Wastewater Management Options Assessment and Implementation Plan

Hyden Liquid Effluent Pond

Prepared for the Shire of Kondinin

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1 Introduction

Talis Consultants Pty Ltd (Talis) was commissioned by the Shire of Kondinin (the Shire) to undertake an assessment of a Liquid Effluent Pond off Wave Rock Road in Hyden (the Site) to determine if the pond meets the criteria set out by the Department of Health (DoH) in the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974* (the DoH Regulations).

A recent application to add a new toilet and relocate clothes washing facilities within the Wave Rock Caravan Park resulted in the DoH questioning the status of the approvals for the pond, and the current capacity of the pond. This process identified that the pond is located on Crown Land vested to the Shire, and therefore the responsibility of the Shire.

The assessment found that the Liquid Waste Pond (LWP) was mostly non-compliant with DoH Regulations, and significant remediation work will be required for the pond to be compliant. Following from these initial works, an option development and evaluation was undertaken to identify and compare four potential solutions for a compliant wastewater management solution.

1.1 Scope of Report

The report presents a description of the Site and its environmental attributes, outlines the waste generation estimate for the Site under regular operating conditions, the findings of the compliance assessment, Master Plan Designs and Capital Cost Estimate for each option, and assessment of these findings, and presents Talis' Recommendations and Implementation Plan for the Shire. Therefore, the report is structured as per the following sections:

- Introduction;
- Site Description;
- Waste Generation Estimate;
- Compliance Assessment;
- Pond Decommissioning;
- Option Conceptualisation;
- Financial Assessment;
- Option Assessment; and
- Recommendations and Implementation Plan.

2 Site Description

2.1 Site Information

The Site is located approximately 3.5 kilometres (km) east-north-east from the Hyden town centre and is accessed from Wave Rock Road. The pond is located on Reserve 28833, directly northeast of the Wave Rock Wildlife Park, adjacent to the entry road to the Wave Rock Airport and Wave Rock Resort.

2.2 Pond Overview

The pond is a stand-alone effluent pond that accepts effluent wastes from the Wave Rock Wildlife Park, the Wave Rock Caravan Park, Wave Rock Cabins, and the Public Toilets at Wave Rock Car Park. These facilities each have their own septic tank, and only effluent overflow from these tanks are managed within the effluent pond.

It is understood that the pond was constructed in the 1970s, and that any approvals from this time were in hardcopy only and are likely to have subsequently been lost by both the DoH and other stakeholders.

Based on measurements from aerial imagery, observations from the Site visit and assumption of standard design criteria, the general design characteristics of the pond were estimated and are presented in Table 2-1.

Table 2-1: Effluent Pond Design Characteristics

Aspect	Value
Dimensions (m) [Length x Width x Depth]	56 x 35 x 1.8
Side Slope [V:H]	1:3
Catchment Area (m^2)	1,960
Operational Capacity* (m^3)	1,800
Full Capacity (m^3)	2,713

Notes: **The Operational Volume is based on a 500mm freeboard*

The pond has an estimated total operational capacity of 1,800m^3, and a total full capacity of 2,713m^3.

2.3 DoH Regulations

As the DoH have raised questions regarding the integrity of the pond, the assessment of the pond will be undertaken against the DoH Regulations.

Regulation 50(1)(f) outlines that effluent discharged into a waste stabilization pond must have plans, specifications and dimensions which comply with the following conditions:

i) The pond shall have an effective depth of 1.07m unless otherwise approved by the Chief Health Officer; and

ii) The sides shall have a slope of 3:1; and

iii) The bank shall have a minimum width of 2.4m, and shall be raised at least 228mm above natural ground level; and

iv) The inner banks shall be kept clear of weed growth at all times; and

v) All overflow channels and drainage areas shall be kept free of weed growth; and

vi) The pond shall be surrounded with a 1.8m wire mesh fence, with a locked access gate.

2.4 Applicable Guidelines

Though the compliance assessment has been conducted against the DoH Regulations, other commonly applicable guidelines have been considered as part of the assessment of the pond, and in informing the development of the Implementation Plan.

The DWER is responsible for managing and protecting WA's water resources and routinely publishes Water Quality Protection Notes (WQPN) that provide guidance and advice on acceptable practices used to protect the quality of WA's water resources. *WQPN #39: Ponds for stabilising organic matter, February 2009* (WQPN #39) provides advice on the design, construction, and operation of waste stabilisation pond systems (e.g. liquid waste facilities) in WA to ensure effective retention of liquids in the ponds and environmental performance.

Other guidelines considered in the assessment and recommendations include:

- *Western Australian Guidelines for Biosolids Management, December 2012* (WA Biosolids Guidelines);
- *Water Corporation's Design Guideline: Waste Stabilisation Ponds, August 2019* (Water Corp Design Guidelines);
- *DWER Guideline: Odour Emissions* (Odour Guidelines)
- *AS 1547:2012 Onsite Domestic Wastewater Management* (AS 1547:2012)
- *National Airports Safeguarding Framework Guideline C* (Airport Safeguarding Guidelines)
- *Contaminated Sites Act 2003 (WA);*
- *Contaminated Sites Regulations 2006 (WA);*
- *DWER Assessment and Management of Contaminated Sites Guideline 2021* (Contaminated Sites Guideline*); and*
- *DWER Identification, reporting and classification of contaminated sites in Western Australia 2017.*

2.5 Environmental & Social Siting

2.5.1 Zoning and Surrounding Land Uses

The Site and surrounding lots to the south are Recreational Public Purpose Reserves under the Local Planning Scheme. Land to the north and east is zoned as rural, whilst land to the west is an Environmental Conservation Reserve.

The Wave Rock Caravan Park, Wave Rock Cabins, the Wave Rock Car Park and the Wave Rock Wildlife Park are all located within 250m of the Site to the south and southwest of the pond. The Wave Rock

Airport is located approximately 750m north, while the Wave Rock Resort and Lake Magic are located approximately 1km northeast.

2.5.2 Local Climate Data

The local and regional climate data sources utilised in designing the LWP system at the Site include the following:

- Rainfall;
- Temperature;
- Pan Evaporation; and
- Wind.

Local climatic data is typically sourced from the Bureau of Meteorology (BOM) website. The BOM weather station closest to the Site that has a long-term data record (>50 years) is Hyden (Station Number: 010568), approximately 3 km east of the Site. The temperature, rainfall and wind speed data has been sourced from this station. However, due to incomplete long-term records, pan evaporation data has been sourced from the Scientific Information for Landowners (SILO) database. SILO is a database of Australian climate data from 1889 to the present that is hosted by the Queensland Department of Environment and Science (DES). The spatial grid selected (Latitude: -32.45, Longitude: 118.90) encompasses the Site in its entirety.

A 50-year data period was selected to gain a large range of rainfall scenarios whilst maintaining the quality of the data, as the SILO model indicates there are significant limitations on data pre-1957.

2.5.2.1 *Temperature*

The highest mean temperature is 34°C, occurring in January, whilst the lowest mean temperature is 5°C occurring in July and August. Table 2-2-2 shows the average maximum and minimum temperatures at the Hyden station (Station number: 010568) for years 1972 to 2022. The Site experiences a temperate climate, with distinctly dry and hot summers.

Table 2-2-2: Maximum and Minimum Temperatures for the Site (1972-2022)

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max. Temp. (°C)	34	33	30	26	21	18	17	18	21	25	29	32
Mean Min. Temp. (°C)	16	16	14	11	8	6	5	5	6	8	12	14

2.5.2.2 *Rainfall*

The climate is considered to be temperate as per the Köppen classification system used by BOM. The local climate is defined by wet winter and dry summer. Rainfall is erratic with the majority of rain

occurring within the wet season (April to November). The monthly rainfall rates for the Site from 1972 to 2022 for various scenarios are provided in able 2-2-3.

able 2-2-3: Rainfall Data for the Site in Millimetres (1972-2022)

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	21	21	20	25	38	43	46	43	29	23	23	16	344
50th Percentile	15	38	7	7	10	28	61	76	3	23	52	9	329
90th Percentile	74	57	63	54	81	76	74	74	54	49	51	36	470
Highest	208	113	108	63	111	91	93	111	68	101	99	138	559

The mean annual rainfall for the Site is calculated as 344 millimetres (mm) with the highest recorded annual rainfall at 599mm, which occurred in 1991. The 50th and 90th percentile rainfall years recorded a rainfall of 317mm (in 1988) and 472mm (in 1981), respectively.

2.5.2.3 *Pan Evaporation*

The approximate average daily pan evaporation rates for the Site are based on the calculated monthly rates from SILO. Table 2-2-4 outlines the average pan evaporation data, from 1972 to 2022.

Table 2-2-4: Pan Evaporation Average Data for the Site in Millimetres (1972-2022)

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly	314	258	223	146	98	75	76	93	128	189	241	299	1,941
50th Percentile	297	239	207	130	79	59	58	75	111	174	225	280	1,931
90th Percentile	338	277	235	151	101	67	68	91	129	195	251	322	2,109
Highest	345	299	253	171	116	72	86	95	149	211	274	358	2267

The daily average pan evaporation ranges from 2mm to 10mm and monthly from 58mm to 297mm. The total annual pan evaporation rate for the Site is calculated as 1,941mm, more than three times the highest annual rainfall recorded at the Site.

2.5.2.4 *Wind*

Wind speed is measured as the average speed of the wind measured over a ten-minute interval before the time of observation and is measured ten metres above the ground. Figure 2-1 indicates that winds are predominantly easterly and south-easterly in the morning (9am), switching to a westerly direction in the afternoon (3pm). Wind speed generally increases in the afternoon, with average speeds rarely above 20km/h.

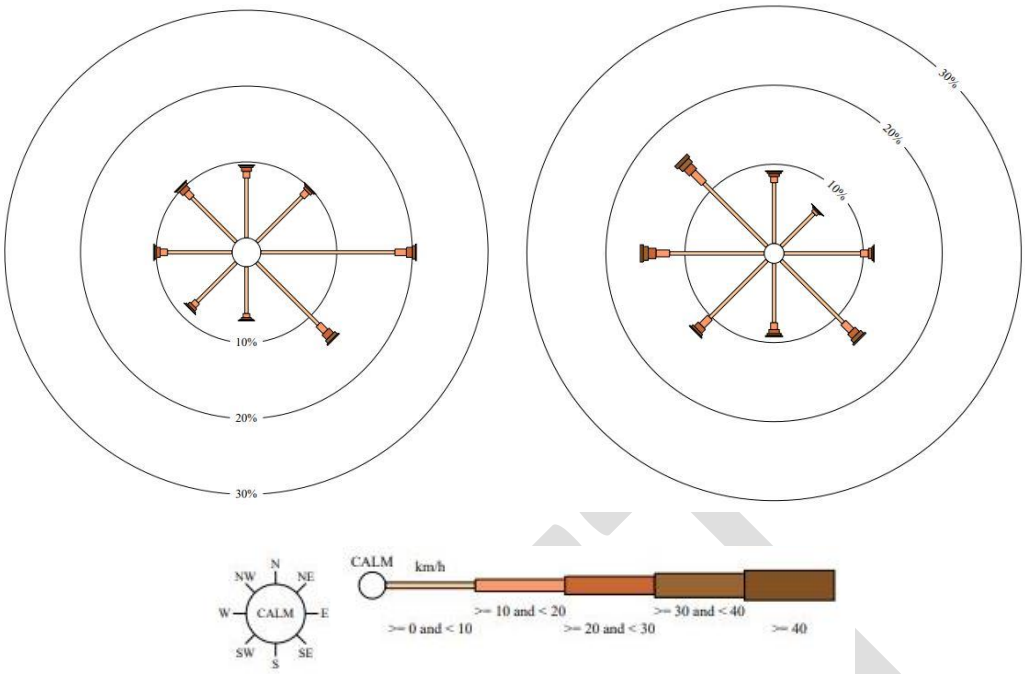

Figure 2-1: Average Wind Rose Data for 9am (left) and 3pm (right)

2.5.3 Geology and Hydrogeology

According to NationalMap (https://nationalmap.gov.au/), the surface geology at the Site is Lunette Dunes, comprising quartz and gypsum dunes and mounds, which may include minor silt, sand, gravel, and clay flats adjacent to playas. Aquifers at the Site are described as local, low productivity, shallow aquifers comprised of surficial sediments. Groundwater quality beneath salt lakes have been recorded at levels greater than 500 mS/m, and acid groundwater with a pH lower than 4 has been recorded southeast of Hyden[1].

Anecdotally, soils surrounding the Site are generally low permeability, and groundwater is shallow in the vicinity of the Site. Figure 1 in Appendix A shows the surface geology at the Site.

2.5.4 Surface Water

The Camm River is located immediately north of the Site, and the pond is located approximately 20 metres from a channel hydrography zone connected to the river.

The Camm River is a major tributary of the Lockhart River, comprised of a large number of salt-lake chains that flow only during wet years. Water in the Camm River is saline, and the system typically experiences very low flow due to the shallow falls across its length.

The Site is also located near Hyden's drinking water catchment, which is located both topographically and hydraulically upgradient from the Site atop Wave Rock.

Figure 1 in Appendix A shows the key hydrological features at the Site.

[1] *Waterway assessment of the Camm River: Lockhard River confluence to Hyden*, Department of Water, December 2009

2.5.5 Aboriginal Heritage Sites

A search of the DATA WA's Aboriginal Heritage Places dataset identified that the Site is located in Wave Rock Scarred Tree (S02824) under the 'Artefacts' types of Aboriginal Heritage places, though this Site is not under the protected sites category. The Aboriginal Heritage Place named as "Wave Rock" (Object ID 17032) is adjacent to the Site to the west.

Two more Aboriginal sites are present on the opposite side of the Wave Rock Rd in the south of the Site which are 'Hippos Yawn' (Object ID 4947) and 'Hyden Rock' (Object ID: 5931). All of the four Aboriginal Heritage sites are under non-protected sites.

Figure 2, in Appendix A, highlights the aboriginal heritage aspects for the Site and surrounding areas.

2.5.6 European Heritage Sites

A search of the Heritage Council WA – Local Heritage Survey dataset identified no known European or post-colonial heritage values within the Site.

Four heritage places were identified to the southeast of the Site, including the Hyden Golf Club, Hyden Rock Dam, the Original Hyden Townsite, and Wandilla. These are shown in Figure 2, available in Appendix A.

2.5.7 Flora and Fauna

2.5.7.1 *Threatened and Priority Fauna*

A search of the Protected Matters Search Tool database indicated that there were several fauna species identified present within a 2km buffer area surrounding the pond, as described in Table 2-5.

Table 2-5: Threatened and Priority Fauna

Presence	Species ID & Name	Threatened Category
May	*Calidris ferruginea* (Curlew Sandpiper)	Critically Endangered
Known	*Zanda latirostris* (Carnaby's Black Cockatoo, Short-billed Black-cockatoo)	Endangered
May	*Pseudomys shortridgei* (Heath Mouse, Dayang, Heath Rat)	
May	*Myrmecobius fasciatus* (Numbat)	
May	*Falco hypoleucos* (Grey Falcon)	Vulnerable
Known	*Leipoa ocellata* (Malleefowl)	
Likely	*Aphelocephala leucopsis* (Southern Whiteface)	
Likely	*Phascogale calura* (Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor)	
May	*Dasyurus geoffroii* (Chuditch, Western Quoll)	

2.5.7.2 *Declared Rare and Priority Flora*

The Protected Matters Search Tool's Threatened Species Database was used to identify any rare or priority flora present within or around the Site (Figure 12). There were eight records of declared rare or priority flora being present within a 2km buffer area surrounding the pond.

The species that have been identified around the Site are shown in Table 2-6.

Table 2-6: Rare and Priority Flora

Presence	Species	Threatened Category
May	*Verticordia staminosa var. cylindracea* (Granite Featherflower)	Endangered
	Acacia lanuginophylla (Woolly Wattle)	
	Grevillea involucrata (Lake Varley Grevillea)	
Likely	*Eremophila verticillata* (Whorled Eremophila)	
	Caladenia graniticola (Pingaring Spider-orchid, Granite Spider-orchid)	
	Roycea pycnophylloides (Saltmat)	
	Tribonanthes purpurea (Granite Pink)	Vulnerable
May	*Banksia sphaerocarpa var. dolichostyla* (Ironcaps Banksia, Ironcap Banksia)	

2.5.7.3 *Threatened and Priority Ecological Communities*

A search of the Protected Matters Search Tool's Threatened Ecological Communities (TECs) database indicated that TECs may be present at the Site or within the potential Site boundary, as shown in Figure 3 within Appendix A. The likely TEC to occur is Eucalypt Woodlands of the Western Australian Wheatbelt, which falls under the Critically Endangered status.

3 Waste Generation Estimate

To provide an estimate of the waste generation at the Site, the DoH's *Supplement to Regulation 29 and Schedule 9 – Wastewater system loading rates* were utilised. The key loading rates relevant to upstream generators were as follows:

- Caravan Park (tent site or caravan park bay): 140L/person/day
- Caravan Park (3-bedroom chalet): 761L/dwelling/day
- Factories & Shops (café staff): 70L/person/day
- Public Building (café sit in customers): 30L/person/day
- Public Building (infrequent use): 10L/person/day
- Food Premises/Food Production (wastewater generated from cooking and food production operations, excludes loading for sit-in customers): System owner to propose wastewater/liquid waste hydraulic loading. Hydraulic loading must be based on peak flow events and implement controls (wastewater metering or maximum capacity limits)

A summary of generators upstream of the pond and the key generating infrastructure has been summarised in Table 3-1.

Table 3-1: Upstream Generators Infrastructure Summary

Site	Key Infrastructure	Throughput
Wave Rock Caravan Park	Camping & caravan sites, communal and ensuite bathrooms, offices, caretaker residence & clothes washing facilities	800 guests per day (peak maximum capacity)
Wave Rock Cabins	Cabins with bathrooms	6 x 3-bedroom cabins
Wave Rock Café & Wildlife Park	Café kitchen, patron toilets	3 staff 200 patrons
Wave Rock Public Toilets	New and old toilet blocks	130,000 visitors per annum

Assuming that 10% of generated wastewater is solid material trapped within the septic tank system, a summary of the peak daily effluent generation for the pond is shown in Table 3-2.

Table 3-2: Peak Daily Effluent Generation Summary

Aspect	Peak Daily Throughput	Loading Rate (L/day)	Daily Effluent Generation (m^3)
Wave Rock Caravan Park - Patrons	800	140	101
Wave Rock Caravan Park - Caretaker	4	140	0.50
Wave Rock Caravan Park - Offices	2	70	0.13
Wave Rock Cabins	6	761	4.12
Wave Rock Café - Staff	3	70	0.19
Wave Rock Café - Patrons	200	30	5.40

Aspect	Peak Daily Throughput	Loading Rate (L/day)	Daily Effluent Generation (m^3)
Wave Rock Café - Kitchen	1	3000	2.43
Wave Rock Public Toilets	357	10	3.21
		TOTAL	**117**

The peak generation rate of 116.8m^3/day is assumed to occur over the 3-day Wave Rock Weekender Festival, which typically occurs in September each year.

To estimate the effluent generation during standard operations it is assumed that the standard generation rate is 20% of the peak generation rate. Additionally, an increased generation rate has been estimated to account for generation rate expected over school holidays. This school holiday rate has been assumed as 50% of the peak generation rate.

A model of wastewater generation over the course of the year was developed with consideration given to the different generation rates and the times at which they occur. A breakdown of the days and the corresponding generation volumes are shown in Table 3-3.

Table 3-3: Estimate of Daily Capacity and Generation Volumes

Generation Scenario	Capacity	Days	Daily Generation (m^3)	Generation m^3/Year
Standard Operation	20%	264	23	6,165
School Holidays	50%	97	58	5,663
Peak (Wave Rock)	100%	4	117	467
			TOTAL	**12,296**

A summary of the estimated monthly effluent generation volumes is shown in Table 3-4.

Table 3-4: Estimate of Monthly Effluent Generation Volumes

Generation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Effluent Generation (m^3)	1,810	654	829	1,261	724	771	1,214	724	1,284	934	701	1,390

4 Compliance Assessment

The following sections outline observations from the Talis Site visit, highlighting where elements of the pond deviates from regulations and best practice guidelines, or represents risk for the Shire.

4.1 Compliance with DoH Regulations

Talis Staff attended Site to inspect the pond on the 11th of August 2023, and the assessment of compliance against the DoH regulations has been summarised in Table 4-1.

Table 4-1: Summary of Compliance with DoH Regulations

Regulation	Description	Comments
50(f)(i)	The pond shall have an effective depth of 1.07m unless otherwise approved by the Chief Health Officer; and	Pond depth could not safely be established by visual inspection, design drawings note depth of 1.8m.
50(f)(ii)	The sides shall have a slope of 3:1; and	Internal and external pond batters appeared steeper than 3:1 (V:H).
50(f)(iii)	The bank shall have a minimum width of 2.4m, and shall be raised at least 228mm above natural ground level; and	The pond edge is raised above ground level, providing compliance with the bund height. Bund width varied across the pond, however the southeastern edge appeared thinner than the required width.
50(f)(iv)	The inner banks shall be kept clear of weed growth at all times; and	The inner banks had significant vegetation growth, including a tree and well-established bushes.
50(f)(v)	All overflow channels and drainage areas shall be kept free of weed growth; and	No determinable overflow from the pond was established, however vegetation was found on the external banks of the pond.
50(f)(vi)	The pond shall be surrounded with a 1.8m wire mesh fence, with a locked access gate.	Pond surrounds are partially fenced, however not fully fenced and locked

Overall, the pond was mostly non-compliant with the DoH Regulations, and significant remediation work would be required to bring the pond into compliance. Of particular concern is the stability and integrity of the pond. During inspections, Talis observed crumbling of the interior banks, potentially due to wind-driven waves. Extensive well-established vegetation, and a thinning of the bank in areas also contributed to the loss of integrity of the pond, with evidence of water and nutrient leakage particularly noticeable along the eastern extent of the pond.

A summary of photos taken during the Site visit identifying key issues with the pond has been provided in Appendix B.

4.2 Compliance with Applicable Guidelines

Though compliance with the DoH Regulations is critical, consideration should be given to the best practise guidelines for other siting, design, and operational aspects of the pond. WPQN #39 has been used to assess these other elements for the pond.

The siting of the pond is a key factor, with the WQPN #39 recommending that a separation distance of 250m from public places should be maintained. The pond does not currently comply with this separation, with the Wave Rock Café & Wildlife Park, Wave Rock Cabins, and the Wave Rock Caravan Park all within that buffer zone, with the Wave Rock Café only 90m from the LWP.

The WPQN #39 also recommends several design features, including a low permeability liner with a permeability less than 10^{-9}m/s, and an emergency overflow weir to ensure the pond isn't damaged if it overtops. Embankment armouring is also recommended for protection against wave action in ponds with surface dimensions greater than 25m. Though the pond was observed to be constructed from a clayey material, the integrity of the liner is unlikely to be meeting this performance specification due to the presence of trees and shrubs growing in the pond, and the erosion of the internal pond banks. Damage to banks from may also be, in part, due to the lack of emergency overflow from the pond, as well as the lack of embankment protection.

Design of the pond, including a water balance assessment, is recommended within WPQN #39 to ensure that the pond does not overtop from either pond loading nor from regular rainfall events. A multi-stage pond system is also discussed within WPQN#39 to assist in the treatment of pathogens and reductions in nutrient loading. Implementation of a multi-pond system could be considered at the Site to improve water quality and environmental outcomes at the Site.

There are a number of operational factors that are also recommended by WPQN #39, including regular inspection of the pond, inlets and outlets, erosion control measures, management of vegetation, and environmental monitoring of pond water quality, odours, and seepage from the pond. Talis understands that the pond does not currently have a regular inspection or maintenance schedule, and this would help result in the early identification and rectification of any issues in the future.

5 Pond Decommissioning

Prior to the implementation of the preferred option, the existing Liquid Waste Facility (LWF) at the Site needs to be decommissioned, ensuring safe and appropriate removal and disposal of the facility's infrastructure.

The LWF consists of the following key infrastructure elements, all of which will need to be removed for complete decommissioning:

- One unlined LWP;
- Conveyance network; and
- Fencing.

The process for decommissioning the existing LWF has been considered as the same for all options and is described below.

5.1.1 Liquid Waste Pond

The existing LWP is 56m long, 35m wide, 1.8m deep, with steeper than 1:3 (V:H) side slopes. The effluent in the LWP will be collected through the use of a controlled waste liquid vacuum truck and discharged to an appropriate facility.

Once sludge in the LWP has been sufficiently dewatered a loader will be used to remove the sludge to be stockpiles onsite and tested to determine an appropriate disposal method. Sludge will be loaded onto a dump truck and sent to a suitable landfill for disposal.

As the existing pond is not expected to have a lining system decommissioning the LWP will entail the ripping and removal of the embankments and basal layer, to ensure rainwater infiltration can return to normal stasis with no ponding of surface water.

Earthworks are required to access the base of each pond since the side slopes are too steep for any earthwork equipment. The basal layer must be removed via an excavator or similar earthwork equipment to expose the base of each pond. All decommissioned materials need to be loaded onto a dump truck or flatbed truck and transported to an appropriate landfill facility for disposal.

5.1.1.1 *Soil Testing*

The Site has been used for a potentially contaminating land use; sewage / wastewater treatment as listed in Appendix B of the Contaminated Sites Guideline. Therefore, decommissioning works will look to segregate soils that are in direct contact with the lining system and or show evidence of impact (i.e., are stained or odorous). These should be sampled and tested to confirm the waste classification of the material. This testing process allows for the segregation the various components, ensuring materials are disposed of in the correct and most effective manner.

Soil samples should be collected from the mass of soils to be exported from Site in alignment with the sample frequency outlined in Section 6 of the Landfill Waste Classification and Waste Definitions 1996. Soil samples should be analysed for the following suite of analytes which are in line with the typical contaminants of concern for a sewage / wastewater treatment plant as listed in Appendix B of the Contaminated Sites Guideline:

- Nutrients (e.g., nitrogen, phosphorus);

- Metals (e.g., aluminium, arsenic, cadmium, chromium, cobalt, lead, manganese, nickel, potassium, zinc);
- Per- and polyfluorinated alkyl substances (PFAS);
- Phenols; and
- Pathogens (e.g., E. coli, Enterococci).

Following the initial removal of the liquid waste facility's underlying soils, the exposed soils should be tested to verify that there are no contaminated soils remaining. An Environmental Consultant should undertake a walkover and field screening of the cleared area undertaking an inspection to ensure no impacted material remains in place across the footprint of the decommissioned facility.

5.1.2 Conveyance Network

There is an existing network of pipework of that connect the septic tanks to the LWP. Earthworks will be required to expose the underground pipework. All decommissioned materials will need to be loaded onto a dump truck or flatbed truck and transported to a licenced landfill facility for disposal.

Due to the difference in option locations and types the extent of pipe network removal cannot be defined.

5.1.3 Fencing

The LWP is partially surrounded by fencing. This fencing will need to be disassembled ahead of reuse or disposal.

5.1.4 Rehabilitation Strategy

Following the completion of the decommissioning works the final task will be the completion of the rehabilitation across the remediated Site surface. Reprofiling of the void spaces left following the decommissioning of the LWF should be completed as soon as possible following validation.

Talis reccomends that the landform is constructed such that it blends in to the natural surroundings so as not to compromise the long-term amenity of the area as well as ensuring it adequately promotes vegetation development consistent with the natural area. Additionally, the reprofiling design should ensure surface water management during stormwater events will not lead to erosion or scouring from surface water flow.

6 Option Conceptualisation

The assessment of the existing system undertaken under Talis' original scope of works, found the pond was mostly non-compliant with the DoH Regulations, and significant remediation work would be required to bring the pond into compliance. Following the Site visit, Talis engaged with multiple stakeholders to develop a number of potential options for management of effluent at the Site.

Talis has developed high-level conceptual designs and costings for four options which were confirmed with the Shire at the Project Initiation Meeting. The options include:

- Option 1 – Current Location Rebuild

  This will involve decommissioning the current facility, and constructing a new pond system in the same location;

- Option 2 – Mound Land Application

  Decommissioning the current facility, and replacing the pond system with a standalone system for the Shire's Public Toilets;

- Option 3 – Disposal to Water Corporation Facility

  Decommissioning the current facility, and installing a pumped system to the Water Corporation's facility closer to Hyden; and

- Option 4 – Rebuild at Airport

  Decommissioning the current facility and installing a new pond system adjacent to the airport.

A masterplan layout of the four options is presented in Figure 4 in Appendix A.

6.1 Option 1 – Current Location Rebuild

6.1.1 Concept Design

The Liquid Waste Facility (LWF) will consist of three (3) ponds and has been designed in compliance with WQPN #39. The ponds would be located approximately 100m to the east of the existing pond. This new position has been chosen as it is at a higher elevation level. The LWF will be located 250m northeast of the Wave Rock Wildlife Park. Effluent from septic tanks will enter the ponds through an extension of the existing pipe network. Sunlight and oxygen naturally biodegrade the incoming organic matter and evaporation reduces the volume of liquid waste in the pond system.

The ponds will be lined with an effective depth 1.07m and a slope of 1:3, which covers a total area of approximately 17,525m^2, ensuring compliance with the DoH Guidelines. The surrounding banks will be designed with a width of 4m and will feature embankment armouring. The ponds will be surrounded by 1.8m wire mesh fence with a locked access gate.

The proposed lining system for the ponds is as follows:

- 300mm thick Compacted Subgrade Layer;
- 2mm High Density Polyethylene (HDPE) Double-Textured Geomembrane;
- Protection geotextile; and
- 150mm thick road base layer.

To mitigate the potential for any stormwater ingress the crest of the ponds will be elevated above the existing ground level, sloping away from the top of the pond.

The basic design characteristics of the ponds are presented in Table 6-1 and are in accordance with the WQPN #39.

Table 6-1: LWF Design Characteristics

Evaporation Pond	Dimensions [L X W X D] (m)	Side Slopes [V:H] (m)	Operational Volume* (m^3)	Total Volume (m^3)
Pond 1	75 X 70 X 1.5	1:3	4,419	6,937
Pond 2	75 X 70 X 1.5	1:3	4,419	6,937
Pond 3	75 X 70 X 1.5	1:3	4,419	6,937
		Total	**13,257**	**20,810**

** Operational Volume is considered to be at 500mm freeboard from pond crest.*

A water balance model was developed to demonstrate that the ponds can evaporate the accumulated liquid waste every calendar year. The model considers long term trends in waste generation data as well as weather patterns. The water balance model can be found in Appendix C.

The water balance shows that there are also monthly periods in which the evaporation pond is theoretically empty, allowing maintenance to occur. In addition, since there are three evaporation ponds, one pond can undergo maintenance works without interruption to the sullage's facility's services.

6.1.2 Operational Requirements

6.1.2.1 *Maintenance Requirements*

The LWF inspection and maintenance schedule should include observations of pond conditions, managing surface scums, and performing stabilization tests. Maintenance will be required for inlet and outlet pipework, including regular inspections to prevent blockages. Erosion control measures should be implemented for outer and inner pond to maintain condition. Security measures such as fencing, and sign posting should be regularly maintained to deter intruders and animals.

6.1.2.2 *Monitoring Requirements*

Effective pond management requires weekly monitoring. Assessments involve observing the appearance of pond waters, including colour, gas bubbling, and floating matter. Documentation should be used for capturing maintenance actions in response to events like rainfall, equipment malfunctions, containment breaches, pipe blockages, and issues erosion. Inspections of pond embankments for seepage and erosion should be conducted. Pond input and output volumes should be monitored, as well as organic loading parameters such as biochemical oxygen demand and suspended solids.

Pond performance should be analysed twice yearly, assessing pH, electrical conductivity, biochemical oxygen demand, suspended solids, and nutrient levels at both inlet and outlet points. Groundwater quality monitoring should be completed to measure water tables and quality variations.

6.1.3 Environmental Risk

The following section describes how the infrastructure can affect the environmental siting discussed in Section 2.5.

The Site has low productivity, shallow aquifers comprised of surficial sediments. Some potential environmental risks include:

- If the LWPs are not properly lined or leakages occur from the LWP can result in contaminants leaching into the soils and groundwater at the Site.
- Runoff from the LWP, particularly during heavy rain or flooding events, can carry pollutants into nearby surface water bodies, leading to contamination of soils and groundwater at the Site.
- There is the potential for unpleasant odours to be generated by the LWPs, potentially impacting nearby receptors.
- The proximity of the LWPs to the buffer zone of threatened and priority fauna increases the risk of adverse effects on these species.

6.1.4 Reputational Risk

The environmental and cultural risks associated with the Site could pose significant reputational threats to the Shire, particularly due to its vicinity to a significant tourism site. Potential impacts to the natural environment or aboriginal heritage sites in the area could negatively affect Hyden's image as a tourist destination. When considering the proximity to the Wave Rock tourist site and related businesses, these receptors can be negatively impacted if the LWF produces unpleasant odours.

Contaminants leaching into the groundwater may not only contaminate local groundwater resources, but also raise concerns among tourists about the overall environmental health of the region. Degradation in water quality could affect local ecosystems, as well as impact agriculture and industry, potentially impacting Shire residents in addition to the tourist population.

6.1.5 Statutory Compliance

6.1.5.1 *DoH Regulations*

The LWF has been designed to meet the conditions outlined in the DoH Regulations, as outlined in Table 6-2 below.

Table 6-2: Summary of Compliance with DoH Regulations

Regulation	Description	Comments
50(f)(i)	The pond shall have an effective depth of 1.07m unless otherwise approved by the Chief Health Officer; and	Ponds have been designed with an effective depth of 1.07m.

Regulation	Description	Comments
50(f)(ii)	The sides shall have a slope of 3:1; and	Internal and external pond batters have been designed with a slope of 3:1.
50(f)(iii)	The bank shall have a minimum width of 2.4m, and shall be raised at least 228mm above natural ground level; and	Banks have been designed to a width of 4m, and are raised more than 228mm with additional bunding surrounding ponds.
50(f)(iv)	The inner banks shall be kept clear of weed growth at all times; and	The HDPE liner will prevent the growth of any weeds.
50(f)(v)	All overflow channels and drainage areas shall be kept free of weed growth; and	Maintenance and monitoring regime will ensure the prevention of weed growth.
50(f)(vi)	The pond shall be surrounded with a 1.8m wire mesh fence, with a locked access gate.	Ponds have been designed with a 1.8m wire mesh fence and a locked access gate.

6.1.5.2 *WPQN #39 Compliance*

Table 6-3 below shows the WPQN #39 design recommendations and correlated design feature for the ponds.

Table 6-3: Summary of Compliance with WPQN #39 Recommendations

Recommendation	Description	Comments
1	Locations that should be avoided include hard-rock, karst, seismic fault or drainage lines, peat beds, wetlands, shallow groundwater tables (within one metre to the base of the pond liner), seasonal flood-ways, disturbed soils where differential soil settlement is likely, contaminated material dumps, and designated ethnographic or heritage sites.	Ponds have been designed on a shallow ground water table, with seasonal flood-ways, though are located in an area offering localised protection from flooding.
2	To limit occasional odour impacts from ponds, buffer zones to public places and residences should exceed 250 metres. Pond designers should consider the prevailing wind direction and, if practical, locate ponds downwind from odour-sensitive sites.	Closest residence is approximately 250m away. Closest public place, the Wave Rock Café, is approximately 190m away.
14	A minimum freeboard of 400 millimetres is recommended to contain incidental rainfall and wave action. If practical, orientate longest side of pond at right angles to the prevailing wind to limit wave-caused erosion. Higher freeboards or controlled release	Freeboard is designed to be 500mm, and the HDPE-liner will prevent any erosion caused by wind-driven waves.

Recommendation	Description	Comments
	structures may be required in extreme rainfall zones, such as in tropical areas.	
24	All ponds should have security fencing to prevent inadvertent access by people and animals.	1.8m security fencing is included in design.
27a	Facultative pond water depths range from 120 to 200 centimetres	Pond depth is designed as 150cm.
27h	For ponds with surface dimensions exceeding 25 metres, embankment armouring against wave action is recommended. Stone rip-rap, 'gunite', 'shotcrete' or similar may be used	Embankments have been designed to include armouring.

6.2 Option 2 – Mound Land Application

6.2.1 Concept Design

A Mound System has been assessed to overcome the soil and Site conditions limiting the application of effluent to land. The system has been designed in accordance with AS 1547:2012. The mounds will consist of pressure-dosed sand filters that lie above the soil surface and discharge directly to natural soil.

The Mound System has been sized to only account for the effluent generation of the public toilets, at an estimated peak of 5.6m^3 per day. The system will consist of six mounds covering a total area of 1,120m^2. Each mound will be 19.65m in length, 9.65m wide at the base, and 1.28m tall. The mounds will have a slope of 1:3 (V:H), making the width at the top of the mound 1.6m. The Mound System sizing estimate can be found in Appendix D.

The key elements of the mound system are:

- Dosing chamber;
- Perforated distribution pipe; and
- Elevated mounds with:
  - Ploughed basal layer;
  - Sand fill media;
  - Distribution bed of coarse aggregate; and
  - Topsoil and native vegetation.

The mounds will be established in parallel lines that will follow the contours of the Site topography. Bunding will be implemented upstream of the Mound System to mitigate surface water from encountering the area, maintaining the systems hydraulic efficiency.

6.2.2 Operational Requirements

6.2.2.1 *Maintenance Requirements*

Maintaining a Mound Land Application System involves regular inspections which should be tracked through maintenance logs. A contingency plan, accompanied by a troubleshooting guide, is essential, outlining emergency actions and contact details in the event of unexpected system failures. The maintenance regimen extends to various components, such as vegetation management to preserve the integrity of the mound, regular inspections of the mound structure, and upkeep of distribution and pump systems.

6.2.2.2 *Monitoring Requirements*

Ensuring the effective operation of a Mound System requires a monthly monitoring. Soil moisture levels should be closely observed to determine the system's hydraulic efficiency, while vegetation and effluent quality monitoring ensures compliance with environmental standards. Groundwater monitoring is necessary to assess the potential impact on local water resources.

6.2.3 Environmental Risk

Potential environmental risks associated with the Mound System could include:

- The construction and operation of a mound system may pose a risk of contaminating groundwater, effluent from the mound system can carry pollutants that impact the groundwater quality, and the mound system has no lining system to minimise groundwater infiltration;
- Runoff from the Mound System can carry contaminants into nearby surface water bodies;
- Odours may develop should the mound be operated incorrectly; and
- In areas with low productivity and shallow aquifers, there's an increased risk of nutrient leaching, potentially reaching groundwater or nearby surface water.

6.2.4 Reputational Risk

Degradation of water quality may impact the town's image as an attractive destination, thereby deterring potential visitors. Furthermore, the risk of water contamination raises alarms about the health and ecological integrity of local water bodies. This could lead to negative perceptions regarding the town's reputation as a tourist-friendly and environmentally conscious destination.

Additionally, as this option only considers effluent generated by the Shire's operations in the area, an additional management measure will be required to maintain effluent generated from the other businesses in the area. As the implementation of that solution is beyond the control of the Shire, consideration may not be given to some of the factors outlined in this report, which could lead to additional environmental, or cultural impacts, with the potential to impact the Shire's reputation.

6.2.5 Statutory Compliance

The Mound System will need approval from the Chief Health Officer as the system isn't included in the apparatus described within the DoH Regulations.

6.3 Option 3 – Disposal to Water Corporation Facility

6.3.1 Concept Design

This option involves the disposal of effluent to the Water Corporation's Septage Tank Effluent Disposal (STED) sewer network. The Site is outside of the STED scheme sewer district boundary and Water Corporation has established that there are no plans to expand the current boundary and has expressed no interest in managing private infrastructure. Given the location outside the sewer district, a conveyance system with a private pump station would be necessary to connect to the STED. The Shire, as the owner of the crown vested land, would be responsible for owning and managing this pump station.

The conveyance network would consist of DN80 high pressure mains and a private pump station. The network would be approximately 4,000m in length and be installed along surrounding roads at a depth of 1.2m, connecting to the STED sewer network through existing shaft AD4846 on Lynch Street. Water Corporation has the capacity to accept effluent at a rate of 2 L/s. The pump design should consider the required discharge rate, the elevation and pressure losses along the routing of the pipeline.

Water Corporation has confirmed that the conveyance system would need to include emergency storage capabilities, which could possibly be attained within the existing septic tanks. Additionally, there are maintenance requirements and annual fees associated with maintaining the connection. Water Corporation has noted the need for hydraulic plans and an estimated capacity to ascertain whether the Site is suitable for the STED system.

Prior to discharge the Shire would be required to acquire a trade waste permit. This process would involve the following:

- Completion of a Trade Waste Application Form;
- Confirmation of eligibility, pump rate and discharge location;
- Provision of sewerage detention time in pressure main (not to exceed 24 hours);
- Provision of site hydraulic drawings;
- Completion of a grease arrestor assessment by Water Corporation; and
- Approval of Pre-treatment devices by Water Corporation.

6.3.2 Operational Requirements

6.3.2.1 *Maintenance Requirements*

Maintaining the pipe network will involve maintenance of pump station and conveyance network. Testing and calibrating the control system will be required to ensure accurate readings, while inspecting electrical components. Routine testing of the emergency bypass system and the removal of any debris from the pump station and pipeline are required to maintain the system function.

6.3.2.2 *Monitoring Requirements*

Ensuring the performance of the network requires regular inspection and monitoring. Visual inspections of the pump station, encompassing pumps, valves, and control equipment, should be undertaken at least weekly to identify any indications of wear, corrosion, or damage. Monitoring pump performance, including flow rates, pressure levels, and power consumption, should also be

undertaken on a continual basis to detect any irregularities and allow rapid response to any emergency issues.

Inspections of the entire pipeline are necessary to identify potential issues such as leaks, or physical damage. Weekly visual inspections should be undertaken along the length of the pipeline to identify if any damage or leaks are occurring. Periodic inspections via leak detection equipment or pressure testing should be undertaken to evaluate the total system integrity at a reduced frequency.

6.3.3 Environmental Risk

Potential environmental risks associated with the pipeline could include:

- The potential for accidental spills or leaks along the pipeline route poses a risk of contamination of surrounding soils and groundwater.
- The installation of the pipeline may result in soil disturbance, leading to increased erosion and sedimentation in nearby water bodies.

Talis notes that this option presents a reduced environmental risk for the Shire when compared to other options. This is attributed to the fact that once the effluent is released into Water Corporation's jurisdiction, the responsibility is subsequently transferred to Water Corporation.

6.3.4 Reputational Risk

The environmental and cultural risks associated with the installation and operation of a pumping system to transport effluent is likely to pose a reduced risk for the Shire comparted to other options explored.

The disruption of natural environment resulting from construction activities and remaining infrastructure may impact the scenic appeal of the town. Additionally, noise and vibration disturbances from the operation of pumps may result in noise pollution.

6.3.5 Statutory Compliance

There are no statutory requirements for the conveyance network and pump station, however the system will need to comply with Water Corporation discharge requirements and monitoring requirements as per Trade Waste Agreement between parties. Additionally, the system should meet criteria outlined in Water Corporations *Wastewater Private Pumping Stations Guidance Note* and *Design Standard DS 51.*

6.4 Option 4 – Rebuild at Airport

6.4.1 Concept Design

The LWF will be relocated to a new location, at the Airport approximately 1 km north from the original Site. The design of the LWF will be the same as Option 1, with minor adjustments based on the characteristics of the Site, including separation to groundwater. A pump station will need to be included in the conveyance network, due to the distance between the septage tanks and the proposed location of the LWF. The network would consist of approximately 1km of HDPE pipe and be installed along roads at a depth of 1.2m.

LWP design features will be the same as Option 1, as per the DoH Regulations, refer to Section 6.1.1 for design details.

The key advantage of this proposed relocation is the increased distance from the Wave Rock tourist precinct and sensitive environmental and cultural receptors, in contrast to the existing LWP's location.

6.4.2 Operational Requirements

6.4.2.1 *Maintenance Requirements*

Ensuring the sustainable operation of ponds necessitates proper maintenance. The inspection and maintenance schedule should involve observations of LWP and liner conditions. Maintenance tasks extend to inlet and outlet pipework access pits, requiring regular inspections to prevent blockages. Essential erosion control measures for both outer and inner pond banks should be implemented, with overflow channels, and drainage areas kept clear of weed growth. Security measures like fencing and signposting should be consistently maintained to deter intruders and animals.

6.4.2.2 *Monitoring Requirements*

The effective management of the pond will require weekly regular monitoring during operation. Assessments involve the observation of pond waters, including aspects such as colour, gas bubbling, and floating matter. Documentation will be essential to record maintenance actions in response to events like rainfall, equipment malfunctions, containment breaches, pipe blockages, and issues with chemical dosing or erosion. Regular inspections of pond embankments for seepage and erosion should be undertaken to check for erosion or seepage from the pond.

Pond performance analysis should occur twice yearly and encompass assessing pH, electrical conductivity, biochemical oxygen demand, suspended solids, and nutrient levels at both inlet and outlet points. Additionally, groundwater quality monitoring is required for measuring water tables and quality variations during groundwater passage beneath the pond.

6.4.3 Environmental Risk

Potential environmental risks of building the pond at the new Site include:

- Runoff from the pond from leakages or spillages can result in contamination from the LWP may carrying into nearby surface water bodies.
- If the LWPs are not properly lined or leakages from the LWP can result in contamination from the pond can leach into the soils and groundwater at the Site.
- The potential for soil erosion and sedimentation increases, particularly if the pond is inadequately designed or if vegetation cover is disturbed during construction.
- Inadequate containment or mishandling of wastewater within the pond could result in the release of harmful substances, including chemicals or pathogens, posing a threat to ecosystem.
- Evaporation ponds may attract wildlife, particularly birds which can significantly increase the risk of wildlife strikes.

6.4.4 Reputational Risk

The environmental and cultural risks associated with the Site could pose reputational risk to the Shire, particularly due to its vicinity to a significant tourism site. Potential impacts to the natural environment or aboriginal heritage sites in the area could negatively affect Hyden's image as a tourist destination.

Contaminants leaching into the groundwater may not only contaminate local groundwater resources but may also raise concerns among tourists about the overall environmental health of the region. Degradation in water quality could affect local ecosystems, as well as impact agriculture and industry, potentially impacting Shire residents in addition to the tourist population.

It is noted that this option poses a lower risk solution than Option 1 due to the increased distance between the Wave Rock tourist precinct and the facility.

6.4.5 Statutory Compliance

6.4.5.1 *DoH Regulations*

The ponds have been designed to meet the conditions outlined in the DoH Regulations, as outlined in Table 6-4 below.

Table 6-4: Summary of Compliance with DoH Regulations

Regulation	Description	Comments
50(f)(i)	The pond shall have an effective depth of 1.07m unless otherwise approved by the Chief Health Officer; and	Ponds have been designed with an effective depth of 1.07m.
50(f)(ii)	The sides shall have a slope of 3:1; and	Internal and external pond batters have been designed with a slope of 3:1.
50(f)(iii)	The bank shall have a minimum width of 2.4m, and shall be raised at least 228mm above natural ground level; and	Banks have been designed to a width of 4m, and are raised above 228mm with additional bunding surrounding ponds.
50(f)(iv)	The inner banks shall be kept clear of weed growth at all times; and	The HDPE pond liner will prevent weed growth.
50(f)(v)	All overflow channels and drainage areas shall be kept free of weed growth; and	Maintenance and monitoring regime will ensure the prevention of weed growth.
50(f)(vi)	The pond shall be surrounded with a 1.8m wire mesh fence, with a locked access gate.	Ponds have been designed with a 1.8m wire mesh fence and a locked access gate.

6.4.5.2 *WPQN #39 Compliance*

Table 6-5 below shows the WPQN #39 design recommendations and correlated design feature for the ponds.

Table 6-5: Summary of Compliance with WPQN #39 Recommendations

Recommendation	Description	Comments
1	Locations that should be avoided include hard-rock, karst, seismic fault or drainage lines, peat beds, wetlands, shallow groundwater tables (within one metre to the base of the pond liner), seasonal flood-ways, disturbed soils where differential soil settlement is likely, contaminated material dumps, and designated ethnographic or heritage sites.	Groundwater may be shallow within the pond development footprint, however the 1m separation may be maintained.
2	To limit occasional odour impacts from ponds, buffer zones to public places and residences should exceed 250 metres. Pond designers should consider the prevailing wind direction and, if practical, locate ponds downwind from odour-sensitive sites.	No residence within 250m, closest building, the airport, is 500m away from ponds.
14	A minimum freeboard of 400 millimetres is recommended to contain incidental rainfall and wave action. If practical, orientate longest side of pond at right angles to the prevailing wind to limit wave-caused erosion. Higher freeboards or controlled release structures may be required in extreme rainfall zones, such as in tropical areas.	Freeboard is designed to be 500mm, and the HDPE-liner will prevent any erosion caused by wind-driven waves.
24	All ponds should have security fencing to prevent inadvertent access by people and animals.	1.8m security fencing is included in design.
27a	Facultative pond water depths range from 120 to 200 centimetres	Pond reaches 150cm depth.
27h	For ponds with surface dimensions exceeding 25 metres, embankment armouring against wave action is recommended. Stone rip-rap, ‘gunite’, ‘shotcrete’ or similar may be used	Embankments have been designed to include armouring.

6.4.5.3 *Airport Safeguarding Guideline*

The Airport Safeguarding Guideline provides guidance on managing the risk of wildlife strikes in the proximity of airports. The Wildlife Hazard Management Action Table presented in Appendix E indicates that water infrastructure has a high wildlife attraction risk and that actions for new developments in wildlife management areas should be mitigated. However, due to the scarcity of aeroplanes landing at the airport, and the significant number of existing water bodies in the vicinity of the airport, the risk of wildlife strikes may be reduced to low/very low.

7 Financial Assessment

7.1 Capital Cost Estimates

Talis has prepared indicative high-level cost estimates for the capital works required for the development of Options 1 to 4, as well as for the decommissioning of the original LWP. These have been based on the modelled areas and volumes from the water balance assessment process and should be revisited at the detailed design stage to provide more accurate costings. The cost estimates do not include potential maintenance works required during aftercare, nor operational costs.

Local loading has been set at 25% having regard to regional indices listed within the Rawlinson's Australian Construction Handbook (Edition 42, 2024). The indices are a broad indication of the cost variation within WA and are considered appropriate for this project. A Professional Services loading of 10% has been applied to cater for consultancy and specialist services required to assist with approvals, design, project management and contract administration activities, Site supervision and Construction Quality Assurance. In addition, a contingency of 25% has been incorporated into the capital cost estimate model, in addition to a 15% allowance for contractor preliminaries. A summary of the capital cost estimates for the four options is presented in Table 7-1. A breakdown of the high-level cost estimates is contained in Appendix F.

Table 7-1: Summary of Capital Cost Estimates

Description	Option 1	Option 2	Option 3	Option 4
Subtotal Cost	$545,155	$73,939	$2,150,709	$842,568
Local Loading (25%)	$136,289	$18,485	$537,677	$210,642
Professional Services (10%)	$54,516	$7,394	$215,071	$84,257
Contingency (25%)	$136,289	$18,485	$537,677	$210,642
Preliminaries (15%)	$81,773	$11,091	$322,606	$126,385
Total Cost	**$954,021**	**$129,393**	**$3,763,740**	**$1,474,493**

Taking into account the local loading, contingency, preliminaries, and professional services factors the overall capital cost estimate for implementing Option 1 is $954,021, for Option 2 is $129,393, for Option 3 is $3,763,740, and for Option 4 is $1,474,493.

When evaluating Option 1 and 4 the primary cost comes from the supply and installation of the HDPE liner for the LWP's at approximtaely $200,000. The next highest contributor to the cost is the haulage and purchase of engineered fill and soil suitable for the LWP construction, which has the potential to be the most cost-sensitive element of the project if suitable material cannot be found close to the Site. Option 1 assumes the existing pump is suitable for continued use, while Option 4 requires the installation of a pump station and has larger pipe network distance resulting in an increased cost of $520,472.

Option 2 has the lowest capital cost of the options, which is attributed to the reduced waste acceptance volume. The greatest contributor to cost is the conveyance network at $18,750, followed by the haulage and purchase of sandfill media for the system. The cost of importing suitable sandy material is the most sensitive element of this Option, and the price may signficiantly increase should suitable material not be found within a short haulage distance of the Site.

Option 3 is the most expensive of the 4 options. This is due to the significant distance of the conveyance network, which is estimated to cost $1,811,150. The next largest contributor to cost is the pump station, estimated at $250,000.

The estimates account for the capital cost to develop each option, and are based on the following assumptions:

- Option 1 and 4 quantities are based on approximate LWP sizes developed using Talis' water balance excel spreadsheet, and no ponds have been modelled for 3D accuracy;
- Option 2 quantities have been developed using Talis' Mound sizing excel spreadsheet and have only been calculated to manage the Public Toilet effluent generation estimate;
- Rates are based on Talis' experience in the field and rates published in Rawlinson's Australian Construction Handbook (Edition 42, 2024) and could change depending on market conditions;
- Professional Fees and Services of 10% has been added to the total cost;
- Local loading of 20% has been added to the total cost;
- Contingency of 25% has been added to the total cost; and
- Allowance has not been made for additional costs associated with inflation and the costings are exclusive of GST.

7.1.1 Current LWF Decomissioning

A cost estimate has been prepared for the works required to decommission the existing LWF. The total cost of decommissioning, including local loading is estimated at $381,095. When evaluating the cost estimate it is noted that the highest contributor to cost is the removal of the liquid waste and cost of disposal to an appropriate facility, and if the pond can naturally be left to evaporate the remnant water, savings in excess of $300,000 could be achieved.

No additional cost has been calculated for professional services, contingency or preliminaries as it is not required for the decommissioning works.

7.2 Operational Cost Estimates

Talis has prepared indicative high-level cost estimates for the operational works required for the maintenance of Options 1 to 4. The cost estimates are based on similar works completed by Talis, and industry resources. This encompasses various expenses such as utilities, labour, maintenance, and other necessary resources for sustaining regular activities. The operational cost estimates have been calculated for a 20-year period, with an inflation rate of 2.5% each year.

Consideration has been given to a 25% contingency as part of the operational cost estimate. Table 7-2 presents a summary of the operational cost estimates for the works, with a full breakdown presented in Appendix F.

Table 7-2: Summary of 20 Year Operational Cost Estimates

Description	Option 1	Option 2	Option 3	Option 4
Current Cost Per Annum	$19,325	$7,900	$38,075	$36,900
Year 20 Cost Per Annum	$29,471	$12,048	$58,064	$56,272
Subtotal Cost	$413,942	$169,218	$815,567	$790,398
Contingency (25%)	$103,485	$42,305	$203,892	$197,600
20 Year Total Cost	**$517,427**	**$211,523**	**$1,019,458**	**$987,998**

The current annual Operational Cost Estimate for Option 1 is $19,325, for Option 2 is $7,900, for Option 3 is $38,075, and for Option 4 is $36,900.

The highest operational cost estimate is for Option 3, with the largest component of the cost ascribed to an allowance for energy to run the pumping system. Annual trade waste disposal costs have not been included for Option 3 as it is currently unclear if this will be required, though this may further increase the operational costs.

Option 4 has the second highest operational cost estimate, with the highest cost elements resulting from site inspection and environmental monitoring. Similarly to Option 4, an allowance for energy to the pump, and ongoing pump maintenance has been allowed for.

Option 1 operational costs are a result of environmental monitoring events, estimated at approximately $10,000 per year, and weekly inspections to be conducted by the Shire.

The lowest operation cost of the options is Option 2, as the system does not require as frequent monitoring as the other options due to the lower waste throughput. The highest cost is estimated to be for an environmental monitoring event to occur once annually at $5,000.

The operational cost estimates are based on the following assumptions:

- Option 1 and 4 LWPs will require two environmental monitoring events per year;
- Option 2 will require one environmental monitoring event per year; and
- Option 3 and 4 will require two maintenance events per year.

8 Options Assessment

Talis has evaluated the options available to the Shire based on high-level master plan design and costing for each option. Talis has given due consideration to the requirements for the Shire's wastewater treatment pond system in assessing the following key aspects:

- Infrastructure:
  - Constructability, long term liability and practicality;
  - Location and sizing;
- Operational:
  - Maintenance requirements;
  - Monitoring requirements;
- Environmental risk;
- Reputational risk;
- Statutory compliance; and
- Financial impact.

The technical assessment of the residual waste disposal options was conducted on the aspects listed through the adoption of a Multi-Criteria Analysis (MCA). MCA has been used to identify the most viable option available to the Shire, addressing both short-term and long-term requirements. To score the options, a simple 'Traffic Light' assessment was used to determine whether a proposed option criteria was Advantageous (3), Neutral (2) or Disadvantageous (1) in comparison to other options. The score for each criteria was then added for each option to provide a total score. A summary of the evaluation criteria and options assessment scores are shown in Table 8-1.

Advantageous (3)	Neutral (2)	Disadvantageous (1)

Table 8-1: Options Assessment Table

Criteria	Option			
	1	2	3	4
Constructability and practicality	2	3	1	2
Location and sizing	1	2	3	3
Maintenance requirements	3	3	2	2
Monitoring requirements	3	3	2	2
Groundwater contamination	2	1	3	3
Environmental risk	2	2	3	3
Reputational Risk	1	1	3	2
Financial Impact	2	3	1	2
Statutory Compliance	2	3	3	3
Total Score	**18**	**21**	**21**	**22**

A review of the assessment scores shows that Option 4 has the highest score of 22 point, with Option 2 and Option 3 closely following on 21 points, followed by Option 1 with 18 points.

Option 1 received the lowest score due to its location being in proximity to tourist sites, as well as to the being located within a flood plain. Being close to tourist sites means that odours from the pond could be detected, which in turn is a reputational risk for the town, and the flood plain location exposes the system to increased risk of being compromised.

Option 2 received a high score as it is practical to construct and has minimal monitoring and maintenance requirements. The cost of the system is also significantly lower than the other options due to the reduce waste acceptance volume. This option does have a high reputational risk as remaining waste generated may not be disposed of appropriately.

Option 3 received a high score due to its minimal risk to environment and reputation. The option has minimal monitoring requirements, however, will require some regular maintenance. While Option 3 is low environmental risk, it comes at the highest capital and operational costs. Additionally, due to the length of the network and reliance on Water Corporation this option may not be practical to build.

Option 4 scores the highest for the assessment criteria due to the location of the LWF being further away from tourist sites and the Camm River, reducing environmental risk to sensitive receptors. The option comes with a relatively high capital and operational cost, but is not the most expensive option,

and affords greater protection to the Shire's reputation by ensuring correct management of all generated effluent.

9 Recommendations and Implementation Plan

Under the previous Scope of Works, Talis prepared an Implementation Plan to define the key tasks required for the evaluation and development of a compliant liquid effluent pond. This implementation plan has been updated based on the results of this report.

The proposed works and tasks have been generally arranged in chronological order and have been assigned priorities from low to high. Though these tasks are generally sequential, there may be opportunity to undertake tasks concurrently to accelerate the delivery of a compliant effluent management system. The Implementation Plan has been summarised in Table 9-1.

The current Scope of Works encompasses Task 2.1.

Table 9-1: Implementation Plan

Task	Description	Priority Level	Estimated Completion
1.0	**Inspections and Monitoring**		
1.1	Implement a regular program of inspections to monitor pond integrity	High	October 2023
1.2	Implement monitoring program to establish extent of pond leakage	Medium	January 2024
2.0	**Option Development and Assessment**		
2.1	Undertake an Option Development and Options Assessment process to identify and conceptualise potential solutions	High	March 2024
2.2	Select a preferred option to proceed to implementation	High	May 2024
3.0	**Conceptual and Detailed Design**		
3.1	Undertake Conceptual Design of the Selected Option	Medium	July 2024
3.2	Undertake Detailed Design of the Selected Option	Medium	August 2024
4.0	**Approvals**		
4.1	Approvals application for DoH	Medium	September 2024
4.2	Approvals application for DWER (if required)	Medium	September 2024
4.3	Other approvals requirements (e.g. planning)	Medium	September 2024
5.0	**Tendering**		
5.1	Preparation of Tender Documentation	Medium	August 2024
5.2	Preparation of Tender Package	Medium	August 2024
5.3	Tender Period	Medium	September 2024
5.4	Selection of Preferred Tenderer	Medium	October 2024
6.0	**Construction**		
6.1	Construction of selected option	High	Novmeber 2024

Talis notes that given the environmental and cultural constraints in the surrounding areas, and high peak throughput of effluent requiring management, delivery of a local solution may prove challenging. Careful consideration of financial, environmental and reputational aspects should be considered when selecting a preferred option.

APPENDIX A
Figures

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au

677,000 678,000 679,000 680,000

6,411,000 6,410,000 6,409,000 6,408,000

Camm River

Qa

Qdlu

Ag

Czs

Hyden-Lake King Rd

Hyden-Lake King Rd

Camm River

Camm River

Surface Geology

Ag: Undifferentiated felsic intrusive rocks, including monzogranite, granodiorite, granite, tonalite, quartz monzonite, syenogranite, diorite, monzodiorite, pegmatite. Locally metamorphosed, foliated, gneissic. Local abundant mafic and ultramafic inclusions

Czs: Sand or gravel plains; may include some residual alluvium; quartz sand sheets commonly with ferruginous pisoliths or pebbles; local clay, calcrete, laterite, silcrete, silt, colluvium

Qa: Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted

Qdlu: Quartz and gypsum dunes and mounds (kopi); may include minor silt, sand, gravel, and clay flats adjacent to playas; locally includes some playa sediments

Data source: Towns, Roads - Landgate, 2023. Rivers - DWER, 2023. Surface Geology - Geoscience Australia, 2023. Imagery: ESRI, 2023.

LEGEND

- Hyden Wastewater Pond
- 2km Buffer

Hydrography

- Major River
- Minor River
- Basin
- Channel
- Flat
- Reservoir

Western Australian Roads

- Freeway / Highway
- Minor Road
- Other

LOCALITY

0 100 200 300 400 500 km

ENVIRONMENTAL CONSTRAINTS

Hyden Wastewater Pond Assessment

Shire of Kondinin

N 0 150 300 450 600 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:15,000

Prepared:	E Jackson	Date:	9/08/2023
Reviewed:	M Hobley	Revision:	A
Project:	TW23048		

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Figure 01

Document Path: \\server\talis\SECTIONS\Waste\PROJECTS\TW2023\TW23048 - Hyden Wastewater Pond Assessment\GIS\Maps\TW23048 - Hyden Wastewater Pond Assessment\TW23048 - Hyden Wastewater Pond Assessment.aprx

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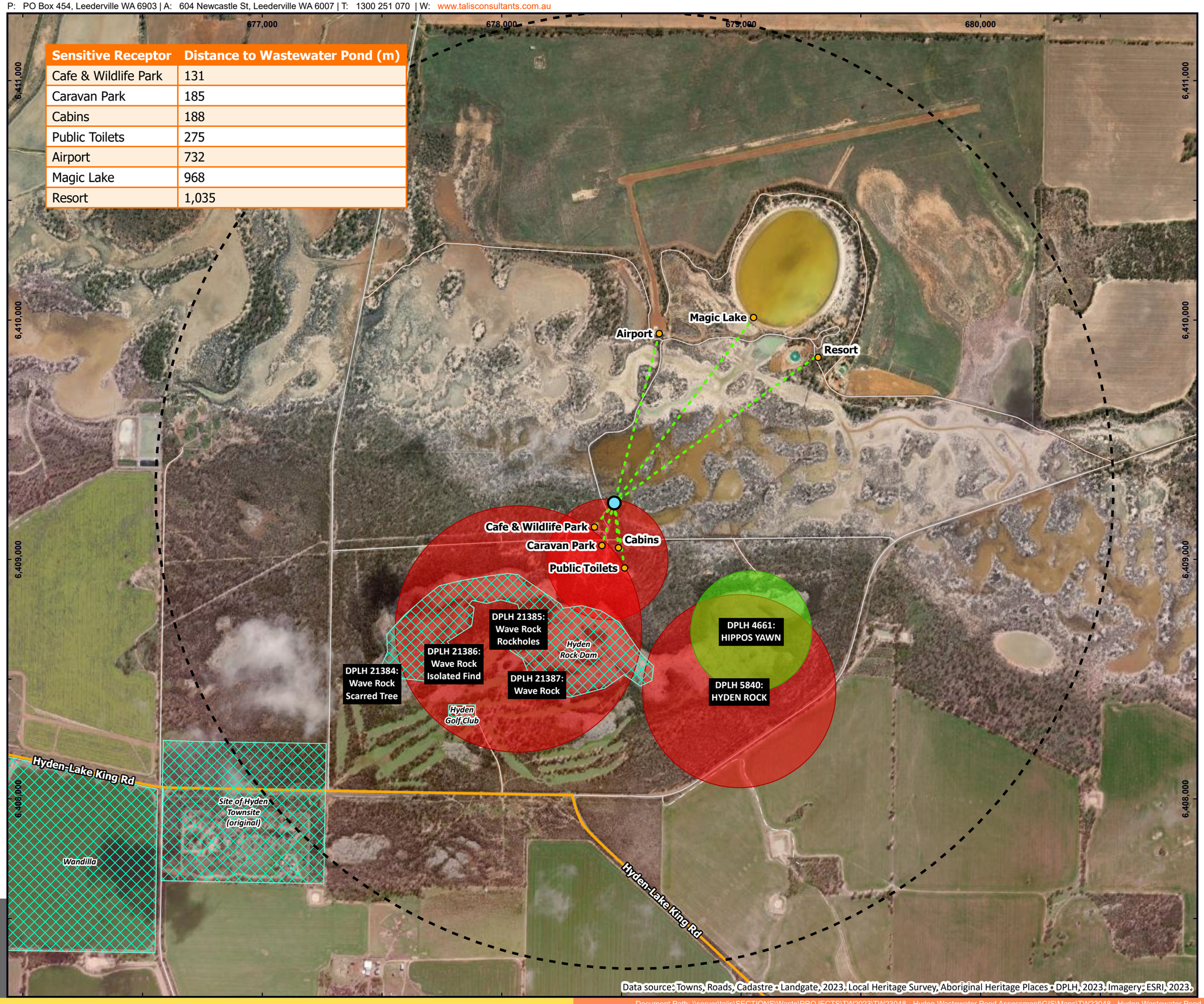
Sensitive Receptor	Distance to Wastewater Pond (m)
Cafe & Wildlife Park	131
Caravan Park	185
Cabins	188
Public Toilets	275
Airport	732
Magic Lake	968
Resort	1,035



Data source: Towns, Roads, Cadastre - Landgate, 2023. Local Heritage Survey, Aboriginal Heritage Places - DPLH, 2023. Imagery: ESRI, 2023.

LEGEND

- Hyden Wastewater Pond
- 2km Buffer
- Local Heritage Survey

Sensitive Receptors

- Sensitive Receptor
- Separation Distance

Aboriginal Heritage Places

- Lodged
- Registered Site
- Stored Data / Not a Site

Western Australian Roads

- Freeway / Highway
- Minor Road
- Other

LOCALITY

0 100 200 300 400 500 km

CULTURAL CONSTRAINTS

Hyden Wastewater Pond Assessment

Shire of Kondinin

N 0 150 300 450 600 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:15,000

Prepared:	E Jackson	Date:	22/09/2023
Reviewed:	M Hobley	Revision:	A
Project:	TW23048		

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Figure 02

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au

677,000 678,000 679,000 680,000

6,411,000 6,410,000 6,409,000 6,408,000

3

Hyden-Lake King Rd

Hyden-Lake King Rd

Data source: Towns, Roads - Landgate, 2023. Flora, Fauna, TEC - DBCA, 2023. Imagery: ESRI, 2023.

LEGEND

- Hyden Wastewater Pond
- 2km Buffer

Threatened and Priority Flora

- 2 Priority 2
- 3 Priority 3

Threatened and Priority Fauna

- Specially protected species
- Threatened species

Threatened Ecological Communities

- Threatened

Western Australian Roads

- Freeway / Highway
- Minor Road
- Other

LOCALITY

0 100 200 300 400 500 km

THREATENED AND PRIORITY FLORA, FAUNA AND ECOLOGICAL COMMUNITIES

Hyden Wastewater Pond Assessment

Shire of Kondinin

N 0 150 300 450 600 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:15,000

Prepared:	E Jackson	Date:	9/08/2023
Reviewed:	M Hobley	Revision:	A
Project:	TW23048		

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Figure 03

Document Path: \\server\talis\SECTIONS\Waste\PROJECTS\TW2023\TW23048 - Hyden Wastewater Pond Assessment\GIS\Maps\TW23048 - Hyden Wastewater Pond Assessment\TW23048 - Hyden Wastewater Pond Assessment.aprx

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675,000 676,000 677,000 678,000 679,000

6,411,000 6,410,000 6,409,000 6,408,000

Option 4

Option 1

Option 2

Option 3

Hyden

Marshall St

Hyden-Lake King Rd

Hyden-Lake King Rd

Data source: Towns, Roads - Landgate, 2024. Imagery: ESRI, 2024.

LEGEND

Waste Water Pond Options

- **Option 1** - Current Location Build
- **Option 2** - Mound Land Application
- **Option 4** - Rebuild at Airport
- **Option 3** - Disposal to Water Corporation Facility

Western Australian Roads

- Freeway / Highway
- Minor Road
- Other

LOCALITY

0 100 200 300 400 500 km

WASTE WATER POND OPTIONS

Hyden Wastewater Pond Assessment

Shire of Kondinin

N 0 150 300 450 600 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:15,000

Prepared:	E Jackson	Date:	18/03/2024
Reviewed:	M Hobley	Revision:	A
Project:	TW23048		

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Figure 04

Document Path: \\server\Talis\SECTIONS\Waste\PROJECTS\TW2023\TW23048 - Hyden Wastewater Pond Assessment\GIS\Maps\TW23048 - Hyden Wastewater Pond Assessment\TW23048 - Hyden Wastewater Pond Assessment.aprx

APPENDIX B
Site Inspection Photos

Photo B-1: Vegetation and crumbling of pond outer bank

Photo B-2: Pond outer bank showing potential seepage and established vegetation

Photo B-3: Significant vegetation established in pond internal bank

Photo B-4: Evidence of internal pond banks crumbling

Photo B-5: Evidence of damage to internal pond banks from wind-driven wave action

Photo B-6: Incomplete pond fencing shown back right

APPENDIX C
Pond Water Balance Model

Table 1.1: Site Details

Site Location:	Wave Rock
Latitude:	-32.44
Longitude:	118.9

Table 1.2: SILO Rainfall Data (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual	Percentile
1971	2	7	4	9	16	47	46	16	7	7	1	0	161	4%
1972	11	3	0	62	22	88	58	39	57	35	39	0	415	74%
1973	0	0	33	83	114	39	46	64	39	32	33	24	507	92%
1974	0	2	0	62	26	42	55	35	24	30	5	35	315	32%
1975	0	57	12	33	31	16	27	88	34	60	42	0	400	64%
1976	1	3	0	7	47	32	18	61	14	40	8	22	253	11%
1977	28	71	2	59	24	69	96	18	53	20	14	35	488	91%
1978	15	62	14	10	16	59	21	59	31	8	20	3	317	36%
1979	18	71	1	24	24	30	29	24	6	19	8	16	268	13%
1980	25	28	8	24	57	39	36	26	12	15	46	1	316	34%
1981	46	1	4	0	34	59	29	61	24	28	25	2	312	30%
1982	7	8	14	4	10	76	43	31	53	5	53	48	354	55%
1983	0	20	9	36	83	24	49	46	32	7	14	4	324	40%
1984	0	5	27	11	10	19	58	41	15	19	39	6	251	9%
1985	1	45	12	6	44	92	27	56	23	10	12	4	331	47%
1986	0	0	2	26	44	32	44	24	37	8	22	98	338	51%
1987	3	0	9	45	64	47	41	44	37	10	6	24	329	43%
1988	10	25	0	39	87	47	38	33	14	20	7	2	321	38%
1989	104	22	63	45	47	42	49	21	31	28	1	2	454	81%
1990	5	1	2	13	31	62	76	27	20	20	33	16	305	26%
1991	3	34	106	22	34	69	41	117	53	19	18	10	523	94%
1992	2	5	30	16	83	84	34	73	30	15	39	0	409	72%
1993	0	1	3	0	57	53	31	53	20	17	14	35	284	23%
1994	13	20	2	11	60	62	83	26	21	54	6	27	384	60%
1995	7	6	3	28	29	76	61	39	61	19	39	3	370	58%
1996	0	57	30	33	34	30	62	39	40	7	16	0	348	53%
1997	0	0	17	59	18	76	55	51	25	7	11	11	330	45%
1998	54	15	83	48	71	47	76	51	40	45	6	27	562	98%
1999	202	22	50	33	13	28	52	41	13	0	6	3	465	83%
2000	64	8	1	5	29	9	76	67	37	37	62	8	402	66%
2001	15	5	0	28	8	24	29	39	21	11	22	16	219	8%
2002	6	34	20	26	71	42	58	82	44	22	14	14	432	79%
2003	6	53	9	16	24	42	41	46	23	19	22	7	306	28%
2004	0	5	15	22	83	44	12	53	36	48	7	3	327	42%
2005	98	20	59	42	17	20	34	37	51	5	14	10	404	70%
2006	28	2	0	20	26	30	65	26	23	26	2	32	278	17%
2007	0	22	6	42	34	32	83	33	51	103	39	38	484	87%
2008	28	17	3	1	15	44	65	44	32	13	33	4	298	25%
2009	1	1	12	10	22	17	36	19	6	0	11	10	145	2%
2010	38	20	1	16	22	19	80	35	39	51	25	141	485	89%
2011	7	11	17	2	22	44	14	29	21	5	96	12	281	21%
2012	46	2	59	11	39	14	72	53	68	24	5	11	402	68%
2013	0	12	5	39	71	14	55	27	32	42	58	2	357	57%
2014	0	2	36	22	22	37	46	64	10	12	25	6	281	19%
2015	80	11	83	26	42	34	49	53	14	10	4	16	422	77%
2016	74	113	20	11	18	42	31	64	47	28	22	6	476	85%
2017	15	41	8	8	10	28	62	79	3	24	50	10	335	49%
2018	0	1	6	28	10	44	33	44	13	22	2	1	206	6%
2019	2	45	30	9	36	42	38	21	11	1	33	11	277	15%
2020	2	11	78	31	100	47	46	19	11	42	1	1	387	62%
2021	1	34	30	48	39	34	43	82	37	51	20	0	419	75%
2022	0	0	33	81	34	82	89	133	50	24	12	2	540	96%
Average	20	20	20	27	39	44	49	47	30	23	22	16	358	

Table 1.3: SILO Pan Evaporation Data (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
1971	308	291	220	157	116	66	59	82	133	205	274	358	2,267
1972	328	285	253	134	92	49	57	70	98	154	206	297	2,023
1973	345	253	190	98	64	48	47	65	96	165	213	308	1,892
1974	321	268	214	111	73	61	61	75	110	147	230	325	1,995
1975	323	275	233	149	103	62	86	92	123	155	221	322	2,143
1976	334	299	252	171	81	72	79	89	114	197	242	330	2,258
1977	319	247	249	162	91	51	54	73	104	183	255	297	2,084
1978	327	232	224	138	93	53	65	70	101	195	225	348	2,072
1979	339	253	253	130	83	61	61	95	149	166	254	310	2,153
1980	330	247	234	152	102	55	59	79	135	211	211	297	2,111
1981	297	284	219	150	76	64	68	88	115	188	246	297	2,093
1982	340	262	225	141	105	67	63	91	116	189	215	250	2,063
1983	321	272	179	145	75	61	50	70	95	187	235	289	1,978
1984	327	277	235	141	99	66	58	77	117	180	241	282	2,099
1985	340	226	227	150	77	50	49	66	96	152	232	280	1,945
1986	292	277	212	141	75	54	56	68	115	174	211	280	1,954
1987	297	275	223	129	61	61	56	72	110	187	231	256	1,957
1988	277	240	212	123	66	41	50	84	119	150	248	295	1,906
1989	264	200	180	119	77	55	56	70	115	139	240	283	1,797
1990	297	262	214	141	91	57	56	74	101	186	213	276	1,966
1991	287	211	165	101	66	56	51	60	73	139	177	263	1,647
1992	305	226	185	122	65	46	55	62	99	151	183	281	1,780
1993	296	222	226	154	101	60	64	81	130	189	239	302	2,066
1994	293	244	198	116	75	51	59	84	101	178	225	225	1,849
1995	302	260	209	130	96	59	63	72	107	172	229	269	1,967
1996	344	228	194	110	61	57	61	73	98	183	216	301	1,927
1997	322	260	227	111	84	54	44	73	101	170	224	262	1,932
1998	279	242	179	134	76	63	67	78	112	175	211	262	1,877
1999	225	211	163	120	77	67	60	75	118	186	240	295	1,836
2000	261	197	200	146	77	59	61	75	107	156	213	237	1,789
2001	271	226	219	120	95	64	69	85	124	192	241	272	1,977
2002	306	220	221	124	92	57	58	70	112	170	233	280	1,943
2003	273	239	189	123	83	62	56	74	105	181	230	315	1,928
2004	302	244	214	127	69	56	59	70	106	152	218	273	1,889
2005	214	210	186	93	80	58	57	93	110	180	226	273	1,780
2006	265	237	219	130	77	62	68	80	114	172	257	251	1,931
2007	295	232	203	116	77	62	57	79	113	148	166	253	1,801
2008	283	239	194	130	89	55	51	69	97	171	223	282	1,883
2009	310	239	197	124	79	50	53	73	110	187	232	233	1,887
2010	265	183	192	143	78	60	50	76	97	138	207	221	1,709
2011	261	217	206	136	84	62	57	81	125	201	197	262	1,889
2012	262	234	150	117	68	49	58	70	97	158	228	270	1,758
2013	283	225	207	127	64	59	57	87	122	187	219	263	1,899
2014	299	234	185	115	82	59	53	68	122	193	225	265	1,900
2015	250	251	182	96	62	48	53	68	98	169	240	259	1,774
2016	288	190	182	123	79	65	61	73	100	166	226	260	1,814
2017	260	197	207	126	99	61	66	73	114	151	202	269	1,825
2018	299	248	203	137	88	70	59	95	139	184	251	321	2,095
2019	291	229	189	132	87	68	63	77	118	195	211	303	1,963
2020	328	221	202	144	79	48	61	78	121	145	205	310	1,941
2021	314	267	204	111	87	59	72	83	111	155	207	287	1,956
2022	373	288	248	157	110	84	93	108	131	196	259	335	2,382
Average	299	242	208	130	82	58	60	77	111	173	225	283	1,949

Table 1.4: Rainfall AEP

AEP		Rainfall (mm)											
Duration		63.2%	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%	0.1%	0.05%	4.0%
Hours	BoM	1:1	1:2	1:5	1:10	1:20	1:50	1:100	1:200	1:500	1:1000	1:2000	1:25
0.02	1 min	1.28	1.48	2.16	2.68	3.23	4.03	4.7	5.62	6.95	8.11	9.44	3.50
0.03	2 min	2.22	2.55	3.64	4.44	5.27	6.44	7.4	8.66	10.7	12.4	14.4	5.66
0.05	3 min	2.98	3.43	4.92	6.02	7.17	8.81	10.2	12	14.8	17.2	20	7.72
0.07	4 min	3.6	4.15	6	7.38	8.82	10.9	12.6	15	18.5	21.6	25.1	9.51
0.08	5 min	4.13	4.76	6.92	8.54	10.3	12.7	14.8	17.6	21.8	25.4	29.5	11.10
0.17	10 min	5.94	6.88	10.1	12.6	15.2	19.1	22.4	26.8	33.2	38.7	45.1	16.50
0.25	15 min	7.12	8.25	12.1	15.1	18.3	22.9	26.9	32.2	39.9	46.6	54.2	19.83
0.33	20 min	8	9.27	13.6	16.9	20.5	25.6	30	35.9	44.4	51.9	60.4	22.20
0.42	25 min	8.73	10.1	14.8	18.4	22.2	27.7	32.4	38.7	47.8	55.8	65	24.03
0.50	30 min	9.35	10.8	15.8	19.6	23.6	29.4	34.3	40.9	50.6	59	68.7	25.53
0.75	45 min	10.8	12.5	18.1	22.4	26.8	33.3	38.6	46	56.8	66.3	77.1	28.97
1.00	1 hour	12	13.8	20	24.5	29.4	36.2	42	49.9	61.6	71.9	83.6	31.67
1.50	1.5 hour	13.9	16	22.9	28	33.4	41	47.3	56.3	69.5	81.1	94.3	35.93
2.00	2 hour	15.4	17.7	25.2	30.8	36.7	45	51.9	61.8	76.3	89.1	104	39.47
3.00	3 hour	17.8	20.4	29.1	35.5	42.2	51.8	59.8	71.4	88.3	103	120	45.40
4.50	4.5 hour	20.6	23.6	33.6	41.1	48.9	60.3	69.7	83.7	104	121	141	52.70
6.00	6 hour	22.7	26	37.2	45.6	54.5	67.4	78.2	94.2	117	136	159	58.80
9.00	9 hour	26	29.8	42.8	52.7	63.4	79	92.2	111	138	161	188	68.60
12.00	12 hour	28.3	32.5	47	58.2	70.3	88.1	103	125	154	181	210	76.23
18.00	18 hour	31.6	36.3	52.9	65.9	80.2	101	120	144	178	208	242	87.13
24.00	24 hour	33.7	38.8	56.8	71.2	87	111	131	157	194	226	263	95.00
30.00	30 hour	35.3	40.6	59.6	74.8	91.8	117	139	166	204	238	276	100.20
36.00	36 hour	36.4	41.9	61.6	77.5	95.3	122	145	171	210	245	284	104.20
48.00	48 hour	38.2	43.8	64.4	81	99.7	127	152	177	217	252	292	108.80
72.00	72 hour	40.4	46.3	67.4	84.4	103	132	158	181	221	257	297	112.67
96.00	96 hour	42.2	48.1	69.2	85.9	104	133	159	182	223	259	299	113.67
120.00	120 hour	43.9	49.8	70.7	86.9	105	134	159	183	225	261	301	114.67
144.00	144 hour	45.7	51.7	72.3	87.9	105	134	159	185	227	263	304	114.67
168.00	168 hour	47.6	53.7	74	89.1	105	134	160	187	230	266	308	114.67

Table 1.5: Pan Evaporation Data (mm)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual
90th %-ile Daily	10.3	8.0	8.0	5.2	2.9	1.7	1.7	2.3	3.3	5.9	8.2	9.6	2,084
90th Percentile	318.6	247.2	248.5	162.4	91.4	51.3	53.9	72.6	103.6	182.5	255.0	297.2	
50th %-ile Daily	9.4	8.9	6.8	4.5	2.4	1.8	1.8	2.2	3.7	5.6	6.8	9.0	1,954
50th Percentile	291.9	277.4	211.8	140.6	74.5	54.3	55.5	67.5	114.8	174.0	211.1	280.3	
Maximum Daily	9.0	7.8	5.8	4.3	2.4	2.0	2.2	2.5	3.6	5.7	6.8	8.4	1,877
Maximum	278.5	241.6	179.3	134.2	75.5	62.5	66.7	78.2	111.9	175.3	211.3	261.7	
Average Daily	9.6	7.8	6.7	4.2	2.7	1.9	1.9	2.5	3.6	5.6	7.3	9.1	1,949
Average	298.7	242.2	207.5	130.3	82.4	58.4	59.7	77.1	111.3	173.0	225.1	283.4	
# Days	31	28	31	30	31	30	31	31	30	31	30	31	365

Table 1.6: Rainfall Year Summary (mm)

Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	20.5	20.3	20.5	26.7	39.0	43.6	48.8	47.1	29.7	23.5	22.2	15.7	357.6
50th Percentile	0.0	0.0	2.1	26.0	44.4	32.1	43.5	23.9	37.2	8.1	22.2	98.0	337.5
90th Percentile	28.0	71.3	1.5	58.6	24.2	68.8	95.8	17.5	53.1	20.2	14.0	35.0	488.0
Maximum	54.2	15.2	82.7	48.1	71.2	47.0	75.6	50.8	40.4	44.8	5.6	26.8	562.4

Table 2.1: Total Leachate Generation (m3)

Generation Scenario	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
90th Percentile	1,810	654	829	1,261	724	771	1,214	724	1,284	934	701	1,390	12,296
50th Percentile	1,810	654	829	1,261	724	771	1,214	724	1,284	934	701	1,390	12,296
Maximum	1,810	654	829	1,261	724	771	1,214	724	1,284	934	701	1,390	12,296
Average	1,810	654	829	1,261	724	771	1,214	724	1,284	934	701	1,390	12,296

Table 2.3: Days of Operating Type

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Baseload (Days)	0	0	0	0	0	0	0	0	0	0	0	0	0
Standard Operation (Days)	0	28	28	14	31	28	17	31	20	25	30	12	264
School Holidays (Days)	31	0	3	16	0	2	14	0	6	6	0	19	97
Peak (Wave Rock Weekender) (Days)	0	0	0	0	0	0	0	0	4	0	0	0	4
Monthly Generation (m^3)	**1,810**	**654**	**829**	**1,261**	**724**	**771**	**1,214**	**724**	**1,284**	**934**	**701**	**1,390**	**12,296**

Table 2.2: Key Waste Input

Aspect	Value
Annual Waste Input (m^3)	12,296
5-day Waste Input (m^3)	491
Peak Operating Capacity (m^3)	117
Baseload	3%
Standard Operation	20%
School Holidays	50%
Peak (Wave Rock Weekender)	100%

Table 2.4: Maximum 5-Day Waste Input

Peak	
Day 1	117
Day 2	117
Day 3	117
Day 4	117
Standard Operation	23
Total Maximum 5-Day Waste Input	**491**

Table 3.1: Pond Design Characteristics

Aspect	Pond 1	Pond 2	Pond 3
W (m)	70	70	70
L (m)	75	75	75
h (m)	1.5	1.5	1.5
Side Slope (1:V)	3	3	3
Freeboard (m)	0.5	0.5	0.5
Evaporation Depth (m)	1.07	1.07	1.07
Base Width (m)	61	61	61
Base Length (m)	66	66	66
Operational Width (m)	67	67	67
Operational Length (m)	72	72	72
Evaporation Width (m)	63.58	63.58	63.58
Evaporation Length (m)	68.58	68.58	68.58
Pond Catchment Area (m^2)	5,250	5,250	5,250
Pond Evaporation Area (m^2)	4,360	4,360	4,360
Operational Capacity (m^3)	4,419	4,419	4,419
Total Capacity (m^3)	6,937	6,937	6,937
Bund Volume (m^3)	1,983	1,983	1,983

Table 3.2: Total Pond Design Characteristics

	Total
Area (m^2)	18758
Perimeter (m)	618
Operational Capacity (m^3)	13257
Total Capacity (m^3)	20810
Bund Volume (m^3)	5948
Perimeter Each Pond	870

Bund Geometry	
Bank Width (m)	4
Depth of Flow w/o Freeboard (m)	1.07
LHS Slope (1:V)	3
RHS Slope (1:V)	3
Freeboard (m)	0.5
Freeboard included?	YES
Bottom width, T (m)	13.42
Design Depth inc. Freeboard (m)	1.57
Swale Area, As (m^2)	13.675
Wetted Perimeter, Pw (m)	13.93
Hydraulic Radius, Rh (m)	0.98
Hydraulic Depth, Dh (m)	1.02

Table 4.1: Water Balance Inputs

Aspect	Value
Runoff Coefficient	1
Evaporation Coefficient	0.7

Table 4.2: Rainfall Scenario Inputs

Year	Rainfall
1	90th Percentile
2	90th Percentile
3	50th Percentile
4	50th Percentile
5	50th Percentile

Table 4.3: Leachate Inputs

Pond	% of Leachate in Pond
Pond 1	33%
Pond 2	33%
Pond 3	33%

Table 4.4: Storm Check Inputs

Aspect	Value
Storm Event Duration	24 hour
Storm Event AEP	1:20
Storm Event Rainfall (mm)	87

Table 4.5: Water Balance

Year	Month	Pond 1	Pond 2	Pond 3
1	Jan	0	0	0
1	Feb	0	0	0
1	Mar	0	0	0
1	Apr	232	232	232
1	May	322	322	322
1	Jun	783	783	783
1	Jul	1,526	1,526	1,526
1	Aug	1,638	1,638	1,638
1	Sep	2,029	2,029	2,029
1	Oct	1,889	1,889	1,889
1	Nov	1,418	1,418	1,418
1	Dec	1,158	1,158	1,158
2	Jan	936	936	936
2	Feb	773	773	773
2	Mar	299	299	299
2	Apr	532	532	532
2	May	621	621	621
2	Jun	1,082	1,082	1,082
2	Jul	1,826	1,826	1,826
2	Aug	1,937	1,937	1,937
2	Sep	2,328	2,328	2,328
2	Oct	2,188	2,188	2,188
2	Nov	1,717	1,717	1,717
2	Dec	1,457	1,457	1,457
3	Jan	1,169	1,169	1,169
3	Feb	541	541	541
3	Mar	182	182	182
3	Apr	309	309	309
3	May	556	556	556
3	Jun	816	816	816
3	Jul	1,280	1,280	1,280
3	Aug	1,441	1,441	1,441
3	Sep	1,714	1,714	1,714
3	Oct	1,536	1,536	1,536
3	Nov	1,242	1,242	1,242
3	Dec	1,364	1,364	1,364
4	Jan	1,077	1,077	1,077
4	Feb	448	448	448
4	Mar	89	89	89
4	Apr	217	217	217
4	May	464	464	464
4	Jun	723	723	723
4	Jul	1,187	1,187	1,187
4	Aug	1,348	1,348	1,348
4	Sep	1,621	1,621	1,621
4	Oct	1,444	1,444	1,444
4	Nov	1,150	1,150	1,150
4	Dec	1,272	1,272	1,272
5	Jan	984	984	984
5	Feb	355	355	355
5	Mar	0	0	0
5	Apr	128	128	128
5	May	375	375	375
5	Jun	634	634	634
5	Jul	1,098	1,098	1,098
5	Aug	1,259	1,259	1,259
5	Sep	1,532	1,532	1,532
5	Oct	1,355	1,355	1,355
5	Nov	1,061	1,061	1,061
5	Dec	1,183	1,183	1,183

Table 4.6: Storm Check

Year	Month	Pond 1	Pond 2	Pond 3
1	Jan	457	457	457
1	Feb	457	457	457
1	Mar	457	457	457
1	Apr	689	689	689
1	May	778	778	778
1	Jun	1,240	1,240	1,240
1	Jul	1,983	1,983	1,983
1	Aug	2,095	2,095	2,095
1	Sep	2,486	2,486	2,486
1	Oct	2,346	2,346	2,346
1	Nov	1,875	1,875	1,875
1	Dec	1,615	1,615	1,615
2	Jan	1,392	1,392	1,392
2	Feb	1,230	1,230	1,230
2	Mar	756	756	756
2	Apr	988	988	988
2	May	1,078	1,078	1,078
2	Jun	1,539	1,539	1,539
2	Jul	2,282	2,282	2,282
2	Aug	2,394	2,394	2,394
2	Sep	2,785	2,785	2,785
2	Oct	2,645	2,645	2,645
2	Nov	2,174	2,174	2,174
2	Dec	1,914	1,914	1,914
3	Jan	1,626	1,626	1,626
3	Feb	997	997	997
3	Mar	638	638	638
3	Apr	766	766	766
3	May	1,013	1,013	1,013
3	Jun	1,273	1,273	1,273
3	Jul	1,737	1,737	1,737
3	Aug	1,897	1,897	1,897
3	Sep	2,170	2,170	2,170
3	Oct	1,993	1,993	1,993
3	Nov	1,699	1,699	1,699
3	Dec	1,821	1,821	1,821
4	Jan	1,533	1,533	1,533
4	Feb	905	905	905
4	Mar	546	546	546
4	Apr	673	673	673
4	May	920	920	920
4	Jun	1,180	1,180	1,180
4	Jul	1,644	1,644	1,644
4	Aug	1,805	1,805	1,805
4	Sep	2,078	2,078	2,078
4	Oct	1,901	1,901	1,901
4	Nov	1,606	1,606	1,606
4	Dec	1,728	1,728	1,728
5	Jan	1,441	1,441	1,441
5	Feb	812	812	812
5	Mar	457	457	457
5	Apr	584	584	584
5	May	832	832	832
5	Jun	1,091	1,091	1,091
5	Jul	1,555	1,555	1,555
5	Aug	1,716	1,716	1,716
5	Sep	1,989	1,989	1,989
5	Oct	1,812	1,812	1,812
5	Nov	1,517	1,517	1,517
5	Dec	1,640	1,640	1,640

APPENDIX D
Mound System Sizing Model

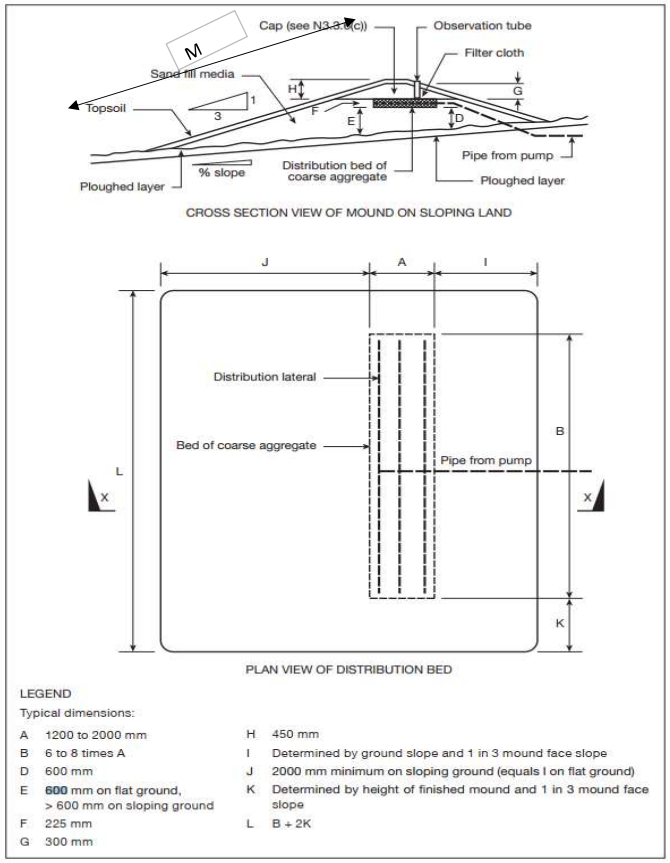

FIGURE N1 WISCONSIN MOUND SYSTEM

Table 1.1: Mound Design

Aspect		Unit	Calculation
Generation Estimate	5.6	m^3/day	
Daily Loading Rate	0.005	m^3/m^2/day	
Total Basal Area Required	1120	m^2	
A	2	m	
B	12	m	
D	0.6	m	
E	0.6	m	
F	0.225	m	
G	0.3	m	
H	0.45	m	
I	3.825	m	
J	3.825	m	
K	3.825	m	
L	19.65	m	
Height	1.275	m	H + D + F
Base Width	9.65	m	J + A + I
Peak Width	1.59	m	W - End triangles
Basal Area 1 Mound	189.62	m^2	L * W
Cross Sectional Area	6.90	m^2	Swale
Volume 1 Mound	135.57	m^3	
Area 1 Mound	189.62	m^2	Width * B2K
Volume Aggregate 1	5.4	m^3	B*A*F
Volume Sand 1 mound	130.2	m^3	V Mound - V Agg
Area of Filter Cloth 1	54.3	m^2	2AB + 2BF + 2AF
M	4.0	m	sqrt(J^2 + Height^2)
Topsoil V required	138.6	m^3	(2M + A) * 0.15m * B2k

Table 1.2: Total System Design

Aspect		Unit	Calculation
No. of Mounds	5.9	Item	
T Volume Aggregate	31.9	m^3	
T Area of Filter Cloth	320.7	m^2	
Total Volume mounds	800.7	m^3	
Total Area mounds	1120.0	m^2	
Volume Sand	768.8	m^3	V Mound - V Agg
Perimeter T system	155.1	m	

Table 1.2: Total System Design (Rounding up to 6 Mounds)

Aspect		Unit	Calculation
No. of Mounds	6	Item	
T Volume Aggregate	32.4	m^3	
T Area of Filter Cloth	325.8	m^2	
Total Volume mounds	813.4	m^3	
Total Area mounds	1137.7	m^2	
Volume Sand mounds	781.0	m^3	V Mound - V Agg
Perimeter T system	171.1	m	perimeter mounds plus 4m ES

APPENDIX E
Wildlife Hazard Management Action Table

Wildlife Hazard Management Action Table

Attachment 1

Land use types	Likely attractants ▲ natural elements ■ structural elements ● waste and food			Wildlife attraction risk	Actions for existing development and land uses in wildlife management areas			Actions for new and changed development and land uses in wildlife management areas		
					0-3 km (Area A)	3-8 km (Area B)	8-13 km (Area C)	0-3 km (Area A)	3-8 km (Area B)	8-13 km (Area C)
Agriculture										
Turf farm, piggery, abattoir, aquaculture	▲	■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fruit tree farm/orchard	▲	■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fish processing/packing plant	▲	■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Farm (cattle, dairy, poultry, crops)	▲	■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Horticulture, viticulture, market farms/gardens	▲	■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Forestry	▲		●	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Plant nursery	▲	■	●	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Conservation										
Wildlife/conservation area - wetland, waterways	▲			High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Wildlife/conservation area - dryland	▲			Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Recreation										
Significant open water (ancillary to development)	▲			High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Showground	▲	■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Significant landscaped space (ancillary to development)	▲			Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Golf course	▲	■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Park, playground	▲		●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Picnic areas, camping ground	▲		●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Racetrack, horse riding school	▲	■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sports facility (tennis, bowls, football fields)	▲	■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Commercial										
Food processing or storage facility		■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fast food, drive-in, outdoor restaurant		■	●	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Shopping centre		■	●	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Warehouse (food storage)		■	●	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Car park		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Cinemas		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Hotel/motel		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Office building		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Petrol station		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Warehouse (non-food storage)		■	●	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Utilities										
Food / organic waste facility		■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - landfill			●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - transfer station		■	●	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Water infrastructure (drains, channels, basins)	▲			High	Mitigate	Mitigate	Monitor	Mitigate	Mitigate	Monitor
Non-putrescible waste facility - landfill			●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Non-putrescible waste facility - transfer station		■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sewage / wastewater treatment facility		■	●	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Potable water treatment facility	▲	■		Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action

APPENDIX F
Cost Estimate

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)
1	**LWP**				
1.01	General Site clearance and rationalisation of surface	m^2	18,758	$ 0.92	$ 17,257
1.02	Preparation of Formation Surfaces	m^2	18,758	$ 2.10	$ 39,392
1.03	Haulage and stockpile of soil from offsite source within 30km radius	m^3	5,948	$ 13.20	$ 78,514
1.04	Placement of Engineered Fill to form pond embankments from stockpile within 5km	m^3	5,948	$ 10.59	$ 62,989
1.05	Preparation of pond Compacted Subgrade Layer	m^2	18,900	$ 2.10	$ 39,690
1.06	Supply and Install 2.0mm Double-Textured HDPE in pond	m^2	18,900	$ 10.94	$ 206,766
1.07	Excavate and backfill anchor trenches in pond	m	870	$ 25.28	$ 21,994
				Sub-total	**$ 466,602**
2	**Conveyance Network**				
2.01	Supply and install 200mm diameter Solid Wall PE100 SDR11 Discharge Inlet Pipe	m	100	$ 187.50	$ 18,750
2.02	Supply and install 200mm diameter Solid Wall PE100 SDR11 Anaerobic Outlet Pipe, including tee-pieces and pipe boots	m	10	$ 187.50	$ 1,875
				Sub-total	**$ 20,625**
3	**Miscellaneous**				
3.01	Supply and install chain-link Security Fence (1.8m with barbed wire top)	m	645	$ 63.00	$ 40,635
3.02	Supply and Installation of High Galvanized Mesh Security Gate (8m wide and 1.8m high) With 3 Strand Barbed Wire Top	Item	1	$ 2,650.00	$ 2,650
3.03	Supply and install 3m x 9m '14mm' roped cargo net 300mmx300mm mesh for egress from pond fixed to 2 x galvanised steel posts with concrete bases at crest of pond, with mounting hooks and SOLAS approved life ring.	Item	3	$ 3,005.54	$ 9,017
3.04	Supply, place and compact 200mm thick aggregate basecourse for 9m wide access road	m^3	180	$ 31.26	$ 5,627
				Sub-total	**$ 57,928**
				Subtotal	**$ 545,155**
	Preliminaries		*15%*		*$ 81,773*
	Local Loading		*25%*		*$ 136,289*
	Professional Services		*10%*		*$ 54,516*
	Contingency		*25%*		*$ 136,289*
				Total	**$ 954,021**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)	2025 103%	2030 115%	2035 128%	2040 140%	2045 153%
1	**Ponds**									
1.01	Environmental Monitoring allowance	Event/year	2	$ 5,000.00	$ 10,000	$ 10,250	$ 11,500	$ 12,750	$ 14,000	$ 15,250
1.02	Shire inspection, 3 hours weekly	Hours/year	156	$ 35.00	$ 5,460	$ 5,597	$ 6,279	$ 6,961	$ 7,644	$ 8,326
				Sub-total	**$ 15,460**	**$ 15,847**	**$ 17,779**	**$ 19,712**	**$ 21,644**	**$ 23,577**
				Subtotal	**$ 15,460**	**$ 15,847**	**$ 17,779**	**$ 19,712**	**$ 21,644**	**$ 23,577**
	Contingency		*25%*		*$ 3,865*	$ 3,962	$ 4,445	$ 4,928	$ 5,411	$ 5,894
				Total	**$ 19,325**	**$ 19,808**	**$ 22,224**	**$ 24,639**	**$ 27,055**	**$ 29,471**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)
1	**Mound**				
1.01	General Site clearance and rationalisation of Mound System Area	m^2	1,251	$ 0.92	$ 1,151
1.02	150mm Topsoil clearing within mound system footprint, to include disposal to stockpile within 500m	m^3	139	$ 7.74	$ 1,073
1.03	Preparation and ploughing of Basal Layer	m^2	1,138	$ 2.10	$ 2,389
1.04	Haulage and stockpile of sandfill media from offsite source within 30km radius	m^3	781	$ 13.20	$ 10,309
1.05	Placement of Sand fill media to form mounds	m^3	781	$ 9.81	$ 7,662
1.06	Supply and install of filter cloth	m^2	321	$ 3.10	$ 994
1.07	Supply and install of course aggregate	m^3	32	$ 98.27	$ 3,184
1.08	Supply, placement and compaction of Engineered Fill to form upgradient bunding	m^3	24	$ 90.98	$ 2,186
1.09	Redistribution of 150mm topsoil from stockpile within 500m	m^3	139	$ 7.74	$ 1,073
				Sub-total	**$ 30,021**
2	**Conveyance Network**				
2.01	Supply and install 200mm diameter Solid Wall PE100 SDR11 Discharge Inlet Pipe	m	100	$ 187.50	$ 18,750
2.02	Supply and install 100mm perforated HDPE distribution pipe	m	42	$ 187.50	$ 7,838
				Sub-total	**$ 26,588**
3	**Miscellaneous**				
3.01	Supply and install chain-link Security Fence (1.8m with barbed wire top)	m	171	$ 63.00	$ 10,773
3.02	Supply and Installation of High Galvanized Mesh Security Gate (8m wide and 1.8m high) With 3 Strand Barbed Wire Top	Item	1	$ 2,650.00	$ 2,650
3.03	Supply, place and compact 200mm thick aggregate basecourse for 9m wide access road	m^3	125	$ 31.26	$ 3,908
				Sub-total	**$ 17,331**
				Subtotal	**$ 73,939**
	Preliminaries		*15%*		*$ 11,091*
	Local Loading		*25%*		*$ 18,485*
	Professional Services		*10%*		*$ 7,394*
	Contingency		*25%*		*$ 18,485*
				Total	**$ 129,393**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)	2025	2030	2035	2040	2045
						103%	115%	128%	140%	153%
1	**Mounds**									
1.01	Environmental Monitoring allowance	Event/year	1	$ 5,000.00	$ 5,000	$ 5,125	$ 5,750	$ 6,375	$ 7,000	$ 7,625
1.02	Shire inspection, 2 hours monthly	Hours/year	24	$ 55.00	$ 1,320	$ 1,353	$ 1,518	$ 1,683	$ 1,848	$ 2,013
				Sub-total	**$ 6,320**	**$ 6,478**	**$ 7,268**	**$ 8,058**	**$ 8,848**	**$ 9,638**
				Subtotal	$ 6,320	$ 6,478	$ 7,268	$ 8,058	$ 8,848	$ 9,638
	Contingency		*25%*		*$ 1,580*	$ 1,620	$ 1,817	$ 2,015	$ 2,212	$ 2,410
				Total	**$ 7,900**	**$ 8,098**	**$ 9,085**	**$ 10,073**	**$ 11,060**	**$ 12,048**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)
1	**Earthworks**				
1.01	General Site clearance and grubbing	m^2	12,000	$ 0.92	$ 11,040
1.02	Excavation within pipe network footprint, to include disposal of surplus soils to stockpile within 500m	m^3	3,000	$ 9.00	$ 27,000
				Sub-total	**$ 38,040**
2	**Conveyance Network**				
2.01	Supply and install 200mm diameter Solid Wall PE100 SDR11 Discharge Pipe	m	4,070	$ 445.00	$ 1,811,150
2.02	Pump station, including supply and instal of pump, control board, electricity connection etc	Item	1	$ 250,000.00	$ 250,000
				Sub-total	**$ 2,061,150**
3	**Connection Fees**				
3.01	Wastewater reticulation connections development fee	Item	1	$ 1,963.39	$ 1,963
3.02	Wastewater Infrastructure Contributions	Item	1	$ 43,344.00	$ 43,344
				Sub-total	**$ 45,307**
4	**Miscellaneous**				
4.01	Supply and install chain-link Security Fence (1.8m with barbed wire top)	m	20	$ 63.00	$ 1,260
4.02	Supply and Installation of High Galvanized Mesh Security Gate (4m wide and 1.8m high)	Item	1	$ 1,043.84	$ 1,044
4.03	Supply, place and compact 200mm thick aggregate basecourse for 9m wide access road	m^3	125	$ 31.26	$ 3,908
				Sub-total	**$ 6,211**
				Subtotal	**$ 2,150,709**
	Preliminaries		*15%*		*$ 322,606*
	Local Loading		*25%*		*$ 537,677*
	Professional Services		*10%*		*$ 215,071*
	Contingency		*25%*		*$ 537,677*
				Total	**$ 3,763,740**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)	2025	2030	2035	2040	2045
						103%	115%	128%	140%	153%
1	**Conveyance Network**									
1.02	Shire inspection, 3 hours weekly	Hours	156	$ 55.00	$ 8,580	$ 8,795	$ 9,867	$ 10,940	$ 12,012	$ 13,085
				Sub-total	**$ 8,580**	**$ 8,795**	**$ 9,867**	**$ 10,940**	**$ 12,012**	**$ 13,085**
2	**Pump station**									
2.01	General pump maintenance allowance	Event/year	2	$ 5,000.00	$ 10,000	$ 10,250	$ 11,500	$ 12,750	$ 14,000	$ 15,250
				Sub-total	**$ 10,000**	**$ 10,250**	**$ 11,500**	**$ 12,750**	**$ 14,000**	**$ 15,250**
3	**Utility Services**									
3.01	Energy generation allowance	Month	12	$ 990.00	$ 11,880	$ 12,177	$ 13,662	$ 15,147	$ 16,632	$ 18,117
				Sub-total	**$ 11,880**	**$ 12,177**	**$ 13,662**	**$ 15,147**	**$ 16,632**	**$ 18,117**
				Subtotal	$ 30,460	$ 31,222	$ 35,029	$ 38,837	$ 42,644	$ 46,451
	Contingency		*25%*		*$ 7,615*	$ 7,805	$ 8,757	$ 9,709	$ 10,661	$ 11,613
				Total	**$ 38,075**	**$ 39,027**	**$ 43,786**	**$ 48,546**	**$ 53,305**	**$ 58,064**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)
1	**LWP**				
1.01	General Site clearance and rationalisation of surface	m^2	18,758	$ 0.92	$ 17,257
1.02	Preparation of Formation Surfaces	m^2	18,758	$ 2.10	$ 39,392
1.03	Haulage and stockpile of soil from offsite source within 30km radius	m^3	5,948	$ 13.20	$ 78,514
1.04	Placement of Engineered Fill to form pond embankments from stockpile within 5km	m^3	5,948	$ 10.59	$ 62,989
1.05	Preparation of pond Compacted Subgrade Layer	m^2	18,900	$ 2.10	$ 39,690
1.06	Supply and Install 2.0mm Double-Textured HDPE in pond	m^2	18,900	$ 10.94	$ 206,766
1.07	Excavate and backfill anchor trenches in pond	m^2	870	$ 25.28	$ 21,994
				Sub-total	**$ 466,602**
2	**Conveyance Network**				
2.01	Supply and install 200mm diameter Solid Wall PE100 SDR11 Discharge Inlet Pipe	m	1,052	$ 187.50	$ 197,250
2.02	Supply and install 200mm diameter Solid Wall PE100 SDR11 Anaerobic Outlet Pipe, including tee-pieces and pipe boots	m	10	$ 187.50	$ 1,875
2.03	Pump station, including supply and instal of pump, control board, electricity connection etc	Item	1	$ 125,000.00	$ 125,000
				Sub-total	**$ 324,125**
3	**Miscellaneous**				
3.01	Supply and install chain-link Security Fence (1.8m with barbed wire top)	m	610	$ 63.00	$ 38,430
3.02	Supply and Installation of High Galvanized Mesh Security Gate (8m wide and 1.8m high) With 3 Strand Barbed Wire Top	Item	1	$ 2,650.00	$ 2,650
3.03	Supply and install 3m x 9m '14mm' roped cargo net 300mmx300mm mesh for egress from pond fixed to 2 x galvanised steel posts with concrete bases at crest of pond, with mounting hooks and SOLAS approved life ring.	Item	3	$ 3,005.54	$ 9,017
3.04	Supply, place and compact 200mm thick aggregate basecourse for 9m wide access road	m^3	56	$ 31.26	$ 1,744
				Sub-total	**$ 51,841**
				Subtotal	**$ 842,568**
	Preliminaries		*15%*		*$ 126,385*
	Local Loading		*25%*		*$ 210,642*
	Professional Services		*10%*		*$ 84,257*
	Contingency		*25%*		*$ 210,642*
				Total	**$ 1,474,493**

Item	Description	Unit	Total Quantities	Rate	Total Amount ($)	2025	2030	2035	2040	2045
						103%	115%	128%	140%	153%
1	**Ponds**									
1.01	Environmental Monitoring allowance	Event/year	2	$ 5,000.00	$ 10,000	$ 10,250	$ 11,500	$ 12,750	$ 14,000	$ 15,250
1.02	Shire inspection, 3 hours weekly	Hours	156	$ 55.00	$ 8,580	$ 8,795	$ 9,867	$ 10,940	$ 12,012	$ 13,085
				Sub-total	**$ 18,580**	**$ 19,045**	**$ 21,367**	**$ 23,690**	**$ 26,012**	**$ 28,335**
2	**Pump**									
2.01	General pump maintenance allowance	Event/year	1	$ 5,000.00	$ 5,000	$ 5,125	$ 5,750	$ 6,375	$ 7,000	$ 7,625
				Sub-total	**$ 5,000**	**$ 5,125**	**$ 5,750**	**$ 6,375**	**$ 7,000**	**$ 7,625**
3	**Utility Services**									
3.01	Energy generation allowance	Month	12	$ 495.00	$ 5,940	$ 6,089	$ 6,831	$ 7,573	$ 8,316	$ 9,058
				Sub-total	**$ 5,940**	**$ 6,089**	**$ 6,831**	**$ 7,573**	**$ 8,316**	**$ 9,058**
				Subtotal	$ 29,520	$ 30,258	$ 33,948	$ 37,638	$ 41,328	$ 45,018
	Contingency		*25%*		*$ 7,380*	$ 7,565	$ 8,487	$ 9,409	$ 10,332	$ 11,255
				Total	**$ 36,900**	**$ 37,823**	**$ 42,435**	**$ 47,048**	**$ 51,660**	**$ 56,272**

Assets | Engineering | Environment | Noise | Spatial | Waste

Talis Consultants
ABN 85 967 691 321

HEAD OFFICE
604 Newcastle Street,
Leederville
Western Australia 6007

PO Box 454,
Leederville
Western Australia 6903

NSW OFFICES
Nowra
76 Bridge Road, Nowra
New South Wales, 2541

PO Box 1189, Nowra
New South Wales, 2541

Newcastle
58 Cleary Street, Hamilton
New South Wales, 2303

P: 1300 251 070
E: enquiries@talisconsultants.com.au