
TN	65.0	17.0
Filterable reactive phosphorus	8.27	5.80
TP	11.0	8.0
E. coli **(MPN/100mL)**	>24,000	445
Enterococci **(MPN/100mL)**	>24,000	120

7.2.3 Impact of risk event

Seepage of untreated wastewater to ground, particularly beneath the base of the digestion pits where the depth to groundwater is reduced and untreated sewage is input, is likely to result in localised mounding and contamination of groundwater. Impacts to groundwater quality may include changes to the physical and chemical characteristics of the water (oxidising or reducing effect on soil) and increased contaminant loads of nutrients, metals, persistent organic pollutants and pathogens.

Contaminated groundwater may impact on the downgradient beneficial uses of groundwater and cultural use of the Yawuru Lands by the Yawuru people. Impacts may also occur to the environmental values of nationally and internationally significant areas where groundwater discharges to Dampier Creek.

7.2.4 Criteria for assessment

Relevant groundwater water quality criteria include:

- The ANZECC and ARMCANZ (2000) tropical Australia trigger values for physical and chemical stressors in estuaries for TN, TP, NO_x and ammonia.
- ANZECC and ARMCANZ (2000) 99% species protection trigger values for toxicants in marine waters. Although the tributary of Dampier Creek is considered to be slightly to moderately disturbed, the higher level of protection was selected based on the RAMSAR status of Dampier Creek and Roebuck Bay.
- ANZECC and ARMCANZ (2000) livestock drinking water guidelines because livestock watering was identified as a potential beneficial use of groundwater in the area.
- Guidelines for the non-potable use of groundwater (NPUG) to protect the public who may be exposed to contaminated groundwater in a non-potable setting (DoH 2014).

7.2.5 Applicant controls

The Applicant proposes to undertake the works to the pond liner in accordance with the manufacturer specifications and using the quality control test methods and specifications recommended by the manufacturer. This will include visual third-party inspections, recording and reporting practices. The GCL product used will have a low permeability and is expected to be much lower than 1×10^{-9} m/s.

7.2.6 Consequence of risk event

Groundwater beneficial use

Considering the beneficial use of groundwater downgradient of the Premises, the Delegated Officer has determined that the seepage of wastewater through the pond liner has the potential to cause low level off-site impacts at a local scale and minimal off site impacts on a wider scale. Therefore, the Delegated Officer considers the consequence of the emission to be **Moderate**.

Dampier Creek environmental values

Considering the tributary of Dampier Creek being the discharge point for groundwater travelling away from the Premises, the Delegated Officer has determined that the seepage of wastewater through the pond liner may cause short term impact to an area of high conservation significance. Therefore, the Delegated Officer considers the consequence of the emission to be **Major**.

7.2.7 Likelihood of risk event

Groundwater beneficial use

The Applicant is proposing to install a low permeability GCL in accordance with manufacturer specifications and subsequent QA/QC procedures confirming that the installation is free from leaks, defects and is fit for purpose. Due to the Applicant's proposed controls, the Delegated Officer considers that the risk event will probably not occur in most circumstances and would relate mainly to wear and tear over time. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

Dampier Creek environmental values

The Applicant is proposing to install a low permeability GCL in accordance with manufacturer specifications and subsequent QA/QC procedures confirming that the installation is free from leaks, defects and is fit for purpose. Due to the Applicant's proposed controls, distance to the receptor and existing groundwater information shown in Section 6.1 and 6.2, the Delegated Officer considers that the risk event may only occur in exceptional circumstances. Therefore, the Delegated Officer considers the likelihood to be **Rare**.

7.2.8 Overall rating of risk event

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix contained in the *Guidance Statement: Risk Assessment* (DER 2017) and has determined the overall rating for the risk event to be **Medium**.

Medium risk events are acceptable provided they are subject to regulatory controls. This generally means the inclusion of outcome-based conditions on the relevant instrument. These conditions will be comprised of the Applicant's proposed controls along with confirmatory QA/QC reporting submissions to DWER.

7.3 Risk Assessment – Discharge of treated wastewater via irrigation

7.3.1 Description of risk event

The discharge to land of treated wastewater for irrigation has the potential to impact groundwater and down-gradient receptors where infiltration of contaminants occurs beyond the root-zone of vegetation within the irrigation area. This may occur where the hydraulic application rate of wastewater exceeds the capacity of the available crop area to uptake the water, resulting in the flushing of contaminants to groundwater. This may also occur where the treated wastewater has a high concentration of contaminants that are not able to be taken up by the crop. During rainfall events or when soil moisture conditions are high there is also the potential for this to occur in appropriately sized irrigation areas.

This may not have a significant impact on nitrogen removal from the wastewater, as microbial processes could continue to remove this nutrient below the root-zone. However, there is a risk that high infiltration rates could limit phosphorus sorption on minerals below the root-zone. This would be the case if the subsoil were to become sufficiently anaerobic and cause the partial reduction of iron oxides on sand coatings, the principal adsorption sites for phosphorus. The reductive dissolution of iron oxide coatings on sand grains in subsoils could also release arsenic into pore-water where this element could potentially be leached to the water table. This means that seepage of nutrients into groundwater may occur, depending on the extent to which soil microbial processes, sorption and volatilisation are able to remove these chemical constituents from soil pore-water.

7.3.2 Identification and general characterisation of emission

The Applicant proposes to discharge up to 4.77 ML/day of treated wastewater to three irrigation pivot areas totaling 82.76 ha. This results in a hydraulic loading rate of 57.6 kL/ha/day or 21.0 ML/ha/yr. The expected nutrient concentrations within the discharge are contained in Table 16 above.

It should be noted that part of the 4.77 ML/day volume is irrigated to a separate 17.91 ha seedling irrigation area at a rate of 28 kL/day, however it is not known if this is a permanent, ongoing arrangement and therefore the seedling area has not been considered in terms of hydraulic and contaminant loading for this risk assessment.

Discharge to irrigation will generally occur every day and be consistently applied throughout the day. The Applicant has stated that discharge to irrigation will not take place immediately before, during or immediately after rain events.

7.3.3 Impact of risk event

The infiltration of treated wastewater below the root zone and unavailability for uptake by the irrigated crop may cause nutrients and other contaminants present in wastewater to pass the root zone and increase contaminant concentrations in groundwater. This has the potential to impact downgradient users of groundwater and the environmental values of Dampier Creek, where groundwater flowing in a south-west direction from the Premises is considered to discharge.

Increased contaminant loads in groundwater could potentially impact on the long term health of sensitive flora and fauna of the Roebuck Bay tidal flats. Contaminants in wastewater have the potential to cause algal blooms or bioaccumulate and may predispose certain species, such as wading birds that predate on molluscs, to adverse impacts. Excess nutrients could cause algae or bacteria to cause a toxic environment for some species within the tidal flats.

In accordance with the Precautionary Principle, and the Principle of Intergenerational Equity; the first two principles of the EP Act, the Delegated Officer is obliged to consider short and long term impacts to the highly sensitive down-stream environment and high value cultural connection of this area to the Yawuru people. It is therefore appropriate that the long-term impacts of disposal of contaminants in wastewater to ground must be considered in this assessment, to prevent protracted enduring impacts at a later time.

7.3.4 Criteria for assessment

Relevant groundwater water quality criteria include:

- The ANZECC and ARMCANZ (2000) tropical Australia trigger values for physical and chemical stressors in estuaries for TN, TP, NO_x and ammonia.
- ANZECC and ARMCANZ (2000) 99% species protection trigger values for toxicants in marine waters. Although the tributary of Dampier Creek is considered to be slightly to moderately disturbed, the higher level of protection was selected based on the RAMSAR status of Dampier Creek and Roebuck Bay.
- ANZECC and ARMCANZ (2000) livestock drinking water guidelines because livestock watering was identified as a potential beneficial use of groundwater in the area.
- Guidelines for the non-potable use of groundwater (NPUG) to protect the public who may be exposed to contaminated groundwater in a non-potable setting (DoH 2014).

7.3.5 Applicant controls

Applicant controls include the wastewater treatment process and the use of a Rhodes Grass (*Chloris gayana*) crop for the uptake of nutrients in the irrigated wastewater. The rate of application is also a mechanism to control nutrient uptake by the cropping pasture. Irrigation is managed to not occur immediately before, during or after periods of rainfall, however there is no collection of soil moisture information to confirm when conditions are suitable for irrigation. The Rhodes Grass crop has a root zone depth of approximately 2 metres and is harvested when required. The harvested material is transported offsite for use as hay, resulting in an export of nutrients off the Premises.

The Licence requires monthly sampling be taken of the quality of wastewater applied to the irrigation areas and includes nutrients TDS, TSS, BOD, *E. coli*, oil and grease and a limited suite of metals. Nitrogen and phosphorus cumulative loading to the irrigation areas is monitored and the total nitrogen and total phosphorus data provided as part of annual environmental reports. The reports do not include the nutrient load added through the commercial application of fertiliser to the cropping areas.

7.3.6 Consequence of risk event

Groundwater beneficial use

Considering the beneficial use of groundwater downgradient of the Premises, the Delegated Officer has determined that infiltration of contaminants beyond the root-zone due to the irrigation of treated wastewater, has the potential to cause low level off-site impacts at a local scale and minimal off site impacts on a wider scale. Therefore, the Delegated Officer considers the consequence of the emission to be **Moderate**.

Dampier Creek environmental values

Considering the Dampier Creek wetland being the discharge point for groundwater travelling away from the Premises and the high conservation significance of this area, the Delegated Officer has determined that the irrigation of treated wastewater with infiltration of contaminants beyond the root-zone may cause short term impact to an area of high conservation significance. Therefore, the Delegated Officer considers the consequence of the emission to be **Major**.

7.3.7 Likelihood of risk event

Information supplied by the Applicant shows that the current and proposed irrigation areas are sufficiently sized on the basis of water uptake and nutrient removal via harvested Rhodes Grass (Section 6.3 and Section 6.4). However, there is the potential for high hydraulic loading to occur during rainfall events or when high soil moisture would limit the residence time of soluble nitrogen and phosphorus compounds in the root-zone.

Modelling undertaken by the Applicant indicates that groundwater may not reach the discharge area at Dampier Creek for at least 134 or more years due to the hydraulic gradient and aquifer conditions present. The model predicts maximum nutrient concentrations at the Dampier Creek discharge area will occur in 584 years from the commencement of operation of the Premises. Metal loading in groundwater discharging to Dampier Creek was not predicted.

Groundwater monitoring conducted since Premises operation commenced has shown that generally the irrigation of treated wastewater has not resulted in a change to nutrient concentrations in groundwater, when compared to up-gradient and pre-construction conditions (Section 6.1). In the case of metals that may be present in the irrigation water, current trends within groundwater were not able to be fully assessed due to the level of analysis conducted. However observed concentrations were generally below reporting limits indicating that currently there are no observable impacts to potential downgradient users of groundwater.

Groundwater beneficial use

Due to the Applicant's proposed controls and existing groundwater information, the Delegated Officer considers that the risk event will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood to be **Unlikely**.

Dampier Creek environmental values

Due to the Applicant's proposed controls, distance to the receptor and transport time predicted in the groundwater model, the Delegated Officer considers that the risk event may only occur in exceptional circumstances. Therefore, the Delegated Officer considers the likelihood to be **Rare**.

7.3.8 Overall rating of risk event

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix contained in the *Guidance Statement: Risk Assessment* (DER 2017) and has determined the overall rating for the risk event to be **Medium**.

Medium risk events are acceptable provided they are subject to regulatory controls. This generally means the inclusion of outcome-based conditions on the relevant licence. These conditions will likely be comprised of the Applicant's proposed controls along with additional monitoring imposed by DWER.

8. Regulatory controls

8.1 Construction and commissioning of works

The Delegated Officer considers the following conditions are suitable for managing the risks associated with the construction and commissioning of works:

- Works Approval Condition 1 and 2: Infrastructure and equipment requirements.
- Works Approval Conditions 3 to 7: Critical containment infrastructure and compliance reporting.
- Works Approval Condition 8 and 9: Environmental commissioning requirements.
- Works Approval Condition 10 and 11: Environmental commissioning report.
- Works Approval Conditions 17 to 20: Emissions and discharges.
- Works Approval Conditions 21 to 23: Records and reporting (general).

8.2 Operation

8.2.1 Time limited operations

The Delegated Officer considers the following conditions are suitable for managing the risks associated with the time limited operations of the works:

- Works Approval Conditions 12 to 14: Time limited operations requirements.
- Works Approval Condition 15 and 16: Time limited operations report.
- Works Approval Conditions 17 to 20: Emissions and discharges.
- Works Approval Conditions 21 to 23: Records and reporting (general).

8.2.2 Transition to licence L9094/2017/1

Based on the assessment of current and future wastewater irrigation practices, the Delegated Officer considers that additional monitoring within the conditions of L9094/2017/1 may be required to address some information gaps relating to the longer term risks associated with the irrigation of wastewater.

The Delegated Officer concedes that there is unlikely to be any material change to the environment over the short-term allowing the Premises to continue operating in accordance with the current regulatory controls until such a time as an application is made to amend the current operating Licence to reflect the proposed infrastructure and throughput changes (authorised in the works approval).

Water Corporation should consider submitting a plan to support the following aspects in any application made to amend the Licence to increase irrigation of wastewater at the site.

Soil monitoring

Consultants acting on behalf of the Applicant have undertaken some soil sampling from the irrigation areas at the Premises. However, it is not clear from the information that has been provided whether sufficient sampling has been undertaken to characterise the spatial distribution of soil properties and how these are changing with ongoing irrigation. Consequently, it is recommended that the following soil monitoring strategy derived from the *Environmental Guidelines: Use of Effluent by Irrigation* (NSWDEC 2004) is undertaken. The NSW guidance recommends that soil samples in wastewater irrigation areas are collected in the following way:

- At least one composite near-surface soil sample is collected for each hectare of the irrigation areas. The composite sample will consist of 40 samples collected from the depth interval of 0-10 cm collected in each one-hectare area; and
- Composite soil-profile samples are also collected from within each irrigation area. The composite soil samples will be collected within a five-metre diameter plot and will be compiled from at least five sites within this plot. Samples from each sample site will be collected at depth intervals of about 0-20 cm, 20-40 cm, 40-70 cm, and 70-100 cm which will be combined to form composite samples for these depth intervals. Wherever possible, the samples should be collected from specific soil horizons.
- The soil sampling and analysis program should consider the parameters and frequencies listed in Table 17.

Such sampling would help determine the extent to which phosphorus adsorption is taking place in the soil profile beneath the irrigation areas and would indicate the lifespan of the irrigation scheme before the adsorption sites become fully saturated with this element. The soil sampling would also help determine whether significant amounts of potentially leachable nitrogen are accumulating in the soil profile in the irrigation areas.

Table 17: Recommended soil sampling strategy

	Frequency of sampling	
Constituent[1]	**Surface soil**	**Soil profile at four depth increments**
pH (no units)	Annually	Annually
Electrical conductivity (EC) (dS/m)	Annually	Annually
Nitrate-N	Annually	Annually
Total N	After 3 years	N/A
Available P	Annually	N/A
Total P	After 3 years	Every 3 years
Exchangeable sodium percentage	Annually	Every 3 years
Heavy metals and pesticides	After 10 years[3]	N/A
P sorption capacity[2] (kg/ha)	After 3 years (site-specific)	Every 3 years (site-specific)

Notes: 1. mg/L unless otherwise stated.

2. As recommended by an accredited laboratory or soil scientist.

3. Or more frequently if any are identified/calculated as a particular risk factor in effluent.

Leaf-tissue analysis

Leaf tissue samples from the Rhodes Grass crop in the irrigation areas should be collected and analysed on an annual basis for nitrogen and phosphorus. The information obtained from the samples, together with measurements of the total harvested biomass yield (on a dry-weight basis), will be used to determine the total amount of nitrogen and phosphorus removed annually in harvested biomass from the irrigation areas. This information is necessary to determine the efficiency of the irrigation scheme in preventing uncontrolled emissions of nutrients to soil and groundwater and to indicate if the efficiency of nutrient recovery declines over time. The *Environmental Guidelines: Use of Effluent by Irrigation* (NSWDEC 2004) may be used to support the development of this requirement.

Soil pore-water monitoring

At least one ceramic-cup or similar lysimeter at a depth of 1 - 2 metres should be installed in each irrigation area. The sampling of these lysimeters on a least a quarterly basis would enable the nitrogen and phosphorus contents of soil pore-water that seeps beneath the crop root-zone to be monitored on an ongoing basis. Increases in the concentrations of nutrients in soil pore-water would indicate an increased risk of groundwater contamination taking place beneath the irrigation site and should trigger a management response to prevent this taking place. The recommended monitoring suite for water captured in lysimeters includes the following parameters: Total N, Total P, ammonium-N, Total Kjeldahl- N, nitrate-N, filterable reactive-P and Total Dissolved Solids.

Data from the lysimeters could also be used as a more accurate “source term” for any additional solute transport modelling that is undertaken to determine the fate and transport of nutrients in groundwater near the Premises.

Changes to groundwater analytical suite:

Major ions (i.e. Na^+, K^+, Ca^{2+}, Mg^{2+}, HCO_3^-, SO_4^{2-}, Cl^-)

The following chemical parameters are to be included in the current groundwater monitoring program at the facility: Sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), bicarbonate (HCO_3^-), sulphate (SO_4^{2-}) and chloride Cl^-.

The reason for including these parameters is that inputs of wastewater to an aquifer typically cause changes in the chemical composition of groundwater long before widespread contamination by nutrients or other chemical constituents of environmental concern takes place. Increases in bicarbonate, calcium and potassium ions, including changes to their relative proportions in groundwater, can be early-warning indicators of contamination.

Pathogens

As faecal pathogens have the potential to impact on the beneficial use of ambient groundwater, determination of *E. coli* concentrations in groundwater should be included in the current groundwater monitoring program. Sampling for pathogen indicators would only be required in sentinel bores located within and close to the Premises.

9. Strategic Planning Matters

DWER has a long history of engagement with the Shire of Broome, Water Corporation and Landcorp on fit-for-purpose public open space (POS) water supply issues. The *Shire of Broome Public Open Space Irrigation Options Study* (Options Study) was completed in October 2016 and identifies treated wastewater from the Premises and non-potable ground water as an integrated supply option for irrigation of POS.

The Department generally supports any proposals to reuse treated wastewater to reduce the take from the scheme borefields. Water Corporation's current works approval for an additional centre pivot does not align with this approach. The Shire indicated that Water Corporation has agreed to substitute the treated wastewater supply with a non-potable groundwater source. The Shire is satisfied with this approach due to mosquito problems in public open spaces irrigated with treated wastewater.

Mosquito breeding can be associated with some methods of effluent disposal or dispersal, however there are design considerations and operational practices that can reduce mosquito breeding. Further information can be found in the *Guidelines for the Non-potable Uses of Recycled Water in Western Australia (Department of Health)* and the *Guidelines for preventing mosquito breeding associated with wastewater treatment and disposal in the Northern Territory (NT Government 2016)*. Additional treatment trains to reduce health risks may also be an option.

DWER has been dealing with proposals to expand the town bore field under the Rights in Water and Irrigation Act 1914, including provision of a non-potable POS water supply. The existing town water supply bore locations in the south of the P1 area have had impacts on the salt water interface. Water Corporation is currently modelling options to expand the borefield further north and east to accommodate town growth and POS provision post closure of the Broome South WWTP. Future proposed developments on the Dampier Peninsular involving significant quantities of groundwater may place pressure on the town water supply aquifers.

Currently there is sufficient allocation to provide POS water supply from the town borefield. However, water efficiency best practice could also incorporate treated wastewater from the Premises to:

- Reduce the take from the scheme borefield.
- Reduce future pressures on town drinking water supply and the environment.
- Reduce logistics and cost of retrofitting piping if TWW from Broome North was used for POS in the future.
- Remove the need for clearing and potential nutrient impacts associated with additional centre pivot irrigation at the Premises.
- Maximise use of government COVID 19 recovery funds to improve sustainability outcomes for the town of Broome (the Shire's *3 Year Broome Covid 19 Recovery Plan* identifies a waste water reuse infrastructure project and acknowledges that the use of recycled water delivers sound environmental outcomes).

10. Consultation

Table 18 provides a summary of the consultation undertaken by the department.

Table 18: Consultation with external stakeholders

Consultation method	Comments received	Department response
Application advertised on the department's website and the West Australian Newspaper (19/10/2020)	None received	N/A
Shire of Broome advised of proposal 19 October 2020	On the 23 November 2020 (A1956420) the Shire of Broome advised that with the planned closure of Broome South WWTP, that public open spaces that are currently irrigated with treated wastewater from the Broome South WWTP will be supplied with untreated bore water for irrigation and that as such the council will no longer be relying on treated wastewater for irrigation of any public open spaces.	N/A
Yawuru Native Title Holders Aboriginal Corporation RNTBC advised of proposal 19 October 2020	None received	NA
Department of Health (DoH) advised of proposal 19 October 2020	DWER received comment on 10 November 2020 (DWERDT366753) that the applicant requires approval from DoH to demonstrate that works will not impact on the quality of recycled water under Recycled Water Scheme Approval M19/00000. DWER was also advised that the Applicant needed to demonstrate 30 days retention time to mitigate helminth larvae and ova within the treated wastewater.	Comments have been considered within the risk assessment and associated discussion as presented in this report. Advised Water Corporation of DoH advice in relation to M19/0000

Consultation method	Comments received	Department response
Department of Biodiversity, Conservation and Attractions (DBCA) advised of proposal 19 October 2020	Advice was received on 17 November 2020 from DBCA who advised that due to the proposal being within the catchment area for the RAMSAR Convention -listed Yawuru Nagulagun/ Roebuck Bay Marine Park that there should be no net increase in the export of nutrient from the site as a result of the granting of the Application. DBCA also provided comment on the clearing of native vegetation within the Premises as it has the potential to impact on the greater bilby a threatened species under the Biodiversity Conservation Act 2016, and although none have been recorded in the area during the 2019 survey, the area should be assessed again by a suitably qualified zoologist in accordance with Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia 2017. Should bilby individuals be found within the proposed clearing area, this area they should be relocated in consultation with DBCA.	Comments referred to DWER's Native vegetation Clearing Branch for consideration in clearing permit assessment.
International Livestock Export Pty Ltd advised of proposal 19 October 2020	None received	NA
Applicant was provided with draft documents on (24 December 2020)	Refer to Appendix 1 for comments received on the 1st draft	Refer to Appendix 1
Applicant was provided with revised draft documents on (11 March 2021)	Refer to Appendix 2 for comments received on the revised draft	Refer to Appendix 2

11. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies referenced in this Decision Report (summarised in the 'References' section).

Based on this assessment, it has been determined that the Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Jarrod Abrahams 2021.04.23 12:10:52 +08'00'

MANAGER WASTE INDUSTRIES

REGULATORY SERVICES

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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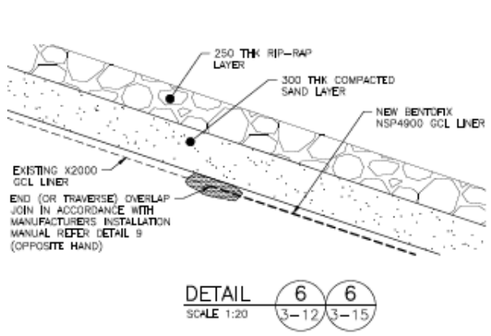
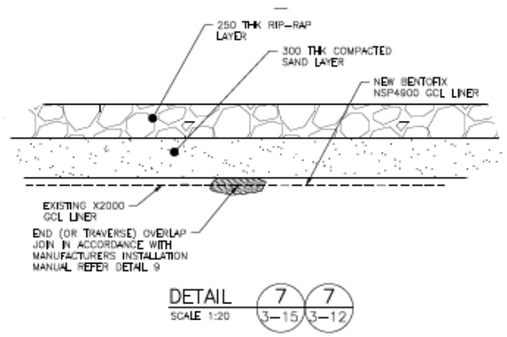
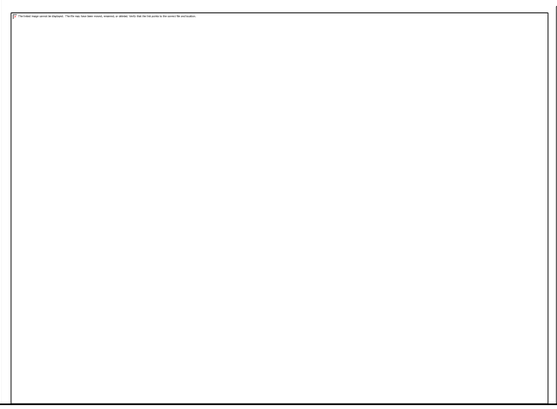
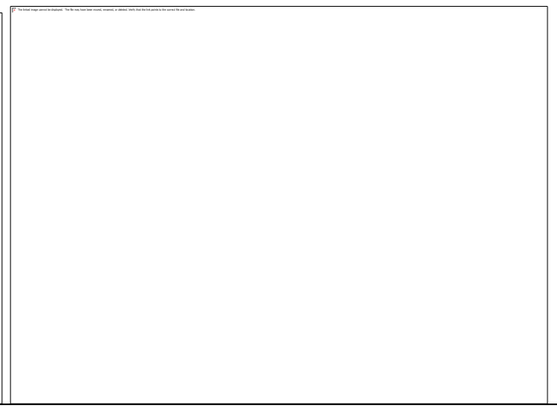
Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Condition or Section	Summary of Licence Holder comment	DWER response
Comments on draft Works Approval W6451/2020/1		
Cover page	The assessed production or design capacity is listed as 4500 cubic meters per day under Category 54, it should be 4770 cubic meters per day.	Noted and corrected.
Condition 1	The wording of the condition should be changed from *The works approval holder must* to *The works approval holder may*. The Corporation understands it is a standard condition, but these works are being undertaken at Water Corporation's discretion i.e. we are not being directed by DWER to undertake these works to improve operations/emissions. Must should be amended to May.	This is the standard wording for this condition currently used by DWER and won't be changed. The word *must* is used in this instance because it's a direction from DWER to implement the works in a particular manner so that the risk assessment of the Application remains valid. The requirements of the table are what has been considered through the risk assessment to be required and necessary to control emissions at the determined risk rating, based on the content of the Application.
N/A – Condition requested to be included after Condition 1	Request that the following condition be included: The Works Approval Holder must not depart from the requirements specified in Column 3 of Table 1 except: (a) where such departure does not increase risks to public health, public amenity or the environment; and (b) all other Conditions in this Works Approval are still satisfied.	Noted and included as condition 2.
Table 1 Previous item 2 (b-ii) and Item 3 (d-ii) (Now item 4 and 2)	Remove condition requiring protective layer requires rip -rap protection. Pond 1 berm will not have a rip rap protective layer over BGM. The key advantage of Coletanche BGM is that it can be left exposed and does not require a soil overburden cover layer like other liner types. Please see attached manufacturers correspondence. During a Regional HAZOP concern was raised relating to maintaining the rip rap (weeds), as it is a narrow berm and non-trafficable.	Noted and removed.
Table 1 Previous Item 2 (d) and Item 3 (f) (Now item 4 and 2)	Change wording to allow geobags or drying beds to be utilised.	No change. The current condition does not specify what method of sludge drying is to occur. It only requires it to take place at the Sludge drying beds where there are existing controls for leachate (concrete bunding and pipelines back to the treatment ponds).
Table 1 Previous Item 4 a) & b) (Now removed and requirement incorporated into item 2 and 4)	The Applicant confirmed that installed spillways will be concrete lined.	Noted.
Table 1 Previous Item 6 a) (now item 3)	The Applicant confirmed that the Polymer dosing system is mobile plant and that geobags are proposed for routine desludging.	Noted. The requirement was reworded to: *(a) A liquid polymer dosing system must be installed that is capable of adding polymer to the sludge to aid the dewatering process*
Table 1 Previous item 7 a) (now item 6)	Remove statement that tanks must be double lined, as this was not specified in the Application. No need for these tanks to be double lined - unnecessary requirement based on the low risk to environment (treated ww, on site storage, overflows/spills directed back to treatment pond). Existing tanks on site not double lined.	Noted and removed.
Previous Condition 2 (now Condition 3)	Since a condition in a works approval cannot apply a requirement on DWER i.e. DWER cannot be required to approve the CQA Report within a certain timeframe the conditions should require the 'suitably qualified geotechnical engineer' to certify the works as compliant prior to Pond 1 works. If the original condition is implemented significant costs if the contractor cannot commence works on Pond 1 once Pond 2 is online. then this will impose a huge cost impost as the contractor will NOT be able to finish Pond 2 and put it straight back online	The specified condition is in accordance with current DWER practice and guidance outlined in the *Guidance Statement: Setting conditions* (2015) and the *Guideline: Industry Regulation Guide to Licensing* (2019). The statement that a condition of a works approval cannot apply a requirement on DWER is not reflected in Section 62 of the EP Act. Section 62(1) specifies that:

Condition or Section	Summary of Licence Holder comment	DWER response
	to start work on Pond 1. IF we have to finish Pond 2 and then wait for a few months, the contractor will need to demobilise and remobilise at great cost.	*A works approval or licence may be granted subject to such conditions as the CEO considers to be necessary or convenient for the purposes of this Act relating to the prevention, control, abatement or mitigation of pollution or environmental harm*. This condition is considered necessary by the CEO, through delegation, for the prevention of pollution or environmental harm caused by the seepage of sewage through an inadequately installed liner in the anaerobic zone of Pond 2. Therefore, the Delegated Officer is not limited in specifying this condition. Additionally, Section 4.1 of the *Guideline: Industry Regulation Guide to Licensing* (2019) outlines DWER's position on the confirmation of works and specifies that the Department considers it appropriate, on the basis of risk, to ensure that critical containment infrastructure meets its requirements prior to environmental commissioning, or any form of operation commencing. Based on the proposed operations and the risk assessment in Section 7, the Delegated Officer considers that the anaerobic zone in Pond 2 is medium risk infrastructure for the containment of wastewater. The scheduling of works proposed in the Application would require Pond 2 to be operated before the work on Pond 1 could commence, therefore a Critical Containment Infrastructure Report would be required. The Applicant should note that the condition is intended to apply specifically to the anaerobic zone in Pond 2 and does not relate to the remainder of the works within Pond 2, such as the berm, baffle and other installations. If construction sequencing allows, the report may be submitted to DWER to determine compliance while the remaining work in Pond 2 is completed. To further clarify the intent of the condition and it's link to published guidance on Critical Containment Infrastructure, the condition has been reworded to: *3. The works approval holder may only contain waste within Pond 2 where;* *(a) the Critical Containment Infrastructure Report required by condition 4 has been submitted to the CEO; and* *(b) the CEO has notified the works approval holder that the Critical Containment Infrastructure Report as required by condition 4 meets the requirements of that condition;* *or* *(c) at least 15 business days have passed after the Critical Containment Infrastructure Report for that item of infrastructure as required by condition 4 has been submitted to the CEO.* The following changes to related conditions have also been made: *4. The works approval holder must within 30 calendar days of the Pond 2 anaerobic zone required by Table 1: Row 1(b) being constructed;* *(a) undertake an audit of their compliance with the corresponding design and construction / installation requirements of condition 1; and* *(b) prepare and submit to the CEO a Critical Containment Infrastructure Report on that compliance.* All references to the *Construction Quality Assurance Report* have been changed to *Critical Containment Infrastructure Report*.
Previous Condition 5 (now Condition 6)	Revise wording so that only one environmental compliance report is required. Activities in condition 1 will not be undertaken at the same time and wording of the condition implies that up to 10 environmental compliance reports would need to be developed at completion of the Broome North 7ML/D upgrade works.	It was not the Delegated Officer's intent to require up to 10 environmental compliance reports. The standard condition wording has been used, which is phrased for a simple works program without multiple steps and the appropriate modifications were not made. It should be noted however that due to the proposed staging of the works, more than one Environmental Compliance Report will be required for commissioning to commence on infrastructure from the relevant stage. This in turn ensures that the emissions and discharges of the modified Pond 2 are authorised through an instrument issued under Part V of the EP Act. This is outlined in Section 4.2 and 4.4 of the *Guideline: Industry Regulation Guide to Licensing* (2019). To reflect the staged approach in both construction and commissioning, three Environmental Compliance Reports would be required, with the individual reports submitted after the completion of each stage. The condition has been reworded to:

Condition or Section	Summary of Licence Holder comment	DWER response
		6. *The works approval holder must within 30 calendar days of each works stage specified in Table 1 being completed;* Changes to condition 1 were also required to reflect the staged approach: Condition 1 has been modified to include a column titled *works stage* and the items of infrastructure and equipment have been listed against each works stage based on communications received from the Applicant on 24 February and 8 March 2021. Conditions 12 – 14 allowing the time limited operation of the works following commissioning have also been included. This allows use of the new and modified infrastructure and equipment through a Part V instrument while the subsequent licence amendment is being determined.
Previous Condition 8 (now Condition 9) Table 2 (Commissioning duration)	Irrigation pivot 3 is not included in the 240 calendar days. Pivot 3 will be dependant of availability of treated wastewater and season conditions suitable for seeding. Note: should the works approval holder's request to submit 1 environmental compliance report as per Condition 5 above the environmental commissioning will only commence once all 10 infrastructure items listed in condition 1 are complete.	Noted. Due to the modifications referred to above and uncertainty regarding when Pivot 3 would be tested/seeded, Pivot 3 is no longer listed under environmental commissioning in the works approval. Testing the functionality can be done and reported as part of the Environmental Compliance Report for the relevant works stage (Stage 3). Only Pivot 3 has been included in Stage 3 so that timeframes and commissioning of the remainder of the works are not impacted.
Previous Condition 8 (now Condition 9) Table 2 (Seeding)	Remove or revise wording that the irrigation area must be seeded prior to the discharge of treated wastewater. Treated wastewater must be used on Pivot 3 as part of soil preparation and seeding process. The Broome North Wastewater Treatment Plant Facility does not have the capacity to use raw/potable water to prepare the soil for seeding. Currently the existing infrastructure does not allow raw/potable water to be added to the network and fill the required contact tank. The only available bore has an abstraction rate of only 8L/sec and an approximant volume needed to commence soil preparation and seeding is in approximately 45-50L/sec. On an environmental perspective Water Corporation believes utilising treated wastewater as a reuse option as opposed to groundwater as a far more sustainable practice. When the decision has been made to seed Pivot 3 the site operators use information from the BoM evapotranspiration rates for Broome, which are updated daily, to prepare (moisten) soil to a depth of at least 300mm before seeding (over a period of 7-10 days). This info gives the operator the amount of moisture required in mm of rain (in this case TWW) required to replenish what is lost to atmosphere. The Fieldboss pivot controllers use an equivalent of mm of rain to determine watering time (this is measured, and the data entered into controller during commissioning), we monitor and record actual usage in kL from magflow's through OIP's and SCADA. The operator uses the West Roebuck BoM weather station (located 2.5km to the North East of BNWWTP) for actual rainfall and adjust watering schedule to suit. During a tropical low or predicted cyclone (heavy rainfall events) we tie the pivots down and isolate operation to prevent overwatering and bogging. It should also be noted that overwatering (allowing water to pool, waterlog soil and runoff) is highly detrimental to the first week of germination. Crop loss will also be highly noticeable during the 3-4 week seedling phase. An increase of treated wastewater is increased only once the crop has been established and can effectively manage the uptake of nutrients from the treated wastewater.	Noted. The requirement was intended to prevent the authorisation of a sustained discharge to an area of bare ground with no planted crop. This requirement is no longer relevant to condition 9 as commissioning has not been specified for Pivot 3. A time limited operational requirement has been added through Condition 14 Table 3 Row 6 which requires the following: *(a) Prior to seeding, treated wastewater must only be discharged to Pivot 3 to provide soil moistening in preparation for seeding;* *(b) Discharge of treated wastewater for soil moistening must not occur for longer than 14 consecutive days;*
Throughout	DWER to confirm related condition numbers throughout the works approval.	The condition reference links appear to have broken when converting the works approval to a PDF. The condition references have been corrected.
Condition 12	Total Residual Chlorine is done by Operators and not by NATA certified labs. Please add a note to similar to pH "In-field non-NATA accredited analysis is permitted	Noted and included.
Previous Condition 12 (now Condition 15)	Condition may remain the same on the basis all 10 infrastructure items listed in condition 1 are completed.	Based on the restructure of the works approval only one commissioning report is required.
Definitions (Geotech Engineer)	Include the clause: Or as otherwise approved in writing by the CEO to act in this capacity. This clause was provided in other works approvals issued recently by DWER.	Noted and included.
	Remove reference to *employed by* and revised sub-condition (c) wording to *is an independent third-party external to the works*	Noted and revised.

Condition or Section	Summary of Licence Holder comment	DWER response
	approval holder	
Definitions (missing definition)	'Suitably qualified civil engineer' is not defined under the licence.	Noted. The appropriate definition has been included in accordance with the definition for a Geotech Engineer and the Applicant's related comments above.
Schedule 3 Geosynthetic Clay Liner	The Applicant provided the following additional information on how the GCL will be anchored or attached to the concrete base; The new deep anerobic pot in pond 2 will be excavated and lined with exactly the same system as to what exists in pond1. The GCL layer will be protected and confined under a 300mm thick sand layer. This will be protected with a 250mm thick riprap layer to protect against erosion through wave action. The riprap and 300mm sand overburden layer will be separated by a layer of geofabric (bidim). The new GCL layer will be bonded to the existing GCL liner as shown in Detail 6, 7 and 9 in the additional comment's column. The pond 2 will be emptied, dried and the new anerobic pot will be excavated. The excavated soil will be compacted and profiled and the concrete base slab will be poured at the bottom of the deep pot (see Detail 2 in the additional comments column for details). Whilst this concrete is curing, the slope walls of the deep pot will be lined with GCL system shown below. All GCL installation will be undertaken as per manufacturers recommendations and the GCL installation will be supervised by an person with relevant experience. A construction quality assurance report will be submitted by the Water Corporation which will certify that the GCL system has been installed as per the design and satisfies the GCL manufacturer's recommendations. After the concrete base slab has cured and tested, the GCL layer will be laid onto and secured to the it with bentofix clay paste as recommended by the manufacturer. This GCL-concrete interface will be protected by the overlaying 300mm sand, and geofabric and riprap as shown in Detail 2. Any pipe penetrations through the GCL liner will be sealed as per manufacturer's instructions as shown in Detail 5.    	The Delegated Officer has considered the additional information provided and listed the following requirement within Schedule 3 Table 8: Geosynthetic Clay Liner: *(d) must be adequately joined and sealed with the concrete base of the anaerobic zone pit so that no water is able to pass through the join;*

Condition or Section	Summary of Licence Holder comment	DWER response
		
Schedule 3: Requirements b) (ii)	Delete reference to Specific Commercial Products – Bentofix NSP4900 (as set out in Global Synthetics commercially branded flyers). WC reserve the right to change commercial product. If certain 'characteristics' of a GCL are required for environmental purposes, these should be listed rather than specifying a branded product on the market.	Noted. The requirement was changed to: *(b) The quality control report must verify that the supplied GCL meets the minimum requirements for;* *(i) sodium bentonite property; and* *(ii) material property,* *as set out in the manufacturer's technical information document*
Comments on draft Decision Report		
Section 3.1 Table 4: Item 3	Remove "overlain and connected to" as it implied a mechanical connection. The reference to "connected" in statement "The new liner with then be sealed (overlain and connected to) with the existing Betofix…" implies a mechanical connection. The installation method is to overlap the new liner over the existing liner. There is no mechanical 'connection" e.g. bolts, brackets, etc.	Noted. The requirement has been reworded to: *The new GCL will be sealed and bonded with the existing Bentofix X2000 GCL in Pond 2 and the concrete digestion pit base using a bentonite clay paste*
Section 3.1 Table 4: Item 5	Change "through" to "via". Sludge does not pass through a poly dosing system. Polymer is injected into the system.	Noted. The requirement has been reworded to: *Installation of a mobile liquid polymer dosing system which adds a polymer to the sludge, aiding the dewatering process*
Throughout document	Change leachate to filtrate. In several places the document uses the term "leachate" for water that drains out of drying beds or geobags. Leachate has connotations more related to landfill or other high strength waste flows.	The Delegated Officer does not consider that the term *leachate* applies mainly to landfills and notes that DWER uses the more general meaning of the term referring to *water that has drained through a solid and leached out some of the constituents*. For consistency with existing instruments and published guidance the term *leachate* will remain in the document.
Section 3.1	Change construction hours. Construction operating hours will occur from 7am to 7pm Monday to Friday but may extend outside of these timeframes with the necessary approvals from Shire of Broome.	Noted. The section discussing construction hours has been changed to: *Construction hours will be between 7 am to 7 pm Monday to Friday but may occur outside these timeframes if required. Construction outside of the day-time hours (7 am to 7 pm Monday to Saturday) listed in the Environmental Protection (Noise) Regulations 1997 (Noise Regulations) will need to occur in accordance with Regulation 13 of the Noise Regulations and a Noise Management Plan approved by the Shire of Broome.*
Section 4 Table 6: *Health Act 1911* Recycled Water Scheme Approval	Correction to Statement. The recycling scheme is still subject to regulation by DoH under the Public Health Act – as although the irrigation occurs on our premise boundary, the product (fodder) leaves the boundary. It is subject to regulation under the *Guidelines for Non-potable Uses of Recycled Water in Western Australia*.	Noted. Reference to the Recycled Water Scheme Approval not being required has been removed.
Section 4 Table 6: Dangerous Goods Licence	DGS021433 is held for Chlorine storage only. Diesel is not on the DG licence due to storage volumes being less than the trigger volume. This particular installation and quantity does not trigger the need to be on the DG license as the diesel is not stored with other fire risk DG (as per schedule 1 of the DG	Noted. The Dangerous Goods licence number has been added to the table. Context regarding the licence only being for chlorine gas due to diesel storage being below manifest thresholds has

Condition or Section	Summary of Licence Holder comment	DWER response
	Regulations), and meets the separation distances specified in AS2927 (2019) storage and handling of chlorine table 6.1.	also been added.
Section 4.4.2, Section 6.6 and Section 7.2.1	Correction of minimum retention time from 30 days to 25 days. Correspondence received from DoH is that a minimum 25 day retention time is required with a target criterion of 30 days. Please refer to attached correspondence from DoH reference letter F-AA-23417.	Noted. References to DoH required minimum retention times has been corrected to 25 days within the relevant sections.
Section 6.1	WC Disagrees with DWER statement and seeks reassessment. DWER states maximum TN recorded down-hydraulic gradient was 43 mg/L, this is incorrect maximum value recorded is 23 mg/L (GHD, 2020a). As stated by DWER, there is extensive nutrient concentration data for groundwater at the site (up to 27 samples per groundwater bore over 9 years). It is not an appropriate way to assess data to just refer to the maximum concentration measured. Long-term medians and trends are more appropriate to use in an assessment of groundwater concentrations. Erroneous concentrations should be attributed to sampling error / laboratory error etc. and not relied upon. Note the decision report shows no increasing trends in groundwater concentrations over the 10 years of operating the WWTP. It also notes there are no groundwater impacts down-hydraulic gradient compared to up-hydraulic gradient and concentrations measured prior to construction of the WWTP.	The TN concentration of 43 mg/L was recorded down-hydraulic gradient of the pivot irrigation area at monitoring bore 15/10 in May 2020. This monitoring result was reported in the 2019-2020 AER for the Premises. The text has been updated to reflect that this summary includes data from the 2019-2020 AER as well as the baseline environmental assessment. The Delegated Officer considers that the discussion of nutrient results does not rely solely on identification of maximum concentrations. The discussion also refers to median concentrations being within the range of baseline concentrations and includes a summary of trends as reported in the baseline environmental assessment. Minor edits have been made for clarity and further context regarding the nutrient trends from the Mann Kendall Trends Tests has been provided.
Section 6.1	WC Disagrees with DWER statement and seeks reassessment. GHD (2020a) report shows there are no metal groundwater impacts down-hydraulic gradient of the site compared to up-hydraulic gradient. The decision report has mis-interpreted the statement by GHD stating 'median metals concentrations were below ANZECC (2000) livestock drinking water and DWER (2014) non-potable use guidelines across the well network.' This is referring to the fact that the median concentrations from each individual bore were below the applicable guidelines, not the median of entire bore network is below the applicable guidelines. This also shows that WWTP operations are not impacting metals concentrations in groundwater down-hydraulic gradient of the site. Three individual bores (22/10 – 24/10) had one exceedance of Arsenic in groundwater above guidelines and one bore (21/10) had two exceedances above guidelines. However, the median concentrations were below guidelines and these four bores are located ~2km south-west of the site. All bores located down-hydraulic gradient of the WWTP ponds and pivots on-site had zero exceedances of guidelines. One bore (23/10) had an individual exceedance of Chromium for NPUG (DER, 2014). Again, the long-term median concentration was below guideline and all bores on-site down-hydraulic gradient were again below guidelines for all samples collected. One bore (13/10) had an individual exceedance from 30 samples collected of Copper for livestock drinking water. Again, the long-term median concentration was below guideline and the bore is displaying a decreasing trend. Two bores (19/10 and 23/10) had an individual exceedance of Nickel for NPUG (DER, 2014). Again, the long-term median concentration was below guideline and all bores on-site down-hydraulic gradient were again below guideline for all samples collected. One bore (11/10) had four exceedances from 29 samples collected of Selenium for livestock drinking water. Again, the long-term median concentration was below guideline and the bore is displaying a decreasing trend. All other metals analysed did not contain one exceedance above the applicable guidelines within the extensive data set of 10 years of sampling. The 99% species protection trigger values for estuaries applies to the groundwater discharging to the receptor not the concentrations measure on-site. It is noted Dampier Creek is over 2km south-west of the WWTP, thus exceedances of metal concentrations on-site does not conclude you have a potential risk to the receptor. The current licence requirements reflects this with standard trace metals required to be analysed and not ultra-trace LORs. GHD (2020b) also notes that all 99% protection species exceedances were measured up-hydraulic gradient as well and down-hydraulic gradient and there is no evidence on-site operations are impacting metals concentrations in groundwater. Based on the GHD reports, we do not agree with the decision report conclusions that 'activities at the premises or an alternative source cannot be determined without further temporal and spatial analysis of the groundwater dataset'.	The Delegated Officer notes that the information referred to in this comment was not listed within GHD 2020a. This monitoring data was subsequently provided by the Applicant as part of the consultation period. The Delegated Officer has reviewed the provided monitoring data and revised the discussion of metals results and uncertainties in Section 6.1. The updated discussion identifies that the median concentrations of metals in each groundwater bore were generally equivalent to a result of less than the LOR. The Delegated Officer notes that while the median concentrations in most monitoring bores were below the applicable livestock and NPUG values, higher LORs for some analytes and locations meant this could not be fully confirmed for all locations. The Delegated Officer considers that the monitoring data provided does not indicate the presence of gross metals impacts to groundwater from the Premises activities and has updated the discussion accordingly. Based on the provided monitoring data, the Delegated Officer still considers that a determination of whether Premises operations are contributing to metal concentrations cannot be made with certainty. This is due to most of the temporal data being below LOR, precluding any trend analysis of the groundwater dataset that may show whether metal concentrations have remained stable. The existing data only shows that Premises operations have not resulted in impacts above the adopted analysis LORs and subsequently there are no current impacts to the down-gradient beneficial use of groundwater. Although minor, this uncertainty does need to be factored into the Risk Assessment in Section 7. Clarification has also been provided regarding how the 99% species protection criteria applies.
Section 6.1	WC Disagrees with DWER statement and seeks reassessment. The current licence does not require pathogens to be monitored in groundwater. Escherichia coli (*E. coli*) was monitored in the on-site groundwater monitoring bores between 2008 and 2012. A minimum of 10 samples were monitored for *E.coli* from each groundwater bore over this period the median concentrations of each individual bore being <10 CFU/100mL. The Water Corporation does not believe the concentration measured by GHD (2020b) in 5/20 was a result of on-site activities and is an anomalous result and agrees with the decision report further monitoring should be conducted to confirm this.	The Delegated Officer notes that the 2008-2012 *E. coli* monitoring data referred to in this comment was not provided within GHD 2020a and these results relate to pre-construction and only the initial operating period of the Premises. The discussion of pathogen results has been updated to include a summary of these results. Other comments provided are consistent with the original discussion of licence monitoring requirements and the May 2020 groundwater monitoring event.

Condition or Section	Summary of Licence Holder comment	DWER response
Section 6.2	WC Disagrees with DWER statement and seeks reassessment. The Rockwater (2008) groundwater model was commissioned prior to the construction and operation of the WWTP. As stated by the decision report the model was developed with limited groundwater monitoring data to calibrate the model and thus there is large degree of uncertainty in the model. Since this model was developed over 10 years of quarterly groundwater monitoring has been conducted at the WWTP. Real world data is a more appropriate measurement of potential impacts than a theoretical model and as the decision report notes no groundwater impacts have been measured down-hydraulic gradient of the WWTP compared to up-hydraulic gradient showing the operation of the WWTP and irrigation pivots is causing groundwater impacts beneath the site.	The Delegated Officer has provided further context regarding groundwater monitoring undertaken since the commencement of Premises operations. Much of this section is still relevant however, as it is a summary of the groundwater model provided to DWER. The model has also not been re-calibrated in consideration of the groundwater monitoring data collected since Premises operations commenced.
Section 6.3	WC Disagrees with DWER statement and seeks reassessment. Incorrect calculation applied to assessment of risk. The average daily irrigation rate used in the equation (1.17 x 106 m^3/day) is wrong by a factor of 1,000, the correct volume is 1.17 x 10^3 m^3/day. The equation used by DWER to calculate area also differs from the equation listed in US EPA (2006) report: A = area (hectares) Q = flow rate of wastewater (m^3/day) Lw = annual hydraulic loading (m/yr) Q = 1.17 x 10^3 m^3/day Lw = 3.1 m/yr (annual evaporation rate) x 0.7 (Rhodes grass crop factor) = 2.17 m/yr Substituting these values into the above equation gives you an Area = 19.7 hectares This shows we have 3 times the area available to irrigate with TWW than required. This contradicts DWERs assessment that there is an increased risk of seepage of nutrients into groundwater and that the hydraulic loading rate is 'high'. The findings of this calculation are supported by the 10 years of groundwater monitoring showing no increase in nitrogen or phosphorus concentrations in groundwater beneath the site.	The Delegated Officer notes that the arrangement of the equation and the irrigation rate used in the calculation was an error and should have been 1.29 x 10^3 m^3/day (1,290 m^3/day). This results in an area requirement of 21.7 ha, which is below the provided irrigation area. DWER have used the area calculation provided on Page 5-3 USEPA (2006) report and not the calculation on Page 10-7 relating to Soil Aquifer Treatment (SAT). Disposal via irrigation is considered to be Slow Rate Land Treatment, as SAT is more equivalent to a direct infiltration scenario. The revised calculation has been provided in Section 6.3 and this has been considered in the Risk Assessment in Section 7.
Section 6.5	WC Disagrees with DWER statement and seeks reassessment. DWER believes that based on the high hydraulic loading rates exhibited in the existing irrigation areas and that proposed for the future expansion areas, the need for fertiliser supplements needs to be re-considered as excess water is likely pushing these nutrients beyond the root zone and potentially increasing the total nutrient loading to groundwater. Due to the wrong hydraulic loading rate calculated by DWER in Section 6.3, the conclusion drawn about nutrients pushing beyond the root zone does not align with the actual operations of irrigation pivots.	As discussed above, the calculation in Section 6.3 was in error, has been revised and the hydraulic loading rate is now considered appropriate for the irrigation area provided. References to reconsidering fertiliser use have been removed and Section 6.5 now just provides context regarding the use of fertiliser at the Premises.
Section 7.1: Table 15 and previous Section 7.2	WC Disagrees with DWER statement and seeks reassessment. The Water Corporation does not agree with the risk event of "Increased potential for partial treatment of wastewater, including inversion of anaerobic and facultative zones with each treatment pond (due to doubling in throughput within same pond capacity)". With regards to DWER comment around the limited understanding of treatment processes when increasing the throughput within the same pond volume will have a reduced treatment capacity please note the following. The existing system (particularly the maturation pond) is conservatively sized which means that better use of the available design area allows increased throughput. In addition, the inclusion of an anaerobic zone in pond 2 brings about over 60% reduction in the influent BOD load to that pond. This is significant in the context of the revised treatment train. Without the addition of this anaerobic zone the increased capacity would be impossible. As also discussed in section 7.2.1 with regards to minor changes in influent quality having an impact on the overall performance is not accurate. Due of their relatively long hydraulic retention times pond systems are particularly good at handling shock loads with little impact on the effluent quality. The DWER risk assessment framework follows the emissions, pathway and receptors model, this risk event refers to odour and increased contaminant loading in final effluent as one risk event which doesn't comply with the framework. As OPAMs investigation showed there will be no increase of odour emissions following the upgrade of the WWTP and no odour impacts have previously occurred at the WWTP, therefore the risk of odour impact is low. The risk event for the irrigation of TWW is covered in Section 7.4, therefore it does not make sense to assess the risk event twice in Section 7.2 as well.	The Delegated Officer has reviewed the context regarding shock loads and seasonal turnover in pond systems. References to the partial treatment of wastewater and throughput capacities have been removed from the risk event. The risk event has been revised to: *Increased potential for seasonal inversion/turnover of anaerobic and facultative zones within treatment ponds* The potential emission, pathway and impact have also been revised to: *Odour*, *Air / wind dispersion* and *Amenity impacts* The Delegated Officer has considered that Pond 1 already contains a deep anaerobic zone as proposed for Pond 2 and notes that no odour complaints relating to the Premises have been received by DWER or the Applicant since operations commenced. The consequence, likelihood and overall risk rating of the risk event have been revised to *slight*, *rare* and *low* respectively. This risk event is no longer needed to be continued to a detailed risk assessment and the section has been removed from the Decision Report. The Delegated Officer concurs that the risks from increased contaminants loadings to groundwater are already addressed through the Pond Seepage and Discharge of treated wastewater via irrigation risk events.
Previous Section 7.2.1	WC Disagrees with DWER statement and seeks reassessment.	As discussed above, the detailed assessment for this risk event has been removed from the

Condition or Section	Summary of Licence Holder comment	DWER response
	Second paragraph – the extrapolation of 2016/17 inflow/outflow data to 3.5 ML/day is not appropriate. As stated by the Water Corporation in the works approval the upgrades to the WWTP will be completed in a staged approach with this application including the installation of a third pivot. Further pivots will be required as inflow volumes increase over the time, however, the staged approach to the upgrade will ensure the nutrient and phosphorus loading limits remain below the licence and NIMP loading limits for TN and TP. Third paragraph – As stated in the works approval, the proposed approved premises production post upgrade is 4.77 ML/day not 7.0 ML/day. The proposed value is based on the disposal capacity of the WWTP post-upgrade as to not exceed the licence and NIMP loading limits. The Water Corporation does not agree with DWERs assessment that the upgrade should correspond to an increase in volumetric sizing of the ponds, as stated above. Minor changes in influent quality having an impact on the overall performance is not correct. Because of their relatively long hydraulic retention times pond systems are particularly good at handling shock loads with little impact on the effluent quality. See comment above relating to modification of existing ponds to achieve required treatment capacity. Fourth paragraph – The Water Corporation does not consider a residence time change from 10.21 days to 10.02 days as a reduction. The Water Corporation does not agree that a change in residence time of approximately 4.5 hours means there is sufficient uncertainty that treatment objectives will consistently be maintained. Please see the attached Broome North WWTP Pond physical and actual processing capacities vs required processing capacities table which summarises the process. As discussed above, in terms of the DWER comment around the limited understanding of treatment processes when increasing the throughput within the same pond volume will have a reduced treatment capacity please note the following. The existing system (particularly the maturation pond) is conservatively sized which means that better use of the available design area allows increased throughout. In addition, the inclusion of an anaerobic zone in pond 2 brings about over 60% reduction in the influent BOD load to that pond. This is significant in the context of the revised treatment train. Without the addition of this anaerobic zone the increased capacity would be impossible. DWER did not provide evidence for how they came to the conclusion that relatively minor changes in incoming water quality could potentially impact sludge/bacteriological populations. Water Corporation believes minor changes in influent quality having an impact on the overall performance is simply not correct. Due to their relatively long hydraulic retention times pond systems are particularly good at handling shock loads with little impact on the effluent quality. The Water Corporation does not agree that treated wastewater quality will deteriorate to that similar to untreated sewage. There is no evidence that the anaerobic and facultative layer will invert, the current WWTP has not had this occur during 10 years of operations. Water Corporation are aware of cold climate systems (examples in New Zealand) being poorly maintained which can show reasonable drops in BOD and nutrient loads through the ponds but did not indicate final effluent to the levels or criteria of raw sewage. Current groundwater operations have demonstrated no impacts to groundwater or potential stock water purposes, this is not considered to change following the upgrade. Section 7.2.3 - The DoH guidelines for the non-potable use of recycled water do not apply to the treatment of wastewater. Section 7.2.5 - The Water Corporation does not believe the assessed risk event follows the DWER framework of the emissions, pathway and receptors model, and therefore an overall risk rating of medium set by the Delegated Office is not accurate. Descriptions of the risk events detailed by DWER in section 7.2.1 should be reassessed before any overall risk assessment be considered.	Decision Report. The risks from increased contaminant loadings to groundwater are already addressed through the Pond Seepage (Section 7.2) and Discharge of treated wastewater via irrigation (Section 7.3) risk events.
Section 7.1: Table 15 and previous Section 7.3 (now Section 7.2)	WC Disagrees with DWER statement and seeks reassessment. The construction of liner will be in accordance with works approval, which includes quality assurance and quality control (QA/QC) plan to be developed prior to installation and approved by DWER. Based on the manufacturing information and the QA/QC controls that will be in place during installation the Water Corporation considers the likelihood of the risk event occurring as rare and the risk to be low.	The Delegated Officer notes that the risk assessment has been undertaken in accordance with the *Guidance Statement: Risk Assessment* (DER 2017). Risk ratings determined under this framework only consider the Applicant's proposed controls and do not take into account additional regulatory controls imposed by DWER, such as the QA/QC documentation review prior to use of Pond 2 that is proposed in the draft Works Approval. The framework also provides a specific risk matrix that is used to determine the final risk rating, based on consequence and likelihood. Under this matrix, if the likelihood was changed to *Rare* this would still result in an overall rating of *Medium* and not *Low* due to the *Moderate* consequence of the event. Notwithstanding the above, the Delegated Officer has revised the assessment of this risk event and provided additional context within what is now Section 7.2. Due to the difference in sensitivity and distance to the potential receptors, separate consequence and likelihoods have been determined for impacts to the beneficial use of groundwater and the environmental values of Dampier Creek. Impact to groundwater beneficial use is considered to have a *Moderate* consequence and *Unlikely* likelihood, while Dampier Creek is considered to have a *Major*

Condition or Section	Summary of Licence Holder comment	DWER response
		consequence and *Rare* likelihood. This results in an overall rating of *Medium* for the risk event.
Previous Section 7.4 (now Section 7.3)	WC Disagrees with DWER statement and seeks reassessment. Section 7.4.1 As per previous comment on Section 6.3 the hydraulic loading-rate of irrigated wastewater is not high and the area available to irrigate is 3 times the applied TWW flow rate and therefore would not result in significant TWW infiltrating through the root zone to groundwater. DWERs assessment in paragraphs 1-5 is based off the wrong assumption the hydraulic loading rate is higher than the crop requirements. Based on the correct hydraulic loading calculation and the 10 years of routine groundwater monitoring showing there is no increase in nitrogen or phosphorus concentrations in groundwater beneath the site, the operation of the WWTP and irrigation scheme is considered not to pose an unacceptable risk. The Water Corporation considers heavy metals and pathogens to have been adequately characterised based of the GHD reports (2020a and 2020b) with long-term monitoring showing no increase in metals or pathogen concentrations in groundwater beneath the site. Broome North WWTP receives wastewater from the same catchment as Broome South WWTP. The Broome South WWTP licence was re-issued in January 2020 did not raise a concern with persistent organic pollutants during the review and did not include it as part of the monitoring program for the WWTP. Although the application of fertilisers has not been fully assessed, the long-term groundwater monitoring at the WWTP has shown no increase in nitrogen or phosphorus concentrations in groundwater beneath the site. Section 7.4.2 As per comment above, DWER refers to wrong assumption that TWW is irrigated in excess of the Rhodes grass crop requirement. As stated by the decision report the model was developed with limited groundwater monitoring data to calibrate the model and thus there is large degree of uncertainty in the model. Since this model was developed over 10 years of quarterly groundwater monitoring has been conducted at the WWTP. Real world data is a more appropriate measurement of potential impacts than a theoretical model and as the decision report notes no groundwater impacts have been measured down-hydraulic gradient of the WWTP compared to up-hydraulic gradient showing the operation of the WWTP and irrigation pivots is causing groundwater impacts beneath the site. The Broome North WWTP operates under management plans including a nutrient irrigation management plan that ensures TWW is irrigated on Rhodes grass in a sustainable manner. Also, groundwater data immediately down-hydraulic gradient of the WWTP and irrigation pivots shows there is no evidence of significant seepage when compared with nutrient, metal and pathogen concentrations in up-gradient bores and with groundwater quality data monitored prior to construction of the WWTP. There is no evidence of a nutrient plume beneath the WWTP and with the controls in place at the Broome North WWTP it is considered highly unlikely groundwater beneath the site will impact down-gradient receptors. Section 7.4.4 As per comment above the Water Corporation does not agree with DWERs assessment that metals, pathogens and POPs are not adequately defined in the current groundwater program. The current Broome South licence which is less than 18 months old and does not include the same list of potential contaminates as this decision report identifies even though both WWTPs are in the same catchment. The TN and TP data provided in the AER is what DWER requires as per the licence conditions. It is interesting to note DWER thinks this data provided in the AERs is of limited value. DWER does not provide a definition of short, medium and long term. WC seeks clarification. Furthermore, WC disagrees with DWER statement and seeks reassessment. **Short term** As per comments above, available evidence suggests seepage is not occurring past the root zone, as shown by the hydraulic loading calculation and groundwater monitoring. In the case of metals and *E.coli* an assessment of long-term data demonstrates no impacts in groundwater beneath the WWTP. **Medium term** As above the Water Corporation does not agree with the assumptions made by DWER in terms of hydraulic loading and characterisation of metals, *E.coli* and POPs in groundwater. DWER implies that the extended duration of irrigation practices a plume of contaminated groundwater is expected to flow off-site, however, there is no evidence of this occurring during that past 10 years of operations and isn't expected to occur based on the	As discussed above, the calculation in Section 6.3 was in error, has been revised and the hydraulic loading rate is now considered appropriate for the irrigation area provided. As a result, the Delegated Officer has revised the risk assessment and provided additional context within what is now Section 7.3. As previously discussed, the Delegated Officer considers that the Premises' contribution to metals in groundwater has not been fully characterised, as trends below the standard trace LOR are not able to be determined. The existing data only shows that Premises operations have not currently resulted in impacts to potential down-gradient beneficial uses of groundwater. Context around this uncertainty has been provided in Section 7.3.7 and needs to be considered when determining the likelihood of the risk event. Groundwater monitoring for pathogen indicators did not take place between 2012 and the 2020 point in time assessment discussed in GHD 2020b. On this basis the Delegated Officer does not consider there to be long term monitoring for pathogens in groundwater during Premises operations. However, the lack of this information is not considered to make a material change to the risk assessment, as the determined consequence and likelihoods for the risk event relate more to nutrients and metals. The Delegated Officer has reviewed information relating to the Broome South WWTP and notes that persistent organic pollutants (POPs) are referred to as potential wastewater contaminants in Section 6.6.3 and individual POPs are referred to in Section 8.6.3 of the Licence Review Decision Report, dated 13 December 2018. The Broome South licence was amended in January 2020 to enact the Minister's Appeal Determination, not re-issued; as a result there was no revision of the December 2018 risk assessment at that time. The amendments were not in relation to persistent organic pollutants. The Delegated Officer considers that inclusion of POPs as a potential wastewater contaminant is consistent with the Broome South risk assessment. Reference to the groundwater model and monitoring data has been removed from what is now Section 7.3.3 (previously 7.4.2). Context around the groundwater model and monitoring has been provided in Section 7.3.7, as discussed above. The statement that TN and TP data provided in the AER is of limited value relates specifically to determining the full load of nutrients applied to the irrigation area, as there is also the application of fertiliser which is not accounted for. Only the TN and TP load discharged through wastewater is reported in the AER. It was not intended to be a general statement that the data is not useful and this has been clarified in the revised Decision Report. The Delegated Officer may consider including fertiliser application rate within AER requirements when the licence is amended after the completion of the proposed works. There is no specific definition for short, medium and long term, however they can generally be considered to be <20, 20-100 and >100 years respectively. This is similar to the durations used in the Primary Industries Volume of ANZECC and ARMCANZ (2002). The Delegated Officer has removed references to short, medium and long term. The terms have been replaced by listing the relevant receptors due to their difference in sensitivity and distance from the Premises. Potential impacts to the beneficial use of groundwater is more relevant in the short to medium term, while potential impacts on the environmental values of Dampier Creek is more relevant in the long term. Separate consequence and likelihoods have been determined for the two receptors based on the information in Section 5.3, 7.3.6 and 7.3.7. Impact to groundwater beneficial use is considered to have a *Moderate* consequence and *Unlikely* likelihood, while impact to Dampier Creek is considered to have a *Major* consequence and *Rare* likelihood. This results in an overall rating of *Medium* for the risk event. References to the *Contaminated Sites Act 2003* and a contaminant plume have been removed from Section 7.3.

Condition or Section	Summary of Licence Holder comment	DWER response
	management practices in place on-site. DWER has not provided any evidence even though 10 years of monitoring data show no events have occurred. It is not appropriate for DWER to infer the WWTP will be considered potentially contaminated site in the future requiring management under the CS Act 2003. There is no evidence of increased contaminants in groundwater beneath the site and all concentrations are below stock water guidelines. This reference to the CS Act 2003 should be removed from the document. **Long term** Long term-discussion issues as above. DWER has adopted an ultra-conservative approach with no evidence outlining their conclusion. Based on the available evidence of 10 years of groundwater monitoring and management plans in place it is not clear how the overall risk rating of high was assessed.	

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

Condition or Section	Summary of Licence Holder comment	DWER response
Comments on revised draft Works Approval W6451/2020/1		
Condition 1 Table 1 Item 1(a)	Amend *Removed sludge must be directed to the Sludge drying beds* and replace with *Removed sludge must be directed to a suitable dewatering facility* The (existing) sludge drying beds may not be large enough to deal with anticipated volume of sludge and the Contractor may use other methods e.g. Geobags or centrifuge. We also cannot use the existing sludge drying bed during the upgrade works as we need to amend the sludge drying bed facility as part of our upgrade. The existing drying beds would not be available for emptying and desludging pond 1 as the filtrate from the existing desludging beds returns to pond 1. Our comment was directed at the sludge removal during the upgrade works where we empty the pond, deepen it, construct the new division wall and remove sludge during that time. The sludge will have to be stored at a "temporary lined storage area" to dry out before it can be tested and disposed of at a suitable facility. Our operational staff regularly undertake such work and this will be a similar operation. Hence we need to use another temporary facility where the sludge can sit for a few months while it dried out and can be trucked away.	The requirement for the sludge drying bed area to be used during desludging for the works on Pond 1 and 2 was included due to a misinterpretation of statements in the application. The reference to a geobag on a specifically lined area north of Pond 1 was thought to have referred to the existing sludge drying beds. The requirement has been reworded to: *(a) Pond 2 must be isolated, drained and de-sludged prior to the commencement of works above the pond liner. Removed sludge must be directed to a lined, temporary sludge drying area which directs all leachate to Pond 1;*
Table 1 Item 1(e)	Amend *A sludge withdrawal pipeline and pump system must be installed…* and replace with *A sludge withdrawal system must be installed…* The pump for sludge withdrawal will not be installed prior to the pond being required for operation and thus conflicts with condition 6. The pump will be installed as a separate later stage which likely has a slight construction delay compared to the Ponds contract. The desludging pipework (in the deep anaerobic pot) and the desludging pump concrete slab will have to be installed during the pond works. The desludging pumps and electrical work will be installed later as part of work that will be undertaken for the WWTP balance works. The balance works contract will include everything else except for the pond works.	Noted. The requirement has been reworded to: *(e) A sludge withdrawal system must be installed and connected to the anaerobic zone. The system must be capable of conveying sludge to the existing sludge drying beds;*
Table 1 Previous Item 2(a) (now removed)	Amend *A liquid polymer dosing system must be installed…* and replace with *A liquid polymer dosing system must be provided…* The liquid polymer system will not be permanently installed and may be (for example) a mobile plant, possibly serving multiple sites or be hired equipment. There are two separate sludge removal activities that will occur. The desludging undertaken as part of the pond civil works will use polymer as required. It is anticipated that the desludging during regular operations will be undertaken only once in two or three months. During the ongoing operations of the upgraded WWTP, we intend to use a portable Polymer dosing system (known in the industry as a poly dolly). This will be brought to site and used to inject polymer into the pipeline conveying the sludge to the sludge drying bed. After the desludging is completed the poly dolly will be either demobilised or stored away in the shed.	The Delegated Officer has considered the provided information relating to the manner in which the polymer dosing system functions during desludging. As this system is somewhat temporary and does not require fixed infrastructure or installation of the equipment, it is more appropriately captured as a process requirement during the subsequent amendment to licence L9094/2017/1. The requirement relating to the polymer dosing system has been removed.
Table 1 Previous Item 2(b) (now removed)	Amend *Pipeline outlets must be installed to allow conveyance of sludge…* and replace with S*ludge pump and pipeline outlets must be installed to allow conveyance of sludge…*	Noted.
Table 1 Previous Item 2 (now removed)	Move entire requirement outside of stage 1 to (for example a new stage 2). The liquid polymer system is mobile equipment as referred to above and sludge pumps are not required for normal operation of the ponds and may be constructed much later than when the pond are required to be operating.	The Delegated Officer has considered the provided information and the proposed changes relating to the sludge drying beds referred to in DWER's responses above. Installation of the pump is considered to be minor work with minimal emission and discharge risk, and the outcome for sludge to be contained in the sludge drying beds is addressed elsewhere in the works approval. The sludge drying beds item and requirements have been removed from Table 1.
Table 1 Previous Item 3: existing pumps and pipelines (now removed)	Delete requirement. The pumps and pipeline described is not required for operation of Pond 1 and may be constructed much later than when Pond 1 is required to be operating. Stage 2 item 6 also appears to be the same equipment. i.e a duplication.	The intent of the infrastructure items and associated requirements was to capture any pipeline reconfigurations that needed to be undertaken prior to operating the pond, which is why this was duplicated in each stage. On review, the Delegated Officer considers that this is addressed more simply through a requirement listed specifically for Pond 1 and 2. The two existing pumping and pipeline system items and requirements have been removed from Table 1 and Table 3. The following requirement has been added to Pond 2: *(h) Existing pipelines must be reconfigured to accommodate the new and modified infrastructure.* The following requirement has been added to Pond 1: *(g) Existing pipelines must be reconfigured to accommodate the new and modified*

Condition or Section	Summary of Licence Holder comment	DWER response
		infrastructure.
Table 1 Previous Item 5(a) (now Item 3(a))	Amend *Removed sludge must be directed to the Sludge drying beds* and replace with *Removed sludge must be directed to a suitable dewatering facility* As above through Item 1(a).	Reasoning addressed above through Item 1(a). The requirement has been reworded to: *(a) Pond 1 must be isolated, drained and de-sludged prior to the commencement of works above the pond liner. Removed sludge must be directed to a lined, temporary sludge drying area which directs all leachate to Pond 2;*
Table 1 Previous Item 5(d) (now Item 3(d))	Amend *A sludge withdrawal pipeline and pump system must be installed…* and replace with *A sludge withdrawal system must be installed…* As above through Item 1(e).	Noted. The requirement has been reworded to: *(d) A sludge withdrawal system must be installed and connected to the anaerobic zone. The system must be capable of conveying sludge to the existing sludge drying beds;*
Table 1 Previous Item 7 (now Item 4)	These tanks will be constructed as part of the "balance works" not the civil pond package.	Noted. This infrastructure has been included in Stage 3 and for clarity has been renamed to: *Treated wastewater disinfection tanks*
Table 1 Previous Item 7(b) (now Item 4(b))	Delete. The existing tank's hardstand are designed as a tank foundation and are not designed to collect spill from the tanks. Thus the existing tank hardstands are not directed to the treatment ponds. It is intended the new tanks be constructed as per the existing tanks. The tanks are not and will not be bunded. However the existing tanks have the overflow from all tanks piped into the pond. The new tanks will be the same. The requirement appears to suggest the concrete hardstand is constructed free of leaks and lined. Further the tanks are GRP and not lined.	The Delegated Officer has considered the information and reviewed the application noting that a hardstand and bunding was not specified for the wastewater holding tanks. This requirement has been reworded to: *(b) Must be provided with an overflow pipeline capable of returning potential overflows to the treatment ponds*
Table 1 Previous Item 7(c) (now Item 4(c))	Delete. The existing tank's hardstand are designed as a tank foundation and are not designed to collect spill from the tanks. In addition the contents of the tank is disinfected (chlorinated) reuse water not leachate.	Noted. Reference to leachate within the requirement was an error and was meant to refer to leaks. The requirement has been reworded to: *(c) Must be installed free of leaks and defects.*
Condition 5(a)	Delete term *Geotechnical* from engineers qualifications requirements. All CCR submitted by industry are developed by specialist engineers who are not necessarily Geotechnical engineers. Also for example refer CQA report from DWER found online, was also signed off by a Waste Engineer.	The definition for geotechnical engineer required the person to have a Bachelor of Engineering recognised by Engineers Australia and have a minimum of five years of experience working in a supervisory area of geotechnical engineering. This can still be achieved by someone who's job title is not specifically geotechnical engineer, such as a waste engineer. Notwithstanding the above, the condition has been reworded to: *5. The Critical Containment Infrastructure Report required by condition 4, must be;* *(a) written and certified by a suitably qualified person who has performed construction quality assurance (CQA) testing on the anaerobic zone GCL installation;* The associated term has been changed from *Suitably qualified geotechnical engineer* to *Suitably qualified person* and the definition has been changed to: *means a person who:* *(a) holds a Bachelor of Engineering recognised by Engineers Australia;* *(b) has a minimum of five years of experience working in a supervisory area of liner construction quality assurance; and* *(c) is an independent third party external to the works approval holder;* *or* *(d) is otherwise approved in writing by the CEO to act in this capacity*
Condition 14 Table 3 Item 4(c)	Amend *Leachate from…* and replace with *Filtrate from…* The dewatered product is better referred to as filtrate due to process involved for example drying beds (if used) filter via a bed of graded sand, geobags filter via the geofabric construction.	No change. As previously stated, DWER uses the more general meaning of the term referring to *water that has drained through a solid and leached out some of the constituents*. The Delegated Officer has reviewed a number of existing category 54 instruments and notes that the term leachate is

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		used in conditions relating to sludge dewatering. This is also the case for the premises' existing licence L9094/2017/1. For consistency with the existing instrument the term leachate will remain.
Table 3 Previous Item 5(b) (now removed)	Delete. The existing tanks hardstand are designed as a tank foundation and are not designed to collect spill from the tanks. Thus the existing tank hardstands are not directed to the treatment ponds. It is intended the new tanks be constructed as per the existing tanks.	Reasoning addressed above through Table 1 previous Item 7(b) (now Item 4(b)). This requirement has been removed.
Table 3 Previous Item 5(c) (now Item 5(b))	Delete. The existing tanks hardstand are designed as a tank foundation and are not designed to collect spill from the tanks. Thus the existing tank hardstands are not directed to the treatment ponds. It is intended the new tanks be constructed as per the existing tanks.	Reasoning addressed above through Table 1 previous Item 7(b) (now Item 4(b)). The requirement has been reworded to: *(b) Overflows from the tanks must be returned to the pond system.*
Comments on draft Decision Report		
Section 3.1 Table 4 Item 1 bullet point 4	Amend *Leachate* to inlet screens slab and replace with *leaks or spills* Leachate is defined as "A leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed". The term "leachate" is not appropriate for the application.	As previously stated, DWER uses a more general meaning for the term leachate. However, in this instance leaks and spills would be a more appropriate term. The text has been reworded to: *Hardstand area designed to return leaks, spills and runoff to the treatment pond system.*
Table 4 Item 6 bullet point 2	Delete *Design to return leachate and runoff to the treatment plant* and replace with *Tanks to be fitted with an overflow designed to return overflow to the treatment plant* The tank hardstands are designed as a support for the tank, not to collected spills. The tank overflow is directed to the ponds.	As previously stated, the requirement for a hardstand was an error. The text has been reworded to: *Fitted with an overflow pipeline designed to return overflow to the treatment plant* Reference to the hardstand was removed and the infrastructure was renamed to: *New treated wastewater disinfection tanks*
Table 4 Item 6 bullet point 3	Amend *Leachate* from tanks and replace with *leaks or spills* The term *leachate* is not appropriate for the application.	As previously stated, the use of the term leachate was an error. The change referred to above removes the term.
Section 3.1	Amend *Pond 1 will be drained to allow works to commence and Pond 2 will be put into service so that the base load treatment can continue* and replace with *Pond 2 will be put into service so that the base load treatment can continue then Pond 1 will be drained to allow works on pond 1 to commence*. The sequence as described was not correct.	Noted. The text has been reworded to: *After the Pond 2 works have been completed, the pond will be put into service so that base load treatment can continue, then Pond 1 will be drained to allow works on Pond 1 to commence.*
Section 3.3 Table 5 Item 1 bullet point 2	Amend *Leachate* and replace with *leaks or spills* The term *leachate* is not appropriate for the application.	Noted. In this instance leaks and spills would be a more appropriate term. The text has been reworded to: *Concrete hardstand area graded to direct leaks, spills and runoff to the treatment pond system*
Table 5 Item 6 bullet point 4	Remove *1:100 year 72 hour* The storage dam design criteria is not for 1:100 year 72 hour. Water Corporation did not state this.	Noted. The Delegated Officer considers this to be an error, as the application and Environmental Assessment Report attached to existing licence L9094/2017/1 refer to a 1:50 year rainfall event over 72 hours. The text has been reworded to: *Capable of containing annual inflows and a 1:50 year 72 hour rainfall event (2% annual exceedance probability)*
Table 5 Item 7 bullet point 1	Amend *Leachate* from sludge drying beds and replace with *filtrate* The term *leachate* is not appropriate for the application.	No change. As previously stated, DWER uses a more general meaning for the term leachate and use of the term in relation to sludge dewatering is consistent with other instruments, including the premises' existing licence L9094/2017/1.

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Table 5 Item 9 bullet point 1	Amend *4 x125kVA diesel generators* and replace with *2 x125kVA diesel generators* There are now 2 new 125kVA generators (installed in Nov 2019) replacing the previous 2x80kVA + 2 x 20kVA (removed from service).	Noted. The text has been reworded to: *2 x 125kVA diesel generators*
Section 6.1 Pg 21	Water Corporation disagrees with DWER statement. DWER states maximum TN recorded down-hydraulic gradient was 43 mg/L, this is incorrect maximum value recorded is 23 mg/L (GHD, 2020a). As stated by DWER, there is extensive nutrient concentration data for groundwater at the site (up to 27 samples per groundwater bore over 9 years). It is not an appropriate way to assess data to just refer to the maximum concentration measured. Long-term medians and trends are more appropriate to use in an assessment of groundwater concentrations. Erroneous concentrations should be attributed to sampling error / laboratory error etc. and not relied upon. This was also previously raised on version 1 of the decision report.	As previously stated in the response to this matter raised on the initial draft, the TN concentration of 43 mg/L was recorded down-hydraulic gradient of the pivot irrigation area at monitoring bore 15/10 in May 2020 and was reported in the 2019-2020 AER. To clarify this, the summary of groundwater nutrient information in Section 6.1 refers to its source being GHD 2020a and the 2019-2020 AER. This section of the Decision Report provides an overview of groundwater nutrient results and accordingly refers to maximum concentrations as well as the median results being within the general range of baseline concentrations, including a summary of trends as reported in GHD 2020a. The Delegated Officer has not relied solely on maximum concentrations when undertaking the assessment.
Section 6.7	Remove *The treatment pond system is designed to contain a 1:50 annual exceedance probability* and *Water Corporation advise the plant is able to contain greater than 1:100 AEP rainfall event…* Storage dam design criteria is not designed for a 1:50 or 1:100 rainfall event.	The Delegated Officer has considered the comment and reviewed the information contained in Section 5.5 of the application's Supporting Information document. As a result, the following revisions to Section 6.7 have been made: Previous paragraph 1 was removed from the report. Paragraph 3 was revised to the following: *Water Corporation maintain that through wastewater treatment occurring within Pond 1 and Pond 2, the entire capacity of the treated wastewater holding dam is available to contain significant volumes of water in the event of high rainfall, and can be maintained to provide maximum air space in the lead up to the wet season. Water Corporation advise that the existing 150 ML treated wastewater storage dam is capable of containing annual inflows, as well as a 1 in 50 year rainfall event of 526 mm over 72 hours. This corresponds to a 2% annual exceedance probability (AEP). In the unlikely event that over flow should occur, the final effluent will be sufficiently diluted so as to have minimal impact on adjacent land.*
Section 8.2.2 Pg 45-46	Water Corporation acknowledges. The Water Corporation appreciate the additional potential controls that could be implemented at the site provided by DWER, however, believe the potential controls provided are not in line with the operational risk and the current operational groundwater data measured at the site. The Water Corporation will consider future appropriate controls based on the management plans provided by our agronomics specialist.	The Delegated Officer notes that in consideration of the revised assessment lowering the risk rating for irrigation of treated wastewater to medium, the full suite of monitoring referred to in the section may not be relevant. The Works Approval Holder should however, prior to submission of the subsequent licence amendment, give consideration to soil pore-water monitoring below the crop root zone at the irrigation area. This will provide more direct information on the potential nutrient inputs to groundwater as a result of the irrigation scheme.