



Kiama Council

# Annual Surface & Groundwater Monitoring Report (EPL) Gerroa Waste Disposal Depot

(EPL: May 2020 to February 2021 &  
Ammonia Monitoring: March 2020 to February 2021)

Report E2W-025 DR001 (V2)

19 March 2021



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Pty Ltd  
Environmental & Groundwater Consulting



Client: Kiama Municipal Council

Project: Annual Surface & Groundwater Monitoring Report  
Gerroa Waste Disposal Depot  
(EPL: May 2020 to February 2021, & Ammonia Monitoring: March 2020 to February 2021)

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Water Sampling & Laboratory Analyses Completed By:  
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## **1. Introduction**

Earth2Water Pty Ltd (E2W) was engaged by Kiama Municipal Council (Council) to provide an annual groundwater and surface water monitoring report for the Gerroa Waste Disposal Depot (GWDD). The GWDD Environment Protection Licence (EPL) was revoked in May 2008 and altered the previous reporting periods from August-July, to 1 April 2008 - 31 March 2009. The EPL reporting periods and monitoring periods have changed since 2009 (i.e. 2009-2010 monitoring report included results from five monitoring events including February 2009, May 2009, August 2009, November 2009 and February 2010. The 2010-2011 monitoring report included results from four monitoring events including May 2010, August 2010, November 2010 and February 2011. The 2011-2012 annual report includes results from five monitoring events including May 2011, August 2011, November 2011, February 2012 and May 2012.

The previous EPL reports (2010-2016) were provided as annual reports which included results from four regular quarterly monitoring events (May, August, November and February). The annual report from May 2016 to May 2018 included nine (9) quarterly monitoring events, whilst EPL (June 2018 to April 2019) included ten monitoring events (Ammonia only: 15 June 2018, 12 July 2018, 17 October 2018, 6 December 2018, 4 April 2019, and three EPL quarterly events; 22 August 2018, 16 November 2018, 12 February 2019. Last years annual EPL report (2019-2020) includes nine monitoring events (i.e. ammonia analyses @ June 2019, July 2019, September 2019, October 2019, & January 2020), and four quarterly EPL events; May 2019, August 2019, November 2019 and February 2019).

This annual EPL report (2020-2021) includes nine (9) monitoring events (i.e. ammonia analyses @ March 2020, June 2020, September 2020, December 2020, & January 2021), and four quarterly EPL events; May 2020, August 2020, November 2020 and February 2021). This EPL is the sixteenth provided by E2W to the NSW EPA on behalf of Council, and meets the general conditions outlined in the previous EPL (Lic No: 5959, R1.10).

This EPL report also follows NSW EPA correspondence and E2W previous report entitled “Second Interim Groundwater Report- Gerroa Waste Disposal Depot”, dated 14 May 2018 which outlined the rising ammonia trends at several deep wells (e.g. MW-1D, MW-3, MW-4, MW-5, MW-6D, MW-7D, Appendix D). The additional monthly monitoring continues to be undertaken to assess the variable to rising ammonia trends at multiple well locations at the former landfill site.

### **1.1 Background and Remediation Activities**

Council has owned and operated the GWDD since the 1960’s. It was previously licensed as a Solid Waste Class 1 Landfill, operating under the EPL No. 5959. The site also functioned as a night soil depot for liquid pump out sullage. Land filling operations at the GWDD were discontinued in October 2003.

From July 2004 to February 2005, the landfill was rehabilitated to eliminate, or at least minimise the potential for landfill leachate generation. The waste mound was reshaped, capped with a 0.5 m thick clay barrier and 0.3 m thick combined drainage/re-vegetation layer. The former night soil trench was also remediated in August 2004 (i.e. approximately 300 tonnes of bio-solid sludge were excavated and placed underneath the clay cap).

In February 2005, an irrigation system was installed to assist with the re-vegetation of the landfill mound using a combination of native and annual grasses. A groundwater holding dam (30 x 30 m) was also constructed next to the two existing evaporation ponds to contain and supply water for the irrigation system. A spear point (yield ~2 L/sec) was installed on the north-west corner of the landfill mound to allow groundwater (and landfill leachate) to fill the holding dam as well as supply water for the irrigation system.

The sludge pond (southern lined dam) at Gerroa Landfill has not been used since Council ceased undertaking the septic clean-outs. Waste Processing Solutions Pty Ltd was engaged by KMC in September 2009 to de-water the sludge in the lined pond, and subsequently taken to a Soilco Pty Ltd owned site. Removal of the pond liner (HDPE) was undertaken in October 2011 by Council and disposed to Shellharbour landfill (note: spillage of residual sludge may have occurred during removal of the liner).

Up until November 2008, Ecowise Pty Ltd (now ALS) performed the quarterly surface and groundwater monitoring at the landfill site. E2W and Council undertook the monitoring in November 2008, and subsequently Council and/or ALS performing the quarterly monitoring rounds herein. Water samples are sent to ALS for laboratory analyses. The access to the landfill is currently secured, with gates locked.

## 1.2 Objectives

The objective of the ongoing monitoring is to assess the potential impact of the GWDD on local surface and groundwater systems. This round of monitoring provides an assessment of water quality trends associated with the landfill rehabilitation works completed in February 2005.

## 2. Scope of Work

E2W was commissioned by Council to collate and interpret surface and groundwater data from the GWDD on the following dates

- EPL Events: 28 May 2020, 13 August 2020, 6 November 2020, and 1 February 2021. Each monitoring event comprised the following:
  - Sampling of onsite and offsite groundwater wells; MW-1S, MW-1D, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-7S, MW-7D, MW-9, MW-10 and MW-11.
  - Ammonia Monthly Monitoring: Sampling dates included: 8 January 2021, 18 December 2020, 9 September 2020, 17 June 2020, 5 March 2020. Wells samples include; MW-1D, MW-3, MW-5, MW-6D, MW-7D, MW-11, MW-12, MW-13 & MW-14.
- Sampling of surface water at all five locations along Blue Angle Creek (ML-1, ML-2, ML-3, ML-4, ML-5<sup>1</sup>). In previous reporting periods, several testing locations (i.e. ML-1, ML-3 and ML-4) were inaccessible due to being located on private property belonging to Cleary Brothers).

Similar EPL reports were previously completed by E2W for the dates; 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013,

<sup>1</sup> November 2008 was the first time ML-5 had been sampled since October 2004.



2013-2014, 2014-2015, 2015-2016, 2016-2018, and 2019-2020. Council has indicated (2017) that EPL reports are no longer required, however monitoring is conducted to assess the water quality and address any requirements for site management or remediation.

E2W completed the following scope of work to satisfy Council's surface and groundwater monitoring program at GWDD:

- Assist Council to interpret quarterly sampling results and provide recommendations.
- Prepare this annual report for May 2020 to February 2021 to provide information in accordance with Section R1.10 of the EPL (No. 5959). The annual report is to include the following:
  1. Tabulation of the monitoring data obtained for the period.
  2. Graphical representation of the current and previous monitoring data. Statistically significant variations or anomalies will be highlighted.
  3. Analyses and interpretation of monitoring data.
  4. Analyses and response to any complaints received.
  5. Identification of any deficiencies in the environmental performance of the GWDD, as highlighted by the monitoring data, trends and/or accidents.
  6. Proposal of recommendations to address the above identified deficiencies.
  7. Recommendations on improving the overall environmental performance of the facility.

This annual report includes four rounds of additional monitoring at key wells to assess ammonia trends at selected locations (refer to E2W, *"Second Interim Groundwater Report Gerroa Waste Disposal Depot, dated 14 May 2018"*).

Based on NSW EPA correspondence, ammonia results from wells (MW-1D, MW-3) are as follows:

- MW-1D: On 10 November 2016 and 20 February 2017, ammonia levels at this monitoring point were 12.5mg/L and 6.65mg/L respectively. These are the highest recorded results since 2011 results.
- MW3: On 31 May 2016 and 10 November 2016, ammonia levels at this monitoring point were 4.31mg/L and 1.30mg/L respectively. It is noted that on 16 February 2016, ammonia was detected as 20.9mg/L however, Council's consultant indicated that this result was an anomaly. Aside from this result, and 7.78mg/L being detected on 18 February 2013, all other results have been below 1.00 mg/L.

The 6 wells located in proximity to the landfill mound (MW-1D, MW-3, MW-4, MW-5, MW-6D, MW-7D) are recommended to be monitored for ammonia on a more regular basis, including the three downgradient wells (MW-12,13, 14) next to MW-1D (refer to Figure 4).

### 3. Licence Criteria and Relevant Guidelines

The EPL for the GWDD was revoked by the DECC in May 2008. The ongoing groundwater monitoring is undertaken to assess the effectiveness of the capping works and environmental status of the landfill post closure and rehabilitation. The revocation notice is subject to the following conditions:

- The licensee must maintain the landfill capping works.

- The licensee must undertake groundwater monitoring at groundwater wells MW-1S, MW-1D, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-7S, MW-7D, MW-9, MW-10 and MW-11 (in accordance with Table 3.1 below).
- Should the monitoring results indicate ammonia concentrations greater than 20% above ammonia concentrations reported in Table GW-1 of Kiama Municipal Council, Gerroa Waste Disposal Depot - Annual Groundwater and Surface Water Monitoring Report - August 2006 to May 2007, dated 17 August 2007, the licensee must notify the EPA within 7 days of receiving the results (Appendix C).
- The licensee must undertake surface water monitoring at surface water monitoring points ML-1, ML-2, ML-3, ML-4 and ML-5 (in accordance with Table 3.1 below).
- Should the monitoring results indicate ammonia concentrations greater than 10% above ammonia concentrations reported in Table SW-1 of Kiama Municipal Council, Gerroa Waste Disposal Depot - Annual Groundwater and Surface Water Monitoring Report - August 2006 to May 2007, dated 17 August 2007, the licensee must notify the EPA within 7 days of receiving the results (Appendix C, exceedances are present).

**Table 3.1: Surface and Groundwater Monitoring Requirements**

Parameters	Monitoring Frequency – Groundwater	Monitoring Frequency – Surface water
Alkalinity	Quarterly (#1)	Quarterly (#1)
pH	Quarterly (#1)	Quarterly (#1)
Conductivity	Quarterly (#1)	Quarterly (#1)
Total Dissolved Solids	Quarterly (#1)	Quarterly (#1)
Nitrogen (Ammonia)	Quarterly (#1)	Quarterly (#1)
Phosphorous (Total)	Quarterly (#1)	Quarterly (#1)
Nitrate	Quarterly (#1)	Quarterly (#1)
Nitrite	Quarterly (#1)	Quarterly (#1)
Total Kjeldahl Nitrogen	Quarterly (#1)	Quarterly (#1)
Calcium	Annual	Annual
Chloride	Annual	-
Fluoride	Annual	-
Magnesium	Annual	Annual
Sulphate	Annual	-
Sodium	Annual	Annual
Bicarbonate	Annual	Annual
Carbonate	Annual	Annual
Potassium	Annual	Annual
Dissolved Organic Carbon	Annual	-
Iron	Annual	Annual
Manganese	Annual	Annual
Redox Potential	Annual	Annual
Faecal Coliforms	-	Annual
Enterococci	-	Annual

*Note: Bicarbonate/alkalinity was conducted on quarterly basis (only an annual requirement).*

*Quarterly (#1) = monitoring is conducted on quarterly basis by KMC, however EPL requires sampling only “twice a year”. The enterococci analyses was not conducted for the surface water events during 2019 to 2021 (Note: enterococci is not a reliable indicator of landfill leachate at the site).*

The parameters listed in Table 3.1 were included in the three quarterly monitoring events from May 2020 to February 2021 (Table 6). Annual parameters were sampled during the August 2016,



November 2018, February 2019, and August 2019/2020 monitoring periods. Ammonia was measured in the five monitoring rounds from March 2020 to February 2021.

Ongoing quarterly monitoring with the same parameters is proposed for the future monitoring reports. A temporary monthly monitoring program is underway (Since late 2017) to address the rising ammonia trends in several key wells at the landfill site.

The DECC's Contaminated Sites: Guidelines for Assessment and Management of Groundwater Contamination (March 2007) outlines a best-practice framework for assessing and managing groundwater contamination. The guidelines are made under the Contaminated Land Management Act (1997) and recommend adopting the ANZECC (2000) chemical concentration trigger values for the protection of (fresh and marine) aquatic ecosystems.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000/2018) guidelines include risk-based trigger levels and indicative interim working levels (IIWLs). The IIWLs are of low reliability and used when insufficient data is available to calculate a trigger level. It should be noted that the ANZECC (2000) water quality guidelines are applicable to receiving water and not to groundwater. However, they form an appropriate basis for undertaking a screening level assessment of groundwater quality. The selection of the applicable guideline values should be based on an assessment of potential pathways by which human or environmental exposure might take place and the beneficial end use of the groundwater (i.e. ecosystem support).

The choice of a beneficial use classification for groundwater at the site depends on the quality of the water and its potential use in the long term. Although groundwater in the aquifer surrounding the waste disposal facility is likely to be of relatively good quality (depending on the presence of saline intrusions), there are no known groundwater extraction bores (agricultural or domestic) within the immediate vicinity. Therefore, the most appropriate beneficial use category of the groundwater is considered for the protection of aquatic ecosystems in the discharge zones of nearby Blue Angle Creek and Seven Mile Beach (i.e. fresh and marine water, respectively).

Based on the closest environmental receptors being both marine and fresh waters (i.e. Seven Mile Beach, Blue Angle Creek and Crooked River Estuary), the guidelines adopted for the site are based on the protection of both marine and freshwater aquatic ecosystems. These assessment guidelines are presented with the summarised analytical results (i.e. Tables; Groundwater GW-1, Surface Water SW-1).

Exceedances of ANZECC (2000) trigger values for marine water ecosystems have been highlighted in Tables GW-1 and SW-1.

#### **4. Environmental Setting**

The GWDD is located approximately 1.5 km southwest of the Gerroa Road bridge crossing of Crooked River and near the northern end of Seven Mile Beach. Blue Angle Creek is located around 80 m to the northwest of Crooked River Road (Figure 1).

The facility covers an area of approximately 3.2 hectares. The location and general layout of the site is shown in Figures 1 and 2. Prior to the remediation of the site in February 2005, the GWDD comprised the following:

- An elevated landfill mound ranging from 4 m to approximately 15 m AHD.
- Two lined evaporation sludge ponds. These ponds accepted septic sludge associated with Gerringong's upgraded sewerage system. These ponds are now lined and used to hold groundwater pumped from the site to enable irrigation on the landfill mound.
- A night soil deposit, which historically accepted night soil sludge; and
- A small recycling facility.

The former night soil depot was located adjacent to the north-western slope of the landfill mound (Figure 2). The former depot consisted of two excavated infiltration trenches which, up until August 2002, received pump-out wastewater from septic tanks in the Gerringong/Gerroa region. The two trenches were approximately 100 m in length (5 m wide) and while operational, partially filled with untreated wastewater.

#### 4.1 Climate

Between 1895 and 2011, the average yearly rainfall at Gerringong Mayflower Village (Latitude 34.75° S, Longitude 150.82° E) is 1,343.4 mm/year, with the heaviest rainfalls occurring in summer and autumn months.

However, rainfall data from Toolijooa (Nyora) Station is taken from July 2012 due to the closure of Mayflower Village Station. Climatic data indicates Gerringong/Gerroa received approximately 1559 mm of rain from February 2015 to February 2016<sup>2</sup> (Appendix B). The highest months of above average rainfall were recorded in April 2015 (426.4 mm), and August 2015 (378 mm), whilst January 2015 (316 mm i.e. just prior to reporting period).

The rainfall in 2016 and 2017 was only 953 mm/year and 889 mm/year (January to December) indicating drought conditions. The rainfall from January to July 2018 is 429 mm/7 months indicating the persistence of dry weather. The rainfall from May 2018 to April 2019 is only 860mm/year, indicating again the persistence of dry weather (drought conditions).

The rainfall from March 2019 to February 2020 was only 774 mm/year, which is approximately 35% less than the average annual rainfall (Appendix B). The below average rainfall since 2016/2017 and lowest in 2019/2020, is the key factor in ammonia trends around the landfill mound due to less dilution from the reduced runoff.

The rainfall during 2020 to 2021 = 1152.8 mm, indicating a return to the annual average.

#### 4.2 Topography

A general layout of the site topography is presented in Figure 1. The GWDD is situated within an estuarine landscape consisting of dune ridges, swamps and lagoons. The vegetation surrounding the facility comprises scrub and a littoral rainforest. Local relief is less than 5 m AHD and slopes less than 5%. The landfill forms a mound, reaching some 12 m above the surrounding ground surface.

The reduced groundwater level (RL) of the landfill footprint area ranges from approximately 3.3 to 5.2 m AHD. The footprint area (23,000 m<sup>2</sup>) and height of the rehabilitated landfill mound (15.9 m AHD, July 2005) is practically the same as pre-remediation conditions (i.e. October 2003).

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<sup>2</sup> Information obtained from the Bureau of Meteorology website ([www.bom.gov.au/climate](http://www.bom.gov.au/climate)).

### 4.3 Geology

The GWDD is located within the Seven Mile Soil Landscape as defined by Hazelton (1992). Coastal Plain Quaternary marine sands and Quaternary alluvium underlie the site.

Previous site investigations, as discussed in the URS report (2002), identified light brown fine-grained dune sands to a depth of 4 to 6 m below grade. The sands vary in thickness (between dune ridges and swales) and are largely contained above the groundwater table.

Beneath the dune sands, fine-grained grey beach sands containing shell fragments are present to a depth of approximately 14 m. The base of the sequence comprises estuarine silty and sandy clays. Further inland, the sedimentary sequence comprises estuarine clays closer to the surface, particularly in the vicinity of Blue Angle Creek where the ground surface is 2 to 3 m lower than the landfill area.

### 4.4 Hydrogeology

The GWDD is underlain by an unconfined and permeable sandy aquifer. Groundwater is encountered at a depth of approximately 3 - 4 m below ground level (i.e. approximately 1 m AHD) at the landfill area and becomes shallower towards Blue Angle Creek to the west and Seven Mile Beach to the east.

The groundwater quality varies from potable to saline, with electrical conductivities ranging from 0.3 to 50 mS/cm. The groundwater generally becomes more saline with depth and in the vicinity of tidal saline water bodies (i.e. Blue Angle Creek and Seven Mile Beach).

The hydraulic conductivity of the beach and dune sands at Gerroa has a geometric average of 10 m/day (Gerroa-Gerringong Sewerage Scheme EIS, 1999). It is noted that the organic silty sands between 0 - 0.15 mbgl have a lower permeability (approximately 0.1 m/day, E2W site investigations, March 2004).

In the area of the GWDD, groundwater gradients are controlled by topography, the Seven Mile Beach shoreline, Blue Angle Creek and Crooked River Estuary. It is interpreted that a natural groundwater divide runs through the landfill (URS 2003, E2W 2004), with groundwater to the west flowing towards Blue Angle Creek and groundwater to the east towards Seven Mile Beach. It is likely the natural groundwater divide is influenced by the coastal dunes and presence of the landfill mound (due to increased recharge). The position of the groundwater divide may change with the tide and seasons. During 2004/2005 (a drought period), the predominant flow direction is inferred to be towards Seven Mile Beach.

Groundwater discharge at Blue Angle Creek and Seven Mile Beach will be influenced by the presence of a fresh groundwater/salt water interface. The interface results from the density difference between the groundwater and sea water and is a dynamic and complex region with upward hydraulic gradients, tidal fluctuations, micro-biological processes, groundwater and surface interaction and substantial salinity variations. The groundwater/salt water interface can be associated with enhanced natural attenuation (biodegradation, dilution, sorption etc.), which acts to reduce the levels of contaminants prior to their discharge to marine ecosystems.

Groundwater is also interpreted to discharge as baseflow within Blue Angle Creek. Due to the action of tides, salt water is intermittently present in Blue Angle Creek with salinity governed by

tide levels. The saline water intrusion at high tide extends approximately 2 km upstream of the confluence between Blue Angle Creek and Crooked River.

It is understood offsite migration of contaminants (nutrients, iron and some ammonia) has occurred in the local shallow and deep groundwater systems (URS 2002, 2003; E2W 2004, 2006). This groundwater contamination arises from nutrient enrichment, which is associated with the former landfilling operations at the GWDD.

The leachate plume identified in the well network arises from historical waste disposal at the site, which commenced in the 1960s. The landfill remediation (completed in February 2005) will reduce future landfill leachate generation, however shrinking/diminishing of the existing plume will depend on natural attenuation processes (i.e. dilution, adsorption, biodegradation dispersion etc.) over time (years).

The groundwater quality immediately outside the footprint area is subjected to increased dilution arising from runoff (1 ha) and groundwater recharge from the landfill mound. This dilution together with natural attenuation decreases the leachate levels in the aquifer.

#### **4.5 Hydrology**

The hydrology of the area is dominated by Blue Angle Creek, Crooked River and Seven Mile Beach (Figure 2).

The closest environmental receptors of water running through the GWDD are Blue Angle Creek, Seven Mile Beach and Crooked River Estuary (Figure 1). Blue Angle Creek flows into the Crooked River Estuary at the northern end of Seven Mile Beach. The estuary discharges into the ocean when the mouth is open.

Previous Crooked River and Blue Angle Creek surface water quality investigations were discussed in the URS report (2002). The results indicate a considerable variation in water quality, particularly between dry and wet conditions, which may be associated with inputs from the wider catchment area.

When the entrance to Crooked River is open, the lower part of the river is well flushed with oceanic waters. This results in levels of nutrients, bacteria and toxicants that generally comply with guideline levels. Immediately following wet weather, water quality in the estuarine section of Crooked River generally deteriorates, with increased levels of particulate material, bacteria, sulphide, nutrients and metals (URS, 2003).

Of the four main tributaries that feed into the estuarine section of Crooked River, water quality in Blue Angle Creek was the most degraded with phosphorus, nitrogen, hydrogen sulphide, copper and zinc (URS, 2003). Surface water runoff from the landfill mound is diffused and infiltrated into the surrounding sandy soils.

### **5. Previous Monitoring Results**

The primary conclusion from the monitoring report submitted by URS (2002-2003) prior to remediation in 2005 is summarised below:

- High concentrations of nutrients, in particular ammonia-nitrogen, continue to be detected under the site and migrating offsite. The levels recorded are well in excess of ANZECC (2000) guidelines for the protection of fresh and marine water ecosystems.

The following key points are also noted:

- High concentrations of ammonia-nitrogen and TKN were consistently detected in monitoring wells MW-1 and MW-5, which are located on the outer extent of the facility. This indicates the potential for migration of the nutrient plume in a south-easterly direction towards Seven Mile Beach. High concentrations of ammonia-nitrogen were also detected in monitoring wells MW-3 and MW-7, which are also located on the outer extent of the facility, indicating the potential for migration of the nutrient plume in a north-westerly direction towards Blue Angle Creek.
- Elevated concentrations of ammonia-nitrogen were detected in the shallow monitoring wells MW-9 to MW-11, adjacent to Blue Angle Creek.

## 6. Surface and Groundwater Monitoring

Surface and groundwater monitoring between May 2020 and February 2021 for the EPL was undertaken by ALS Environmental. ALS also conducted the additional monitoring (ammonia only) at nine (9) key wells between March 2020 and February 2021 (Figure 4).

Sampling was carried out on the following dates for the **EPL Wells**:

- 28 May 2020,
- 13 August 2020,
- 6 November 2020; and
- 1 February 2021.

Refer to Tables (GW-1 and SW-1). The February 2021 and May 2020 monitoring rounds include ammonia results at the three downgradient wells (MW-12,13,14).

The sample dates for assessing ammonia trends at the 9 key groundwater Wells (MW-1D, MW-3, MW-5, MW-6D, MW-7D, MW-11, MW-12, MW-13 & MW-14) are as follows:

- 8 January 2021,
- 18 December 2020,
- 9 September 2020,
- 17 June 2020,
- 5 March 2020.

Refer to Table 7 and the a summary of results.

The recommended procedure for sample collection, storage, handling and quality control generally employed by ALS is outlined in the NEPM (2013). E2W used the November 2008 sampling round to instruct Council staff on surface and groundwater sampling protocol. The samples are all sent to ALS (Sydney) for laboratory analyses. E2W understand that ALS carry out the quarterly sampling at the GWDD and submit the samples to ALS (Sydney via the Wollongong office) for analyses.

## 6.1 Monitoring locations

The following outlines the nature of the monitoring and analytical program at the site and the conditions at the time of sample collection from information provided by ALS and/or Council. Groundwater was sampled from six monitoring wells (MW-3, MW-4, MW-5, MW-9, MW-10, MW-11), and three nested wells (i.e. MW-1S/MW-1D, MW-6S/MW-6D and MW-7S/MW-7D, where S = shallow, D = deep).

Additional samples were collected from three wells (MW-12,13,14) located on the east side of the waste mound to better assess the ammonia trends in proximity to MW-1 and MW-1D.

Surface water was sampled at five locations (ML-1, ML-2, ML-3, ML-4 and ML-5) along Blue Angle Creek (Figure 2). The available surface water monitoring results are presented in tables (SW-1).

Variable EC levels in surface water testing locations indicate that sampling may not have been undertaken during low tide (sampling at low tide provides a reflection of groundwater discharge).

## 6.2 Sampling Sites - Groundwater

The sampling sites are described below, while sampling depths for the bundled piezometers and conventional wells are summarised in Table 6.2.

- MW-1S (shallow - 6 m depth) and MW-1D (deep - 10.5 m depth) - Located next to the previous multilevel piezometer MW-1 and approximately 40 m from the SE corner of the landfill perimeter. The well is situated down-gradient of the landfill mound and intended to intersect flow heading towards Seven Mile Beach.
- MW3 - Approximately 20 m to the north of the landfill clearing, fronting native bushland. This well is to establish background water quality conditions and determine offsite migration of groundwater in a northerly direction.
- MW4 - Located immediately adjacent to the night soil depot, which is a source of potential nutrient and bacterial contamination.
- MW5 - Approximately 30 m to north of the night soil depot. The well is within the extent of contamination arising from the depot and landfill-impacted groundwater.
- MW-6S (shallow - 6 m depth) and MW-6D (deep - 10.5 m depth) - Located next to multilevel piezometer MW-6 and approximately 50 m NW of landfill and night soil depot. The well is situated down-gradient of the landfill and night soil depot.
- MW-7S (shallow - 6 m depth) and MW-7D (deep - 10.5 m depth) - Located 15 m to the east of multilevel piezometer MW-7 and approximately 100 m NW of landfill and night soil depot. This well was installed to establish background water quality conditions and determine offsite migration of groundwater contaminants towards Blue Angle Creek.
- MW9 - Located offsite and adjacent to Blue Angle Creek downstream of ML-1 to determine if potentially contaminated groundwater is discharging into the estuarine environment.
- MW10 - Located offsite and adjacent to Blue Angle Creek downstream of ML-1 to determine if potentially contaminated groundwater is discharging into the estuarine environment.
- MW11 - Located offsite and adjacent to Blue Angle Creek downstream of ML-1 to determine if potentially contaminated groundwater is discharging into the estuarine environment.
- MW-12,13,14: Shallow wells installed in July 2007 to assist with remedial works (if required) on the downgradient boundary of the landfill mound. These three wells have been monitored to



better characterise the water quality trends (i.e. ammonia, refer to Table 7) on the downgradient boundary of the site (Figure 4).

### 6.3 Sampling Sites - Surface Water

#### Blue Angle Creek

- ML-1. Approximately 100 m upstream of the depot along Blue Angle Creek at the end of the tidal limit. This sampling location was chosen to establish upstream water quality and offsite conditions.
- ML-2. Approximately 500 m downstream of the depot along Blue Angle Creek. This sampling location was chosen to establish offsite and downstream water quality and assess the potential for contamination associated with the depot.
- ML-3. Approximately 200 m upstream of the flood gates along Blue Angle Creek, and 100m upstream of ML-4. This sampling location was chosen to establish upstream water quality and offsite conditions due to agricultural activities in the catchment area.
- ML-4. Approximately 100 m upstream of the flood gates along Blue Angle Creek. This sampling location was chosen to establish upstream water quality and offsite conditions.
- ML-5. Approximately 400 m downstream of the flood gates along Blue Angle Creek, between MW-9 and MW-11. This midstream sampling location was chosen to establish offsite receptor water quality conditions.

The surface water and groundwater sample locations are illustrated in Figure 2, and Table 6.1.2.

**Table 6.1.2: Monitoring Summary for May 2020 to February 2021**

Sample ID	Screen Interval (m AHD) & Sample Location	May 2020 to February 2021
MW-1S	Approx. 0 to -3	Aug & Nov 2020 (2)
MW-1D	Approx. -4 to -7	X
MW-3	0 to 1.5	X
MW-4	0.79 to -0.71	X
MW-5	0.55 to -0.95	X
MW-6S	Approx 0 to -3	Aug 2020 (1)
MW-6D	Approx -4 to -7	X
MW-7S	Approx 0 to -3	X
MW-7D	Approx -4 to -7	X
MW-9	-0.53 to -1.53	X
MW-10	-0.525 to -1.525	X
MW-11	0.095 to -0.905	X
ML-1	Upstream of landfill	4 dates sampled
ML-2	Downstream of landfill	4 dates sampled
ML-3	Upstream of landfill	4 dates sampled
ML-4	Upstream of landfill	4 dates sampled
ML-5	Opposite landfill	4 dates sampled

Notes: X = Sample collected. MW = Monitoring well sample from landfill site. ML = Surface water sample from Blue Angle Creek. The 6 wells (MW-1S/MW-1D etc) are considered more reliable monitoring locations (compared to multilevel piezometers) as they were constructed with standalone 50 mm diameter PVC screens and not the 7 mm poly tubing (low flow system). The MW-12,13,14 are constructed with 3m PVC (50mm diam) well screens at approx. 1 to -2 mAHD.

## 6.4 Sample Collection and Laboratory Analysis

The surface and groundwater analytical program from May 2020 to February 2021 is presented in Tables GW-1 (groundwater) and SW-1 (surface water). The nested wells (MW-1S, MW-1D, MW-6S, MW-6D, MW-7S, MW-7D) installed in 2006 have replaced the bundled piezometers 3 (i.e. MW-1, MW-6, MW-7). The results from the nested wells are graphed separately for the water quality trend assessment.

The 6 wells located in proximity to the landfill mound (MW-1D, MW-3, MW-4, MW-5, MW-6D, MW-7D and MW-12,13,14) are monitored for ammonia on a more regular basis to assess ammonia trends (Figure 2, Table 7).

## 7. Water Monitoring Results

All groundwater and surface water analytical results from 2003 to 2021 are presented in Tables GW-1 and SW-1, with the most recent (9) monitoring data highlighted. The field records and laboratory reports are presented in Appendix A and Table 6 (summary of data set). Results for the additional wells (9) to assess ammonia trends are presented in Table 7.

Compliance exceedances are noted in Appendix C (i.e. ML-3 & ML-4, and mostly at MW-11 during 2019-2020). Further investigations are required to assess the ammonia trends at MW-11 and links to the onsite wells (MW-6D/MW-7D, with rising ammonia trend) as the data indicates leachate plume migration towards the Blue Angle Creek and 7 Mile beach (Figure 4).

A summary of all available monitoring data (2003 to 2021) is presented in Graph-1 to Graph-7. The graphs illustrate ammonia and total phosphorous concentrations (key indicators of leachate impact) for the groundwater wells<sup>4</sup> and surface water sampling locations as well as the depth to groundwater (m AHD, 2001 to 2021).

The graphs illustrate the ammonia concentrations in the shallow (Graph-1) and deep monitoring wells separately (Graph 2). Contaminant migration rates and flushing characteristics are different at shallow and deep levels of the aquifer.

The graphs highlight water quality trends with respect to seasonal and water level changes, as well as water quality improvements associated with the landfill rehabilitation completed in 2005.

The monitoring data shows that ammonia concentrations at MW-3 and MW-5 have returned to low levels (below ANZECC 2000) in late 2017 to April 2019, with several exceptions. Elevated ammonia concentrations at three EPL wells (MW-1D, MW-6D and MW-7D) require further monitoring to assess the trends, and potential remedial actions (as required). The previously rising ammonia trend at MW-11 may have related to plume migration, however has recently returned to low levels and decreasing ammonia trends.

The additional wells (MW-12,13,14) monitored on the downgradient boundary indicate elevated and rising ammonia concentrations on the east flow path (i.e. ammonia between 26.6 to 97.7

<sup>3</sup> The bundled wells were believed to provide spurious results due to the low purge volumes.

<sup>4</sup> Results from multilevel piezometers MW-1, MW-6 and MW-7 (Graph-01 & Graph-03) are considered anomalous due to well construction issues.

mg/L). The ammonia concentrations on the eastern boundary have stabilised from the previous monitoring period.

## 7.1 Groundwater Data

Groundwater was collected from a network of twelve monitoring wells at onsite and offsite locations (Figure 2) from May 2020 to February 2021. The results of the groundwater results obtained are summarised in Table GW-1, Graph-1 to Graph-5 and the following subsections.

### 7.1.1 Groundwater Depth and Flow Regime

The depth to groundwater was measured prior to each sampling event (in conventional wells) using a water level probe. The depth to the groundwater below top of casing and relative to a common reference (i.e. Australian Height Datum, m AHD) is presented in Table GW-1. The inferred groundwater contours are presented in Figures 3A & 3B. Reduced groundwater levels (m AHD) between 2001 and 2021 is illustrated in Graph-5.

A broad groundwater divide is interpreted to occur at the landfill mound (sand dune area) and inferred to be located midway between Crooked River and Seven Mile Beach. As the position of the groundwater divide is influenced by the surface water bodies, the prevailing dry climate and recharge through the waste mound, it is likely local groundwater flow characteristics have altered over recent years. The drought conditions indicate a relatively flat hydraulic gradient directed to the west and east, respectively.

The drought period (2017 to 2019/2020) is interpreted to increase ammonia concentration around the landfill mound. The increased ammonia is interpreted to arise from the lower rainfall/runoff input and recharge over the leachate plume (i.e. less dilution from rainfall recharge) and plume movement from under the mound. The higher rainfall during 2020/2021 has stabilised and slightly decreased the previous ammonia trend.

The reduced groundwater levels from the twelve wells indicate a relatively low to moderate water table elevation. Field sampling records show that the depth to groundwater between October 2003 and February 2012 is below 1.87 mAHD. The groundwater levels recorded from the 2011-2012-2013, 2014-2015 monitoring round are similar to slighter lower than the 2015-2016 monitoring period, reflecting variable rainfall patterns and leachate movement over time. The 2015-2016 wet weather and higher water table is similar to the February 2011 wet period. The water levels during 2016-2018 show a decline due to lower than average annual rainfall during 2016 to 2018. Rainfall during from June 2018 to May 2019 (860 mm/yr) is lower than previous years and is reflected in the lowering water table trend (Graph-5).

The rainfall from March 2019 to February 2020 was 774 mm/year, causing a general lowering of the water table (i.e. <1m and around 0.5m AHD at most areas). The groundwater level rose in the past year given the higher rainfall in 2020/2021 (1,152.8 mm).

The inferred groundwater contours for the site are presented in Figures 3A & 3B (reflecting dry and wet weather periods). The groundwater levels and degree of mounding has significantly lowered over the past year. The groundwater levels reflect a dynamic groundwater environment and period of low rainfall. Ammonia concentrations on the east boundary are considered to reflect a low recharge environment and low dilution.

### 7.1.2 Field Parameters

The groundwater, field parameters measured during sampling are considered indicative only (small purge volumes). Insitu measurements (within borehole) are likely to provide a more accurate rendition of the field chemistry, especially with respect to dissolved oxygen.

### 7.1.3 pH (field) and Redox

The groundwater pH measured from the twelve wells ranges from approximately pH 5.2 to PH 8.0. The pH in each well was generally stable over the monitoring rounds (May 2020 to February 2021).

On its own, pH is not considered a reliable indicator of leachate contamination, as sediments and decomposing organic material associated with the creek bed also have an influence on pH.

Redox is not consistently measured during monitoring periods. Redox potential is measured annually (August 2016, 2017, 2018, 2019, 2020) with positive (116 mV) to negative (-138 mV) readings and is generally comparable to previous monitoring periods. The negative redox readings are generally associated with the presence of landfill leachate and elevated ammonia concentrations.

### 7.1.4 Total Dissolved Solids (TDS and EC)

The TDS levels in groundwater collected from the site range from approximately 191 to 18,000 mg/L (fresh to brackish). The lowest and highest TDS levels were obtained from MW-5 and MW-9, respectively. The elevated TDS level for MW-9/10/11 is related to the well's proximity to Blue Angle Creek and associated tide and estuary mouth closure influences.

Salinity increases as groundwater flows towards Blue Angle Creek (MW-9 to MW-11). A decrease in salinity (TDS) occurs in several wells close the landfill perimeter (i.e. MW-3, MW-4, MW-5), which is interpreted to occur from dilution arising from an increase in stormwater runoff from the landfill mound post-capping (& decreased leachate generation).

### 7.1.5 Dissolved Oxygen (DO)

Field analyses from the twelve wells recorded dissolved oxygen (DO) concentrations ranging from between approximately 1.07 and 7.74 mg/L. The concentrations of DO reported for the site from 2003 to 2021 are variable. However, measurements may reflect the instruments (imprecise) used and/or purging process.

Based on the distribution of DO in the groundwater at the site, it is inferred that landfill leachate caused a depletion of groundwater DO and is generally increasing due to decreasing nutrient concentrations. This phenomenon is seen on many landfill sites, where organic carbon and nutrients provide surplus electron acceptors, which react with and consume the available DO in the groundwater. It is likely the groundwater under the landfill mound is anaerobic due to the presence of the landfill leachate (DOC, ammonia etc) and poor flushing due to the landfill capping.

## 7.2 Nutrients

### 7.2.1 Nitrogen

Groundwater collected from the monitoring wells at the GWDD were analysed for ammonia-nitrogen, total Kjeldahl nitrogen (TKN) and oxidised nitrogen (nitrate and nitrite). Discussions regarding potential impact to the environment will focus on ammonia-nitrogen, as it is the main indicator of groundwater contamination from leachate.

The guidelines for total ammonia-nitrogen for the protection of fresh water and marine ecosystems vary according to pH and temperature. Given the range of pH and temperature measured across the site and in Blue Angle Creek, the guidelines are 1.88 and 2.84 mg/L for fresh and marine waters, respectively (at a pH of 7.3).

At least one groundwater samples collected from MW-1D, MW-6D, MW-7D, and MW-11 exceeded the ANZECC (2000) trigger value for ammonia. These monitoring wells are located east or west of the landfill mound, indicating leachate is migrating towards Blue Angle Creek.

Groundwater wells (MW-1, MW-3 and MW-4 pre-rehabilitation) initially reported the highest concentrations of ammonia. Following the landfill rehabilitation, ammonia levels have declined in the shallow groundwater system and are below ANZECC guidelines (Graph-1, except MW-3 in February 2016 which is inferred as an anomaly).

Groundwater from deep wells (MW-1D, MW-6D and MW-7D) showed a consistent declining trend until 2017/2018 (& below ANZECC 2000), however an increasing ammonia trend is evident from 2019 to 2020, the trend stabilised and potential changes in the 2020-21 period.

The three wells (MW-6D/MW-7D and MW-1D) show an irregular but increasing ammonia trend with some elevated concentrations starting from 2017/ 2018, and 2019/2020 (Appendix D, Table 7). The ammonia results from the additional wells (MW-12,13,14) indicate an elevated and rising concentrations on the east side of the mound (i.e. ammonia from 26.6 to 97.7 mg/l). The trends in 2020/2021 show potential stabilisation and possible decrease.

Nitrate was analysed for all samples with MW-1D, MW-6S, MW-6D, MW-7D, MW-9, MW-10 are generally below or marginally exceeded the ANZECC (2000) guideline (freshwater trigger value, 0.7 mg/L).

All groundwater samples analysed on at least occasion from all wells during May 2020 to February 2021 exceed ANZECC (2000) fresh and marine water TKN trigger values (0.5 and 0.12 mg/L, respectively). Monitoring wells located adjacent to Blue Angle Creek (i.e. MW-9, MW-10) continue to report stable or decreasing concentrations of ammonia, (Graph-1). The ammonia concentrations at MW-11 (2019-2020) indicate potential increase and landfill leachate plume migration from the landfill mound (i.e. refer to ammonia trends at MW-7D/6D). The rising trend at MW-11 decreased in the 2020-2021 monitoring period.

Table 7.1.3 (below) and Figure 4 provide an overview of groundwater ammonia trends from May 2020 to February 2021 reporting period.

**Table 7.1.3: Groundwater Ammonia Trends – May 2020 to February 2021**

Well ID	Ammonia Trend	Exceedance of ANZECC (2000) Ammonia	Trigger 20% exceedance (Ammonia)	Comment
MW-1S	Decreasing trend. below ANZECC	No exceedance	No exceedance	Shallow sample - east of landfill
MW-1D	Recent rising trend. Since mid 2016 to 2019 data is variable with significant ammonia spikes. All results in 2018-2021 exceeds ANZECC. Reducing Trend in 2020/21	Exceedance	No Exceedance	Deep sample - east of landfill
MW-3	Overall decreasing & stable trend. Anomalous result in February 2016 (20.9 mg/L) and 4.31 mg/L in May 2016. Stable/decrease ammonia in 2017-2021	No Exceedance	No exceedance	North of landfill.
MW-4	Decreasing/stable trend. below ANZECC	No Exceedance	No exceedance	West of landfill
MW-5	Overall decreasing trend. Two ammonia results in mid 2016 exceed ANZECC (6.93 mg/L). Stable/decrease ammonia in 2017 - 2021	No Exceedance	No Exceedance	North of landfill.
MW-6S	Stable & reducing trend, below ANZECC	No Exceedance	No Exceedance	Shallow sample - down-gradient of night soil deposit
MW-6D	Recent increasing & variable trend. Elevated and spiked ammonia results in 2017-2021 indicating variability and rising trend. Results in 2019-21 exceed ANZECC (2000)	Exceedance	No Exceedance	Deep sample - down-gradient of night soil deposit
MW-7S	Decreasing/Stabilising trend. below ANZECC	No exceedance	No exceedance	Shallow sample - down-gradient and adjacent to Crooked River Road
MW-7D	Former decrease/stable trend to a rising trend (2019-20). Stable trend in 2020 to 2021. Ammonia generally below 1 mg/L prior to mid 2018	Exceedance	No Exceedance	Deep sample - down-gradient and adjacent to Crooked River Road
MW-9	Stable/decreasing trend. below ANZECC	No exceedance	No exceedance	Next to Blue Angle Creek
MW-10	Stable/decreasing trend. below ANZECC	No exceedance	No exceedance	Next to Blue Angle Creek
MW-11	Former decrease/Stable trend to a rising trend (2019-20) & decreasing trend in 2020/21.	Exceedance	<b>Exceedance</b>	Next to Blue Angle Creek

*Note: Three wells (MW-9, 10, 11) are located on the creek bank, potentially affected by flood waters and vegetation. ANZECC (2000) refers the marine trigger value (2.84 mg/L). The TKN/Ammonia ratio for MW-9/MW-10 are different to MW-11 (i.e. similar to MW7D/6D ammonia).*

As outlined in the revocation notice, ammonia concentrations greater than 20% above ammonia concentrations reported in Table GW-1 of Kiama Municipal Council, Gerroa Waste Disposal Depot - Annual Groundwater and Surface Water Monitoring Report - August 2006 to May 2007, dated 17 August 2007 are to be highlighted (refer to Appendix C). The results from ML-3 & ML-4 and ML-11 exceeded the 10% trigger value.



### 7.2.2 Total Phosphorus (TP)

The ANZECC (2000) TP guideline for fresh and marine ecosystems is 0.05 and 0.025 mg/L, respectively. Between May 2020 and February 2021, all groundwater sample results exceeded the ANZECC (2000) trigger values (Table GW-1 and Graphs 3 & 4).

The well MW-6D (former night soil deposit) reported a maximum of 12.1 mg/L on 10 November 2016. TP was at 6.84 mg/L in the 2011-2012 monitoring period, however decreased to a maximum of 4.8 mg/L in the 2012-2013 monitoring period. In 2013-2014 and 2014 -2015 total phosphorous was a maximum of 9.07 mg/L and 3.93 mg/L, respectively indicating variability.

In November 2015 the TP was reported at 12 mg/L at MW-6D. The highest TP was 2.54 mg/L from August 2018 to February 2019. During the 2019 to 2020 monitoring period, TP was more stable and ranged from 2.48 to 3.54 mg/L. TP ranged from 2.52 to 3.76 mg/L at MW-6D during 2020 to 2021.

The well (MW-7D) reported a maximum (TP =8.14 mg/L in November 2015) which is similar to previous years (TP =8.46 mg/L, November 2014). TP at MW-6D and MW-7D (near former night soil) shows variability (Graph-4) and may relate to the 2013 dewatering/sludge pond decommissioning and mobilisation of nutrients during rainfall. TP concentrations are relatively stable during 2019-2020, and 2020-2021 which ranged from 0.8 to 1.20 mg/L, and 0.81 to 0.89 mg/L, respectively.

The concentrations of TP immediately east and north of the landfill (MW-3 and MW-5) and next to Blue Angle Creek (MW-9 to MW-11) are lower, indicating that the former night soil deposit is the likely source of TP in the local groundwater.

In relation to the former night soil deposit (primary TP source), a localised TP plume is interpreted to potentially migrate towards Blue Angle Creek (MW-4/MW-6S to MW-7S, and to MW5). The TP plume is also detected at MW-4 (south of the night soil deposit) with TP ranging from 0.19 to 1.07 mg/L during 2020 to 2021.

The TP concentrations of TP on the east/north (MW-3/MW-1) are likely to originate from the landfill mound. TP concentrations at MW-1S (eastern side of landfill) show a variable trend.

The TP results show variability and likely to be linked to flushing and desorption/sorption within the sandy aquifer following rainfall/runoff.

## 7.3 Hydrogeochemical Indicators

Concentrations of major ions (i.e. chloride, sulphate, calcium, magnesium, sodium, alkalinity and potassium) are presented in Table GW-1. The concentrations at all monitoring wells are within previously reported ranges and characterised by the ions sodium, chloride and bicarbonate (alkalinity).

The landfill is interpreted to contribute some concentrations of ions including calcium, potassium, magnesium and bicarbonate/alkalinity. Contribution of sodium and chloride is difficult to ascertain as these ions are common in the marine environments (e.g. salt spray, tidal influence) and abundant in wells close to Blue Angle Creek (MW-9, MW-10, MW-11) or in proximity to Seven Mile Beach (MW-1S, MW-1D).

### **7.3.1 Inorganic Contaminants (Iron, Manganese and Fluoride)**

Iron concentrations were only analysed for samples collected in August for each year (2016, 2017, 2018, 2019 and 2020). Concentrations of iron (filtered at the laboratory) ranged between 0.22 and 12.8 mg/L (MW-6D @ maximum). All wells (excluding MW-5, MW-7s) reported concentrations above the ANZECC (2000) guideline for iron in freshwater ecosystems (0.3 mg/L). Multiple natural and landfill related sources of iron are likely to exist at the site and offsite area (lithology and landfill).

The ANZECC (2000) guideline for iron is an indicative interim working level (IIWL) and is of low reliability. No guideline is available for iron in marine water, which is more relevant for Blue Angle Creek and Crooked River receiving water bodies.

Manganese concentrations were analysed for samples collected in August 2016, 2017, 2018, 2019 & 2020. Concentrations of manganese ranged between 0.003 and 0.138 mg/L, without exceeding the ANZECC (2000) freshwater guideline (1.9 mg/L).

The levels of filterable iron and manganese are generally similar to previous reporting periods. Variation in the concentrations may also reflect turbidity of water samples and filtering procedures.

Concentrations of fluoride (analysed in August 2016, 2017, 2018, & 2019) ranged from <0.1 to 0.4 mg/L, which are similar to previous reporting periods. No reliable ANZECC (2000) guideline exists for fluoride in fresh or marine waters. Fluoride was not analysed in August 2020.

### **7.4 Organic Contaminants**

Dissolved organic carbon (DOC) concentrations were only analysed for samples collected on the August 2016, 2017, 2018, 2019, 2020, & 2021. The concentration of dissolved organic carbon (DOC) in samples from the twelve wells ranged from 5 mg/L to 124 mg/L (maximum at MW-1s). The results are generally comparable to previous monitoring periods.

No recommended ANZECC (2000) guidelines exist for DOC and used to indicate potential organic carbon related to landfill leachate (DOC is linked with elevated landfill leachate concentrations at the site).

### **7.5 Discussion and Trends - Groundwater**

The key trends in groundwater levels and nutrient contamination from 2003 to 2021 are presented in Graph-1 to Graph-5. The recent variable ammonia trends (2015 to 2021) at deep wells (MW-1D, MW-3, MD6D) are also included in the graphs. The three deep wells (& MW-12,13,14) are monitored monthly-to-bimonthly basis to assess if any remedial/control measures are required to address the variable ammonia trends.

The monitoring data indicates that ammonia concentrations in the deep groundwater were approaching the ANZECC guidelines following landfill rehabilitation works (Graph-2). Trends for the deep wells (MW-1D, MW-6D and MW-7D) show a declining trend from 2009 to 2017/2018, however an increasing to variable trend occurring during drought conditions (up to 2020). The higher rainfall during 2020/2021 is interpreted to stabilise and potentially be decreasing ammonia trends.

The ammonia concentrations are elevated (Above ANZECC 2000) in proximity to MW-1D as shown by MW-12,13,14 (Figures 2 & 4, Table 7).

Groundwater (ammonia) trends for the three wells (MW-9, 10) located adjacent Blue Angle Creek show a stable or declining trend (Graph-1). These two wells are influenced from tides and flooding (including estuary mouth closures).

The well (MW-11) also located near the creek show variable and increasing ammonia trend up to 2020, indicating the migration of the leachate plume from the former landfill site. Ammonia has decreased rapidly at MW-11 in the 2021 monitoring results. The TKN/ammonia pattern of MW-11 is similar to MW-7D/6D indicating likely landfill leachate (note: MW-9 & MW-10 have different TKN/ammonia ratios related to the creek/catchment area).

Graph-1 indicates ammonia concentrations in the shallow wells have steadily decreased (generally below guidelines) since land-filling operations at the GWDD ceased in October 2003.

Prior to landfill rehabilitation, groundwater quality trends indicate landfill leachate generation may be related to rainfall recharge into buried waste and subsequent groundwater and contaminant migration. The results post-landfill rehabilitation indicates landfill leachate concentrations in the shallow groundwater are decreasing, becoming diluted from attenuation/rainfall via runoff from the landfill mound. The potential for landfill leachate generation was significantly reduced following remedial works, as the buried waste was capped with an impervious clay barrier.

The groundwater ammonia trends (ammonia being a key landfill leachate indicator) indicate shallow groundwater quality is improving.

The deep wells (MW-1D, MW-6D, MW-7D and MW-12,13,14) indicate the leachate plume in the deep parts of the aquifer has increasing to variable ammonia trends due to the prevailing drought conditions (since 2017 to 2020. Table 7). Ammonia trends are interpreted to be stabilising and/or decreasing following the return to average rainfall conditions in late 2020/early 2021.

## **7.6 Surface Water**

Surface water sampling was undertaken in 4 quarterly events from May 2020 to February 2021. Samples were collected from five locations (ML-1, ML-2, ML-3, ML-4 and ML-5) along Blue Angle Creek (Figure 2).

The data set from the 3 sample locations (ML-1, ML-3, ML-4) is limited due to previous restricted access (i.e. land is owned by Cleary Bros with access denied for sampling).

The upstream water quality is relatively may be degraded due to farming and areas of acid soils. Sample locations, ML-1, ML-4 (upstream) are considered appropriate to assess water quality impacts from the upstream sources (CBros land).

The sample locations (ML-5 @ midstream, ML-2& ML-3 @downstream) are suitable to assess impacts from the landfill, however it is noted that the creek also receives groundwater discharge, surface water runoff from the catchment and tidal movements which diminish the potential for observable impacts from the landfill, especially during the high and low tide flows.

All analytical results for surface water monitoring points (ML-1 to ML-5) are presented in Table SW-1.

Blue Angle Creek is tidally influenced and has a marine water influence at all sample locations, as shown by the broad range of TDS/conductivity results (i.e. fresh to saline, Table SW-1). The variable nutrient results (ammonia, TKN) at all surface water locations is interpreted to related to the water quality changes during high and low tide.

The surface water monitoring data at upstream/downstream locations is variable and likely to reflect a combination of tidal sampling regimes and inputs from the broader catchment area (e.g. samples should be coordinated with the tide so that both creek samples are collected during a run-out tide when the maximum amount of groundwater (potential leachate) discharges into the creek).

### 7.6.1 Field Parameters

#### *pH (field) and Redox*

The pH was similar at ML-1 to ML-5 and ranged from pH 4.6 to 7.1. Sampling results indicate that pH is slightly acidic at upstream areas with Blue Angle Creek and may relate to the acid soils in the catchment area.

Redox was measured in August 2016, 2017, 2018, 2019, & 2020 monitoring period at all five locations. Redox ranged from 83.9 to 144 mV from upstream to downstream creek locations.

#### *Total Dissolved Solids (TDS and EC)*

Restricted access has limited the assessment of upstream and downstream locations in previous years. The monitoring data indicates large fluctuations in TDS/EC due to the tide (low, high) at all five locations. The TDS concentration upstream of the flood gates (ML-1, ML-3, ML-4) was less than those recorded downstream of the flood gates (ML-2).

The EC ranges from 110 uS/cm to 35,600 uS/cm, whilst the TDS ranges from 82 mg/L to 24,800 mg/L at ML1 to ML-5.

The surface water samples are located in the creek that is known to be influenced by tides. The presence of mangroves and other aquatic plants also reflects the typically saline water in Blue Angle Creek.

Groundwater samples collected from MW-9, MW-10 and MW-11 are also brackish/saline (but less than the surface water) indicating a hydraulic connection with the tides in Blue Angle Creek. This data indicates that tidal waters from Crooked River Estuary can influence water quality and elevate the salinity of the 3 wells (MW-9, MW-10 and MW-11).

### 7.6.2 Nutrients

#### *Nitrogen*

Concentrations of ammonia in the surface waters collected from Blue Angle Creek have been and continue to vary with time (Graph-6 and Table 7.2.2). The upstream catchment area of Blue Angle creek is improved pastures and grazing (i.e. agricultural sources of nutrients).

**Table 7.2.2: Surface Water Ammonia Trends – May 2020 to February 2021**

Sample ID	Minimum (mg/L)	Maximum (mg/L)	Trend*	Trigger 10% Exceedance of Ammonia, & Comments
ML-1	0.03	0.37	Increasing	No Limited site access & below ANZECC guidelines
ML-2	<0.01	0.51	Increasing	No, below ANZECC guidelines
ML-3	0.02	0.34	Increasing	Yes. (22/11/2019, 14/2/2020, 6/11/20, & 1/2/2021) below ANZECC guidelines
ML-4	0.02	0.34	Increasing	Yes (22/11/2019, 1/2/2021) below ANZECC guidelines
ML-5	0.04	0.61	Increasing	No. below ANZECC guidelines.

*Note: Trend \*= relates to increased in ammonia concentrations at each location from March 2020 to February 2021. All ammonia results were below the ANZECC (2000) guidelines and results are similar or lower than previous rounds.*

Highest ammonia (ML-5 @ 0.61 mg/L) concentration is associated with high TKN (1 mg/L), brackish water (TDS= 1330 mg/L) which is inferred to reflect background water quality (downstream of fertilised farms, sewerage treatment plant) and potentially the landfill. The ammonia concentrations at the nearby well (MW-11) was showing a rising trend during 2018 to 2020 which may have an influence on the creek water quality.

Sampling at ML-5 (resumed in November 2008 but had not been sampled since October 2004) indicates that the water quality is variable (Table SW-1), indicating multiple pollutant sources and tidal influence.

Previous restricted access to upstream locations (ML-1, ML-3 and ML-4) limits conclusions regarding impacts due to the limited data set and dynamic environment of the creek. E2W note the recent ammonia results (2020 to 2021) from the five sample location indicates a potential rise in ammonia concentrations. However, the data set is variable given the salinity and different tide levels during sampling from upstream to downstream locations.

Elevated ammonia (&TKN) in surface water compared to groundwater wells in proximity to the creek (MW-9, MW-10, and MW-11) indicates that sources of ammonia also occur from the upstream catchment area (agricultural land and fertiliser use).

Concentrations of TKN exceeded the ANZECC (2000) guidelines for fresh and marine waters for all samples collected along Blue Angle Creek. The highest concentration was reported at the upstream location (ML-1 = 1.4 mg/L on 1/2/2021), which may also indicate the influence of fertiliser and degraded runoff from the surrounding agricultural activities. Concentrations of TKN in groundwater are elevated and variable.

Increases in nitrogen from upstream and downstream of the landfill have been observed during previous monitoring periods. While these increases may be attributable to the discharge of

ammonia-rich groundwater from the landfill, other sources (random) of nitrogen input such as runoff from sub-catchments and nutrients bound in sediments cannot be discounted. It is also possible that poor quality estuarine waters from Crooked River move up Blue Angle Creek during tidal cycles. Sewerage discharges into sand dunes may also occur due to capacity issues at the Gerroa sewerage treatment plant.

Interpretation of the nutrients into surface water bodies from the landfill is complicated by the sampling regime (i.e. sampling at various tides) and other potential sources of nitrogen. The fluctuating flow regime near Blue Angle Creek and wet weather events may reduce the potential for landfill leachate to impact the creek.

The recent monitoring data and rising ammonia trends from MW-11 and MW-7D/MW-6D indicate that closer monitoring of the creek is required during the prevailing drought conditions as landfill leachate may discharge in the area of sample locations (ML-5/ML-3).

Total organic carbon (TOC) was not measured during the 2018 to 2021 monitoring period.

As stipulated in the revocation notice, ammonia concentrations greater than 10% above ammonia concentrations reported in Table SW-1 of Kiama Municipal Council, Gerroa Waste Disposal Depot - Annual Groundwater and Surface Water Monitoring Report - August 2006 to May 2007, dated 17 August 2007 are to be highlighted (Appendix C).

Exceedances greater than the trigger (10% above ammonia) were reported at ML-3/ML-4 and MW-11 in the 2020-2021 monitoring period (Appendix C). The ammonia trigger (10%) exceedances for ML-3 & ML-4 are below the ANZECC 2000 guidelines.

#### ***Total Phosphorous (TP)***

Concentrations of TP from Blue Angle Creek were analysed from all samples collected in May 2020 to February 2021 (Table SW-1).

Previous levels (2011-2012 monitoring period) reported an increase in TP concentrations, which exceeded the IIWLs ANZECC 2000, (fresh 0.05 mg/L, marine 0.025 mg/L) at ML-2 and ML-5 for all sampling rounds. The 2012-2013 monitoring period reported an variable increase in TP concentrations which exceeded the ANZECC 2000, (fresh 0.05 mg/L, marine 0.025 mg/L) at ML-2 (0.05 mg/L, May 2012 and 0.13 mg/L, February 2013) and ML-5 (1.95 mg/L, February 2013). The 2013-2014 monitoring period reported two exceedences of the ANZECC 2000 guidelines for ML-2 in May 2013 & February 2014 (0.09 mg/L and 0.12 mg/L, respectively) and one exceedence at ML-5 in 2013 (0.06 mg/L).

TP concentrations at ML-2 ranged from 0.04 mg/L to 0.09 mg/L and continue to show a variable trend for 2016-2018. During 2018 to 2019, the TP concentrations at ML-2 ranged from <0.05 mg/L to 0.2 mg/L and showing an ongoing variable trend. The trend is likely to reflect the dynamic nature of the surface water and surrounding rural environment.

ML-5 reported all TP concentrations ranged from 0.05 mg/L to 0.08 mg/L in 2016-2018, and <0.05 to 0.06 mg/L from 2018 to 2019. TP is variable over time (Graph-7). The variability is considered to reflect the dynamic nature of a tidal environment and multiple sources (agriculture, natural sources and possibly the landfill).



The following TP concentrations were reported for the 2019 to 2020, and **2020 to 2021** monitoring period;

- ML-1. TP ranges from 0.16 to 0.26 mg/L, and **<0.05 to 0.1 mg/L**.
- ML-2. TP ranges from <0.05 to 0.24 mg/L, and **<0.05 to 0.09 mg/L**.
- ML-3. TP ranges from 0.32 to 0.36 mg/L, and **0.02 to 0.13 mg/L**.
- ML-4. TP ranges from 0.22 to 0.31 mg/L, and **<0.01 to 0.09 mg/L**.
- ML-5. TP ranges from <0.05 mg/L to 0.32 mg/L, and **0.02 to 0.11 mg/L**.

The TP data indicates that TP is elevated in the upstream/background samples. All sample locations exceed the ANZECC (2000) guidelines for TP and TKN, which is indicative of fertiliser/agricultural activities in the catchment area. The TP concentrations in 2020/2021 are lower than the previous year (2019/2020).

### 7.6.3 Bacteriological Contaminants

Surface water sample locations (ML-2 and ML-5) were analysed for thermotolerant (faecal) coliforms and enterococcus coliforms in August 2016, 2017 & 2018 (Table SW-1), but not during the 2019 to 2021 monitoring period. The bacteriological results are considered to relate to the local fauna and grazing in the area, and not the landfill leachate as the micro-organisms are filtered out in the groundwater system.

Previous monitoring results are as follows:

- Sample result from ML-2 (1 CFU/100 mL) and ML-5 (1 CFU/100 mL) in August 2018 for enterococcus were below the ANZECC (2000) fresh and marine guidelines (35 CFU/100 mL). Samples result from ML-2 (44 CFU) in August 2017 for enterococcus was above ANZECC (2000) fresh and marine guidelines (35 CFU/100 mL).
- For August 2016, August 2017 and August 2018, the downstream sample (ML-2) reported enterococcus of 28, 44 and 1 CFU/100 mL respectively, whilst the midstream sample (ML-5) reported 21, 6, 1 CFU/100 mL. The results are considered to reflect seasonal and biological conditions, and not the leachate. Both locations are significantly lower than 2010-2011 monitoring period results (ML-2, 1300 CFU/100 mL and ML-5, 1200 CFU/100 mL, November 2010) but above the 2011-2012 (ML-2, 18 CFU/100 mL and ML-5, 8 CFU/100 mL) and 2012-2013 (ML-2, 4 CFU/100 mL and ML-5, 15 CFU/100 mL).

Multiple sources of coliforms exist in the creek. The rehabilitated landfill represents an insignificant contribution, due to its distance from the creek (i.e. local fauna and flora, farms) and filtering in the aquifer.

### 7.6.4 Inorganic Contaminants

Total or dissolved organic carbon (TOC/DOC) concentrations were not analysed during the 2019-2021, and previous 2016-2018 monitoring periods. TOC was included for November 2018 and February 2019 monitoring period.

Surface water samples from August 2016, 2017 and 2018 reported elevated concentrations of iron (ML-5 = 0.23 mg/L, 0.32 mg/L, 0.18 mg/L and ML-2 = 1.07 mg/L, 0.88 mg/L, 0.18 mg/L). Concentrations were below the ANZECC 2000 guidelines (0.3 mg/L) in August 2018 to May 2019. However, the ANZECC (2000) guideline for iron in fresh water is a low reliability IIWL.

The following Fe & Mn concentrations were reported for the 2019 to 2020 monitoring period;

- ML-2. The Fe (total) = 0.14 mg/L and Mn 0.019 mg/L

- ML-5. The Fe (total) = <0.1 mg/L and Mn 0.035 mg/L

The following elevated Fe & Mn concentrations were reported for the 2020 to 2021 monitoring period, and similar to previous years;

- ML-1 to ML-5. The Fe (total) ranging from 0.54 to 0.65 mg/L
- ML-1 to ML-5. The Mn (total) ranging from 0.01 to 0.012 mg/L

#### **7.6.5 Major Ions**

Concentrations of major cations (sodium, potassium, alkalinity, magnesium, calcium) in the surface water (Blue Angle Creek) indicate domination of sodium (marine water influence), which is consistent with previous monitoring rounds.

#### **7.6.6 Quality Assurance/Quality Control**

Interpretive Quality Control Reports (QCI, Appendix A) were not provided by ALS (Sydney) for the surface and groundwater laboratory data. ALS is NATA accredited for the analyses performed and appropriate sample bottles and analyses were carried for the monitoring works. Sample bottles are despatched (same day) from the site to the laboratory under chain of custody procedures with appropriately trained field sampling technicians.

The analytical data is considered to be suitable for the quarterly monitoring events during 2020 to 2021.

### **8. Leachate Plume and Landfill Rehabilitation**

The monitoring results have been used to assess potential impacts to fresh and marine aquatic ecosystems. The groundwater migrating from the former landfill discharges to Blue Angle Creek and Seven Mile Beach. The range of groundwater contaminants identified from the latest monitoring events indicates the GWDD is a source of leachate (mostly ammonia and TKN), total phosphorous and iron.

Ammonia is the primary landfill leachate indicator. However, the waste is also a source of dissolved salts, metals and organics associated with the dissolution of ions (predominantly calcium and bicarbonate).

Following the closure of the landfill in 2003 and remedial works completed by Council and E2W in February 2005, the generation and migration of ammonia has declined in the shallow and deep groundwater system (Graphs-1 & 02). Monitoring wells MW-3, MW-4 and MW-5 are considered to reflect the typical groundwater quality arising from the landfill rehabilitation (>80% decrease in ammonia over time).

The deep groundwater monitoring wells (MW-1D, MW-6D and MW-7D) installed in 2006 show water quality improvements but at a slower rate relative to the shallow groundwater. The deep groundwater takes longer to improve due to the slower groundwater flushing and climatic conditions. However, during August 2009 to 2020 the ammonia concentrations in deep wells show a decreasing trend (Graph-2). Since 2018, the deep groundwater wells (MW-1D, MW-6D, MW-7D, and MW-12,13,14) show a rising ammonia trend due to the dry weather (i.e. drought 2017 to 2020).

The ammonia trends are stabilising and decreasing from 2020/2021 due to the return of average rainfall conditions. The ammonia trends are interpreted to relate climatic patterns (low rainfall; 2017-2020) and dilution of the leachate plume from runoff and rainfall infiltration through the aquifer.

The most significant contaminant is ammonia-nitrogen, with a remnant plume extending in both north-west and south-east directions reflecting flows either side of the groundwater divide. Prior to rehabilitation, leachate originating from the landfill and night soil depot infiltrated the shallow aquifer, as well as migrating under the predominant groundwater flow regime towards Seven Mile Beach and Blue Angle Creek, respectively.

E2W consider the leachate plume in the shallow groundwater has shrunk due to the decrease in leachate generation and capping of the landfill. The time series trends show that significant groundwater quality improvements occurred since landfill closure.

Monitoring results indicate a clear improvement in water quality and aquifer restoration during average rainfall conditions. The water quality trends at the site during drought conditions indicate that more time is required to restore the local groundwater quality.

Some elevated phosphorous occurs around the former night soil and is interpreted to arise from rainfall and land disturbance around the source area (i.e. removal of lined ponds in ~2011).

The landfill rehabilitation conducted between July 2004 and February 2005 has resulted in a measurable improvement in the shallow groundwater quality at GWDD. While ammonia remains elevated but has began to fall below the ANZECC 2000 guidelines in the deep groundwater, E2W consider that water quality will continue to improve in the shallow/deep aquifer due to the reduced leachate generation, natural attenuation and return of average rainfall conditions.

The surface water results from the 2019-2021 monitoring period reported ANZECC (2000) guideline exceedences (phosphorous, TKN) at all sample locations (ML-1 to ML-5). The increasing ammonia in the creek during 2020/2021 requires additional monitoring to assess potential impacts from the leachate plume. The elevated concentrations of MW-11 (near creek) have decreased during 2020/2021 monitoring period.

The surface water environment is dynamic and influenced by tidal flushing and discharges (runoff, seepage, baseflow) from the surrounding catchment and aquifer.

## **8.1 Ecological Issues**

Groundwater migrating from the landfill to Seven Mile Beach is diluted by the dynamic processes operating in this environment. Contaminants contained within this discharge may be diluted and dispersed via biological, chemical and physical processes occurring at the groundwater/salt water interface. Plant uptake of excess nutrients in the groundwater may also occur as the depth to groundwater becomes shallower as it approaches the beach.

The effect of nutrient-impacted groundwater discharging to Blue Angle Creek and/or Crooked River Estuary is unclear and difficult to ascertain given the variability, dynamic environment, and multiple nutrient sources in the catchment area. The landfill contaminants (ammonia, TP) are not significant risk of harm chemicals (e.g. benzene or Pb) and can be naturally attenuated (biodegraded) and taken-up and reduced by the flora.

Potential impacts of landfill leachate to Blue Angle Creek would depend on the groundwater-surface water interaction, climate and the rehabilitation works. Results from MW-9, MW-10 (monitoring wells adjacent creek) indicate a reduction in ammonia (Graph-1), whilst ammonia at MW-11 was rising up to mid 2020, but has recently (November 2020 to February 2021) decreased to below the guidelines. Previously, MW-11 has a history of variable ammonia concentrations; however since May 2010 to February 2018 ammonia was below ANZECC guidelines. The rising ammonia trends during 2018 to 2020 are linked with the drought period (2017-2020).

The well (MW-11) rising ammonia trend is potentially linked to the upgradient wells (MW-6D, MW-7D) which also have rising trends reflecting the migration of the landfill leachate plume. The well (MW-11) may be influenced by the landfill leachate plume and also the creek environment due to its foreshore environment. Further monitoring is required to assess the trends and any management actions.

E2W interpreted that some nitrogen-impacted groundwater would discharge to the creek (and mix with other water in the estuary), however the extent of attenuation of the nitrogen plume prior to discharge is unclear. Attenuation is likely to occur through a combination of dilution, uptake of nutrients by riparian vegetation, mixing of groundwater from the creek, flows and tidal movements within the creek and oxidation of the ammonia to nitrate/nitrite and generation of nitrogen gas.

## 9. Conclusions

Surface and groundwater quarterly monitoring (4 EPL rounds) was completed at the GWDD by ALS from May 2020 to February 2021. An additional 5 monitoring events were conducted by ALS to assess the ammonia trends at 9 wells (MW-1D, 3,5, 6D, 7D,11, & MW-12,13,14) from March 2020 to January 2021 (Table 7). The monthly & EPL results is used to guide any further monitoring or management/remedial requirements.

The data has been assessed by E2W to identify potential impacts to the groundwater and surface water systems. This EPL follows E2W previous report “Second Interim Groundwater Report-Gerroa Waste Disposal Depot” dated May 2018, which assessed the variable ammonia trends in several deep wells (e.g. MW-1D, MW-3, MW-6D).

The following conclusions are offered:

- The rehabilitation of the landfill mound and night soil depot (completed February 2005) has improved the local groundwater quality. The improvement to local surface water quality is not clear, and impacts are not readily discernible from landfill or background sources (agricultural, tidal water & runoff quality).
- Groundwater at the landfill site is directed towards Blue Angle Creek (base-flow discharge) and Seven Mile Beach via a groundwater salt/water interface.
- The key landfill indicator (ammonia-nitrogen) shows a decreasing/stabilising trend in shallow and deep wells located next to the landfill mound and former night soil deposit. The deep wells (e.g. MW-1D, MW-6D, MW-7D, MW-11, and MW-12,13,14 mg/L) show a rising ammonia trend for 2019-2020, however the trend stabilises and decreases during the 2020/2021 monitoring period. The variable ammonia trends over the past few years relates to the climate, and drought period (2017 to 2020, Table 7). The return of average rainfall (1152.8 mm) during 2020/2021 is interpreted to stabilise and/or reverse the previous ammonia rising trends.
- Concentrations (above ANZECC 2000) of nutrients, in particular ammonia, continue to be elevated and variable in the deep groundwater (MW-1D, MW-6D, MW-7, Figure 4).
- Catchment area characteristics, climate and tidal regime influence the water quality in Blue Angle Creek and the adjacent wells (MW-9, MW-10 and MW-11). The elevated ammonia concentrations at MW-11 (foreshore well) in 2020 has reduced to below the guidelines in 2021.
- Concentrations of total phosphorous (TP) in the shallow/deep groundwater is generally variable, with elevated and variable trends at MW-1D, MW-3, MW-4, MW-5, MW-6D, MW-7D. Areas of variable TP (MW-6D) is associated to the former night soil deposits, with likely mobilisation during rainfall.
- Ammonia concentrations in surface water samples collected at downstream locations (Blue Angle Creek) are generally variable, similar to previous years, and below ANZECC (2000) guidelines.
- An exceedance (greater than 10% above ammonia values in Appendix C) were reported at ML-3, ML-4 and MW-11. Ongoing monitoring of ammonia concentrations is required at the creek to assess any potential impacts that may arise from migration of landfill leachate..
- Total phosphorus (TP) concentrations at ML-5 ranged from 0.02 to 0.11mg/L, whilst TP ranged from <0.01 mg/L to 0.09 mg/L at ML-2. The TP results from the new locations (ML-1, 3 and 4) are similar to ML-2 & ML-5. The TP in surface water is generally variable due to the dynamic nature of the tidal creek. It is likely that water quality in Blue Angle Creek reflects

other nutrient sources (i.e. high TKN, TP) in agricultural catchment, and potentially from the GWDD.

- All other water quality indicators were consistent with the previous monitoring results.
- Monitoring results indicate an improvement in water quality and aquifer restoration at the former Gerroa landfill. Additional monitoring is required to verify the ammonia trends upon the return of average rainfall conditions.

The monitoring data shows that ammonia concentrations at MW-3 and MW-5 have returned to low levels (below ANZECC 2000) since 2018. Elevated ammonia concentrations at three EPL wells (MW-1D, MW-7D, MW-6D) and new wells (MW; 12,13,14, ammonia ranges from 26.6 to 97.7 mg/L) require further monitoring to assess the trends, and need for any remedial actions (i.e. extraction of groundwater, as required). The rise in ammonia at the eastern boundary is linked to the recent drought period, with some evidence of the ammonia trends stabilising and decreasing with the return to average annual rainfall in 2021.

The current water quality trends are linked to the drought period (2017-2020) and changing aquifer conditions with less rainfall recharge/dilution.

The nutrient concentrations (particularly ammonia) in the shallow and deep groundwater are likely to continue to decrease over time (note: phosphorous may take longer to decline as it is likely to adsorb/retarded by the aquifer matrix and mobilised by rainfall). The landfill capping system reduces rainfall infiltration into the buried waste (reduces leachate generation) and diverts runoff from the 3 Ha capped mound into the aquifer, causing dilution and attenuation of the residual leachate.

Monitoring of surface and groundwater conditions at the GWDD following the completion of landfill remediation has provided beneficial data regarding the effectiveness of the rehabilitation works. The "surface and shallow" groundwater quality is improving and generally meeting the ANZECC (2000) guidelines. More consistent water quality and meeting of the guidelines is expected in the future, especially when the annual rainfall returns to average conditions (e.g. Gerroa rainfall = average of 1.2 m/year, whilst rainfall @ 2019/20 = 0.75 m/year)

Based on recent groundwater trends, it is interpreted that the deep groundwater quality improvement is also dependant on the prevailing climate with the rising ammonia trends relate to the drought, and onset of a wet cycle from 2021. The ammonia trends are interpreted may reverse back to declining trends with the return of average rainfall conditions.

## 9.1 Recommendations

In order to improve the quality of monitoring at the site, E2W recommends that the following is incorporated into subsequent sampling rounds:

- Continue to monitor and assess ammonia trends of the 3 eastern boundary wells (MW-12,13,14) at approximately 2 monthly intervals. Remedial works are recommended at above 100 mg/L (ammonia) at the four wells (MW-12,13,14, MW-1D) located on the east boundary.
- E2W recommend that council should consider remedial works (e.g. such as groundwater extraction & irrigation of the mound) if the ammonia concentrations continue to rise and/or consistently exceed 50 mg/L (ammonia) at the creek foreshore area (e.g. MW-11 or MW-7D).
- Obtain survey details (RL) for the 6 piezo-meter wells (MW-1S/MW-1D, MW-6S/MW-6D and MW-7S/MW-7D) to enable reduction of groundwater levels to mAHD.



- Assess quality assurance/control from laboratory and perform re-analyses for elevated results.
- Review tidal charts and climate prior to surface water sampling. Sample collection should be co-ordinated with the tide so that both creek samples are collected during a low run-out tide when the maximum amount groundwater discharges into the creek.
- Closer monitoring of key locations (SW: ML-3/ML-5, & GW: MW-11/MW-7D) at the creek area which receives baseflows from the landfill site (i.e. check for ammonia rises & spikes).



## **Figures**

**&**

## **Graphs**



Source: Neil Charters Pty Ltd

SITE LOCATION

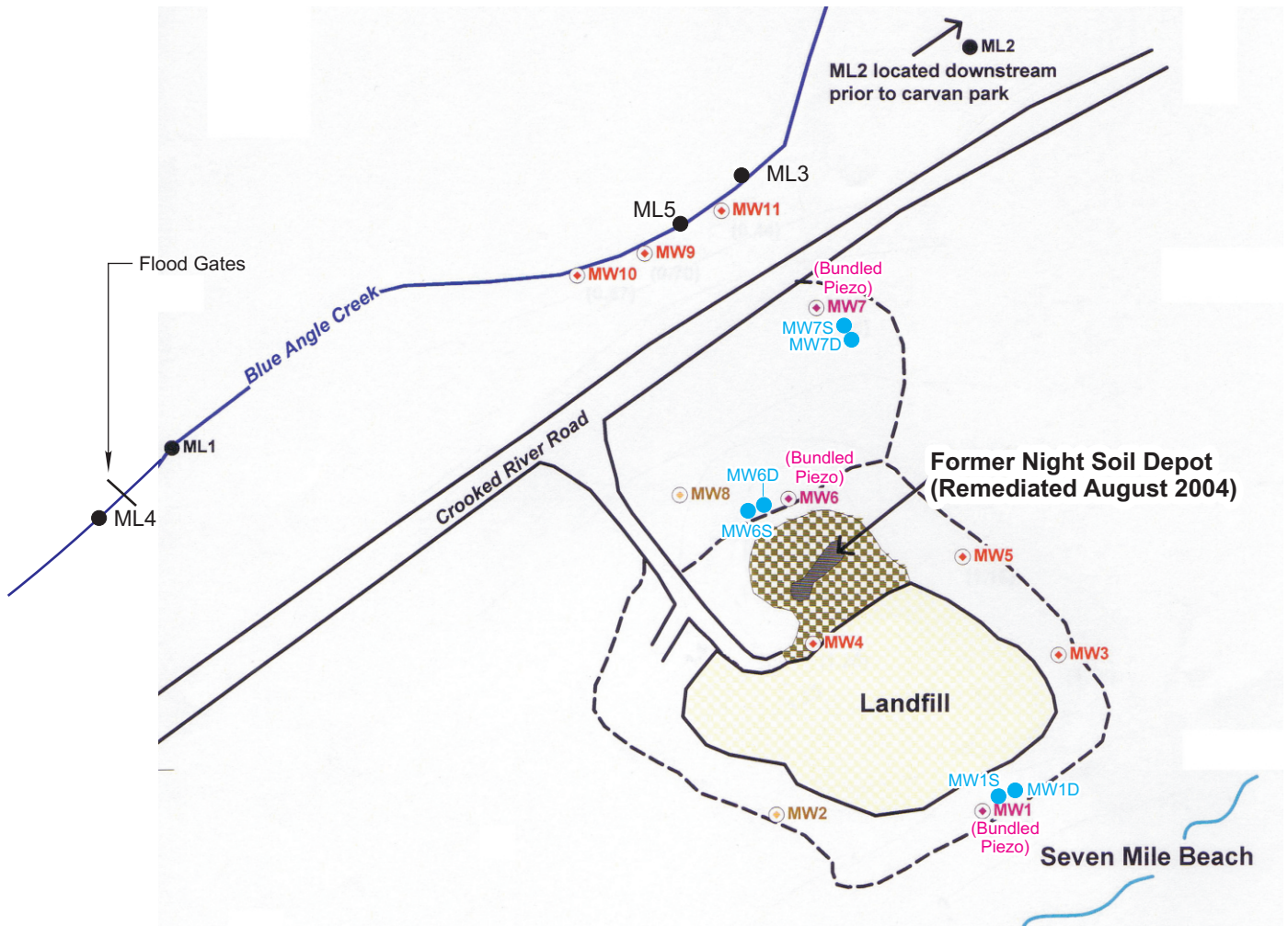
Date: March 2021

GERROA ANNUAL MONITORING REPORT (2020-2021)

Reference: E2W-025\_55.cdr

Figure 1





#### KEY

MW1S ● Monitoring Well - Shallow, August 2006

MW1D ● Monitoring Well - Deep, August 2006

MW1 ● Standard Monitoring Well

ML1 ● Surface Water Monitoring

**Note:** Bundled Piezometers MW1,6,7 - not sampled  
ML-3 no longer sampled, ML-2 and ML-4 no access  
Refer to Figure 4 for the location of MW-12,13, 14

Landfill Rehabilitation Works; 2004 to 2005

0 50 100m  
Approximate Scale

## SITE LAYOUT & WELL LOCATIONS

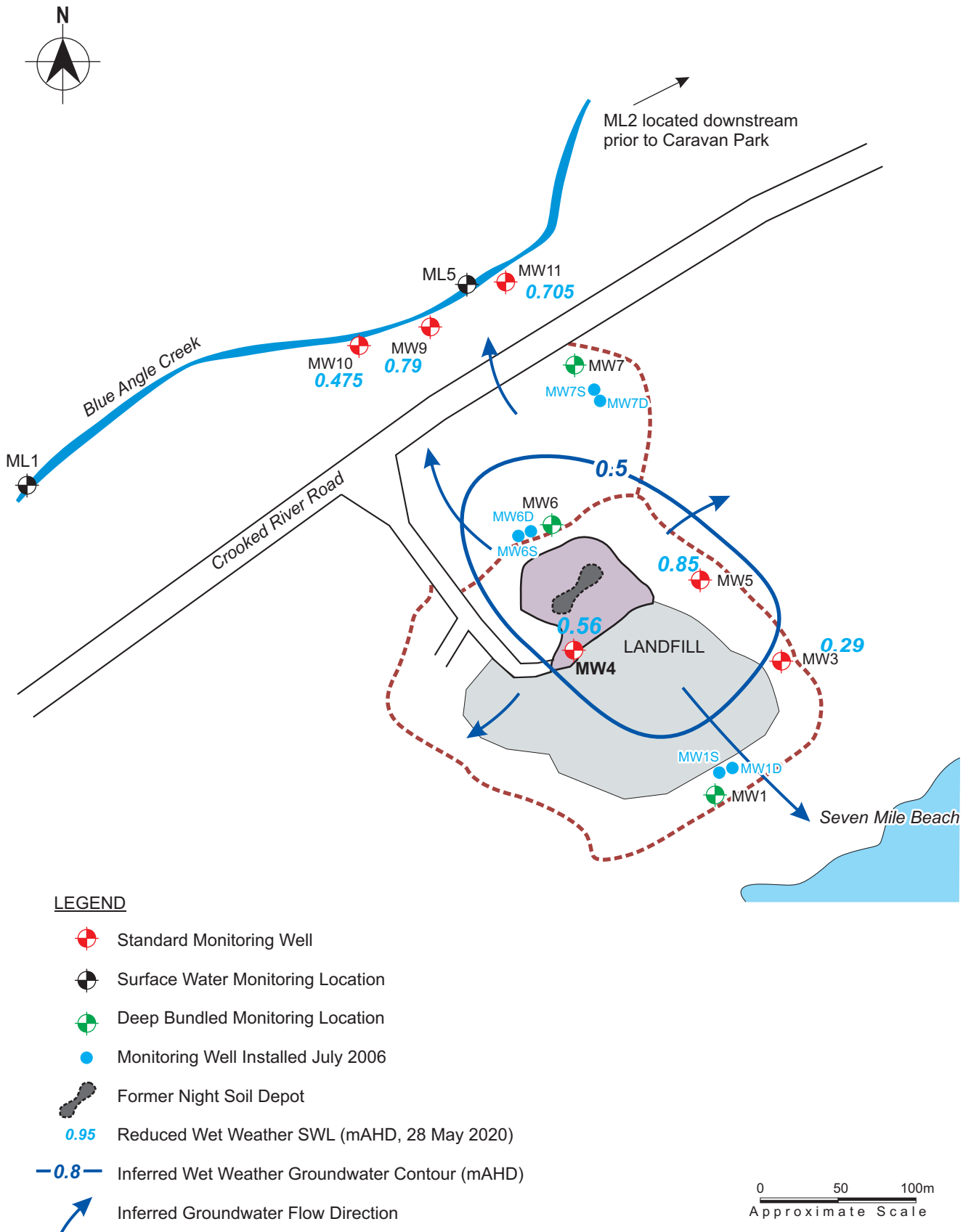
Source: URS Australia Pty Ltd

Date: March 2021

Reference: E2W-025\_01.cdr

GERROA ANNUAL MONITORING REPORT (2020-2021)

**Figure 2**



Source: URS Australia Pty Ltd- baseplan

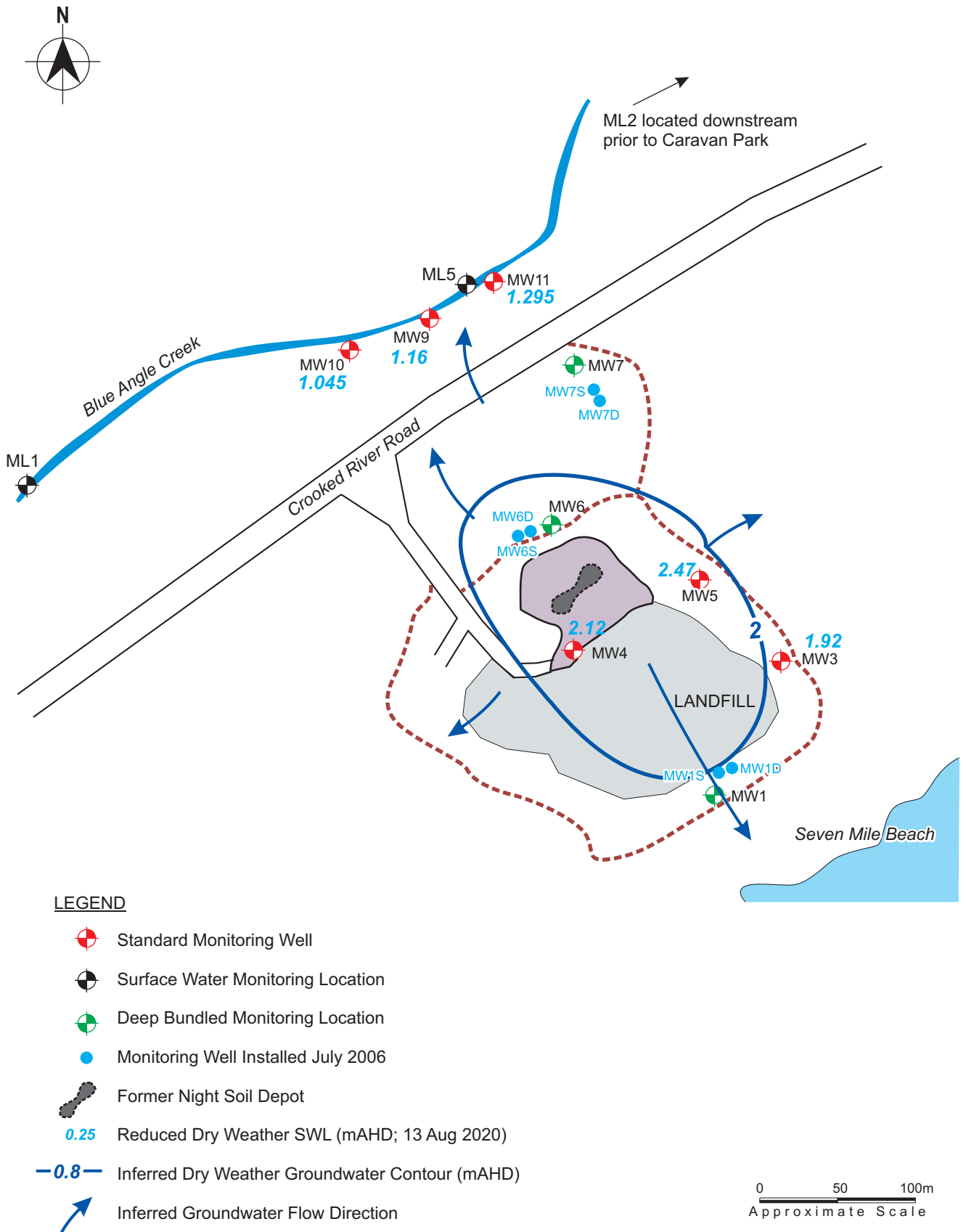
INFERRED GROUNDWATER FLOW REGIME (Dry, May 2020)

GERROA ANNUAL MONITORING REPORT (2020-2021)

Date: March 2020

Reference: E2W-025\_59.cdr

**Figure 3A**



Source: URS Australia Pty Ltd- baseplan

INFERRED GROUNDWATER FLOW REGIME (Wet, Aug 2020)

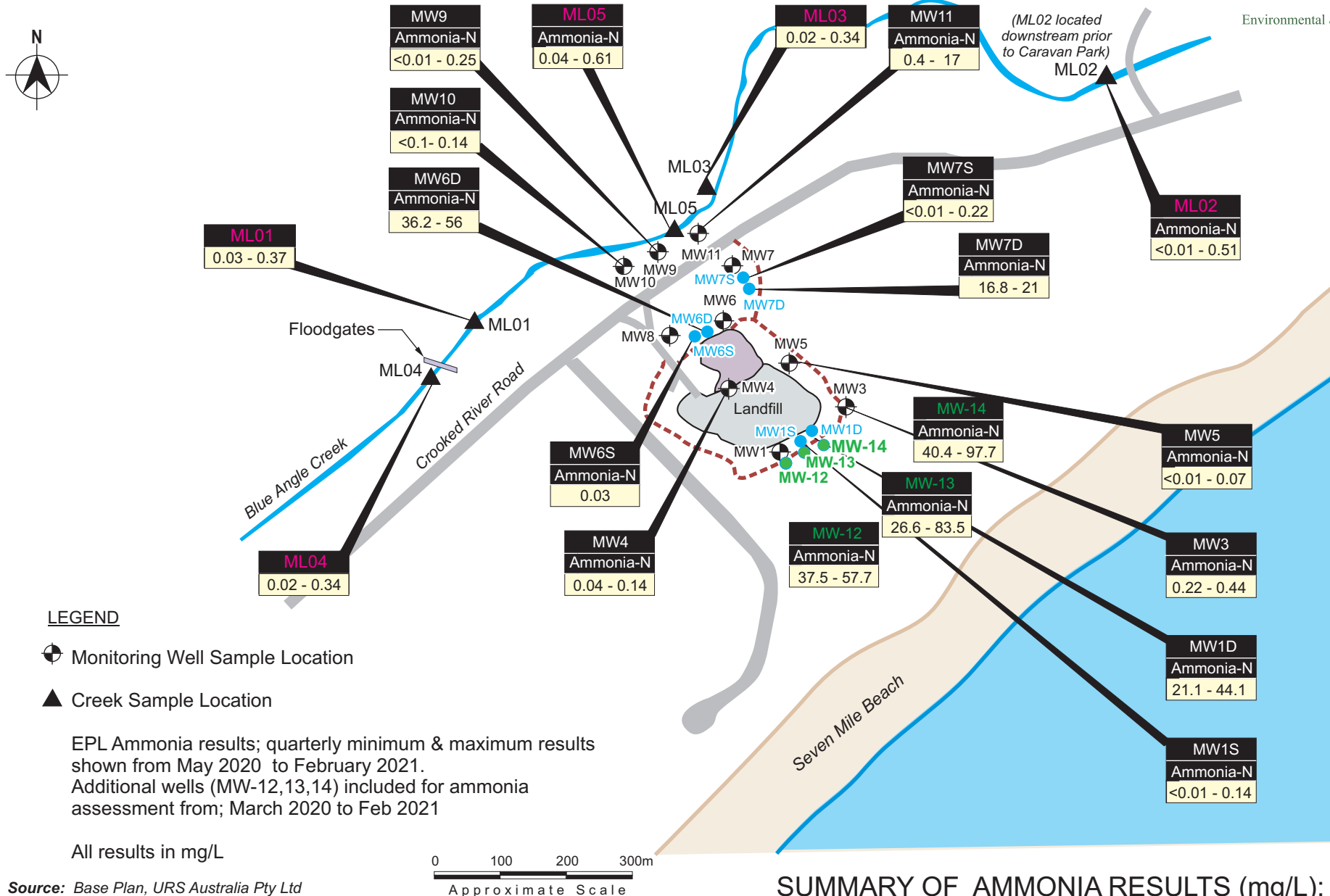
GERROA ANNUAL MONITORING REPORT (2020-2021)

Date: March 2021

Reference: E2W-025\_59.cdr

**Figure 3B**





Source: Base Plan, URS Australia Pty Ltd

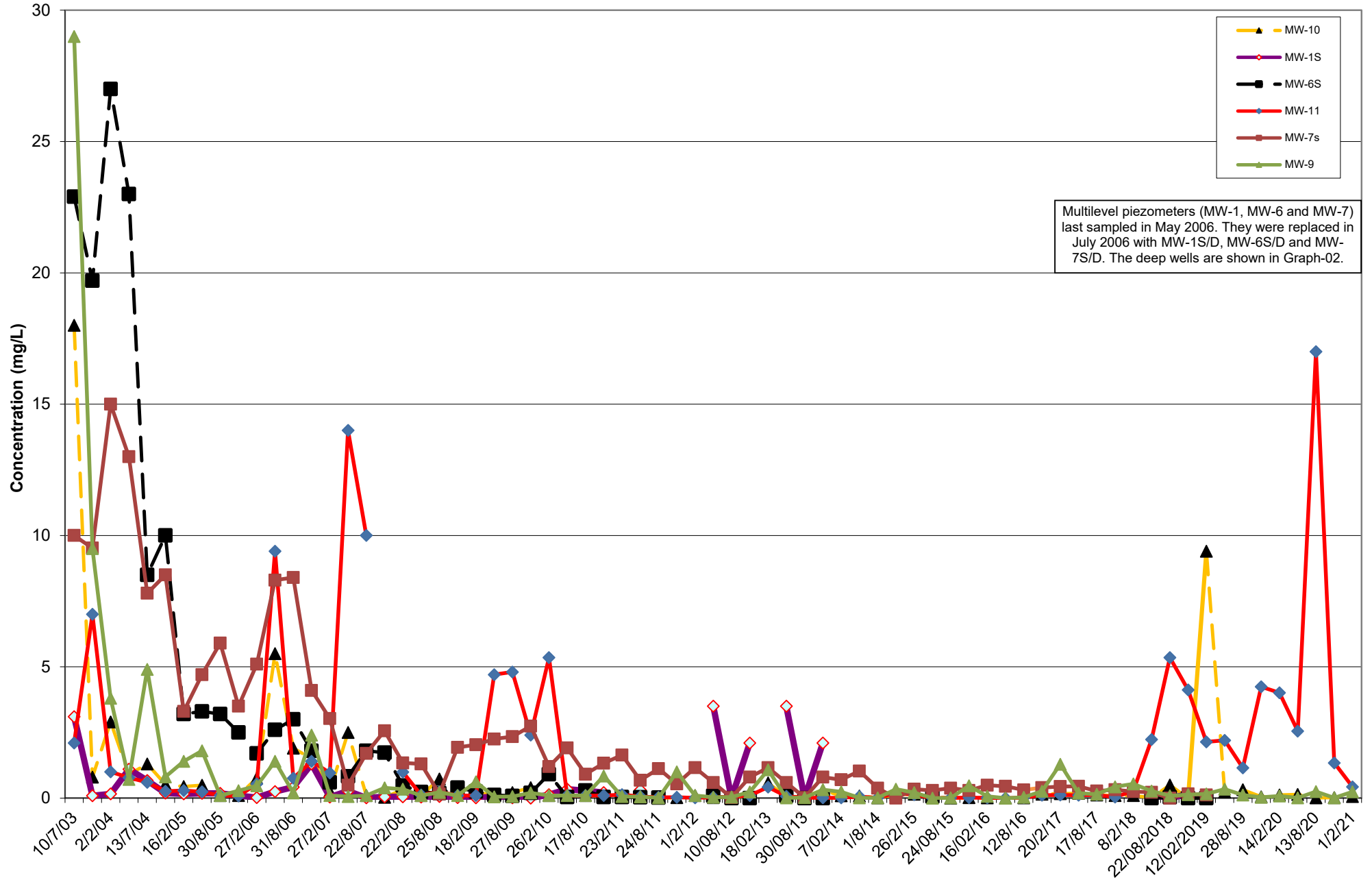
Date: 12 March 2021

Reference: E2W\_025\_58.cdr

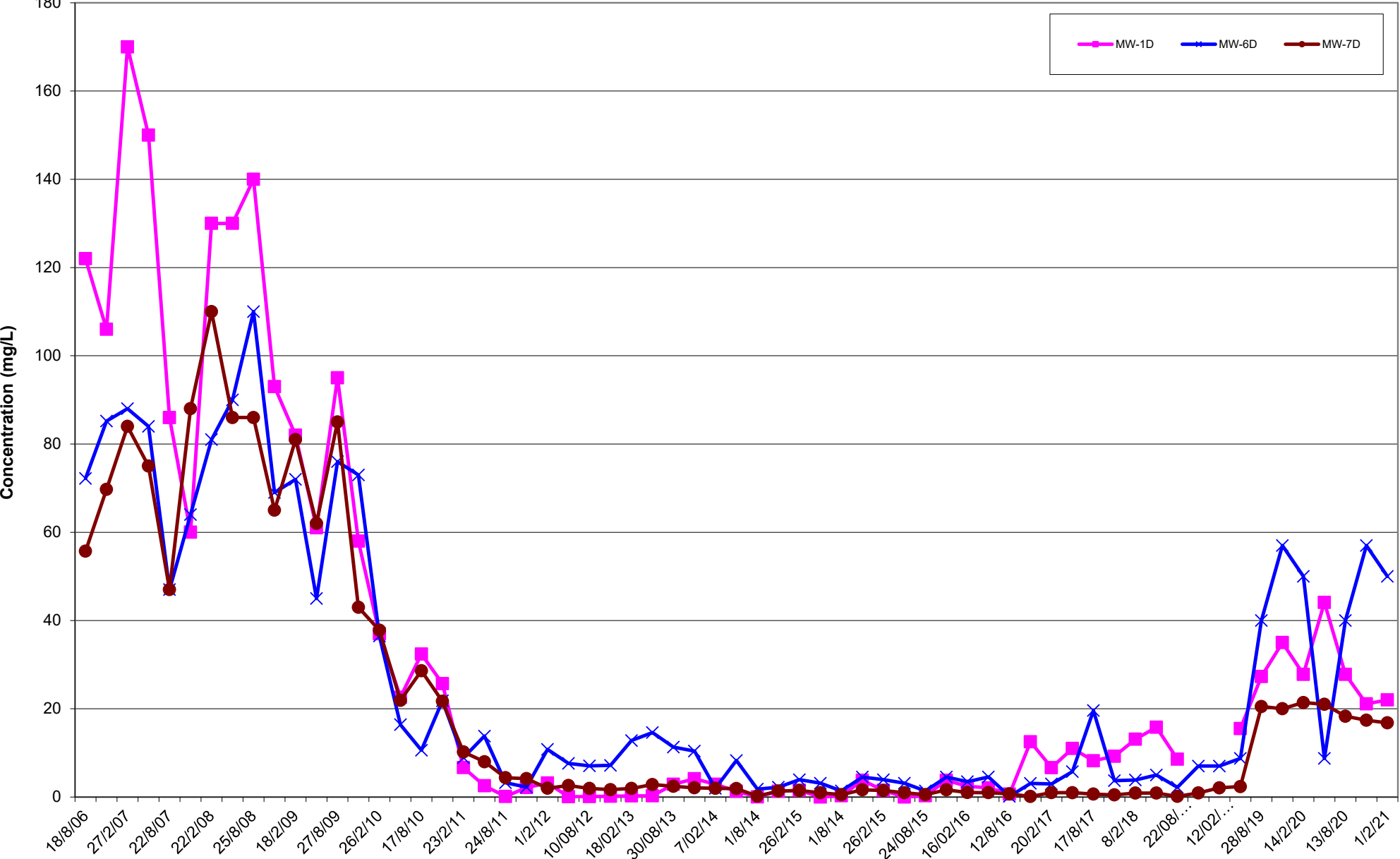
GERROA ANNUAL MONITORING REPORT (2020-2021)

Figure 4

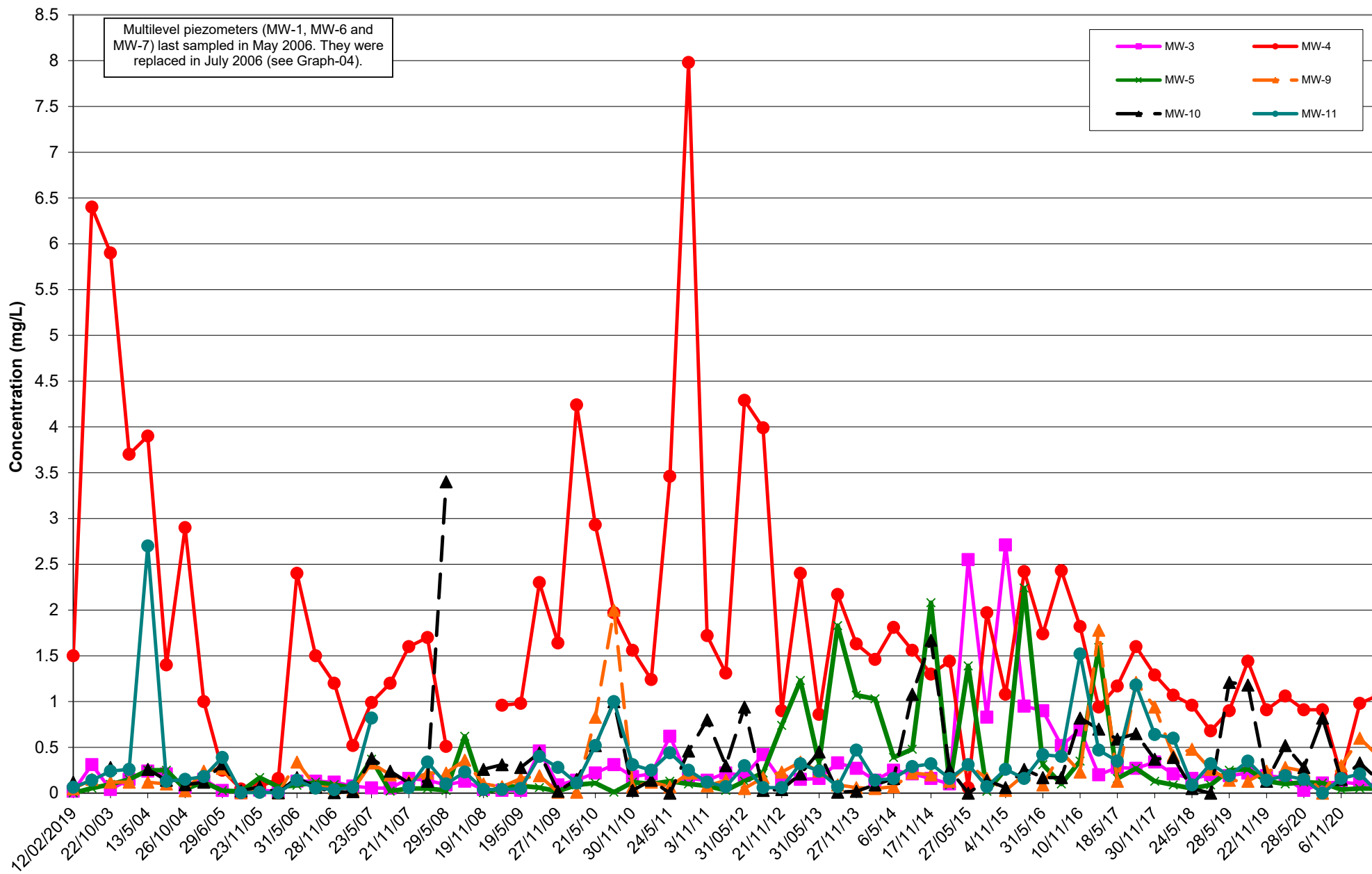
**Graph-01: Groundwater Ammonia Time-Series Trends - Shallow & Creek Wells (2006 to 2021)**



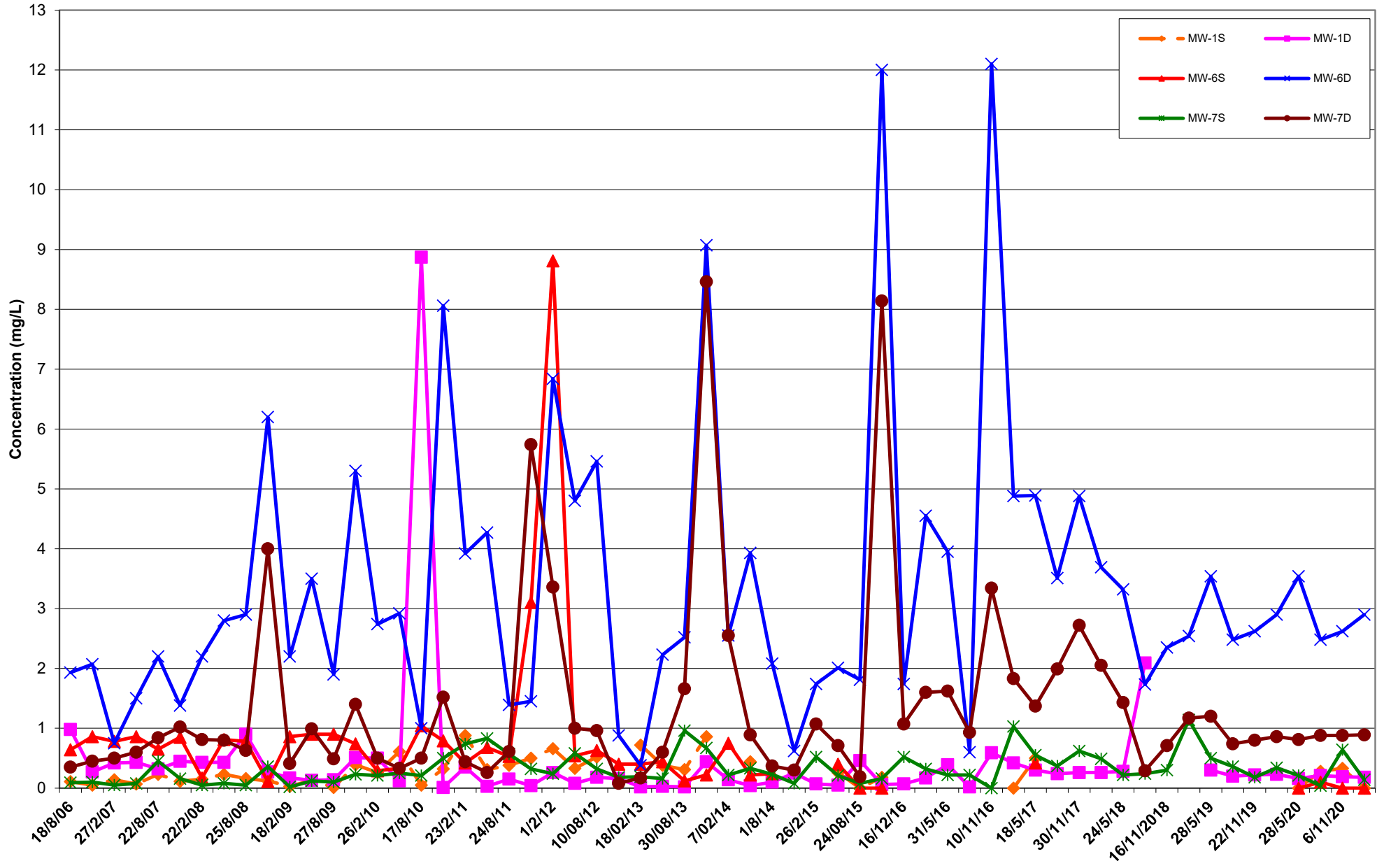
Graph -02: Groundwater Ammonia Time-Series Trends - Deep Wells (2006 to 2021)



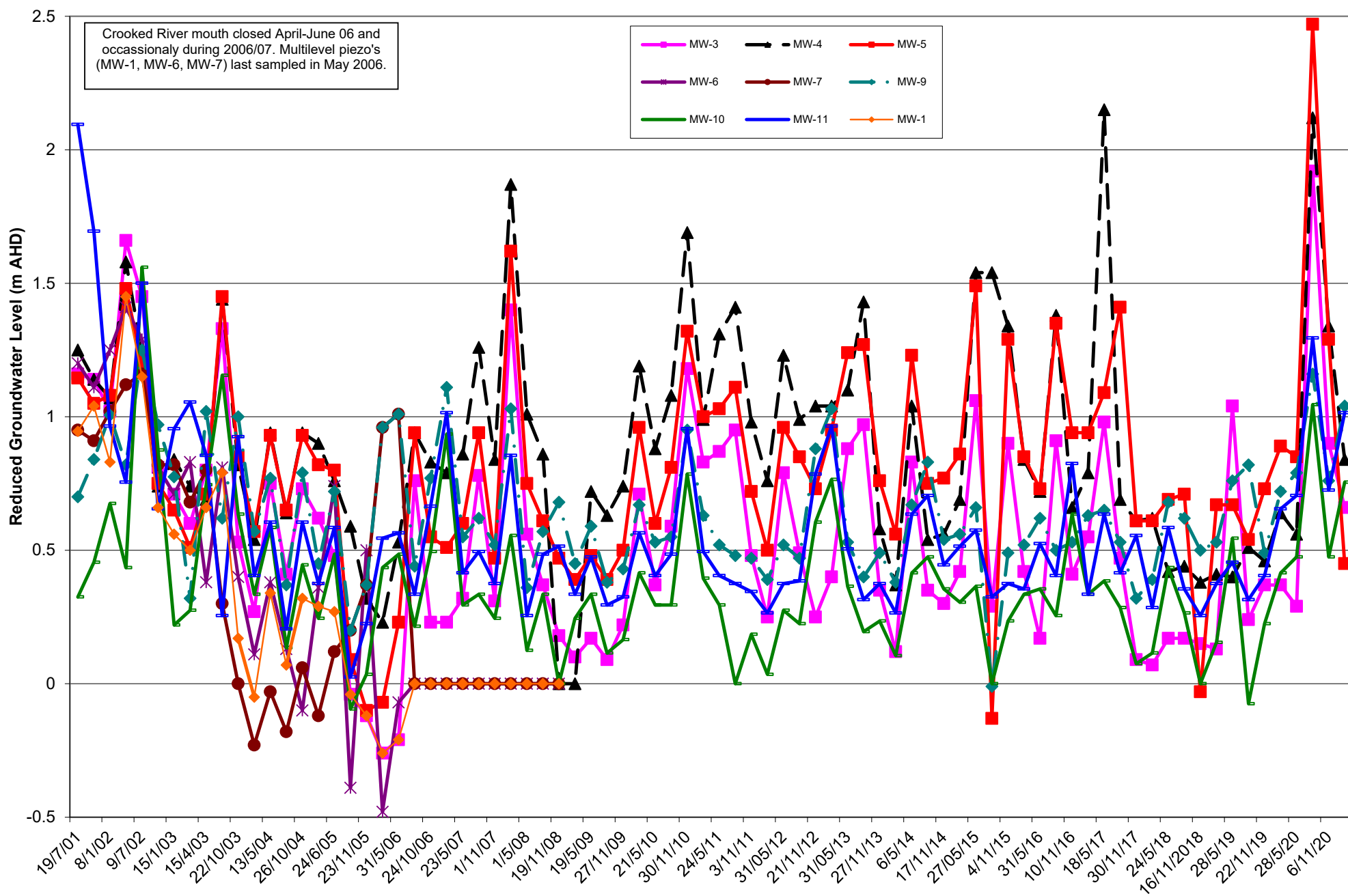
**Graph-03: Groundwater Total Phosphorous Time-Series Trends - Standard Wells (2006 to 2021)**



Graph-04: Groundwater Total Phosphorous Trends - New Shallow & Deep Wells (2006 to 2021)

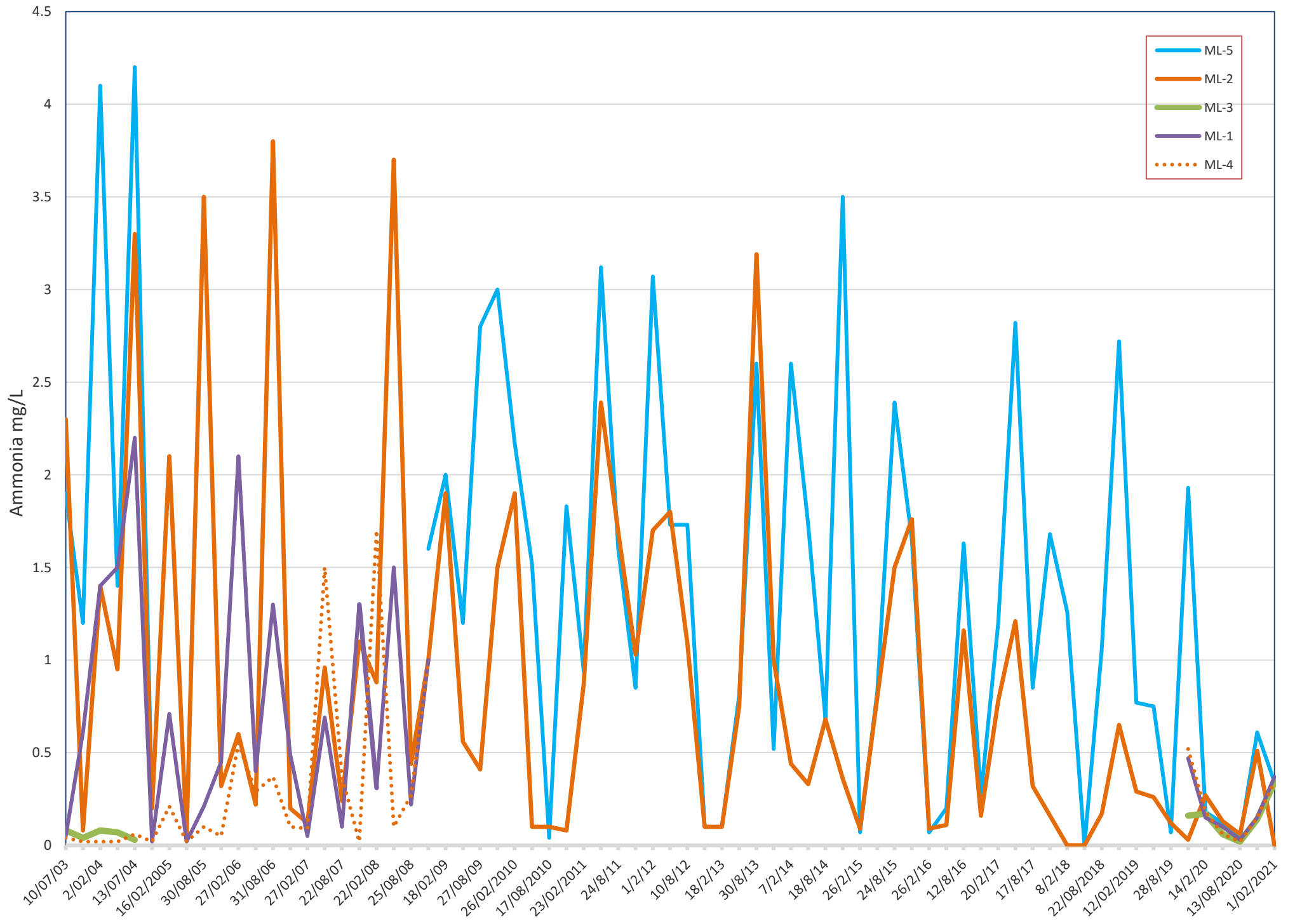


**Graph-05: Depth to Groundwater (m AHD) Trends; 2001 to 2021**

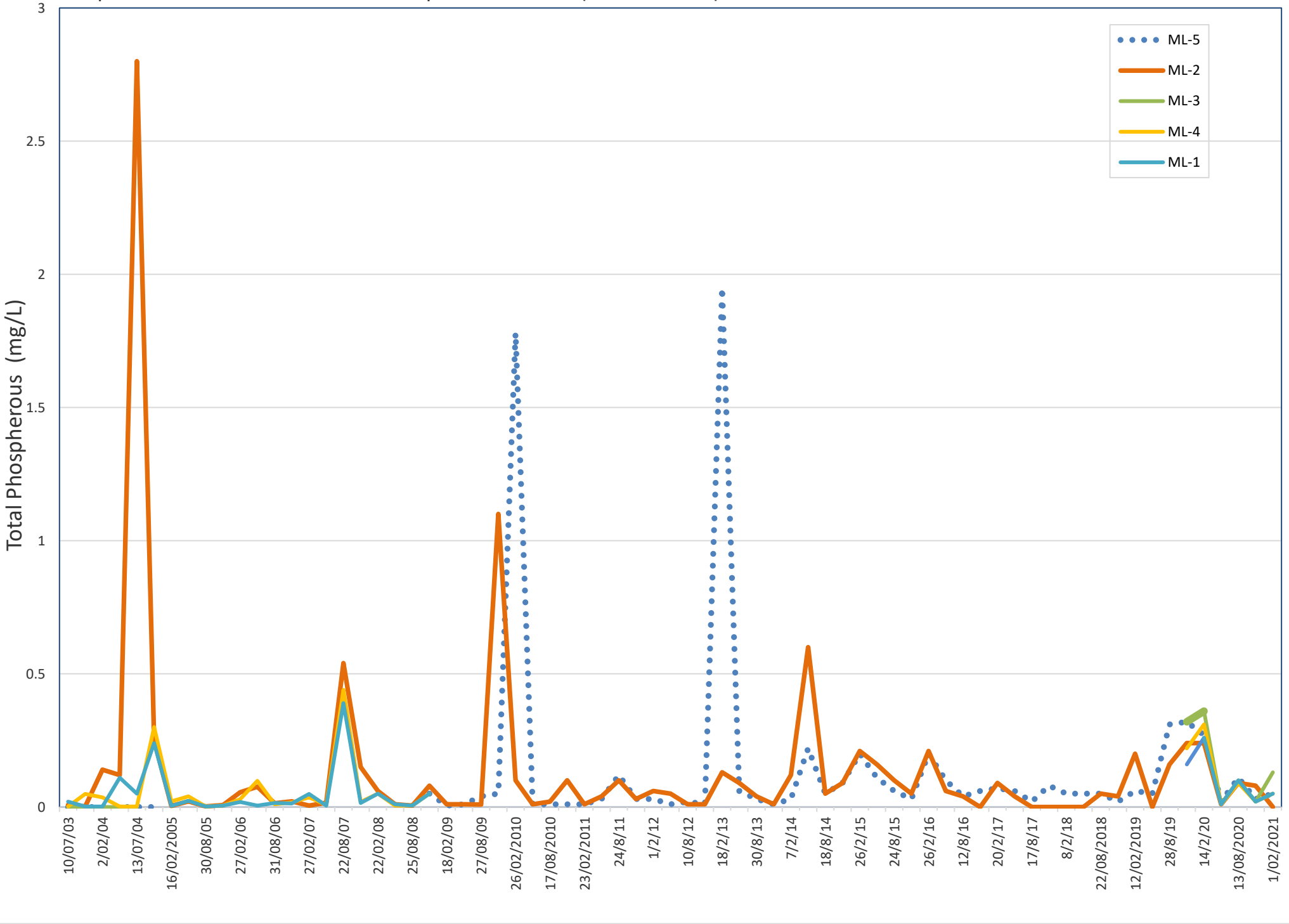




Graph-06: Surface Water Ammonia Trends (2003 to 2021)



Graph-07: Surface Water & Total Phosphorous Trends (2003 to 2021)



## Tables

# T-1 Summary GW (MW-1S)

## Gerroa Waste Disposal Depot (2010-2021)

Sample ID	ANZECC, 2000		MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S	MW1S
Field Measurements	Fresh	Marine	21/5/10	18/2/13	17/11/14	26/2/15	27/5/15	24/8/15	4/11/15	16/2/16	31/5/16	12/8/16	10/11/16	20/2/17	18/5/17	17/8/17	30/11/17	8/2/18	24/5/18	28/5/20	13/8/20	6/11/20	1/2/21
Ground Level (m AHD)			NA																				
Depth to Groundwater (m AHD)																							
Groundwater depth (m bTOC)			3.74	3.75	NA	NA	3.06	----	3.2	NA	NA	NA	NA	NA	3.11	NA	NA	NA	NA	NA	NA	NA	NA
Height of Stick up (m)			0.65	0.65			0.65		0.65						0.65						0.65	0.65	
Groundwater Depth (mbgl)			3.09	3.1			2.41	----	2.55						2.46					----	2.24	3.21	----
pH (field)	6.5-8.0 (a)	8-8.4 (a)	6.8	7			6.2	----	6						6.4					----	6.5	6.4	----
Temperature (T deg C)			-																				
Electrical Conductivity (mS/cm)	0.125-2.2 (a)		1.95	1.1			0.772	----	0.342						0.691					----	0.482	0.315	----
Salinity (ppt)			-																				
Dissolved Oxygen (mg/L)	8.5-11.0 (a)	9.0-10.0 (a)	1.39	1.48			2.19	----	2.2						2.29					----	2.35	4.14	----
Dissolved Oxygen (%)			-																				
Turbidity (NTU)	6-50 (a)	0.5-10 (a)	-																				
Redox Potential (mV)			-																		-44.6		
Comments			nc	nc																			
Sodium			-																	<10	61	<10	96.50
Potassium			-																		2		
Calcium			-																		24		
Magnesium			-																		8		
Chloride			-																		111		
Alkalinity (as CaCO3)			386	362			102	----	51						139					----	70	76	----
Bicarbonate			386	362			102	----	51						139					----	70	76	----
Carbonate (as CaCO3)			<1	<1			<1	----	<1						<1					----	<1	<1	----
Sulphate (SO4)			-																	MB	<10	MB	LCS
pH (lab)			-																				
Total Dissolved Solids (TDS)			1300	640			734	----	385						561					----	522	361	----
Hardness (as CaCO3)			-																				
Total Suspended Solids (TSS)			-																				
Iron (filtered)	0.3 (1)		-																		10.6		
Manganese	1.90		-																		0.01		
Nitrate (NO3 as N)	0.7 (7)		0.26	<0.10			<0.01	----	<0.01						<0.01					----	<0.10	<0.01	----
Nitrite (NO2 as N)			<0.01	<0.10			<0.01	----	<0.01						<0.01					----	<0.10	<0.01	----
Ammonia (NH3 as N)	1.88 (2)	2.84 (2)	0.27	0.13			0.09	----	0.23						0.31					----	<0.01	0.14	----
Total Kjeldhal Nitrogen (TKN)	0.5 (5)	0.12 (6)	4.4	1.8			3.5	----	2.1						5.5					----	4.3	2.9	----
Dissolved Organic Carbon			-																	----	124		----
Fluoride (Electrode)			-																	----	0.3		----
Total Phosphorus (TP)	0.05 (7)	0.025 (7)	0.61	0.72			0.26	----	0.2						0.50					----	0.28	0.33	----

Note:

Exceeds ANZECC (2000) guidelines  
marine/fresh water ecosystems  
Focus of this monitoring report  
nc = no comment

NA = not available

- 35
1. Trigger value is an indicative interim working level only (IIWL).
  2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.
  3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
  4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.
  5. Trigger value for total Nitrogen in lowland rivers in NSW.

6. Trigger value for total Nitrogen in marine ecosystems in NSW.
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact.
- a. Reference only, not directly applicable to groundwater.

### Gerroa Waste Disposal Depot (2010 to 2021)

[illegible]

Note: Exceeds ANZECC (2000) guidelines marine/fresh water ecosystems <b>Focus of this monitoring report</b> nc = no comment      NA = not available		Notes: 1. Trigger value is an indicative interim working level only (IWL). 2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3. 3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW. 4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW. 5. Trigger value for total Nitrogen in lowland rivers in NSW.	6. Trigger value for total Nitrogen in marine ecosystems in NSW. 7. Trigger value for a 95% protection level. 8. Guideline for water quality and aesthetics: primary contact. a. Reference only, not directly applicable to groundwater.
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**Gerroa Waste Disposal Depot (2010 to 2021)**

[illegible]

Exceeds ANZECC (2000) guidelines  
marine/fresh water ecosystems

Focus of this monitoring report  
nc = no comment NA = not available

1. Trigger value is an indicative interim working level only (IWVL).
2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.
3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.
5. Trigger value for total Nitrogen in lowland rivers in NSW.

6. Trigger value for total Nitrogen in marine ecosystems in NSW
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact.
  - a. Reference only, not directly applicable to groundwater.



### Gerroa Waste Disposal Depot (2010 to 2021)

[illegible]

Note:	Exceeds ANZECC (2000) guidelines marine/fresh water ecosystems Focus of this monitoring report	35	1. Trigger value is an indicative interim working level only (IWVL). 2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3. 3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW. 4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW. 5. Trigger value for total Nitrogen (T) lowland rivers in NSW.
	nc = no comment	NA = not available	

6. Trigger value for total Nitrogen in marine ecosystems in NSW
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact.
- a. Reference only, not directly applicable to groundwater.

ms in NS

a. Reference only, not directly applicable to groundwater.

### Gerroa Waste Disposal Depot (2010 to 2021)

Sample ID	ANZECC, 2000		MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS	MWS
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Note:		1. Trigger value is an indicative interim working level only (IWL).	6. Trigger value for total Nitrogen in marine ecosystems in NSW
Exceeds ANZECC (2000) guidelines	35	2. Arsenium trigger at pH = 8.0, for a 95% probability for average pH = 7.3	7. Trigger value for total Nitrogen in marine ecosystems in NSW
marine/fresh water ecosystems		3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.	8. Guideline for water quality and aesthetics: primary contact
Focus of this monitoring report		4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW	a. Reference only, not directly applicable to groundwater
nc = no comment	NA = not available	5. Trigger value for total Nitrogen in lowland rivers in NSW	

### GW-1 Summary Groundwater (MW-6s)

### Gerroa Waste Disposal Depot (2010 to 2021)

Sample ID	ANZECC, 2000		MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	MW6s	
Field Measurements	Fresh	Marine	21/5/10	17/8/10	30/11/10	23/2/11	24/5/11	24/8/11	3/11/11	1/2/12	31/5/12	10/8/12	21/11/12	18/2/13	31/5/13	30/8/13	27/11/13	7/2/14	7/2/14	6/5/14	1/8/14	27/5/15	18/5/17	2018-19	MW6s	MW6s	MW6s	MW6s	
Ground Level (m AHD)			NA																			NA	Note #	dry					
Depth to Groundwater (m AHD)			NA													-	-	-	-			NA							
Groundwater depth (m bTOC)			4.69	4.57	4.45	4.48	4.43	4.39	4.71	4.88	4.5	4.7	4.66	4.43	4.35	4.4	4.77	4.94	4.94	4.37	4.77	4.2	4.33		----	4.77	----	----	
Height of Stick up (m)			0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		----	0.6	----	----	----	
Groundwater Depth (mbgl)			4.09	3.97	3.85	3.88	3.83	3.79	4.11	4.28	3.9	4.1	4.06	3.83	3.75	3.8	4.17	4.34	4.34	3.77	4.17	3.6	3.73		----	3.17	----	----	
pH (field)	6.5-8.0 (a)	8-8.4 (a)	7.5	7.3	6.8	6.9	7.2	7	7.6	7.3	7.5	7.4	7.6	6.9	6.9	7.1	7.4	7.2		7.3	6.2	6.6			----	6.7	----	----	
Temperature (T deg C)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Electrical Conductivity (mS/cm)	0.125-2.2 (a)		0.52	0.65	0.502	0.37	0.569	0.511	0.504	0.504	0.475	<1	0.396	1.06	0.432	0.474	0.679	0.662		0.659	573	644			----	881	----	----	
Salinity (ppt)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Dissolved Oxygen (mg/L)	8.5-11.0 (a)	9.0-10.0 (a)	1.74	2.56	2.63	2.19	2.18	2.94	1.9	1.82	2.29	1.2	2.4	2.58	1.46	1.9	2.13	2.33	2.33	1.85	2	3.48	3.21		----	3.51	----	----	
Dissolved Oxygen (%)			-	-	27.70	-	-	-	-	-	-	11.8	-	-	-	-	-	-		20.9						----			
Turbidity (NTU)	6-50 (a)	0.5-10 (a)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Redox Potential (mV)			-	-	-	-	-33.80	-	-	-	-	<0.1				-57	-	-		65						-79.9			
Comments			nc	nc	nc	nc	-	-	-	nc	nc	nc	nc	nc															
Sodium			-	-	8	-	-	44	-	-	-	14	-	-	-	30	-	-		24						102			
Potassium			-	-	6	-	-	8	-	-	-	8	-	-	-	6	-	-		6						2			
Calcium			-	-	80	-	-	41	-	-	-	75	-	-	-	75	-	-		124						24			
Magnesium			-	-	9	-	-	7	-	-	-	6	-	-	-	7	-	-		10						23			
Chloride			-	-	14	-	-	42	-	-	-	21	-	-	-	34	-	-		30						214			
Alkalinity (as CaCO3)			182	263	208	176	130	133	196	226	227	202	237	315	62	217	273	248	<1	182	262	40	80		----	90	----	----	
Bicarbonate			182	263	208	176	130	133	196	226	206	202	237	315	62	217	273	248	248	182	262	40	80		----	90	----	----	
Carbonate (as CaCO3)			<1	<1	<1	<1	<1	<1	<1	<1	21	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		----	<1	----	----	
Sulphate (SO4)			-	-	26	-	-	40.00	-	-	-	18	-	-	-	34	-	-		60						26			
pH (lab)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		7	7								
Total Dissolved Solids (TDS)			314	350	308	332	280	334	328	342	286	314	372	616	286	309	364	356	356	280	504	320	343			----	543	----	----
Hardness (as CaCO3)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Total Suspended Solids (TSS)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
Iron (filtered)	0.3 (1)		-	-	5.59	-	-	3.13	-	-	-	<0.05			-	1.17	-	-		<0.05							0.61		
Manganese	1.90		-	-	0.116	-	-	0.06	-	-	-	0.025			-	0.019	-	-		0.03							0.005		
Nitrate (NO3 as N)	0.7 (7)		0.37	1.71	0.01	1.16	7.48	0.04	<0.01	0.8	0.01	0.76	3.54	0.11	<0.01	1.05	0.62	0.05	0.05	0.06	8.3	<0.01	0.02		----	0.1	----	----	
Nitrite (NO2 as N)			0.01	0.02	<0.01	<0.01	0.03	<0.01	<0.01	0.31	0.01	0.08	0.32	<0.01	<0.01	0.92	0.1	0.04	0.04	<0.01	0.75	<0.01	<0.01		----	0.03	----	----	
Ammonia (NH3 as N)	1.88 (2)	2.84 (2)	0.83	1.8	1.73	0.48	0.23	0.19	0.4	0.25	0.12	0.08	0.2	0.91	0.04	0.29	0.04	0.04	0.04	0.03	0.02	0.09	0.06		----	0.03	----	----	
Total Kjeldhal Nitrogen (TKN)	0.5 (5)	0.12 (6)	1.5	2.6	2.5	1	2.40	0.60	0.80	2.00	0.9	3.1	1	4.2	1.9	1.1	1	0.6	0.6	1.5	2.0	2.9	4.2		----	1.1	----	----	
Dissolved Organic Carbon			-	-	8	-	-	7	-	-	-	4	-	-	-	9	-	-		10						14			
Fluoride (Electrode)			-	-	0.3	-	-	0.60	-	-	-	0.6	-	-	-	0.4	-	-		0						0			
Total Phosphorus (TP)	0.05 (7)	0.025 (7)	0.33	1.04	0.79	0.42	0.68	0.53	3.10	8.81	0.54	0.63	0.4	0.4	0.44	0.12	0.2	0.8	0.8	0.2	0.2	0.4	0.42		----	0.1	----	----	

**Note:**

Exceeds ANZECC (2000) guidelines  
marine/fresh water ecosystems

### Focus of this monitoring report

nc = no comment

NA = not available

**Note #:** Well is seldom sampled due to being dry at time of sampling

1. Trigger value is an indicative interim working level only (IIWL).
2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.
3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.
5. Trigger value for total Nitrogen in lowland rivers in NSW.

6. Trigger value for total Nitrogen in marine ecosystems in NSW.
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact.
  - a. Reference only, not directly applicable to groundwater.

### Gerroa Waste Disposal Depot (2010 to 2021)

[illegible]

**Note:**

Exceeds ANZECC (2000) guidelines  
marine/fresh water ecosystems

Focus of this monitoring report

- |   |  |
|---|--|
| 1. Trigger value is an indicative interim working level only (IIWL).                  | 6. Trigger value for total Nitrogen in marine ecosystems in NSW. |
| 2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3. | 7. Trigger value for a 95% protection level.                     |
| 3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.              | 8. Guideline/ water quality and aesthetics: primary contact.     |
| 4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.           | a. Reference only, not directly applicable to groundwater.       |
| 5. Trigger value for total Nitrogen in lowland rivers in NSW.                         |  |

## Gerroa Waste Disposal Depot (2010 to 2021)

[illegible]

Exceeds ANZECC (2000) guidelines marine/fresh water ecosystems		35	1. Trigger value is an indicative interim working level only (IWL).	6. Trigger value for total Nitrogen in marine ecosystems in NSW.
Focus of this monitoring report			2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.	7. Trigger value for a 95% protection level.
no comment	NA = not available		3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.	8. Guide/infer water quality and aesthetics: primary contact.
			4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.	a. Reference only, not directly applicable to groundwater.
			5. Trigger value for total Nitrogen in lowland rivers in NSW.	

[illegible]

Exceeds ANZECC (2000) guidelines		35	1. Trigger value is an indicative interim working level only (IWL).	6. Trigger value for total Nitrogen in marine ecosystems in NSW.	---
marine/fresh water ecosystems			2. Ammonia trigger at pH $\geq 8.0$ , for a 95% protection, corrected for average pH = 7.3.	7. Trigger value for a 95% protection level.	---
Focus of this monitoring/report			3. Trigger value for oxides of Nitrogen ( $\text{NO}_x$ ) for lowland rivers in NSW.	8. Guideline for water quality and aesthetics: primary contact.	---
no = no comment	NA = not available		4. Trigger value for oxides of Nitrogen ( $\text{NO}_x$ ) for marine ecosystems in NSW.	a. Reference only, not directly applicable to groundwater.	---
			5. Trigger value for total Nitrogen in lowland rivers in NSW.		---



### Gerroa Waste Disposal Depot (2010 to 2021)

[illegible]

Exceeds ANZECC (2000) guidelines marine/fresh water ecosystems	38	1. Trigger value is an indicative interim work level only (IWL).	6. Trigger value for total Nitrogen in marine ecosystems in NSW.
Focus of this monitoring report		2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.	7. Trigger value for a 95% protection level.
no = no comment	NA = not available	3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.	8. Guideline for water quality and aesthetics: primary contact.
		4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.	a. Reference only, not directly applicable to groundwater.
		5. Trigger value for total Nitrogen in lowland rivers in NSW.	

## Gerroa Waste Disposal Depot (2010 to 2021)

Sample ID		ANZECC, 2000																
Field Measurements		Fresh	Marine	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10	MW10
Ground Level (m in AHD)		1.275	1.787	1.787	23.01	24.51	24.51	1.475	1.475	1.475	1.475	1.475	1.475	1.475	1.475	1.475	1.475	1.475
Depth to Groundwater (m in AHD)		0.0295	0.295	0.785	0.395	0.295	NA	0.185	0.035	0.275	0.225	0.605	0.765	0.365	0.195	0.235	0.105	0.475
Groundwater Depth (m in BTOC)		2.14	2.14	1.65	2.04	2.14	-	2.25	2.4	2.16	2.21	1.83	1.67	2.07	2.24	2.2	2.33	2.02
Height of Stick up (m)		0.95	0.95	0.06	0.06	0.06	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Groundwater Depth (temp)		1.18	1.18	0.69	1.08	1.18	NA	1.29	1.44	1.12	1.25	0.87	0.71	1.11	1.28	1.34	1.37	1.08
pH (dewar)		6.5-8.0 (a)	6.5-8.4 (a)	4	4	5.1	5.4	5.3	4.9	5.2	4.7	5	5.1	5	5.4	5.3	5.1	4.2
Temperature (T deg C)		1.90	1.90	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Electrical Conductivity (mS/cm)		0.125-2.2 (a)	0.125-2.2 (a)	4.69	4.63	3.06	8.84	5.12	-	5.7	14.8	6.3	24	10.2	14.4	28.2	22.7	8.54
Salinity (ppt)		2.69	2.69	4.93	4.7	9.61	6.1	-	4.16	3.05	3.26	2.4	15.3	3.43	20.1	30.2	3.8	3.06
Dissolved Oxygen (mg/L)		8.5-11.2 (a)	8.10-10 (a)	4.69	4.93	4.7	9.61	6.1	-	4.16	3.05	3.26	2.4	15.3	3.43	20.1	30.2	3.8
Dissolved Oxygen (%)		6.50 (a)	0.5-1.0 (a)	-	50.30	-	-	-	-	24.9	-	-	-	-	-	-	-	3.5
Turbidity (NTU)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2
Resist. Potential (mV)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	318
Comments		nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	172
Sodium		-	-	406	-	-	-	-	2390	-	-	-	-	-	1100	-	-	1860
Potassium		-	-	7	-	-	-	-	48	-	-	-	-	-	88	-	-	150
Calcium		-	-	2	-	-	-	-	114	-	-	-	-	-	44	-	-	65
Magnesium		-	-	13	-	-	-	-	336	-	-	-	-	-	76	-	-	209
Chloride		-	-	449	-	-	-	-	4740	-	-	-	-	-	1760	-	-	13600
Alkalinity (as CaCO3)		<1	<1	28	3	10	-	6	2	6	4	1	<1	5	9	10	4	<1
Bicarbonate		<1	<1	28	3	10	-	6	2	6	4	1	<1	5	9	10	4	<1
Carbonate (as CaCO3)		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulfate (SO4)		-	-	42	-	-	-	-	642	-	-	-	-	-	304	-	-	1410
pH (lab)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.20
Total Dissolved Solids (TDS)		20500	10100	1810	5740	2700	-	3440	10500	3980	8280	10700	7550	3870	3760	10800	19400	7970
Hardness (as CaCO3)		-	-	10.4	-	-	-	-	2.28	-	-	-	-	-	0.54	-	-	1000
Total Suspended Solids (TSS)		0.3 (1)	-	0.03	-	-	-	-	0.28	-	-	-	-	-	0.77	-	-	0.77
Iron (ITR)		-	-	-	-	-	-	-	1.90	-	-	-	-	-	0.02	-	-	0.02
Manganese		-	-	-	-	-	-	-	0.25	-	-	-	-	-	0.014	-	-	0.009
Nitrate (NO3 as N)		0.7 (7)	-	0.2	0.3	1.36	0.44	0.05	-	0.15	<0.01	0.03	0.25	<0.01	0.01	<0.01	0.04	0.02
Nitrite (NO2 as N)		-	-	<0.01	<0.01	0.05	0.02	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (NH3 as N)		1.88 (2)	2.84 (2)	<0.02	0.02	0.03	-	0.02	<0.01	0.03	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Kjeldahl Nitrogen (TKN)		0.5 (5)	0.2 (2)	2.2	6.2	59.3	1.2	2.6	8.2	8	1.5	10	1.4	1.4	3.1	8.1	0.3	<0.2
Dissolved Organic Carbon		-	-	430	-	-	-	-	12	-	-	-	-	-	24	-	-	15
Fluoride (Electrode)		-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorus (TP)		0.05 (7)	0.025 (7)	0.15	0.52	<1.00	0.03	0.14	0.046	0.8	0.3	0.94	0.03	0.04	0.21	0.45	<0.01	0.16
																		0.18
																		0.26
																		0.14
																		0.06
																		0.26
																		0.17
																		0.82
																		0.53
																		0.33
																		0.6
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No

Exceeds ANZECC (2000) guidelines marine/fresh water ecosystems	35	1. Trigger value is an indicative interim working level only (IWL).
Focus of this monitoring report		2. Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.
nc = no comment	NA = not available	3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
		4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.

6. Trigger value for total Nitrogen in marine ecosystems in NSW
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact.
  - a. Reference only, not directly applicable to groundwater.



### Gerroa Waste Disposal Depot (2003 to 2021)

Exceeds ANZECC (2000) guidelines

0.054

**Focus of this monitoring report**

nm = not measured (app) = approximately NR = no result

- |   |  |
|---|--|
| 1. Trigger value is an indicative interim working level only (IWVL).  | 6. Trigger value for Nitrogen in marine ecosystems in NSW.     |
| 2. Ammonia trigger value specified at pH = 8.0, for a 95% protection level, is corrected for an average pH = 7.3. | 7. Trigger value for a 95% Protection level.                   |
| 3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.  | 8. Guideline for water quality and aesthetics: Primary Contact |
| 4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.                                       | a. Reference only, not directly applicable to groundwater.     |
| 5. Trigger value for total Nitrogen in lowland rivers in NSW.   |  |

Table SW-1: Summary Analytical Results for Surface Water  
(ML-2)

Gerroa Waste Disposal Depot (2016 to 2021)

Sample ID	ANZECC, 2000		ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2	ML-2
Field Measurements	Fresh	Marine	31/5/16	12/8/16	10/11/16	20/2/17	18/5/17	17/8/17	29/11/17	8/2/18	24/5/18	22/8/18	16/11/18	12/2/19	28/5/19	28/8/19	22/11/19	14/2/20	28/5/20	13/8/20	6/11/20	1/2/21
pH (field)	6.5-8.0 (a)	8-8.4 (a)	6.9	6.8	7.1	7.2	7.1	6.7	7.3	7.2	7.1	7.2	7.0	7.4	7.3	7.5	6.9	6.3	4.9	6.4	7.1	6.6
Temperature																						
Electrical Conductivity (mS/cm)	0.125-2.2 (a)		43.2	5.24	47.3	30.1	15.3	29.1	30.8	41.8	47.2	43.6	34.8	45.4	43.6	51.2	46	2.91	5.43	0.449	22	34.7
Eh (ORP) (mV)				1.0				132				229								144		
Salinity (ppt)																						
Dissolved Oxygen (mg/L)	8.5-11.0 (a)	9.0-10.0 (a)	4.82	5.66	4.73	4.87	6.38	4.90	3.21	3.25	3.25	5.72			6.76	3.43	2.87	0.87	4.47	5.08	5.59	3.2
Dissolved Oxygen (%)																						
Turbidity (NTU)	6-50 (a)	0.5-10 (a)																				
<b>Laboratory Analyses</b>																						
Sodium (ICP)				922				4750				7660				11200			112	64		
Potassium (ICP)				35				180				272				412			5			
Calcium (ICP)				63				246				316				427			6			
Magnesium (ICP)				104				525				914				1360			8			
Chloride				----				----														
Alkalinity (as CaCO3)			118	110	109	139	136	120	<1	<1	<1	111	114	116	106	102	128	24	<1	15	111	105
Sulphate (SO4)			118	----	109	139	136	----	153	145	121	----										
pH			<1	----	<1	<1	<1	----	153	145	121	----										
Redox Potential (mV)																						
Total Dissolved Solids (TDS)			33200	3070	33100	19400	9970	18800	21200	15800	27200	28600	24300	35800	27800	38000	31000	1480	3140	245	13800	24800
Total Suspended Solids (TSS)																						
<b>Metals (mg/L)</b>																						
Iron (ICP)	0.3 (1)			1.07				0.88				0.18				0.14				0.65		
Manganese (ICP)	1.90			0.042				0.028				0.012				0.019				0.012		
<b>Nutrients (mg/L)</b>																						
Nitrate (NO3 as N)	0.7 (7)		0.13	0.16	0.06	<0.01	0.02	0.31	0.01	<0.01	0.06	0.15	0.02	0.02	0.06	0.01	<0.01	<0.01	<0.01	0.1	0.06	0.06
Nitrite (NO2 as N)			<0.01	0.02	<0.01	<0.01	0.04	0.04	0.04	<0.01	0.01	0.02	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Ammonia (NH3 as N)	1.88 (2)	2.84 (2)	0.11	1.16	0.16	0.78	1.21	0.32	0.16	<0.05	<0.10	0.17	0.65	0.29	0.26	0.12	0.03	0.27	0.13	0.06	0.51	<0.01
Total Kjeldahl Nitrogen (TKN)	0.5 (5)	0.12 (6)	0.5	1.9	<0.5	1.0	2.3	0.5	0.8	<0.5	<0.5	<0.5	0.7	<0.5	0.5	<1.0	<0.5	2	0.6	0.7	0.9	0.8
Total Organic Carbon (TOC)				----				----				----	3.45	7.59								
Total Phosphorus (TP)	0.05 (7)	0.025 (7)	0.06	0.04	<0.05	0.09	0.04	<0.05	<0.05	<0.05	<0.05	<0.05	0.04	0.20	<0.05	0.16	0.24	0.24	<0.01	0.09	0.08	<0.05
<b>Biological (CFU/100 ml)</b>																						
Enterococcus	35 (8)	35 (8)		28				44				~5										
Thermotolerant (Faecal) coliforms	150 (8)	150 (8)		18				~94				~1										

Exceeds ANZECC (2000) guidelines **0.054**

Focus of this monitoring report

nm = not measured (app) = approximately NR = no result

1. Trigger value is an indicative interim working level only (IWL).
2. Ammonia trigger value at pH =8, 95% protection,corrected ave pH=7.3.
3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.
5. Trigger value for total Nitrogen in lowland rivers in NSW.
6. Trigger value for total Nitrogen in marine ecosystems in NSW.
7. Trigger value for a 95% protection level.
8. Guidelinefor water quality and aesthetics: primary contact.
- a. Reference only, not directly applicable to groundwater.

Table SW-1: Summary Analytical Results for Surface Water Location (ML-3)

## Gerroa Waste Disposal Depot (2003 to 2021)

Sample ID	ANZECC, 2000		ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3	ML-3
<b>Field Measurements</b>	Fresh	Marine	22/10/03	2/02/04	13/05/04	13/07/04	26/10/04	2004-2014	2015-2016	2016-2018	28/05/19	28/08/19	22/11/19	14/02/20	28/5/20	13/8/20	6/11/20	1/2/21
pH (field)	6.5-8.0 (a)	8-8.4 (a)	7.63	7.42	7.65	7.26	4.25	No access (Cleary Bros. Land) - no samples taken 18/02/2009; 19/05/2009; 27/08/2009; 2	No access (Cleary Bros. Land) - no samples taken 30/08/2013; 27/11/2013 an	No access (Cleary Bros. Land) - no samples taken	No Access	No Access	6.7	6.1	4.6	6.4	6.4	6.4
Temperature			20.5	21.34	13.03	13.16	18.75											
Electrical Conductivity (mS/cm)	0.125-2.2 (a)		13.1	5.3	3.1	8.5	0.4						34.4	0.882	2590	110	1780	28200
Eh (ORP) (mV)			nm	nm	nm	nm	nm									118		
Salinity (ppt)			7.53	2.85	1.62	4.72	0.21											
Dissolved Oxygen (mg/L)	8.5-11.0 (a)	9.0-10.0 (a)	4.6	4.5	2.2	0.8	1.2						1.34	1.09	3.89	4.87	5.57	1.77
Dissolved Oxygen (%)			52.9	41.1	24	7.6	12.2											
Turbidity (NTU)	6-50 (a)	0.5-10 (a)	30.1	27.1	21.5	20.6	15.1											
<b>Laboratory Analyses</b>																		
Sodium (ICP)			-	-	-	-	-									12		
Potassium (ICP)			-	-	-	-	-									3		
Calcium (ICP)			-	-	-	-	-									4		
Magnesium (ICP)			-	-	-	-	-									2		
Chloride			-	-	-	-	-											
Alkalinity (as CaCO <sub>3</sub> )			-	-	-	-	-											
Sulphate (SO <sub>4</sub> )			-	-	-	-	-											
pH			-	-	-	-	-											
Redox Potential (mV)			-	-	-	-	-											
Total Dissolved Solids (TDS)			-	-	-	-	-						22800	602	1390	82	982	16000
Total Suspended Solids (TSS)			-	-	-	-	-											
<b>Metals (mg/L)</b>																		
Iron (ICP)	0.3 (1)		-	-	-	-	-									0.57		
Manganese (ICP)	1.90		-	-	-	-	-									0.01		
<b>Nutrients (mg/L)</b>																		
Nitrate (NO <sub>3</sub> as N)	0.7 (7)		-	-	-	-	-						<0.01	<0.01	0.04	0.1	<0.01	<0.01
Nitrite (NO <sub>2</sub> as N)			-	-	-	-	-						<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia (NH <sub>3</sub> as N)	1.88 (2)	2.84 (2)	0.08	0.04	0.08	0.07	0.03						0.16	0.17	0.06	0.02	0.14	0.34
Total Kjeldahl Nitrogen (TKN)	0.5 (5)	0.12 (6)	-	-	-	-	-						<0.5	2.3	0.6	0.6	0.6	1.1
Total Organic Carbon (TOC)			-	-	-	-	-											
Total Phosphorus (TP)	0.05 (7)	0.025 (7)	-	-	-	-	-						0.32	0.36	<0.01	0.1	0.02	0.13
<b>Biological (CFU/100 ml)</b>																		
Enterococcus	35 (8)	35 (8)	10	390	72	60	140											
Thermotolerant (Faecal) coliforms	150 (8)	150 (8)	16	32 (app)	50	18 (app)	220											

Exceeds ANZECC (2000) guidelines

0.054

Notes:

1. Trigger value is an indicative interim working level only (IIWL).
2. Ammonia trigger value specified at pH = 8.0, 95% protection level, corrected pH = 7.3.
3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW.
5. Trigger value for total Nitrogen in lowland rivers in NSW.
6. Trigger value for total Nitrogen in marine ecosystems in NSW.
7. Trigger value for a 95% Protection level
8. Guideline for water quality and aesthetics: Primary Contact
- a. Reference only, not directly applicable to groundwater.

## Focus of this monitoring report

nm = not measured (app) = approximately NR = no result



Table SW-1: Summary Analytical Results for Surface Water Location (ML-4)

### Gerroa Waste Disposal Depot (2003 to 2021)

[illegible]

Exceeds ANZECC (2000) guidelines

### Focus of this monitoring report

nm = not measured (app) = approximately NR = no result

1. Trigger value is an indicative interim working level only (IWL).
2. Ammonia trigger value at pH = 8, 95% protection, corrected at pH = 7.3.
3. Trigger value for oxides of Nitrogen (NOx) for lowland rivers in NSW.
4. Trigger value for oxides of Nitrogen (NOx) for marine ecosystems in NSW
5. Trigger value for total Nitrogen in lowland rivers in NSW
6. Trigger value for total Nitrogen in marine ecosystems in NSW.
7. Trigger value for a 95% protection level.
8. Guideline for water quality and aesthetics: primary contact  
a. Reference only, not directly applicable to groundwater

Gerroa SW tables lab DP 11-3-21

### Focus of this monitoring report

Exceeds ANZECC (2000) guidelines	0.054
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### Focus of this monitoring report

nm = not measured (app) = approximately NR = no result

- 1/1



Table 6: Groundwater and Surface Water Monitoring - 2020 to 2021 (EPL)

Analytes	Groundwater Wells & Blue Angle Creek									Detection Limit	Method Reference
	28/05/20	13/08/20	6/11/20	1/02/21	5/03/20	17/06/20	9/09/20	18/12/20	8/01/21		
Physical Properties											
pH	X	X	X	X						0.01 pH unit	pH meter and probe/APHA4500-HB
Electrical Conductivity	X	X	X	X						0.01 mS/cm	Conductivity meter and probe
Dissolved Oxygen	X	X	X	X						0.0001	DO meter and probe
Redox (Orp)		X								1 mV	Platinum electrode probe
Temperature										1 °C	Temperature meter and probe
Total Dissolved Solids	X	X	X	X						5 mg/L	Determined gravimetrically by drying (APHA 2540 C)
Suspended Solids										2 mg/L	APHA2540D
Turbidity										1 NTU	Turbidimeter
Nutrients											
Ammonia-nitrogen	X	X	X	X	X	X	X	X	X	0.01 mg/L	FIA
Total Phosphorus	X	X	X	X						2 µg/L	FIA
Nitrate-nitrogen	X	X	X	X						10 µg/L	FIA
Nitrite-nitrogen	X	X	X	X						1 µg/L	FIA
Total Kjeldhal Nitrogen	X	X	X	X						50 µg/L	FIA
Hydro-chemical											
Calcium		X								0.5 mg/L	USEPA 6010 A
Chloride		X								0.5 mg/L	Titrated with mercuric nitrate using diphenol-carbazonel/xylene cyanol FF indicator
Fluoride		X								0.1 mg/L	APHA4500-FC
Magnesium		X								0.02 mg/L	USEPA 6010 A
Sulphate										1 mg/L	ICID/MS
Sodium		X								0.05 mg/L	USEPA 6010 A
Bicarbonate/Alkalinity		X	X	X						0.5 mg/L	APHA2340C
Potassium		X								0.05 mg/L	USEPA 6010 A
Organic Contaminants											
Dissolved Organic Carbon		X								0.50 mg/L	APHA 5310C
Total Organic Carbon										0.1 mg/L	APHA 5310C
Inorganic Contaminants											
Iron		X								1 µg/L	USEPA 6010 A
Manganese		X								1 µg/L	USEPA 6010
Biological Contaminants											
Thermotolerant (Faecal) coliforms MF										1cfu/100 ml	WMM 009 (~AS 4276.7 - 1995)
Enterococcus MF										1cfu/100 ml	WMM 013 (~AS 4276.9 - 1995)



**Table 7: Gerroa Landfill Assessment- Ammonia Trends at Key Wells (9)**

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/1/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D	MW 1D
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	13.0	8.18	8.58	----	15.0	15.5	20.5	27.3	34	24.9	35	27.8	30.9	44.1	27.8	23.3	21.1	32.5	16.4	22
Water Quality Trend				Variable to Rising Ammonia Trend & above Guidelines (recently decreasing)																			

Note:

(2) Ammonia trigger at pH = 8.0, for a 95% protection, corrected for average pH = 7.3.

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/10/18	16/11/18	6/12/18	17/1/19	12/2/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3	MW 3
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	0.29	8.55	0.21	0.34	0.64	0.35	0.33	0.30	0.39	0.34	0.35	0.38	0.41	0.32	0.37	0.42	0.3	0.44	0.22	0.25	0.3	0.43	0.31	0.35
Water Quality Trend				Generally stable & below guidelines																							

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/10/18	16/11/18	6/12/18	17/1/19	12/2/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5	MW 5
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	0.07	0.05	0.02	1.44	0.08	0.07	0.48	0.06	0.08	0.03	<0.01	0.08	0.05	0.04	0.05	0.04	0.02	0.07	<0.01	0.02	<0.01	0.18	0.02	<0.01
Water Quality Trend				Generally Stable & Below Guidelines																							

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/1/19	16/11/18	6/12/18	17/1/19	12/2/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D	MW 6D
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	6.40	4.97	2.20	7.69	7.02	8.45	5.78	7.02	5.05	8.74	4.87	40	44.4	36.3	57	50	44.5	56	52.4	41.5	36.2	42.5	37.2	36.4
Water Quality Trend				Variable to Rising Ammonia trend & above Guidelines																							

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/1/19	16/11/18	17/1/19	12/2/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D	MW 7D
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	1.58	0.74	0.15	0.63	0.91	1.72	2.08	1.32	2.36	0.8	20.5	17.9	13.7	20	21.4	14.8	21	18.3	19.2	17.4	18.1	18.5	16.8
Water Quality Trend				Stable to rising Ammonia trend & above guidelines																						

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	22/8/18	17/1/19	16/11/18	17/1/19	12/2/19	4/4/19	28/5/19	12/7/19	28/8/19	18/9/19	17/10/19	22/11/19	14/2/20	18/12/20	5/3/20	28/5/20	13/8/20	9/9/20	6/11/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11	MW 11
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	3.17	6.05	5.35	5.79	2.26	2.24	2.14	1.60	2.2	1.9	1.15	47.4	5.3	4.24	4.01	1.31	5.79	2.55	17	2.15	1.34	0.97	0.43
Water Quality Trend				Generally variable & above/below guidelines																						

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	17/10/18	6/12/18	17/1/19	4/4/19	12/7/19	18/9/19	14/2/20	17/10/19	5/3/20	28/5/20	17/6/20	9/9/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 12	MW12	MW12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12	MW 12
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	29.8	24.5	27.5	31.7	23.0	34.4	33.1	44	57	35.9	46.9	57.7	55.9	37.5	42.3	38.9	46.7
Water Quality Trend				Generally Stable to increasing trend & above guidelines																

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	17/10/18	6/12/18	17/1/19	4/4/19	12/7/19	18/9/19	14/2/20	17/10/19	5/3/20	28/5/20	17/6/20	9/9/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 13	MW13	MW13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13	MW 13
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	26.7	24.8	32.8	32.8	26.1	26.0	24.7	46.8	36.5	62	43.6	54.7	52.3	26.6	46.6	34.6	83.5
Water Quality Trend				Generally rising ammonia trend & above guidelines (variable)																

Date		ANZECC 2000	ANZECC 2000	15/6/18	12/7/18	17/10/18	6/12/18	17/1/19	4/4/19	12/7/19	18/9/19	14/2/20	17/10/19	5/3/20	28/5/20	17/6/20	9/9/20	18/12/20	8/1/21	1/2/21
Well Location	LOR	Fresh	Marine	MW 14	MW14	MW14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14	MW 14
Ammonia as N	mg/L	1.88 (2)	2.84 (2)	1.83	27.2	39.4	46.3	34.0	40.9	54.9	81.4	83	96.5	81.1	97.7	95.3	73.1	84.4	69.9	40.4
Water Quality Trend				Generally Increasing ammonia trend & above guidelines (recently decreasing)																

## Appendix A

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2003642**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MS JULIE MILEVSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0557**  
**Project** : **Gerroa Landfill**  
**Order number** : **126590**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **Gerroa Landfill**  
**Quote number** : **WO/026/19**  
**No. of samples received** : **21**  
**No. of samples analysed** : **21**

**Page** : 1 of 11  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Aneta Prosaroski**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **+61 2 4225 3125**  
**Date Samples Received** : **13-Aug-2020 13:50**  
**Date Analysis Commenced** : **13-Aug-2020**  
**Issue Date** : **24-Aug-2020 12:29**



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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Ashesh Patel	Senior Chemist	Sydney Inorganics, Smithfield, NSW
Glenn Davies	Environmental Services Representative	Laboratory - Wollongong, NSW
Ivan Taylor	Analyst	Sydney Inorganics, Smithfield, NSW



## 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.

- **Analytical work for this work order will be conducted at ALS Sydney.**
- EK057G: LOR raised for Nitrite, Nitrate and NOx on sample 2 due to sample matrix.
- ED041G: LOR raised for Sulfate on sample 2 due to sample matrix.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- EK055G/EK061G: It has been noted that Ammonia is greater than TKN for sample 6, however this difference is within the limits of experimental variation.
- pH performed by ALS Wollongong via in-house method EA005FD and EN67 PK.
- Electrical conductivity performed by ALS Wollongong via in-house method EA010FD and EN67 PK.
- ORP (Oxidation Reduction Potential) performed by ALS Wollongong via in-house method EA075FD and EN67 PK.
- Sampling and groundwater depth measurements completed by ALS Wollongong via inhouse sampling method EN/67.11 Groundwater Sampling.
- Sampling completed by ALS Wollongong in accordance with in-house sampling method EN/67.6 Rivers and Streams.
- Dissolved oxygen (DO) performed by ALS Wollongong via in-house method EA025FD and EN67 PK.
- All field analysis performed by ALS Wollongong were completed at the time of sampling.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.





## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW1D	MW1S	MW3	MW4	MW5
Client sampling date / time					13-Aug-2020 10:00	13-Aug-2020 10:10	13-Aug-2020 10:40	13-Aug-2020 08:15	13-Aug-2020 10:55
Compound	CAS Number	LOR	Unit		EW2003642-001	EW2003642-002	EW2003642-003	EW2003642-004	EW2003642-005
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.3	6.5	7.4	7.0	7.6
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1580	482	413	807	655
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		812	522	276	420	464
<b>EA075FD: Field Redox Potential</b>									
Redox Potential	----	0.1	mV		-129	-44.6	-132	22.9	-71.2
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		452	70	176	288	155
Total Alkalinity as CaCO3	----	1	mg/L		452	70	176	288	155
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		56	<10	<1	24	32
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		234	111	25	59	86
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		79	24	61	117	82
Magnesium	7439-95-4	1	mg/L		38	8	5	11	8
Sodium	7440-23-5	1	mg/L		116	61	12	25	31
Potassium	7440-09-7	1	mg/L		36	2	3	5	3
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Manganese	7439-96-5	0.001	mg/L		0.018	0.013	0.049	0.074	0.004
Iron	7439-89-6	0.05	mg/L		4.26	10.6	3.58	0.70	0.26
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L		0.2	0.3	0.2	0.2	0.1
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		27.8	<0.01	0.22	0.04	<0.01
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.10	<0.01	0.41	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.10	<0.01	6.32	<0.01



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW1D	MW1S	MW3	MW4	MW5
Client sampling date / time					13-Aug-2020 10:00	13-Aug-2020 10:10	13-Aug-2020 10:40	13-Aug-2020 08:15	13-Aug-2020 10:55
Compound	CAS Number	LOR	Unit		EW2003642-001	EW2003642-002	EW2003642-003	EW2003642-004	EW2003642-005
					Result	Result	Result	Result	Result
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.10	<0.01	6.73	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		27.9	4.3	0.5	1.8	0.2
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		27.9	4.3	0.5	8.5	0.2
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.21	0.28	0.12	0.19	0.04
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L		16.8	4.53	4.22	7.92	6.19
∅ Total Cations	----	0.01	meq/L		15.0	----	----	----	----
∅ Total Cations	----	0.01	meq/L		----	4.56	4.05	7.96	6.18
∅ Ionic Balance	----	0.01	%		5.61	----	----	----	----
∅ Ionic Balance	----	0.01	%		----	0.34	2.02	0.26	0.11
<b>EP002: Dissolved Organic Carbon (DOC)</b>									
Dissolved Organic Carbon	----	1	mg/L		19	124	11	5	7
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.11	2.35	1.08	4.80	1.52
<b>QWI-EN 67.11 Sampling of Groundwaters</b>									
Depth	----	0.01	m		2.21	2.24	2.53	3.12	2.28



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW6D	MW6S	MW7D	MW7S	MW9
Client sampling date / time					13-Aug-2020 08:50	13-Aug-2020 09:05	13-Aug-2020 11:15	13-Aug-2020 11:25	13-Aug-2020 13:10
Compound	CAS Number	LOR	Unit		EW2003642-006	EW2003642-007	EW2003642-008	EW2003642-009	EW2003642-010
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.0	6.7	7.2	7.2	6.7
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1950	881	1150	734	9070
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		986	543	596	396	5490
<b>EA075FD: Field Redox Potential</b>									
Redox Potential	----	0.1	mV		-138	-79.9	-137	-24.0	-23.3
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		859	90	486	105	187
Total Alkalinity as CaCO3	----	1	mg/L		859	90	486	105	187
<b>ED041G: Sulfate (Turbidimetric) as SO4 2- by DA</b>									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		9	26	21	18	363
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		150	214	64	153	2740
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		162	24	101	30	56
Magnesium	7439-95-4	1	mg/L		25	23	16	14	149
Sodium	7440-23-5	1	mg/L		100	102	60	81	1500
Potassium	7440-09-7	1	mg/L		56	2	27	<1	59
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Manganese	7439-96-5	0.001	mg/L		0.138	0.005	0.057	0.003	0.010
Iron	7439-89-6	0.05	mg/L		12.8	0.61	3.38	0.22	1.26
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L		0.4	0.3	0.3	0.2	0.4
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		52.4	0.03	18.3	<0.01	0.25
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	0.03	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	0.14	<0.01	0.02	<0.01



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW6D	MW6S	MW7D	MW7S	MW9
Client sampling date / time					13-Aug-2020 08:50	13-Aug-2020 09:05	13-Aug-2020 11:15	13-Aug-2020 11:25	13-Aug-2020 13:10
Compound	CAS Number	LOR	Unit		EW2003642-006	EW2003642-007	EW2003642-008	EW2003642-009	EW2003642-010
					Result	Result	Result	Result	Result
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	0.17	<0.01	0.02	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		49.9	1.1	18.3	0.3	3.3
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		49.9	1.3	18.3	0.3	3.3
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		2.85	0.10	0.88	0.04	0.30
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L		21.6	8.38	12.0	6.79	88.6
∅ Total Cations	----	0.01	meq/L		19.7	----	11.0	----	----
∅ Total Cations	----	0.01	meq/L		----	7.58	----	6.17	81.8
∅ Ionic Balance	----	0.01	%		4.68	----	4.35	----	----
∅ Ionic Balance	----	0.01	%		----	5.00	----	4.75	3.98
<b>EP002: Dissolved Organic Carbon (DOC)</b>									
Dissolved Organic Carbon	----	1	mg/L		33	14	14	8	35
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.42	3.51	1.13	2.15	3.59
<b>QWI-EN 67.11 Sampling of Groundwaters</b>									
Depth	----	0.01	m		3.43	3.17	3.18	3.03	1.16



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW10	MW11	MW12	MW13	MW14
Client sampling date / time					13-Aug-2020 13:30	13-Aug-2020 01:30	13-Aug-2020 09:25	13-Aug-2020 09:45	13-Aug-2020 10:25
Compound	CAS Number	LOR	Unit		EW2003642-011	EW2003642-012	EW2003642-013	EW2003642-014	EW2003642-015
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		5.3	7.4	7.2	7.3	7.2
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		3030	1800	2020	1580	2460
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		1490	908	948	728	1150
<b>EA075FD: Field Redox Potential</b>									
Redox Potential	----	0.1	mV		116	107	-116	-124	-121
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO <sub>3</sub>	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO <sub>3</sub>	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO <sub>3</sub>	71-52-3	1	mg/L		10	396	635	516	785
Total Alkalinity as CaCO <sub>3</sub>	----	1	mg/L		10	396	635	516	785
<b>ED041G: Sulfate (Turbidimetric) as SO<sub>4</sub> 2- by DA</b>									
Sulfate as SO <sub>4</sub> - Turbidimetric	14808-79-8	1	mg/L		138	53	53	70	52
<b>ED045G: Chloride by Discrete Analyser</b>									
Chloride	16887-00-6	1	mg/L		817	332	292	179	348
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L		14	60	107	78	91
Magnesium	7439-95-4	1	mg/L		44	32	47	47	54
Sodium	7440-23-5	1	mg/L		474	197	142	102	175
Potassium	7440-09-7	1	mg/L		21	43	51	45	77
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Manganese	7439-96-5	0.001	mg/L		<0.001	0.006	0.021	0.015	0.019
Iron	7439-89-6	0.05	mg/L		1.68	0.32	7.82	4.45	7.09
<b>EK040P: Fluoride by PC Titrator</b>									
Fluoride	16984-48-8	0.1	mg/L		<0.1	0.3	0.1	0.2	0.2
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		<0.01	17.0	36.8	27.8	69.9
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW10	MW11	MW12	MW13	MW14
Client sampling date / time					13-Aug-2020 13:30	13-Aug-2020 01:30	13-Aug-2020 09:25	13-Aug-2020 09:45	13-Aug-2020 10:25
Compound	CAS Number	LOR	Unit		EW2003642-011	EW2003642-012	EW2003642-013	EW2003642-014	EW2003642-015
					Result	Result	Result	Result	Result
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.2	19.0	40.1	29.4	70.1
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		2.2	19.0	40.1	29.4	70.1
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.15	0.16	0.22	0.24	0.22
<b>EN055: Ionic Balance</b>									
∅ Total Anions	----	0.01	meq/L		26.1	18.4	22.0	16.8	26.6
∅ Total Cations	----	0.01	meq/L		----	----	19.3	15.3	23.6
∅ Total Cations	----	0.01	meq/L		25.5	15.3	----	----	----
∅ Ionic Balance	----	0.01	%		----	----	6.59	4.68	6.06
∅ Ionic Balance	----	0.01	%		1.25	9.16	----	----	----
<b>EP002: Dissolved Organic Carbon (DOC)</b>									
Dissolved Organic Carbon	----	1	mg/L		31	25	23	22	34
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		3.90	2.75	1.52	1.39	1.07
<b>QWI-EN 67.11 Sampling of Groundwaters</b>									
Depth	----	0.01	m		1.39	1.36	1.93	2.16	1.65





## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	ML-1	ML-2	ML-3	ML-4	ML-5
Client sampling date / time					13-Aug-2020 12:20	13-Aug-2020 14:20	13-Aug-2020 12:45	13-Aug-2020 12:30	13-Aug-2020 13:20
Compound	CAS Number	LOR	Unit		EW2003642-016	EW2003642-017	EW2003642-018	EW2003642-019	EW2003642-020
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		6.5	6.4	6.4	6.4	6.2
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		150	449	110	125	223
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		88	245	82	86	135
<b>EA075FD: Field Redox Potential</b>									
Redox Potential	----	0.1	mV		83.9	144	118	102	104
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO <sub>3</sub>	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO <sub>3</sub>	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO <sub>3</sub>	71-52-3	1	mg/L		17	15	13	12	13
Total Alkalinity as CaCO <sub>3</sub>	----	1	mg/L		17	15	13	12	13
<b>ED093T: Total Major Cations</b>									
Calcium	7440-70-2	1	mg/L		4	6	4	4	5
Magnesium	7439-95-4	1	mg/L		3	8	2	3	4
Sodium	7440-23-5	1	mg/L		17	64	12	14	29
Potassium	7440-09-7	1	mg/L		3	5	3	3	3
<b>EG020T: Total Metals by ICP-MS</b>									
Manganese	7439-96-5	0.001	mg/L		0.011	0.012	0.010	0.011	0.011
Iron	7439-89-6	0.05	mg/L		0.54	0.65	0.57	0.62	0.62
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.03	0.06	0.02	0.02	0.04
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.10	0.10	0.10	0.10	0.10
<b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.10	0.10	0.10	0.10	0.10
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.6	0.7	0.6	0.6	0.7
<b>EK062G: Total Nitrogen as N (TKN + NO<sub>x</sub>) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		0.7	0.8	0.7	0.7	0.8





## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				ML-1	ML-2	ML-3	ML-4	ML-5
Client sampling date / time				13-Aug-2020 12:20	13-Aug-2020 14:20	13-Aug-2020 12:45	13-Aug-2020 12:30	13-Aug-2020 13:20
Compound	CAS Number	LOR	Unit	EW2003642-016	EW2003642-017	EW2003642-018	EW2003642-019	EW2003642-020
				Result	Result	Result	Result	Result
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>								
Total Phosphorus as P	----	0.01	mg/L	0.10	0.09	0.10	0.09	0.11
<b>EP025FD: Field Dissolved Oxygen</b>								
Dissolved Oxygen	----	0.01	mg/L	4.91	5.08	4.87	4.90	4.80



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				Blank	----	----	----	----
Client sampling date / time				12-Aug-2020 11:35	----	----	----	----
Compound	CAS Number	LOR	Unit	EW2003642-021	-----	-----	-----	-----
				Result	----	----	----	----
<b>ED093F: Dissolved Major Cations</b>								
Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
<b>EG020F: Dissolved Metals by ICP-MS</b>								
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2001185**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **9**  
**No. of samples analysed** : **9**

**Page** : **1 of 4**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **05-Mar-2020 09:54**  
**Date Analysis Commenced** : **06-Mar-2020**  
**Issue Date** : **10-Mar-2020 16:38**



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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by 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.

- Analytical work for this work order will be conducted at ALS Sydney.



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				MW 1D	MW 3	MW 5	MW 6D	MW 7D
Client sampling date / time				05-Mar-2020 09:30	05-Mar-2020 09:50	05-Mar-2020 10:00	05-Mar-2020 08:50	05-Mar-2020 10:10
Compound	CAS Number	LOR	Unit	EW2001185-001	EW2001185-002	EW2001185-003	EW2001185-004	EW2001185-005
				Result	Result	Result	Result	Result
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	30.9	0.30	0.02	44.5	14.8



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW 11	MW 12	MW 13	MW 14	----
Client sampling date / time					05-Mar-2020 10:30	05-Mar-2020 09:10	05-Mar-2020 09:20	05-Mar-2020 09:40	----
Compound	CAS Number	LOR	Unit		EW2001185-006	EW2001185-007	EW2001185-008	EW2001185-009	-----
					Result	Result	Result	Result	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		5.79	46.9	43.6	81.1	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2002506**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MS JULIE MILEVSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0557**  
**Project** : **Gerroa Landfill Quarterly**  
**Order number** : **126590**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **Gerroa Landfill**  
**Quote number** : **WO/026/19**  
**No. of samples received** : **17**  
**No. of samples analysed** : **17**

**Page** : **1 of 6**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Aneta Prosaroski**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**

**Telephone** : **+61 2 4225 3125**  
**Date Samples Received** : **28-May-2020 14:28**  
**Date Analysis Commenced** : **28-May-2020**  
**Issue Date** : **11-Jun-2020 13:59**



Accreditation No. 825  
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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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Glenn Davies	Environmental Services Representative	Laboratory - Wollongong, NSW





## 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.

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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.

- **Analytical work for this work order will be conducted at ALS Sydney.**
- EK067G: LOR raised for TP on samples 10 and 12 due to sample matrix.
- It has been noted that Ammonia is greater than TKN for various samples, however this difference is within the limits of experimental variation.
- pH performed by ALS Wollongong via in-house method EA005FD and EN67 PK.
- Electrical conductivity performed by ALS Wollongong via in-house method EA010FD and EN67 PK.
- Sampling and sample data supplied by ALS Wollongong.
- Sampling and groundwater depth measurements completed by ALS Wollongong via inhouse sampling method EN/67.11 Groundwater Sampling.
- Sampling completed as per FWI-EN001 Groundwater Sampling.
- Dissolved oxygen (DO) performed by ALS Wollongong via in-house method EA025FD and EN67 PK.
- Field tests completed on day of sampling/receipt.
- All field analysis performed by ALS Wollongong were completed at the time of sampling.



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW1D	MW1S	MW3	MW4	MW5
Client sampling date / time					28-May-2020 10:45	28-May-2020 10:30	28-May-2020 10:15	28-May-2020 08:20	28-May-2020 10:00
Compound	CAS Number	LOR	Unit		EW2002506-001	EW2002506-002	EW2002506-003	EW2002506-004	EW2002506-005
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.4	----	7.6	7.0	7.8
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1600	----	805	837	429
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		931	----	551	468	240
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		542	----	213	371	173
Total Alkalinity as CaCO3	----	1	mg/L		542	----	213	371	173
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		44.1	----	0.44	0.11	0.07
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	<0.01	0.02	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	0.01	0.09	0.01
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	0.01	0.11	0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		43.2	----	1.1	0.9	0.5
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		43.2	----	1.1	1.0	0.5
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.16	----	0.11	0.91	0.11
<b>EN67 PK: Field Tests</b>									
Field Observations	----	0.01	--		----	DRY	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.81	----	4.03	5.10	4.29
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		3.80	----	4.16	4.68	3.90



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW6D	MW6S	MW7D	MW7S	MW9
Client sampling date / time					28-May-2020 09:00	28-May-2020 08:35	28-May-2020 09:40	28-May-2020 09:20	28-May-2020 13:00
Compound	CAS Number	LOR	Unit		EW2002506-006	EW2002506-007	EW2002506-008	EW2002506-009	EW2002506-010
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.1	----	7.2	7.8	6.3
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1780	----	1100	796	27000
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		974	----	574	431	16800
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		799	----	516	228	62
Total Alkalinity as CaCO3	----	1	mg/L		799	----	516	228	62
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		56.0	----	21.0	0.22	<0.01
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	<0.01	<0.01	0.31
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	<0.01	<0.01	0.31
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		52.3	----	21.8	0.8	1.7
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		52.3	----	21.8	0.8	2.0
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		2.52	----	0.81	0.21	<0.05
<b>EN67 PK: Field Tests</b>									
Field Observations	----	0.01	--		----	DRY	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.74	----	1.54	3.99	6.46
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		4.91	----	4.67	4.52	1.53



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW10	MW11	ML-1	ML-2	ML-3
Client sampling date / time					28-May-2020 13:15	28-May-2020 12:45	28-May-2020 11:40	28-May-2020 13:45	28-May-2020 12:05
Compound	CAS Number	LOR	Unit		EW2002506-011	EW2002506-012	EW2002506-013	EW2002506-014	EW2002506-015
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		5.2	6.0	4.6	4.9	4.6
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		28900	19700	3380	5430	2590
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		18000	13800	2040	3140	1390
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		6	77	<1	<1	<1
Total Alkalinity as CaCO3	----	1	mg/L		6	77	<1	<1	<1
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.14	2.55	0.10	0.13	0.06
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.54	0.04	0.05	<0.01	0.04
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.54	0.04	0.05	<0.01	0.04
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		10.3	4.4	0.6	0.6	0.6
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		10.8	4.4	0.6	0.6	0.6
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.82	<0.05	<0.01	<0.01	<0.01
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		7.74	5.04	3.79	4.47	3.89
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		1.96	1.95	----	----	----



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	ML-4	ML-5	----	----	----
Client sampling date / time					28-May-2020 11:50	28-May-2020 13:05	----	----	----
Compound	CAS Number	LOR	Unit		EW2002506-016	EW2002506-017	-----	-----	-----
				Result	Result		----	----	----
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		4.7	4.7	----	----	----
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		3090	3850	----	----	----
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		1920	2180	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<1	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		<1	<1	----	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.06	0.12	----	----	----
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	----	----	----
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.04	0.02	----	----	----
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.04	0.02	----	----	----
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.6	0.6	----	----	----
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		0.6	0.6	----	----	----
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		<0.01	0.02	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		3.82	4.11	----	----	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2002507**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **3**  
**No. of samples analysed** : **3**

**Page** : **1 of 2**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **28-May-2020 14:31**  
**Date Analysis Commenced** : **01-Jun-2020**  
**Issue Date** : **02-Jun-2020 16:18**



Accreditation No. 825  
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- 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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



## 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.

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 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.

- Analytical work for this work order will be conducted at ALS Sydney.

## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				MW 12	MW 13	MW 14	----	----
Client sampling date / time				28-May-2020 11:15	28-May-2020 11:05	28-May-2020 10:35	----	----
Compound	CAS Number	LOR	Unit	EW2002507-001	EW2002507-002	EW2002507-003	-----	-----
				Result	Result	Result	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	57.7	54.7	97.7	----	----



## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2002807**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **9**  
**No. of samples analysed** : **9**

**Page** : **1 of 4**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **17-Jun-2020 14:10**  
**Date Analysis Commenced** : **20-Jun-2020**  
**Issue Date** : **23-Jun-2020 11:21**



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- Analytical Results

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### 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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



## 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.

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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.

- Analytical work for this work order will be conducted at ALS Sydney.



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				MW 1D	MW 3	MW 5	MW 6D	MW 7D
Client sampling date / time				17-Jun-2020 12:15	17-Jun-2020 12:00	17-Jun-2020 11:50	17-Jun-2020 11:30	17-Jun-2020 11:40
Compound	CAS Number	LOR	Unit	EW2002807-001	EW2002807-002	EW2002807-003	EW2002807-004	EW2002807-005
				Result	Result	Result	Result	Result
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	37.2	0.34	0.04	50.2	20.8



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				MW 11	MW 12	MW 13	MW 14	----
Client sampling date / time				17-Jun-2020 12:50	17-Jun-2020 12:35	17-Jun-2020 12:25	17-Jun-2020 12:10	----
Compound	CAS Number	LOR	Unit	EW2002807-006	EW2002807-007	EW2002807-008	EW2002807-009	-----
				Result	Result	Result	Result	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	5.91	55.9	52.3	95.3	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2004057**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **9**  
**No. of samples analysed** : **9**

**Page** : **1 of 4**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **09-Sep-2020 12:42**  
**Date Analysis Commenced** : **14-Sep-2020**  
**Issue Date** : **15-Sep-2020 18:59**



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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



## 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.

- **Analytical work for this work order will be conducted at ALS Sydney.**



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Client sample ID

				MW 1D	MW 3	MW 5	MW 6D	MW 7D
Client sampling date / time				09-Sep-2020 09:50	09-Sep-2020 09:30	09-Sep-2020 09:20	09-Sep-2020 09:00	09-Sep-2020 09:10
Compound	CAS Number	LOR	Unit	EW2004057-001	EW2004057-002	EW2004057-003	EW2004057-004	EW2004057-005
				Result	Result	Result	Result	Result
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	23.3	0.25	0.02	41.5	19.2





## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW 11	MW 12	MW 13	MW 14	----
Client sampling date / time					09-Sep-2020 10:30	09-Sep-2020 10:10	09-Sep-2020 10:00	09-Sep-2020 09:40	----
Compound	CAS Number	LOR	Unit		EW2004057-006	EW2004057-007	EW2004057-008	EW2004057-009	-----
					Result	Result	Result	Result	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		2.15	37.5	26.6	73.1	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2004986**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MS JULIE MILEVSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0557**  
**Project** : **Gerroa Landfill**  
**Order number** : **Post Purchase**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **Gerroa Landfill**  
**Quote number** : **WO/026/19**  
**No. of samples received** : **17**  
**No. of samples analysed** : **17**

**Page** : **1 of 6**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Aneta Prosaroski**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **+61 2 4225 3125**  
**Date Samples Received** : **06-Nov-2020 10:16**  
**Date Analysis Commenced** : **06-Nov-2020**  
**Issue Date** : **13-Nov-2020 16:31**



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- Analytical Results

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### 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
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Glenn Davies	Environmental Services Representative	Laboratory - Wollongong, NSW



## General Comments

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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.

- **Analytical work for this work order will be conducted at ALS Sydney.**
- EK061:LOR raised due to sample matrix.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- pH performed by ALS Wollongong via in-house method EA005FD and EN67 PK.
- Electrical conductivity performed by ALS Wollongong via in-house method EA010FD and EN67 PK.
- Sampling and groundwater depth measurements completed by ALS Wollongong via inhouse sampling method EN/67.11 Groundwater Sampling.
- Sampling completed by ALS Wollongong in accordance with in-house sampling method EN/67.6 Rivers and Streams.
- Dissolved oxygen (DO) performed by ALS Wollongong via in-house method EA025FD and EN67 PK.
- All field analysis performed by ALS Wollongong were completed at the time of sampling.



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW1D	MW1S	MW3	MW4	MW5
Client sampling date / time					06-Nov-2020 10:25	06-Nov-2020 10:30	06-Nov-2020 10:00	06-Nov-2020 08:30	06-Nov-2020 09:40
Compound	CAS Number	LOR	Unit		EW2004986-001	EW2004986-002	EW2004986-003	EW2004986-004	EW2004986-005
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.4	6.4	7.4	7.2	8.0
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1380	315	543	483	402
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		706	361	328	298	250
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		407	76	180	240	119
Total Alkalinity as CaCO3	----	1	mg/L		407	76	180	240	119
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		21.1	0.14	0.30	0.11	<0.01
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		23.3	2.9	0.5	1.2	0.2
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		23.3	2.9	0.5	1.2	0.2
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.19	0.33	0.10	0.98	0.05
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.29	4.14	1.67	4.90	1.86
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		3.17	3.21	3.55	3.90	3.46



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW6D	MW6S	MW7D	MW7S	MW9
Client sampling date / time					06-Nov-2020 08:50	06-Nov-2020 08:40	06-Nov-2020 09:10	06-Nov-2020 09:15	06-Nov-2020 12:15
Compound	CAS Number	LOR	Unit		EW2004986-006	EW2004986-007	EW2004986-008	EW2004986-009	EW2004986-010
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.1	----	7.2	7.5	6.7
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1720	----	1090	649	9090
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		890	----	574	432	5720
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		761	----	480	130	128
Total Alkalinity as CaCO3	----	1	mg/L		761	----	480	130	128
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		36.2	----	17.4	0.16	0.01
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	<0.01	<0.01	0.07
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	<0.01	<0.01	0.07
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		37.2	----	18.3	0.8	6.1
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		37.2	----	18.3	0.8	6.2
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		3.76	----	0.88	0.64	0.60
<b>EN67 PK: Field Tests</b>									
Field Observations	----	0.01	--		----	DRY	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.39	----	1.73	5.88	7.27
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		4.68	----	4.43	4.27	1.56



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	MW10	MW11	ML-1	ML-2	ML-3
Client sampling date / time					06-Nov-2020 12:25	06-Nov-2020 12:00	06-Nov-2020 11:20	06-Nov-2020 12:50	06-Nov-2020 11:30
Compound	CAS Number	LOR	Unit		EW2004986-011	EW2004986-012	EW2004986-013	EW2004986-014	EW2004986-015
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		5.5	6.8	6.6	7.1	6.4
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		6430	3980	1960	22000	1780
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		3660	2260	1150	13800	982
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO <sub>3</sub>	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO <sub>3</sub>	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO <sub>3</sub>	71-52-3	1	mg/L		12	142	50	111	43
Total Alkalinity as CaCO <sub>3</sub>	----	1	mg/L		12	142	50	111	43
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.02	1.34	0.15	0.51	0.14
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	0.02	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	0.01	0.06	<0.01
<b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	0.01	0.08	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		4.0	3.9	0.6	0.9	0.6
<b>EK062G: Total Nitrogen as N (TKN + NO<sub>x</sub>) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		4.0	3.9	0.6	1.0	0.6
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.33	0.21	0.02	0.08	0.02
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		5.86	3.77	2.72	5.59	5.57
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		1.96	1.93	----	----	----



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Client sample ID	ML-4	ML-5	----	----	----
Client sampling date / time					06-Nov-2020 11:40	06-Nov-2020 12:10	----	----	----
Compound	CAS Number	LOR	Unit		EW2004986-016	EW2004986-017	-----	-----	-----
				Result	Result		----	----	----
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		6.5	6.7	----	----	----
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1900	2440	----	----	----
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		1030	1330	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		45	65	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		45	65	----	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.15	0.61	----	----	----
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	0.02	----	----	----
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	0.01	----	----	----
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	0.03	----	----	----
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.6	1.0	----	----	----
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		0.6	1.0	----	----	----
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.02	0.03	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		2.41	3.75	----	----	----



## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2005765**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **9**  
**No. of samples analysed** : **9**

**Page** : **1 of 4**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **18-Dec-2020 15:00**  
**Date Analysis Commenced** : **22-Dec-2020**  
**Issue Date** : **30-Dec-2020 22:24**



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

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- Analytical Results

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### 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



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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.

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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.

- Analytical work for this work order will be conducted at ALS Sydney.



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Sample ID

				MW 1D	MW 3	MW 5	MW 6D	MW 7D
Sampling date / time				18-Dec-2020 12:50	18-Dec-2020 12:40	18-Dec-2020 12:30	18-Dec-2020 13:25	18-Dec-2020 12:20
Compound	CAS Number	LOR	Unit	EW2005765-001	EW2005765-002	EW2005765-003	EW2005765-004	EW2005765-005
				Result	Result	Result	Result	Result
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	32.5	0.43	0.18	42.5	18.1



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Sample ID	MW 11	MW 12	MW 13	MW 14	----
Sampling date / time					18-Dec-2020 13:25	18-Dec-2020 13:10	18-Dec-2020 12:55	18-Dec-2020 12:45	----
Compound	CAS Number	LOR	Unit		EW2005765-006	EW2005765-007	EW2005765-008	EW2005765-009	-----
					Result	Result	Result	Result	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		1.31	42.3	46.6	84.4	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2100114**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **9**  
**No. of samples analysed** : **9**

**Page** : **1 of 4**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **08-Jan-2021 15:06**  
**Date Analysis Commenced** : **15-Jan-2021**  
**Issue Date** : **19-Jan-2021 08:59**



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, unless the sampling was conducted by ALS. 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW



## 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.

- Analytical work for this work order will be conducted at ALS Sydney.



## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Sample ID

				MW 1D	MW 3	MW 5	MW 6D	MW 7D
Sampling date / time				08-Jan-2021 13:10	08-Jan-2021 13:00	08-Jan-2021 12:55	08-Jan-2021 13:45	08-Jan-2021 12:45
Compound	CAS Number	LOR	Unit	EW2100114-001	EW2100114-002	EW2100114-003	EW2100114-004	EW2100114-005
				Result	Result	Result	Result	Result
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	16.4	0.31	0.02	37.2	18.5





## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)

Sample ID

				MW 11	MW 12	MW 13	MW 14	----
Sampling date / time				08-Jan-2021 14:00	08-Jan-2021 13:30	08-Jan-2021 13:17	08-Jan-2021 13:05	----
Compound	CAS Number	LOR	Unit	EW2100114-006	EW2100114-007	EW2100114-008	EW2100114-009	-----
Result				Result	Result	Result	Result	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	0.97	38.9	34.6	69.9	----

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2100391**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MS JULIE MILEVSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0557**  
**Project** : **Gerroa Landfill**  
**Order number** : **126590**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh, Tom Roose**  
**Site** : **Gerroa Landfill**  
**Quote number** : **WO/026/19**  
**No. of samples received** : **17**  
**No. of samples analysed** : **17**

**Page** : **1 of 7**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Aneta Prosaroski**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**

**Telephone** : **+61 2 4225 3125**  
**Date Samples Received** : **01-Feb-2021 12:30**  
**Date Analysis Commenced** : **01-Feb-2021**  
**Issue Date** : **09-Feb-2021 16:26**



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- Analytical Results

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### 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Robert DaLio	Sampler	Laboratory - Wollongong, NSW



## 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.

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^ = 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.

- **Analytical work for this work order will be conducted at ALS Sydney.**
- EK067G: LOR raised for TP on various samples due to sample matrix.
- EK059G: LOR raised for NOx on sample 12 due to sample matrix.
- TDS by method EA-015 may bias high for various samples due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- EK055G: It has been noted that Ammonia is greater than TKN on sample 1, however this difference is within the limits of experimental variation.
- pH performed by ALS Wollongong via in-house method EA005FD and EN67 PK.
- Electrical conductivity performed by ALS Wollongong via in-house method EA010FD and EN67 PK.
- Sampling and groundwater depth measurements completed by ALS Wollongong via inhouse sampling method EN/67.11 Groundwater Sampling.
- Sampling completed by ALS Wollongong in accordance with in-house sampling method EN/67.6 Rivers and Streams.
- Dissolved oxygen (DO) performed by ALS Wollongong via in-house method EA025FD and EN67 PK.
- All field analysis performed by ALS Wollongong were completed at the time of sampling.



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW1D	MW1S	MW3	MW4	MW5
Sampling date / time					01-Feb-2021 09:33	01-Feb-2021 09:48	01-Feb-2021 09:11	01-Feb-2021 10:23	01-Feb-2021 09:00
Compound	CAS Number	LOR	Unit		EW2100391-001	EW2100391-002	EW2100391-003	EW2100391-004	EW2100391-005
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.3	----	7.4	7.2	8.0
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1430	----	709	461	287
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		706	----	470	272	191
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		398	----	162	198	114
Total Alkalinity as CaCO3	----	1	mg/L		398	----	162	198	114
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		22.0	----	0.35	0.14	<0.01
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.01	----	0.01	0.03	0.03
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.01	----	0.01	0.03	0.03
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		20.7	----	0.8	1.1	0.3
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		20.7	----	0.8	1.1	0.3
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.18	----	0.09	1.07	0.05
<b>EN67 PK: Field Tests</b>									
Field Observations	----	0.01	--		----	DRY	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		2.31	----	2.47	4.19	2.81
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		3.35	----	3.79	4.40	4.30



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW6D	MW6S	MW7D	MW7S	MW9
Sampling date / time					01-Feb-2021 10:31	01-Feb-2021 10:36	01-Feb-2021 08:38	01-Feb-2021 08:43	01-Feb-2021 11:45
Compound	CAS Number	LOR	Unit		EW2100391-006	EW2100391-007	EW2100391-008	EW2100391-009	EW2100391-010
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		7.0	----	7.1	7.6	6.4
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		1750	----	1129	584	17000
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		827	----	584	331	11800
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO <sub>3</sub>	DMO-210-001	1	mg/L		<1	----	<1	<1	<1
Carbonate Alkalinity as CaCO <sub>3</sub>	3812-32-6	1	mg/L		<1	----	<1	<1	<1
Bicarbonate Alkalinity as CaCO <sub>3</sub>	71-52-3	1	mg/L		717	----	492	175	63
Total Alkalinity as CaCO <sub>3</sub>	----	1	mg/L		717	----	492	175	63
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		36.4	----	16.8	0.12	0.24
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.02	----	0.01	<0.01	0.01
<b>EK059G: Nitrite plus Nitrate as N (NO<sub>x</sub>) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.02	----	0.01	<0.01	0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		39.0	----	17.2	0.4	4.6
<b>EK062G: Total Nitrogen as N (TKN + NO<sub>x</sub>) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		39.0	----	17.2	0.4	4.6
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		2.86	----	0.89	0.14	0.40
<b>EN67 PK: Field Tests</b>									
Field Observations	----	0.01	--		----	DRY	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		1.82	----	3.22	3.20	5.05
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		4.53	----	4.46	4.65	1.28



## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW10	MW11	ML-1	ML-2	ML-3
Sampling date / time					01-Feb-2021 11:52	01-Feb-2021 11:38	01-Feb-2021 11:26	01-Feb-2021 12:06	01-Feb-2021 11:17
Compound	CAS Number	LOR	Unit		EW2100391-011	EW2100391-012	EW2100391-013	EW2100391-014	EW2100391-015
					Result	Result	Result	Result	Result
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		5.2	6.4	6.4	6.6	6.4
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		16000	7650	32800	34700	28200
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		11300	5310	23300	24800	16000
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		4	68	76	105	73
Total Alkalinity as CaCO3	----	1	mg/L		4	68	76	105	73
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		0.06	0.43	0.37	<0.01	0.34
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.10	<0.01	<0.01	<0.01
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		0.01	<0.10	0.03	0.06	<0.01
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		0.01	<0.10	0.03	0.06	<0.01
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.3	3.4	1.4	0.8	1.1
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		2.3	3.4	1.4	0.9	1.1
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		0.14	<0.20	<0.05	<0.05	0.13
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		2.87	4.12	1.48	3.20	1.77
<b>FWI-EN/001: Groundwater Sampling - Depth</b>									
Depth	----	0.01	m		1.68	1.64	----	----	----



## Analytical Results

Sub-Matrix: <b>WATER</b> (Matrix: <b>WATER</b> )				Sample ID	ML-4	ML-5	----	----	----
Sampling date / time					01-Feb-2021 11:07	01-Feb-2021 11:34	----	----	----
Compound	CAS Number	LOR	Unit		EW2100391-016	EW2100391-017	-----	-----	-----
				Result	Result		----	----	----
<b>EA005FD: Field pH</b>									
pH	----	0.1	pH Unit		<b>6.3</b>	<b>6.5</b>	----	----	----
<b>EA010FD: Field Conductivity</b>									
Electrical Conductivity (Non Compensated)	----	1	µS/cm		<b>30300</b>	<b>35600</b>	----	----	----
<b>EA015: Total Dissolved Solids dried at 180 ± 5 °C</b>									
Total Dissolved Solids @180°C	----	10	mg/L		<b>18000</b>	<b>15500</b>	----	----	----
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		<b>72</b>	<b>76</b>	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		<b>72</b>	<b>76</b>	----	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>									
Ammonia as N	7664-41-7	0.01	mg/L		<b>0.34</b>	<b>0.34</b>	----	----	----
<b>EK057G: Nitrite as N by Discrete Analyser</b>									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	----	----	----
<b>EK058G: Nitrate as N by Discrete Analyser</b>									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	----	----	----
<b>EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser</b>									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
<b>EK061G: Total Kjeldahl Nitrogen By Discrete Analyser</b>									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<b>1.1</b>	<b>1.0</b>	----	----	----
<b>EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser</b>									
^ Total Nitrogen as N	----	0.1	mg/L		<b>1.1</b>	<b>1.0</b>	----	----	----
<b>EK067G: Total Phosphorus as P by Discrete Analyser</b>									
Total Phosphorus as P	----	0.01	mg/L		<0.05	<b>0.05</b>	----	----	----
<b>EP025FD: Field Dissolved Oxygen</b>									
Dissolved Oxygen	----	0.01	mg/L		<b>1.87</b>	<b>2.06</b>	----	----	----





### ***Inter-Laboratory Testing***

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

- (WATER) ED037P: Alkalinity by PC Titrator
- (WATER) EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser
- (WATER) EK061G: Total Kjeldahl Nitrogen By Discrete Analyser
- (WATER) EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser
- (WATER) EK058G: Nitrate as N by Discrete Analyser
- (WATER) EK057G: Nitrite as N by Discrete Analyser
- (WATER) EK055G: Ammonia as N by Discrete Analyser
- (WATER) EK067G: Total Phosphorus as P by Discrete Analyser
- (WATER) EA015: Total Dissolved Solids dried at  $180 \pm 5$  °C

## CERTIFICATE OF ANALYSIS

**Work Order** : **EW2100392**  
**Client** : **KIAMA COUNCIL**  
**Contact** : **MR PAUL CZULOWSKI**  
**Address** : **11 MANNING STREET**  
**KIAMA NSW, AUSTRALIA 2533**

**Telephone** : **+61 02 4232 0444**  
**Project** : **Gerroa Landfill Ammonia Testing**  
**Order number** : **126591**  
**C-O-C number** : **----**  
**Sampler** : **Duncan McIntosh, Tom Roose**  
**Site** : **----**  
**Quote number** : **WO/015/18**  
**No. of samples received** : **3**  
**No. of samples analysed** : **3**

**Page** : **1 of 2**  
**Laboratory** : **Environmental Division NSW South Coast**  
**Contact** : **Glenn Davies**  
**Address** : **1/19 Ralph Black Dr, North Wollongong 2500**  
**4/13 Geary Pl, North Nowra 2541**  
**Australia NSW Australia**  
**Telephone** : **02 42253125**  
**Date Samples Received** : **01-Feb-2021 12:36**  
**Date Analysis Commenced** : **03-Feb-2021**  
**Issue Date** : **05-Feb-2021 15:00**



Accreditation No. 825  
 Accredited for compliance with  
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- Analytical Results

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### 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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW



## General Comments

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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.

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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.

- Analytical work for this work order will be conducted at ALS Sydney.

## Analytical Results

Sub-Matrix: **WATER**  
 (Matrix: **WATER**)














Sample ID

				MW 12	MW 13	MW 14	----	----
Sampling date / time				01-Feb-2021 10:07	01-Feb-2021 10:00	01-Feb-2021 09:25	----	----
Compound	CAS Number	LOR	Unit	EW2100392-001	EW2100392-002	EW2100392-003	-----	-----
				Result	Result	Result	----	----
<b>EK055G: Ammonia as N by Discrete Analyser</b>								
Ammonia as N	7664-41-7	0.01	mg/L	46.7	83.5	40.4	----	----

## Appendix B

## Appendix B: Climate Data for Gerroa Landfill (2002 to 2021)

Station: Bombo Headland

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Graph													
<a href="#">2001</a>												11.2	
<a href="#">2002</a>	99.6	288.2	125.4	62.8	52.4	28	18.2	12	9.6	7.2			
<a href="#">2003</a>								41					
<a href="#">2007</a>												87	
<a href="#">2008</a>	55			102	12.6	127.8	86	46.2	69.2	88.4	12.6	99.4	
<a href="#">2009</a>	11.6	87.4	48.6	66.4	0	75.8	53	2.8	21	187.8	56	106.2	716.6
<a href="#">2010</a>	69	201	90.4	54.2	83.6	71.2	111.2	67.4	121	132.2	51	83.8	1136
<a href="#">2011</a>	87.6	59	297.8	78.6	100.2	93	187.4	87.4	52.8	112.6	144.2	50.8	1351.4
<a href="#">2012</a>	61	289	213.2	109.6	11.4	86	64.8	8	19.8	91.6	35.2	53.8	1043.4
<a href="#">2013</a>	170.8	153.2	74.2	183.6	121.8	220.2	69.6	17.8	89	12.8	137.2	85.2	1335.4
<a href="#">2014</a>	26.2	42	306.2	103.8	10.8	34.2	7.8	154.4	52.4	86.8	47.4	159.8	1031.8
<a href="#">2015</a>	208	98.4	53	247.6	44.2	69.8	48	269.4	82.8	46.6	57.2	105.6	1330.6
<a href="#">2016</a>	124.6	25.6	86.6	32.6	9.2	328.4	91.6	91.4	56.4	30.6	25.8	50.8	953.6
<a href="#">2017</a>	18.8	158.8	309.6	76	49.4	54	1.4	35.2	0.4		116.8	46.4	
<a href="#">2018</a>	69	111.6	43	15.6	16.6	172	3.2	54.2	40.4	137.4	88.6	82.4	834
<a href="#">2019</a>	107.2	22.8	159.4	33.8	9.2	119	16.6	45.8	68.4	35	26.8	2	646
<a href="#">2020</a>	44.8	213.4	76.4	36	59.8	35.6	216.2	100.4	24	68	76.2	80.2	1031
<a href="#">2021</a>	166.6	115.6											

2020/2021 1152.8

## Appendix C

**Appendix C: (KMC: H24.011.000)**

**Ammonia levels and 20% trigger factor for Groundwater and 10% trigger factor for Surface Water at Gerroa Landfill**

Sample ID	MW1D	MW1S	MW3	MW4	MW5	MW6D	MW6S	MW7D	MW7S	MW9	MW 10	MW 11	MW 12	MW 13	MW 14	ML-1	ML-2	ML-3	ML-4	ML-5
20% trigger level (mg/L)	164.4	1.32	39.24	21.8	7.07	98.8	27.78	85.32	14.3	4.26	2.85	2.96								
10% trigger level (mg/L)																0.836	1.38	0.066	0.23	2.38
22/02/08	130	0.16	-	0.88	0.1	81	3.2	110	3.3	0.34	0.3	0.99				0.31	0.88	-	1.7	-
29/05/08	130	0.18	0.75	0.65	0.10	90	3.3	86	4.7	0.10	0.10	0.12				1.5	3.7	-	0.10	-
25/08/08	140	0.18	0.77	0.65	0.10	110	3.2	86	5.9	0.22	0.73	0.24				0.22	0.44	-	0.27	
19/11/08	93	0.10	0.78	-	0.10	69	2.5	65	3.5	0.10	-	0.10				<1	<1	-	<1	1.6
18/02/09	82	0.02	0.60	-	0.02	72	1.7	81	5.1	0.62	0.25	0.10				Cleary Bros land	1.9	Cleary Bros land	Cleary Bros land	2
19/05/09	61	0.25	0.73	0.79	0.03	45	2.6	62	8.3	0.05	0.08	4.7				-	0.56	-	-	1.2
27/08/09	95	0.42	0.89	0.54	0.02	76	3.0	85	8.4	0.06	0.21	4.8				-	0.41	-	-	2.8
27/11/09	58	1.3	0.8	0.5	0.1	73	1.8	43	4.1	0.2	0.4	2.4				-	1.5	-	-	3.0
26/02/10	37	0.04	0.31	0.24	0.02	36.5	0.6	37.8	3.03	<0.1	<0.1	5.36					1.9			2.17
21/05/10	22.6	0.27	0.62	0.38	0.08	16.4	0.83	21.9	0.49	<0.10	<0.10	<0.10				-	<0.10			1.52
30/11/10	25.7	0.05	0.66	0.22	0.04	21.8	1.73	21.7	2.56	0.84	<0.10	<0.10				-	0.08	-	-	0.04
24/02/11	6.67	0.05	0.26	0.91	0.03	8.90	0.48	10.2	1.34	0.06	<0.10	0.13					0.87	-	-	1.83
24/05/11	2.56	0.04	0.14	1.16	0.03	13.8	0.23	7.99	1.30	0.05	0.03	0.06					2.39			3.12
24/08/11	0.12	0.06	0.42	0.58	0.03	3.24	0.19	4.38	0.16	<0.01	-	0.03					1.69	-	-	1.60
03/11/11	2.15	0.02	0.29	0.64	0.08	2.25	0.40	4.17	1.93	1.00	0.02	0.03					1.03			0.85
01/02/12	3.16	<0.01	0.23	0.68	0.02	10.8	0.25	1.98	2.03	<0.10	<0.10	0.01				-	1.70	-	-	3.07
31/05/12	0.07	0.05	0.04	0.18	0.03	7.62	0.12	2.61	2.25	0.03	0.02	0.03					1.08			1.73
10/08/12	0.09	<0.01	0.35	0.10	0.05	7.06	0.08	1.94	2.34	0.04	0.02	0.05					1.09			1.73
21/11/12	0.17	-	0.44	0.15	0.23	7.17	0.20	1.67	2.74	0.23	<0.10	<0.10				-	<0.10	-	-	<0.10

Sample ID	MW1D	MW1S	MW3	MW4	MW5	MW6D	MW6S	MW7D	MW7S	MW9	MW 10	MW 11	MW 12	MW 13	MW 14	ML-1	ML-2	ML-3	ML-4	ML-5
20% trigger level (mg/L)	164.4	1.32	39.24	21.8	7.07	98.8	27.78	85.32	14.3	4.26	2.85	2.96								
10% trigger level (mg/L)																0.836	1.38	0.066	0.23	2.38
18/02/13	0.26	0.13	7.78	0.44	0.55	12.8	0.91	1.93	1.2	1.08	0.58	0.42					<0.10			<0.10
31/05/13	2.2	1.9	2.1	16.5	16.8	14.6	0.04	2.82	1.91	<0.01	0.05	0.07					0.75			0.81
21/06/13	0.01	0.15		0.46	0.04	17.5														
30/08/13	2.88	0.28	0.14	<0.01	0.06	11.3	0.29	2.43	0.91	0.84	0.06	0.02					3.19			2.6
Re-sample 20/09/13																	0.01			0.04
27/11/13	4.13	0.21	0.25	0.37	5.88	10.4	0.04	2.09	1.33	0.32	0.30	0.01					1.00			0.52
07/02/14	2.88		0.11	0.22	0.64	9.08	0.04	1.97	1.64	0.24	0.09	<0.01					0.44			2.60
06/05/14	1.29	0.31	0.13	0.28	4.47	8.27	0.03	1.91	0.68	<0.01	0.08	0.06					0.33			1.73
18/08/14	0.02	-	0.17	0.09	1.28	1.79	0.02	0.20	1.12	<0.01	<0.01	<0.01				-	0.68	-	-	0.04
17/11/14	1.30	-	0.32	0.35	1.40	2.23	-	1.36	0.54	0.34	0.13	0.19				-	0.36	-	-	3.50
26/02/15	1.51	-	0.18	0.09	14.5	3.92	-	1.48	1.16	0.21	0.15	0.13				-	0.09	-	-	0.07
27/05/15	<0.01	0.09	0.15	0.75	0.03	3.13	0.09	0.96	0.59	<0.01	0.05	<0.01				-	0.80	-	-	0.83
24/08/15	0.77	-	0.28	0.15	0.02	1.77	-	1.38	0.54	0.02	-	0.01				-	1.50	-	-	2.39
04/11/15	3.78	0.23	0.74	0.26	0.03	4.53	-	1.64	0.80	0.47	0.02	0.02					0.05			1.65
16/02/16	2.43	-	20.9	0.12	<0.01	3.48	-	1.02	0.7	0.07	<0.01	<0.01				-	0.02	-	-	1.24
31/05/16	2.08	-	4.31	0.74	6.93	4.55	-	1.00	1.03	<0.05	<0.05	<0.05				-	0.11	-	-	0.20
12/08/16	0.66	-	0.56	0.16	2.34	0.14	-	0.70	0.38	0.03	<0.01	0.02				-	1.16	-	-	1.63
10/11/16	12.5	-	1.30	0.11	0.17	3.10	-	0.13	-	0.26	0.15	0.11				-	0.16	-	-	0.27
20/02/17	6.65	-	0.43	0.05	0.15	2.96	-	0.99	0.34	1.29	0.17	0.11				-	0.78-		-	1.20
18/05/17	11	0.31	0.18	0.12	0.04	5.76	0.06	0.98	0.29	0.19	0.18	0.04				-	1.21	No access	-	2.82
17/08/17	8.22		0.19	0.13	0.03	19.6	-	0.65	0.38	0.15	0.12	0.12				-	0.32	No access	-	0.85



Sample ID	MW1D	MW1S	MW3	MW4	MW5	MW6D	MW6S	MW7D	MW7S	MW9	MW10	MW11	MW12	MW13	MW14	ML-1	ML-2	ML-3	ML-4	ML-5
20% trigger level (mg/L)	164.4	1.32	39.24	21.8	7.07	98.8	27.78	85.32	14.3	4.26	2.85	2.96								
10% trigger level (mg/L)																0.836	1.38	0.066	0.23	2.38
29/11/17	9.24	-	0.24	0.15	0.12	3.71	-	0.49	0.29	0.43	0.10	0.12				-	0.16	-	-	1.68
8/02/18	13.1	-	0.27	0.10	0.14	3.85	-	0.89	0.49	0.54	0.10	0.27				-	<0.05	-	-	1.26
01/03/18 (ammonia only)	9.83	-	0.27	0.07	0.09	7.40		0.83												
15/03/18 (ammonia only)	16.2	-	0.28	0.15	0.08	4.43	-	0.93												
05/04/18 (ammonia only)	12.1	-	0.27	0.09	0.08	12.1	-	1.24												
18/04/18	22.8	-	0.3	0.14	0.07	6.71	-	1.35												
24/05/18	15.8	Dry	0.3	0.06	0.08	4.99	Dry	0.89	0.45	0.27	<0.01	2.23				-	<0.10	-	-	<0.10
12/07/18	8.18		8.55		0.05	4.97		0.74				6.05	24.5	24.8	27.2					
22/08/18	8.58	Dry	0.21	0.08	0.02	2.2	Dry	0.15	0.31	0.09	0.16	5.35	17.7	18.6	30.8		0.17			1.06
17/10/18			0.34		1.44	7.69		0.63				5.79	27.5	32.8	39.4					
16/11/18	damaged	Dry	0.64	0.05	0.08	7.02	Dry	0.91	0.4	0.13	Dry	4.12	35.2	37.5	54.7	no access	0.65	no access	no access	2.72
06/12/18	damaged		0.35		0.07	8.45		1.11				2.26	31.7	32.8	46.3					
17/01/19	Damaged		0.33		0.48	5.78		1.72				2.24	23	26.1	34					
12/02/19	11.7		0.3	0.06	0.06	22.7	DRY	2.08	0.44	0.16	0.38	0.29				no access		no access	no access	0.77
15/03/19 (ammonia only)	14.0		0.30		0.12	4.43		0.81				0.90	24.7	25.7	32.2					

Sample ID	MW1D	MW1S	MW3	MW4	MW5	MW6D	MW6S	MW7D	MW7S	MW9	MW 10	MW 11	MW 12	MW 13	MW 14	ML-1	ML-2	ML-3	ML-4	ML-5
20% trigger level (mg/L)	164.4	1.32	39.24	21.8	7.07	98.8	27.78	85.32	14.3	4.26	2.85	2.96								
10% trigger level (mg/L)																0.836	1.38	0.066	0.23	2.38
04/04/19	15.0		0.39		0.08	5.05		1.32				1.60	34.4	26.0	40.9					
28/05/19	15.5	Dry	0.34	0.05	0.03	8.74	Dry	2.36	0.45	0.34	0.23	2.20				no access	0.26	no access	no access	0.75
21/06/19	23.1		0.39		0.04	1.37						0.56	29.6	32.7	52.9					
27/08/19	27.3	-	0.42	0.08	0.08	40.0	-	20.5	0.27	0.12	0.32	1.15	43.8	41.8	68.4	-	0.12			0.07
12/07/19	20.5		0.35		<0.01	4.87		0.80				1.90	33.1	24.7	54.9					
17/10/19	24.9		0.32		0.04	36.3		13.7				5.3	36.5		83.0					
22/11/19	35		0.38	0.10	0.05	57	-	20.0	0.32	0.03	0.05	4.24				0.47	0.03	0.16	0.52	1.93
05/12/19	41.0		0.43		0.09	53.6		19.6				3.29	58.2	55.7	93.6					
31/01/20	26.9	-	0.39	0.10	0.10	35.8	-	17.1				4.52	38.6	38.2	57.9					
14/02/20	27.8	dry	0.37	0.08	0.04	50	-	21.4	0.25	0.08	0.12	4.01	57	62	96.5	0.15	0.27	0.17	0.18	0.18
5/3/20	30.9		0.3		0.02	44.5		14.8				5.79	46.9	43.6	81.1					
28/5/20	44.1	----	0.44	0.11	0.07	56	----	21	0.22	<0.01	0.14	2.55	57.7	54.7	97.7	0.1	0.13	0.06	0.06	0.12
17/6/20													55.9	52.3	95.3					
13/8/20	27.8	<0.01	0.22	0.04	<0.01	52.4	0.03	18.3	<0.01	0.25	<0.01	17.0				0.03	0.06	0.02	0.02	0.04
9/9/20	23.3		0.25		0.02	41.5		19.2				2.15	37.5	26.6	73.1					
6/11/20	21.1	0.14	0.3	0.11	<0.01	36.2	----	17.4	0.16	0.01	0.02	1.34				0.15	0.51	0.14	0.15	0.61
18/12/20	32.5		0.43		0.18	42.5		18.1					42.3	46.6	84.4					
8/1/21	16.4		0.31		0.02	37.2		18.5				0.97	38.9	34.6	69.9					
1/2/21	22	----	0.35	0.14	<0.01	36.4	----	16.8	0.12	0.24	0.06	0.43	46.7	83.5	40.4	0.37	<0.01	0.34	0.34	0.34

Note; Summary Information provided by Kiama Council @ March 2020

## Appendix D



DOC17/218276

The General Manager  
Kiama Municipal Council  
Via e-mail at: [council@kiama.nsw.gov.au](mailto:council@kiama.nsw.gov.au)

Attention: Ms Julie Milevski

07 September 2017

Dear Mr Forsyth

**Gerroa Waste Disposal & Recycling Facility  
Ground and Surface Water Monitoring Results**

I refer to the email from Ms Julie Milevski of Kiama Municipal Council (Council) to the Environment Protection Authority (EPA) dated 7 April 2017 providing ground and surface water monitoring results for the Gerroa Waste Disposal & Recycling Facility located at 349 Crooked River Road, Gerroa (the Premises). I apologise for the delay in responding to this matter.

The results have been reviewed and the EPA is seeking further information as below.

**MW1D**

On 10 November 2016 and 20 February 2017, ammonia levels at this monitoring point were 12.5mg/L and 6.65mg/L respectively. These are the highest recorded results since 2011 results.

**MW3**

On 31 May 2016 and 10 November 2016, ammonia levels at this monitoring point were 4.31mg/L and 1.30mg/L respectively. It is noted that on 16 February 2016, ammonia was detected as 20.9mg/L however, Council's consultant indicated that this result was an anomaly. Aside from this result, and 7.78mg/L being detected on 18 February 2013, all other results have been below 1.00mg/L.

The EPA is seeking further explanation as to the cause of the suspected elevated ammonia results and whether any remediation action is required. Please provide the requested response in writing to Unit Head Waste Compliance, PO Box 513, WOLLONGONG, NSW, 2520 or by email to [waste.operations@epa.nsw.gov.au](mailto:waste.operations@epa.nsw.gov.au) or by Fax at (02) 4224 4110. The submission must be made by **5pm on 29 September 2017.**

If you have any questions about this matter, please contact Greg Frost on (02) 4224 4113.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Matthew Corradin'.

**MATTHEW CORRADIN**  
**Unit Head Waste Compliance**  
**Environment Protection Authority**

**Client: Kiama Municipal Council**

**Project: Second Interim Groundwater Report  
Gerroa Waste Disposal Depot**

**Prepared for: Tony Hardy  
Kiama Municipal Council  
P.O. Box 75, Kiama, NSW, 2533.**

**Report: 14 May 2018  
Reference: E2W-025 Gerroa R002 (V1)**

**Authorised by: Earth2Water Pty Ltd**

**Dino Parisotto - Director**  
*BAppSc Geology (Hons); MAppSc (Groundwater)*  
*SCPA Certified Practitioner- Site Assessment and Management*

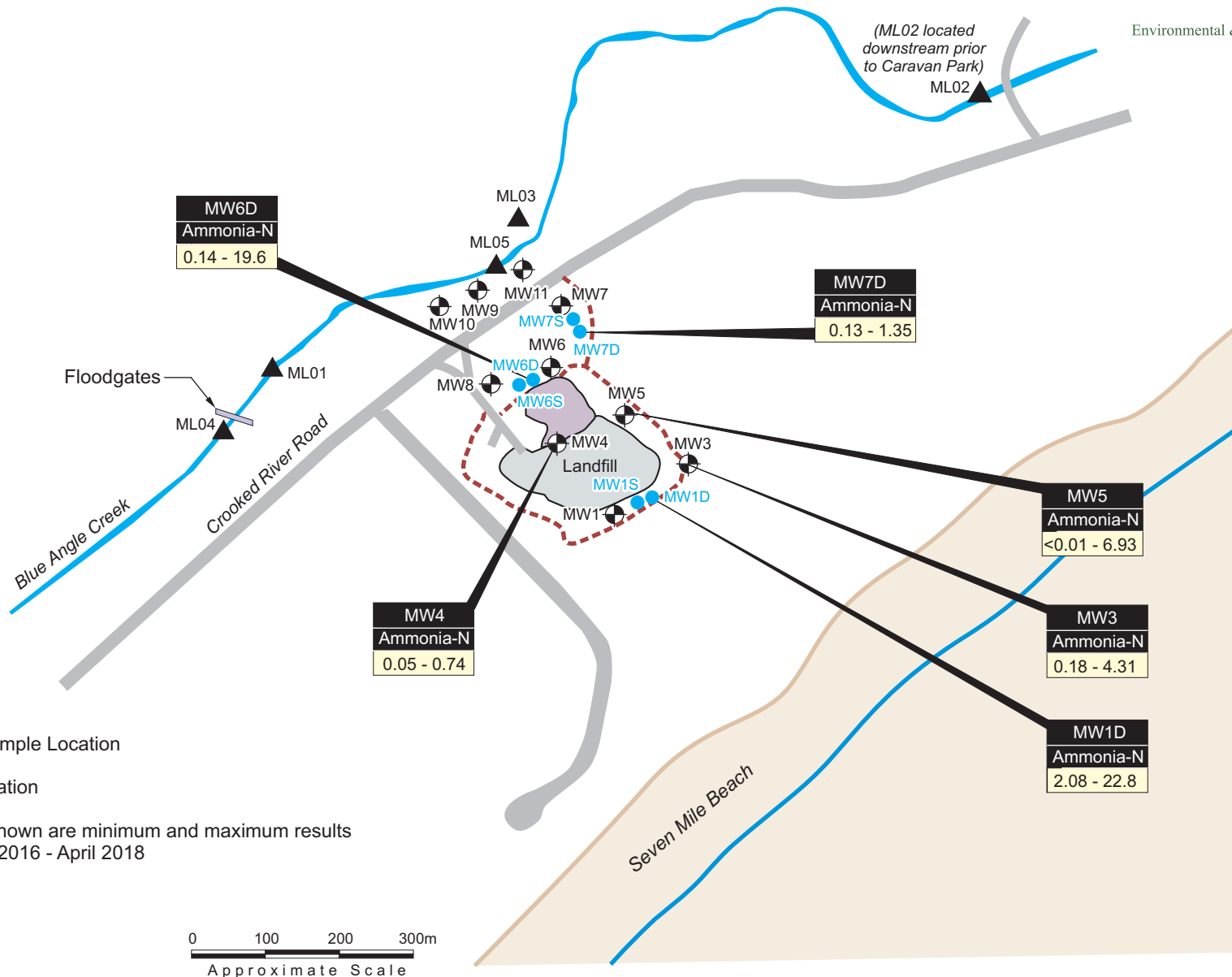


**Ph: (02) 4234 0829 Mobile: 0422 334102  
175 Fern Street, Gerringong, NSW, 2534**

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Source: Base Plan, URS Australia Pty Ltd

## GROUNDWATER AMMONIA RESULTS (mg/L) 2016-2018

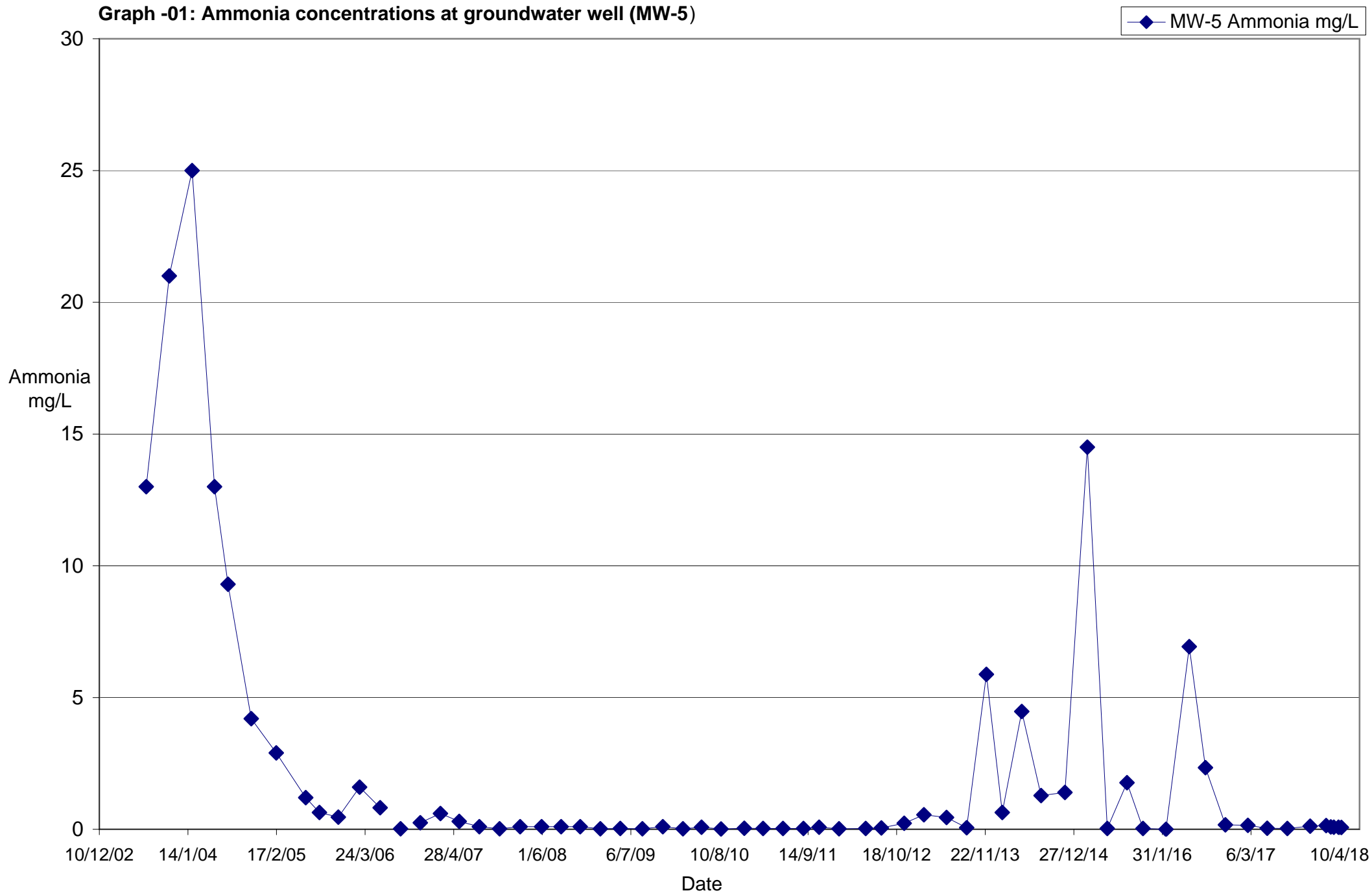
GERROA INTERIM REPORT

Date: April 2018

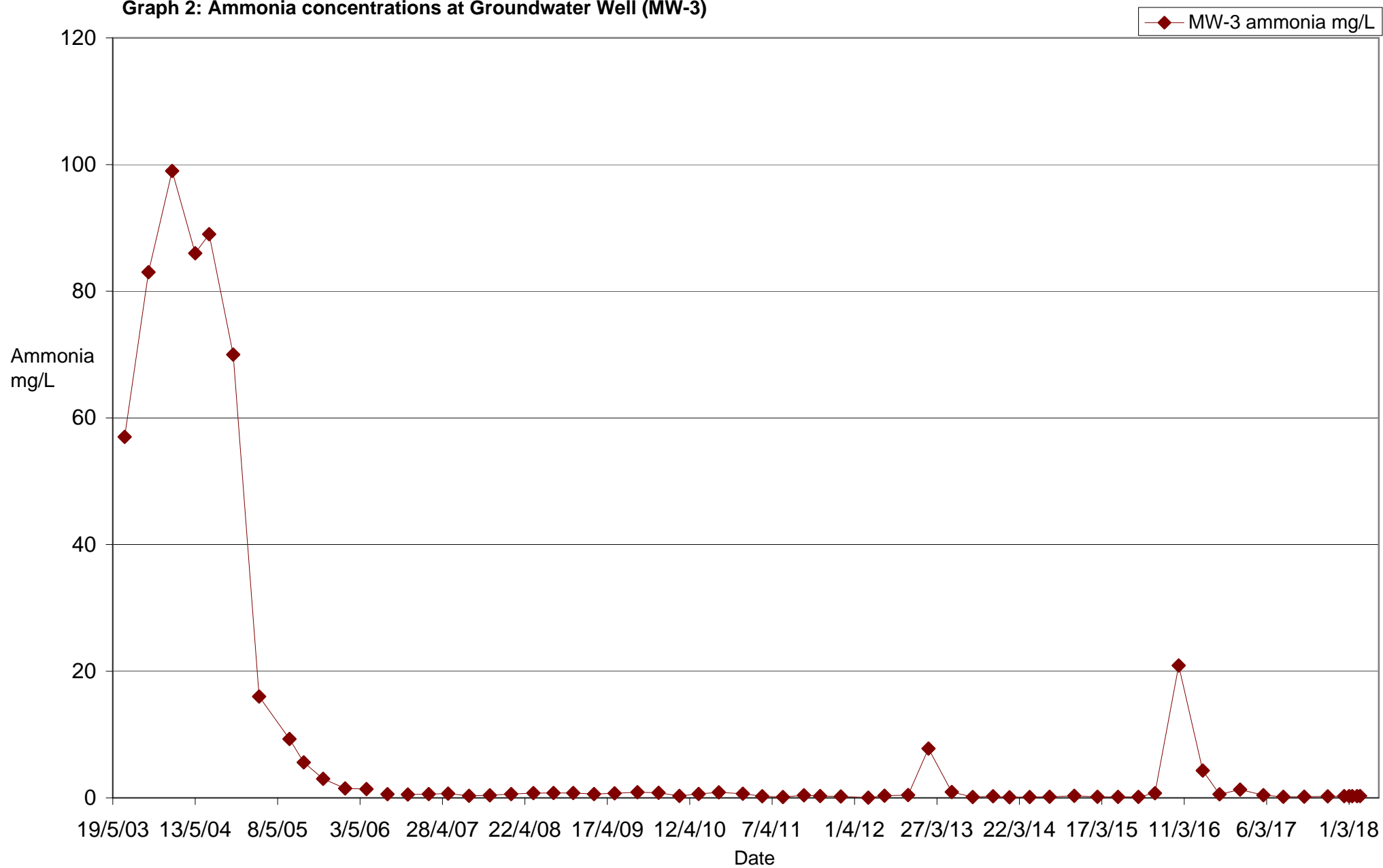
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**Figure 1**

Graph -01: Ammonia concentrations at groundwater well (MW-5)

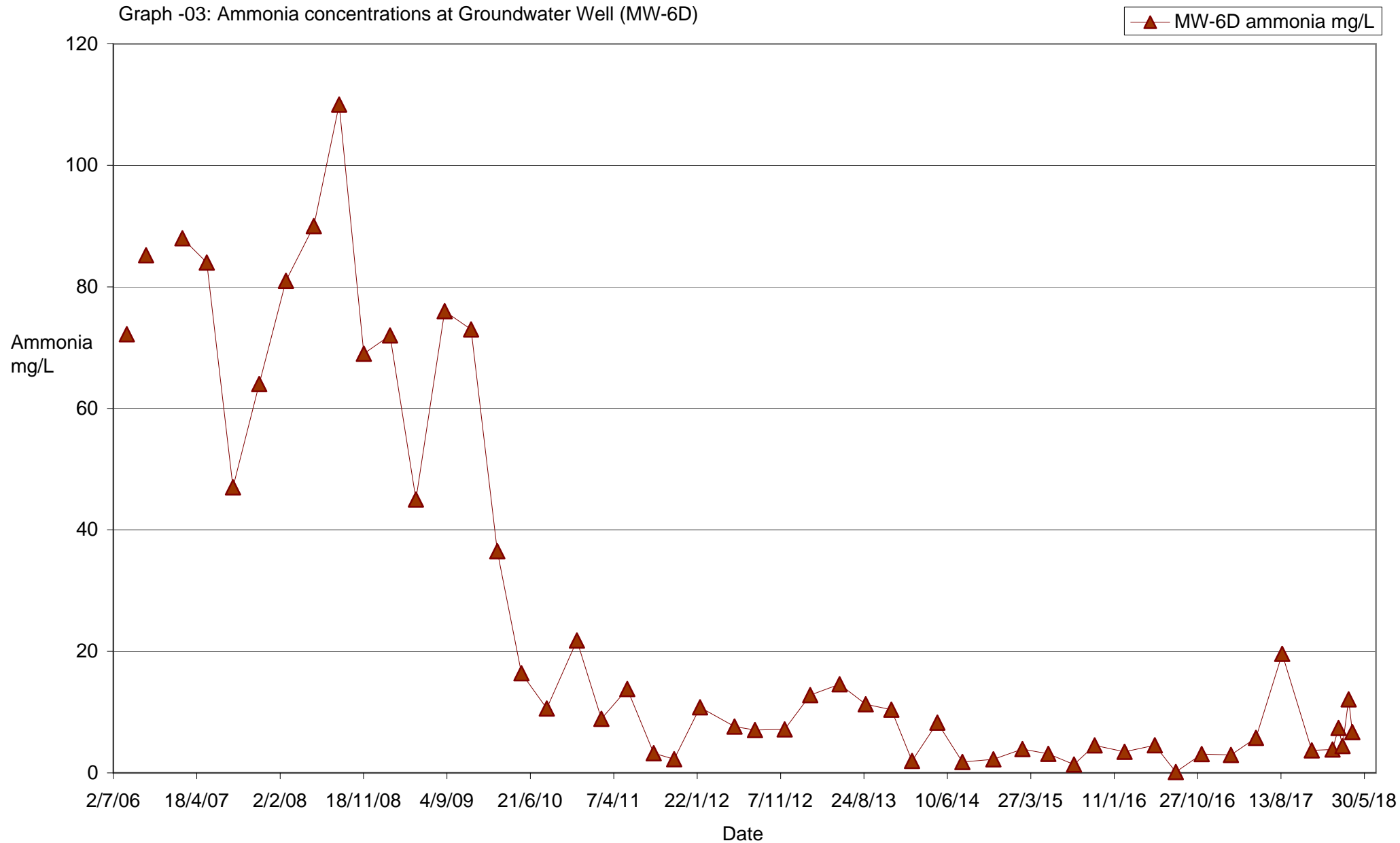


Graph 2: Ammonia concentrations at Groundwater Well (MW-3)

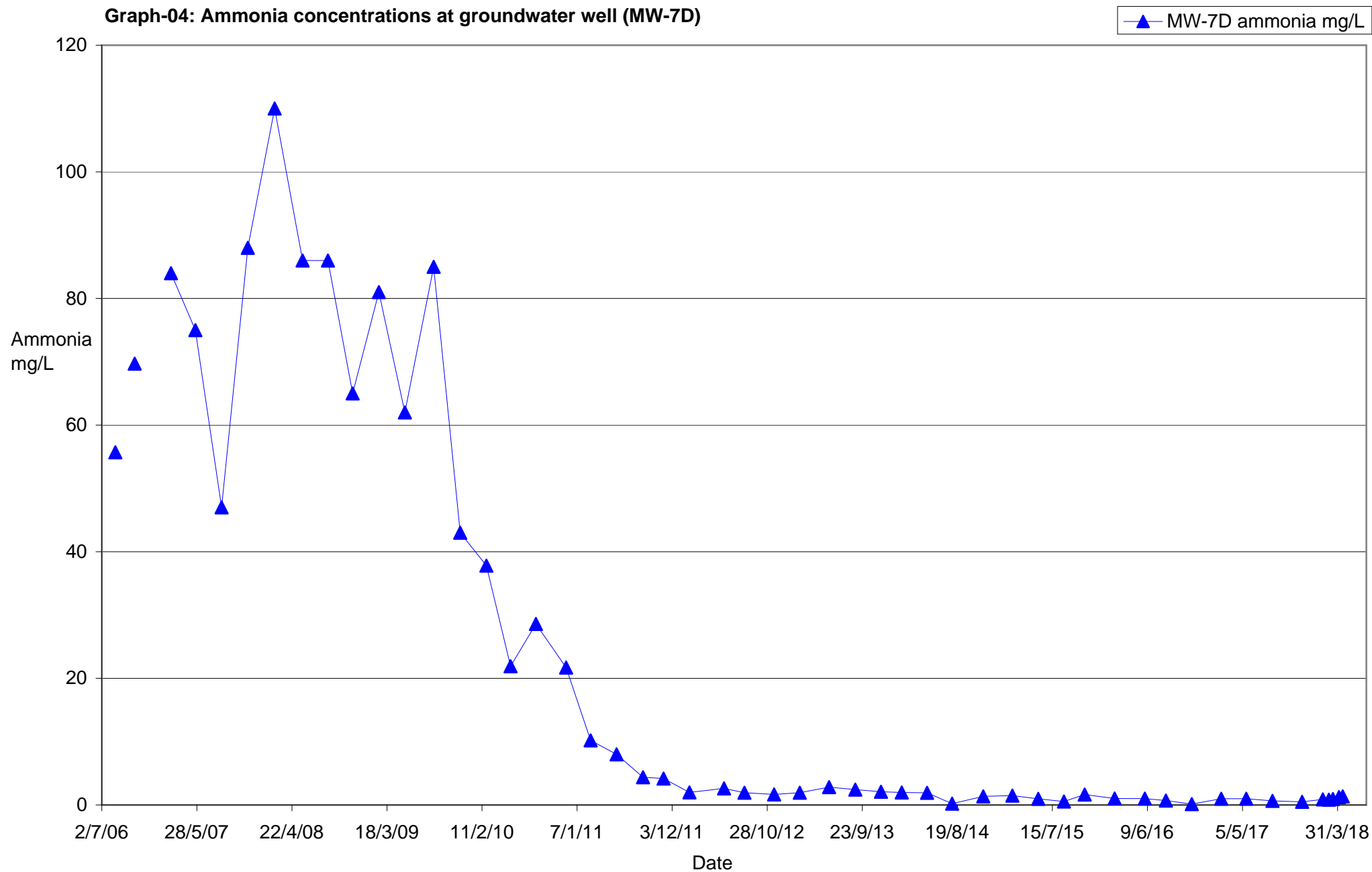




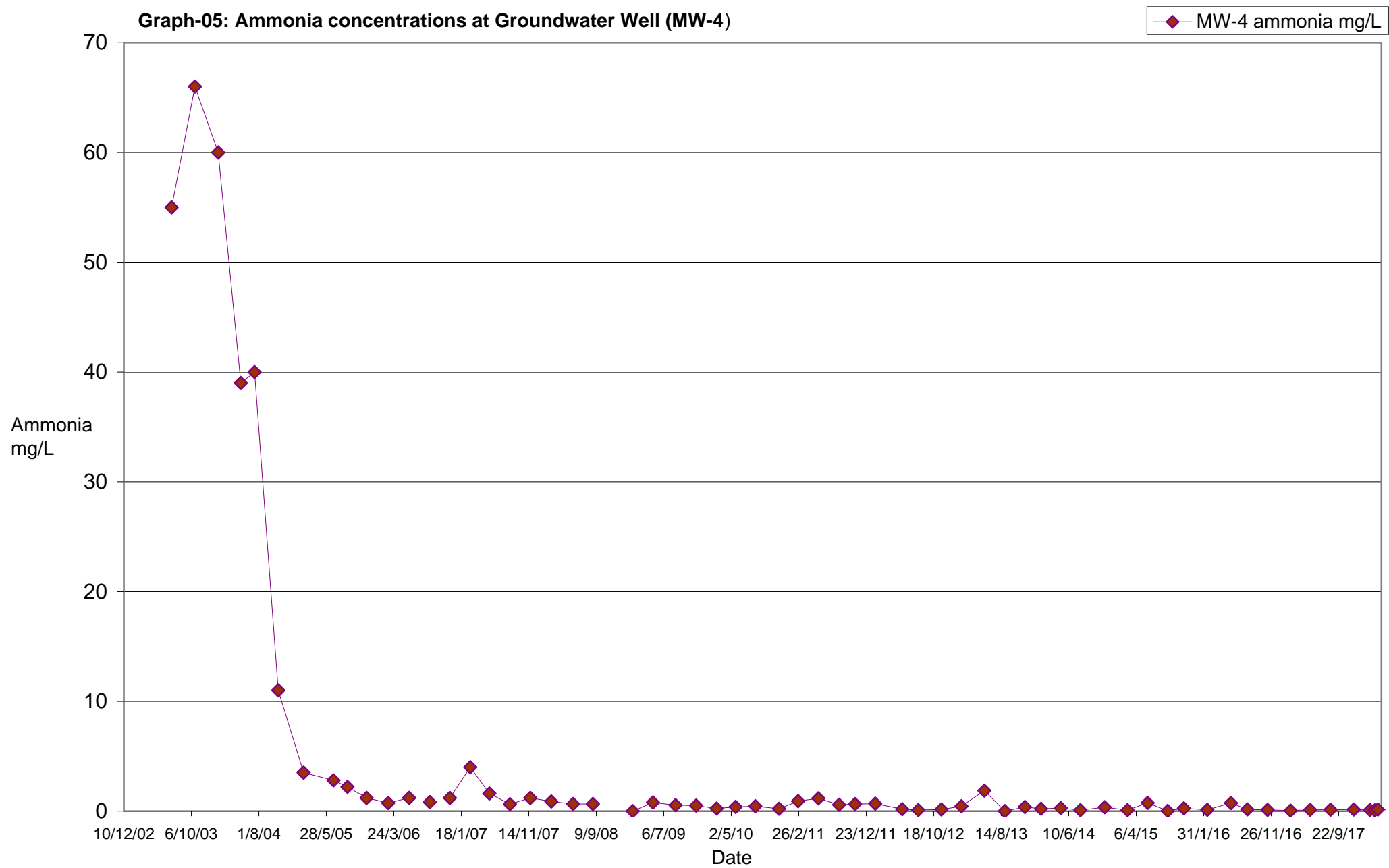
Graph -03: Ammonia concentrations at Groundwater Well (MW-6D)



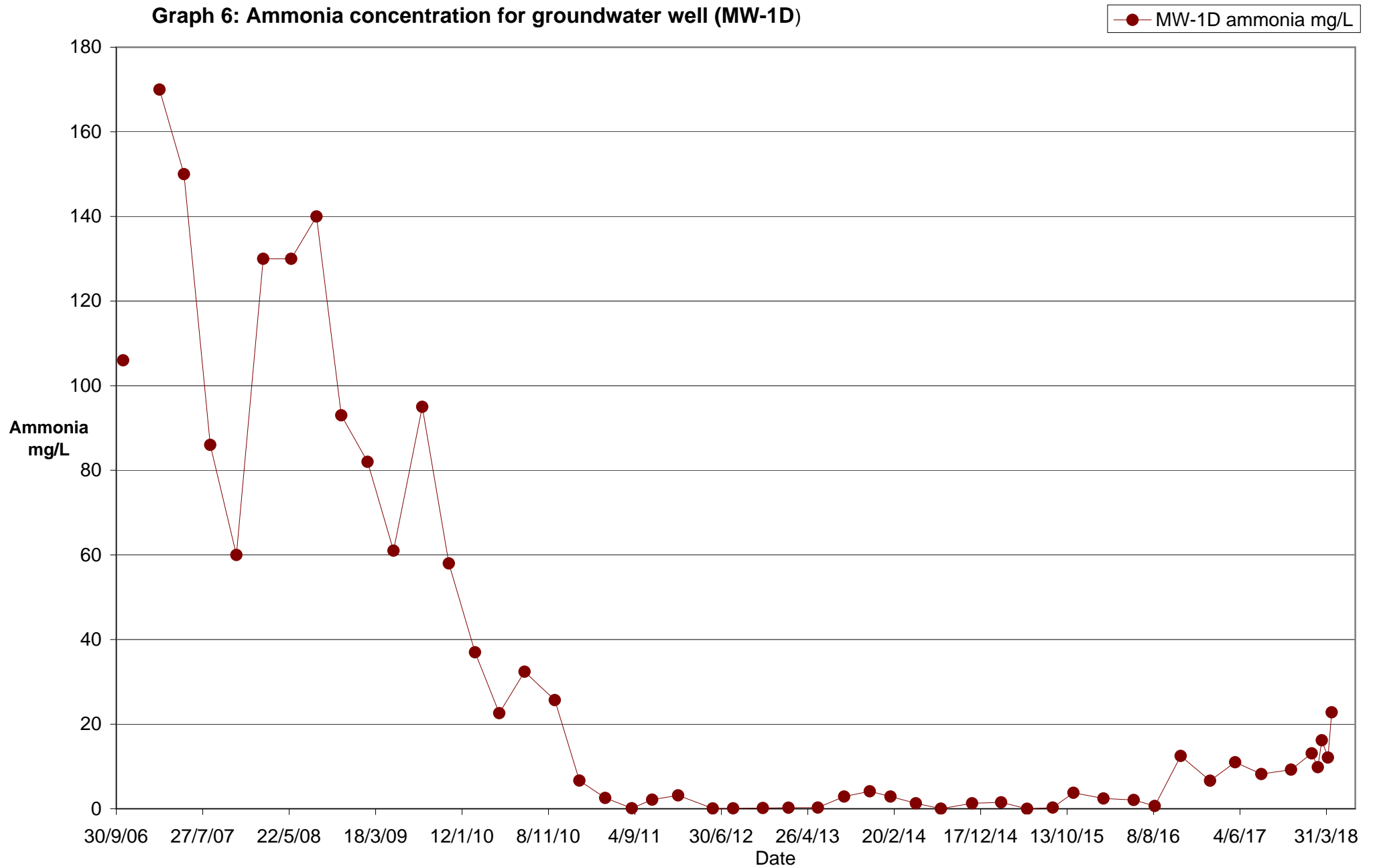
Graph-04: Ammonia concentrations at groundwater well (MW-7D)



Graph-05: Ammonia concentrations at Groundwater Well (MW-4)



**Graph 6: Ammonia concentration for groundwater well (MW-1D)**



## Appendix E

### Limitations

Earth2Water Pty Ltd has prepared this report for the use of Kiama Council in accordance with the standard terms and conditions of the consulting profession. This report is prepared in accordance with the scope of work and for the purpose outlined in the proposal. The methodology adopted and sources of information used by E2W are outlined in this report.

This report was prepared in August 2018 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report, and our previous experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review recommendations and or conclusions offered.

LAST PAGE OF REPORT



***Thank you for the opportunity to work with  
Kiama Council.***

*Your feedback is appreciated at Earth2Water  
([dino@earth2water.com.au](mailto:dino@earth2water.com.au))*



**earth<sup>2</sup>water**  
Pty Ltd  
Environmental & Groundwater Consulting

## Appendix E

### Limitations

Earth2Water Pty Ltd has prepared this report for the use of Kiama Council in accordance with the standard terms and conditions of the consulting profession. This report is prepared in accordance with the scope of work and for the purpose outlined in the proposal. The methodology adopted and sources of information used by E2W are outlined in this report.

This report was prepared in March 2021 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations. The behaviour of some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report, and our previous experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review recommendations and or conclusions offered.