# ENVIRONMENTAL MONITORING

# REPORT 2022

BIDGEE BANKS GOLF COURSE

2021 / 2022

JOB NO: 8554

DM McMahon Pty Ltd
6 Jones Street (PO Box 6118)
Wagga Wagga NSW 2650

t (02) 6931 0510
www.dmmcmahon.com.au

## Report type

Environmental Monitoring Report

## Site address

Bidgee Banks Golf Course
Landon Street
Gundagai NSW 2720

## Report number

8554

## Prepared for

Ganesh Ganeshamoorthy
Cootamundra-Gundagai Regional Council
255 Sheridan Street
PO Box 34
Gundagai NSW 2720
ganesh.ganeshamoorthy@cgrc.nsw.gov.au

## Prepared by

DM McMahon Pty Ltd
6 Jones Street (PO Box 6118)
Wagga Wagga NSW 2650
Tel: 0269 310 510
Email: admin@dmmcmahon.com.au

## Document Control

| Prepared by | Signed | Date | Revision |
|---|---|---|---|
| **David McMahon** CEnvP SC<br>BAppSc SA<br>GradDip WRM<br>MEnvMgmt<br>MALGA MEIANZ MSSA |  | 13/05/22 | 00 |

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## 1.0 Introduction

Environmental monitoring is carried out at the Bidgee Banks Golf Course for Cootamundra-Gundagai Regional Council (CGRC) to monitor the effects of irrigating soils with treated effluent from the Gundagai Sewage Treatment Works. The treated effluent is stored in a primary pond for 25 days before being released into a lagoon for storage prior to irrigation. The golf course is approximately 20 hectares in area and approximately 20 Megalitres (ML) of effluent was irrigated in the 2021/22 irrigation season. Irrigation occurs on a demand basis usually from late spring throughout summer and into early autumn.

The scope of works is to conduct the monitoring to satisfy CGRC's Environment Protection Licence No. 1721 that was varied in July 2021 (Notice No. 1609932). Specific to the licence conditions and as requested by CGRC, the agreed scope of works conducted by McMahon are as follows:

- Fortnightly monitoring of the treated effluent in the storage dam that is used to irrigate the golf course.
- Annual groundwater sampling at two monitoring points.
- Annual soil monitoring at three locations to assess any temporal changes in nutrients that may occur due to the irrigation of treated effluent. At each location samples are collected at four increments (0-10cm, 10-30cm, 30-60cm and 60-100cm) to satisfy the DEC 2004 (Formerly NSW EPA) environmental guidelines Use of Effluent by Irrigation.
- Calculate the nutrient load applied to the soil in the treated effluent to assess the assimilation of nutrients.
- Compilation of an annual environmental monitoring report with a comparison of results compared to long term monitoring data which commenced in 1999.

## 2.0 Seasonal Conditions

Rainfall for the irrigation season (October 2021 to April 2022) was variable but overall above average, while temperatures were near normal, **Tables 1** and **2**. Weather data was sourced from BOM Station 073141, Nangus Road Gundagai. Long term data was sourced from BOM Station 073128 Ridge Street Gundagai. The long-term average was collected between 1976 to 1995.

**Table 1:** *Gundagai weather data May 2021 to April 2022*

| Month | Average Minimum Temperature (°) 2021/2022 | Average Maximum Temperature (°) 2021/2022 | Total Rainfall (mm) 2021/2022 |
|---|---|---|---|
| May 2021 | 5.4 | 18.7 | 53.7 |
| June 2021 | 4.0 | 14.5 | 120.5 |
| July 2021 | 3.9 | 12.9 | 102.4 |
| August 2021 | 3.4 | 16.2 | 44.4 |
| September 2021 | 5.1 | 18.5 | 101.0 |
| October 2021 | 7.6 | 21.8 | 50.1 |
| November 2021 | 11.2 | 23.0 | 130.4 |
| December 2021 | 14.1 | 30.9 | 19.4 |
| January 2022 | 17.8 | 30.9 | 134.8 |
| February 2022 | 14.7 | 30.0 | 43.8 |
| March 2022 | 15.0 | 28.6 | 24.8 |
| April 2022 | 10.5 | 23.2 | 80.0 |

**Table 2:** *Gundagai long term average weather data*

| Month | Average Minimum Temperature (°) Long Term | Average Maximum Temperature (°) Long Term | Average Rainfall (mm) Long Term |
|---|---|---|---|
| May | 6.0 | 18.0 | 67.7 |
| June | 3.2 | 13.6 | 60.3 |
| July | 2.0 | 12.8 | 78.6 |
| August | 3.1 | 14.9 | 63.2 |
| September | 5.1 | 17.6 | 68.4 |
| October | 7.5 | 21.7 | 69.2 |
| November | 10.3 | 25.8 | 49.5 |
| December | 13.1 | 29.2 | 52.3 |
| January | 15.0 | 31.6 | 65.8 |
| February | 15.6 | 31.4 | 41.1 |
| March | 12.9 | 27.8 | 43.6 |
| April | 8.7 | 22.8 | 54.9 |

## 3.0 Results

### Soil

Fairways 8 and 5 were chosen as soil sampling sites in order to obtain a cross-section of the soils at the Bidgee Banks Golf Course. Fairway 8 is on the northern side of the course and on slightly higher ground than Fairway 5, which is adjacent to the Murrumbidgee River. A site where no irrigation occurs, on the south-eastern end of Fairway 6, was chosen as a soil testing control for comparison of readily monitored changes in the irrigated sites. Soils are typically well drained alluvial grey-brown silty loams to clay loams. A GPS (Global Positioning System) is used to log soil sample locations for monitoring and site management.

All the soils sampled are well-drained river loams. The soils demonstrate structure and an abundance of organic material (i.e. roots) down to the sampled depth. The soils appeared to be in good physical condition with the absence of any pans or water logging.

At each of the three soil monitoring locations the following analysis is conducted, **Table 3**.

**Table 3:** *Soil analysis parameters*

| Depth | Analysis |
|---|---|
| 0-10cm | Total Phosphorus, Total Kjeldahl Nitrogen, Nitrate, Phosphorus (Colwell), Phosphorus Buffer Index, Conductivity, Chloride, pH, Sulphur, Cation Exchange Capacity |
| 10-30cm | Conductivity, Nitrate as N, Total Phosphorus, pH |
| 30-60cm | Conductivity, Nitrate as N, Total Phosphorus, pH |
| 60-100cm | Conductivity, Nitrate as N, Total Phosphorus, pH |

The results of the topsoil analysis show a soil with a relatively stable pH and low electrical conductivity with low exchangeable sodium percentage (ESP). Macronutrients are generally lower in the non-irrigated sample point, but all sample points display similar seasonal variations.

The subsoil analysis has remained relatively stable compared to historical data with some minor temporal variation.

The results of the sampling can be seen in the following **Tables 4** and **5** and the historical phosphorous and ESP data trends can be seen in **Figures 1** and **2**.

**Table 4:** *Topsoil analysis*

| Parameter | Desirable Range | Fairway 5 | Fairway 8 | Non-Irrigated |
|---|---|---|---|---|
| Phosphorus Total (mg/kg) | >30[3] | 450 | 551 | 455 |
| Total Kjeldahl Nitrogen (mg/kg) | >200[1] | 4730 | 2360 | 3180 |
| Nitrate Nitrogen (ppm) | >30[3] | 24 | 2.8 | 8.4 |
| Phosphorus Colwell (ppm) | >30[3] | 110 | 47 | 28 |
| P Buffer Index (PBI) | > 30[4] | 41 | 40 | 37 |
| Available K (ppm) | > 225[5] | 550 | 310 | 350 |
| Available Sulphur KCl (ppm) | >10[1] | 14 | 9 | 6 |
| EC (dS/m) | <0.5[1] | 0.16 | 0.08 | 0.07 |
| ECe (dS/m) | <2[1] | 1.3 | 0.5 | 0.6 |
| Organic C (% C) | 2[1] | 5.2 | 2.6 | 2.9 |
| Chloride (ppm) | < 125[4] | 53 | 28 | <10 |
| pH ($H_2O$) | 6 - 8[1] | 6.1 | 6.5 | 6.3 |
| pH (CaCl2) | 5.5 - 7[1] | 5.6 | 5.8 | 5.5 |
| CEC (meq/100gm) | 5 - 15[1] | 15.6 | 15.0 | 11.9 |
| Aluminium (meq/100gm) | <1[2] | <0.1 | <0.1 | <0.1 |
| Calcium (meq/100gm) | n/a | 10 | 9.7 | 8.6 |
| Magnesium (meq/100gm) | n/a | 4 | 4.4 | 2.4 |
| Sodium (meq/100gm) | <4.3[2] | 0.14 | 0.1 | 0.03 |
| Potassium (meq/100gm) | *no data* | 1.4 | 0.79 | 0.89 |
| Ca:Mg Ratio | >2[1] | 2.5 | 2.2 | 3.6 |
| K:Mg Ratio | *no data* | 0.4 | 0.2 | 0.4 |
| Aluminium % | <5%[1] | <1.0 | <1.0 | <1.0 |
| Calcium % | 65-80%[1] | 65 | 65 | 72 |
| Magnesium % | 10-15%[1] | 26 | 30 | 20 |
| Sodium % | <5%[1] | 0.19 | 0.67 | 0.28 |
| Potassium % | 1-5%[1] | 9 | 5.3 | 7.5 |

*1.NSW Agriculture (1998),*

*2. Charman & Murphy (1991),*

*3. Gunter (1997),*

*4. Peverill, Sparrow & Reuter (1999),*

*5. Incitec Fertilisers et al. Technical Bulletin*

**Table 5:** *Subsoil analysis*

| Depth | Parameter | Desirable Range | Fairway 5 | Fairway 8 | Non-Irrigated |
|---|---|---|---|---|---|
| 10-30cm | Conductivity (µS/cm) | <500 | 110 | 150 | 100 |
| | Nitrate as N (mg/kg) | >30[3] | 8 | <1 | 3 |
| | Phosphorus Total (mg/kg) | >30[3] | 351 | 405 | 301 |
| | pH ($H_2O$) | 6 - 8[1] | 6.2 | 5.5 | 6.5 |
| 30-60cm | Conductivity (µS/cm) | <500[1] | 115 | 150 | 95 |
| | Nitrate as N (mg/kg) | >30[3] | 4 | <1 | 1 |
| | Phosphorus Total (mg/kg) | >30[3] | 407 | 507 | 357 |
| | pH ($H_2O$) | 6 - 8[1] | 6.2 | 5.0 | 6.5 |
| 60-100cm | Conductivity (µS/cm) | <500[1] | 119 | 88 | 92 |
| | Nitrate as N (mg/kg) | >30[3] | 1 | <1 | 1 |
| | Phosphorus Total (mg/kg) | >30[3] | 453 | 553 | 358 |
| | pH ($H_2O$) | 6 - 8[1] | 6.0 | 5.5 | 6.5 |

*1. NSW Agriculture (1998)*

*2. Charman & Murphy (1991)*

*3. Gunter (1997)*

*4. Peverill, Sparrow & Reuter (1999)*

*5. Incitec Fertilisers et al. Technical Bulletin*

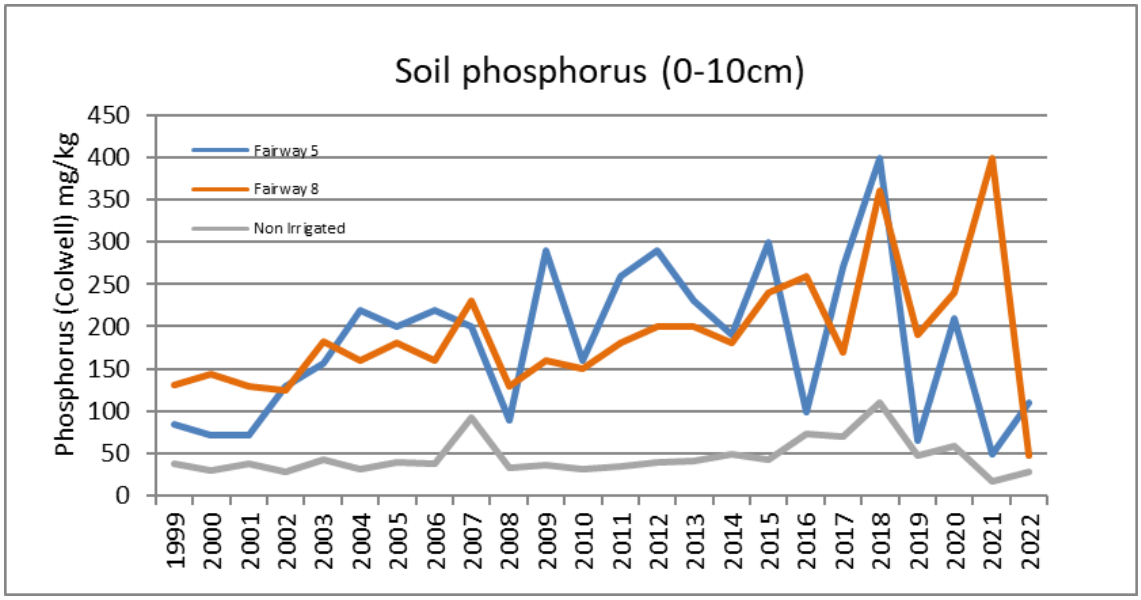


**Figure 1:** *Historical topsoil phosphorus levels*

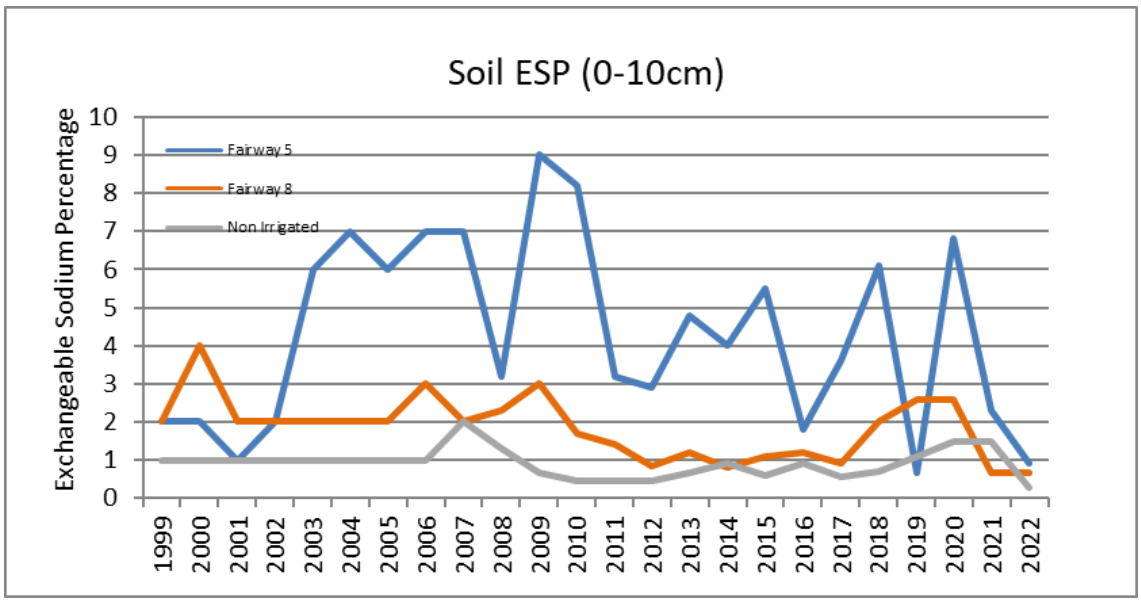


**Figure 2:** *Historical topsoil ESP levels*

**Treated Effluent**

25 water samples from May 2021 to April 2022 were collected from the treated effluent in the storage dam that is used to irrigate the golf course. Water samples are analysed for BOD, Faecal Coliforms, Conductivity, Total Nitrogen, Oil & Grease, Total Phosphorus, pH, Sodium Adsorption Ratio and Total Suspended Solids.

The results of the monitoring show generally stable parameters except for faecal coliforms that show some variation, **Table 6**. The variable faecal coliform readings could be attributable to the replacement works that is being conducted at the Gundagai Sewage Treatment Works during the monitoring period, but this was not confirmed as it is outside of the scope of works.

The treated effluent at average concentrations is classed as low strength effluent for irrigation in relation to the DEC guidelines, **Table 7**.

**Table 6:** *Effluent analysis 2021/22*

| **Pollutant** | ***Desirable Level*** | **Minimum** | **Average** | **Maximum** |
|---|---|---|---|---|
| BOD mg/L | <40[2] | 2 | 9 | 17 |
| Conductivity µS/cm | 280 - 800 | 552 | 610 | 874 |
| Faecal Coliforms cfu/100ml | < 1000 | 4 | 817 | 5000 |
| Oil & Grease mg/L | <5 | 1 | 3 | 7 |
| pH | 6.5-8.0 | 7.2 | 7.9 | 9.2 |
| Phosphorus (total) mg/L | <10 | 1.71 | 3.36 | 4.78 |
| Sodium Adsorption Ratio | <6 | 1 | 2 | 3 |
| Nitrogen (total) mg/L | <50 | 2 | 12 | 26 |
| Total Suspended Solids mg/L | N/A | 2 | 21 | 40 |

*1. AWG (2018)*
*2. DEC NSW (2004)*
*3. EPA NSW (1995)*

**Table 7:** *Classification of effluent*

| **Constituent** | **Strength** | | | |
|---|---|---|---|---|
| | Effluent range 2021/2022 | Low | Medium | High |
| Total Nitrogen | **2 - 26** | *<50* | *50-100* | *>100* |
| Total Phosphorus | **1.71 - 4.78** | *<10* | *10-20* | *>20* |
| Total Suspended Solids | **2 - 40** | *<600* | *600-1,000* | *>1,000-2,500* |

**Groundwater**

One groundwater sample was collected on the 19 April 2022 from the two monitoring bores that are located in the vicinity of fairways 17 and 7 respectively.

Monitoring bore number one, located on Fairway 17, had a Standing Water Level (SWL) of -3.85 metres below ground level while monitoring bore number two 2 could not be located and is assumed to have been destroyed.

The groundwater sample was analysed for BOD, Conductivity, Total Nitrogen, Oil & Grease, Total Phosphorus, pH, Sodium Adsorption Ratio and TSS, **Table 8**. The results are consistent with long term trends.

**Table 8:** *Groundwater analysis 2021/22*

| **Pollutant** | ***Desirable Level*** | **Bore 1** | **Bore 2** |
|---|---|---|---|
| BOD mg/L | <40[2] | 2 | No sample |
| Conductivity µS/cm | *280 - 800* [1] | 655 | No sample |
| Oil & Grease mg/L | *<5* [3] | 2 | No sample |
| pH | *6.5-8.0* [1] | 6.8 | No sample |
| Phosphorus (total) mg/L | *<10* [2] | 12.5 | No sample |
| Sodium Adsorption Ratio | *<6* [3] | 2 | No sample |
| Nitrogen (total) mg/L | *<50*[2] | 4 | No sample |
| Total Suspended Solids mg/L | *n/a* | 2950 | No sample |
| **Comments** | | | |
| Water Quality | n/a | Poor | No sample |
| Particulate Matter | n/a | Yes - sediment | No sample |

*1. ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.*

*2. DEC NSW (2004) Use of Effluent by Irrigation, Environmental Guidelines*

## 4.0 Nutrient Loading

In the 2021/22 irrigation season approximately 20,000 kilolitres (20 ML) of effluent was irrigated over an area of approximately 20 hectares. Maximum nutrient loading rates are calculated annually to compare nutrient concentrations in irrigated effluent with the anticipated crop uptake of nutrients. **Table 9** shows the nutrient mass balance incorporating average effluent quality and quantities applied. The nutrient mass balance indicates that for perennial grasses the nitrogen and phosphorus supply in the effluent irrigation is below the anticipated plant uptake. Processes such as mineralization, fixation from legumes and fertilising will boost nitrogen supply to more desirable levels for healthy plants.

**Table 9:** *Nutrient mass balance*

| Parameter | Effluent Quality (Mean value) | Nutrient Loading | Nutrient Removal | Nutrient Balance |
|---|---|---|---|---|
| | mg/L | kg/ha/yr | kg/ha/yr | kg/ha/yr |
| Nitrogen | 12 | 12 | 130 | -118 |
| Phosphorus | 3.36 | 3.36 | 16 | -12.6 |

### Calculating the maximum nutrient loading rates

The following equation is used to determine the recommended effluent flow rate in kilolitres per day over the 20 hectares.

$$Q = \frac{A * 1000 * L_C}{C}$$

Where:

A = the irrigation area (hectares)

C = concentration of constituents (milligrams per litre)

Q = average effluent flow rate (kilolitres per day)

$L_c$ = critical loading rate of constituent (kilograms per hectare per day)

[k] – Irrigation loads were calculated based on 1000KL a day over the 20 ha.

The amount of effluent that can be applied to perennial grasses has been calculated for minimum, average and maximum nutrient levels in the irrigated effluent. The amounts of effluent (Q) that can be applied for the different nutrient levels can be seen in **Tables 10** and **11**. The values have been calculated in kilolitres per hectare per year.

**Table 10:** *Phosphorus calculations*

| Phosphorus Concentration Ranges | Min | Average | Max |
|---|---|---|---|
| **C -** concentration phosphorus in effluent mg/L | 1.71 | 3.36 | 4.78 |
| **$L_c$-** critical loading rate of phosphorus kg/ha/year | 16 | 16 | 16 |
| **A -** The irrigation area (hectares) | 20 | 20 | 20 |
| **Q -** Average effluent flow rate kL/ha/year | 3347 | 4762 | 9357 |
| Actual amount of effluent irrigated kL/ha/year | 1000 | 1000 | 1000 |
| Actual Phosphorus applied in effluent (load) kg/ha | 1.71 | 3.36 | 4.78 |

**Table 11:** *Nitrogen calculations*

| Nitrogen Concentration Ranges | Min | Average | Max |
|---|---|---|---|
| **C -** concentration of nitrogen in effluent mg/L | 2 | 12 | 26 |
| **$L_c$-** critical loading rate of nitrogen kg/ha/year | 130 | 130 | 130 |
| **A -** The irrigation area (hectares) | 20 | 20 | 20 |
| **Q -** Average effluent flow rate kL/ha/year | 5000 | 10833 | 65000 |
| Actual amount of effluent irrigated kL/ha/year | 1000 | 1000 | 1000 |
| Actual Nitrogen applied in effluent (load) kg/ha | 2 | 12 | 26 |

The critical loading rate of constituent ($L_c$) has been calculated from annual nutrient uptake ranges for perennial pasture as per DEC guidelines (2004). **Table 12** outlines the nutrient uptake ranges in comparison to the actual amount of nutrient applied in the irrigated effluent (at the mean nutrient concentration).

**Table 12:** *Crop nutrient uptake and actual nutrient application 2021/22*

| Crop | Annual Phosphorus uptake range (kg/ha) *NSW EPA 1995* | Phosphorus applied in effluent at mean concentration (kg/ha) | Annual Nitrogen uptake range (kg/ha) *NSW EPA 1995* | Nitrogen applied in effluent at mean concentration (kg/ha) |
|---|---|---|---|---|
| Perennial Pasture | 8 - 16 | 3.36 | 65 - 130 | 12 |

**Table 13** shows the recommended irrigation rate for sustainable assimilation of nutrients for perennial grasses based on the minimum, average and maximum nutrient loading compared to the actual irrigation rate in 2021/22. The data show that sustainable irrigation of the treated effluent with occurring with actual application rates below the calculated plant uptake.

**Table 13:** *Recommended effluent application rates (ML/ha)*

| Effluent application | Actual application | Perennial Pasture | |
|---|---|---|---|
| | | Phosphorus | Nitrogen |
| Minimum | 1.0 | 9.4 | 65.0 |
| Average | 1.0 | 4.8 | 10.8 |
| Maximum | 1.0 | 3.3 | 5.0 |

## 5.0 Conclusion

From the mass balance calculations, the amount of nitrogen and phosphorus applied in the effluent is theoretically lower than what the plants can effectively utilise. This shows that at average rates, plants should theoretically be able to assimilate the applied nutrients. The amount of effluent applied is below the recommended application rate range for phosphorus and nitrogen.

## 6.0 References

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## 7.0 Disclaimer

The information contained in this report has been extracted from field and laboratory sources believed to be reliable and accurate. DM McMahon Pty Ltd assume any responsibility for the misinterpretation of information supplied in this report. The accuracy and reliability of recommendations identified in this report need to be evaluated with due care according to individual circumstances. It should be noted that the recommendations and findings in this report are based solely upon the said site location and the ground level conditions at the time of testing. The results of the said investigations undertaken are an overall representation of the conditions encountered. The properties of the soil within the location may change due to variations in ground conditions outside of the tested area. The author has no control or liability over site variability that may warrant further investigation that may lead to significant design changes.

## 8.0 Notice of Copyright



## 9.0 Attachments

Laboratory report – 7 pages

Charles Sturt University

**ENVIRONMENTAL AND ANALYTICAL LABORATORIES**

Locked Bag 588
Wagga Wagga NSW 2678

Tel: +61 2 6933 2849
Fax: +61 2 6933 2477
Email: eal@csu.edu.au
http://science-health.csu.edu.au/eal

**DM McMahon Pty Ltd**
**PO Box 6118 6 Jones Street**
**Wagga Wagga NSW 2650**
**Attention: David McMahon**

Thursday, May 5, 2022

**NATA Accredited Laboratory Number: 9597**

**Accredited for compliance with ISO/IEC 17025 - Testing**

# LABORATORY ANALYSIS REPORT

**Report Number:2204-0053**
**Page 1 of 2**
*For all enquiries related to this report please quote document number: 2204-0053*

**Facility:**

**Order #**

**Date Analysis Commenced**
22-April-2022

**Sample Type**
Water

**Collected By**
Z. Delaney

**Date Received**
22-April-2022

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|---|
| 22Apr-0156 | **Point 1 (Irrigation)** 19.04.22 10.15 | | | | | |
| | | **Biochemical Oxygen Demand** | **8** | mg/L | APHA 5210 B/4500-O G | 2 |
| | | **Calcium (dissolved)** | **20.0** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Faecal coliforms** | **360** | cfu/100mL | * AS/NZS 4276.7:2007 | |
| | | **Conductivity** | **590** | µS/cm | APHA 2510 B | 1 |
| | | **Magnesium (dissolved)** | **10.1** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Nitrogen, total** | **17** | mg/L | * APHA 4500-Norg B + 4110 B | 2 |
| | | **Nitrate/Nitrite as N** | **9.1** | mg/L | LTM-W-014 | 0.1 |
| | | **Oil & Grease** | **<1** | mg/L | APHA 5520 D | 1 |
| | | **Phosphorus, Total** | **2.99** | mg/L | LTM-W-030 | 0.01 |
| | | **pH** | **6.8** | pH units | APHA 4500-H+ B | |
| | | **Sodium Adsorption Ratio** | **3** | Ratio | LTM-W-039 | |
| | | **Sodium (dissolved)** | **61.8** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Total Kjeldahl Nitrogen** | **8** | mg/L | LTM-W-034 | 2 |
| | | **Total Suspended Solids** | **20** | mg/L | APHA 2540 D | 2 |
| 22Apr-0157 | **Piezo 1** 19.04.22 11.06 | | | | | |
| | | **Biochemical Oxygen Demand** | **2** | mg/L | APHA 5210 B/4500-O G | 2 |
| | | **Calcium (dissolved)** | **25.5** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Conductivity** | **655** | µS/cm | APHA 2510 B | 1 |
| | | **Magnesium (dissolved)** | **33.3** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Nitrogen, total** | **4** | mg/L | * APHA 4500-Norg B + 4110 B | 2 |
| | | **Nitrate/Nitrite as N** | **0.1** | mg/L | LTM-W-014 | 0.1 |

Charles Sturt University

**ENVIRONMENTAL AND ANALYTICAL LABORATORIES**

Locked Bag 588
Wagga Wagga NSW 2678

Tel: +61 2 6933 2849
Fax: +61 2 6933 2477
Email: eal@csu.edu.au
http://science-health.csu.edu.au/eal

**DM McMahon Pty Ltd**
**PO Box 6118 6 Jones Street**
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**Attention: David McMahon**

Thursday, May 5, 2022

**NATA Accredited Laboratory Number: 9597**

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# LABORATORY ANALYSIS REPORT

**Report Number:2204-0053**
**Page 2 of 2**
*For all enquiries related to this report please quote document number: 2204-0053*

**Facility:**

**Order #**

**Date Analysis Commenced**
22-April-2022

**Sample Type**
Water

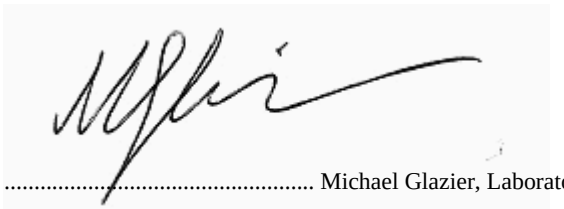
**Collected By**
Z. Delaney

**Date Received**
22-April-2022

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|---|
| 22Apr-0157 | **Piezo 1** 19.04.22 11.06 | | | | | |
| | | **Oil & Grease** | **2** | mg/L | APHA 5520 D | 1 |
| | | **Phosphorus, Total** | **12.5** | mg/L | LTM-W-030 | 0.01 |
| | | **pH** | **6.8** | pH units | APHA 4500-H+ B | |
| | | **Sodium Adsorption Ratio** | **2** | Ratio | LTM-W-039 | |
| | | **Sodium (dissolved)** | **80.7** | mg/L | APHA 3030 B/3120 B | 2 |
| | | **Total Kjeldahl Nitrogen** | **4** | mg/L | LTM-W-034 | 2 |
| | | **Total Suspended Solids** | **2950** | mg/L | APHA 2540 D | 2 |

***Note:***

**** NATA Accreditation does not cover the performance of this service.***



Signed ..... Michael Glazier, Laboratory Manager.

*All samples analysed as received.*
*All soil results are reported on a dry basis.*
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Locked Bag 588
Wagga Wagga NSW 2678

Tel: +61 2 6933 2849
Fax: +61 2 6933 2477
Email: eal@csu.edu.au
http://science-health.csu.edu.au/eal

**DM McMahon Pty Ltd**
**PO Box 6118 6 Jones Street**
**Wagga Wagga NSW 2650**
**Attention: David McMahon**

Thursday, May 5, 2022

**NATA Accredited Laboratory Number: 9597**

**Accredited for compliance with ISO/IEC 17025 - Testing**

# LABORATORY ANALYSIS REPORT

**Report Number:2204-0067**
**Page 1 of 4**
*For all enquiries related to this report please quote document number: 2204-0067*

**Facility:**

**Order #**

**Date Analysis Commenced**
24-April-2022

**Sample Type**
Soil

**Collected By**
Z. Delaney

**Date Received**
24-April-2022

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|---|
| 22Apr-0189 | **Fairway 5 0-10** 22.04.22 10.15am | | | | | |
| | | **Phosphorus, Total** | **450** | mg/kg | LTM-S-015 | 2 |
| | | **Total Kjeldahl Nitrogen** | **4730** | mg/kg | LTM-S-011 | 2 |
| 22Apr-0190 | **Fairway 8 0-10** 22.04.22 9.50am | | | | | |
| | | **Phosphorus, Total** | **551** | mg/kg | LTM-S-015 | 2 |
| | | **Total Kjeldahl Nitrogen** | **2360** | mg/kg | LTM-S-011 | 2 |
| 22Apr-0191 | **Control 0-10** 22.04.22 10.40am | | | | | |
| | | **Phosphorus, Total** | **455** | mg/kg | LTM-S-015 | 2 |
| | | **Total Kjeldahl Nitrogen** | **3180** | mg/kg | LTM-S-011 | 2 |
| 22Apr-0192 | **Fairway 5 10-30** 22.04.22 10.18am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **110** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **8** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **351** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.2** | pH units | LTM-S-004 | |
| 22Apr-0193 | **Fairway 5 30-60** 22.04.22 10.26am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **115** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **4** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **407** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.2** | pH units | LTM-S-004 | |
| 22Apr-0194 | **Fairway 5 60-100** 22.04.22 10.30am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **119** | µS/cm | LTM-S-003 | 1 |

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**Facility:**

**Order #**

**Date Analysis Commenced**
24-April-2022

**Sample Type**
Soil

**Collected By**
Z. Delaney

**Date Received**
24-April-2022

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|---|
| 22Apr-0194 | **Fairway 5 60-100** 22.04.22 10.30am | | | | | |
| | | **Nitrate as N** | **1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **453** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.0** | pH units | LTM-S-004 | |
| 22Apr-0195 | **Fairway 8 10-30** 22.04.22 9.53am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **150** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **<1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **405** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **5.5** | pH units | LTM-S-004 | |
| 22Apr-0196 | **Fairway 8 30-60** 22.04.22 10.05am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **150** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **<1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **507** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **5.0** | pH units | LTM-S-004 | |
| 22Apr-0197 | **Fairway 8 60-100** 22.04.22 10.05am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **88** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **<1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **553** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **5.5** | pH units | LTM-S-004 | |
| 22Apr-0198 | **Control 10-30** 22.04.22 10.43am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **100** | µS/cm | LTM-S-003 | 1 |

Charles Sturt University

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# LABORATORY ANALYSIS REPORT

**Report Number:2204-0067**
**Page 3 of 4**
*For all enquiries related to this report please quote document number: 2204-0067*

**Facility:**

**Order #**

**Date Analysis Commenced**
24-April-2022

**Sample Type**
Soil

**Collected By**
Z. Delaney

**Date Received**
24-April-2022

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|---|
| 22Apr-0198 | **Control 10-30** 22.04.22 10.43am | | | | | |
| | | **Nitrate as N** | **3** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **301** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.5** | pH units | LTM-S-004 | |
| 22Apr-0199 | **Control 30-60** 22.04.22 10.48am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **95** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **357** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.5** | pH units | LTM-S-004 | |
| 22Apr-0200 | **Control 60-100** 22.04.22 10.55am | | | | | |
| | | **Conductivity (1:5 soil/water)** | **92** | µS/cm | LTM-S-003 | 1 |
| | | **Nitrate as N** | **1** | mg/kg | LTM-S-007 | 1 |
| | | **Phosphorus, Total** | **358** | mg/kg | LTM-S-015 | 2 |
| | | **pH (1:5 soil/water)** | **6.5** | pH units | LTM-S-004 | |

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**Report Number:2204-0067**
**Page 4 of 4**
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| **Facility:** | **Order #** | **Date Analysis Commenced** |
|---|---|---|
| | | 24-April-2022 |
| **Sample Type** | **Collected By** | **Date Received** |
| Soil | Z. Delaney | 24-April-2022 |

| EAL ID | Client ID. / Date/Time sample taken | Test | Result (units) | Method Reference | Limit of Reporting |
|---|---|---|---|---|---|

Signed ..... Michael Glazier, Laboratory Manager.

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| Sample Name | | CONTROL | FAIRWAY 5 | FAIRWAY 8 |
|---|---|---|---|---|
| Nitrate Nitrogen | mg/kg | 8.4 | 24 | 2.8 |
| Phosphorus (Colwell) | mg/kg | 28 | 110 | 47 |
| | | | | |
| Phosphorus Buffer Index (PBI-Col) | | 37 | 41 | 40 |
| Available Potassium | mg/kg | 350 | 550 | 310 |
| Sulphur (KCl40) | mg/kg | 6 | 14 | 9 |
| | | | | |
| Electrical Conductivity (1:5 water) | dS/m | 0.07 | 0.16 | 0.08 |
| Elec. Cond. (Sat. Ext.) | dS/m | 0.6 | 1.3 | 0.5 |
| Organic Carbon (W&B) | % | 2.9 | 5.2 | 2.6 |
| Chloride | mg/kg | <10 | 53 | 28 |
| pH (1:5 Water) | | 6.3 | 6.1 | 6.5 |
| pH (1:5 CaCl2) | | 5.5 | 5.6 | 5.8 |
| Cation Exch. Cap. | cmol(+)/kg | 11.9 | 15.6 | 15 |
| Aluminium (KCl) | cmol(+)/kg | <0.1 | <0.1 | <0.1 |
| Calcium (Amm-acet.) | cmol(+)/kg | 8.6 | 10 | 9.7 |
| Magnesium (Amm-acet.) | cmol(+)/kg | 2.4 | 4 | 4.4 |
| Sodium (Amm-acet.) | cmol(+)/kg | 0.03 | 0.14 | 0.1 |
| Potassium (Amm-acet.) | cmol(+)/kg | 0.89 | 1.4 | 0.79 |
| Calcium/Magnesium Ratio | | 3.6 | 2.5 | 2.2 |
| | | | | |
| Aluminium (KCl) | % | <1.0 | <1.0 | <1.0 |
| Calcium (Amm-acet.) | % | 72 | 65 | 65 |
| Magnesium (Amm-acet.) | % | 20 | 26 | 30 |
| Sodium % of Cations (ESP) | % | 0.28 | 0.91 | 0.67 |
| Potassium (Amm-acet.) | % | 7.5 | 9 | 5.3 |

Tested by Nutrient Advantage Laboratory Werribee VIC
022019507 - Control
022019508 - Fairway 5
022019509 - Fairway 8