# Buronga Landfill Expansion

## Water Management Plan

**Wentworth Shire Council**

SSD-10096818
17 September 2024
Ref: 202597R12_Apx.J_Rev03

tonkin

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# Document History and Status

| Rev | Description | Author | Reviewed | Approved | Date |
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| 0 | For Client Comment | BT | DN | MI | 22 Dec 2023 |
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**Client: Wentworth Shire Council**
**Ref: 202597R12_Apx.J_**

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# 1 Introduction

## 1.1 Background

This Water Management Plan (WMP) has been prepared by Tonkin on behalf of Wentworth Shire Council (WSC) as part of the Landfill Environmental Management Plan (LEMP) in support of the expansion to the Buronga Landfill (the site). The WMP was prepared by Ben Taylor (BT) who is a Senior Environmental Engineer with 18 years of industry experience including stormwater drainage design in both South East Queensland and South Australia. He has also been involved in the preparation of a number of stormwater Management Plans for Adelaide metropolitan and regional councils. Ben was supported by Dean Noske (DN) and Mamdoh Ibrahim (MI), Dean is a Certified Environmental Practitioner (Site Contamination Specialist) with 21 years' experience in contaminated land assessment, complex soil and groundwater investigation design, conceptual model development, and the coordination of multi-disciplinary site investigations involving risk-based investigation, management and remediation strategies. Mamdoh Ibrahim (Principal Engineer- Waste), has 23 years of industry experience including design, construction, operation, closure and post closure of landfills in Australia and internationally CVs of the mentioned team members are provided in Appendix B.

WSC currently holds Environmental Protection Licence (EPL) 20209 which covers waste disposal activities (Construction of landfill cells and leachate and stormwater collection systems) and resource recovery activities (recovered aggregate processing and storage / Waste storage) at the site and is under the development processes of the expansion to the site under a Development Consent Application Number: SSD 10096818.

## 1.2 Site and Ownership

The site is located at 258 Arumpo Road, Buronga NSW and is shown in Figure 2 and Figure 3 of Appendix A. The site is owned and operated by WSC.

## 1.3 Compliance with Regulatory Requirements

The primary regulatory requirements for the operation of the site are:

- NSW Department of Planning, Industry and Environment, 2023, Buronga Landfill Expansion Development Consent, 19 July 2023, Ref: SSD-10096818 (the Development Consent);
- NSW EPA, 2023, Environment Protection Licence – 20209, Licence Version Date 8 March 2023 (the EPL);
- NSW EPA, 2016, *Environmental Guidelines, Solid Waste Landfills*, Second Edition, April 2016, Ref: EPA 2016/0259 (The Landfill Guidelines);
- Waste Avoidance and Resource Recovery Act 2001 (NSW) (WAAR Act 2001);
- Protection of the Environment Operations Act 1997 (NSW) (the POEO act 1997);
- Landcom, 2004. *Managing urban stormwater: soils and construction*, Volume 1, March 2004, 4th edition.

## 1.4 Compliance with Environmental Protection Licence

WSC holds EPL number 20209 for the operations at the site. This WMP has been prepared to ensure compliance with the EPL. It is noted that this WMP is submitted to the EPA for consultation and approval.

## 1.5 Relevant Limits and Performance Measures

The WMP includes specific limits and performance measures to ensure compliance with statutory requirements and to protect environmental quality. These limits and measures are aligned with the conditions set out in the EPL and other relevant guidelines.

The relevant limits and performance measures include the allowable concentrations of pollutants in groundwater and stormwater. These measures ensure that the landfill operations do not adversely impact the surrounding environment, particularly in terms of water quality.

Detailed information on these limits and performance measures are presented in Section 3.1.3.4.

## 1.6 Performance Indicators

Performance indicators are used to monitor and evaluate the effectiveness of the water management strategies implemented at the site. These indicators help in assessing compliance with the established limits and in identifying any need for corrective actions.

Performance indicators include regular monitoring of groundwater and stormwater quality parameters such as pH, electrical conductivity (EC), and concentrations of key pollutants, as described in Section 3.1.3.4. These indicators provide a quantitative basis for assessing the environmental performance of the landfill and ensuring ongoing compliance with regulatory requirements.

## 1.7 Reference Documentation

This plan was written with reference to the following documents and legislation:

- NSW Department of Planning, Industry and Environment, 2023, Buronga Landfill Expansion Development Consent, 19 July 2023, Ref: SSD-10096818 (the Development Consent);
- NSW EPA, 2023, Environment Protection Licence – 20209, Licence Version Date 8 March 2023 (the EPL);
- NSW EPA, 2016, *Environmental Guidelines, Solid Waste Landfills*, Second Edition, April 2016, Ref: EPA 2016/0259 (The Landfill Guidelines);
- Waste Avoidance and Resource Recovery Act 2001 (NSW) (WAAR Act 2001);
- Protection of the Environment Operations Act 1997 (NSW) (the POEO act 1997);
- Landcom, 2004. *Managing urban stormwater: soils and construction*, Volume 1, Match 2004, 4th edition.
- Wentworth Shire Council (2015), Buronga Landfill, Landfill Environmental Management Plan, December 2015, Ref: 21/21400/181846.
- GHD (2012). Buronga Landfill Geotechnical Investigation Report, Wentworth Shire Council, 05 November 2012, Ref: 21/21400/181848.
- Tonkin (2021), Buronga Landfill Expansion Geotechnical Investigation Report, 11 June 2021, Ref: 202597R02A.
- Tonkin (2022), Buronga Landfill Expansion Environmental Impact Statement, SSD-10096818, 25 January 2022, Ref: 202597R04Rev1. (the expansion development EIS)
- Tonkin (2022), Buronga Landfill Expansion Submission Report, SSD-10096818, 1 December 2022, Ref: 202597R05Rev2.
- Tonkin (2023), Buronga Landfill Expansion Amendment Report, SSD-10096818, 8 February 2023, Ref: 202597R07Rev0.
- Tonkin (2023), Buronga Landfill Expansion Groundwater Impact Assessment, 19 September 2021, Ref: 202597R03Rev0.

## 1.8 Consultation

In accordance with Development Consent (SSD_10096818) Condition A11, the draft of this WMP was provided to the EPA for consultation.

# 2 Site Overview

## 2.1 Hydrogeology and Groundwater Use

The site is situated within the southern part of the Western Porous Rock resource unit. The resource unit incorporates all groundwater within sediments of Tertiary and Quaternary age and all alluvial sediments within the outcropped area. The two major aquifers of the resource unit are the Renmark Group Aquifer and the Pliocene Sands Aquifer, the sands of which are weakly cemented and thus defined as porous rock (NSW Office of Water 2013)[1].

The Renmark Group Aquifer forms the major confined aquifer covering most of the water source. It is an accumulation of riverine sediments deposited approximately 30 to 50 million years ago (NSW Office of Water 2013). It is comprised of intercalations of lignite, peat, carbonaceous clay and medium to coarse grained quartz sand (NSW Office of Water 2013). Salinity in the Renmark Group ranges from 2,000 to 36,000 mg/L TDS with the freshest water located in the northern margins and salinity increasing down the hydraulic gradient. Vertical stratification is commonly observed in the areas to the north and east.

The Pliocene Sands Aquifer forms the major shallow unconfined/semiconfined aquifer covering most of the water source. It is comprised of layers of sand and gravel deposited approximately 2 to 6 million years ago. The aquifer is predominantly sands of marine origin comprised of the Loxton-Parilla Sand, while to the east lies a small area of sands of riverine origin comprised of the Calivil Formation (NSW Office of Water 2013). The Loxton-Parilla Sands contain significant deposits of heavy mineral sands (rutile, zircon and ilmenite), whilst overlying younger deposits contain bentonite and gypsum. The Pliocene Sands Aquifer contains highly saline groundwater ranging from 1,000 to 82,000 mg/L TDS and very locally up to 160,000 mg/L TDS near salt lakes.

As noted in the Groundwater Impact Assessment[2], during the February 2021 site investigations, groundwater was intercepted in most boreholes, at ranging from 9.5 m below ground level in the south west to 7-8 m in the east. In two boreholes (H7 and H9) the groundwater level rose by approximately 1 m when left overnight suggesting the clay may be partially confining the aquifer.

The Western Porous Rock SDL is governed by the Water Sharing Plan for the NSW Murray-Darling Basin Porous Rock Groundwater Sources (NSW Office of Water 2011). In accordance with the expansion development EIS[3], the Water NSW Real Time Data website[4] showed that there were 20 groundwater bores within a 2 km radius of the site of which 5 were within 1 km of the site. Two bores were located within the site boundaries with many to the east and south east located around Laker Gol Gol. Information of these groundwater bores is summerised in Table 2-1. A previous investigation[5] reported that the water level in the on-site wells was 9.29 m and 7.37 m below ground level (bgl) for on-site wells GW087083 and GW088479, respectively and that all wells within 1-2 km of the site were registered for monitoring purposes.

It is expected that the wells to the north may be used for stock watering and the ones to the south may be used for irrigation, though it is noted that the salinity is unlikely to be suited to these uses given the proximity to Lake Gol Gol to the east and Mourquong Disposal Basin to the west.

**Table 2-1 Groundwater Bores Information**

[1] NSW Office of Water (2013) Western Murray Porous Rock and Lower Darling Alluvium Groundwater Sources, Groundwater Status Report 2011, January 2013.

[2] Tonkin (2023), Buronga Landfill Expansion Groundwater Impact Assessment, 19 September 2021, Ref: 202597R03Rev0.

[3] Tonkin (2022), Buronga Landfill Expansion Environmental Impact Statement, SSD-10096818, 25 January 2022, Ref: 202597R04Rev1.

[4] https://realtimedata.waternsw.com.au/

[5] GHD (2012). Buronga Landfill Geotechnical Investigation Report, Wentworth Shire Council, 05 November 2012, Ref: 21/21400/181848.

| Bore ID | Status | Distance (km) | Date completed | Borehole depth (m) | Elevation (m AHD) |
|---|---|---|---|---|---|
| GW087083 | Manual Observations | 0.4 (on site) | 1/03/1972 | 20 | 40.54 |
| GW088479 | Unknown | 0.6 (on site) | 21/03/2007 | 61 | 37.89 |
| GW087644 | Unknown | 1.3 west | 5/03/1991 | 17.2 | 36.12 |
| GW088478 | Unknown | 1.7 north | 16/05/2007 | 52 | 36.74 |
| GW088168 | Unknown | 1.8 south | 2/02/2000 | 10.5 | -0.5 |
| GW088169 | Unknown | 2.0 south | 3/02/2000 | 10.5 | -0.05 |
| GW088170 | Unknown | 2.0 south | 7/02/2000 | 13.5 | -0.5 |
| GW087038 | Unknown | 2.0 south | 12/10/1977 | 10.97 | -0.11 |
| GW087073 | Unknown | 2.1 east | 12/10/1972 | 12.19 | -0.12 |
| GW087812 | Unknown | 2.3 south east | 10/12/1996 | 5.5 | -0.5 |
| GW273072 | Equipped | 2.4 east | 12/03/2009 | 24 | -0.6 |
| GW273069 | Supply Obtained | 2.4 east | 11/02/2009 | 20 | -1 |
| GW087081 | Unknown | 2.4 north | 12/10/1972 | 12.5 | -0.2 |
| GW600409 | Equipped | 2.6 south | 6/09/2012 | 15 | 39 |
| GW087039 | Unknown | 2.6 south | 12/03/1972 | 10.97 | -0.1 |
| GW273071 | Equipped | 2.6 east | 6/03/2009 | 25.5 | -0.6 |
| GW087811 | Unknown | 2.7 south east | 5/12/1996 | 11.5 | -0.5 |
| GW087074 | Unknown | 2.7 south | 12/10/1972 | 14.02 | -0.13 |
| GW087328 | Filled | 2.7 south east | 21/10/1977 | 16 | -0.14 |
| GW087813 | Unknown | 2.7 south east | 11/12/1996 | 6.5 | -0.5 |
| GW088473 | Unknown | 2.8 | 26/02/2007 | 47 | 35.08 |
| GW088305 | Unknown | 2.8 | 14/09/2005 | 20.56 | 32.39 |
| GW087529 | Unknown | 2.8 | 4/04/1987 | 15 | -0.48 |
| GW273068 | Supply Obtained | 2.8 | 9/02/2009 | 0 | -1 |
| GW273074 | Equipped | 2.8 | 30/03/2009 | 25 | -0.4 |
| GW088167 | Unknown | 2.9 | 28/01/2000 | 3.08 | -0.5 |
| GW087814 | Unknown | 3.0 | 12/12/1996 | 8 | -0.5 |

| Bore ID | Status | Distance (km) | Date completed | Borehole depth (m) | Elevation (m AHD) |
|---|---|---|---|---|---|
| GW087331 | Unknown | 3.1 west | 19/10/1977 | 12 | -0.11 |

## 2.2 Climate

According to Climate Data.org[6] the Buronga area is elevated approximately 43m above sea level and the climate is considered to be a local steppe climate. Rainfall is generally low throughout the year whilst the climate is classified as "Bsh" by the Koppen-Geiger system. The average annual temperature is 18.2 degrees centigrade and the annual rainfall is 274mm. The driest month is March with an average of only 16 mm of rain, whilst in September the precipitation reaches its peak with an average monthly rainfall of 28 mm. A climate graph is presented in Figure 2-1.

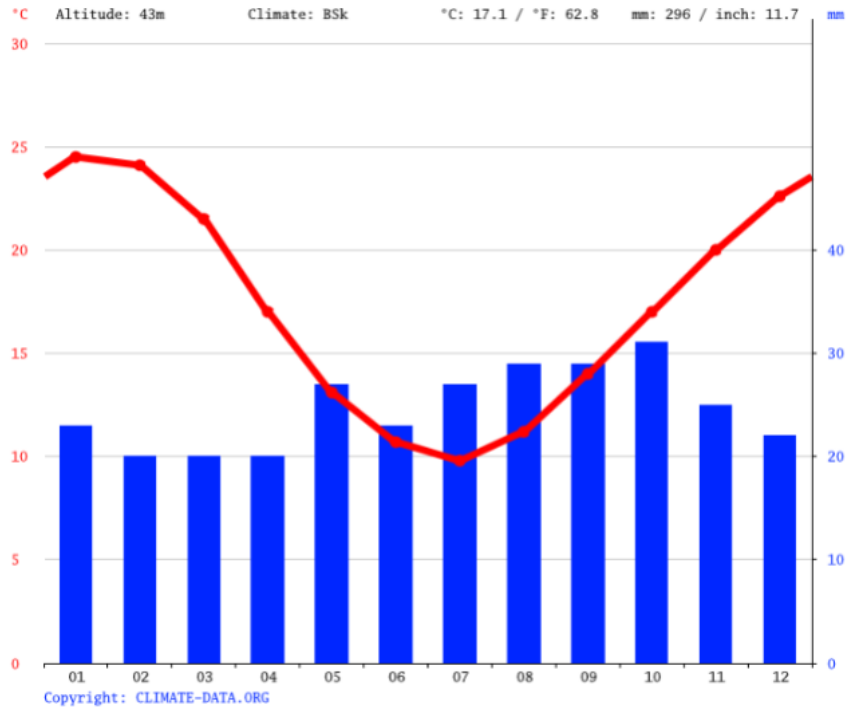



**Figure 2-1 Climate Graph : Weather by Month**

## 2.3 Surface Water

The closest surface water bodies are Gol Gol Lake, approximately 1.5 km east, and the Murray River, over 5 km south. There is no direct waterway or pathway from the Project area to either of the mentioned water bodies. The site is outside the flood planning area defined in the Wentworth LEP 2011. The lack of surface water bodies and defined drainage is not unexpected given the gently undulating to flat topography and low rainfall (274 mm average annual rainfall).

[6] https://en.climate-data.org/oceania/australia/new-south-wales/buronga-764924/#climate-graph

Surface water at the site naturally flows eastward, towards Lake Gol Gol, navigating around embankments and the base of the landform before reaching a sediment pond located in the southeast corner of the site. The site's lowest elevation is situated at the eastern toe of the landfill at RL 35 m. Natural slopes across the site range from approximately 2% to 6%.

## 2.4 Stormwater Infrastructure

The existing stormwater sedimentation basin is located at the south east of the site.

The location of the basins for Stage 1 are shown in Figure 7 of Appendix A. The locations have been selected to allow for gravity flow to the basins whilst minimising the potential impact on vegetation by selecting already cleared areas and/or minimising the footprint as far as practical for the north-eastern basins where higher quality vegetation was found. Associated stormwater drains directing stormwater towards stormwater basins are designed and to be constructed.

The basin sizes required for the development are described in Table 2-2.

**Table 2-2 Stormwater Basins for Buronga Landfill**

| Basin | Area (ha) | Settling Zone Volume ($m^3$) | Sediment Storage Volume ($m^3$) | Total Basin Volume ($m^3$) |
|---|---|---|---|---|
| Stage 1 North Western | 17.1 | 1493 | 746 | 2239 |
| Stage 1 North Eastern | 4.3 | 376 | 188 | 564 |
| Stage 1 Southern | 20.0 | 1743 | 872 | 2615 |

# 3 Water Management Plan

### 3.1.1 General

WSC will continue to undertake all practical measures to prevent contaminated waters leaving site. Site operations will generate different quality waters, including:

- Runoff from undisturbed areas within the site (clean stormwater runoff);
- Runoff from rehabilitated (revegetated) areas of the site (clean stormwater runoff);
- Runoff from disturbed areas of the site (potentially turbid stormwater runoff);
- Runoff from within the active landfilling area (leachate contaminated stormwater);
- Runoff from the waste transfer and storage areas (potentially contaminated stormwater); and
- Leachate from within the landfill.

Management of water at the landfill is aimed at:

- Minimising the generation of contaminated water;
- Minimising erosion and reducing the sediment load (suspended solids) of stormwater discharged from the site;
- Preventing impact to surface water and groundwater in the vicinity of the site; and
- Ensuring that adequate water is available to meet operational requirements.

Clean stormwater will be kept separate and diverted around disturbed areas of the site to minimise the generation of leachate and sediment laden water.

The following sections outline the management of groundwater, stormwater, erosion and sediment, and leachate.

### 3.1.2 Monitoring Procedures

WSC will undertake regular monitoring of groundwater and stormwater to ensure that the site is not causing detrimental impact to the environment or creating health and safety issues on site. The operation of the landfill will be reviewed by WSC every 12 months or as required to assess the compliance of the landfill operation with regulatory requirements, the site licence, the LEMP and this WMP.

All sampling must be carried out by suitable qualified and experience personnel, in accordance with EPA accepted procedures. These procedures include those described in the EPA Publication "*Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales*[7]" (EPA Water Sampling Guideline), the *National Environment Protection (Assessment of Site Contamination) Measure 2013* (Cth.) (ASC NEPM) and the *Environmental Guidelines: Solid Waste Landfills*. All laboratory analysis must be performed by a laboratory accredited by the National Association of Testing Authorities (NATA) to undertake the analysis specified. Selected analytes have been based upon the requirements of the *Environmental Guidelines: Solid Waste Landfills* and the site licence. Records of monitoring undertaken at the site must be recorded and retained as required by the site licence.

Where required, a Quality Assurance and Control (QA/QC) Program has been be included as part of the Environmental Monitoring Program in accordance with AS/NZS 5667.1:1998(R 2016) Water Quality - Sampling including the collection of:

- Field Split Duplicates;
- Blind Duplicates; and

[7] NSW Environmental Protection Authority, *Approved methods for the Sampling and Analysis of Water Pollutants in New South Wales*, NSW Department of Environment and Conservation, Sydney, March 2004, Ref: DEC 2004/35

- Rinsate Blanks

Additionally, the analytical laboratories will complete their own internal QA procedures (as required by NATA registration) during the analysis of the samples.

Details of the monitoring to be performed for individual aspects are provided in the sections below.

### 3.1.3 Groundwater

#### 3.1.3.1 Groundwater Monitoring

Monitoring of groundwater shall be undertaken on a routine basis to detect any pollution of groundwater incurred through the landfill operation. Groundwater conditions shall be monitored through the gauging, sampling and analysis of groundwater within the existing groundwater monitoring well network of four previously existing monitoring wells (BH1, BH2, BH3 and BH4) on a biannual (six monthly) basis. As recommended in the Groundwater Impact Assessment, two of the wells (BH1 and BH4) are located up hydraulic gradient, specifically to the northeast of the landfill. Conversely, BH2 and BH3 are located down hydraulic gradient, maintaining a northeast orientation. As the landfill moves north and east, the well network will be progressively extended to maintain upgradient, cross-gradient and down-gradient monitoring wells. Details of the borehole construction are provided in the 2012 GHD Geotechnical Investigation Report. In compliance with Section B18 (a) of the Development Consent, three additional monitoring wells MW01, MW02 and MW03 were drilled on site around the proposed extent of Stage 1A to serve the dual purpose of providing groundwater elevation to inform the design of Stage 1A as well as functioning as ongoing environmental monitoring wells for the landfill operation if required.

Drilling of monitoring wells was undertaken by a licenced driller from In-Depth Drilling on 17 April 2023. Monitoring wells were drilled using a Rockmaster drill rig mounted on a Toyota Landcruiser using solid auger methodology. Installation of wells was supervised by a Tonkin Geotechnical Engineer and the recovered soils were logged by a Geotechnical Engineer in accordance with AS 1726 Geotechnical Site Investigations.

All monitoring wells were installed using Class 18 PVC screens with the slotted interval. The screened interval was backfilled with clean filter gravel, where possible, overlain by a bentonite plug and cement grout in accordance with the Minimum Construction Requirements for Water Bores in Australia. Monitoring wells were finished with a cap and lockable standpipe cover to protect the wellhead.

Monitoring wells were drilled to a nominal depth of 15 m with final depths adjusted depending on collapse of the borehole and conditions encountered. Details of each additional monitoring well are provided in Table 3-1[8]. Coordinates and elevations of the monitoring wells were surveyed by a licenced surveyor and coordinates are presented to MGA2020, Zone 54.

**Table 3-1 Summary of Additional Monitoring Wells**

| Well ID | Easting | Northing | Elevation (mAHD) | Monitoring Point Elevation (mAHD) | Total Depth (m) | Screened Interval (mBGL) |
|---|---|---|---|---|---|---|
| MW01 | 610953.17 | 6223123.95 | 44.090 | 45.014 | 15.0 | 8.6-14.6 |
| MW02 | 610952.87 | 6223123.65 | 37.795 | 38.783 | 12.0 | 1.3-7.3 |
| MW03 | 610893.05 | 6223245.46 | 39.566 | 40.524 | 13.0 | 3.5-9.5 |

Locations of all groundwater monitoring wells are shown in Figure 14 of Appendix A.

[8] Tonkin (2023). Buronga Landfill Expansion Stage 2 Geotechnical Investigation Report, 31 May 2023, Ref: 202597R09Rev0.

Groundwater gauging using a calibrated electronic water meter will be undertaken prior to both six monthly and annual monitoring events. This is deemed to be important in determining seasonal or temporal groundwater level fluctuations, including the detection of any groundwater point recharge from any landfilling activities.

As presented following in Table 3-2 six monthly monitoring will involve the measurement and recording of groundwater field parameters only. This should be undertaken *in-situ* utilising a calibrated down hole water quality meter with appropriate cable length.

Annual sampling shall involve the collection of groundwater samples into appropriate laboratory supplied sample containers. Samples should be collected utilising appropriate groundwater sampling methodologies, suitable for the hydrogeological setting and groundwater field parameters should be recorded and monitored throughout the purging process. If no purge methods are utilised then appropriate sample quantity should be collected for the monitoring of field parameters.

Upon collection, laboratory samples will be immediately placed in chilled cooler boxes and transferred under Chain of Custody to a NATA-accredited laboratory for the analyses presented in Table 3-2. Quality assurance and quality control procedures will be implemented during the fieldwork, including the analysis of rinsate, duplicate and triplicate samples.

On receipt of the analytical data from the laboratory a Tier 1 Qualitative review of the data shall be undertaken against the background (upgradient well) concentrations and the ANZECC guidelines for Potable drinking water as well as the 95% aquatic ecosystems protection where relevant trigger levels exist. Summary statistics and a trend analysis shall be undertaken for comparative purposes when sufficient data population exists.

WSC will facilitate monitoring of groundwater at the site on a 6 monthly basis, with some analytes monitored on an annual basis, in accordance with the requirements of the site EPL.

Groundwater monitoring at the site will encompass the following:

- Sampling and analysis of the groundwater monitoring wells BH1-BH4, MW01-MW03;
- Sampling and analysis for the analytes shown in Table 3-2.

**Table 3-2 Groundwater Quality Monitoring Parameters and Schedule**

| Analyte | Sampling method | Groundwater Frequency |
|---|---|---|
| pH, EC, DO, ORP, Temperature | *Field Measurement* | 6-monthly and annual |
| Standing Water Level | *Field Measurement* | 6-monthly and annual |
| Alkalinity | Laboratory sample | Annually |
| Total dissolved solids | Laboratory sample | Annually |
| Cations and Anions (Ca, Cl, F, Mg, K, Na, $SO_4$) | Laboratory sample | Annually |
| Metals and metalloids (Al, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn) | Laboratory sample | Annually |
| Nitrogen ($NO_x$, $NH_3$, TOC) | Laboratory sample | Annually |
| Total Organic Carbon | Laboratory sample | Annually |
| Pesticides (OCP, OPP) | Laboratory sample | Annually |
| Phenolics – total | Laboratory sample | Annually |
| Hydrocarbons (BTEX, TRH, PAH) | Laboratory sample | Annually |

#### 3.1.3.2 The water licence requirements for the development

The Landfill doesn't possess a Water Licence and doesn't extract groundwater for any purposes rather than groundwater quality monitoring as described in section 3.1.3.1

#### 3.1.3.3 Groundwater Level Monitoring data

The Mildura climate (as recorded at Mildura Airport (BOM Site No. 076031)) is characterised by:

- Mean temperature range 4 °C to 33 °C with the coldest month in July and hottest in December to March
- Mean rainfall of 285.4 mm/yr is consistent across the year and higher in late winter/spring. On average, 43.6 days/year receive rainfall ≥ 1 mm with the highest number of rain days in July. Summer rainfall occurs over a smaller number of high intensity events.

Groundwater is relatively shallow and essentially unconfined so are, theoretically able to rise with recharge; however the low rainfall and clay units would limit this and it is unlikely that groundwater levels would significantly rise. As a result, the overall risk to groundwater from the Project is deemed low; however, given the limited information and potentially shallow groundwater, monitoring of upgradient and downgradient wells should be undertaken to provide early detection of any potential groundwater impacts from the Project.

### 3.1.3.4 Groundwater Impact Assessment Criteria

The overarching reference to be used in this assessment is the NEPM[9], and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality[10]. The NEPM and the ANZECC guidelines contain investigation and screening levels suitable for the assessment of contaminants of potential concern in groundwater and surface water at the site.

Given the potable quality of groundwater beneath the site, and the potential for impact on freshwater aquatic ecosystems, the following criteria in order of sensitivity are proposed (Table 3-3) in accordance with the preliminary hydrogeological and groundwater review. The EPL provides trigger values for various analytes at groundwater monitoring locations which are given in Table 3-4. If the results of any three consecutive monitoring rounds exceeds, or is outside the range of the trigger values for any parameter, WSC must submit a report to the EPA within 14 days proposing a Groundwater Assessment Program identifying a strategy for assessing the nature and extent of the groundwater contamination.

**Table 3-3 Groundwater Health and Ecological Levels**

| Title | Level | Reference |
|---|---|---|
| Groundwater GILs (Groundwater investigation levels) | Potable Water | NEPM Schedule B1 Table 1C |
| NHMRC Australian Drinking Water Guidelines (Version 3.8, September 2022) | Drinking water | ADWG 2011 Table 10.5 and 10.6 |
| NHMRC Australian Drinking Water Guidelines | Recreational and Aesthetics | NHMRC Recreational Water |
| Groundwater GILs (Groundwater investigation levels) | Fresh water ecosystem | NEPM Schedule B1 Table 1C |
| ANZECC 95% protection levels for freshwater | Fresh water ecosystem 95% | ANZECC Table 3.4.1, Table 8.3.14 |
| ANZECC 2000 Stock Water and Irrigation | Primary Production | ANZECC Table 4.3.2, Table 4.2.10 |

**Table 3-4 EPL Trigger Values**

| Analyte (Units) | Points (EPA Identification Number) | | | | |
|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 |
| pH (pH Units) | 5.35 – 9.26 | 5.11 – 9.5 | 5.54 – 9.1 | 4.97 – 10.3 | 4.9 – 8.4 |
| Ammonia (mg/L) | 0.62 | 0.26 | 1.4 | 0.33 | 0.15 |
| Total Nitrogen (mg/L) | 4.2 | 3.3 | 2.3 | 1.0 | 3.0 |
| Dissolved organic carbon (mg/L) | 69.9 | 63.4 | 45.8 | 92.9 | 40.3 |

[9] NEPC (2013). National Environment Protection (Assessment of Site Contamination) Measure, 11 April 2013

[10] ANZECC & ARMCANZ (2000). National Water Quality Management Strategy 2011 *(Version 3.8 Updated September 20220)*, Australian and New Zealand Guidelines for Marine Water Quality, October 2000.

| Analyte (Units) | Points (EPA Identification Number) | | | | |
|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 |
| Potassium (mg/L) | 36.9 | 9.1 | 6.9 | 8.9 | 4.95 |
| TPH C15-C36 Fractions (µg/L) | 125.8 | 139.8 | 106.9 | 50 | 50 |

#### 3.1.3.5 Investigation and Mitigation

During the field intrusive investigations, the groundwater was predominantly intercepted in the clay layer and was intersected at around 7 to 9 m below ground level; however the potential confinement of the aquifer by the clay layer may result in higher groundwater levels. Based on the conceptual site model, the groundwater appears to flow toward the east; towards Lake Gol Gol. Given the relatively flat topography the hydraulic gradient is likely to be slow with velocities of $1.8 \times 10^{-5}$ m/day to $3.3 \times 10^{-10}$ m/day, i.e. the groundwater would take 153 years to travel 1 m.

Groundwater is relatively shallow and essentially unconfined so are, theoretically able to rise with recharge; however the low rainfall and clay units would limit this and it is unlikely that groundwater levels would significantly rise. As a result, the overall risk to groundwater from the Project is low; however, given the limited information and potentially shallow groundwater, monitoring upgradient and downgradient wells should be undertaken to provide early detection of any potential groundwater impacts from the Project.

#### 3.1.3.6 Mitigation Measures

The site investigation work undertaken to date indicates that groundwater is located 7-9 m bgl and may be partially confined by a clay layer. The vertical and lateral movement of groundwater is anticipated to be low due to low rainfall, flat topography and low subsoil permeability.

Cells constructed in accordance with best management practices as per the Landfill Guideline and maintain a minimum 2 m separation to groundwater.

The groundwater monitoring plan shall provide a clear indication of the effect of the site activities to the quality of the groundwater.

The Leachate management plan provides a methodology to minimise the leachate production, pump out and treat the leachate to prevent the contamination of soil and groundwater.

## 3.2 Stormwater Monitoring

Stormwater monitoring shall be undertaken in the proposed stormwater ponds to detect any pollution of surface water by the landfill operation and prevent any pollution from moving off site. There are no ambient surface water bodies within the immediate vicinity of the site, however monitoring of stormwater should be undertaken at the site.

Stormwater samples will be collected from each stormwater pond. Quarterly samples recovered for in situ analysis will be analysed in the field using hand-held equipment. Annual grab samples will be immediately placed in chilled cooler boxes and transferred under Chain of Custody to a NATA-accredited laboratory for the analyses shown in Table 3-5. Quality assurance and quality control procedures will be undertaken, including the analysis of duplicate and triplicate samples. Results of analyses will be compared with historical concentrations and the ANZECC guidelines for aquatic ecosystems where relevant trigger levels exist.

**Table 3-5 Stormwater Monitoring Parameters and Schedule**

| Analyte | Sampling method | Stormwater Frequency |
|---|---|---|
| pH, EC, Temperature | *In situ* | 3-monthly |
| Redox potential | *In situ* | 3-monthly |
| Standing Water Level | *In situ* | 3-monthly |
| Total suspended solids | Grab sample | 3-monthly |
| Cations and Anions (Ca, Cl, F, Mg, K, Na, $SO_4$) | Grab sample | Annually |
| Metals and metalloids (Al, As, Ba, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Zn) | Grab sample | Annually |
| Nitrogen ($NO_x$, $NH_3$, TOC) | Grab sample | 3-monthly |
| Pesticides (OCP, OPP) | Grab sample | Annually |
| Phenolics – total | Grab sample | Annually |
| Hydrocarbons (BTEX, TRH, PAH) | Grab sample | Annually |

# 4 Reporting

## 4.1 Annual Reporting

WSC will prepare an Annual Return in accordance with the requirement of the EPL. The Annual Return will include the following:

- A certified Statement of Compliance,
- A signed Monitoring and Complaints Summary,
- A Statement of Compliance for Licence Conditions,
- A Statement of Compliance for Load Based Fee,
- A Statement of Compliance for Requirement to Prepare Pollution Incident Response Management Plan,
- A Statement of Compliance for Requirement to Publish Pollution Monitoring Data; and
- A Statement of Compliance for Environmental Management Systems and Practices.

The Annual Return will be prepared for the required reporting period, and will be submitted to the EPA no later than 60 days after the end of the reporting period. WSC will retain a copy of the Annual Return for a period of at least 4 years after the Annual Return is supplied to the EPA.

The Annual Return will be prepared for the required reporting period and will be submitted to the EPA no later than 60 days after the end of the reporting period. WSC will retain a copy of the Annual Return for a period of at least 4 years after the Annual Return is supplied to the EPA.

The monitoring and complaints summary will contain the following information:

- Tabulated results of all monitoring information collected;
- Graphical presentation of data from at least the last three years in order to show variability/and or trends. Any statistically significant variations or anomalies will be highlighted and explained;
- An analysis and interpretation of all monitoring data;
- An analysis of and response to any complaints received;
- Identification of any deficiencies in environmental performance identified by the monitoring data, trends or incidents and of remedial action taken or proposed to be taken to address these deficiencies; and
- Recommendations on improving the environmental performance of the facility.

The monitoring and complains summary must be signed by WSC or by a person approved in writing by the EPA to sign on behalf of the Licence holder.

## 4.2 Incident Reporting

Any incident that causes or threatens material harm to the environment or may lead to a breach of EPL conditions must be communicated by WSC or its employees immediately after first becoming aware of the incident. Notifications must be made by telephoning the Environment Line service on 131 555. The Planning Secretary must be notified in writing via the Major Projects website. Written notice including details of the notification must be provided to EPA within 7 days of the date of which the incident occurs. Reportable incidents could include but are not limited to:

- Identification of non-domestic quantities (>200 g/tonne) of hazardous waste mixed amongst solid waste;
- Fire at the landfill;
- Entry of leachate or waste into the stormwater management system;
- Identification of any failure of an environmental protection system;

- Identification of a significant difference in groundwater or stormwater indicator parameters; and
- Any other incident or observation that could potentially pose an immediate environmental hazard outside normal operating conditions.

The occurrence of any such incident will also be recorded in the site's daily logbook as appropriate.

As required in the development consent, the written incident notification shall be provided to the Planning Secretary within seven days after WSC becomes aware of an incident. The written notification must:

- identify the development and application number;
- provide details of the incident (date, time, location, a brief description of what occurred and why it is classified as an incident);
- identify how the incident was detected;
- identify when the applicant became aware of the incident;
- identify any actual or potential non-compliance with conditions of consent;
- describe what immediate steps were taken in relation to the incident;
- identify further action(s) that will be taken in relation to the incident; and
- identify a project contact for further communication regarding the incident.

Within 30 days of the date on which the incident occurred, WSC must provide the Planning Secretary and the EPA with a detailed report on the incident addressing all requirements below, and such further reports as may be requested. The Incident Report must include:

- a summary of the incident;
- outcomes of an incident investigation, including identification of the cause of the incident;
- details of the corrective and preventative actions that have been, or will be, implemented to address the incident and prevent recurrence; and
- details of any communication with other stakeholders regarding the incident.

Where an authorised officer of the EPA suspects on reasonable grounds that an event has occurred at the premises that has caused, is causing or is likely to cause material harm to the environment, the authorised officer may request a written report of the event. WSC must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request. The report may be required to contain any or all of the following information:

- The cause, time and duration of the event;
- The type, volume and concentration of every pollutant discharged as a result of the event;
- The name, address and business hours telephone number of employees or agents of the WSC, or a specified class of them, who witnessed the event;
- The name, address and business hours telephone number of every other person who witnessed the event, unless WSC cannot obtain that information after making reasonable effort;
- Action taken by WSC in relation to the event, including any follow up contact with complainants;
- Details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and
- Any other relevant matters.

The EPA and/or the Planning Secretary may make a written request for further details in relation to any of the above matters if it's not satisfied with the report provided by WSC. WSC must provide such further details to the EPA and/or the Planning Secretary within the time specified in the request.

## 4.3 Compliance Reporting

Within six months after the commencement of construction / first year of commencement of operation of the site expansion development, and in the same month each subsequent year, WSC will submit a Compliance Report to the Planning Secretary reviewing the environmental performance of the development to the satisfaction of the Planning Secretary.

Compliance Reports will be prepared in accordance with the Compliance Reporting Post Approval Requirements (Department 2020) and will also:

- identify any trends in the monitoring data over the life of the development;
- identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance of the development.

WSC will make each Compliance Report publicly available within 60 days after submitting it to the Planning Secretary and notify the Planning Secretary in writing at least seven days before this is done.

## 4.4 Independent Audit

Within one year of the commencement of operation of the site expansion development, and every three years after, unless the Planning Secretary directs otherwise, WSC will prepare an Independent Environmental Audit (Audit) of the development.

Audits will:

- be prepared in accordance with the Independent Audit Post Approval Requirements (Department 2020);
- be led and conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Planning Secretary; and
- be submitted to the satisfaction of the Planning Secretary within three months of commissioning the Audit (or within another timeframe agreed by the Planning Secretary).

WSC will:

- review and respond to each Independent Audit Report prepared under the condition as required in the development consent;
- submit the response to the Planning Secretary and any other NSW agency that requests it, together with a timetable for the implementation of the recommendations;
- implement the recommendations to the satisfaction of the Planning Secretary; and
- make each Independent Audit Report and response to it publicly available no later than 60 days after submission to the Planning Secretary and notify the Planning Secretary in writing at least 7 days before this is done.

## 4.5 Record Keeping

The following records shall be kept at the legal address of the site Licensee:

- Copy of conditions of planning consent and authorisation under the *Amended Environmental Planning and Assessment Act 1979*;
- Records of inspections conducted by staff;
- Records of monitoring as discussed above;
- Records of complaints received;
- Correspondence with or records of inspections by EPA;
- Records of situations where licence conditions have been breached and how the breaches were rectified;

- Copy of LEMP in its entirety;
- The site's EPL;
- Site diary/daily log-book;
- Plans of waste storage locations for future possible retrieval;
- Worksite WHS field folder
- Any other applicable Council operational plans and policies including closure and post closure management plans (when developed);
- Copies of any site reporting; and
- Evidence and outcomes of site reviews.

WSC shall ensure that the above records are kept up to date and readily accessible for future reference.

# 5 Contingency Plan

The following Contingency Plan has been developed to outline the procedures to be implemented in the event of an incident that may result in material harm to the environment, particularly concerning water resources at the site. This plan is designed to ensure prompt and effective response actions, minimising the environmental impact and maintaining compliance with regulatory obligations.

## 5.1 Incident Detection and Initial Response

Regular monitoring of groundwater and surface water, as detailed in Section 3 of this WMP, will facilitate the early identification of potential issues. Exceedance of established trigger levels or other indicators of environmental concern will initiate contingency procedures.

Upon detection of an incident or potential non-compliance, immediate steps will be taken to control and contain the situation. This may involve:

- Stopping any operations that may be contributing to the incident.
- Isolating the source of contamination to prevent further spread (e.g., using physical barriers or containment booms).
- Activating on-site emergency response teams to manage the situation effectively.

The Site Manager will coordinate the response, ensuring all necessary actions are implemented swiftly.

## 5.2 Notification and Reporting

Immediately following the detection of an incident, the Site Manager will notify relevant personnel including the operational staff to ensure a coordinated response.

Notification and reporting procedures of any non-compliance incident will be handled as detailed in Section 7.

## 5.3 Mitigation and Remediation Actions

Immediate steps will be taken to reduce the environmental impact of the incident. These may include:

- Containment and neutralization of spills or leaks to prevent contamination from spreading to groundwater or surface water.
- Temporary storage or diversion of contaminated water until it can be treated or safely discharged.
- Implementation of erosion and sediment control measures if the incident involves soil disturbance or runoff.

A remediation plan will be developed and implemented to restore the affected areas to acceptable environmental conditions. Depending on the nature of the incident, this may involve:

- Excavation and removal of contaminated soil.
- Treatment of polluted water using appropriate technologies, such as filtration or chemical neutralization.
- Restoration of vegetation and soil structure in areas impacted by erosion or other disturbances.

## 5.4 Review and Continuous Improvement

Following any incident, a review will be conducted by the Site Manager to assess the effectiveness of the response. This review will consider:

- The root cause of the incident.
- The adequacy and effectiveness of the response actions.
- Any necessary improvements to the WMP and associated contingency measures.

Findings from the post-incident review will be used to update the Contingency Plan, ensuring that any lessons learned are incorporated into future responses. The WMP will be revised as necessary to reflect these updates, ensuring ongoing compliance with regulatory requirements.

## 5.5 Emergency Response Plan

The site's Emergency Response Plan includes detailed procedures for handling incidents such as spills, fires, and other emergencies. The Site Manager and operational staff are responsible for implementing this plan, coordinating with external emergency services as needed. The plan is reviewed regularly to ensure its continued relevance and effectiveness.

# 6 Continuous Improvement Program

The Continuous Improvement Program for the WMP ensures that the site's water management practices evolve to meet emerging environmental standards, address operational challenges, and adapt to changing regulatory requirements. The program is designed to ensure continuous monitoring, evaluation, and enhancement of water management procedures.

## 6.1 Objectives

The objectives of the Continuous Improvement Program are:

- To proactively identify areas where water management practices can be improved.
- To ensure compliance with regulatory requirements, including the EPL and the Development Consent.
- To minimise the environmental impact of water management activities, especially in terms of surface and groundwater protection.
- To implement the best available technologies and practices in water management to reduce contamination risks and optimise water use on-site.

## 6.2 Ongoing Monitoring and Evaluation

Regular monitoring of groundwater and stormwater will continue as outlined in Section 3 of this WMP. Data collected through monitoring programs will be analysed for trends, and any deviations from expected performance will be addressed through the implementation of corrective actions.

The Site Manager will be responsible for ensuring that:

- Monitoring results are reviewed annually to identify trends or areas for improvement.
- Anomalies or exceedances of water quality trigger levels are investigated promptly, and recommendations are made for process improvements.
- Groundwater, stormwater and leachate management practices are aligned with industry best practices and updated regulatory guidelines.

## 6.3 Incorporation of New Technologies and Practices

New technologies and improved operational practices will be evaluated periodically to assess their potential for enhancing water management. Where feasible, these innovations will be incorporated into site operations. This may include:

- Advanced water treatment technologies for managing leachate or contaminated stormwater.
- New techniques for reducing erosion and sediment transport on-site.
- Improved monitoring technologies for more accurate and real-time data collection.

## 6.4 Corrective Actions and Response to Incidents

As part of the continuous improvement process, corrective actions will be initiated in response to any identified non-conformances, such as elevated pollutant levels or breaches of performance criteria. The Site Manager will ensure that corrective actions are documented and that the underlying causes of incidents are addressed to prevent recurrence.

## 6.5 Periodic Review of the WMP

The WMP will undergo a formal review every three years or following significant changes to site operations, regulatory requirements, or major environmental incidents. This review will assess:

- The effectiveness of the current water management strategies.
- The need for modifications based on recent monitoring data or regulatory changes.

- Opportunities for further environmental performance improvements.

## 6.6 Staff Training and Engagement

A key aspect of continuous improvement is the engagement of all site personnel in water management practices. Staff training sessions will be conducted regularly to:

- Ensure awareness of the latest water management techniques and requirements.
- Equip staff with the knowledge to detect and report any potential issues related to water quality.
- Encourage a proactive approach to environmental protection among all site personnel.

# 7 Protocols for Managing Non-compliance

In case of non-compliance with statutory requirements or performance criteria:

- Immediate notification will be sent to the EPA.
- A corrective action plan will be developed and implemented within the shortest possible timeframe.
- Follow-up monitoring will be conducted to ensure the effectiveness of the corrective actions.

WSC will also notify the Planning Secretary in writing via the Major Projects website within seven days after WSC becomes aware of any non-compliance.

The non-compliance notification will:

- identify the development and the application number;
- set out the condition of consent that the development is non-compliant with;
- the way in which it does not comply and the reasons for the non-compliance (if known); and
- what actions have been, or will be, undertaken to address the non-compliance.

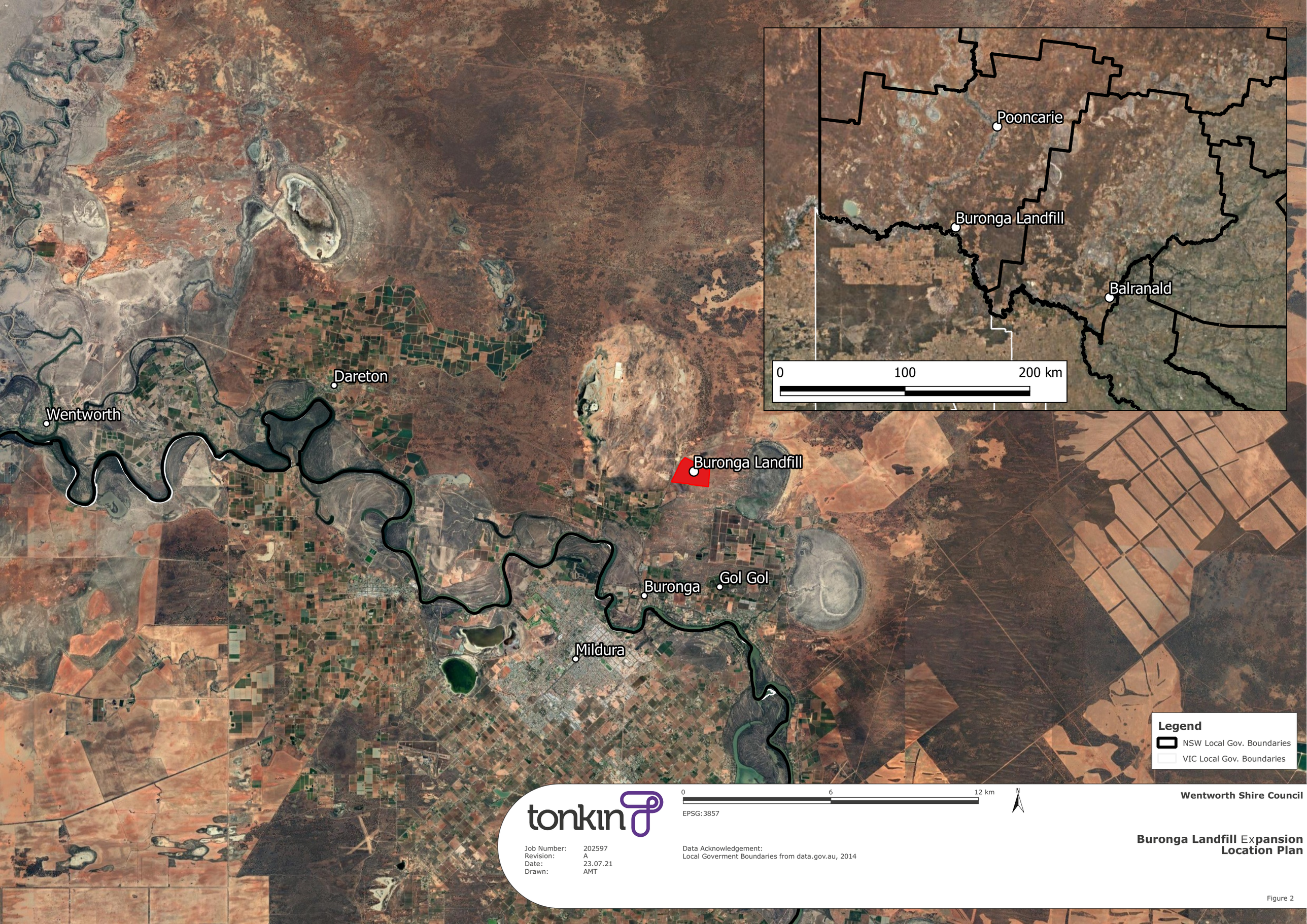
A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

# 8 Plan Review Protocol

The WMP will undergo a formal review every three years or following significant changes in site operations, regulatory requirements, or after any major incident. Any revisions will be submitted to the EPA for approval.

# Appendix A – Figures

**Figure 2: Regional Location Plan**




tonkin

Job Number: 202597
Revision: A
Date: 23.07.21
Drawn: AMT

Data Acknowledgement:
Local Goverment Boundaries from data.gov.au, 2014

**Wentworth Shire Council**

**Buronga Landfill Expansion**
**Location Plan**

Figure 2

**Figure 3: Site Location Plan**


Lot 1 DP1195524

Lot 2 DP1195524

ARUMPO ROAD

Lot 1 DP1037845

Lot 6917 DP1000008

Lot 197 DP756946

Lot 212 DP756946

Lot 2 DP1071616

Lot 7307 DP1180864

Lot 7311 DP1180864

Lot 2 DP1121028

Lot 2 DP1033964

Lot 930 DP756961

Lot 2 DP867041

Lot 1 DP1121028

Lot 1187 DP822097

Lot 7308

**Legend**

- Licenced Area
- Lot Boundaries
- Road Corridor

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0 200 400 600 m

EPSG:3857

N

**Wentworth Shire Council**

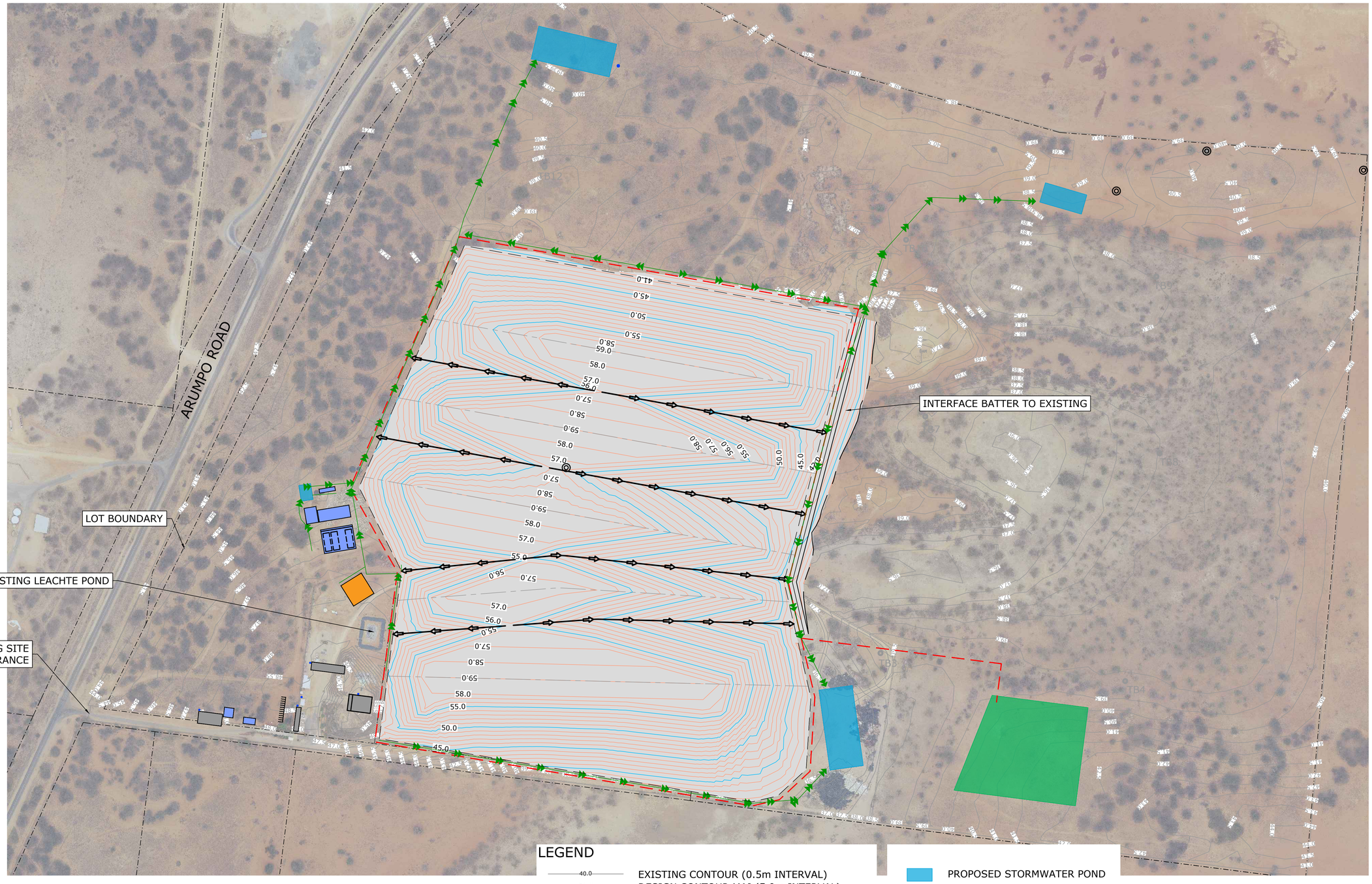
**Buronga Landfill Expansion Site Plan**

| | |
|---|---|
| Job Number: | 20180746 |
| Filename: | 20180746GQ001AGQ |
| Revision: | Rev A |
| Date: | 2019-07-03 16:16 |
| Drawn: | Isaac Nicholls |

Data Acknowledgement:
Imagery from NSW Government Spatial Services, 2019
Cadastre from NSW Government Spatial Services, 2019
Road Data from NSW Government Spatial Services, 2019

**Figure** 3

**Figure 7: Stormwater / Erosion and Sediment Control Plan Stage 1**




## LEGEND

- EXISTING CONTOUR (0.5m INTERVAL)
- DESIGN CONTOUR MAJ (5.0m INTERVAL)
- DESIGN CONTOUR MIN (1.0m INTERVAL)
- PROPOSED STAGE BOUNDARY
- PROPOSED CAP CROWN
- PROPOSED CAP DRAIN
- PROPOSED STORMWATER DRAIN
- PROPOSED STAGE 1 SERVICE ALIGNMENT
- PROPOSED STORMWATER POND
- PROPOSED LEACHATE POND
- ABORIGINAL ARTIFACT SITE
- PROPOSED BUILDING OR SHED
- PROPOSED HARDSTAND AREA
- PROPOSED LFG AREA (FUTURE)

THIS DRAWING IS TO BE VIEWED IN COLOUR AS SOME FEATURES / SYMBOLS ARE DIFFERENTIATED BY COLOUR. DRAWING NOT TO BE RELIED ON IF PRINTED IN GREYSCALE.

0 25 50 100 150
1:2500 (A1); 1:5000 (A3)
100mm ON ORIGINAL DRAWING - DO NOT SCALE DRAWING

SHEET SIZE
A1

| REV | AMENDMENT / REASON FOR ISSUE | DATE | DES. | DWN. |
|---|---|---|---|---|
| C | ISSUED FOR APPROVAL | 8.2.23 | IN | JDT |
| B | ISSUED FOR INFORMATION | 10.8.22 | | |
| A | FOR INFORMATION | 14.09.21 | | |

COORDS: MGA94 ZONE 54
DATUM: ALL LEVELS TO A.H.D.
SCALE: 1:2500
SURVEYED:PRICEMERRET
SURVEY DATE:03.03.21
APPROVED / PROJECT LEADER
MEL SALT

PUBLIC UTILITIES:
THE SERVICES SHOWN ARE DERIVED FROM PLANS OBTAINED FROM THE RELEVANT SERVICE AUTHORITIES. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ARRANGE WITH THE RELEVANT SERVICE AUTHORITIES FOR CONFIRMATION OF SERVICES AND THEIR LOCATION BEFORE EXCAVATION WORK COMMENCES.

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WENTWORTH SHIRE COUNCIL BURONGA

# LANDFILL EXPANSION FIGURE 7 STORMWATER/ EROSION AND SEDIMENT CONTROL STAGE 1

FILENAME: 202597 CONCEPT DESIGN.DWG
PROJECT NUMBER 202597
DRAWING NUMBER 07
REVISION C



T:\2020\202597 BURONGA LANDFILL EXPANSION - WENTWORTH SHIRE COUNCIL\4_WORKING\1 CAD\202597 CONCEPT DESIGN.DWG -C013- (08-02-23 3:57:49PM)

**Figure 14: Monitoring Wells and Standing Water Level Plan**


tonkin

Job Number: 202597
Filename: 202597GQ001Rev0
Revision: Rev 0
Date: 2023-05-31
Drawn: IPN

Data Acknowledgement:
Imagery from ESRI, 2023

**Wentworth Shire Council**

**Buronga Landfill Expansion Detailed Design**
**Stage 2 Geotechnical Investigation**
**Standing Water Level Plan**

**Figure 1**4

## Appendix B: Authors and Reviewers CVs

# Ben Taylor

Senior Engineer

Ben is a Senior Environmental Engineer with 18 years of industry experience. He brings a strong track record of performance in providing innovative and cost-effective solutions to technically challenging projects in urban water management.

Ben's key areas of specialisation include water sensitive urban design (WSUD), regional and urban hydrology, open channel hydraulics, drainage network design, watercourse stabilisation and rehabilitation and detailed design development.

Ben's expertise includes stormwater drainage design in both South East Queensland and South Australia, with a focus on WSUD which has evolved significantly during his career. He has also been involved in the preparation of a number of Stormwater Management Plans for Adelaide metropolitan and regional councils.

Ben is proficient in a range of stormwater modelling packages including MUSIC, DRAINS, HECRAS and SWMM.

His experience has provided him with a great appreciation for the opportunities and challenges within the industry and this, coupled with his pragmatic approach to problem solving, drives his ability to develop well-considered strategies and deliver excellent outcomes.

## Recent, relevant experience

### Watercourse Stabilisation and Rehabilitation

**Senior Engineer | Park Lands Creek Rehabilitation | City of Adelaide | Adelaide | 2014 – 2016 | Project Capital Value - $2M**

Park Lands Creek, a man-made channel built through the south park lands almost 100 years ago, has been subject to major deterioration. Works were required to address channel instability issues that have also led to public safety risks.

Ben led the detailed design of the new channel configuration. The design provided a suitable channel profile while considering the significant local constraints associated with existing infrastructure, significant trees and contaminated soils. The design also focussed heavily on achieving substantial improvements in biodiversity, with a focus on plants that have known cultural significance to the Kaurna people.

**Senior Engineer | First Creek Rehabilitation Projects | City of Burnside | Waterfall Gully | 2017–2021 | Project Capital Value- $2M**

A major flood event in September 2016 resulted in widespread watercourse stability issues within the City of Burnside. Many of these watercourses were located within public reserves or drainage easements on private property. Undertaking a watercourse audit the council identified key priority actions and set aside funding to progressively address the watercourse issues requiring short term remedial works.

Ben completed the initial watercourse audit along First Creek from Waterfall Gully car park through to Glynburn Road. Key areas of concern were identified, including the urgency and scale of works required. He was then engaged with City of Burnside over the subsequent three years to define the schedule of works based on priority including the development of concept

### Qualifications

Bachelor of Engineering (Civil & Environmental)

### Professional accreditations and affiliations

MIEAust

### Skills and expertise

Water Sensitive Urban Design (WSUD)

Watercourse Stabilisation and Rehabilitation

Floodplain Modelling and Mapping

Stormwater Management Planning

Stormwater Drainage Detailed Design

Urban and Rural Hydrology

*Ben's extensive industry experience coupled with his pragmatic approach ensures problems are solved and well-considered outcomes are delivered.*

and detailed design. This required frequent direct engagement with property owners to explain proposed works and obtain access permission. Ben continued to be heavily involved through the tender evaluation and construction phase.

**Senior Engineer | Glenthorne National Park| Department for Environment and Water | O'Halloran Hill | 2019 – 2021 | Project Capital Value - $3M**

Glenthorne National Park was created to preserve and revitalise a large area of open space in the southern suburbs and provide linkages with other existing parks forming a large network of connected reserves. As the stormwater management in Glenthorne National Park is centred around the historical agricultural research, the project sought to modify the drainage regime to reflect a more natural system and enhance environmental values.

Ben completed initial site review and development of concept and detailed design plans, including the inclusion of water quality improvement systems such as sediment traps and biofiltration basins. The design also converted the large farm dam into a functional wetland with reduced volume to permit more frequent flows to the downstream reach. Ben utilised his extensive knowledge of watercourse stabilisation project to design a system that will achieve multiple benefits from biodiversity to public amenity.

**Senior Engineer | Highbury Aqueduct Reserve Drainage Rehabilitation | Department for Environment and Water | Highbury | 2014 – 2020 | Project Capital Value - $0.5M**

Department for Environment and Water took over the management of Highbury Aqueduct Reserve subsequent to the upgrade of the Highbury Aqueduct to a piped connection from the Gorge Road Weir to Hope Valley Reservoir. There were several significant existing stormwater management issues identified across the reserve that required remedial actions.

Ben was involved in the development of the concept and detailed design development, tender evaluation and provide advice during the construction phase. Ben has continued to be a provider of choice for ongoing technical services through the Highbury Aqueduct Reserve.

## Floodplain Modelling and Mapping

**Senior Engineer | Gawler River | Gawler River Floodplain Management Authority | Gawler | 2014 – 2021**

The GRFMA sought to undertake a series of investigations since its formation, including regional flood modelling and mapping in 2007-2008. Subsequent investigations have been completed to review the hydrology and floodplain modelling while also investigating potential mitigation strategies to alleviate flood extents.

Ben was directly involved in the review of the Gawler River hydrology (RRR model) subsequent to the 2010 flood event. This included review of flood records at the relevant gauges in the catchment. Ben also completed hydrological modelling that incorporated a range of mitigation options to provide output hydrographs for testing in the Gawler River flood model.

**Senior Engineer | Mount Barker Creek | District Council of Mount Barker| Mount Barker | 2011 – 2012**

The District Council of Mount Barker sought to undertake regional flood modelling and mapping in 2011. This was to identify the existing flood risks in the township but also recognise the change in hydrology, and potential flood risk, associated with extensive development in the upstream catchment in line with the 30-year Plan for Greater Adelaide.

Ben was project manager and directly involved in the hydrology development and preparation of project documentation. The project also considered potential infrastructure upgrades and mitigation options.

## Stormwater Management Planning

**Senior Engineer | Smith Creek Stormwater Management Plan | City of Playford | 2016 – 2020**

City of Playford progressed the development of a SMP covering the Smith Creek catchment extending from the hills face adjacent to One Tree Hill through to Buckland Park. The catchment is relatively flat with substantial areas of unapproved hot house development and a lack of formal drainage infrastructure outside of the urban portion of the catchment.

Ben provided support in the review of the floodplain mapping to develop the mitigation strategies based on the agreed SMP objectives.

## Stormwater Drainage Design

**Senior Engineer | Liberty Development | Hickinbotham | Two Wells | 2012 – 2021**

Hickinbotham sought to rezone a large parcel of land north of Two Wells for urban development. The site was historically used for dryland cropping and partially within the floodplain of the Light and Gawler River systems, with very little existing formal drainage infrastructure in the region.

Ben was heavily involved in the design of the surface water management system for the development, including the design of a regional flood management strategy to cater for large regional flows through the development. It also included the management of local drainage to comply with the site stormwater objectives around frequency and rate of discharge along with water quality.

## Water Sensitive Urban Design

**Senior Engineer | Pasadena Stormwater Harvesting Scheme | City of Mitcham | Pasadena | 2020 – 2021**

City of Mitcham undertook investigations looking at daylighting of piped stormwater flows for potential larger scale harvesting and passive irrigation to public open spaces. The project helps offset water use from mains supplies while increasing the canopy cover to substantially cool the open spaces on hot days.

Ben was involved in review of the feasibility of a stormwater harvesting scheme including the water balance modelling and hydraulic assessment. He also oversaw the detailed design development through to issuing for tender.

**Senior Engineer | Adelaide Festival Plaza | Built | Adelaide | 2020 – 2021**

The below ground car parks of the Adelaide Festival Plaza car park encountered groundwater during construction by Built. This required a long-term management approach for treatment and discharge.

Ben was involved in review of water quality and liaison with the EPA regarding appropriate discharge strategies. This culminated in the detailed design of a series of raised biofiltration basis within planter beds to address water quality issues prior to discharge to the stormwater drainage system.

**Senior Engineer | Transitioning to a Water Sensitive City | City of Adelaide | Adelaide | 2020 – 2021**

City of Adelaide has embarked on a process to move towards becoming a Water Sensitive City in line with the approaches as defined by the CRC for Water Sensitive Cities (CRCWSC).

Ben provided training to City of Adelaide engineers, planner and asset managers around the use of the CRCWSC Scenario Tool. Specific training sessions were provided to the asset management team regarding the principles of WSUD through to the key maintenance requirements.

**Senior Engineer | Jervois Street WSUD Design | District Council of Yankalilla | Yankalilla | 2018 – 2019 | Project Capital Value - $0.3M**

The development of the Yankalilla, Carrickalinga and Normanville Stormwater Management Plan, identified the existing stormwater outlet to the Bungala River near Jervois Street as a target for augmentation.

Ben provided technical services in reviewing the potential augmentation strategies and oversaw the development of the concept and detailed design, including direct involvement in the engagement process with the impacted landholder. The final solution provided a gross pollutant trap, biofiltration basin for improving water quality in low flows, channel widening and stabilisation, and stabilisation of the large bed drop to the Bungala River with a rock chute.

**Senior Engineer | Ridge Park MAR Detailed Design | City of Unley | Myrtle Ban | 2011 – 2012**

During the Millennium Drought, water restrictions severely limited the ability of local Council's to maintain irrigation supply to public open spaces with any localities losing established vegetation. To help build resilience against future droughts and water restrictions, City of Unley undertook investigations and subsequent detailed design of a stormwater harvesting scheme, including managed aquifer recharge (MAR).

Ben provided technical input in the detailed design of the open channel stabilisation, stormwater offtake and water quality improvement upstream of the mechanical filtration system prior to injection. The scheme ultimately incorporated a litter screens and a biofiltration basin for primary and secondary treatment.

# Dean Noske

Principal Environmental Professional | Discipline Principal Environmental Science

Dean is a Certified Environmental Practitioner (Site Contamination Specialist) with 21 years' experience in contaminated land assessment, complex soil and groundwater investigation design, conceptual model development, and the coordination of multi-disciplinary site investigations involving risk-based investigation, management and remediation strategies. Dean has also acted as auditor's representative on various sites and has worked on a number of highly sensitive sites. He brings a strong track record of performance in undertaking technically robust, assessments and investigations and developing pragmatic, cost-effective and often innovative, solutions that effectively manage and mitigate client risk.

Having successfully delivered a broad range of projects, Dean realises that no two projects are the same. He consistently delivers excellent outcomes by working together with his clients and project teams to apply first principles and craft tailored solutions that meet each project's unique challenges.

Dean has worked across a range of sectors, including public works, land development, mining and resources, Defence, and maritime. His broad, multidisciplinary experience enables him to bring understanding and insight that supports integrated, effective problem-solving and design outcomes. As an experienced Geologist he also brings a deep understanding of geological, local soil, contamination, groundwater and environmental issues, developed over almost two decade's experience in Adelaide and regional Australia.

Dean's ability to translate complex technical details and knowledge to stakeholders from a variety of backgrounds is complemented by his ability to recognise and adapt to the different working styles of others and lead teams to deliver best for project outcomes.

## Recent, relevant experience

**Contaminated Site Assessments**

- Provision of professional advice and technical review of numerous soil and groundwater investigations associated with the construction and installation of water infrastructure pipelines across South Australia.
- Professional advice, Fleurieu Connection Alliance: Environmental Project Director. Included co-ordination of environmental works and provision of environmental advice associated with soil re-use and offsite disposal of soils along the Victor Harbour and Main South Road alignments.
- Combined environmental and geotechnical investigation along a portion of rail corridor, council road and DIT carriageway to determine the feasibility of a proposed stormwater alignment for the City of Prospect.
- Soil, groundwater and soil vapour investigation of a portion of the former Tonsley Innovation Precinct, with the purposes of obtaining construction approvals.
- Soil investigation and remediation planning of contamination hotspot area removal identified within both the Pakapakanthi (Park 16) and Kurangga (Park 20) areas.

### Qualifications

Bachelor of Applied Science (Geology)

Certificate of Environmental Management

### Professional accreditations and affiliations

EIANZ Certified Environmental Practitioner, Site Contamination Specialist (SC41123)

Member ACLCA and ALGA

Member of AUSIMM

### Skills and expertise

Contaminated Site Assessments (PSI's and DSI's)

Groundwater investigations

Remediation and site management plans

Site specific risk assessment

Asbestos in soil assessment

Soil and groundwater remediation

Environmental geology

*Dean is a highly experienced site contamination specialist delivering investigation and remediation projects, with a focus on solutions that put our clients first.*

- Groundwater and Surface Water Quality Investigation, six waste management facilities – Bunya, Caboolture, Dakabin, Narangba, Ningi and Woodford, (Moreton Bay Regional Council, QLD)
- Assessment, management and reporting of the Millicent Orphan site soil, soil vapour and groundwater assessment (SA EPA)
- Groundwater investigation of the former Halifax Street Council Depot (Adelaide City Council)
- Groundwater investigation of Adelaide City Parklands (Adelaide City Council)
- Groundwater investigation of the former Deeds Road Landfill (City of West Torrens)
- Groundwater and hydrogeological study of an existing landfill (Tenterfield Shire Council, NSW)
- Soil and groundwater investigation of a former up-stream bulk fuel storage facility (Wasco Energy Company, QLD
- Assessment, management and reporting of the Clovelly Park and Mitchell Park site assessment (SA EPA)
- Soil contamination investigations at various On the Run service stations (Peregrine Corporation)
- Various soil and groundwater investigations at BP, Mobil, Caltex and United Petroleum service stations
- Soil contamination investigations at the former Mitsubishi plant, Tonsley Park, SA and the former Mitsubishi engine foundry and test area, Lonsdale, SA
- Soil contamination investigations of the Port Adelaide waste water treatment Plant (SA Water)
- Soil and groundwater contamination investigations for various metropolitan and regional sites (DPTI)
- Environmental due diligence assessment of numerous sites across Australia (Telstra)
- Environmental due diligence assessment of numerous sites across Australia (Defence, SA and NT)
- Various combined environmental and geotechnical investigations for numerous Council Roadways
- Desktop Study and Assessment of Risk, City of Onkaparinga, SA
- Groundwater and soil assessment along the joint user hydrant infrastructure (JUHI) underground fuel pipeline at Adelaide Airport, SA
- Soil and groundwater assessment within the vicinity of the 'multi user' high rise car park at Adelaide Airport, SA.

**Certified Environmental Practitioner Reviews**

- Third party certification and review of various assessments, environment management plans and remediation management plans for a consultancy in NSW
- Review and Certification of numerous soil investigation reports (PSI, DSI, VENM, validation etc) and management plans associated with the Darlington Primary School construction in NSW.
- Review and sign off preliminary and detailed investigation works undertaken nationally across 12 sites proposed for development as transport maintenance and freight storage facilities.
- Third party review of an assessment report, remediation action plan (RAP), and completion report for Alexandrina Council, SA
- Third party review of an assessment report for a proposed residential development for City of Tea Tree Gully
- Various third-party reviews of assessment reports (PSIs and DSIs) for another SA consultancy.

**Auditor's Representative**

- Critical assessment of various environmental investigations conducted by other consultant, as a representative of a SA and Victorian EPA accredited Environmental Auditor (Contaminated Land) (DPTI, Mobil Oil Australia Pty Ltd, SA Water and various developers)

**Remedial Actions Plans and Environmental Management Plans**

- Preparation of a remedial action plan for a former landfill (Adelaide Airport Ltd)
- Groundwater monitoring plan, Dublin landfill (SA)

- Soil excavation, Sturt Living Project (Adelaide, SA)
- Preparation of construction environment management plans (CEMPs) for various On the Run service stations (Peregrine Corporation) and property developers
- Preparation of remedial action plan for various former SA Water and DPTI sites
- Preparation of a groundwater monitoring plan for Jacinth Ambrosia mine site (Iluka)
- Preparation of a remediation action plan (RAP) for the onsite encapsulation of lead contaminated material within a proposed recreational open space, Broken Hill (NSW)
- Preparation of an asbestos management plan (AMP) of naturally occurring asbestos at a proposed waste transfer facility Gympie (Qld)
- Preparation of a hydrogeological impact assessment (HIA) of a proposed landfill expansion at Buronga (NSW)

**Soil and Groundwater Remediation**

- Soil and groundwater remediation of a former service station, (Mobil, Croydon Park, SA). In-situ chemical oxidation (ISCO) of an active non aqueous phase liquid (NAPL) plume
- Groundwater remediation through pump and treat technologies at a portion of the former Mitsubishi engine foundry and test area, Lonsdale, SA
- Soil remediation of the former council depot and industrial facility (Adelaide City Council)
- Soil remediation of landfill at Parafield Airport (Adelaide Airport Ltd)
- Soil remediation for a former industrial facility, Millers Hill, Preston, Victoria
- Soil and groundwater remediation of numerous former service stations and garages (SA and Victoria)
- Various UST and fuel dispensing bowser removal works.

**Acid Sulphate Soil Assessment**

- Desktop study and preliminary sampling, Dredging Feasibility, Whyalla, SA
- Sediment sampling, Dredging Feasibility Study, Port River, Adelaide, SA.

**Defence Clearance Works**

- Underground fuel storage area assessment, RAAF Edinburgh, Adelaide, SA
- Soil assessment works, PFOS contaminated soil, RAAF Darwin, NT
- Defence Consultant Manager, Divestment Stages 5, 8, 9A, 9B and 10, DSTO
- Environment Assessment, Divestment Stages 7, 11A and 11B, DSTO, Adelaide, SA
- Environment Assessment, Divestment Stages 3A, 3B and 3C, DSTO, Adelaide, SA
- Environment Assessment, Divestment Stages 4A, 4B and 6A, DSTO, Adelaide, SA
- Environmental Assessment, Whyalla Army Reserve Training Ground, Whyalla, SA

**Mining and Resources**

- Various groundwater monitoring events at the Rio Tinto Alcan, (Gove site at Nhulunbuy, NT)
- Regulatory groundwater monitoring and development of groundwater management plans (Jacinth–Ambrosia Mine, SA)
- Baseline groundwater monitoring (Mintabie/Marla Oil and Gas Exploration, SA)
- Various soil and groundwater sampling events (Cooper Basin, Santos).

# Mamdoh Ibrahim

Principal Waste Engineer

Mamdoh is an experienced Charted Professional Engineer (CPEng) in Civil Engineering specialised in Waste Management with 23 years' industry experience. He brings a strong track record of performance in design, construction supervision and operation of landfills.

Mamdoh has worked in NSW, Australia for over 7 years. Prior to this he worked in Oman and Egypt for many of the major waste management companies and the Omani Government.

His key areas of specialisation include Waste Management Strategies, landfill site selection studies, Landfill Environmental Management Plans, Landfill Master Planning, Landfill gas and Leachate management, Landfill Capping design, Landfill Closure and Post Closure Plans and Quarry Management.

He likes to share his experience and ensure that lessons are learned from each project and is passionate about the delivery of projects that enable the construction of solutions that will benefit communities.

## Recent, relevant experience

**Principal Engineer – Waste | Tonkin | Sydney, NSW | 2023 - current**

- Providing comprehensive technical support to the Waste and Environmental team, focusing particularly on waste management and landfill projects
- Leading the process of landfill site selection, including the identification of necessary approvals and conducting technical studies. Developing concept designs and management strategies tailored to each site
- Serving as the team leader and primary reviewer for critical aspects of landfill projects, such as landfill cell design, filling plans, stormwater management plans, and environmental management plans (LEMP). Additionally, oversee cap design to ensure regulatory compliance and environmental sustainability
- Conducting rigorous Construction Quality Assurance (CQA) inspections and provide detailed review and approval of CQA reports, ensuring the highest standards of construction quality and environmental protection
- Assessing current landfill site operation practices and provide expert advice on potential improvements, optimizing efficiency and environmental impact.

**Landfill Manager | Elizabeth Drive Landfill | Cleanaway and Suez | Sydney, NSW | 2016–2023**

Mamdoh's role as Landfill Manager for this project included the following:

- Establish, review and update landfill masterplan
- Identify CAPEX and budget needs
- Review and approve design work for landfill cells, lining systems, surface water management system, leachate management system, landfill capping and landfill gas collection systems
- Manage excavation of 1.5M cubic meters of Shale and Clay to create the landfill airspace with a total cost of $15M
- Manage cell construction, lining system and leachate collection systems carried out by contractors for 3 General Waste Cells with total construction cost of $3.5M and 2 Restricted Waste Cells with a total cost of $2.5M

### Qualifications

Bachelor of Engineering (Civil)

### Professional accreditations and affiliations

MIEAust, CPEng, NER (Civil Engineering)

Waste Management & Resource Recovery Association (WMRR), Australia

### Skills and expertise

Waste Management

Landfill Engineering

Environmental Engineering

Construction Quality Assurance

Project Management

*Driving excellence through dedication to quality deliverables, authentic and honest communication and innovation.*

- Manage all other construction and infrastructure works in the landfill including internal roads, surface water management, landfill gas collection system works carried out by contractors
- Preparation of tenders, tender evaluation, supervision of works, contract management and review quantity survey reports
- Managed the landfill operation activities receiving around 1M tonne per annum including site team and contractors' teams to achieve the operational KPIs
- Ensure compliance with EPA licence, DA consent and other requirements and report to NSW EPA, Penrith Council, Mine Safety and other authorities. Manage the Landfill Expansion.

**Landfill Engineer | Oman Environmental Services Holding Company| Muscat, Oman | 2010 – 2015**

- Management and Supervision of 3 landfills' operation contracts being Multaqa Landfill, Barka Landfill and Sur Landfill receiving a total of 1.5M tonne per annum
- Review and approval of the design and construction method statements as well as ensuring the functionality of the landfill facilities for 8 engineered landfills and waste management facilities, including Multaqa landfill expansion, Barka landfill, Thumryat Landfill Ezz Landfill, Al Buraimi Landfill, Sohar Landfill, Sur Landfill Expansion and Duqm Waste Treatment Project
- Supervision of projects engineers and attending site visits and major inspections and meetings for several landfill design and construction projects
- Scoping, tendering and supervision of specialised consultants carrying out multiple site selection studies, Environmental Impact Assessment (EIA) studies, topographic survey and geotechnical investigation studies for waste management facilities.

**Team Leader and Reviewer | Environmental Assessment Report and the Aftercare Management Plan for the Closed Landfills | Coolum Landfill and Woombye Landfill | Sunshine Coast Council, QLD | 2023 - 2024**

In this project, Mamdoh applied his extensive experience in capturing any signs of contaminations resulting from the closed landfill, identifying any potential environmental risks, and suggested practical mitigation measures to control the identified risks.

In conducting this project Mamdoh carried out sites inspections for both landfills to identify any changes in the site, the improvements completed by the Council, damages, failures, contamination to the environment, also carried out the update of the Environmental Risk Assessment and the provided recommendations for improvements.

Coolum (closed) Landfill and Woombye (closed) Landfill are owned by Sunshine Coast Council. The Landfills are closed and capped. The project included an Environmental Risk Assessment and Aftercare Management Plan and presents recommendations for effectively enhancing control over the related environmental risks.

**Providing technical support and site inspections | Construction Quality Assurance (CQA) for the lining of cell 6 | Dunmore Landfill | Shellharbour City Council, NSW | 2023**

Providing technical advice to the Council and the Cell Construction Contractor to ensure the installation of the lining system is completed to satisfy the design requirement, and solve the onsite construction difficulties, approve and sign off the different liner layers and the leachate collection system.

Construction quality assurance (CQA) services for the Cell 6 at Dunmore landfill and the associated as-constructed reporting. The services were provided to a high quality and in a timely manner. Due to our involvement in sourcing suitable materials, timely intervention and resolution of construction issues and absence of outstanding CQA matters, potential delays and risks to Council were minimised.

**Review Cell Design | Port Pirie Contaminated Soil Landfill Cell Design | Port Pirie Landfill | Department for Energy and Mining (DEM), SA | 2023**

Provide practical insight to the cell design to ensure the highest capacity with the optimum excavation and backfilling works and compliance with the SA EPA Guidelines.

Mamdoh undertook the cell design review completed by the design team against the requiremenst set within the basis of design, the Client requirements, the site survey, the site stormwater management plan and the EPA guidelines.

Tonkin undertook the design for a Contaminated Soil Cell at the Pt Pirie Landfill (the site), located at Pt Pirie South, SA. The construction of a Contaminated Soil Cell which consists of 4 sub cells is considered as a solution for the disposal of waste streams including lead contaminated soils generated from the Port Pirie Lead Abatement Program (TLAP).

**Team Leader and Reviewer | Bunya, Caboolture and Dakabin Waste management Facilities Filling Plan and Storm Water Management Plan | City of Moreton Bay, QLD | Bunya Caboolture and Dakabin Landfills | 2023 - 2024 |**

Utilising his expertise in landfill operations, Mamdoh leaded Tonkin team to develop practical filling plans that inform the operational teams on preparing for each filling stage, including tasks such as access road preparation and stormwater management. The approach includes realistic estimations of available airspace and recommendations for best practices to optimize waste compaction and airspace utilization.

Mamdoh has undertook site inspection for the 3 landfill sites and guided the project team through the concept staging planning and review of the filling plans and the storm water management plans as well as laision with the Council team and project management aspects.

The project included updates to the current landfill filling plans and stormwater management plans for each of their three major waste management facilities located within the City of Moreton Bay being the Bunya, Caboolture and Dakabin Waste Management Facilities. The plans are intended to: allow to plan for new capital works projects and improve operational efficiencies, recommend the sequence and timing of staged filling at the site, consider the alternate daily cover currently being used by Council in lieu of soil, consider access and egress, roads and wet weather pads, include estimated airspace consumption rates and remaining airspace calculations, include capping and rehabilitation progress recommendations, address the management of surface water runoff, include the minimisation of exposure of runoff to waste resulting in leachate generation, address stormwater management infrastructure.

**Team Leader and Reviewer | West Daly Waste Management Strategy and Wadeye Waste Management Facility Concept Design | West Daly Regional Council, NT | 2023 - 2024**

Mamdoh collaborated closely with the Council to pinpoint the optimal concept design and management strategy for upgrading the landfill. This involved identifying future facilities and processes aimed at enhancing recycling and environmental management.

Tonkin has been engaged by the West Daly Regional Council (WDRC) to undertake engineering concept design for the upgrade of the existing Wadeye Waste Management Facility (the site) located at Wadeye, NT. The site is owned operated by WDRC.

**Principal Waste Engineer | Wurrumiyanga Landfill Upgrade| Wurrumiyanga Landfill | Tiwi Island Regional Council, NT | 2023**

Mamdoh undertook the development of a consultant's scope of service for the environmental approvals, design and documentation of an additional landfill cell as part of the Wurrumiyanga Landfill Upgrade.

Utilizing his experience in initiating and expansion of landfill sites, Mamdoh has undertaken a thorough review of the relevant legislation and guidelines in Northern Territory. He has compiled a list of necessary studies, investigations, designs, and documentation required for constructing an additional cell in the Wurrumiyanga Landfill. Additionally, he has provided an opinion of the anticipated costs associated with conducting these studies, investigations, designs, and obtaining the necessary approvals.

The Project was awarded to Tonkin by Tiwi Island Regional Council to provide a high order list of the feasibility surveys, studies and engineering investigations as well as a high-order list of the environmental studies and likely approvals that are likely to be required based on one upgraded/new landfill cell along with a list of the design (including typical drawings) and documentation required for the design of a new landfill cell.