Regional Waste Management Facility Masterplan

Alice Springs Town Council

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Author(s)	Emma Lewis, Adele Faraone

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EcOz Pty Ltd.
ABN: 81 143 989 039
Level 1, 70 Cavenagh Street
DARWIN NT 0800
GPO Box 381, Darwin NT 0800

Telephone: +61 8 8981 1100
Email: ecoz@ecoz.com.au
Internet: www.ecoz.com.au

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EXECUTIVE SUMMARY

The Alice Springs Regional Waste Management Facility (RWMF) is a municipal waste recovery and disposal site operated by Alice Springs Town Council (ASTC). ASTC engaged EcOz Environmental Consultants to complete a 10 year masterplan for the Regional Waste Management Facility providing a clear strategy for the development of the RWMF up to 2030. Based on a review of current operations and existing site constraints, this masterplan has outlined a strategy for the future operation and development of the RWMF.

At the current filling rate, the current landfill cells (Stages 1-4) can continue filling for the next 5 years (2020 to 2025), bringing the total available airspace for landfilled materials to a volume of 248,000m^3 at a maximum height of 590m AHD. The construction of a new cell, Stage 5, is to be constructed on the boundary of Stage 4 and is to be split into two sub-stages; Stage 5A and Stage 5B. The estimated lifespan of Stage 5 is 9 years (from 2025 to 2034) with an estimated capacity of 526,000m^3.

An analysis of potential areas for expansion of the landfill cells indicates that the unused area to the north of Stages 2, 4 and 5A could be utilised. The current constraints of this area of the site, however, include a large volume of excavation required to set the base of the cell to a level of 570mAHD. Additionally, as this area is covered with historical dumped waste (i.e. asbestos) additional remediation measures would be required prior to use. It is recommended that ASTC and the RWMF undertake further geotechnical and contamination investigations, as well as cost benefit analysis, prior to making any decisions regarding the utilisation of this area and re-use of material. It may be more cost effective to expand the landform south of Stage 5.

In regards to leachate generation, the estimate of 29,830 m^3/year leachate generation in the existing landform is very conservative and likely to be much lower. It is recommended that a detailed water balance be undertaken to determine potential existing volumes of leachate in Stages 1-4 as well as expected volumes to be generated in future stages. The water balance should consider rainfall and evaporation data for the region, rainfall infiltration rates through the current cover system and future capping systems and sizing of any proposed leachate dams or ponds.

Operational improvements and infrastructure investment are key to the progression of a service such as that of the RWMF. The ASTC undertook a review of the current site infrastructure and operations and identified a number of constraints the site currently faces or may potentially face in the future. This report provides a largely conservative approach to identifying the key areas of expansion and development in the future, to solve a number of these constraints. This report can be used to assist in feasibility assessments of proposed infrastructure improvements and future budget development.

1 INTRODUCTION

1.1 Background

The Alice Springs Regional Waste Management Facility (RWMF) is a municipal waste recovery and disposal site operated by Alice Springs Town Council (ASTC). The RWMF services both domestic and commercial customers in the Alice Springs area, including Yulara, MacDonnell Regional Council, Central Desert Regional Council and Barkly Regional Council.

The RWMF is located approximately 5km from the town centre at Lot 7902 on Commonage Road (Figure 2-1).

1.2 Objectives

The objectives of this Alice Springs Regional Waste Management Facility Masterplan are:

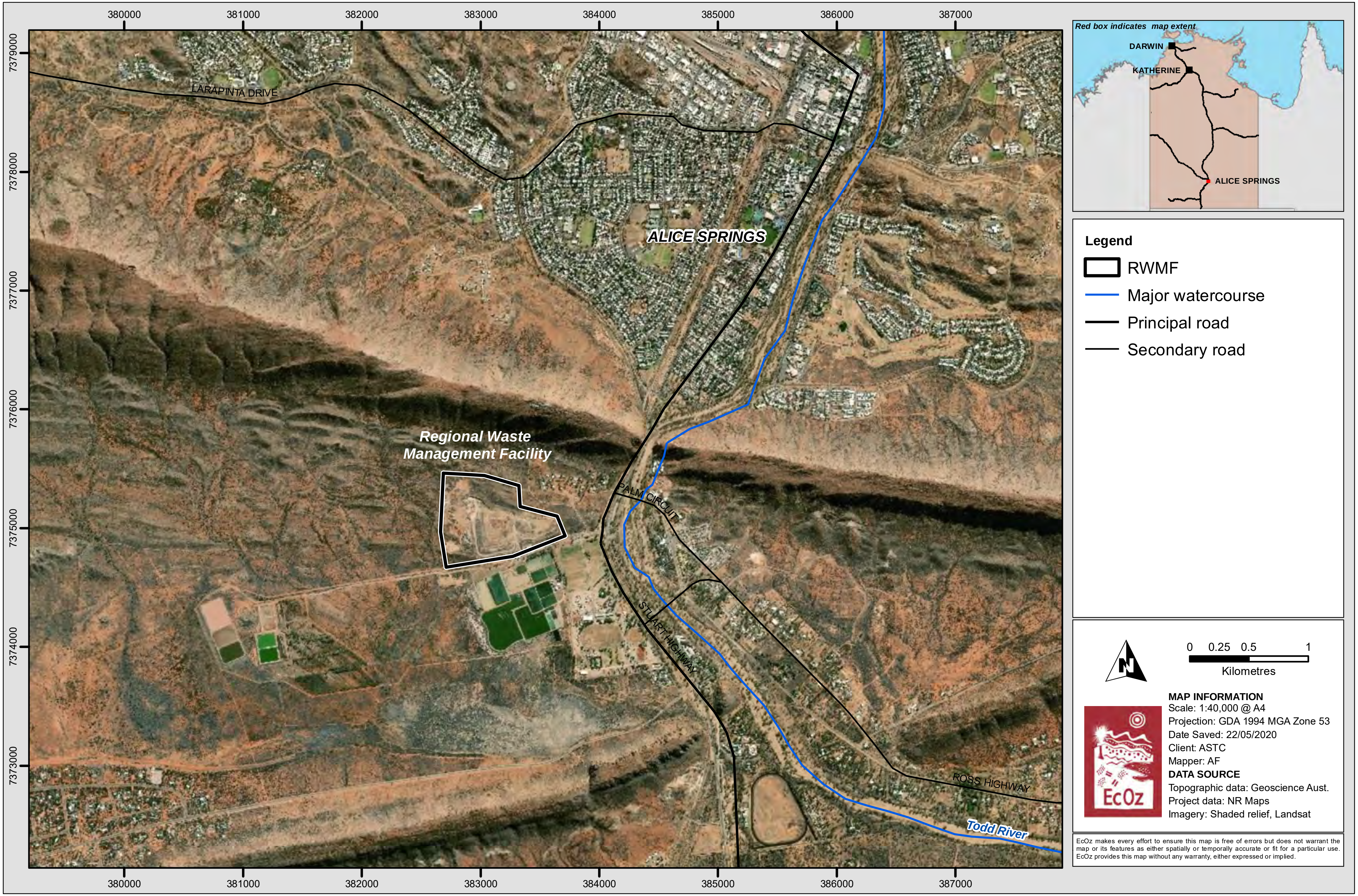
- To present a strategy for development of the RWMF up to 2030
- To provide a clear outlook on the current and expected future operational and capital requirements of all facilities at the RWMF
- To provide an efficient and cost effective strategy for the development of the future cells incorporating environmental considerations
- To provide practical outcomes ensuring that the site remains an integral Council asset for the customers in the Alice Springs area
- To explore expansion of the RWMF, including expansion of infrastructure and their preliminary estimated costs

1.3 Scope

This Masterplan has been developed to comply with relevant environmental legislation, licences and approvals. It addresses the plan objectives and includes the following aspects:

- Regulatory requirements relevant to the site and operations.
- The existing environment surrounding the RWMF and environment conditions relevant to the operations.
- An overview of the existing facility and operational requirements.
- Landfill staging plans and future final landform; including a summary of material quantities to achieve each stage.
- Storm water and leachate management strategies for future stages.
- Infrastructure upgrade requirements including high-level cost estimates.

This outcomes of this Masterplan are subject to the limitations, assumptions and qualifications contained throughout the report.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20032 - Alice Springs RWMF\01 Project Files\Fig 1-1- Location Map Landscape A4 Z52 (revised).mxd

Figure 1-1. Location of Alice Springs RWMF

2 REGULATORY REQUIREMENTS

The key Commonwealth and Northern Territory legislation applicable to the operation of the RWMF is outlined below in Table 3-1.

Table 2-1. Applicable legislation

Environmental aspect	Applicable legislation
Air quality	• *Ozone Protection Act 1989 (Cwlth)* • *Waste Management and Pollution Control Act (NT)* • *National Environment Protection Council. 2003 National Environment Protection (Ambient Air Quality) Measure (NEPM)* • *National Environment Protection Council. 2011 National Environment Protection (Air Toxics) Measure (NEPM)* • *National Environment Protection Council. 1998 National Environment Protection (National Pollutant Inventory) Measure (NEPM)*
Bushfire	• *Bushfires Act (NT)* • *Fire and Emergency Act (NT)*
Dangerous Goods	• *Dangerous Goods Act (NT)* • *Road Transport (Dangerous Goods) Act 1995 (NT)* • *Dangerous Goods (Storage and Handling) Regulations 2000 (NT)* • *Road Transport Reform (Dangerous Goods) Act 1995 (Cwlth)*
Flora & Fauna (including weeds & pests)	• *Animal Welfare Act (NT)* • *Bushfires Act (NT)* • *Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)* • *Fisheries Act (NT)* • *National Environmental Protection Council (Northern Territory) Act (NT)* • *Plant Health Act (NT)* • *Public and Environmental Health Act (NT)* • *Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations (NT)* • *Soil Conservation and Land Utilisation Act (NT)* • *Territory Parks and Wildlife Conservation Act (NT)* • *Weeds Management Act (NT)*
Heritage	• *Australian Heritage Commission Act 1975 (Cwlth)* • *Heritage Act (NT)* • *National Heritage Trust of Australia Act 1997 (Cwlth)*
Noise	• *Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth)* • *Waste Management and Pollution Control Act (NT)*
Waste & Hazardous Waste	• *Environmental Offences and Penalties Act (NT)* • *Work Health and Safety (National Uniform Legislation) Act (NT)* • *Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Cwlth)* • *Litter Act (NT)* • *National Environment Protection Council. 2011. National Environment Protection (Used Packaging Materials) Measure as varied 16 September 2011* • *Public and Environmental Health Act (NT)* • *Public Health (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention) Regulations (NT)* • *Waste Management and Pollution Control Act (NT)*
Water (surface & groundwater)	• *Water Act (NT)*

2.1 Approvals, licences and permits

As an operational landfill, the RWMF requires an Environment Protection Licence (EPL) under Schedule 2 of the *Waste Management and Pollution Control Act (WMPC Act)*. The EPL regulates the operations of the landfill, transfer station, resource recovery centre, leachate ponds and landfill gas. The EPL outlines a number of conditions ASTC must meet in order to be compliant and is administered by the Northern Territory Environment Protection Authority (NT EPA).

The RWMF is licensed under EPL206 to conduct activities prescribed by Schedule 2 of the *WMPC Act*, as follows:

- Operating premises for the disposal of waste by burial that service, or are designed to service, the waste disposal requirements of more than 1,000 persons.
- Operating premises, other than a sewerage treatment plant, associated with collecting, transporting, storing, re-cycling, treating or disposing of a Listed Waste on a commercial or fee for service basis.

The RWMF is licensed to collect, store, treat, recycle and dispose of the listed wastes outlined in Table 3-2.

Table 2-2. Listed wastes authorised to be handled under EPL206

Listed Waste	Collection	Transport	Storage	Treatment	Recycling	Disposal
Acidic solutions or acids in solid form	✓	×	✓	×	×	×
Asbestos	✓	×	✓	×	×	✓
Basic solutions or bases in solid form	✓	×	✓	×	×	×
Containers that are contaminated with residues of listed waste	✓	×	✓	×	×	×
Grease trap waste	✓	×	✓	✓	×	✓
Lead, lead compounds	✓	×	✓	×	✓	×
Tyres	✓	×	✓	×	✓	✓
Waste mixtures, or waste emulsions, of oil and water or hydrocarbon and water	✓	×	✓	✓	×	✓
Soils contaminated with a listed waste	✓	×	✓	×	×	×
Surface active agents (surfactants) that contain principally organic constituents and that may contain metals and inorganic materials	✓	×	✓	×	×	×

Tyres, asbestos and waste oil/oily water are accepted from both residential and commercial sources for disposal. All other listed wastes that the facility is licensed for can only be collected from residential sources and stored above ground on site, prior to eventual transport off site.

Any future proposed works associated with the landfill or management of listed wastes also require an Environmental Protection Approval under Schedule 2 of the *WMPC Act*. Any works not covered by the current EPL require an Environment Protection Approval to be obtained from the NT EPA, prior to works commencing. Upon completion of the works under an Approval, the EPL for the RWMF must be amended to include any altered/additional operational activities or areas.

3 EXISTING ENVIRONMENT

3.1 Location and site description

The RWMF is located approximately 5km from the town centre at Lot 7902 on Commonage Road.

The RWMF is situated within the locality of Ilparpa, in the foothills of the Heavitree Range, to the south west of Heavitree Gap. The RWMF is bound to the north and west by rural land, to the north east by Inarlenge (more commonly known as Little Sisters Town Camp) and to the south by the Alice Springs Waste Water Stabilisation Ponds (separated by Commonage Road).

The land parcel is leased to ASTC under a Crown Lease in Perpetuity, which was issued under the Northern Territory *Crown Lands Act* in December 2002 for the purposes of Municipal Waste Management Facility and Ancillary Uses (Tonkin, 2010). The land parcel covers an area of 56.6 ha, with the extent of the current landfill covering approximately 28 ha as a result of landfilling since the 1960's. It is currently unknown whether there are also legacy landfilling areas outside of the current footprint (but still within the site) as a result of dumping prior to the 1960's.

3.2 Land use

The site is currently zoned as Community Purpose and is used for disposal and storage of wastes. The RWMF was built to enhance environmental sustainability via a variety of long term recycling and waste minimisation strategies for advanced waste management across communities in Central Australia.

The surrounding land is predominately zoned as Conservation and Community Purpose under the *NT Planning Scheme* and is a mix of Crown Land, Private and Crown Lease Perpetual. To the east of the RWMF (including Lot 8391), land is zoned as Community Living and Community Purpose. Immediately south of the site is land zoned as Utilities and Organised Recreation for the Alice Springs Sewage farm (Northern Territory Planning Scheme and NR Maps).

Directly west of the site, Lot 8097 is zoned as Community Purpose, for the purpose of conservation and the natural environment. Lots 8097 (west) and 8391 (east) are both subject to Native Title, under DCD2000/001. The Lhere Artepe Aboriginal Corporation RNTBC (body corporate) administers the land as a representation for the Arrente people of the Mparntwe, Antulye and Irlpme estates (Prescribed Bodies Corporate, 2020).

3.3 Topography, surface water and drainage

There are no watercourses within the RWMF. The nearest surface water body to the RWMF is the Todd River, located approximately 600 m to the east. The Todd River runs through the heart of Alice Springs town centre, however as the region is arid, the river is usually dry, and only flows in response to rainfall events. The RWMF is outside of the 1% Annual Exceedance Probability (1 in 100 year) flood zone as modelled in the Alice Springs Flood Investigation and Floodplain Mapping Study, October 2015 (WRM Water and Environment, 2015).

The RWMF is located on undulating slopes at the foothills of the Heavitree Range with elevations on the northern boundary between 580 to 590m AHD. The southern boundary along Commonage Road is relatively flat at an elevation of approximately 565m AHD. Landfilling has occurred above-ground with the current central high point located at 591m AHD.

Surface water drainage from the site would mostly flow towards Commonage Road, although some drainage would also flow east towards the Stuart Highway via overland flow (Tonkin, 2010).

3.4 Geology and hydrogeology

Alice Springs is located within the Amadeus Basin, which is described by the Department of Primary Industry and Resources as a 'large intracratonic sedimentary basin' which was initiated as part of the Central Australian Superbasin. The basin has been affected by intraplate tectonics over time, with highly deformed rocks. The basin also overlies the Warumpi and Aileron provinces to the north, the Musgrave Province to the south and the Eromanga and Pedirka basins to the south east. The lithology of the basin is comprised of dolostone, limestone, shale, sandstone, siltstone, quartzite, evaporate, diamictite and conglomerate (Geoscience Australia, 2020).

Groundwater bore logs, from bores within the site, record the local geology to be comprised of clay and gravel, siltstone, dolomite and quartz conglomerate (NR Maps, 2020).

The site overlies a local aquifer which is described as having fractured and weathered rocks with minor groundwater resources. The aquifer has been noted to yield up to 0.05-0.5 litres/second (NR Maps, 2020). The direction of regional groundwater flow is expected to be east towards the Todd River, however the directional flow of deeper aquifers is unknown and not necessarily in the same direction (Tierra Environment, 2019).

There are currently 8 groundwater bores at the RWMF that are monitored on an annual basis. Details of the bores and standing water levels recorded in March 2019 are included in Table 3-1. Historical monitoring of groundwater levels indicate that the effluent ponds to the south affect groundwater levels, with a mound being created and groundwater gradients being altered in the vicinity of the ponds. Groundwater quality monitoring results have identified some exceedances of assessment criteria (ANZECC guidelines) however this has been attributed to natural, background water quality, and is not considered indicative of leachate impacts to groundwater (Tierra Environment, 2019).

Table 3-1. Groundwater bore details

Bore	Elevation (mAHD)	Depth to water (m)	Purpose
MW1	565.96	7.27	Leachate detection down-gradient of landfill
MW2	565.41	5.01	Background quality with potential influence from effluent ponds
MW3	579.93	21.33	Background quality (up-gradient of landfill)
MW4A	565.03	3.63	Background quality with potential influence from effluent ponds
MW5A	571.00	12.49	Leachate detection down-gradient of landfill
MW6A	582.31	23.58	Leachate detection within active cell area
MW7A	569.08	10.55	Leachate detection down-gradient of landfill
MW81	567.04	8.39	Background levels (up-gradient of landfill)

3.5 Climate

Rain and evaporation

Alice Springs is classified by the Köppen-Geiger climate classification as having a hot desert climate (BWh) (University of Melbourne). Climate data from the Bureau of Meteorology (BoM) for Alice Springs (station number 15590) is found below in Figure 4-1 and shows the hottest and coolest months of the year and average annual rainfall (BoM, 2020). On average Alice Springs receives 276 mm of rain per year, with the highest rainfall in January (49 mm) and the lowest in August (4 mm). When comparing average rainfall and evaporation data for the site, evaporation data exceeds rainfall all year round. Evaporation rates are extremely high, with an average daily evaporation rate of 8.9 mm (3,249 mm annually).

Climatic conditions require consideration in landfill management, as aspects such as rainfall increase the risk of leachate and surface water runoff.

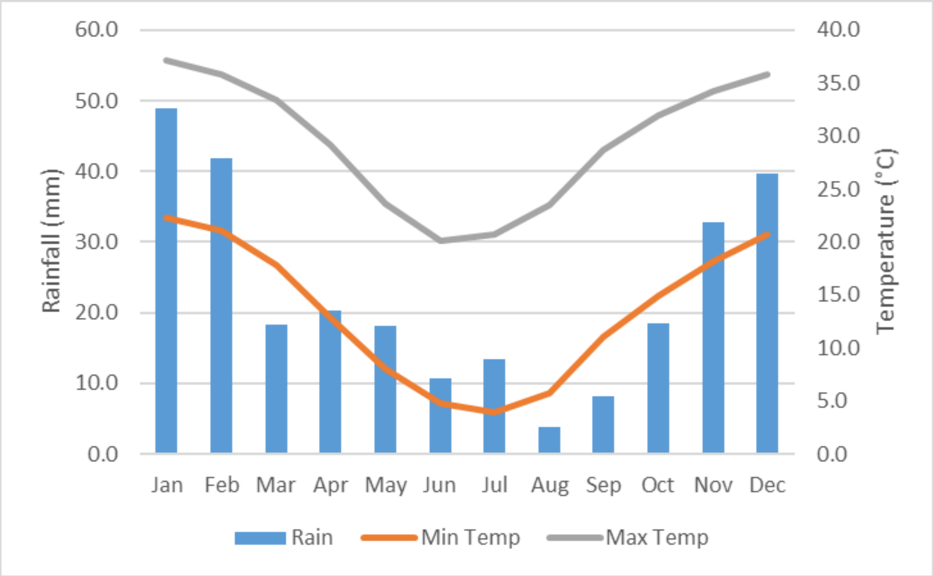


Figure 3-1. Alice Springs Climate Graph (BoM, 2020)

Wind rose data indicates that the average wind direction is predominately easterly and south easterly.

3.6 Leachate and landfill gas

Potential leachate and landfill gas production associated with RWMF are monitored annually in accordance with the RWMF Landfill Environmental Management Plan (LEMP). The monitoring programme for landfill gas includes the monitoring of methane (CH_4), carbon dioxide (CO_2), oxygen (O_2) and volatile organic compounds (VOCs) at various monitoring points (9 - 12 monitoring wells) around the RWMF. Gas monitoring is also undertaken to measure any potential accumulation of landfill gas which may occur in structures such as the weighbridge toilet and office toilet facilities. The landfill leachate monitoring is conducted from a singular leachate well (MW38).

Over the last three years ASTC have engaged Tierra Environment Pty Ltd (Tierra) to conduct the annual monitoring requirements in accordance with the LEMP (Tierra 2017; Tierra 2018 & Tierra 2019). From 2017 to 2019, there has been a slight decrease in methane concentrations recorded at the majority of the monitoring wells; however the concentrations within the active landfill area wells have been above the upper explosive limit (UEL). The slight decrease of methane in the other wells has been associated with a continued moisture deficit in the landfill (due to low annual rainfall totals) (Tierra 2017). In general, if methane concentrations are above the UEL, the gas is not deemed explosive (Cheremisinoff, 2003) therefore the results associated with these recordings are not of serious concern or impact.

The monitoring wells located along the perimeter of the RWMF did not detect any concentrations of methane, however high concentrations of carbon dioxide were detected above the criteria of 1.5% in one well. Without the presence of methane, it was determined that the carbon dioxide was not a product of leachate production.

In monitoring conducted 2016-2017, fluid within the leachate monitoring bore was detected, however it was determined based on the volume, colour, odour and a grab sample that it was not leachate. Since then, the leachate bore has not been able to be sampled due to bore damage. The groundwater monitoring results indicate that there was no leachate contamination in the groundwater underlying the site.

4 LANDFILL FACILITY OVERVIEW

4.1 Current waste operations

The landfill currently has two active cells (Stage 1 and Stage 2, 3, 4 [combined]). Stage 1 is utilised for deep burials of animal carcasses whilst Stage 2, 3, 4 operates an open tip face for putrescible, construction and demolition waste. As landfilling of these stages commenced in the 1960's, the cell preparation is undocumented and therefore the existence of a liner is unknown. In addition to the waste cells described, the RWMF also operates an asbestos disposal cell to the south west of the landfill cells. The asbestos disposal cell uses a grid system to record location details of each asbestos disposal.

There is a dedicated construction and demolition waste processing area, where construction waste is deposited and set for reuse. This includes waste such as timber, clean and dirty concrete, steel and tyres. Green waste is also segregated on-site and stockpiled for mulching and reuse by ASTC.

The oil ponds at the RWMF allow commercial entities to dispose oils into two ponds. The ponds were constructed in 2015 and are lined with compacted material. ASTC reuse the oil to cure mulch, as well as other recyclable items.
Residential users have access to the transfer station for segregation and disposal of waste.

4.2 Site infrastructure

Table 5-1 summarises the existing infrastructure and facilities of the RWMF. A map of the current site configuration is shown in Figure 5-1.

Table 4-1. Current site infrastructure

Facilities and infrastructure	
<u>Gatehouse and weighbridge (entry and exit)</u> The Weighbridge is a weighing facility where there are dual scales on either side of the building allowing council staff to weigh on and off waste that comes through from residential and commercial drop offs. Construction of the weighbridge was completed in 2013.  	<u>Site office and Rediscovery Centre</u> The RWMF office is where operations are managed from, and where staff conduct meetings and safety checks daily. The Rediscovery Centre is a retail recycling and salvage yard where customers can drop-off and buy second-hand goods. 

Transfer station

The Transfer Station at RWMF is a sorting area where waste is screened prior to disposal, and recyclables are separated thus preventing disposal to landfill. The transfer station was completed in 2013.

Hazardous waste compound

The Hazardous Waste Compound is a fenced compound that receives, stores and disposes hazardous waste e.g. batteries, waste oil, household chemicals and gas bottles.

Glass processing facility

The glass crusher at the RWMF is used to crush glass into a range of recyclable materials.

Cardboard compacting facility

The Cardboard Baler at the RWMF is used to bale a range of recyclable items which are then transported interstate for further processing.

Identified constraints and improvements to the current infrastructure and operational activities can be found in Section 9.

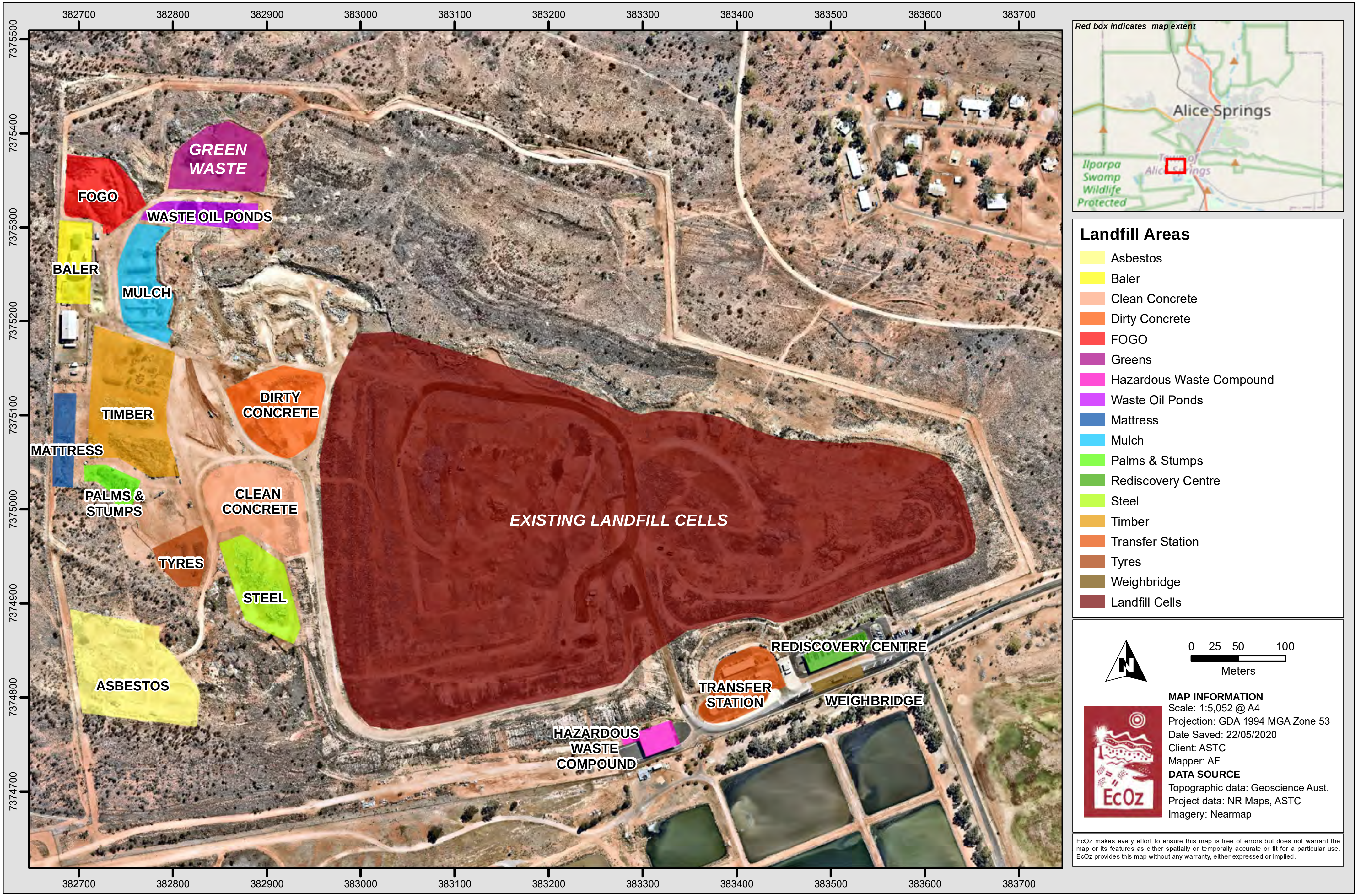


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Figure 4-1. Map of existing landfill

4.3 Waste disposal performance criteria

The RWMF Landfill Environment Management Plan (LEMP) describes the waste disposal and compaction measures to be undertaken to ensure effective and efficient waste disposal and compaction at the site. The LEMP includes disposal performance criteria which have been replicated in Table 5-2.

Table 4-2. Alice Springs RWMF waste disposal performance criteria

Parameter	Performance Criteria	Notes
Waste Layer Thickness	Max 0.6 m	• waste layers shall be placed at approximately 600 mm uncompacted thickness and compacted thoroughly
Total Lift height	Min 2.0 m	• minimum daily lift height 2.0 m after being compacted in layers • maximum height to be governed by placement methodology on site and the safety of exceeding 2 m
Waste disposal area (daily cell/tip face)	Max 80 m^2 E.g. Approx. 9 m (L) x 9 (W)	• disposal area shall be managed to ensure safety at all times and managed in daily cells that minimise the extent of exposed waste face and usage of soil daily cover material • the tip face shall be clearly identified with high visibility markers and signage to promote safety to staff and contractors
Compaction method	Upslope 1(H):3(W)	• waste shall be pushed into the batter slope and upslope • the tip face area should maintain a waste face with a batter slope of approx 1 (high) : 3 (wide)
Final batter slope construction	Slope 1(H): 4W	• the final batters slope around the edge of the extent of waste and forming the final landform shall be a maximum of 1(high): 4 (wide) constructed to aid future constructability and rehabilitation of the capping system
Final capping cover	Min 1.0 m	• Minimum 1.0 m (0.3 interim cover 0.6m subsoil and 0.1m topsoil) – but dependent on final capping design
Target Waste Density	Min 850 kg/m^3	• confirmed by comparison of annual survey and weighbridge data, AS 1289.5.8.1, 5.2.1, 2.1.1, 5.4.1 shall be used to determine the cover density in any waste calculations..
Daily Cover	Min 150 mm	• applied daily and cut back for reuse at next day. AS 1141.4 will be used to determine the bulk density of soil.
Alternative daily cover	Cost effective alternative to soil usage	• alternative as approved by Council eg removable lids; spray on materials; films etc
Interim Cover	Min 300 mm	• cut back and reused prior to placing additional waste
Cover stockpile	Min 1 000 m^3	• stockpile maintained adjacent active tipface

4.4 Waste volumes

A review of the waste disposal data from the RWMF over the past five years was undertaken to determine any trends in landfill disposal versus salvaged recyclables. From 2018 there is a decrease in landfilled volumes whilst salvaging increased, however there is insufficient data to determine if this is an ongoing trend. The landfilled volumes in 2018 also dramatically increase from previous years which could be indicative of local development. In 2019, 30% of the waste taken to the RWMF was salvaged from being landfilled and the total volume landfilled was the lowest recorded since 2015. Between 2015 and 2018, the average salvaging rate was 11%. Figure 5-2 shows the waste disposal rates compared with salvaging over the past five years.

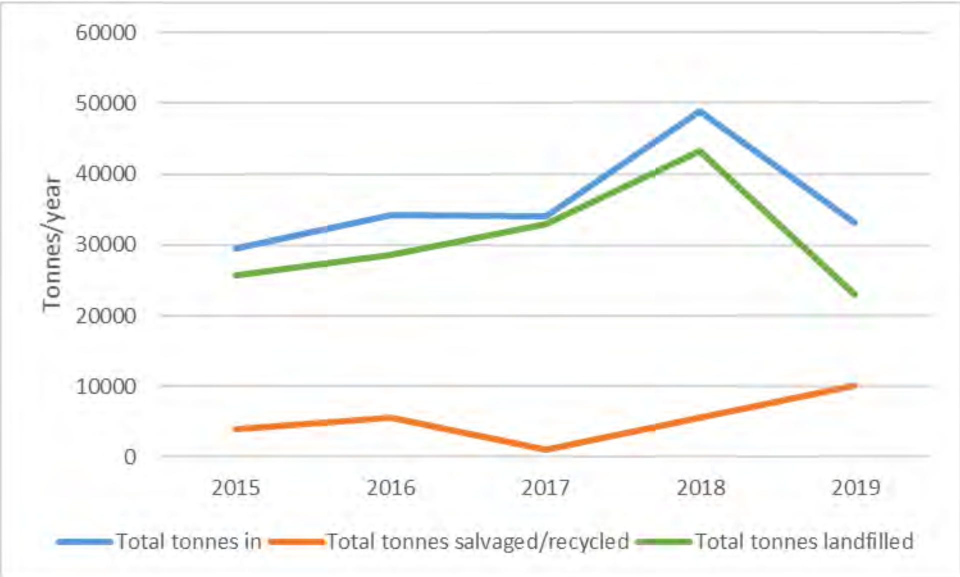

Figure 4-2. RWMF waste disposal rates

Population trends can be used as an indicator of expected waste generation, however, waste disposal rates can often be highly variable depending on construction and development opportunities in the region. As recycling initiatives increase and new technologies for waste management are introduced, waste disposal to landfill is also expected to increase.

4.5 Areas for expansion

A review of the current site layout reveals some currently unused areas that could be used for future expansion – either for landfill consumption or other waste management areas (see Figure 5-3). Landfill airspace is considered more valuable than laydown in areas where there is potential to expand filling activities. There is potential to relocate some current waste management areas on top of the final landform as filling progresses, subject to capping requirements. Alternatively some waste management activities (i.e. the Rediscovery Centre and Transfer Station) may need to be relocated to alternative sites if operations become hindered due to landfill expansion and increased salvaging. These options are explored further in Section 9.

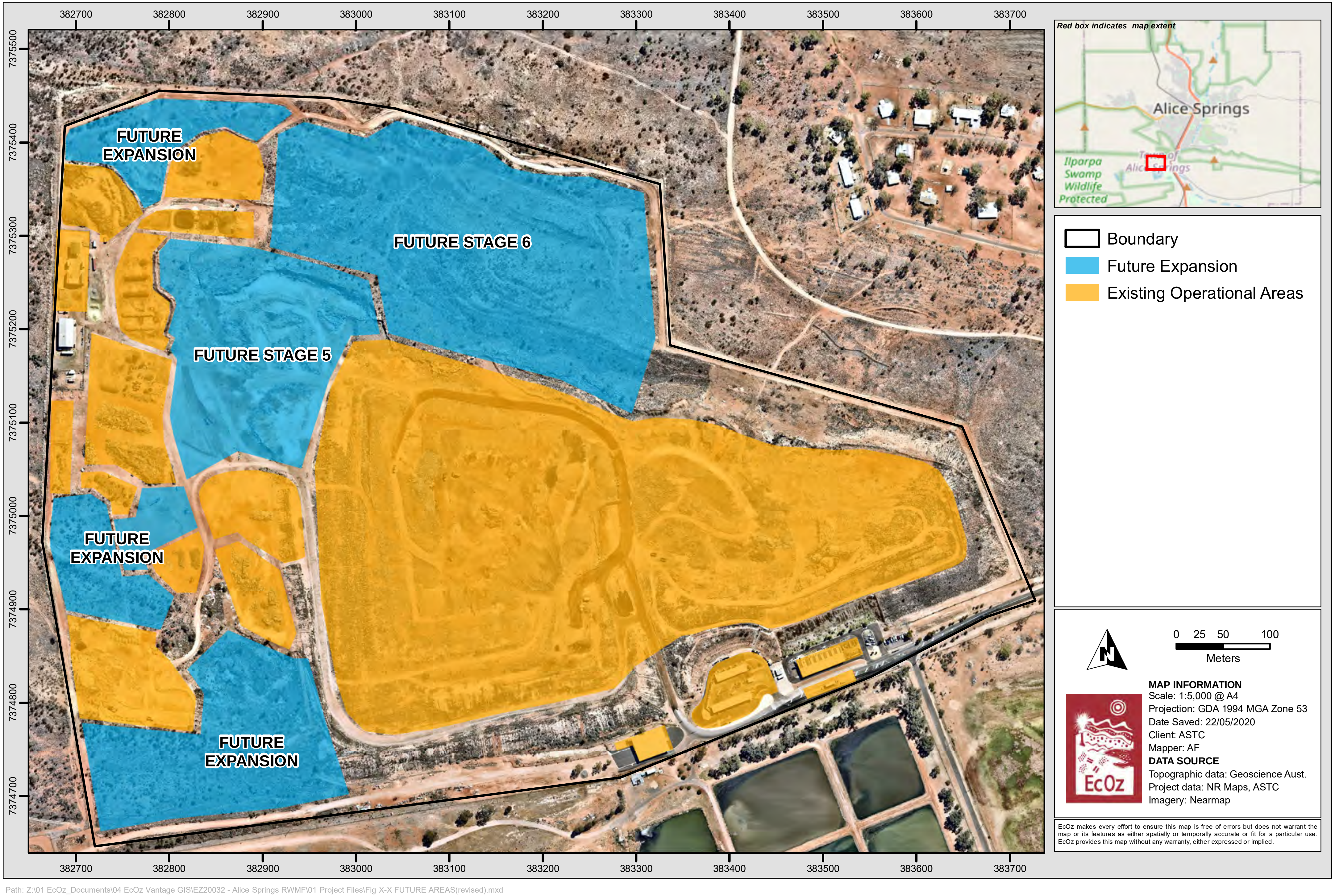

Figure 4-3. Map of available future expansion

5 STAGING & LANDFORMS

5.1 Current landfill capacity

The proposed extent of future works has been developed whilst considering the following assumptions:

- The location of the current landfill cells, identifying areas upon which void space can be filled
- Areas upon which open space is available for the construction of new cells
- Site boundaries
- The location of existing asbestos and other waste management areas
- A base level of 570m AHD for new cells
- No provision for roads or access tracks
- No provision for settlement post closure

An airspace volume analysis of the landfill was performed utilising the 2019 survey data provided to EcOz by ASTC in February 2020, in order to inform the volumes and staging of the final landform.

5.2 Model inputs

For the purpose of predicting airspace consumption over the next ten years, there are several potential scenarios that can be modelled. Firstly, waste disposal rates can be based on the current average landfilling rates, or worst-case waste disposal rates, based on the maximum landfill tonnage from the past five years. In addition, the compaction rates can differ between actual (calculated from volume surveys), minimum recommended in relevant guidelines and target compaction based on the LEMP. A summary of these different modelling factors have been included in Table 6-1.

Table 5-1. Annual landfill disposal factors for modelling

	Average landfill rates	Maximum landfill rates
Tonnage	30,700 tonnes	43,300 tonnes
Volume with minimum compaction (0.8 t/m^3)	38,375 m^3	54,125 m^3
Volume with target compaction (0.85 t/m^3)	36,118 m^3	50,942 m^3

For the initial modelling of stages and final landforms, the average landfill rate with minimum compaction was used (38,375 m^3). This number may be changed to provide best case vs worst case scenarios. In order to predict future landfill disposal volumes, a conservative 3% annual increase was assumed.

5.3 Stage development

The proposed staged development of the site, taking into consideration the site constraints and objectives of the masterplan is provided in Appendix A. The different phases of filling are detailed in the sections below and the respective volumes and timeframes are outlined in Table 6-2.

5.3.1 Stage 1-4

The first phase of the landfill staging identifies the available airspace between the current landform to its highest point of 588m AHD with 1 in 4m batter slopes. In practice, this model may not be achievable on all areas of the existing landform, so for the sake of providing a realistic lifespan, the most accessible available airspace for filling was measured. The total estimated available space for future landfill consumption is 93,700m^3. A quantity analysis of this volume indicates that it will take approximately 2 years, from 2020 to 2022, for it to be landfilled (factoring in waste volume and cover materials).

2m lift increase

Currently there are no planning schemes in the region that prevent the current height of the landfill from increasing. The geographical surroundings allow for a landfill height increase without adversely impacting on the amenity of the area. The final height of landfills is often determined by intended future land-use i.e. allowing sufficient surface area at the crest to facilitate the land-use. It has been assumed that placing another lift on the current landform height will not impact on any future intended land-use. Therefore another 2m lift was modelled, increasing the landform height to 590m AHD, whilst maintaining a 1:4 batter slope. The additional lift provides an additional 154,000m^3 of available airspace (bringing the total available airspace for the existing landform to 248,000m^3).

The quantity analysis indicates that it will take 5 years (2020 to 2025) to fill from the current landform surface to a height of 590m AHD.

5.3.2 Stage 5

Stage 5 is a new cell to be constructed on the boundary of Stage 4. As the existence or depth of a liner of Stage 1-4 is unknown, the base level to connect Stage 5 has been assumed at 570m AHD. When sizing new landfill cells, it is important to maximise the airspace capacity to the capital costs of construction. However, to minimise leachate generation within a cell during early filling, an efficient first lift is required in order to shed storm water off the surface rather than capturing within the open cell base. For this reason it is recommended to split Stage 5 into two cells – 5A and 5B.

Stage 5A

Stage 5A would be built up to a level of 590m AHD, maintaining a batter slope of 1:4, provides 112,000m^3 of available airspace. The quantity analysis indicates that to fill the cell, it will take 2 years from 2025 to 2026.

Stage 5B

The addition of the 5B cell provides an additional 413,800m^3 available airspace to Stage 5, which will take approximately 7 years to fill. In total this brings the capacity of Stage 5 to 526,000m^3 with an estimated lifespan of 9 years (from 2025 to 2034).

5.3.3 Future Stages

Currently there are no forecast closure dates for the landfill and it is assumed that the facility will remain active for waste acceptance until it is considered to be at capacity. There are still unused areas within the RWMF where landfill expansion is achievable should the facility require extension beyond 2034.

An analysis of the unused area located to the north of Stages 2, 4 and 5A, was undertaken to determine the volume of excavation required to allow for landfill expansion in this direction. Current survey data shows there is a local highpoint of 594m AHD, upon which excavation of approximately 646,000m^3 would be required to set the base level of the cell to 570m AHD. In the event that the material in this area is suitable for use in a liner or capping system, the operation could potentially be viable. However a large portion of this area is also covered with historical dumped waste, and there is visible asbestos waste scattered throughout. It is also unknown if there are any historical landfill pits underneath the surface, which could result in to high remediation costs prior to landfill expansion.

The costs to undertake cell preparation and construct a liner system in this area have been included in this report to assist with decision making purposes, however it may prove more cost effective to continue landfill expansion south of Stage 5 instead.

5.4 Liner system

Based on the population size and the requirement to landfill municipal solid waste, the NT EPA *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites* (2013), recommend a composite liner system which consists of a geomembrane in addition to a clay liner for all new waste cells. A typical composite liner system is comprised of the following layers:

- Sub-base – in-situ material, or imported as required
- Clay liner – minimum 900mm thick (alternatives include a geosynthetic clay liner)
- Geomembrane – often made from high density polyethylene (HDPE), minimum 1.5mm thick
- Leachate collection system:
  - A drainage layer consisting of highly permeable aggregate material (sand or gravel)
  - A network of perforated pipes laid within the aggregate layer
  - Filter layers of aggregate or geotextile fabric to prevent clogging
  - Sump(s) at low points from where leachate can be collected.

The leachate collection system shall be designed such that the depth of collected leachate does not exceed 300mm at the topographical low point of the liner.

5.5 Final Capping

It is considered best practice to commence final capping and revegetation as soon as practicable after the final delivery of waste to a particular cell. The final capping must be designed to (NSW EPA, 2016):

- Reduce rainwater infiltration into the waste and thus minimise the generation of leachate (infiltration from the base of the final cap should be less than 5% of the annual rainfall)
- Stabilise the surface of the completed part of the landfill
- Reduce suspended sediment and contaminated runoff
- Minimise the escape of untreated landfill gas
- Minimise odour emissions, dust, litter, the presence of scavengers and vermin, and the risk of fire
- Prepare the site for its future use; this includes protecting people, fauna and flora on or near the site from exposure to pollutants still contained in, or escaping from, the landfill.

At a minimum, the final cover system should include a 300mm intermediate cover layer over the waste, and minimum 600mm layer of low permeability clay. A layer of topsoil should then be placed at a depth consistent with the rehabilitation requirements and future intended use (generally up to 1m). Vegetation on the final cover should be established immediately (NT EPA, 2013).

Table 5-2. Staged landfill volume estimates

Year	Existing void space	Existing + 2m lift	Stage 5A	Stage 5B	Future	Total Waste (m3)	Waste cumulative total (m3)	Waste total (t)	Daily cover (m3)	Daily cover cumulative total (m3)	Daily cover (t)	Total landfill volume consumed (m3)	Cumulative landfill volume consumed (m3)
2020	38375					38375	38375	30700	5756	5756	9210	44131	44131
2021	39526					39526	77901	31621	5929	11685	9486	45455	89586
2022	2036	38676				40712	118613	32570	6107	12036	9771	46819	136405
2023		41933				41933	160547	33547	6290	12397	10064	48223	184629
2024		43191				43191	203738	34553	6479	12769	10366	49670	234299
2025		8897	35590			44487	248225	35590	6673	13152	10677	51160	285459
2026			45822			45822	294047	36657	6873	13546	10997	52695	338154
2027			14159	33037		47196	341243	37757	7079	13953	11327	54276	392430
2028				48612		48612	389856	38890	7292	14371	11667	55904	448334
2029				50071		50071	439926	40057	7511	14802	12017	57581	505915
2030				51573		51573	491499	41258	7736	15247	12377	59309	565224
2031				53120		53120	544619	42496	7968	15704	12749	61088	626312
2032				54714		54714	599333	43771	8207	16175	13131	62921	689233
2033				56355		56355	655688	45084	8453	16660	13525	64808	754041
2034				11609	46437	58046	713733	46437	8707	17160	13931	66752	820793
2035					59787	59787	773520	47830	8968	17675	14349	68755	889548
2036					61581	61581	835101	49264	9237	18205	14779	70818	960366
2037					63428	63428	898529	50742	9514	18751	15223	72942	1033308
2038					65331	65331	963860	52265	9800	19314	15679	75130	1108439
2039					67291	67291	1031151	53833	10094	19893	16150	77384	1185823
2040					69310	69310	1100460	55448	10396	20490	16634	79706	1265529

Total waste landfilled (m3)	79937	132699	95570	359091	433163
Total cover requirement (m3)	11991	19905	14336	53864	64974
Start date	2020	2022	2025	2027	2034
End date	2022	2025	2027	2034	Ongoing
Months to fill	24	38	26	82	Ongoing
Total waste capacity (m3)	79937	19905	95570	359091	-
Total landfill capacity (m3)	91927	152603	109906	412955	770000

NOTE: Assumptions include

- A 3% annual waste increase
- Compaction rates of 0.8 t/m^3
- Daily cover volumes 15% of total waste volumes

6 STORM WATER MANAGEMENT

6.1 General storm water management

There are two principles to general storm water management on landfill sites:

1. Divert clean water run-on from undisturbed areas around the active landfill areas.
2. Direct dirty site water run-off from disturbed areas within the active landfill area to appropriate control measures.

Any water that comes into direct contact with waste should be managed as leachate.

All relevant stormwater calculations (including BoM IFD, runoff and sediment pond sizing) can be found in Appendix B.

6.2 Drainage

Indicative drainage pathways for the various stages are shown on the staging maps in Appendix A. Swale drains should be constructed at the crest of the landforms and spaced down the batters to collect stormwater runoff and drain down the toe of the batter in rock-lined chutes. The rock-lined chutes will discharge into swale drains which drain into sediment basins.

Drainage design considerations are proposed as follows:

- **Swale drains:** to be positioned at the crest of the final landform (per stage), spaced approximately 35 m apart down the batters (above berms), along the toe of the batters, and from the rock-chutes to the sediment basins.

  Swales should be graded at approximately 2% to prevent excess sediment build up within the drains, whilst managing velocity to prevent scour (detailed design to be considered in an Erosion and Sediment Control Plan [ESCP]).

- **Rock-lined chutes:** to be constructed down the batter slopes at a gradient of approximately 14° with appropriate erosion protection (i.e. rock size and placement).
- **Diversion drains:** to be constructed around the perimeter of disturbed areas to collect clean water run-on for discharge into the surrounding environment. Appropriate erosion protection and discharge structures to be determined in an ESCP.

6.3 Sediment basins

Indicative locations of sediment basins are shown in Appendix A and indicative sizing has been summarised in Table 6-1. Sediment basin sizing has been based on the both the *CSIRO Water Sensitive Urban Design (WSUD) Engineering Procedures (2005)* and *WSUD Technical Design Guidelines South East Queensland (2006)*. These calculations are deemed conservative and therefore appropriate for this masterplan. They have been included to provide an indication of storm water management requirements and subsequent costs. It is recommended that an ESCP is prepared for the site, in accordance with *International Erosion Control Association* guidelines, which will identify soil loss rates and erosion risk, and assist in determining actual sediment basin requirements.

Table 6-1. Sediment basin indicative sizing

	Sediment Basin A	Sediment Basin B	Sediment Basin C
Contributing catchment area (ha)	7.7	5.5	11.4
Area of sediment pond (m^2)	300	250	450
Internal batter gradient	1 in 5	1 in 5	1 in 5
Storage volume (m^3) *(volume of sediment accumulated over a 5 year period)*	65	45	90
Storage depth (m) *(includes both permanent pool and depth accumulated sediment)*	2	2	2
Extended Detention Depth (mm) *(can be considered freeboard in this instance)*	300	300	300
Desilting frequency (years) *(target of 5 years)*	5.55	5.38	5.22

7 LEACHATE MANAGEMENT

7.1 Leachate generation

It is recommended that a detailed water balance is undertaken to determine potential existing volumes of leachate in Stages 1-4 as well as expected volumes to be generated in future stages. The water balance should consider rainfall and evaporation data for the region, rainfall infiltration rates through the current cover system and future capping systems and sizing of any proposed leachate dams or ponds. In the absence of a detailed water balance, the NSW EPA (2016) *Solid Waste Landfills* guideline provides conservative infiltration rates that can be adopted to estimate leachate annual generation:

- 10-20% infiltration through final capping
- 50% infiltration through intermediate capping
- 100% infiltration in any active areas (i.e. open tip face)

Using these conservative rates, leachate generation in the current landform and future stages can be estimated.

Table 7-1. Stage 1-4 leachate generation estimates

	Rainfall infiltration (mm/year)	Rainfall infiltration (%)	Surface area (m^2)	Leachate generation (m^3/year)
Current estimates				
Active tip face	276	100	80	22
Existing cover	138	50	216,000	29,808
			TOTAL	**29,830**
Future estimates				
Final cap flat	27.6	10	70,300	1,940
Final cap slope	27.6	10	148,700	4,100
			TOTAL	**6,040**

Table 7-2. Stage 5 leachate generation estimates

	Rainfall infiltration (mm)	Rainfall infiltration (%)	Surface area (m^2)	Leachate generation (m^3/year)
Current estimates				
Active tip face	276	100	80	22
Interim cover flat	138	50	5,000	690
Interim cover slope	82.8	30	45,000	3,700
			TOTAL	**4,412**
Future estimates				
Final cap flat	27.6	10	5,000	138
Final cap slope	27.6	10	45,000	1,242
			TOTAL	**1,380**

7.2 Cell leachate capacity

The estimate of 29,830 m^3/year leachate generation in the existing landform is very conservative and likely to be much lower. As the liner and/or liner condition of the Stage 1-4 landform is unknown and the current leachate monitoring program has not detected the presence of leachate within the waste mass, it is not possible to determine what volume of leachate is currently being contained.

New landfill cells should be designed with a leachate storage capacity of less than 300mm across the base of the liner. Subject to detailed design, Stage 5 has the potential to maintain a leachate storage capacity of 11,500 m^3. Based on the conservative leachate generation estimates, capacity would be reached within 3 years of commencing filling (Stage 5 has an estimated lifespan of 8 years), without any leachate management.

7.3 Leachate management options

Leachate that collects in the liner system needs to be managed appropriately to prevent excess leachate build-up in the waste mass. The installation of a leachate collection system in the liner in required to perform the following functions (NT EPA, 2013):

- Removal of leachate for treatment, disposal, and/or recirculation into the landfill; and
- Control the head of leachate on the liner system to minimise the quantity of leachate leakage.

Once leachate is extracted from the liner system, it should be stored in a pond, dam or tank for further management. There are a number of options for leachate treatment or disposal which are summarised below.

Transporting to an off-site licensed treatment facility

There are hazardous waste treatment plants across Australia that are licensed to take leachate and treat it to a suitable quality for discharge as wastewater or re-use as recycled water. Given the remote location of Alice Springs, likely quantities of leachate and high transport costs, this treatment method may not be financially viable.

Discharge to sewer under an agreement with the local authority

It is common for landfill sites to obtain a trade waste agreement with the local authority for discharge of leachate into the sewer system. Given the close proximity of the RWMF with the sewage treatment plant, it would be worthwhile ASTC undertaking discussions with Power Water Corporation about the potential for leachate disposal. If an agreement can be reached, it is expected that capital infrastructure costs would be relatively low due to the short distance to run pipes. However often local authorities require some level of pre-treatment due to the high levels of ammonia commonly found in landfill leachate. Depending on the volumes expected, the high ammonia levels can impact on the organic nitrogen loads already present in the sewage making treatment more difficult for the sewage plant.

Evaporation

Leachate evaporation can be used as an effective treatment method, either by the use of a specialised evaporator or through evaporation ponds. The evaporation method allows for the bulk volume of leachate to evaporate, leaving behind a sludge that can be buried back in the landfill. Evaporation ponds can be highly effective in arid areas, such as Alice Springs, due to the low rainfall and high evaporation rates. Evaporation ponds require a high capital outlay as they need to be lined in accordance with landfill guidelines. They also need to be sized appropriately for leachate volumes and rainfall, and require ongoing maintenance to remove the sludge.

Reinjection or recirculation back into the waste

Recirculation of leachate back into the landfill is undertaken for a number of reasons including managing leachate flows. Leachate recirculation can also assist in accelerating waste settlement (increasing airspace) and stabilisation of organic waste. Recirculation can occur through various methods including low-pressure surface application (sprinklers or open trenches), horizontal pipes buried within the waste, or vertical wells or trenches. However, if not properly designed, leachate recirculation can result in environmental and operational concerns such as perching or surface outbreaks of leachate, surface water contamination as a result of leaking reinjection pipes or run-off from surface application or slope instability on batters (Environment Agency UK, 2009).

Treatment on-site

There are many methods of leachate treatment, including:

- Biological treatment; both aerobic and anaerobic – examples include activated sludge, reed beds, wetland systems or membrane bioreactors (MBR).
- Physiochemical treatment such as coagulation or flocculation, carbon adsorption or advanced oxidation.
- Advanced filtration methods such as reverse osmosis (RO) systems, and nanofiltration (NF) or ultrafiltation (UF).
- A combination of any of the above.

Each system has benefits and downfalls and ideally need to be custom designed for each site based on volumes and leachate quality. Criteria to consider when investigating treatment options include:

- Capacity to treat key pollutants to discharge or reuse criteria with minimal pre or post treatment requirements.
- Capacity to manage variable flows and concentrations.
- Energy, water, chemical consumption and ongoing maintenance requirements.
- Generation of any by-products and subsequent management of secondary wastes.
- Simplicity of operation and supervision requirements.
- Land space requirements (i.e. wetlands will require a large area whilst an RO system may be containerised).

8 MATERIAL BALANCE

8.1 Geotechnical testing

A geotechnical investigation was completed by SMS Geotechnical Pty Ltd on 17 April 2020. The investigation took a sample from the south face of the stockpile to the north of the landfill (i.e. future landfill cell location). Table 9-1 below outlines a summary of the investigation and the materials suitability for re-use as a liner. The full report can be found in Appendix C.

In general, clay used for the liner construction should have the following properties:

- no rock or soil clumps greater than 50mm in any dimension;
  - 70 per cent passing through a 75mm sieve;
  - 30 per cent passing through a 19mm sieve;
  - 15 per cent passing through a 2mm sieve;
- soil plasticity index > 10;
- CEC > 10 mEq/100g.

Table 8-1. Summary of geotechnical investigation

	Specification Grading	Conformance
Particle size distribution	75mm – 100% 19mm – 84% 2mm – 56%	Conforming
Soil plasticity index	6 %	Non-conforming
Cation exchange capacity	10.1 mEq/100g	Conforming

The results of the investigation indicate that the plasticity index of the soil sample taken is non-conforming for re-use as a liner for new cell construction. A discussion with Ronny Talavera from SMS Geotechnical on 23 April 2020 suggested that re-use of the soil is possible, however the material would need to undergo a rigorous clean to remove the finer particles that are currently in the soil. Additional clay would also need to be added to the soil composition to bring the plasticity index up to 10%. Although possible, this exercise is considered expensive and a cost analysis would need to be undertaken for the site to decide as to whether an imported clay liner would be cheaper.

8.2 Material requirements

The site material balance should consider all soil materials generated and utilised in site operations.

8.2.1 Material generation

There is a large quantity of soil generation on site:

- Clean fill acceptance – currently the facility receives on average 13,000 tonnes of clean fill per annum, which equates to approximately 8000m^3.
- Existing stockpiled materials – there are some stockpiled onsite materials that could be used for re-use.
- Generated from excavation works – large quantity of soil generated on site due to excavation of new cells to a level of 570m AHD.

8.2.2 Material utilisation

- Due to the non-conforming plasticity results of the geotechnical testing of the northern stockpile, this soil cannot be re-used for lining or final capping works of the cells.
- Excavated and/or stockpiled soils can be used for daily cover of waste, based on a cover requirement of 15% v/v.
- Excavated and/or stockpiled soils can be used for intermediate capping.

8.3 Staged material balance

A summary of the balance between soil excavation, generation and utilisation can be found in Table 9-2. The material balance indicates that there is sufficient material on-site to supply daily cover and intermediate capping requirements. Clay material for the liner and capping systems is excluded from this table as it may need to be imported to meet specifications. Alternatively, the use of geosynthetic clay liners should be investigated.

Table 8-2. Material requirements at various cell stages using site-won material

Waste Cell	Excavation (m^3)		Imported Clean fill (m^3)	Daily Cover (m^3)	Final Capping	Total (m^3)	Balance remaining of excavated soil (m^3)
	Cut (m^3)	Fill (m^3)			Immediate soil cover (m^3)		
Existing landfill + 2m additional lift	-	-		31,895	65,705	360,418	
Stage 5 (A + B)	226,611	-		68,199	15,481	145,602	
Stage 6	693,626	-		64,974	-	64,974	
Total	**920,237**	**-**	**160,000**	**165,069**	**81,185**	**246,254**	**833,983**

9 OPERATIONAL IMPROVEMENTS

9.1 Current constraints

The ASTC undertook a review of the current site infrastructure and operations and identified a number of constraints the site currently faces or may potentially face in the future, as detailed below.

Infrastructure

- The current staff room/site office is at capacity during site meetings and building expansion may be required to accommodate staff.
- The Rediscovery Centre requires larger collection and storage areas to keep up with increasing volumes and encourage waste diversion from landfill. The current site is constrained in area making expansion difficult.
- The staff and customer carpark area will need to increase in line with increased operations at the Rediscovery centre. The carpark requires covering to allow for all-weather access. As the landfill expands, the capacity of the carpark will need to be reviewed.
- Current water access points are restricting expansion as they are only accessible at the front end of the site.
- The waste transfer station is capable of managing the current waste streams and volumes accepted, however future recycling opportunities may put strain on the current infrastructure.

Operations and staffing

- Recycling and salvaging activities currently undertaken on the site become difficult during high temperature months due to heat exhaustion.
- Increasing recycling capabilities may require additional staff to manage the operations.
- Investment of appropriate personal protective equipment (PPE) to provide appropriate protection for staff in dusty and windy conditions often experienced on-site.

Plant and equipment

- Regular road maintenance is difficult due to availability of grading equipment.
- Increasing recycling capabilities will require investment in additional plant and equipment, including equipment to reduce the requirement for manual handling when salvaging.

9.2 Future infrastructure

Based on the current constraints identified, as well as future waste diversion initiatives, new or upgraded infrastructure is required for the following:

- Food organics and garden organics (FOGO) collection and management – including a new water point
- Introducing new recycling/diversion initiatives may require capital spend for infrastructure, such as:
  - Sorting and baling equipment for a container collection depot (cash for cans initiative)
  - Shredding of single-use plastics
  - New plant and equipment for increased salvaging, such as forklifts or claw excavators
- Expansion or relocation of the Rediscovery Centre, including:
  - Larger collection and storage areas
  - Sufficient car parking facilities with shaded access
- Expansion or relocation of transfer station to accommodate increased resource recovery, including:
  - Access for dual cranes to collect skips

- o Parking and dual lane driveway for user access
- o Larger sorting and processing shed including shade and water services

9.3 Infrastructure cost estimates

It is difficult to provide infrastructure cost estimates without concept designs. Indicative cost estimates at this stage may be obtained from reference documents, however it is recommend that costings are prepared by a Quantity Surveyor for any proceeding projects. For the purpose of this Masterplan, the future infrastructure projects identified have been outlined in Table 10-1 and some relevant case studies or reference documents provided to help provide an indication of costs.

Table 9-1. Infrastructure project requirements and references

Future infrastructure	Required items of infrastructure	Assumptions and case study reference
Food organics and garden organics (FOGO) – collection, processing and recycling	• Approvals and licenses • Design drawings and documentation • Community consultation • Infrastructure (site preparation and earthworks, concrete slab base, pavements, shed infrastructure, ventilation systems, lighting and electrical, composting infrastructure, security) • Transport vehicles (excavator, forklift, trucks for transportation)	Organics recycling by the Grampians Regional Waste Management Group (R&RAWG, 2010) Cost effective recycling of regional organic waste by the City of Mandurah (R&RAWG, 2010)
Cash for Cans initiative	• Approvals and licenses • Design drawings and documentation • Community consultation • Infrastructure (concrete slab base, shed infrastructure, crusher/baler machine, pallets, security)	Lajamanu container deposit scheme pilot, trialled in the Central Desert Shire, by the Centre for Appropriate Technology (CAT) (R&RAWG, 2010) CAT paper, written by Alison Wright and Leigh Collins (2006)
Expansion of Rediscovery Centre i.e. double in size	• Approvals • Design drawings and documentation • Infrastructure (concrete slab base, shed infrastructure, electrical infrastructure, security)	Design and Operation of Rural and Regional Transfer Stations (2006) Schedule of Rates. Assume existing area of approximately 3,750m^2 doubled.
Expansion of Transfer Station	• Approvals • Design drawings and documentation • Infrastructure (platform, roof, skip bins, drainage, security, weighbridge)	Gregadoo Waste Management Facility, Wagga Wagga City Council (Department of Environment and Conservation NSW, 2006)
Relocation and construction of new Transfer Station	• Approvals and Licenses • Design drawings and documentation • Community consultation • Infrastructure (earthworks, platform, roof, skip bins, drainage, security, weighbridge) • Decommissioning of old Transfer Station	Gregadoo Waste Management Facility, Wagga Wagga City Council (Department of Environment and Conservation NSW, 2006)
Shaded Staff and Customer Carpark Expansion	• Approvals • Design drawings and documentation • Infrastructure (platform, roof)	Design and Operation of Rural and Regional Transfer Stations (2006) Schedule of Rates. Assumption of an area of 150m^2.

Future infrastructure	Required items of infrastructure	Assumptions and case study reference
Expansion of Ground Level Office	• Approvals • Design drawings and documentation • Infrastructure (concrete slab base, shed infrastructure, electrical infrastructure, security)	Design and Operation of Rural and Regional Transfer Stations (2006) Schedule of Rates. Assumption of an area of 150m^2.
Water infrastructure	• Approvals • Design drawings and documentation • Infrastructure (service proving, excavation, trenching of pipe line, backfill, road re-establishment, water connection, water meter)	Design and Operation of Rural and Regional Transfer Stations (2006) Schedule of Rates. Assumption that 1000m length of pipeline is required to connect the eastern part of the landfill to the west.

In addition to capital costs, project management, construction management, ongoing maintenance and operational costs need to be determined which are difficult to estimate without further detail of the infrastructure to be implemented. Of the projects outlined above, it is likely that additional staff would only be required for the FOGO plant, operation of a new transfer station, and potentially a cash for cans scheme.

It is recommended that further cost comparisons with detailed designs occur prior to investment in such infrastructure.

10 CONCLUSIONS AND RECOMMENDATIONS

Alice Springs Town Council engaged EcOz Environmental Consultants to complete a 10 year masterplan for the Regional Waste Management Facility. This masterplan has outlined the following strategy for the future operation and development of the RWMF:

- At the current filling rate, the current landfill cells (Stages 1-4) can continue filling for the next 5 years (2020 to 2025), bringing the total available airspace for landfilled materials to a volume of 248,000m^3 at a maximum height of 590m AHD.
- The construction of a new cell, Stage 5, is to be constructed on the boundary of Stage 4 and is to be split into two sub-stages; Stage 5A and Stage 5B. The estimated lifespan of Stage 5 is 9 years (from 2025 to 2034) with an estimated capacity of 526,000m^3.
- An analysis of potential areas for expansion of the landfill cells indicates that the unused area to the north of Stages 2, 4 and 5A could be utilised. The current constraints of this area of the site, however, include a large volume of excavation required to set the base of the cell to a level 570mAHD. Additionally, as this area is covered with historical dumped waste (i.e. asbestos) additional remediation measures would be required prior to use. It is recommended that ASTC and the RWMF undertake further geotechnical and contamination investigations, as well as cost benefit analysis, prior to making any decisions regarding the utilisation of this area and re-use of material. It may be more cost effective to expand the landform south of Stage 5.
- In regards to leachate generation, the estimate of 29,830 m^3/year leachate generation in the existing landform is very conservative and likely to be much lower. It is recommended that a detailed water balance be undertaken to determine potential existing volumes of leachate in Stages 1-4 as well as expected volumes to be generated in future stages. The water balance should consider rainfall and evaporation data for the region, rainfall infiltration rates through the current cover system and future capping systems and sizing of any proposed leachate dams or ponds.
- Operational improvements and infrastructure investment are key to the progression of a service such as that of the RWMF. The ASTC undertook a review of the current site infrastructure and operations and identified a number of constraints the site currently faces or may potentially face in the future. This report provides a largely conservative approach to identifying the key areas of expansion and development in the future, to solve a number of these constraints. This report can be used to assist in feasibility assessments of proposed infrastructure improvements and future budget development.

11 REFERENCES

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APPENDIX A STAGING PLANS

REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	25.03.2020

FILE: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20032 - Alice Springs RWMF\13 ACAD_Design\EZ20032 - STAGING PLAN.dwg LAYOUT: Layout PLOTTED BY: Adele Faraone PLOT DATE: 27/4/2020 11:10 AM

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Vertical 0 20 40 60 80 100

Alice Springs TOWN COUNCIL

EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

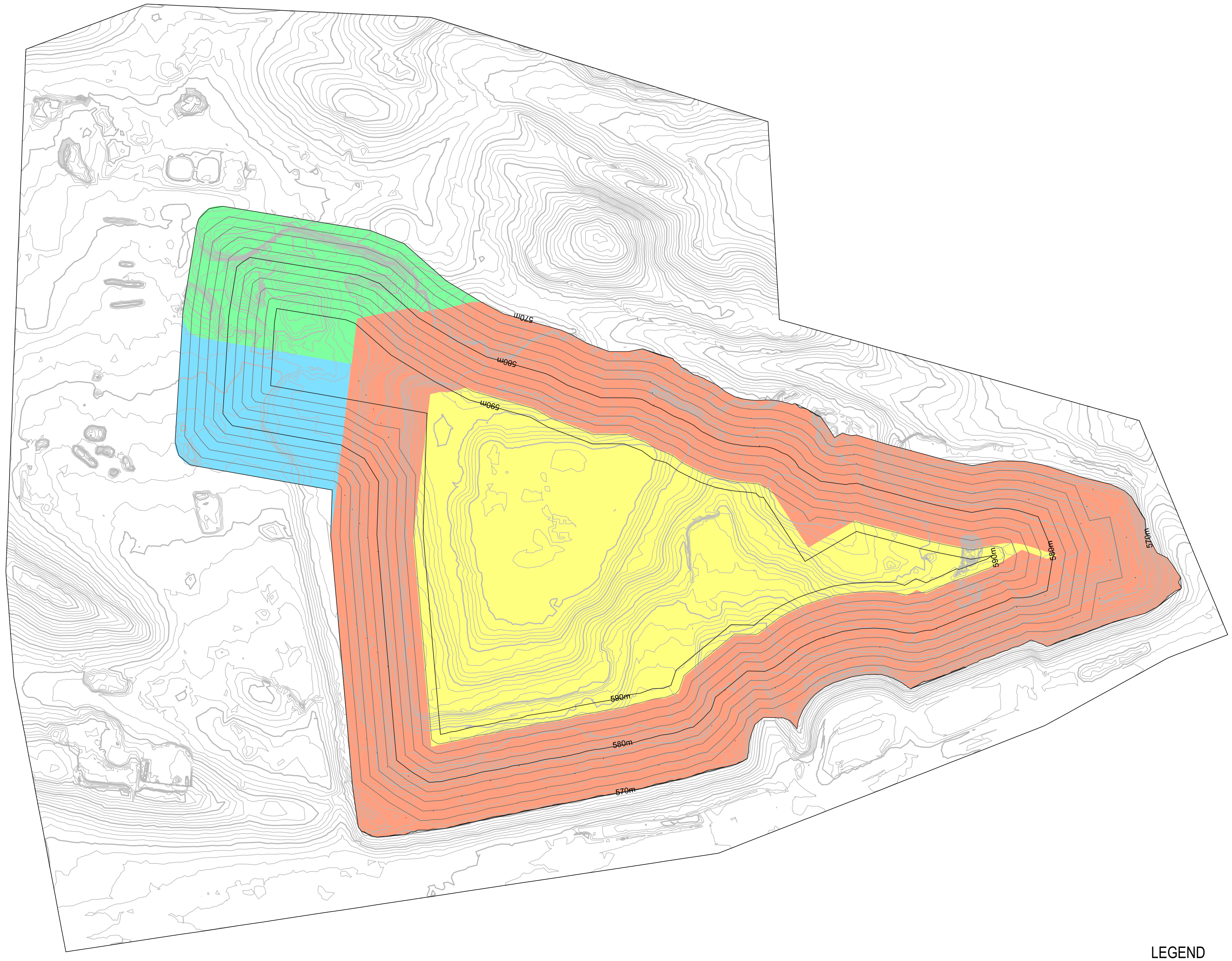
PM	E.LEWIS
DESIGNED	24.03.2020 A.FARAONE
CHECKED	25.03.2020 E.LEWIS
AUTHORISED	25.03.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

RWMF MASTERPLAN ALICE SPRINGS
TOWN COUNCIL
STAGING PLAN

EZ20032-STGPLN

SHEET No. 01 OF 07

REV. B



LEGEND

ITEM	SYMBOL
STAGE 1-4 FILL TO 588m	
STAGE 1-4 2m LIFT TO 590m	
STAGE 5A	
STAGE 5B	

REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	25.03.2020

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N

Scale 1:2000,A1
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Vertical 0 20 40 60 80 100

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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

PM	E.LEWIS
DESIGNED	24.03.2020 A.FARAONE
CHECKED	25.03.2020 E.LEWIS
AUTHORISED	25.03.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA

RWMF MASTERPLAN ALICE SPRINGS

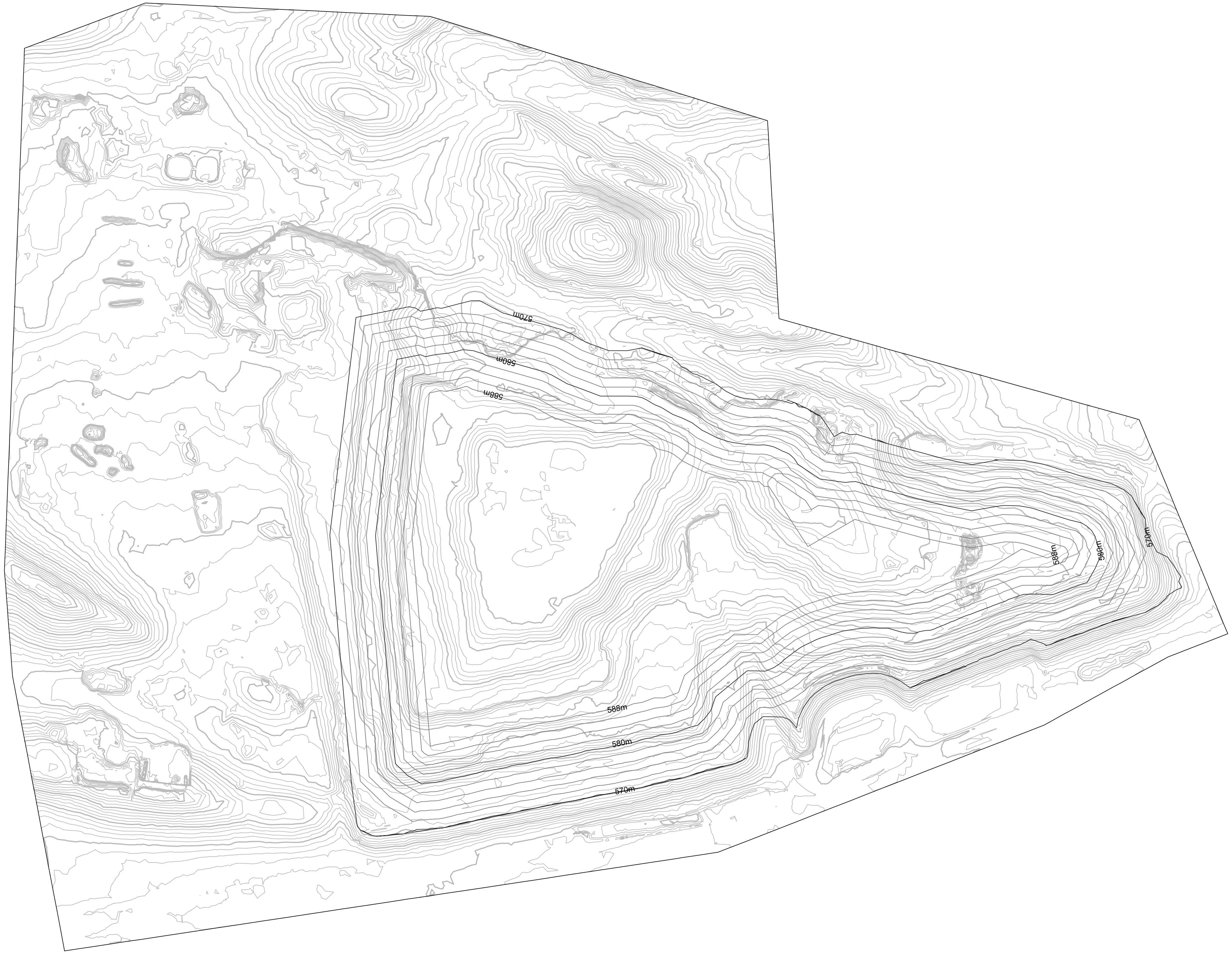
TOWN COUNCIL
PHASING PLAN

STATUS: DRAFT

EZ20032-PHSPLN

SHEET No. 02 OF 07

REV. A



REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	25.03.2020

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N

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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

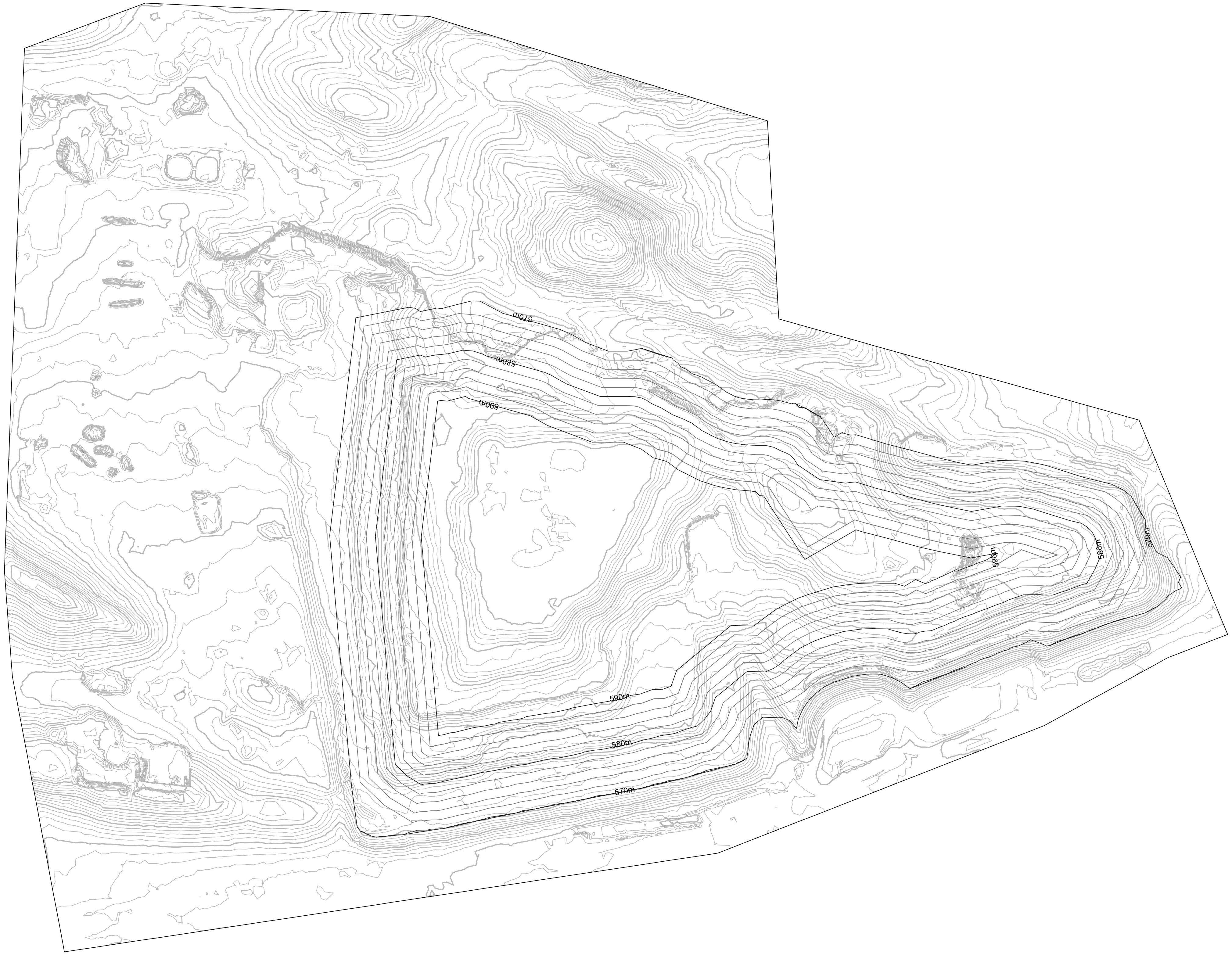
PM	E.LEWIS
DESIGNED	20.03.2020
	A.FARAONE
CHECKED	25.03.2020
	E.LEWIS
AUTHORISED	25.03.2020
	E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

RWMF MASTERPLAN ALICE SPRINGS
TOWN COUNCIL
STAGES 1-4

EZ20032-STG1-4

SHEET No. 03 OF 07

REV. B



REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	25.03.2020

FILE: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20032 - Alice Springs RWMF\13 ACAD_Design\EZ20032 - STG1-4 LIFT.dwg LAYOUT: Layout PLOTTED BY: Adele Faraone PLOT DATE: 27/4/2020 11:12 AM

N

Scale 1:2000,A1
Horizontal 0 20 40 60 80 100
Vertical 0 20 40 60 80 100

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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

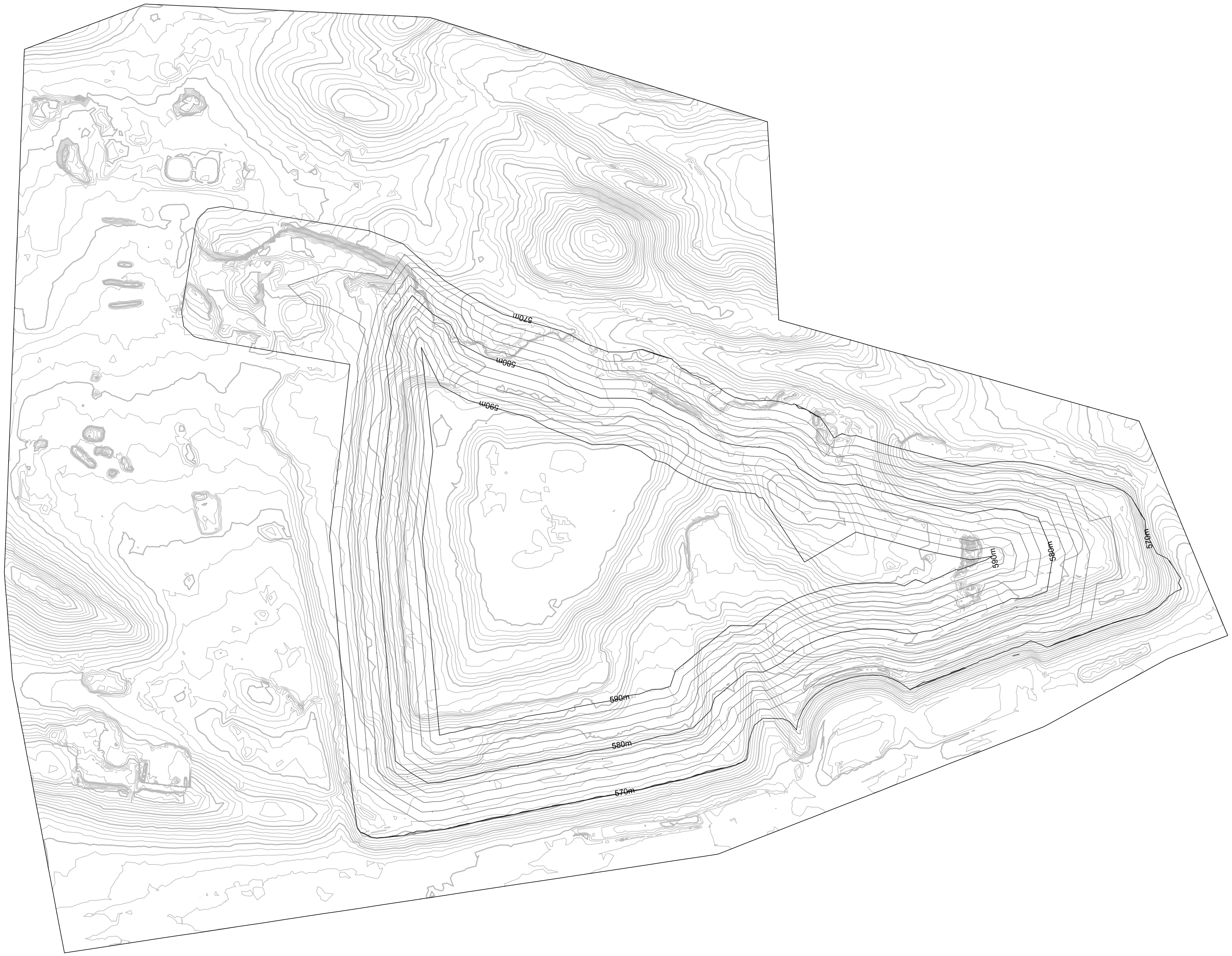
PM	E.LEWIS
DESIGNED	20.03.2020 A.FARAONE
CHECKED	25.03.2020 E.LEWIS
AUTHORISED	25.03.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

RWMF MASTERPLAN ALICE SPRINGS

TOWN COUNCIL
STAGES 1-4 WITH 2m LIFT

EZ20032-SG1-4LIFT

SHEET No. 04 OF 07
REV. B



REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	26.03.2020

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N

Scale 1:2000,A1
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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

PM	E.LEWIS
DESIGNED	26.03.2020 A.FARAONE
CHECKED	26.03.2020 E.LEWIS
AUTHORISED	26.03.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

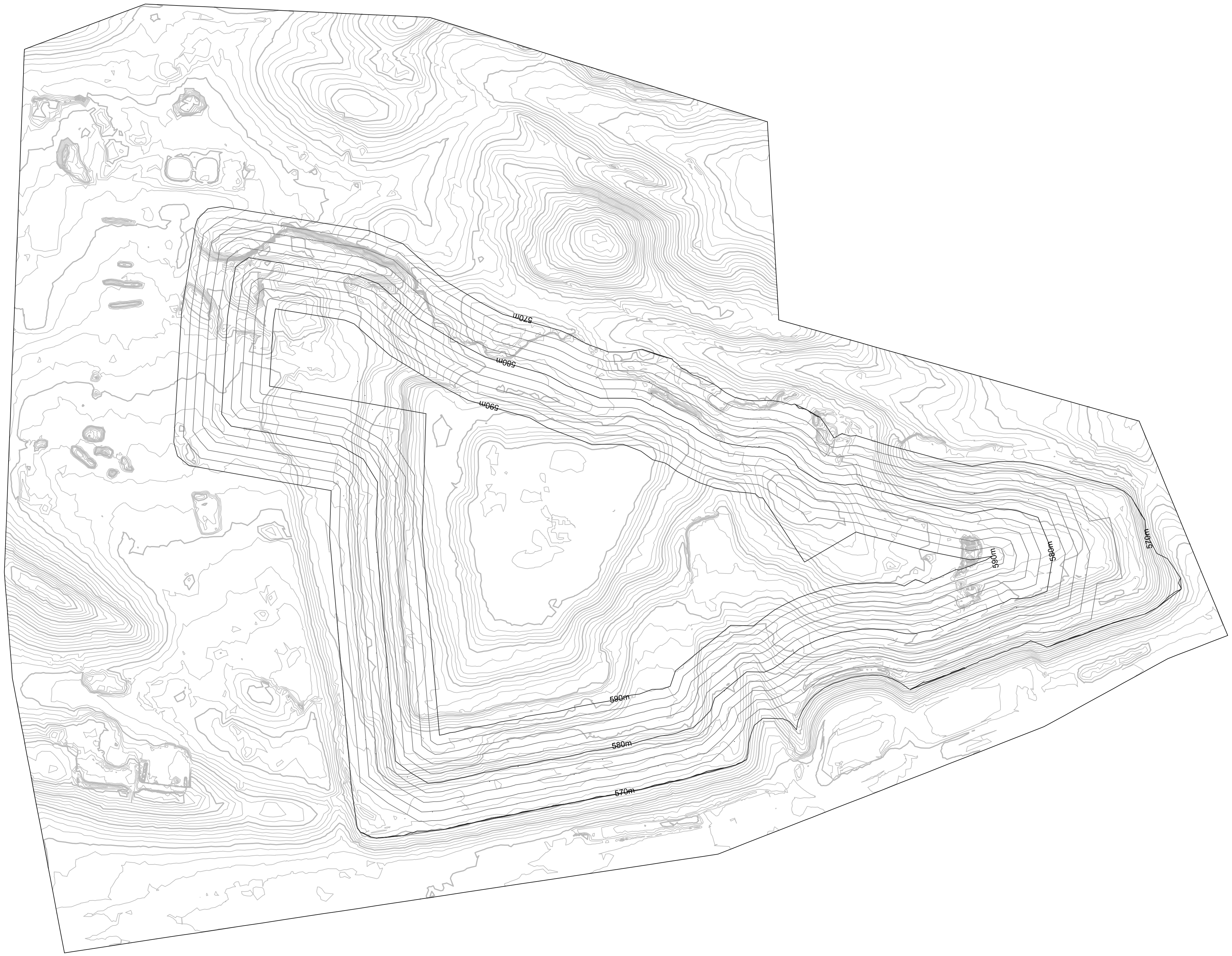
RWMF MASTERPLAN ALICE SPRINGS

TOWN COUNCIL
STAGE 5A

EZ20032-STG5A

SHEET No. 05 OF 07

REV. B



REV.	AMENDMENTS	APP'D	DATE
B	MINOR DRAFTING UPDATE FOR REISSUE TO ASTC	E.L	27.04.2020
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	25.03.2020

FILE: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20032 - Alice Springs RWMF\13 ACAD_Design\EZ20032 - STG5B.dwg LAYOUT: Layout PLOTTED BY: Adele Faraone PLOT DATE: 27/4/2020 11:13 AM

N

Scale 1:2000,A1
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Vertical 0 20 40 60 80 100

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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

PM	E.LEWIS
DESIGNED	24.03.2020 A.FARAONE
CHECKED	25.03.2020 E.LEWIS
AUTHORISED	25.03.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

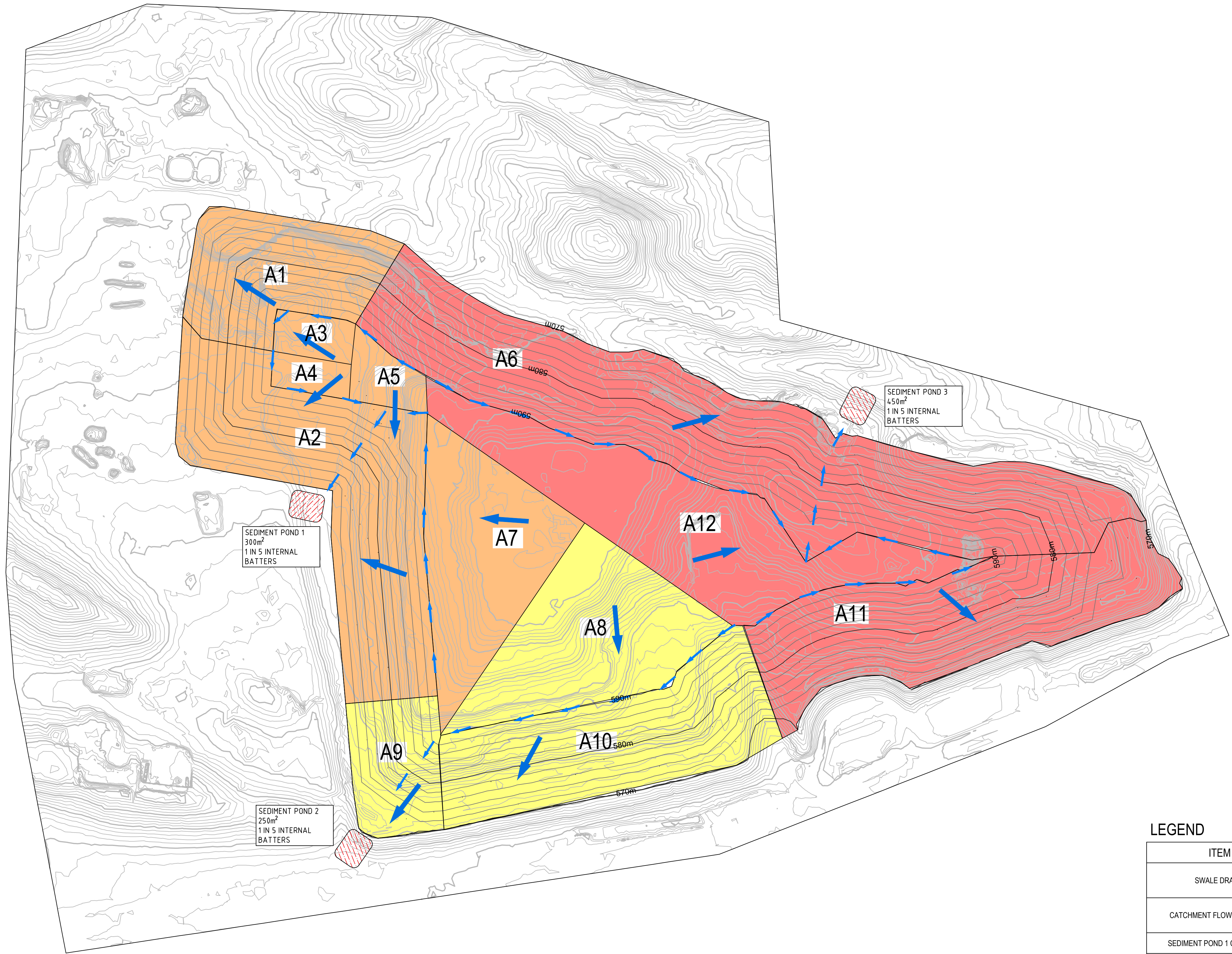
RWMF MASTERPLAN ALICE SPRINGS

TOWN COUNCIL
STAGE 5B

EZ20032-STG5B

SHEET No. 06 OF 07

REV. B



LEGEND

ITEM	SYMBOL
SWALE DRAINS	
CATCHMENT FLOW DIRECTION	
SEDIMENT POND 1 CATCHMENT	
SEDIMENT POND 2 CATCHMENT	
SEDIMENT POND 3 CATCHMENT	
SEDIMENT POND	

REV.	AMENDMENTS	APP'D	DATE
A	DRAFT ISSUE TO ALICE SPRINGS TOWN COUNCIL FOR COMMENT	E.L	24.04.2020

Horizontal 0 20 40 60 80 100
Scale 1:2000,A1
Vertical 0 20 40 60 80 100

FILE: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ20032 - Alice Springs RWMF\13 ACAD_Design\EZ20032 - Stormwater Plan.dwg LAYOUT: Layout PLOTTED BY: Adele Faraone PLOT DATE: 27/4/2020 11:16 AM

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EcOz Environmental Consultants
Level 1, 70 Cavenagh Street
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au

PM	E.LEWIS
DESIGNED	24.04.2020 A.FARAONE
CHECKED	24.04.2020 E.LEWIS
AUTHORISED	24.04.2020 E.LEWIS
MELWAYS:	NA
POS No.:	NA
STATUS:	DRAFT

RWMF MASTERPLAN ALICE SPRINGS

TOWN COUNCIL
STORMWATER PLAN

EZ20032-SW

SHEET No. 07 OF 07

REV. A

APPENDIX B RUNOFF AND SEDIMENT POND CALCULATIONS

Project Name:	Alice Springs Regional Waste Management Facility
Project No.:	EZ20032
Author:	A.F
Date:	23/04/2020

Location: **Alice Springs RWMF**
Latitude: 23.7125 (S)
Longitude: 133.8625 (E)

Data from BOM IFD Program 2016 Rainfall IFD

IFD Design Rainfall Intensity (mm/h)
Issued: 8-Apr-20
Location Label:
Requested coord Latitude 23° 43' 00" Longitude 133° 51' 00"
Nearest grid cell: Latitude 23.7125 (S) Longitude 133.8625 (E)

		Annual Exceedance Probability (AEP)						
Duration	Duration in min	63.20%	50%	20%	10%	5%	2%	1%
1 min	1	78.3	95.2	151	190	231	287	332
2 min	2	67.9	82.9	133	171	210	265	310
3 min	3	62.9	76.8	123	157	192	241	282
4 min	4	59.1	71.9	115	145	177	222	259
5 min	5	55.7	67.8	107	136	166	207	240
6 min	6	52.8	64.1	101	128	156	194	224
10 min	10	43.7	53.1	83.6	105	127	158	182
15 min	15	36.2	44.1	69.5	87.5	106	131	151
20 min	20	31.2	37.9	59.9	75.5	91.5	113	131
25 min	25	27.5	33.4	52.9	66.8	81	101	116
30 min	30	24.6	30	47.6	60.2	73.1	90.9	105
45 min	45	19.1	23.2	37	46.9	57.2	71.6	83.2
1 hour	60	15.8	19.2	30.6	39	47.6	59.8	69.7
1.5 hour	90	11.9	14.5	23.2	29.6	36.3	45.8	53.7
2 hour	120	9.77	11.9	19	24.2	29.7	37.7	44.2
3 hour	180	7.35	8.91	14.2	18.2	22.3	28.4	33.4
4.5 hour	270	5.53	6.68	10.6	13.6	16.7	21.2	25
6 hour	360	4.52	5.46	8.65	11.1	13.6	17.3	20.4
9 hour	540	3.41	4.1	6.49	8.3	10.2	13	15.3
12 hour	720	2.79	3.36	5.31	6.79	8.36	10.6	12.5
18 hour	1080	2.09	2.53	4.01	5.13	6.34	8.06	9.5
24 hour	1440	1.71	2.06	3.29	4.22	5.22	6.65	7.84
30 hour	1800	1.45	1.76	2.82	3.63	4.5	5.73	6.77
36 hour	2160	1.27	1.54	2.49	3.21	3.98	5.08	6
48 hour	2880	1.02	1.25	2.03	2.63	3.28	4.2	4.97
72 hour	4320	0.748	0.919	1.51	1.97	2.47	3.18	3.78
96 hour	5760	0.594	0.733	1.22	1.59	1.99	2.57	3.06
120 hour	7200	0.496	0.612	1.02	1.33	1.66	2.15	2.57
144 hour	8640	0.427	0.526	0.871	1.14	1.42	1.84	2.2
168 hour	10080	0.376	0.462	0.76	0.987	1.23	1.59	1.9

AEP	**C0**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
63.20%	0.26594582	0.72649151	0.16004039	-0.10359758	0.020096971	-0.001697531	5.31E-05
50%#	0.46133363	0.74799126	0.13069384	-0.08917026	0.01688676	-0.001371473	4.09E-05
20%*	0.91963351	0.81840986	0.04035167	-0.047497	0.008141355	-0.000521565	9.93E-06
10%	1.1534303	0.86742347	-0.02032756	-0.02061541	0.002726946	-1.29E-05	-8.15E-06
5%	1.3462833	0.91586429	-0.07951918	0.005202006	-0.002386997	0.000460726	-2.48E-05
2%	1.5640855	0.97747058	-0.15292527	0.03617049	-0.008268688	0.000980185	-4.21E-05
1%	1.7099371	1.0244858	-0.20850606	0.059378278	-0.012620954	0.00135948	-5.47E-05

Project No.: EZ20032
Author: A.F
Date: 23/04/2020

$C^{1}_{10} = 0.1 + 0.0133\ ({}^{10}I_1 - 25)$

$C_{10} = 0.9 * f + C^{1}10\ (1-f)$

Cy = Fy*C10

${}^{10}I_1$ = 39.000000

Alice Springs RWM C^{1}_{10} = 0.2862

ARI	Fy
1	0.8
2	0.85
5	0.95
10	1
20	1.05
50	1.15
100	1.2

f	C1	C2	C5	C10	C20	C50	C100
0.0	0.229	0.243	0.272	0.286	0.301	0.329	0.343
0.1	0.278	0.295	0.330	0.348	0.365	0.400	0.417
0.2	0.327	0.348	0.389	0.409	0.429	0.470	0.491
0.3	0.376	0.400	0.447	0.470	0.494	0.541	0.564
0.4	0.425	0.452	0.505	0.532	0.558	0.611	0.638
0.45	0.450	0.478	0.534	0.562	0.591	0.647	0.675
0.5	0.474	0.504	0.563	0.593	0.623	0.682	0.712
0.6	0.524	0.556	0.622	0.654	0.687	0.753	0.785
0.7	0.573	0.608	0.680	0.716	0.752	0.823	0.859
0.75	0.597	0.635	0.709	0.747	0.784	0.859	0.896
0.8	0.622	0.661	0.738	0.777	0.816	0.894	0.933
0.85	0.646	0.687	0.768	0.808	0.848	0.929	0.970
0.9	0.671	0.713	0.797	0.839	0.881	0.964	1.006

Catchment Imperviousness

Section	Land Type	Fraction Impervious	Area (ha)			C1%	C10%	C18.13%	C1EY
			Total	Impervious	Pervious				
A1	Rural	0.20	1.59	0.32	1.27	0.49	0.41	0.39	0.31
A2	Rural	0.20	3.40	0.68	2.72	0.49	0.41	0.39	0.31
A3	Rural	0.20	0.24	0.05	0.20	0.49	0.41	0.39	0.31
A4	Rural	0.20	0.21	0.04	0.17	0.49	0.41	0.39	0.31
A5	Rural	0.20	0.33	0.07	0.26	0.49	0.41	0.39	0.31
A6	Rural	0.20	5.58	1.12	4.46	0.49	0.41	0.39	0.31
A7	Rural	0.20	1.94	0.39	1.55	0.49	0.41	0.39	0.31
A8	Rural	0.20	2.13	0.43	1.70	0.49	0.41	0.39	0.31
A9	Rural	0.20	0.90	0.18	0.72	0.49	0.41	0.39	0.31
A10	Rural	0.20	2.49	0.50	1.99	0.49	0.41	0.39	0.31
A11	Rural	0.20	2.97	0.59	2.38	0.49	0.41	0.39	0.31
A12	Rural	0.20	2.85	0.57	2.28	0.49	0.41	0.39	0.31
Total Site	Site	0.20	24.63	4.93	19.71	0.49	0.41	0.39	0.31

Project Name: Alice Springs Regional Waste Management Facility
Project No.: EZ20032
Author: A.F
Date: 23/04/2020

Rational Method Flows

General Data		1% AEP						10% AEP					18.13% AEP					1EY					Description
Section	Area	C_{100}	Tc	I_{100}	∑ Ae	Q_{100}	C_{10}	Tc	I_{10}	∑ Ae	Q_{10}	C_5	Tc	I_5	∑ Ae	Q_5	C1	Tc	I1	∑ Ae	Q1	Comments
	Ha		min	mm/min	Ha	m^3/s		min	mm/min	Ha	m^3/s		min	mm/min	Ha	m^3/s		min	mm/min	Ha	m^3/s	
A1	1.59	0.49	3.33	273.84	0.78	0.59	0.41	4.32	142.29	0.65	0.26	0.39	4.81	108.72	0.62	0.19	0.31	6.49	51.42	0.49	0.07	
A2	3.40	0.49	16.19	145.67	1.67	0.68	0.41	4.24	143.09	1.39	0.55	0.39	4.72	109.34	1.32	0.40	0.31	6.37	51.75	1.06	0.15	
A3	0.24	0.49	5.45	232.53	0.12	0.08	0.41	7.08	120.88	0.10	0.03	0.39	7.90	91.94	0.09	0.02	0.31	10.78	42.31	0.08	0.01	
A4	0.21	0.49	5.10	238.29	0.10	0.07	0.41	6.62	123.91	0.09	0.03	0.39	7.38	94.33	0.08	0.02	0.31	10.05	43.61	0.07	0.01	
A5	0.33	0.49	3.35	273.29	0.16	0.12	0.41	4.35	142.01	0.13	0.05	0.39	4.85	108.50	0.13	0.04	0.31	6.54	51.30	0.10	0.01	
A6	5.58	0.49	2.64	291.85	2.74	2.22	0.41	3.42	151.65	2.28	0.96	0.39	3.81	115.97	2.17	0.70	0.31	5.13	55.32	1.73	0.27	
A7	1.94	0.49	9.94	182.72	0.95	0.48	0.41	12.97	93.82	0.79	0.21	0.39	14.54	70.52	0.75	0.15	0.31	20.21	31.00	0.60	0.05	
A8	2.13	0.49	11.50	171.20	1.05	0.50	0.41	15.05	87.37	0.87	0.21	0.39	16.90	65.41	0.83	0.15	0.31	23.59	28.41	0.66	0.05	
A9	0.90	0.49	2.44	297.51	0.44	0.37	0.41	5.44	132.50	0.37	0.14	0.39	6.07	101.08	0.35	0.10	0.31	8.22	47.27	0.28	0.04	
A10	2.49	0.49	2.48	296.23	1.22	1.01	0.41	3.22	153.96	1.02	0.44	0.39	3.59	117.77	0.97	0.32	0.31	4.82	56.28	0.77	0.12	
A11	2.97	0.49	2.48	296.23	1.46	1.20	0.41	3.22	153.96	1.21	0.52	0.39	3.59	117.77	1.15	0.38	0.31	4.82	56.28	0.92	0.14	
A12	2.85	0.49	11.27	172.81	1.40	0.67	0.41	14.74	88.28	1.17	0.29	0.39	16.54	66.13	1.11	0.20	0.31	23.42	28.53	0.89	0.07	
Total Site	24.63	0.49	39.38	90.11	12.09	3.03	0.41	52.69	42.42	10.07	1.19	0.39	58.61	31.10	9.57	0.83	0.00	0.00	0.00	0.00	0.00	

Project Name:	Alice Springs Regional Waste Management Facility
Project No.:	EZ20032
Author:	A.F
Date:	23/04/2020

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Fair and Geyer Equation – Equ 10.3 WSUD Stormwater Technical Manual (2004)

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A} \cdot \frac{(d_e + d_p)}{(d_e + d^*)}\right]^{-n}$$

$$\lambda = 1 - 1/n; \quad n = \frac{1}{1-\lambda}$$

R = fraction of Initial Solids Removed = 80 - 90 % typ.
d_p = Depth of permanent pool
d_e = Extended detention depth above permanent pool
d^* = depth below permanent pool sufficient to retain particles (lower of 1.0m or d_p)
Q = design flow (Typically 3 month, 6 month or 1 year flow)
A = Basin Surface Area
n = turbulence parameter (see above) = 1 for significant short circuiting and turbulence
= 5 for insignificant short circuiting and turbulence
v_s = setting velocity for particles

Table 7.2 Settling velocities under ideal conditions (Maryland Department of Environment, 1987)

Classification of Particle size range	Particle diameter (μm)	Settling velocities (mm/s)
Very coarse sand	2000	200
Coarse sand	1000	100
Medium sand	500	53
Fine sand	250	26
Very fine sand	125	11
Coarse silt	62	2.3
Medium silt	31	0.66
Fine silt	16	0.18
Very fine silt	8	0.04
Clay	4	0.011

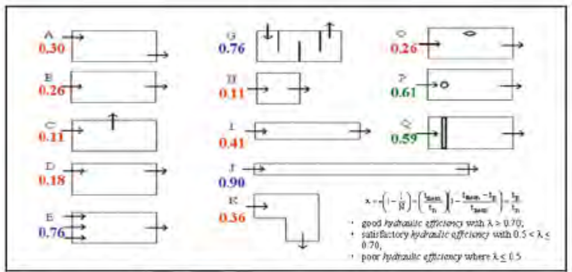

Figure 10.5 Hydraulic Efficiency – A measure of Flow Hydrodynamic Conditions in Constructed Wetlands and Ponds; Range is from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment [Source: Australian Runoff Quality, 2003]

Source: WSUD Engineering Procedures: Stormwater Technical Manual DRAFT 2004

Calculations - Sediment Pond 1

Catchments which require a sediment pond: A1, A2, A3, A4, A5, A7

Target = very fine sand			Notes
Vs =	0.011	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.31	m/s	1 Year ARI
A =	300.0	m^2	Sed. Pond
V_s = / Q/A	10.79		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	95%		
C_a =	7.7	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	59	m^3	
S_a =	65	m^3	
Frequency of Desilting			
F_o =	5.55	years	

Target = fine sand			Notes
Vs =	0.026	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.31	m/s	1 Year ARI
A =	300.0	m^2	Sed. Pond
V_s = / Q/A	25.51		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	98%		
C_a =	7.712	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	61	m^3	
S_a =	65	m^3	
Frequency of Desilting			
F_o =	5.36	years	

Project Name:	Alice Springs Regional Waste Management Facility
Project No.:	EZ20032
Author:	A.F
Date:	23/04/2020

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Fair and Geyer Equation – Equ 10.3 WSUD Stormwater Technical Manual (2004)

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A} \cdot \frac{(d_e + d_p)}{(d_e + d^*)}\right]^{-n}$$

$$\lambda = 1 - 1/n; \quad n = \frac{1}{1-\lambda}$$

R = fraction of Initial Solids Removed = 80 - 90 % typ.
d_p = Depth of permanent pool
d_e = Extended detention depth above permanent pool
d* = depth below permanent pool sufficient to retain particles (lower of 1.0m or d_p)
Q = design flow (Typically 3 month, 6 month or 1 year flow)
A = Basin Surface Area
n = turbulence parameter (see above) = 1 for significant short circuiting and turbulence
= 5 for insignificant short circuiting and turbulence
v_s = setting velocity for particles

Table 7.2 Settling velocities under ideal conditions (Maryland Department of Environment, 1987)

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Medium sand	500	53
Fine sand	250	26
Very fine sand	125	11
Coarse silt	62	2.3
Medium silt	31	0.66
Fine silt	16	0.18
Very fine silt	8	0.04
Clay	4	0.011

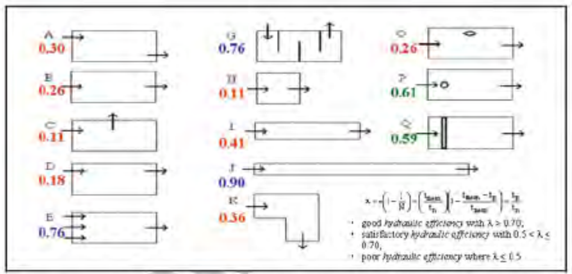

Figure 10.5 Hydraulic Efficiency – A measure of Flow Hydrodynamic Conditions in Constructed Wetlands and Ponds; Range is from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment [Source: Australian Runoff Quality, 2003]

Source: WSUD Engineering Procedures: Stormwater Technical Manual DRAFT 2004

Calculations - Sediment Pond 1

Catchments which require a sediment pond: A8, A9, A10

Target = very fine sand			Notes
Vs =	0.011	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.26	m/s	1 Year ARI
A =	250.0	m^2	Sed. Pond
V_s = / Q/A	10.50		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	95%		
C_a =	5.520	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	42	m^3	
S_a =	45	m^3	
Frequency of Desilting			
F_o =	5.38	years	

Target = fine sand			Notes
Vs =	0.026	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.26	m/s	1 Year ARI
A =	250.0	m^2	Sed. Pond
V_s = / Q/A	24.82		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	98%		
C_a =	5.520	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	43	m^3	
S_a =	45	m^3	
Frequency of Desilting			
F_o =	5.19	years	

Project Name: Alice Springs Regional Waste Management Facility
Project No.: EZ20032
Author: A.F
Date: 23/04/2020

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Fair and Geyer Equation – Equ 10.3 WSUD Stormwater Technical Manual (2004)

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A} \cdot \frac{(d_e + d_p)}{(d_e + d^*)}\right]^{-n} \qquad \lambda = 1 - 1/n; \quad n = \frac{1}{1-\lambda}$$

R	= fraction of Initial Solids Removed = 80 - 90 % typ.	
d_p	= Depth of permanent pool	
d_e	= Extended detention depth above permanent pool	
d*	= depth below permanent pool sufficient to retain particles (lower of 1.0m or d_p)	
Q	= design flow (Typically 3 month, 6 month or 1 year flow)	
A	= Basin Surface Area	
n	= turbulence parameter (see above)	= 1 for significant short circuiting and turbulence = 5 for insignificant short circuiting and turbulence
v_s	= setting velocity for particles	

Table 7.2 Settling velocities under ideal conditions (Maryland Department of Environment, 1987)

Classification of Particle size range	Particle diameter (μm)	Settling velocities (mm/s)
Very coarse sand	2000	200
Coarse sand	1000	100
Medium sand	500	53
Fine sand	250	26
Very fine sand	125	11
Coarse silt	62	2.3
Medium silt	31	0.66
Fine silt	16	0.18
Very fine silt	8	0.04
Clay	4	0.011

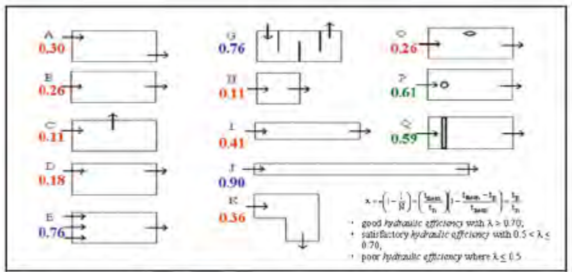

Figure 10.5 Hydraulic Efficiency – A measure of Flow Hydrodynamic Conditions in Constructed Wetlands and Ponds, Range is from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment [Source: Australian Runoff Quality, 2003]

Source: WSUD Engineering Procedures: Stormwater Technical Manual DRAFT 2004

Calculations - Sediment Pond 1

Catchments which require a sediment pond: A6, A11, A12

Target = very fine sand			Notes
Vs =	0.011	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.48	m/s	1 Year ARI
A =	450.0	m^2	Sed. Pond
V_s = / Q/A	10.29		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	95%		
C_a =	11.400	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	86	m^3	
S_a =	90	m^3	
Frequency of Desilting			
F_o =	5.22	years	

Target = fine sand			Notes
Vs =	0.026	m/s	
d_e =	0.30	m	
d_p =	1.0	m	
d* =	1.0	m	
(d_e+d_p) = / (d_e+d^*)	1.0		
Q =	0.48	m/s	1 Year ARI
A =	450.0	m^2	Sed. Pond
V_s = / Q/A	24.32		
λ =	0.26		Pond Shape Assumption
n =	1.35		
Fraction of Initial Solids Removed > 95%			
R =	98%		
C_a =	11.400	ha	
L_o =	1.6	m^3/ha/yr	
F_r =	5	years	
Storage Volume Required			
S_t =	89	m^3	
S_a =	90	m^3	
Frequency of Desilting			
F_o =	5.03	years	

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APPENDIX C GEOTECHNICAL INVESTIGATION RESULTS

SMS Geotechnical Pty Ltd
Shed 12, 66a Smith Street, "Smith Street Trade Centre", Alice Springs, NT, 0870

California Bearing Ratio Test Report

Client:	Alice Springs Town Council	**Job No.:**	SMS3.20026
Address:	93 Todd St, Alice Springs NT 0871	**Report Date:**	17/04/20
Project:	RWMF Materials Testing	**Report No.:**	SMS3.20026 / R2.Rev0
Location:	Alice Springs, NT	**Page:**	1 of 1

Sampling / Test Methods: AS 1289 1.2.1 / 2.1.1 / 5.2.1 / 6.1.1

Laboratory Number:			3200537				
Depth			Stockpile				
Location			South Face of Stockpile				
Date and Time Tested			04/04/20 11.00 am				
Date and Time Sampled			26/03/20 08.00 am				
Description of Sample			White Clayey Sandy Gravel				
Soaked or Unsoaked			Soaked				
Max. Dry Density t/m³			2.03				
Optimum Moisture Content %			10.5				
Material Retained on 19mm A.S. sieve %			16				
Method of establishing the plasticity level			LL ≤35 Greater than 2% of OMC				
Sample curing time, hours			48				
Graph Correction > 1mm Yes / No			No				
C. B. R. Test	Dry Density t/m³	Before Soaking	2.03				
		After Soaking	2.02				
	Density Ratio %	Before Soaking	100.0				
		After Soaking	99.5				
	Moisture Content %	Before Soaking	10.4				
		After Soaking	12.6				
	Laboratory Moisture Ratio (before soaking) %		99.0				
	Surcharge kg		4.5				
	Days Soaked		4				
	Moisture Content After Test %	Top 30mm	13.4				
		Remaining Depth	12.2				
	Swell After Soaking %		+0.5				
	C.B.R. Value %		50 * / 60 **				
	ADOPTED %		60 **				

Remarks

* 2.5 mm Penetration
** 5.0 mm Penetration

N/O = Not Obtainable
\+ = Swell
\- = Consolidation

Sampled by: J Schulz
Tested by: B Nual
Checked by: R Talavera

Accreditation No. 20441

Form SMS2004NT Rev0 160618

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025 – Testing
This document shall not be reproduced, except in full.

Approved Signatory:
Ronny Talavera
Laboratory Manager

SMS Geotechnical Pty Ltd
Shed 12, 66a Smith Street, "Smith Street Trade Centre", Alice Springs, NT, 0870

Particle Size Distribution & Consistency Limits Test Report

Client:	Alice Springs Town Council				
Project:	RWMF Materials Testing			**Date:**	17-Apr-20
Location:	Alice Springs, NT	**Job No.**	SMS3.20026	**Report No.**	SMS3.20026 / R1.Rev0
Lab Reference No.	3200537	**Sample Identification:**	South Face of Stockpile		
Laboratory Specimen Description:		White Clayey Sandy Gravel			

Particle Size Distribution AS1289 3.6.1

Sieve Size	% Passing	Specification Grading 2
150 mm	100	
75 mm	100	
53 mm	96	
37.5 mm	93	100
26.5 mm	88	
19.0 mm	84	70 - 100
13.2 mm	81	
9.5 mm	75	50 - 80
6.7 mm	70	
4.75 mm	63	35 - 65
2.36 mm	56	25 - 50
1.18 mm	50	
600 um	45	
425 um	44	10 - 30
300 um	43	
150 um	40	
75 um	38	4 - 16

Consistency Limits and Moisture Content

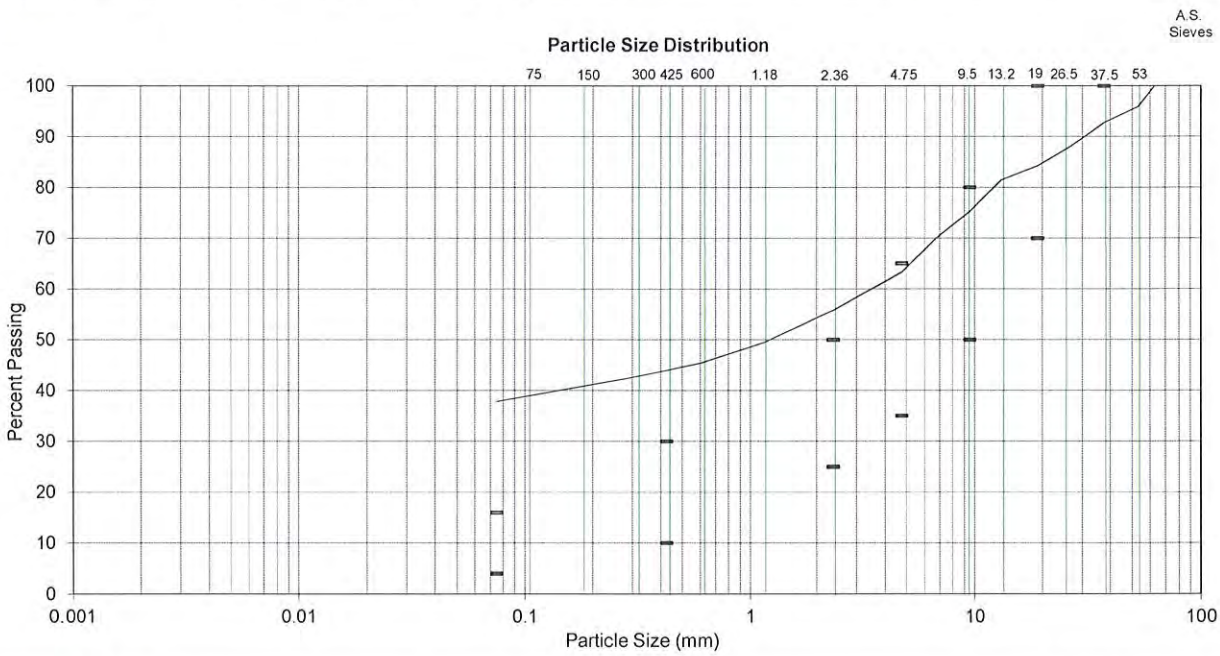
Test		Method	Result	Spec.
Liquid Limit	%	AS1289 3.1.1	23	
Plastic Limit	%	AS1289 3.2.1	17	
Plasticity Index	%	AS1289 3.3.1	6	
Linear Shrinkage	%	AS1289 3.4.1	2.0	
Moisture Content	%	AS1289 2.1.1	NA	

Moisture / Dry Density Relationship AS 1289 5.2.1

Maximum Dry Density:	2.03	t/m3
Optimum Moisture Content:	10.5	%

PI × % pass 425 micron 264 %

Notes :
Sample History: Air Dried, Preparation Method: Wet Sieved
Linear Shrinkage Mould Length: 250mm,
Cracking: Yes, Curling: No, Crumbling: No
ND = not determined NO = not obtainable NP = non plastic



Accreditation No. 20441 Form SMS2009NT Rev0 280618

Approved Signatory, Ronny Talavera - Laboratory Manager

CERTIFICATE OF ANALYSIS

Work Order	: **EM2006184**	Page	: 1 of 2
Client	: **SMS GEOTECHNICAL**	Laboratory	: Environmental Division Melbourne
Contact	: SIMON NELSON	Contact	: Customer Services EM
Address	: UNIT 9 21 BEAFIELD ROAD PARA HILLS WEST SOUTH AUSTRALIA 5096	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 8258 7498	Telephone	: +61-3-8549 9600
Project	: SMS3.20026	Date Samples Received	: 15-Apr-2020 09:25
Order number	: ----	Date Analysis Commenced	: 15-Apr-2020
C-O-C number	: ----	Issue Date	: 21-Apr-2020 13:08
Sampler	: RT		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)			Client sample ID	**3200537, South Face of Stockpile**	----	----	----	----
			Client sampling date / time	06-Apr-2020 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EM2006184-001**	--------	--------	--------	--------
				Result	----	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø **Exchangeable Calcium**	----	0.2	meq/100g	**6.7**	----	----	----	----
ø **Exchangeable Magnesium**	----	0.2	meq/100g	**2.6**	----	----	----	----
ø **Exchangeable Potassium**	----	0.2	meq/100g	**0.4**	----	----	----	----
ø **Exchangeable Sodium**	----	0.2	meq/100g	**0.4**	----	----	----	----
ø **Cation Exchange Capacity**	----	0.2	meq/100g	**10.1**	----	----	----	----
ø **Exchangeable Calcium Percent**	----	0.2	%	**66.2**	----	----	----	----
ø **Exchangeable Magnesium Percent**	----	0.2	%	**25.5**	----	----	----	----
ø **Exchangeable Potassium Percent**	----	0.2	%	**4.3**	----	----	----	----
ø **Exchangeable Sodium Percent**	----	0.2	%	**4.0**	----	----	----	----
ø **Calcium/Magnesium Ratio**	----	0.2	-	**2.6**	----	----	----	----
ø **Magnesium/Potassium Ratio**	----	0.2	-	**5.9**	----	----	----	----

EcOz Environmental Consultants

EcOz Pty Ltd.
ABN 81 143 989 039

Level 1, 70 Cavenagh St,
GPO Box 381,
Darwin, NT 0801

T: +61 8 8981 1100
E: ecoz@ecoz.com.au

www.ecoz.com.au